DANIELS™
ELECTRONICS LTD.

MT-3 RADIO SYSTEMS

VHF TRANSMITTER INSTRUCTION MANUAL

VT-3 132 - 174 MHz

Covers model:	VT-3/140-SWA2, VT-3/160-SWA2
	VT-3/140-SWA8, VT-3/160-SWA8
	VT-3/140-SNA2, VT-3/160-SNA2
	VT-3/140-SNA8, VT-3/160-SNA8

Issue:	3	Previous Issue:	2	
Issue Date:	May 1998	Previous Issue Date:	April 1997	Daniels Electronics Ltd.
Printing Date:	January 2001			Victoria, B.C.
Part No.:	IM21-VT3150			PRINTED IN CANADA

Reviewed By:

Quality Assurance:		
Larry Freeman		12 May 98
Name	Signature	Date

NOTE:

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. This equipment may incorporate minor changes in detail from the information contained in this manual.

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RF Exposure Warning

This transmitting equipment conforms to SAR (Specific Absorption Rate) limits regarding exposure of human beings to radio frequency electromagnetic energy, as defined in the following national and international standards and guidelines:

1. Industry Canada Radio Standards Specification 102 (RSS-102), *Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields*;

2. Health Canada Safety Code 6, *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz*[1];

3. United States Federal Communications Commission, Code of Federal Regulations; 47 CFR Part 1, § 1.1310 *Radiofrequency radiation exposure limits*; and

4. American National Standards Institute (ANSI) criteria for localized SAR in Section 4.2 of "*IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*"[2].

Notes: A. The SAR limit for uncontrolled exposure of persons not classed as RF and microwave exposed workers (including the general public) for transmitter equipment operating below 10 GHz, as defined in the references above, is 2 W/m^2 (0.2 mW/cm^2).

B. This transmitting equipment is designed for use with an outdoor antenna with a characteristic antenna gain of 10 dBi, typically mounted at a significant height above ground to provide for adequate signal coverage. To ensure that the general public is not exposed to a power density above the recommended limit of 2 W/m^2 (0.2 mW/cm^2), the equipment must be installed such that the following minimum safe distances from the antenna are maintained:

6.3 m (20.7 ft)	when configured with	100 W PA
3.5 m (11.3 ft)	when configured with	30 W PA
1.8 m (5.9 ft)	standalone (i.e. no PA)	8 W

C. The following power density formula has been utilized in determining minimum safe distances:

$$S = \frac{PG}{4\pi R^2}$$

where: S = Power density (in appropriate units, e.g. mW/cm^2)
P = Power input to the Antenna (in appropriate units, e.g., mW)
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = Distance to the center of radiation of the antenna (appropriate units, e.g., cm)

[1] Minister of Public Works and Government Services, Canada 1999, Cat. H46- 2/ 99- 237E, ISBN 0- 662- 28032- 6
[2] ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017

1 GENERAL

1.1 Introduction

The VT-3 132 - 174 MHz Transmitter is a low power, synthesized FM transmitter capable of operating in 12.5 kHz or 25/30 kHz channels. The transmitter operates continuous duty in one of two frequency bands: 132 to 150 MHz or 150 to 174 MHz and its output power is continuously adjustable from 0.5 T0 2.0 or 2.0 to 8.0 Watts. A modular design allows each of the transmitter's modules; MT-3 Transmitter Board, MT-3 Audio Processor, VT-3/150 Amplifier, and OS-3H150 Synthesizer Module to be individually assembled and tested. This facilitates construction, tuning, maintenance as well as troubleshooting procedures. The synthesizer module can be programmed to have up to 16 channels exclusive to one frequency band.

The VT-3 132 - 174 MHz Transmitter is designed to interface with Daniels Electronics' MT-3 Repeater System while maintaining MT-2 System compatibility. Both repeater systems are characterized by dependable, low maintenance performance under the most severe environmental conditions.

1.2 Manual Organization

The organization of this manual reflects the modular makeup of the VT-3 product line. Each module is fully described within its respective submanual, all of which are contained within this document. In general, each submanual contains:

1. A functional description and specification summary,
2. a detailed technical description (Theory of Operation) and
3. assembly, setup and alignment procedures relevent to that particular module.

The module manuals are as follows.

Note: material presented in a given "sub-manual" may include information related to other module versions not directly appllicable to the VT-3 132 - 174 MHz Transmitter family (eg, the OS-3H Synthesizer Instruction Manual covers models from 29 MHz to 512 MHz).

VHF Enhanced Transmitter Instruction Manual: This manual provides an overview of the complete transmitter, manual organization and assembly in terms of the other modules.

MT-3 Transmitter Main Board Instruction Manual: This manual pertains to the audio processor module, transmitter Main Board and Front Panel Board. Most of the user selectable options are accessed within the Transmitter Main Board module, including channel selection. Since all external connections (including power and signal lines) are made to the Transmitter Main Board, most of the material pertaining to transmitter operation and installation is found here.

VHF Amplifier Instruction Manual VT-3 132 - 174 MHz : The amplifier module provides the final stages of RF power amplification and harmonic filtering for the transmitter. This manual is intended primarily as a reference since the amplifier module is adjusted at the factory.

Enhanced Synthesizer Instruction Manual OS(R/T)-3(A/H) 132 - 470 MHz: This manual pertains to the enhanced synthesizer module.

VHF Transmitter Channel Designation Table VT-3 132 - 174 MHz: This document relates operating frequency to the transmitter channel number (see section 2.1).

1.3 VT-3 132 - 174 MHz Transmitter Family Models

There are 8 distinct models in the VT-3/150 Synthesized Transmitter family each with different bands of operation, channel spacing and/or power outputs. The 8 models are as follows:

- VT-3/140-SNA2 - synthesized, 132-150 MHz band, 5.0/6.25 kHz channels, 0.5-2.0 W
- VT-3/140-SWA2 - synthesized, 132-150 MHz band, 5.0/6.25 kHz channels, 0.5-2.0 W
- VT-3/140-SNA8 - synthesized, 132-150 MHz band, 5.0/6.25 kHz channels, 2.0-8.0 W
- VT-3/140-SWA8 - synthesized, 132-150 MHz band, 5.0/6.25 kHz channels, 2.0-8.0 W

- VT-3/160-SNA2 - synthesized, 150-174 MHz band, 5.0/6.25 kHz channels, 0.5-2.0 W
- VT-3/160-SWA2 - synthesized, 150-174 MHz band, 5.0/6.25 kHz channels, 0.5-2.0 W
- VT-3/160-SNA8 - synthesized, 150-174 MHz band, 5.0/6.25 kHz channels, 2.0-8.0 W
- VT-3/160-SWA8 - synthesized, 150-174 MHz band, 5.0/6.25 kHz channels, 2.0-8.0 W

The transmitters' band of operation is determined by select components in the synthesizer module and the channel width is determined by the roll-off of the splatter filter on the MT-3 Audio Processor.

1.4 Performance Specifications

1.4.1 General

The following is a general set of specifications for the generic VT-3/150 transmitter. Additional specifications, specific to individual modules may be found in their respective submanuals.

Type:	MT-3 Series Transmitter.
Family:	VT-3/150.
Compatibility:	MT-2 Series and MT-3 Series Radio Systems.
Frequency Range:	132 to 174 MHz.
RF Power Output:	Adjustable: 0.5 to 2.0 W and 2.0 to 8.0 W.
Modulation:	11K0F3E or 16K0F3E (Frequency Modulation).
System Impedance:	50 Ω; Type N connector.
Duty Cycle:	100%; Continuous operation from -40°C to +60°C.
Spurious Emissions:	More than 80 dB below carrier.
Harmonic Emissions:	More than 90 dB below carrier.
Transmitter Mismatch Protection:	20:1 VSWR at all phase angles.
Transmitter Alarm:	Forward power sense and reverse VSWR; • open collector output (separate or 'OR'ed configuration); • linear output (separate lines only).
Operating Temperature Range:	-30˚C to +60˚C, optional -40˚C temperature test.
Operating Humidity:	95% RH (non-condensing) at +25°C.
Operating Voltage:	+13.8 Vdc Nominal (range +11 to +16 Vdc), +9.5 Vdc Regulated.
Transmit Current:	2.5 Amps at 8 Watts RF Power Output.
Front Panel Controls:	NORM (repeat mode), OFF, and KEY TX (Tx on).

PTT Activation:	• Active to ground with or without time-out-timer; • Microphone activated with or without time-out-timer; • Front Panel switch: KEY TX - without time-out-timer; • NORM - with or without time-out-timer. • Isolated (optional relay) with or without time-out-timer.
PTT Time-Out-Timer:	Selectable from 1 sec. to 8 hrs. (factory set 5 min.).

1.4.2 Audio Specifications

Audio Input:	Balanced 600 ohm or unbalanced (optional). Input level sensitivity, -25 dBm to 0 dBm.
Audio Response:	Pre-emphasis (6 dB per octave); +1.0 to -2.0 dB from 300 Hz to 3 kHz;
Flat Audio Response:	+1 to -1 dB from 100 Hz to 3 kHz.
Audio Deviation:	Preset to ±3.0 kHz with a 1 kHz tone.
Subtone Audio Input 1:	0.5 Vpp at 200 Hz for ±500 Hz deviation (internally adjustable).
Subtone Audio Input 1 Frequency range:	60 Hz to 300 Hz.
Subtone Audio Input 2:	0.5 Vpp at 100 Hz for ±500 Hz deviation (internally adjustable).
Subtone Audio Input 2 Frequency range:	DC to 150 Hz.
Direct Modulation Input:	0.5 Vrms at 1 kHz or ±3 kHz deviation.
Direct Modulation Frequency range:	DC to 5 kHz.
Audio Distortion:	Less than 2.5% THD; 1 kHz tone at 1.5 kHz or 3 kHz deviation (-40°C to +60°C).
Hum and Noise:	Better than 55 dB (test receiver band limited: 400 Hz to 30 kHz).

1.4.3 Physical Specifications

Physical Dimensions:	Width:	Height:	Depth:
	7.1 cm (2.8 in)	12.8 cm (5.05 in)	19 cm (7.5 in)
Module Weight:	1.5 kg (3.3 lbs)		
Corrosion Prevention:	Anodized aluminum construction. Stainless steel hardware. Selectively conformal coated glass epoxy 2 and 4 layer printed circuitboards. Gold plated module connectors.		
Module Design:	Compact Eurostandard modular design. Plug-in modules mate with Daniels standard M3 repeater subrack. Subracks / modules comply with IEEE 1101, DIN 41494 and IEC 297-3 (mechanical size / modular arrangement).		
External Connections:	RF Connection: type N connector located on the transmitter module front panel. Motherboard Connections (Audio, Power, and Control) are made through a 48 pin, gold plated, type F connector on the rear of the transmitter module. User connection made through mated "mother board" assembly of the repeater subrack. Type F standard connector complies with DIN 41612 Level 2 (200 mating cycles, 4 day 10 ppm SO_2 gas test with no functional impairment and no change in contact resistance).		
Handle Text Colour:	Red.		

2 SYSTEM OVERVIEW

2.1 Transmitter Operation

Several modules are integrated by the VT-3 Transmitter Main board to provide the complete transmitter. The Transmitter Main Board, Front Panel Board and Audio Processor are generic in that they apply to all transmitter models. The Front Panel Board and Audio Processor are soldered directly to the Transmitter Main Board and are treated collectively in the Transmitter Main Board Manual. The operating frequency and power range is determined by the choice of Amplifier and Frequency Synthesizer Module, which plugs in to the Transmitter Main Board and can be changed with minimal effort. Circuitry and jumpers on the Transmitter Main Board control the operation of all modules and the operation of the transmitter, overall. Technical details and a complete description of transmitter operation can be found in the Transmitter Main Board Manual.

The VT-3 132 - 174 MHz transmitter requires two power supplies; a regulated +9.5 Vdc supply and a +13.8 Vdc supply, the latter of which is connected only to the Amplifier Module. The (nominally) +13.8 Vdc supply's range is +11 Vdc to +16 Vdc. For the 0.5 to 2.0 Watt transmitters, there is no current drawn on the 13.8 Vdc supply. For the 2.0 to 8.0 Watt transmitters, the current drawn from the +13.8 Vdc supply (while transmitting at the rated power) is approximately 1000 mA with temperature, operating frequency and power supply voltage. The current drawn by the 13.8 Vdc line should not exceed 1500 mA. The +9.5 Vdc current drawn by all transmitter models while transmitting at the rated power is approximately 1300 mA and should not exceed 1500 mA. The VT-3 Transmitter has four different standby modes that trade-off standby current consumption for start-up speed. The standby modes are determined by three jumpers (refer to the MT-3 Transmitter Main Board Manual): jumper J6 which always turns on the '+9.5 Vdc Switched' supply, jumper J7 which selects the power source for the MT-3 Audio Processor and jumper J18 which selects the enable line for the OS-3H150 Synthesizer Module.

- MODE 1**:** Jumper J6 out
  - the audio processor is switched by a PTT signal
  - the synthesizer module is switched by a PTT signal
  - standby current: Typically 7 mA
  - start-up time: Typically 50 ms

- MODE 2**:** Jumper J6 in, jumper J7 in the 'y' position, jumper J18 in the 'x' position
  - the audio processor is switched by a PTT signal
  - the synthesizer module is enabled all of the time
  - standby current: Typically 65 mA
  - start-up time: Typically 25 ms

- MODE 3**:** Jumper J6 in, jumper J7 in the 'x' position, jumper J18 in the 'y' position
  - the audio processor is enabled all of the time
  - the synthesizer module is switched by a PTT signal
  - standby current: Synthesized - not used in this mode
  - start-up time: Synthesized - not used in this mode

- MODE 4**:** Jumper J6 in, jumper J7 in the 'x' position, jumper J18 in the 'x' position
  - the audio processor is enabled all of the time
  - the synthesizer or crystal module is enabled all of the time
  - standby current: Typically 90 mA
  - start-up time: Typically 10 ms

The front panel depicted in Section 3.1 bears a DPDT toggle switch (mounted on the Front Panel Board; see the Transmitter Main Board Manual) which controls the operation of the VT-3 132 - 174 MHz Transmitter. When in the 'OFF' position, the transmitter is turned off; however, the +13.8 Vdc remains on the Transmitter Main Board terminals and on the Amplifier Module. When in the 'KEYED' position, +9.5 Vdc is supplied to the transmitter circuitry and the transmitter is continously transmitting. When this switch is in the 'NORM' position, +9.5 Vdc is supplied to the transmitter circuitry although the transmitter remains quiescent until keyed from one of several Push-To-Talk (hereafter PTT) inputs. The red indicator LED is illuminated during transmit.

Microphone, RF output and optional reference input are mounted on the front panel; power and other signal connections are provided by a type 'F' connector at the rear of Transmitter Main Board. Details on their function can be found in the Transmitter Main Board Manual.

2.2 Frequency Selection

2.2.1 Synthesizer Transmitter

Eight backplane connections are used to communicate with the synthesizer unit. Pins D28, D30, and D32 are used (in house) to program the synthesizer. Channel select lines (pins D20, D22, D24, and D26) are used once the synthesizer is programmed to select one of 16 channels. If the channel select lines are all low (channel 0) the frequency for the synthesizer is read from switches FSW1 (most significant), FSW2, FSW3, and FSW4 (least significant). Refer to the VT-3/150 Channel Designation Table Manual for the simplified channel number and frequency information.

For all VT-3/140 models (132-150 MHz) with:

- 5 kHz channel increments (BCD settings from 0000 to 4999):

$$\text{CHNL\#} = \left[\frac{\text{Tx}_{\text{frequency}} - 128\ \text{MHz}}{5\ \text{kHz}}\right]$$

or

$$\text{Tx}_{\text{frequency}} = [\text{CHNL\#} \times 5\ \text{kHz}] + 128\ \text{MHz}$$

- 6.25 kHz channel increments (BCD settings from 5000 to 9999):

$$\text{CHNL\#} = \left[\frac{\text{Tx}_{\text{frequency}} - 128\ \text{MHz}}{6.25\ \text{kHz}}\right] + 5000$$

or

$$\text{Tx}_{\text{frequency}} = [(\text{CHNL\#-5000}) \times 6.25\ \text{kHz}] + 128\ \text{MHz}$$

For all VT-3/160 models (150-174 MHz) with:

- 5 kHz channel increments (BCD settings from 0000 to 4999):

$$\text{CHNL\#} = \left[\frac{\text{Tx}_{\text{frequency}} - 150\ \text{MHz}}{5\ \text{kHz}}\right]$$

or

$$\text{Tx}_{\text{frequency}} = [\text{CHNL\#} \times 5\ \text{kHz}] + 150\ \text{MHz}$$

- 6.25 kHz channel increments (BCD settings from 5000 to 9999):

$$\text{CHNL\#} = \left[\frac{\text{Tx}_{\text{frequency}} - 150\ \text{MHz}}{6.25\ \text{kHz}}\right] + 5000$$

or

$$\text{Tx}_{\text{frequency}} = [(\text{CHNL\#-5000}) \times 6.25\text{kHz}] + 150\ \text{MHz}$$

A channel can be selected from a set of 15 (maximum possible) factory programmed channels by the four channel select lines available at the rear 'F' connector on the Transmitter Main Board. A single user selectable channel is set by switches located on the Transmitter Main Board. See the Transmitter Main Board Manual for details.

2.3 Transmitter Assembly and Adjustment

All modules are mounted on the Transmitter Main Board which then forms a single assembly. An enclosure is formed by an extruded aluminum shell that slides over the Transmitter Main Board as illustrated in section 3.2). This shell also serves as a heatsink to remove heat from the Amplifier module and for this reason, it is important that the four screws that bond the shell to the amplifier module (Screws B in Section (3-2)) be installed before prolonged operation of the transmitter. Moreover, the surface of the Amplifier module that contacts the shell should be clean and free of foreign material. The enclosure is completed by the installation of front and rear plates which are fastened to the Transmitter Main Board (see Transmitter Main Board Manual for parts lists).

Transmitter alignment is performed on a module by module basis and detailed steps are provided in the respective manuals. Alignment is simplified by using an SR-3 Sub rack, SM-3 System Monitor, and RF extender cable to provide transmitter power and signal interconnection. Alternatively, +9.5 Vdc and +13.8 Vdc, as well as any required test signals, may be applied directly to the individual modules. Refer to the corresponding manuals for details.

2.3.1 Complete Transmitter Alignment

A complete Transmitter Alignment is performed at the factory and should not be required under normal circumstances. A large change in operating frequency, as discussed in the next section, may require a complete realignment operation. This operation requires that all the transmitter modules be aligned on a per module basis in the following order.

Sequence	Module	Manual Reference
(1)	Transmitter Main Board	Section 2.2 of this manual, Transmitter Main Board Manual.
(2)	Synthesizer	Synthesizer Manual
(3)	Amplifier	Amplifier Manual
(4)	Audio Processor	Transmitter Main Board Manual

2.3.2 Frequency Change

The transmitter is initially aligned at the factory for the frequency stamped on the 'Factory Set Operating Frequency' label (see section 3.1). This label should list the frequency at which the last complete transmitter alignment was performed. For a small frequency change, a simple channel change (see section 2.2) may be all that is required. A larger frequency change may involve the realignment of other modules. The frequency change in question is the *accumulated frequency change* in relation to the frequency stamped on the label. For example, if the frequency is changed by 0.5 MHz from that stamped on the label, then a second frequency change of 1 MHz in the same direction would result in a total change of 1.5 MHz. The action taken would be on the basis of the 1.5 MHz value. Failure to perform a realignment after a large frequency change could result in unreliable transmitter operation or transmitter operation that does not conform to the published specifications. The allowable frequency change is summarized below.

Note: It is advisable to confirm these frequency ranges with the individual module manuals, notably the Amplifier and Synthesizer Module, as they are subject to change with updated versions. The values in the module manuals take precedent over those tabulated.

FOR MODEL ALL **VT-3 132 - 174 MHz Transmitters**

Size of Frequency Change	Modules to be Aligned
less than ± 0.2 MHz	Transmitter Main Board (Channel Change)
between ± 0.2 and ± 0.5 MHz	Transmitter Main Board (Channel Change), Audio Processor (see section 2.3.4)
between ± 0.5 and ± 1.0 MHz	Transmitter Main Board (Channel Change), Audio Processor (see section 2.3.4), Synthesizer check RF alarm thresholds (section 2.3.5)
± 1.0 MHz or greater	Complete alignment

2.3.3 Output Power Adjustment

The RF power output of the amplifier is set to its rated value of 2.0 Watts or 8.0 Watts at the factory. This should not require adjustment under normal circumstances. However, should it be necessary to correct the output power, the 'Output Power Adjustment' which is described in the Amplifier Manual can be adjusted accordingly. If the Synthesizer module is replaced, it is strongly recommended that the amplifer undergo a realignment as described in the Amplifier Module, unless it is confirmed that the original and replacement Synthesizer module have identical output power (within ± 0.5 dBm).

2.3.4 Deviation Setting

The transmitter maximum deviation range is set by jumpers at the factory to ± 5.0 kHz for the VT-3 132 - 174 MHz transmitter. However, under some conditions such as a large change in transmitter operating frequency, the deviation control may need adjustment. The transmitter deviation is dependent on the operating frequency and this dependency is likely to be more severe at the band edges. For frequency changes exceeding ± 0.5 MHz, especially at the band edges, the deviation should at least be checked and corrected if necessary. See the Audio Processor section of the Transmitter Main Board Manual for details on setting the transmitter deviation. Note that the adjustment of the balance compression levels, which is also discussed in the Audio Processor alignment section, is not required as this adjustment should not be affected by a change in frequency or deviation settings.

2.3.5 Setting RF Alarm Thresholds

The VSWR and Forward Power Alarms are factory preset to give alarm conditions for a 3:1 VSWR and 50 % forward power respectively. The Amplifier Manual describes how to adjust these settings, should different levels be required. If the alarm thresholds are crital to operation of a particular installation and if the transmitter undergos a large change in frequency (see section 2.3.2 above), the threshold alarm levels, particularly the VSWR alarm, should be checked.

2.4 Recommended Test Equipment List

Alignment of the transmitter requires the following test equipment or its equivalent.

Dual Power Supply:	Regulated +9.5 Vdc at 2 A.
	Regulated +13.8 Vdc at 2 A - Topward TPS-4000
Oscilloscope / Multimeter:	Fluke 97 Scopemeter
Current Meter:	Fluke 75 multimeter
Radio communications test set :	Marconi Instruments 2955R
VSWR 3:1 mismatch load:	JFW 50T-035-3.0:1
Alignment Tool:	Johanson 4192

It is recommended that the radio communications test set be frequency locked to an external reference (WWVH, GPS, Loran C) so that the high stability oscillator may be accurately set to within its ±1 ppm frequency tolerance.

2.5 Repair Note

The transmitter is mainly made up of surface mount devices which should not be removed or replaced using an ordinary soldering iron. Removal and replacement of surface mount components should be performed only with specifically designed surface mount rework and repair stations complete with ElectroStatic Dissipative (ESD) protection.

When removing Surface Mount Solder Jumpers, it is recommended to use solder braid in place of manual vacuum type desoldering tools when removing jumpers. This will help prevent damage to the circuit boards.

2.6 Printed Circuitboard Numbering Convention

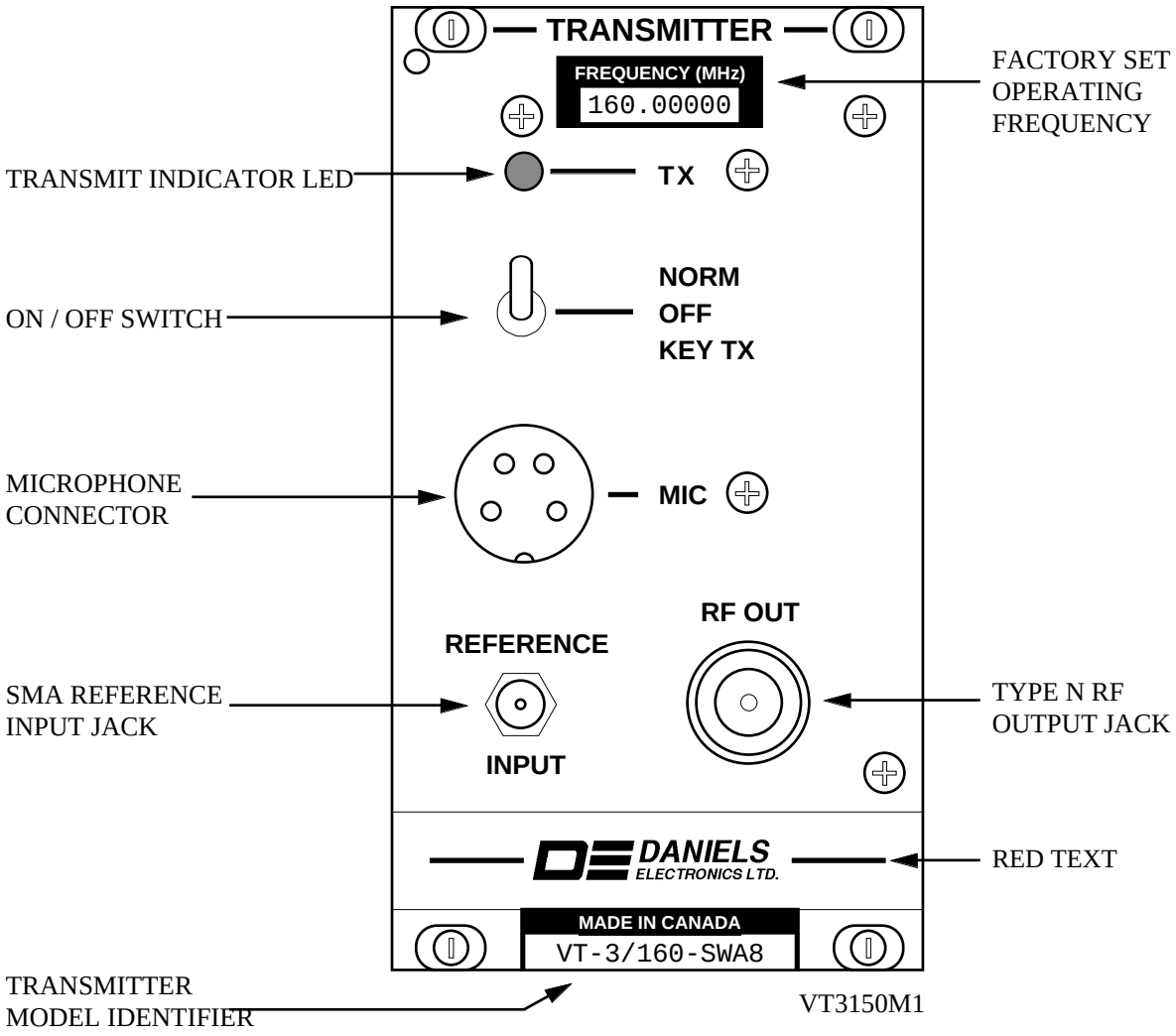
To ease troubleshooting and maintenance procedures, Daniels Electronics Limited has adopted a printed circuitboard (PCB) numbering convention in which the last two digits of the circuitboard number represent the circuitboard version. For example:

- PCB number 43-912010 indicates circuitboard version 1.0;
- PCB number 50002-02 indicates circuitboard version 2.0.

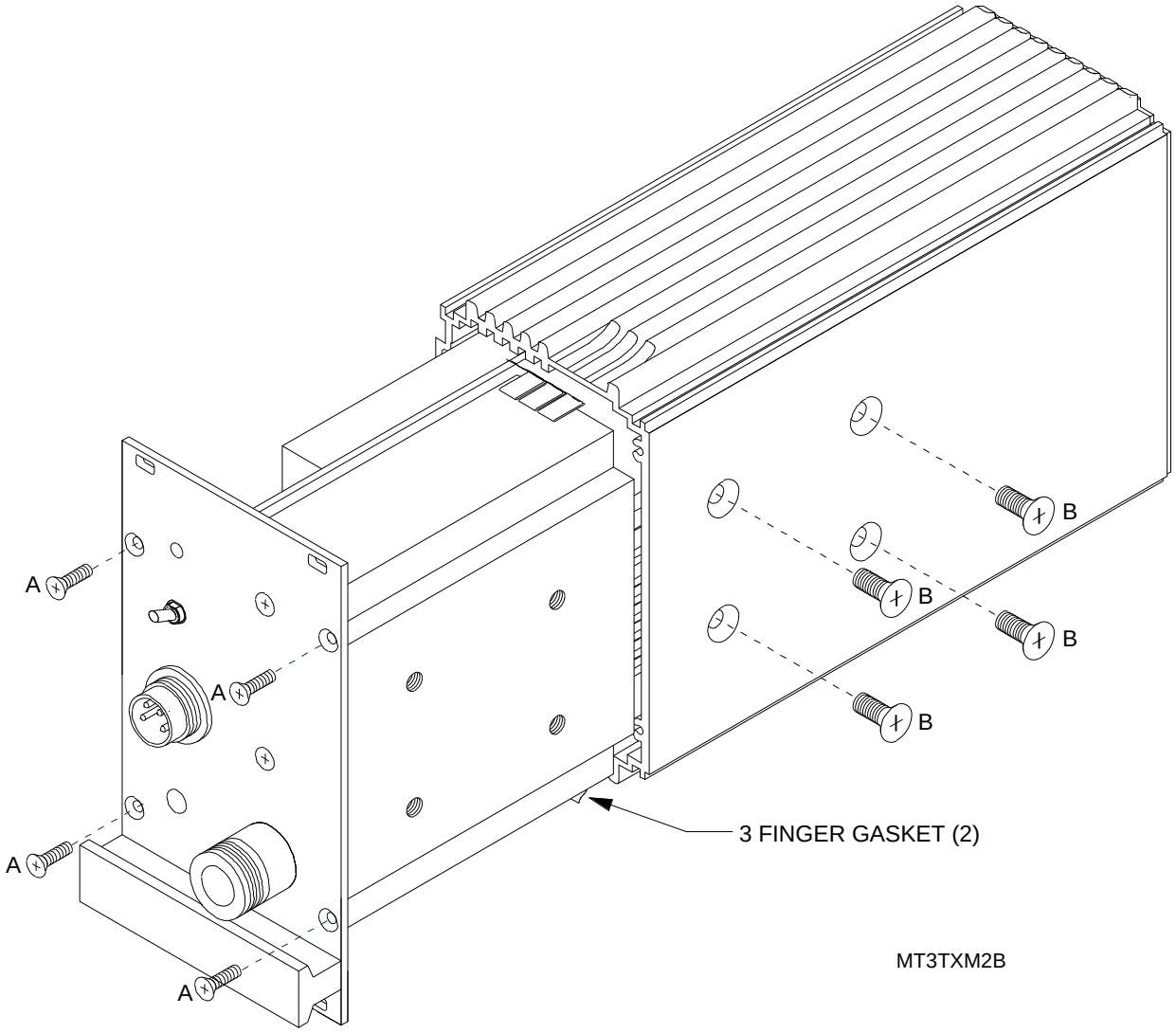
All PCB's manufactured by Daniels Electronics are identified by one of the above conventions.

3 ILLUSTRATIONS

3.1 MT-3 Transmitter Front Panel



3.2 MT-3 Transmitter Case - Exploded View



Instructions

1. Remove the four screws (A) in the Front panel.
2. Remove the four screws (B) on the side of the Transmitter Case.

4 PARTS LIST

Description	Part No.	Qty.
LABEL/LEXAN, 14HP, VHF: RED	3536-10111405	1

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5 REVISION HISTORY

ISSUE	DATE	DESCRIPTION AND (REASON)
3	May 98	• Manual formatted to modular style. All previous revision history in issue 2.

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MT-3 RADIO SYSTEMS

TRANSMITTER MAIN BOARD INSTRUCTION MANUAL

Covers: Version 1.7 of the Transmitter Main Board
Version 1.6 & 1.8 of the FM Audio Processor Board

Issue:	3	Previous Issue:	2	
Issue Date:	November 1998	Previous Issue Date:	May 1998	Daniels Electronics Ltd.
Printing Date:	January 2001			Victoria, B.C.
Part No.:	IM20-MT3TXMN			PRINTED IN CANADA

Reviewed By:

Quality Assurance:

Name	Signature	Date
Larry Freeman	Larry Freeman	12 May 98

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1 GENERAL

1.1 Introduction

The MT-3 Transmitter Main Board integrates the MT-3 Front Panel Board, MT-3 Audio Processor, Synthesizer or Crystal Controlled Oscillator module, and Amplifier module together to comprise a MT-3 series transmitter (see section 5.1: MT-3 Transmitter Block Diagram). The Front Panel Board and the Audio Processor are soldered directly to the Transmitter Main Board while the Amplifier and the Synthesizer or Crystal Controlled Oscillator module are frequency band sensitive, plug-in modules. Circuitry and jumpers on the Transmitter Main Board control the operation of the modules as well as the overall operation of the MT-3 transmitter. Power and signal connections are made through the 48 pin type 'F' connector on the rear of the Transmitter Main Board where they are then routed to the other MT-3 modules. The front and rear panels are attached to the Transmitter Main Board and together with the extruded aluminum shell, form the transmitter enclosure.

1.2 Performance Specifications

1.2.1 General

Type: MT-3 Series Transmitter

Compatibility:	MT-3 Series Amplifier, OC-3 Crystal Controlled Oscillator module, OS-3 and OS-3H Frequency Synthesizer modules.
Modulation:	11K0F3E or 16K0F3E (Frequency Modulation).
Operating Temperature Range:	-30˚C to +60˚C, optional -40˚C to +60˚C temperature test.
Operating Humidity:	95% RH (non-condensing) at +25°C.
Operating Voltage:	+9.5 Vdc Regulated. +13.8 Vdc Nominal (11 - 16 Vdc).
Front Panel Controls:	NORM (repeat mode), OFF, and KEY TX (Tx on).
PTT Activation:	• Active to ground with or without time-out-timer; • Microphone activated with or without time-out-timer; • Front Panel switch: KEY TX - without time-out-timer; • NORM - with or without time-out-timer. • Isolated (optional relay) with or without time-out-timer.
PTT Time-Out-Timer:	Selectable from 1 sec. to 8 hrs. (Factory Default: 5 min.).

1.2.2 Audio Specifications

Audio Input:	Balanced 600 ohm or unbalanced (optional). Input level sensitivity, -25 dBm to 0 dBm.
Audio Response:	Pre-emphasis (6 dB per octave); +0.5 to -2.0 dB from 300 Hz to 3 kHz;
Flat Audio Response:	+1 to -1 dB from 100 Hz to 3 kHz.
Audio Deviation:	Preset to ±1.5 kHz (Narrow Band) or ±3.0 kHz (Wide Band) with a 1 kHz tone (capable ±2.5 kHz or ±5.0 kHz).
Subtone Audio Input 1:	0.5 Vpp at 200 Hz for ±500 Hz deviation (internally adjustable).
Subtone Audio Input 1 Frequency range:	60 Hz to 300 Hz.
Subtone Audio Input 2:	0.5 Vpp at 100 Hz for ±500 Hz deviation (internally adjustable).
Subtone Audio Input 2 Frequency range:	DC to 150 Hz.
Direct Modulation Input:	0.5 Vrms at 1 kHz or ±3 kHz deviation.
Direct Modulation Frequency range:	DC to 5 kHz.

2 THEORY OF OPERATION

2.1 Transmitter Main Board

2.1.1 General

Switch SW1 on the Front Panel Board is a DPDT switch which controls the operation of the transmitter (refer to the operations section of the Transmitter Manual). When SW1 is in the 'OFF' position the transmitter is turned off; however, +13.8 Vdc is still present on the Transmitter Main Board as the +13.8 Vdc supply is not switched. When SW1 is in the 'KEYED' position, +9.5 Vdc is supplied to the transmitter circuitry and the transmitter is continuously keyed on. When SW1 is in the 'NORM' position, +9.5 Vdc is supplied to the transmitter circuitry and the transmitter can be keyed from any of the several Push-To-Talk inputs.

Refer to section 5.2.3 Transmitter Main Board Schematic Diagram.

2.1.2 Transmitter Push-To-Talk

All three of the Push-To-Talk (PTT) inputs that key the transmitter are active low (< +2 Vdc). One PTT input is on the front panel microphone connector. The other two PTT inputs: PTT WTO (PTT With Time-Out-Timer) and PTT NTO (PTT No Time-Out-Timer), are on the backplane connector of the transmitter board. If required, the microphone's PTT input can be configured to activate the transmitter's Time-Out-Timer (TOT). An isolated PTT input can be made available by installing an optional relay (RELAY1) and configuring jumpers J1 to J4 so that the relay controls the PTT circuitry.

2.1.2.1 Microphone PTT

Jumper J1 on the MT-3 Front Panel Board configures the microphone's PTT input (MIC PTT) to either bypass or activate the transmitter's TOT. Installing surface mount jumper J1 in the 'x' position (default) selects the MIC PTT NTO line which bypasses the TOT. Installing surface mount jumper J1 to the 'y' position selects the MIC PTT WTO line which activates the transmitter's TOT. When SW1 is in the 'KEYED' position the MIC PTT NTO line is automatically grounded. Refer to Section 5.3.1, "MT-3 Front Panel Board Component Layout" for the location of jumper J1.

2.1.2.2 PTT With Time-Out-Timer

Pins B10 and Z10 of the backplane connector are the PTT WTO input. When the PTT WTO signal, which is normally high, falls below +2.0 Vdc, the transmitter is keyed. The transmitter is disabled when the PTT WTO input rises above +2.3 Vdc or if the TOT's time-out period is exceeded. If the time-out period is exceeded the PTT WTO input must go high (>+2.3 Vdc) and then low again in order to rekey the transmitter.

The PTT WTO threshold of approximately +2 Vdc (0.3 Vdc hysteresis) is set by U1a, R1, R2, R3, R4, R9, and R10 while diodes D1 and D2 provide overvoltage protection for U1a. The PTT WTO signal output from U1a is 'AND'ed with the MIC PTT WTO by U2a. When either the PTT WTO or the MIC PTT WTO is activated the output of U2a goes low which triggers the transmitter's TOT located on the MT-3 Audio Processor. The TOT's output is 'AND'ed with the MIC PTT NTO signal (U2c) and the PTT NTO signal (U2d). When any one of the preceding three signals (TOT's output, MIC PTT NTO, PTT NTO) go low the transmitter is activated by transistors Q1 to Q7 which switch power to the various modules.

2.1.2.3 PTT No Time-Out-Timer

Pins B14 and Z14 of the backplane connector are the PTT NTO input. When the PTT NTO signal, which is normally high, falls below +2.0 Vdc, the transmitter is keyed. As long as the PTT NTO signal remains below +2.0 Vdc the transmitter will remain keyed. The transmitter is disabled when the PTT NTO signal rises above +2.3 Vdc.

The PTT NTO threshold of approximately +2 Vdc (0.3 Vdc hysteresis) is set by U1b, R5, R6, R7, R8, R9, and R10 while diodes D3 and D4 provide overvoltage protection for U1b. The PTT NTO signal is 'AND'ed with the output of U2c (MIC PTT NTO signal 'AND'ed with the TOT output) by U2d. When the output of U2d goes low the transmitter is activated by transistors Q1 to Q7 which switch power to the various modules.

2.1.2.4 Optional Relay

The transmitter's PTT circuitry can be completely isolated by installing RELAY1. Jumpers J1 to J5 configure the relay to provide an isolated PTT input for either the PTT WTO line or PTT NTO line. The isolated PTT input is enabled by energizing the relay. The transmitter board will accept any of the Aromat TF2E line relays. These relays are DPDT, single side stable, and have coil voltages ranging from +3 Vdc to +48 Vdc. Only one set of relay contacts are used to activate the PTT circuitry.

To configure the isolated input for PTT WTO operation jumpers J2, J3, and J4 must be in the 'y' position. In this mode, pins B10 and Z10 no longer function as the PTT WTO input; however, pins B14 and Z14 continue to function as the normal PTT NTO input.

To configure the isolated input for PTT NTO operation jumpers J2, J3, and J4, must be in the 'x' position. In this mode, pins B14 and Z14 no longer function as the PTT NTO input; however, pins B10 and Z10 continue to function as the normal PTT WTO input.

2.1.2.5 PTT Output

Pin B24 on the backplane connector is an open drain output (Q9) which is pulled low anytime the transmitter is keyed and the synthesizer is locked. A crystal controlled transmitter does not have a locked condition so pin B24 is pulled low anytime the transmitter is keyed. Q9, an N-channel MOSFET capable of sinking currents up to 2 Amps, is activated by Q8 which is activated by the Qualified PTT signal (JS2-6) of the Synthesizer or Crystal Controlled Oscillator module. The Qualified PTT signal also controls the LED ENA line for diode D1 on the front panel board and enable line for the MT-3 Amplifier Module (JP1-1).

2.1.2.6 PTT Voltage Switching

The PTT voltage switching circuitry is comprised of transistors Q1 through Q7 and the associated resistors. The base of Q1 is driven by the output of U2d which is the combined PTT signal from all of the PTT inputs. When the transmitter is keyed, Q1 is turned off and subsequently transistors Q3, Q4, and Q6 are turned on. Transistors Q3, Q4, and Q6 provide three different functions:

- Q3 provides the active low signal for the Synthesizer or Crystal Controlled Oscillator module PTT input;
- Q4 turns on Q5 which turns on the +9.5 Vdc Switched supply;
- Q6 turns on Q7 which turns on the +9.5 Vdc PTT Switched supply.

The '+9.5 Vdc Switched' supply (Q5) can also be activated by installing jumper J6 or by externally grounding the TX Standby Line (pins B12 and Z12). The '+9.5 Vdc PTT Switched' supply and the '+9.5 Vdc Switched' supply both provide +9.5 Vdc but depending on how jumpers J6, J7 and J18 are configured the transmitter's standby mode will change.

2.1.2.7 Transmitter Standby Modes

The MT-3 series transmitters have four different standby modes that trade-off standby current consumption for start-up speed. The standby modes are determined by three jumpers: jumper J6 which always turns on the '+9.5 Vdc Switched' supply, jumper J7 which selects the power source for the MT-3 Audio Processor and jumper J18 which selects the enable line for the OS-3 or OS-3H Synthesizer, or OC-3 Crystal Controlled Oscillator module.

The actual current and start-up time may depend on the oscillator source (crystal or synthesizer) and amplifier module. The current and start-up times given below are representative values

intended only as a guideline. Refer to the instruction manual for the transmitter that came with your system for specifications.

- MODE 1**:** Jumper J6 out
  - the audio processor is switched by a PTT signal
  - the synthesizer or crystal controlled oscillator is switched by a PTT signal
  - standby current: Synthesized - typically 7 mA
    Crystal Controlled - typically 6 mA
  - start-up time: Synthesized - typically 50 ms
    Crystal Controlled - typically 25 ms

- MODE 2**:** Jumper J6 in, jumper J7 in the 'y' position, jumper J18 in the 'x' position
  - the audio processor is switched by a PTT signal
  - the synthesizer or crystal controlled oscillator is enabled all of the time
  - standby current: Synthesized - typically 65 mA
    Crystal Controlled - typically 25 mA
  - start-up time: Synthesized - typically 25 ms
    Crystal Controlled - typically 25 ms

- MODE 3**:** Jumper J6 in, jumper J7 in the 'x' position, jumper J18 in the 'y' position
  - the audio processor is enabled all of the time
  - the synthesizer or crystal controlled oscillator is switched by a PTT signal
  - standby current: Synthesized - not used in this mode
    Crystal Controlled - typically 28 mA
  - start-up time: Synthesized - not used in this mode
    Crystal Controlled - typically 10 ms

- MODE 4**:** Jumper J6 in, jumper J7 in the 'x' position, jumper J18 in the 'x' position
  - the audio processor is enabled all of the time
  - the synthesizer or crystal controlled oscillator is enabled all of the time
  - standby current: Synthesized - typically 90 mA
    Crystal Controlled - typically 46 mA
  - start-up time: Synthesized - typically 10 ms
    Crystal Controlled - typically 10 ms

2.1.3 Audio Circuits

All of the audio signal conditioning (e.g. limiting, filtering, and pre-emphasis) is performed by the MT-3 Audio Processor. The transmitter board routes the audio lines from the backplane connector to the audio processor and then to the synthesizer. The audio lines routed to the audio processor are: two subtone inputs (backplane pins B22 and Z24), a direct modulation input (pin Z28), a squelched/flat audio input (pin Z20), a 600 ohm balanced input (pins B18 and Z18), and an audio control line (pin Z22). The audio processor's balanced input pins are isolated from pins B18 and

Z18 by a transformer (T1). Two audio outputs from the MT-3 Audio Processor are routed to the synthesizer or crystal control oscillator modules.

2.1.3.1 Microphone Audio

Normally the audio from a transmitter's microphone is transmitted by that transmitter; however, the Transmitter Main Board can be configured by the MIC IN and MIC OUT lines so that the audio from an external microphone modulates transmitter. The configuration of the MIC IN (pin Z4) and MIC OUT (pin B4) lines on the MT-3 Transmitter Board are controlled by jumpers J16 and J17 respectively. Jumper J16 selects the audio source for the MT-3 Audio Processor's microphone input. Jumper J17 is used to enable or disable the MIC OUT line. Normally the transmitter's microphone is selected (J16 in the 'x' position) and the MIC OUT line is enabled (J17 is installed).

2.1.3.2 Received Audio

Pin B20 is the audio input from the transmitter's corresponding receiver. The default setting for this line is to have it AC coupled (Jumper J9 is out) and directly connected to the front panel board RX AUDIO line (jumpers J10 and J11 in the 'x' position). Audio amplifier U5 can be enabled by installing jumper J8 which connects power to U5 (continuously in the 'x' position, PTT switched in the 'y' position). Setting jumper J10 in the 'y' position and jumper J11 in the 'z' position enables the audio path through the amplifier. Level control for the squelched, de-emphasized audio input line is provided by R27. Audio amplifier U5 draws approximately 5 mA so it is not normally enabled.

2.1.4 Channel Selection

2.1.4.1 Synthesized Transmitter

Seven backplane connections are used to communicate with the synthesizer unit. Pins D28, D30, and D32 are used (in house) to program the synthesizer. Channel select lines CSEL 0 (least significant bit) through CSEL 3 (most significant bit), which are available at pins D20, D22, D24, and D26, are used once the synthesizer is programmed to select one of 16 channels. If the channel select lines are all low (channel 0) the channel for the synthesizer is read from switches FSW1 (most significant), FSW2, FSW3, and FSW4 (least significant); otherwise one of 15 pre-programmed frequencies is selected. Since the resulting frequency is dependent on the transmitter model, refer to the section on frequency selection in the Transmitter Manual or to the channel designation tables for that particular transmitter.

2.1.4.2 Crystal Controlled Transmitter

The OC-3 Crystal Control Oscillator module is a direct replacement for the synthesizer module and therefore uses the same connections as the synthesizer to connects to the MT-3 Transmitter Main Board. The channel select lines and switches FSW1 to FSW4 are not used by the crystal control module as the transmitter's operating frequency is determined by the Crystal Control Oscillator module's crystal frequency. A frequency multiplication factor, described in the manual for this module, relates the crystal frequency to the operating frequency .

2.1.5 Amplifier Circuits

The MT-3 series Amplifier has 6 connections that are cabled to the transmitter board: +13.8 Vdc, +9.5 Vdc, Enable, Forward Power Sense, Reverse Power Sense, and Ground. The +13.8 Vdc supply (JP1-3) is always on while the +9.5 Vdc supply (JP1-2) is always switched by a PTT signal. The enable line (JP1-1) is active low and is controlled by the Qualified PTT signal from the synthesizer module or crystal controlled oscillator module.

Jumpers J12, J13, J14, and J15 are used to configure the amplifier's forward and reverse power sense lines (JP1-4 and JP1-5). Normally jumpers J13, J14, and J15 are in the 'x' position which directly connects the amplifier's forward and reverse power sense lines to the backplane connector (pins B26 and Z26 respectively). The forward and reverse power sense lines from the Amplifier can be open collector or linear outputs depending on how they are configured in the amplifier module. In open collector configuration the lines are active low, that is, the output will go low when a 'fail' condition is detected. If both lines from the amplifier module are configured as open collector outputs, the power sense lines can be 'OR'ed together to make a general fail indicator (jumper J12 in, jumpers J13, J14, and J15 in the 'y' position). The Fail Indicator is also an open collector output; however, the Fail Indicator is active high (the output goes high when a 'fail' condition is detected). When the transmitter is configured with the general fail indicator option, pin Z26 (VSWR reverse) is not used and pin B26 becomes the Fail Indicator output.

2.1.6 Time-Out-Timer Circuitry

The MT-3 Transmitter also has an associated programmable push-to-talk (PTT) time-out-timer (TOT) circuitry on the Transmitter Main Board. The TOT circuitry is powered via J34 from the continuous +9.5 Vdc supply and is programmable for various time-out periods.

The TOT input trigger (enabled by J33) is normally high and in this state the timer is disabled. When the input trigger level falls below +2.0 Vdc, the timer is activated, the TOT output trigger (enable by J35) is pulled low, and the transmitter is keyed. If the input trigger rises above +2.4 Vdc or if the time-out period is exceeded, the output trigger will go high, disabling the transmitter. If the time-out period is exceeded, the TOT input trigger must go high and then low again in order to rekey the transmitter.

The time-out duration is jumper selectable from 1 second to 8 hours. The positions of the jumpers on the top (Through hole component) side of the Transmitter Main Board. Table 2-1 shows the time-out duration in minutes for the various jumper settings which are listed as enabled (E: jumper shorted - in) or disabled (D: jumper left open - out). The standard factory setting of 5 minutes is shown in bold type in table 2-2.

Table 2-1 Time-Out-Timer Settings

D = DISABLED (no solder jumper installed), E = ENABLED (solder jumper installed). Bold text represents default settings.

				TIME-OUT DURATION (MINUTES)		
				J26 = E	**J26** = D	**J26** = E
J32	**J31**	**J29**	**J28**	**J27 = D**	**J27** = E	**J27** = E
E	E	E	E	0.01	0.01	0.01
E	E	E	D	0.02	0.03	0.01
E	E	D	E	0.04	0.06	0.02
E	E	D	D	0.08	0.12	0.05
E	D	E	E	0.15	0.23	0.10
E	D	E	D	0.31	0.47	0.19
E	D	D	E	0.62	0.94	0.38
E	D	D	D	1.25	1.88	0.75
D	E	E	E	2.5	3.75	1.5
D	**E**	**E**	**D**	**5.0**	7.5	3.0
D	E	D	E	10	15	6.0
D	E	D	D	20	30	12
D	D	E	E	40	60	24
D	D	E	D	80	120	48
D	D	D	E	160	240	96
D	D	D	D	320	480	192

2.2 MT-3 Front Panel Board

The MT-3 Front Panel Board is a subsection of the MT-3 Transmitter Board which is used to mount the front panel switch, diode, and microphone connector. The main purpose of the board is to eliminate a wiring harness for the front panel components. Jumper J1, located on the rear of the circuitboard, is used to select whether or not the MIC PTT line activates the transmitter's TOT. Jumper J2 is used to select whether or not Rx Audio or 13.8 Volt is supplied to pin 4 of the microphone.

- Jumper J1: 'x' position MIC PTT NTO no time-out-timer (factory setting)
  'y' position MIC PTT WTO with time-out-timer
- Jumper J2: 'x' position Rx Audio enabled to MIC-4 pin (factory setting)
  'y' position +13.8 Volts supplied to MIC-4 pin

Refer to section 5.3.2 "MT-3 Front Panel Board Schematic Diagram".

2.3 MT-3 Audio Processor (Version 1.6)

2.3.1 General

The MT-3 Audio Processor is a versatile circuitboard that can provide several types of audio processing for voice or data transmission. Two analog switches on the audio processor, controlled by a common signal, make it possible to transmit voice or data. A continuous +9.5 Vdc supply and a switched +8.0 Vdc supply are required to power the module. The MT-3 Audio Processor is backwards compatible to Daniels Electronics MT-2 series transmitters. Refer to section 5.4.1 "MT-3 Audio Processor Component Layout" and to section 5.4.2 "MT-3 Audio Processor Schematic Diagram" for component location and designation references.

2.3.2 Power Requirements

The audio processor can be configured for continuous audio standby or for switched audio standby by the Transmitter Main Board. If fast audio risetime is desired, the transmitter should be operated in standby mode 2 or 3 as specified in section 2.1.2.7. Power for the microphone input and the balanced input can be separately disabled by jumpers J3 and J4 respectively if the input is not required. This results in a current savings of approximately 11 mA per input. The current requirements for the MT-3 Audio Processor are shown in Table 2-1. The current for the associated TOT is approximately 4 mA when the transmitter is keyed and is included in the keyed values in the table below.

Table 2-1 MT-3 Audio Processor Current Consumption.

Function	Current Draw keyed / unkeyed
Switched Audio Standby	
Both Microphone and Balanced Input enabled	29.0 / 0.5 mA
Only Microphone or Balanced Input enabled	17.5 / 0.5 mA
Only Auxiliary Input enabled	6.0 / 0.5 mA
Continuous Audio Standby	
Both Microphone and Balanced Input enabled	29.0 / 25.5 mA
Only Microphone or Balanced Input enabled	17.5 / 14.0 mA
Only Auxiliary Input enabled	6.0 / 2.5 mA

2.3.3 Audio Processor Turn-on Time

The turn-on time of the audio processor is 25 ms. This measurement is made with the standard factory settings with a 1 kHz tone applied to the balanced input. The turn-on time is the time it takes the audio processor to output a stable audio signal from the time its power (+9.5 Vdc) is switched on. The turn-on time can be virtually eliminated by configuring the audio processor for continuous audio standby (see section 2.1.2.7 Transmitter Standby Modes).

2.3.4 Audio Processor Signals

The MT-3 Audio Processor has six audio inputs, two audio outputs and one audio control input. Five of the audio inputs are used primarily for voice signals. The sixth, the Direct modulation input, is used primarily for data signals. The audio control input is used to switch audio outputs so the transmitter can transmit voice or data.

2.3.4.1 Audio Processor Outputs

Both the audio outputs, Modulation Output (P3-1) and Low Frequency / Direct Modulation Output (P4-2), are gated by audio switches U9 and U10 respectively which are controlled by the Tx Audio Control Input (P4-4). The audio switches operate complimentary to each other so there can ever only be one source modulating the transmitter. In standard configuration, the Modulation Output port is used so switch U9 is always on.

2.3.4.2 Audio Processor Modulation Output

The Modulation Output port is the output port used by all voice input signals. The voice inputs are combined by summing amplifier U4a which has an associated symmetry control (R14). Op-amp U4a together with U5a provide the limiting action for the audio processor. After the audio signals have been combined and limited, they are filtered by a 6 pole lowpass Butterworth filter (U5b, U5c, and U5d). Jumpers JU24, JU25 and JU26 configure the lowpass filter for narrowband or wideband operation: jumpers JU24(x and y) to JU26(x and y) are installed for wideband (25 kHz) channels and are not installed for narrowband (12.5 kHz) channels. The output signal from the filter is then level adjusted by the deviation control pot, R29, before modulating the transmitter.

In special applications, jumper JU6 can be disabled and JU7 enabled, this allows the transmitter to be modulated directly from the auxiliary input. This should not be done without external filtering since jumper JU7 bypasses the limiting and filter circuits.

2.3.4.3 Audio Processor Low Frequency / Direct Mod. Output

The Low Frequency / Direct Modulation Output port has two functions depending on whether the transmitter is synthesized or crystal controlled. In a synthesized transmitter, this port is used to modulate the synthesizer reference frequency. The frequency response of this port is typically DC to 60 Hz. In a crystal controlled transmitter, this port can be used by the Direct Modulation Input to directly modulate the crystal control oscillator module. The frequency response of this port is essentially flat from DC to 5 kHz with no limiting or filtering. Amplification, if desired, is provided by Op-amp U8a which is powered independent of the audio card voice circuits by jumper JU1.

2.3.4.4 Audio Processor Inputs

As previously mentioned, the MT-3 Audio Processor has six audio inputs, five used primarily for voice signals and one for data signals.

The 6 audio inputs on the audio processor are:

- dynamic microphone input
- 600 ohm balanced input
- 2 subtone inputs
- auxiliary input.
- direct modulation input.

2.3.4.5 Audio Processor Microphone Input

The microphone input has an automatically gain controlled (AGC) preamplifier whose input level is controlled by R2. The microphone input level control (R2) can accommodate a -25 dBm to 0 dBm input signal. The compression level for the microphone input is adjusted by R8. The microphone input is limited and filtered and is output at the standard modulation output port.

2.3.4.6 Audio Processor Balanced Input

The 600 ohm balanced input also has an AGC preamplifier, input level control (R31), and compression level control (R38). The balanced input level control can accommodate a -25 dBm to 0 dBm input. The balanced input can have a standard 6 dB/octave pre-emphasis response by enabling jumper JU9 or a flat-audio response by enabling jumper JU10. Like the microphone input, the balance input is limited and filtered and is output at the standard modulation output port.

2.3.4.7 Audio Processor Auxiliary Input

The auxiliary input is a special input and does not have an AGC preamplifier or an input level control. This input can be configured for a pre-emphasis response (enable JU14) or a flat-audio response (enable JU15). The compression level for this input is set by R48. The auxiliary output is normally summed with the voice signals by op-amp U4a, limited, then filtered and output at the standard modulation output port. When jumper JU6 is disabled and jumper JU7 is enabled, the auxiliary input can be used to directly modulate the transmitter. Care should be taken when directly modulating the transmitter with the auxiliary input because the MT-3 transmitters use direct FM modulation and there is no filtering or limiting action provided by the auxiliary input. The input level to the auxiliary input should be -18 dBm and can be driven by one of three inputs:

- the balanced input – JU11 enabled
- the tone/digital input – JU12 enabled
- the direct modulation input – JU13 enabled

When the 600 ohm balanced input is connected to the auxiliary input, the balanced input level control can be used to adjust the level for the auxiliary input. When either the tone/digital input or the direct modulation input are used, the input level is not adjustable.

2.3.4.8 Audio Processor Subtone Inputs

There are two subtone inputs available on the audio processor. Both subtone inputs can be individually configured to be output from the standard Modulation Output port or to be output from the Low Frequency / Direct Modulation Output. In standard configuration, Subtone 1 is summed

with the voice signals to be output from the standard Modulation Output port while Subtone 2 is not used. Both subtone inputs have an input level control.

2.3.4.9 Audio Processor Direct Modulation Input

The Direct Modulation Input is an extremely versatile input. This port is designed to be used for data signals. Depending on the application, the signal can be amplified, AC or DC coupled and output to the Modulation Output or the Low Frequency / Direct Modulation Output port. Please consult the factory for specific jumper settings for your application.

2.4 MT-3 Audio Processor (Version 1.8)

2.4.1 General

The MT-3 Audio Processor is a versatile circuitboard that can provide several types of audio processing for voice or data transmission. Two analog switches on the audio processor, controlled by a common signal, make it possible to transmit voice or data. A continuous +9.5 Vdc supply and a switched +8.0 Vdc supply are required to power the module. The MT-3 Audio Processor is backwards compatible to Daniels Electronics MT-2 series transmitters. Refer to section 5.5.1 "MT-3 Audio Processor Component Layout" and to section 5.5.2 "MT-3 Audio Processor Schematic Diagram" for component location and designation references.

2.4.2 Power Requirements

The audio processor can be configured for continuous audio standby or for switched audio standby by the Transmitter Main Board. If fast audio risetime is desired, the transmitter should be operated in standby mode 2 or 3 as specified in section 2.1.2.7 with JU36 on the audio processor in the 'y' position. Power for the microphone input and the balanced input can be disabled by jumpers JU36 and JU40 respectively if the input is not required. This results in a current savings of approximately 3.5 mA per input. The current requirements for the MT-3 Audio Processor are shown in Table 3-1. The current for the associated TOT is approximately 4 mA when the transmitter is keyed. The keyed values in the table below do not include the current for the TOT.

Table 3-1 MT-3 Audio Processor Current Consumption.

Function	Current Draw keyed / unkeyed
Switched Audio Standby	
Both Microphone and Balanced Input enabled	6.0 / 0.3 mA
Only Microphone or Balanced Input enabled	4.5 / 0.3 mA
Only Auxiliary Input enabled	3.0 / 0.3 mA
Continuous Audio Standby	
Both Microphone and Balanced Input enabled	6.0 / 3.5 mA
Only Microphone or Balanced Input enabled	4.5 / 1.5 mA
Only Auxiliary Input enabled	3.0 / 0.5 mA

2.4.3 Audio Processor Turn-on Time

The turn-on time of the audio processor is 25 ms. This measurement is made with the standard factory settings with a 1 kHz tone applied to the balanced input. The turn-on time is the time it takes the audio processor to output a stable audio signal from the time its power (+9.5 Vdc) is switched on. The turn-on time can be virtually eliminated by configuring the audio processor for continuous audio standby (see section 2.1.2.7 Transmitter Standby Modes).

2.4.4 Audio Processor Signals

The MT-3 Audio Processor has six audio inputs, two audio outputs and one audio control input. Five of the audio inputs are used primarily for voice signals. The sixth, the Direct modulation input, is used primarily for data signals. The audio control input is used to switch audio outputs so the transmitter can transmit voice or data.

2.4.4.1 Audio Processor Outputs

Both the audio outputs, Modulation Output (P3-1) and Low Frequency / Direct Modulation Output (P4-2), are gated by audio switches U9 and U10 respectively which are controlled by the Tx Audio Control Input (P4-4). The audio switches operate complimentary to each other so there can ever only be one source modulating the transmitter. In standard configuration, the Modulation Output port is used so switch U9 is always on.

2.4.4.2 Audio Processor Modulation Output

The Modulation Output port is the output port used by all voice input signals. The voice inputs are combined by U1, a gain level programmable compandor which is configured as an automatic level control amplifier. Op-amp U4a together with U5a provide the limiting action for the audio processor. After the audio signals have been combined and limited, they are filtered by a 6 pole lowpass Butterworth filter (U5b, U5c, and U5d). Jumpers JU24, JU25 and JU26 configure the lowpass filter for narrowband or wideband operation: jumpers JU24(x and y) to JU26(x and y) are installed for wideband (25 kHz) channels and are not installed for narrowband (12.5 kHz) channels. The output signal from the filter is then level adjusted by the deviation control pot, R29, before modulating the transmitter.

In special applications, jumper JU6 can be disabled and JU7 enabled, this allows the transmitter to be modulated directly from the auxiliary input. This should not be done without external filtering since jumper JU7 bypasses the limiting and filter circuits.

2.4.4.3 Audio Processor Low Frequency / Direct Mod. Output

The Low Frequency / Direct Modulation Output port has two functions depending on whether the transmitter is synthesized or crystal controlled. In a synthesized transmitter, this port is used to modulate the synthesizer reference frequency. The frequency response of this port is typically DC to 300 Hz. In a crystal controlled transmitter, this port can be used by the Direct Modulation Input to directly modulate the crystal control cscillator module. The frequency response of this port is essentially flat from DC to 5 kHz with no limiting or filtering. Amplification, if desired, is provided by Op-amp U3b.

2.4.4.4 Audio Processor Inputs

As previously mentioned, the MT-3 Audio Processor has six audio inputs, five used primarily for voice signals and one for data signals.

The 6 audio inputs on the audio processor are:

- dynamic microphone input
- 600 ohm balanced input
- 2 subtone inputs
- auxiliary input.
- direct modulation input.

2.4.4.5 Audio Processor Microphone Input

The microphone input has an automatically level controlled (ALC) preamplifier U1 whose input level is controlled by R2. The microphone input level control (R2) can accommodate a -25 dBm to 0 dBm input signal. The microphone input is limited and filtered and is output at the standard modulation output port. The microphone input can have a standard 6dB/octave pre-emphasis response or a flat-audio response, jumper JU3 at 'x' and 'y' position respectively.

2.4.4.6 Audio Processor Balanced Input

The 600 ohm balanced input also uses the ALC preamplifier U1, with input level control pot (R31). The balanced input level control can accommodate a -25 dBm to 0 dBm input. Like the microphone input, the balance input is limited and filtered and is output at the standard modulation output port.

2.4.4.7 Audio Processor Auxiliary Input

The auxiliary input is a special input and does not have an ALC preamplifier or an input level control. This input can be configured for a pre-emphasis response (enable JU14) or a flat-audio response (enable JU15). The compression level for this input is set by R48. The auxiliary output is normally summed with the voice signals by op-amp U4a, limited, then filtered and output at the standard modulation output port. When jumper JU6 is disabled and jumper JU7 is enabled, the auxiliary input can be used to directly modulate the transmitter. Care should be taken when directly modulating the transmitter with the auxiliary input because the MT-3 transmitters use direct FM modulation and there is no filtering or limiting action provided by the auxiliary input. The input level to the auxiliary input should be -18 dBm and can be driven by one of three inputs:

- the balanced input – JU11 'x' position
- the tone/digital input – JU12 enabled
- the direct modulation input – JU13 enabled

When the 600 ohm balanced input is connected to the auxiliary input, the balanced input level control can be used to adjust the level for the auxiliary input. When either the tone/digital input or the direct modulation input are used, the input level is not adjustable.

2.4.4.8 Audio Processor Subtone Inputs

There are two subtone inputs available on the audio processor. Both subtone inputs can be individually configured to be output from the standard Modulation Output port or to be output from the Low Frequency / Direct Modulation Output. In standard configuration, Subtone 1 is summed with the voice signals to be output from the standard Modulation Output port while Subtone 2 is not used. Both subtone inputs have an input level control.

2.4.4.9 Audio Processor Direct Modulation Input

The Direct Modulation Input is an extremely versatile input. This port is designed to be used for data signals. Depending on the application, the signal can be amplified, AC or DC coupled and output to the Modulation Output or the Low Frequency / Direct Modulation Output port. Please consult the factory for specific jumper settings for your application.

2.5 Low Frequency Modulation

The transmitter has an additional option to address low frequency user modulation requirements. A phase modulated bandwidth from 0 (dc) to 100 Hz (PLL loop filter bandwidth) allows specialized applications such as paging or trunking where a separate low frequency digital/analog modulation channel is required. Low Frequency Modulation allows external access to the low frequency modulation capabilities of the synthesizer module. The DIRECT MODULATION inputs on the J1 control connector of the M-3 motherboard will be used (B20 for TX A, and A20 for TX B). See section 3.11, 'Low Frequency Modulation Configuration' for set up and alignment.

3 TRANSMITTER ALIGNMENT

3.1 General

Transmitter alignment is simplified by using an M-3 Subrack, SM-3 System Monitor, and RF extender cable to provide transmitter power and signal interconnection. Alternatively, +9.5 Vdc and +13.8 Vdc may be applied directly to a transmitter module through positive connection for the +9.5 Vdc to pins B6 and Z6, for the +13.8 Vdc to pins B2 and Z2, and negative connection to pins B30, Z30, B32, and Z32. Transmitter balanced audio (600 Ω) is available at pins B18 and Z18.

3.2 Repair Note

MT-3 Transmitter modules are mainly made up of surface mount devices which should not be removed or replaced using an ordinary soldering iron. Removal and replacement of surface mount components should be performed only with specifically designed surface mount rework and repair stations complete with ElectroStatic Dissipative (ESD) protection.

When removing Surface Mount Solder Jumpers, it is recommended to use solder braid in place of manual vacuum type desoldering tools when removing jumpers. This will help prevent damage to the circuitboards.

3.3 Printed Circuitboard Numbering Convention

To ease troubleshooting and maintenance procedures, Daniels Electronics Limited has adopted a printed circuitboard (PCB) numbering convention in which the last two digits of the circuitboard number represent the circuitboard version. For example:

- PCB number 43-912010 indicates circuitboard version 1.0;
- PCB number 50002-02 indicates circuitboard version 2.0.

All PCB's manufactured by Daniels Electronics are identified by one of the above conventions.

3.4 Recommended Test Equipment List

Alignment of the complete transmitter requires the following test equipment or its equivalent. It is assumed that any adjustment of the Transmitter Main Board will also involve the other modules.

Dual Power Supply:	Regulated +9.5 Vdc at 2 A. Regulated +13.8 Vdc at 2 A - Topward TPS-4000
Oscilloscope / Multimeter:	Fluke 97 Scopemeter
Current Meter:	Fluke 75 multimeter

Radio communications test set :	Marconi Instruments 2955R
VSWR 3:1 mismatch load:	JFW 50T-035-3.0:1
Alignment Tool:	Johanson 4192

It is recommended that the radio communications test set be frequency locked to an external reference (WWVH, GPS, Loran C) so that the high stability oscillator may be accurately set to within its ±1 ppm frequency tolerance.

3.5 Standard Factory Settings and Jumper Configuration

Standard factory settings and the associated jumper configuration for each module of the MT-3 series transmitter are given below.

3.5.1 MT-3 Transmitter Board Factory Configuration

The MT-3 Transmitter Main Board is factory configured as follows:

- Transmitter standby mode 1 (lowest standby current consumption).
- Receiver squelched, de-emphasized audio amplifier disabled.
- Optional relay not installed.
- Separate amplifier power sense outputs.

The corresponding jumper settings are:

• Jumper J2:	'x' position	Optional relay configuration
• Jumper J3:	no connection	Optional relay configuration
• Jumper J4:	'y' position	Optional relay configuration
• Jumper J6:	not installed	Transmitter standby mode select - Mode 1
• Jumper J7:	'y' position	Audio processor standby mode select
• Jumper J9:	not installed	Receiver audio ac/dc input coupling
• Jumper J12:	not installed	Amplifier power sense output configuration
• Jumper J13:	'x' position	Amplifier power sense output configuration
• Jumper J14:	'x' position	Amplifier power sense output configuration
• Jumper J15:	'x' position	Amplifier power sense output configuration
• Jumper J16:	'x' position	Microphone configuration
• Jumper J17:	installed	Microphone output line
• Jumper J18:	'y' position	Synthesizer or crystal module standby mode select
• Jumper J19:	'x' position	600Ω audio transformer enable. 'y' position disables
• Jumper J20:	'x' position	600Ω audio transformer enable. 'y' position disables
• Jumper J21:	not installed	+8 Vdc audio processor supply bypass
• Jumper J22:	'x' position	600Ω audio transformer enable. 'y' position disables
• Jumper J23:	'x' position	600Ω audio transformer enable. 'y' position disables
• Jumper J24:	installed	Subtone #2 output enable
• Jumper J25:	'x' position	Audio output enable

• Jumper J26:	installed	Time-Out-Timer Timing resistor select.
• Jumper J27:	not installed	Time-Out-Timer Timing resistor select.
• Jumper J28:	not installed	Time-Out-Timer Timing period output select.
• Jumper J29:	installed	Time-Out-Timer Timing period output select.
• Jumper J31:	installed	Time-Out-Timer Timing period output select.
• Jumper J32:	not installed	Time-Out-Timer Timing period output select.
• Jumper J33:	installed	Time-Out-Timer input enable
• Jumper J34:	installed	Time-Out-Timer power enable
• Jumper J35:	installed	Time-Out-Timer output enable

Note: Jumpers J1, J5, J8, J10, J11 designations not used

3.5.2 MT-3 Audio Processor Factory Configuration (Version 1.6)

The MT-3 Audio Processor is factory configured as follows:

- Maximum Deviation: ±2.5 kHz (12.5 kHz or 15 kHz channel),
  ±5.0 kHz (25 kHz or 30 kHz channel).
- Microphone Input: 1 kHz signal at -10 dBm gives ±50% maximum deviation,
  1 kHz signal compression set at ±60% maximum deviation.
- Audio Balanced Input: Enabled - pre-emphasis response,
  1 kHz tone at -8 dBm gives ±60% maximum deviation.
  1 kHz signal compression set at ±60% maximum deviation.
- Subtone Input 1: 100 Hz tone at -18 dBm gives ±500 Hz deviation.
- All other audio inputs: Disabled.
- Time-Out-Timer: 5 minutes ± 30 seconds.

The corresponding Audio Processor jumper settings are:

• Jumper JU1:	not installed	Power source select for Direct Modulation circuits.
• Jumper JU2:	not installed	MT-2 deviation enable (MT-2 transmitters).
• Jumper JU3:	installed	Microphone preamplifier power enable.
• Jumper JU4:	installed	Balanced audio preamplifier power enable.
• Jumper JU5:	not installed	Balanced audio ground enable.
• Jumper JU6:	installed	Processed audio path enable (limited and filtered).
• Jumper JU7:	not installed	Unprocessed auxiliary audio path enable (unfiltered).
• Jumper JU8:	not installed	Audio output DC coupled (MT-2 transmitters).
• Jumper JU9:	installed	Balanced input preemphasis response enable.
• Jumper JU10:	not installed	Balanced input flat audio response enable.

- Jumper JU11: not installed — Balanced input to auxiliary audio circuit enable.
- Jumper JU12: not installed — Tone/Digital input to auxiliary audio circuit enable.
- Jumper JU13: not installed — Direct modulation input to auxiliary audio circuit enable.
- Jumper JU14: not installed — Auxiliary input preemphasis response enable.
- Jumper JU15: not installed — Auxiliary input flat audio response enable.
- Jumper JU16: not installed — Subtone input 2 audio path select.
- Jumper JU17: installed — MT-2 Temperature compensation bypass.
- Jumper JU18: not installed — Continuous data mode selection.
- Jumper JU19: 'y'position — Power source for audio switches.
- Jumper JU20 to JU22: — not used
- Jumper JU23: not installed — Direct modulation input to subtone 2 enable.
- Jumper JU24: installed — Lowpass filter response select.
- Jumper JU25: installed — Lowpass filter response select.
- Jumper JU26: installed — Lowpass filter response select.
- Jumper JU27: not installed — Direct Modulation input audio path select.
- Jumper JU28: not installed — Amplified direct modulation bypass.
- Jumper JU29: not installed — Amplified direct modulation input DC couple enable.
- Jumper JU30: not installed — Amplified direct modulation audio path select.
- Jumper JU31: not installed — Subtone 2, AC coupled,to direct modulation output enable.
- Jumper JU32: not installed — Audio output AC coupled (MT-3 crystal transmitters).
- Jumper JU33: not installed — Audio output AC coupled (MT-3 synthesized transmitters).
- Jumper JU34: not installed — Audio output from Direct Modulation circuits select.
- Jumper JU35: not installed — Direct Modulation output source select.
- Jumper JU36: 'x' position — Subtone input 1 audio path select.
- Jumper JU37: not installed — Summed Subtone audio to direct modulation output enable
- Jumper JU38: not installed — Subtone 2, DC coupled, to direct modulation output select.
- Jumper JU39: not installed — Direct Modulation low input impedance enable.

3.6 MT-3 Transmitter Board Alignment

3.6.1 General

Before proceeding with the transmitter alignment, check that the appropriate jumpers are installed. The standard jumper configuration for the Transmitter Main Board, given in section 3.5.1, is normally employed for transmitter alignment. In a standard configuration, the only alignment required on the MT-3 Transmitter Main Board for a synthesized transmitter is to set the frequency switches (FSW1, FSW2, FSW3, and FSW4) for the desired channel frequency. FSW1 is the most significant digit of the frequency switches. The switch settings for the desired channel frequency can be found in the channel designation tables. If the transmitter is using a crystal control oscillator module, the switch settings are irrelevant.

3.6.2 MT-3 Transmitter Board Test Points

TP1: squelched, de-emphasized audio / +13.8 Vdc
TP2: microphone audio
TP3: microphone PTT WTO; inactive +9.5 Vdc, active 0 Vdc
TP4: microphone PTT NTO; inactive +9.5 Vdc, active 0 Vdc
TP5: +9.5 Vdc from backplane connector
TP6: +9.5 Vdc from front panel board
TP7: +9.5 Vdc Switched
TP8: Qualified PTT; inactive +9.5 Vdc, active 0 Vdc: activated by synthesizer
TP9: synthesizer enable; selected by J18
TP10: synthesizer bootstrap line; +5 Vdc
TP11: synthesizer PTT input; inactive +9.5 Vdc, active 0 Vdc
TP12: audio processor TOT input; inactive +9.5 Vdc, active 0 Vdc
TP13: audio processor TOT output; inactive +9.5 Vdc, active 0 Vdc
TP14: audio processor audio output
TP15: audio processor audio control line
TP16: audio processor subtone #2 output
TP17: audio processor direct modulation input
TP18: audio processor subtone #2 input
TP19: audio processor continuous +9.5 Vdc
TP20: audio processor subtone #1 input
TP21: audio processor supply +8 Vdc, selected by J7
TP22: audio processor tone/digital input
TP23: synthesizer receive data line; 0 Vdc
TP24: synthesizer transmit data line; +5 Vdc
TP25: Q1 collector; inactive 0 Vdc, active +9.5 Vdc
TP26: U2d output; inactive +9.5 Vdc, active 0 Vdc
TP27: U1a output (PTT WTO); inactive +9.5 Vdc, active 0 Vdc
TP28: U1b output (PTT NTO); inactive +9.5 Vdc, active 0 Vdc
TP29: Q6 collector / Q7 gate; inactive +9.5 Vdc, active 0 Vdc
TP30: +9.5 Vdc PTT Switched
TP31: U8 pin 1, Time-Out-Timer circuitry set input
TP32: U8 pin 2, Time-Out-Timer circuitry reset input
TP33: Audio processor balanced audio input
TP34: Audio processor balanced audio input

3.7 Module Installation and Removal

Installation of the Enhanced Synthesizer or Crystal Controlled Oscillator module is facilitated by alignment pins on each corner of the module. When the four pins are aligned with their corresponding hole in the Transmitter Main Board, push the module down, taking care to ensure the connector pins on the bottom of the Synthesizer or Crystal Controlled Oscillator module are not bent.

To remove the Enhanced Synthesizer or Crystal Controlled Oscillator module, simply remove the center screw from the module lid and pull the module out. The module should be pulled straight out so that the four alignment pins do not bend or damage the circuitboard.

The Low Power Synthesizer uses two tabs soldered to the Transmitter Main Board for mounting. No alignment pins are used. As a result care must be taken to ensure the connector pins on the bottom of the Synthesizer are not bent. To install the low Power Synthesizer module, remove the two of the synthesizer side screws that correspond to the tabs on the Transmitter Main board and install the synthesizer module taking care not to bend the pins. Replace the two side screws; installing them through the tabs to hold the synthesizer module in place.

When removing the Low Power Synthesizer module, it is important to gently lift the synthesizer module "straight out" in order to prevent damage to the connector pins. Remove the two side screws holding the sinthesizer module to the tabs. Using a plastic coated lifting tool, such as a small screwdriver with the tip covered in heat shrink material, gently lift the synthesizer module from the Transmitter Main Board by applying pressure in a rotating fashion about four corners of the synthesizer module. Replace the two side screws.

3.8 MT-3 Audio Processor Alignment (Version 1.6)

3.8.1 General

Verify the standard factory settings for the MT-3 Audio Processor as given in section 3.5.2 before beginning the standard deviation adjustment procedure. If the transmitter's channel frequency changes, the audio processor should be realigned to optimize the transmitter's performance. The schematic diagram for the audio processor is shown in section 5.4.2 and the component layout is shown in section 5.4.1.

3.8.2 MT-3 Audio Processor Standard Deviation Adjustment

Note: clockwise rotation of controls increases signal levels.

1 Connect the transmitter to the radio communications test set and monitor FM deviation, distortion, and audio frequency. Before adjusting the audio deviation, confirm that the transmitter RF output frequency is correct.

2 Connect the 600 ohm input to the incoming audio (pins B18, Z18). Set the audio frequency to 1 kHz at the desired level of -8 dBm.

3 Increase the balance level control (R31) for maximum gain.

4 Turn the transmitter on.

5 Adjust the balance compression level (R38) for compression at ±60% maximum deviation.

6 Set the audio frequency to 2.4 kHz, then adjust the deviation control (R29) for maximum deviation.

7 Reset the modulating frequency to 1 kHz and re-adjust R38 for ±60% maximum deviation.

8 Repeat steps 6 and 7 until both conditions are met.

9 Vary the audio signal from 1 kHz to 3 kHz and measure the positive deviation and then the negative deviation. Adjust the symmetry control (R14) until the ± deviation is symmetrical. The variation between ± deviation levels should not exceed 300 Hz over the 1 kHz to 3 kHz range.

10 Repeat steps 6 and 7 and re-adjust if necessary.

11 Adjust the balanced input level control (R31) until the deviation produced by a 1 kHz tone at -8 dBm falls below ±60% maximum deviation, then adjust R31 so that the deviation increases until compression is observed. The deviation should be ±1.5 kHz or ±3 kHz for narrowband and wideband channels respectively.

12 A 1 kHz tone at -8 dBm input level should produce ±60% maximum deviation. If not, go back to step 4 and make sure the pot is set for maximum gain and repeat the procedure. If so, increasing the input level by +20 dBm should not increase the deviation. This confirms that the AGC action of preamplifier U2 is working.

13 A 2.4 kHz tone at the desired audio input level should produce the maximum deviation. Increasing the input level by +20 dBm should not increase the deviation. This confirms that the limiting action of U4a and U5a is working.

14 Set the audio frequency back to 1 kHz at -8 dBm output. Confirm and record audio distortion with the appropriate filter on the communications test set.

15 Confirm the audio frequency response by referencing all output deviation measurements to a 1 kHz input tone at ±20% maximum deviation (±500 Hz for narrowband or ±1 kHz for wideband).

16 Remove the signal to the balanced input (pins B18, Z18).

17 Apply a 1 kHz tone at -8 dBm to the microphone audio input. Set the microphone compression control (R8) to produce ±60% maximum deviation. Reduce the signal to -10 dBm and adjust the microphone input level control (R2) for ±50% maximum deviation. Remove the signal.

18. Apply a 100 Hz tone at -18 dBm to the subtone 1 input and adjust the subtone 1 level control (R42) to produce ±500 Hz deviation. Remove the signal.

3.9 Standard Factory Settings and Jumper Configuration

Standard factory settings and the associated jumper configuration for the MT-3 Audio Processor (Version 1.8) are given below.

3.9.1 MT-3 Audio Processor Factory Configuration (Version 1.8)

The MT-3 Audio Processor is factory configured as follows:

- Maximum Deviation: ±2.5 kHz (12.5 kHz or 15 kHz channel), ±5.0 kHz (25 kHz or 30 kHz channel).
- Microphone Input: 1 kHz signal at -10 dBm gives ±50% maximum deviation, 1 kHz signal compression set at ±60% maximum deviation.
- Audio Balanced Input: Enabled - pre-emphasis response, 1 kHz tone at -8 dBm gives ±60% maximum deviation. 1 kHz signal compression set at ±60% maximum deviation.
- Subtone Input 1: 100 Hz tone at -18 dBm gives ±500 Hz deviation.
- All other audio inputs: Disabled.
- Time-Out-Timer: 5 minutes ± 30 seconds.

The corresponding Audio Processor jumper settings are:

• Jumper JU1:	not installed	Power source select for Direct Modulation circuits.
• Jumper JU2:	not installed	MT-2 deviation enable (MT-2 transmitters).
• Jumper JU3:	'y' position	Microphone preamplifier flat response.
• Jumper JU4:	not installed	Subtone input 2 audio path select.
• Jumper JU5:	not installed	Auxiliary input enable (DC or AC coupled).
• Jumper JU6:	installed	Processed audio path enable (limited and filtered).
• Jumper JU7:	not installed	Unprocessed auxiliary audio path enable (unfiltered).
• Jumper JU8:	not installed	Audio output DC coupled (MT-2 transmitters).
• Jumper JU9:	installed	Balanced input preemphasis response enable.

- Jumper JU10: not installed Balanced input flat audio response enable.
- Jumper JU11: 'y' position Balanced input to auxiliary audio circuit enable.
- Jumper JU12: not installed Tone/Digital input to auxiliary audio circuit enable.
- Jumper JU13: not installed Direct modulation input to auxiliary audio circuit enable.
- Jumper JU14: not installed Auxiliary input preemphasis response enable.
- Jumper JU15: not installed Auxiliary input flat audio response enable.
- Jumper JU16: installed Subtone input 1 audio path select.
- Jumper JU17: not installed MT-2 Temperature compensation bypass.
- Jumper JU18: not installed Continuous data mode selection.
- Jumper JU19: not installed Power source for audio switches.
- Jumper JU20: not installed Power source for Q2.
- Jumper JU21: not installed Power source for bilateral switch U9.
- Jumper JU22: 'x' position Audio output to lowpass filter
- Jumper JU23: not installed Direct modulation input to subtone 2 enable.
- Jumper JU24: installed Lowpass filter response select.
- Jumper JU25: installed Lowpass filter response select.
- Jumper JU26: installed Lowpass filter response select.
- Jumper JU27: not installed Direct modulation input audio path select.
- Jumper JU28: not installed Amplified direct modulation bypass.
- Jumper JU29: not installed Amplified direct modulation input DC coupled enable.
- Jumper JU30: not installed Amplified direct modulation audio path select.
- Jumper JU31: not installed Audio output AC coupled (MT-3 synthesized transmitters)
- Jumper JU32: not installed Audio output AC coupled (MT-3 crystal transmitters).
- Jumper JU33: installed Audio ouput AC coupled.
- Jumper JU34: not installed Audio output from direct modulation circuits select.
- Jumper JU35: not installed Direct Modulation output source select.
- Jumper JU36: 'y' position Power source select for AGC Preamplifier.
- Jumper JU37: not installed Direct modulation output enable.
- Jumper JU38: not installed Subtone 2, DC coupled, to direct modulation output select.
- Jumper JU39: not installed Direct modulation low input impedance enable.
- Jumper JU40: installed Power for Microphone preamplifier enable.
- Jumper JU41: not used.
- Jumper JU42: not installed Processed audio path to dircet modulation output.
- Jumper JU43: installed Bilateral switch U9 bypass enable.

3.10 MT-3 Audio Processor Alignment (Version 1.8)

3.10.1 General

Verify the standard factory settings for the MT-3 Audio Processor as given in section 3.9.1 before beginning the standard deviation adjustment procedure. If the transmitter's channel frequency changes, the audio processor should be realigned to optimize the transmitter's performance. The schematic diagram for the audio processor is shown in section 5.5.2 and the component layout is shown in section 5.5.1.

3.10.2 MT-3 Audio Processor Standard Deviation Adjustment

Note: clockwise rotation of controls increases signal levels.

1 Connect the transmitter to the radio communications test set and monitor FM deviation, distortion, and audio frequency. Before adjusting the audio deviation, confirm that the transmitter RF output frequency is correct.

2 Connect the 600 ohm input to the incoming audio (pins B18, Z18). Set the audio frequency to 1 kHz at the desired level of -8 dBm.

3 Increase the balance level control (R31) so that the deviation increases until compression is observed.

4 Adjust the compression control pot (R38) for compression at ±60% maximum deviation.

5 Set the audio frequency to 2.4 kHz, then adjust the deviation control (R29) for maximum deviation.

6 Reset the modulating frequency to 1 kHz and re-adjust R38 for ±60% maximum deviation.

7 Repeat steps 4 and 6 until both conditions are met.

8 Vary the audio signal from 1 kHz to 3 kHz and measure the positive deviation and then the negative deviation. Adjust the symmetry control (R14) until the ± deviation is symmetrical. The variation between ± deviation levels should not exceed 300 Hz over the 1 kHz to 3 kHz range.

9 Repeat steps 4 and 6 and re-adjust if necessary.

10 Adjust the balanced input level control (R31) so that the deviation increases until compression is observed. The deviation should be ±1.5 kHz or ±3 kHz for narrowband and wideband channels respectively.

11 Increase the input level (R31) by +20 dBm, it should not increase the deviation more than maximum. This confirms that the AGC action of preamplifier U1 is working.

12 A 2.4 kHz tone at the desired audio input level should produce the maximum deviation. Increasing the input level by +20 dBm should not increase the deviation. This confirms that the limiting action of U4a and U5a is working.

13 Set the audio frequency back to 1 kHz at -8 dBm output. Confirm and record audio distortion with the appropriate filter on the communications test set.

14 Confirm the audio frequency response by referencing all output deviation measurements to a 1 kHz input tone at ±20% maximum deviation (±500 Hz for narrowband or ±1 kHz for wideband). Remove the signal to the balanced input (pins B18, Z18).

15 Apply a 1 kHz tone at -8 dBm to the microphone audio input. Set the microphone compression control (R2) to produce ±50% maximum deviation. Reduce the signal to -10 dBm and adjust the microphone input level control (R2) for ±50% maximum deviation. Remove the signal.

16. Apply a 100 Hz tone at -18 dBm to the subtone 1 input and adjust the subtone 1 level control (R42) to produce ±500 Hz deviation. Remove the signal.

3.11 Low Frequency Modulation Configuration

Note: the following information originates from Daniels Electronics document number A0361-06.

3.11.1 MT-3 Transmitters

For transmitters, the LTR™ or DCS signal should be applied to the DIRECT MODULATION input (pin Z28), which is also available on the M-3 and SR-3 motherboards at the control connectors J1, P1, or J7 on pins B20 (TX A DIR MOD) and A20 (TX B DIR MOD). **The signal from an LTR™ or DCS encoder should be applied through a 47k resistor to reduce the loading effect of the DIRECT MODULATION input.** The signal should be capacitively coupled to avoid pulling the transmitter frequency off centre. Most LTR™ and DCS encoder modules already have a capacitive output. Note that the controller generating the low frequency signal will need to key the transmitter's PTT input. Note that the synthesizer and the audio processor may require modifications as described later in this document.

MT-3 Transmitter (board version 43-9209**10** through 43-9209**11**)

- J6 installed (synthesizer always powered up by +9.5V SWITCHED line).
- J7 installed in 'X' position (audio processor always powered up by +9.5VSWITCHED line).
- solder a wire from JA4-2 of main board to J51-18 of synthesizer. This connects the subtone output 2 to the synthesizer's phase modulation input.

MT-3 Transmitter (board version 43-9209**12** through 43-9209**13**)

- J6 installed (synthesizer always powered up by +9.5V SWITCHED line).
- J7 installed in 'X' position (audio processor always powered up by +9.5VSWITCHED line).

MT-3 Transmitter (board version 43-9209**14** or higher)

- J6 installed (+9.5V SWITCHED line always powered).
- J7 installed in 'X' position. (audio processor always powered up by +9.5VSWITCHED line).
- J18 installed in the "X' position (synthesizer always powered up by +9.5VSWITCHED line).

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3.11.2 MT-3 Transmitter Audio Processors

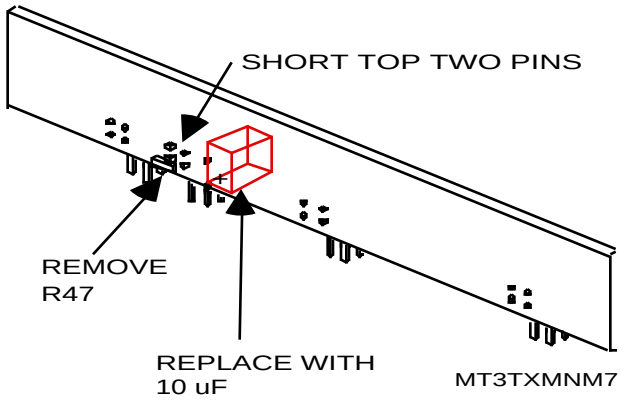
MT-3 Transmitter Audio Processor (board version 43-911910 through 43-911913)

- Remove R47 to avoid having too low an input impedance.
- Change C40 to a 10 uF tantalum capacitor (stock code 1054-6E106M25) with the "+" polarity mark nearest to the edge of the PCB (see figure 3-1). This allows low frequencies to pass.
- Short pins P4-1 and P4-3 (or install J23) together with a short piece of 22 or 24 gauge solid wire and solder (see diagram below). This allows the DIRECT MODULATION

input to the transmitter to be used to gain access to the SUBTONE INPUT 2 which connects to the PHASE MOD IN input of a modified synthesizer.

- Make sure J13 and J16 are not installed.

Figure 3-1 Transmitter Audio Processor Low Frequency Modulation.



MT-3 Transmitter Audio Processor (board version 43-911914 through 43-911916)

- Install jumpers: JU38Y, JU35Y
- Remove jumpers: JU27X, JU27Y, JU31, JU35X, JU37, JU38X
- Short pins P4-1 and P4-3 (or install J23) together with a short piece of 22 or 24 gauge solid wire and solder (see figure 3-1). This allows the DIRECT MODULATION input to the transmitter to be used to gain access to the SUBTONE INPUT 2 which connects to the PHASE MOD IN input of a modified synthesizer.

Note that the SUBTONE 2 input should not be used while this modification is in effect. Note also that adjusting R44 has no effect on the deviation of the low frequency signal.

MT-3 Transmitter Audio Processor (board version 43-911918)

- Contact factory for configuration.

3.11.3 Synthesizer and Crystal Controlled Oscillator

Refer to the manual for the Oscillator used in your Transmitter for the required Low Frequency Modulation modifications.

3.11.4 Tuning the Transmitter

For all MT-3 transmitters, apply a low impedance source of 20-300 Hz to the Direct Modulation input of the transmitter (Pin Z28 of the 48 pin connector) through a 22 uF capacitor, positive terminal connected to pin Z28. A Marconi 2955 works well for this test. Adjust R44 on the audio processor to the fully clockwise position.

- Apply a 100 Hz tone at -8 dBm to the Direct Modulation input of the transmitter (Pin Z28 of the 48 pin connector, and key the transmitter. Adjust the level of the tone until a deviation of 1.5 kHz is acheived. Note that the level required may be anwhere from -10 dBm to 0 dBm depending on the type of transmitter.

- Confirm that the frequency response rolls off by checking that the following deviations are observed: (note that the deviation will NOT roll off at 300 Hz if an OC-3 crystal oscillator is used instead of a synthesizer).

  - 20 Hz tone gives about 700 Hz deviation
  - 100 Hz tone gives 1.5 kHz deviation
  - 300 Hz tone gives about 500 Hz deviation

- Finally, confirm subtone 1 modulation: set-up for 100 Hz Mod with 500 Hz Dev.

  - Check 200 Hz Mod, Dev = 1.5 (VHF) / 2.0 kHz (UHF)
  - Check 300 Hz Mod, Dev = 1.5 (VHF) / 4.0 kHz (UHF)

4 TRANSMITTER INTERCONNECT PIN DEFINITIONS

The MT-3 series Transmitter employs a 48 pin Eurostandard connector for interfacing to all transmitter power, audio, and control functions. The following are the MT-3 series Transmitter backplane connections to the M-3 Motherboard.

Pin	Name	Pin	Name	Pin	Name
D2	No Connect	B2	+13.8 Vdc	Z2	+13.8 Vdc
D4	No Connect	B4	MIC Out	Z4	MIC In
D6	No Connect	B6	+9.5 Vdc	Z6	+9.5 Vdc
D8	No Connect	B8	Relay Positive	Z8	Relay Negative
D10	No Connect	B10	PTT WTO	Z10	PTT WTO
D12	No Connect	B12	Tx Standby	Z12	Tx Standby
D14	No Connect (IMC1)	B14	PTT NTO	Z14	PTT NTO
D16	No Connect (IMC2)	B16	No Connect (MT-2 +9.5V)	Z16	No Connect (MT-2 +9.5V)
D18	No Connect (IMC3)	B18	Balanced Input 2	Z18	Balanced Input 1
D20	Channel Select 0 (LSB)	B20	Squelched,De-emph Audio	Z20	Squelched, Flat Audio
D22	Channel Select 1	B22	Subtone Input 1	Z22	Tx Audio Control
D24	Channel Select 2	B24	PTT Output	Z24	Subtone Input 2
D26	Channel Select 3 (MSB)	B26	Forward Power Sense	Z26	Reverse Power Sense
D28	Synth Tx Data (Output)	B28	Monitor Out	Z28	Direct Mod Input
D30	Synth Rx Data (Input)	B30	Ground	Z30	Ground
D32	Synth Bootstrap (Input)	B32	Ground	Z32	Ground

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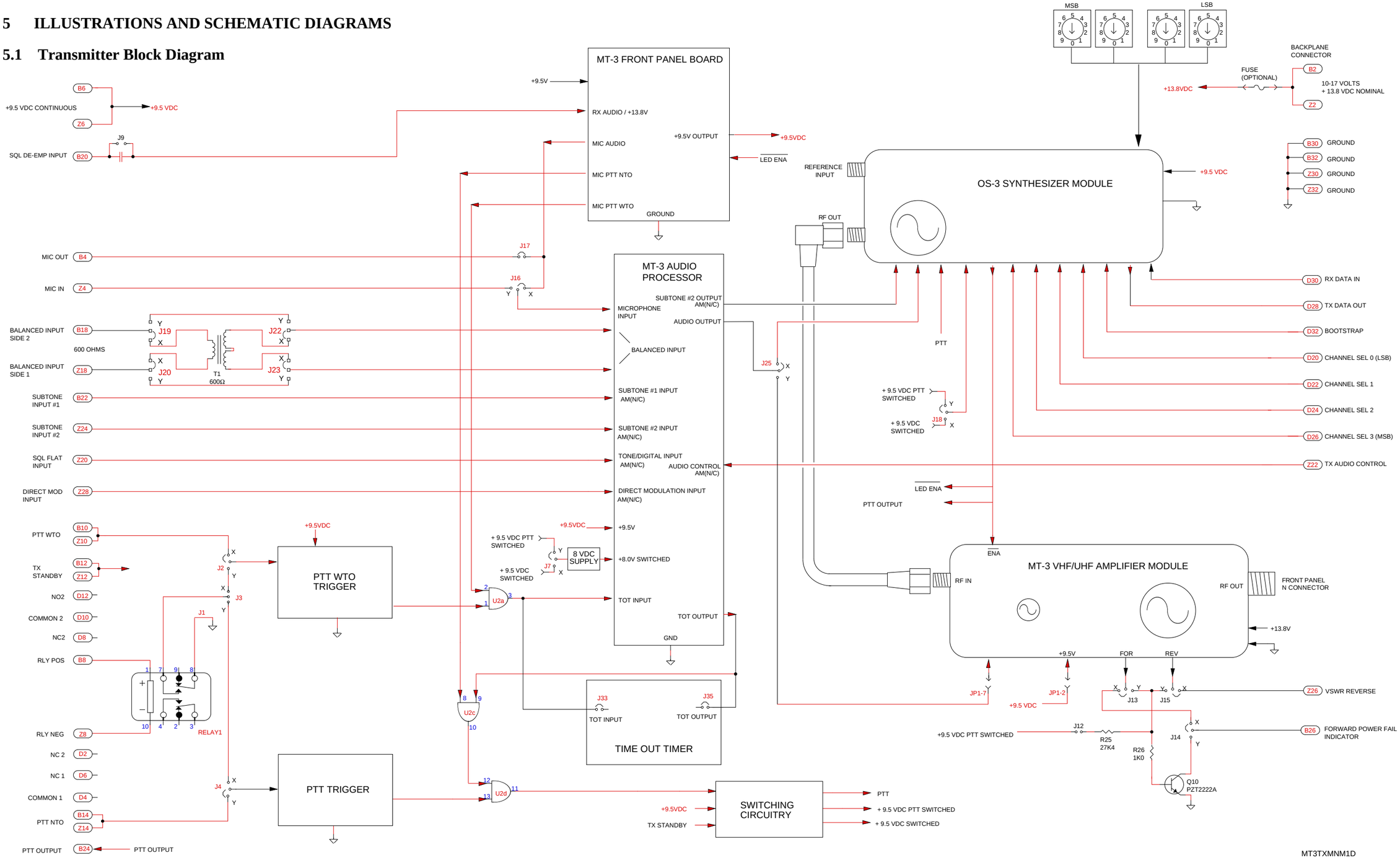
5 ILLUSTRATIONS AND SCHEMATIC DIAGRAMS

5.1 Transmitter Block Diagram



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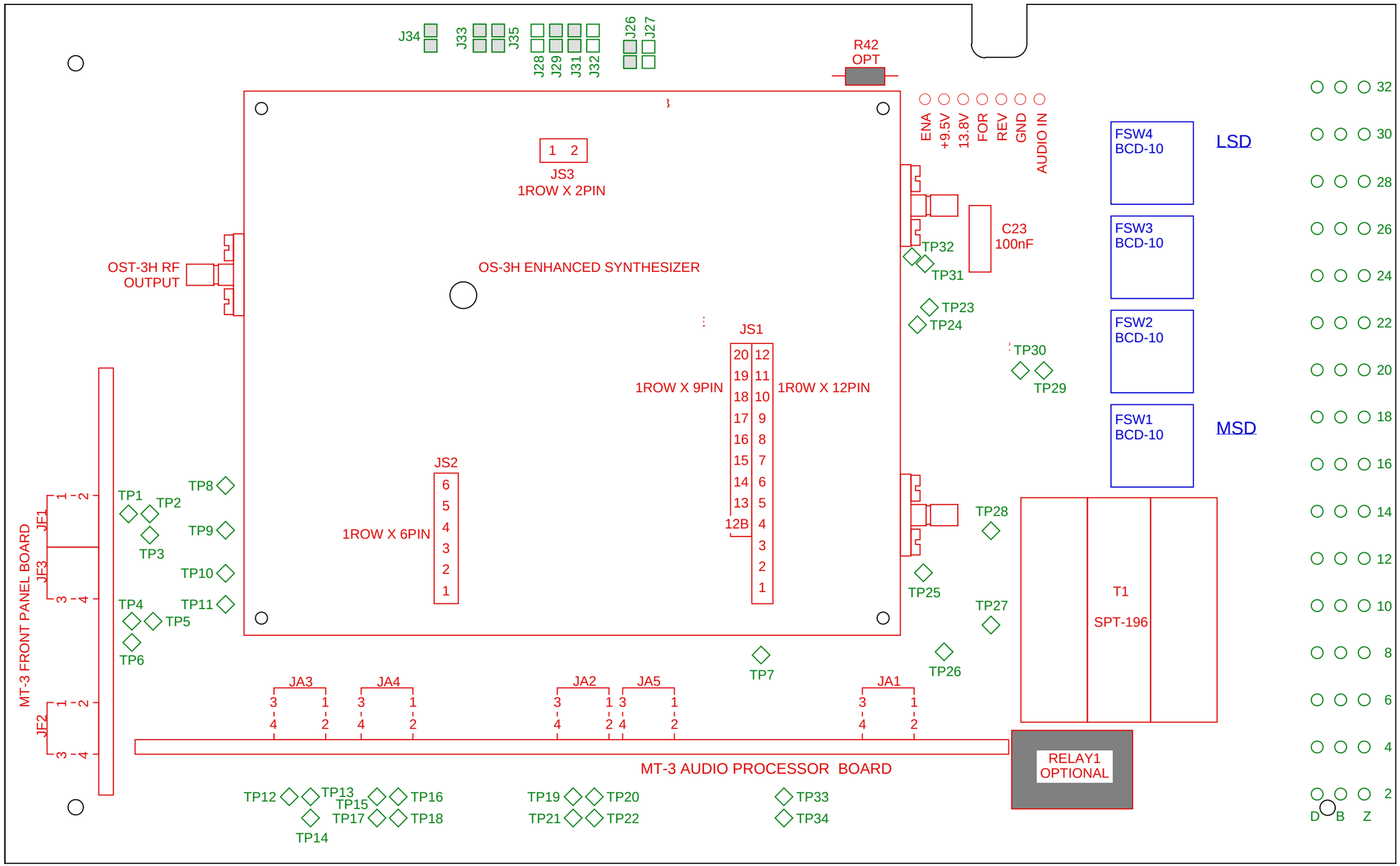
5.2 MT-3 AM Transmitter Board Electrical Assembly

5.2.1 MT-3 AM Transmitter Board Component Layout (Top)

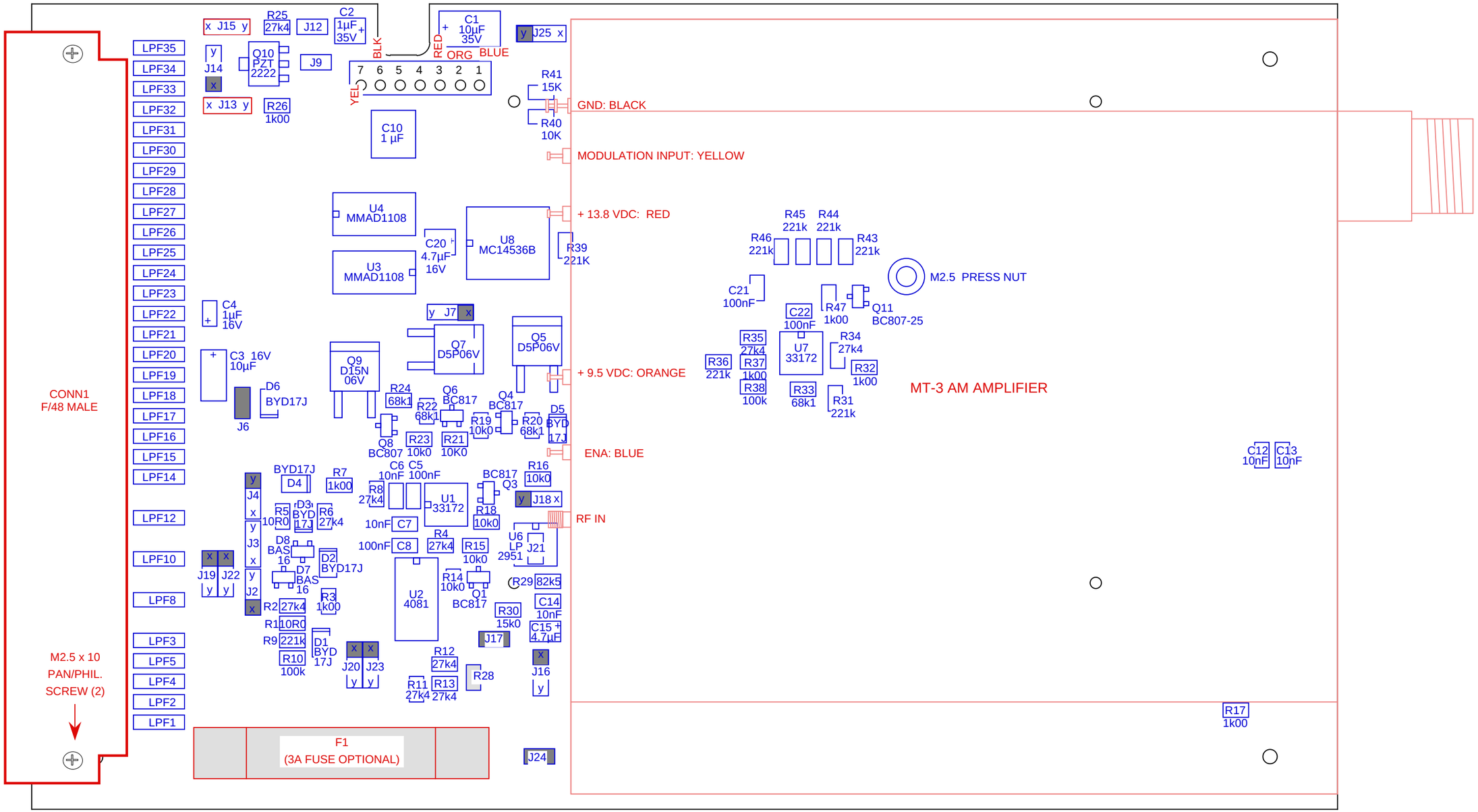


43-920917

Factory installed jumpers

MT3TXMNM2B

5.2.2 MT-3 AM Transmitter Main Board Component Layout (Bottom)

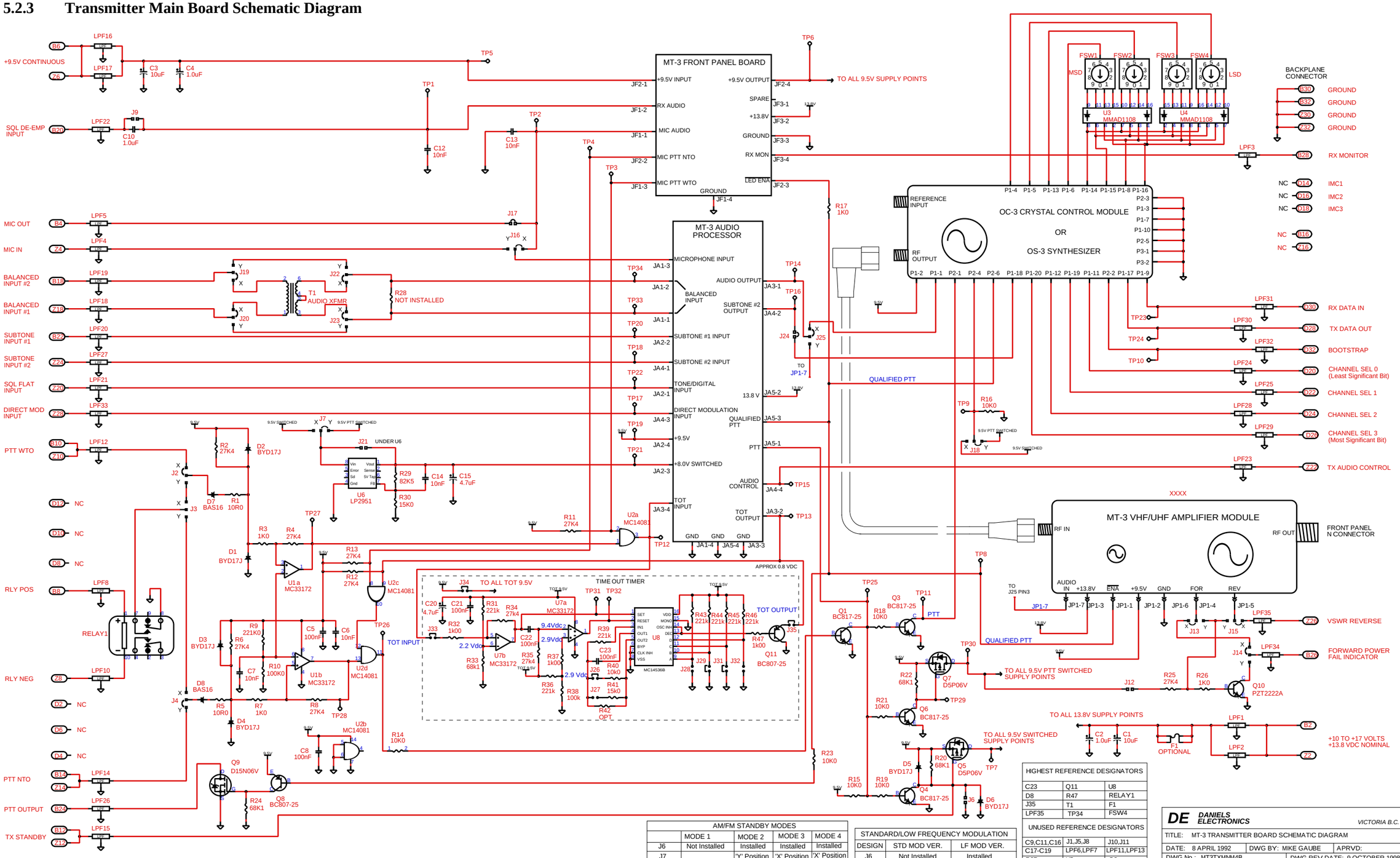


Factory installed jumpers

Components Not Installed

MT3TXMNM3B

5.2.3 Transmitter Main Board Schematic Diagram



AM/FM STANDBY MODES				
	MODE 1	MODE 2	MODE 3	MODE 4
J6	Not Installed	Installed	Installed	Installed
J7		'Y' Position	'X' Position	'X' Position
J18		'X' Position	'Y' Position	'X' Position

STANDARD/LOW FREQUENCY MODULATION		
DESIGN	STD MOD VER.	LF MOD VER.
J6	Not Installed	Installed
J7	'Y' Position	'X' Position
J18	'Y' Position	'X' Position

HIGHEST REFERENCE DESIGNATORS		
C23	Q11	U8
D8	R47	RELAY1
J35	T1	F1
LPF35	TP34	FSW4

UNUSED REFERENCE DESIGNATORS		
C9,C11,C16	J1,J5,J8	J10,J11
C17-C19	LPF6,LPF7	LPF11,LPF13
R27	U5	Q2
-----	-----	-----

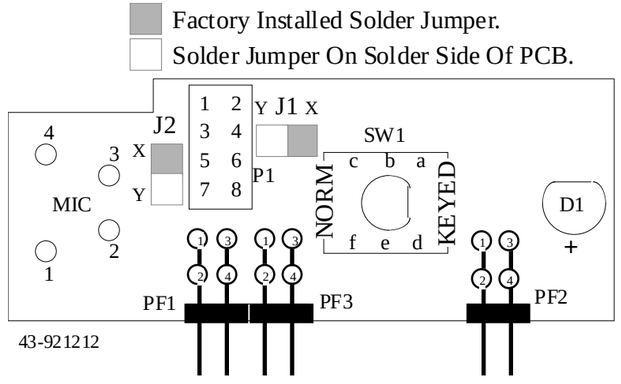
DE DANIELS ELECTRONICS — VICTORIA B.C.

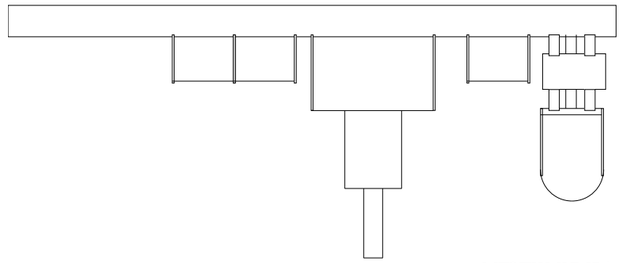
TITLE: MT-3 TRANSMITTER BOARD SCHEMATIC DIAGRAM

DATE: 8 APRIL 1992	DWG BY: MIKE GAUBE	APRVD:
DWG No.: MT3TXMNM4B	DWG REV DATE: 9 OCTOBER 1998	
BOARD No.: 43-920917	BOARD REV: 1.7	

5.3 Front Panel Board

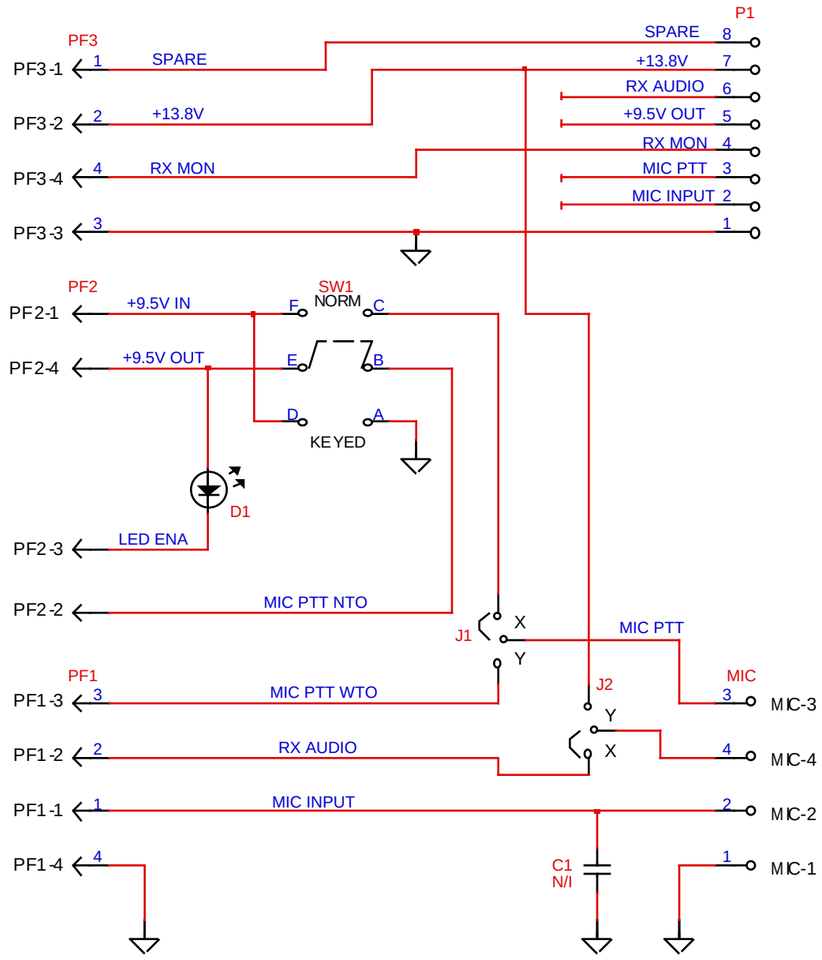
5.3.1 Front Panel Board Component Layout





MT3TXMNM5A

5.3.2 Front Panel Board Schematic Diagram

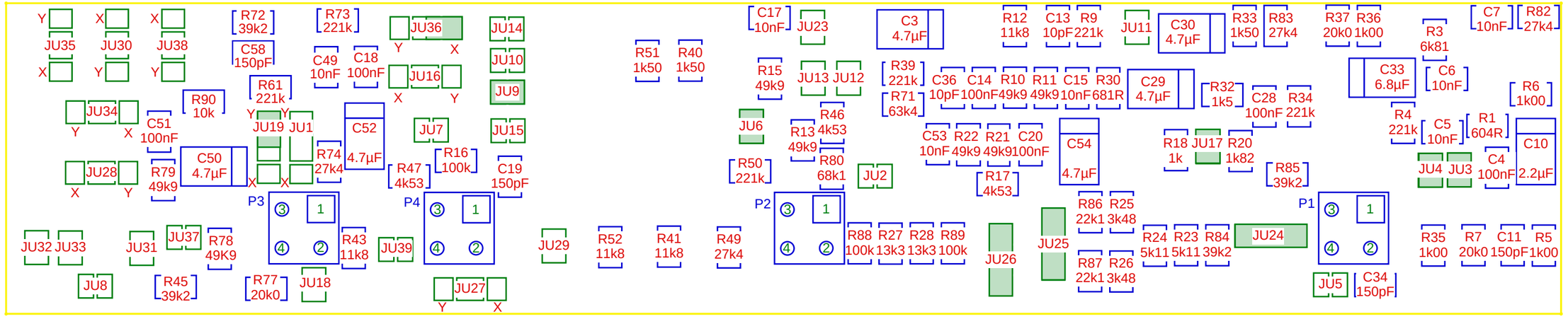


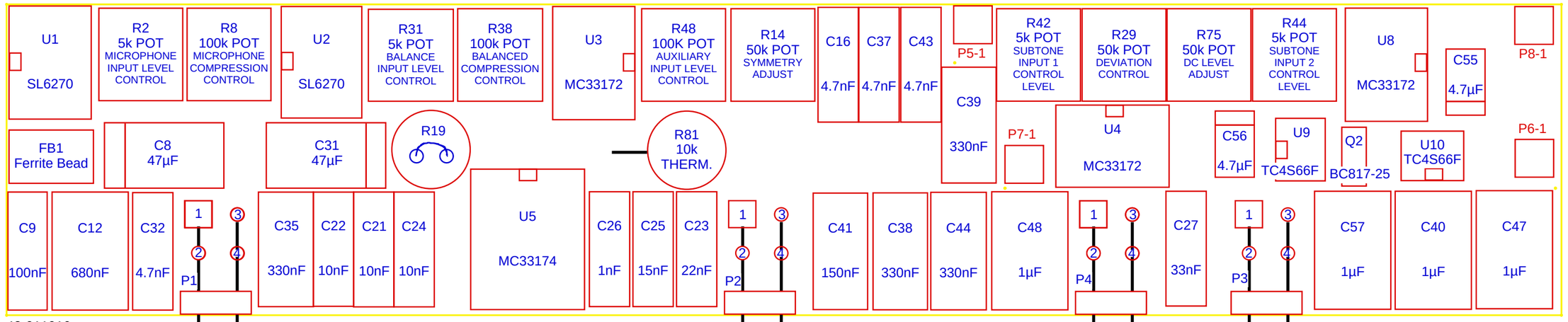
DE DANIELS ELECTRONICS			VICTORIA B.C .
TITLE: MT-3 FRONT PANEL BOARD			
DATE.: 07 APRIL 1992	DWN: M. GAUBE	APRVD:	
DWG No: MT3TXMNM6A		DWG REV DATE: 28 MAY 97	
BOARD NO.: 43-921212		BOARD REV.: 1.2	

5.5 **MT-3 Audio Processor Electrical Assembly**- PCB No. 43-911916

5.5.1 MT-3 Audio Processor Component Layout

Figure 5-9 MT-3 Audio Processor Component Layout





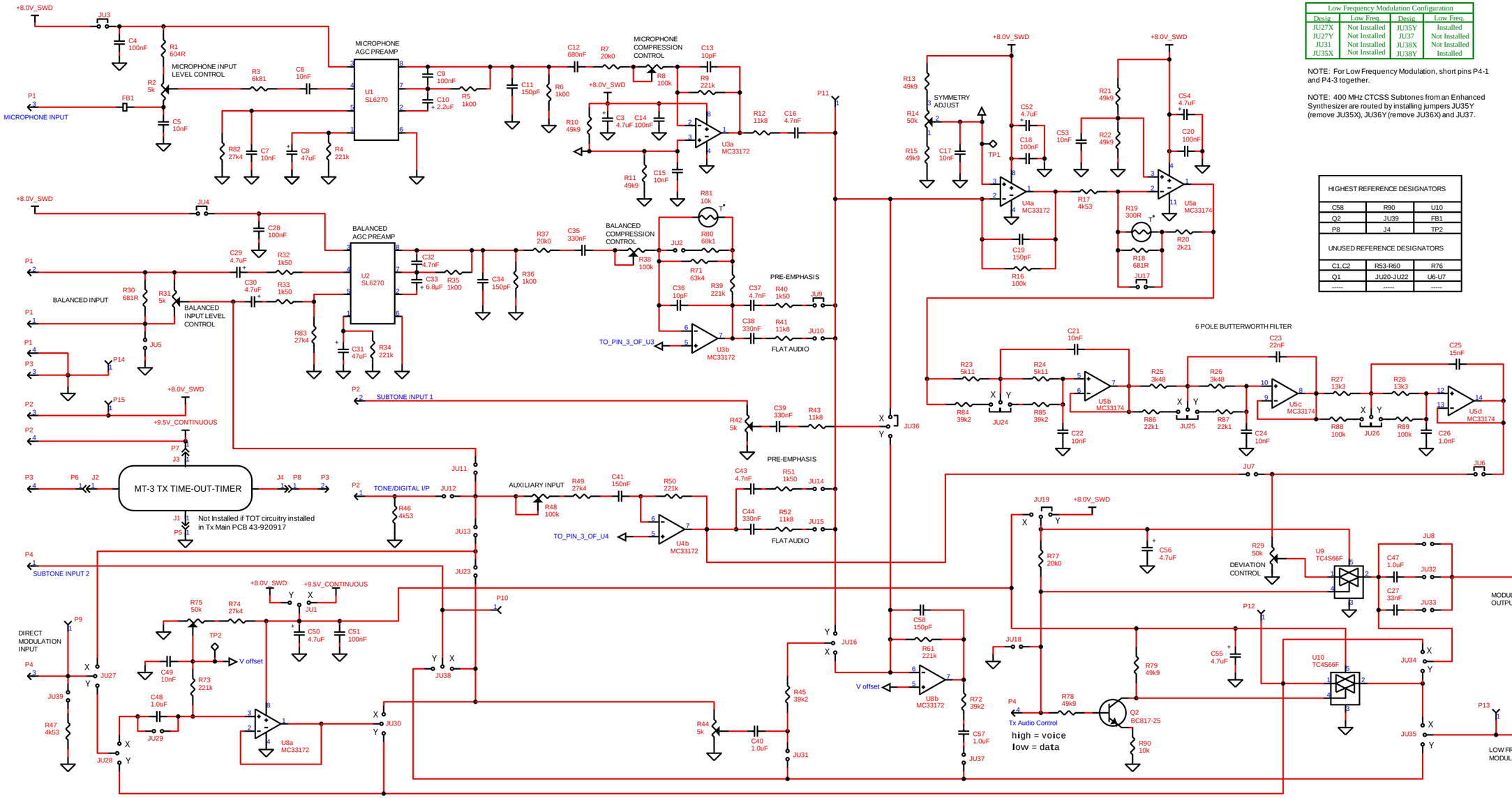
43-911916

MT3APM1A

Low Frequency Modulation Configuration			
Desig	Low Freq.	Desig	Low Freq.
JU27X	Not Installed	JU35Y	Installed
JU27Y	Not Installed	JU37	Not Installed
JU31	Not Installed	JU38X	Not Installed
JU35X	Not Installed	JU38Y	Installed

NOTE: For Low Frequency Modulation short pins P4-1 and P4-3 together.

5.4.2 Audio Processor Schematic Diagram V1.6



Low Frequency Modulation Configuration			
Desig	Low Freq.	Desig	Low Freq.
JU27X	Not Installed	JU35Y	Installed
JU27Y	Not Installed	JU37	Not Installed
JU31	Not Installed	JU38X	Not Installed
JU35X	Not Installed	JU38Y	Installed

NOTE: For Low Frequency Modulation, short pins P4-1 and P4-3 together.

NOTE: 400 MHz CTCSS Subtones from an Enhanced Synthesizer are routed by installing jumpers JU35Y (remove JU35X), JU36Y (remove JU36X) and JU37.

HIGHEST REFERENCE DESIGNATORS		
C58	R90	U10
Q2	JU39	FB1
P8	J4	TP2
UNUSED REFERENCE DESIGNATORS		
C1,C2	R53-R60	R76
Q1	JU20-JU22	U6-U7
-----	-----	-----

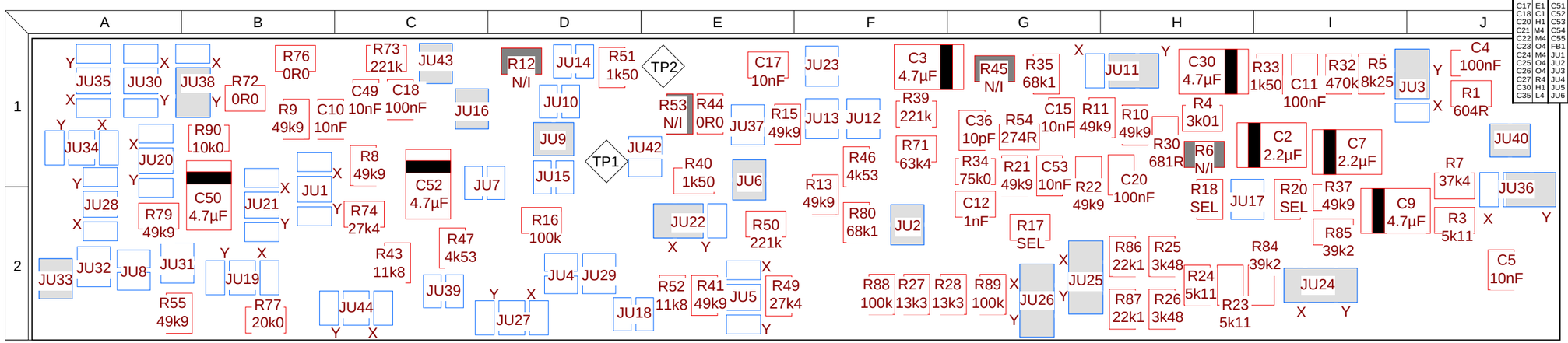
DE DANIELS ELECTRONICS		VICTORIA B.C.
TITLE: MT-3 TX AUDIO PROCESSOR SCHEMATIC DIAGRAM		
DATE: 19 SEPTEMBER 1991	DWN BY: MICHAEL GAUBE	APRVD:
DWG No: MT3APM2C	DWG REV DATE: 28 NOVEMBER 1997	
BOARD No: 43-911916	BOARD REV: VERSION 1.6	

5.5 Audio Processor Electrical Assembly (Version 1.8)

5.5.1 Audio Processor Component Layout

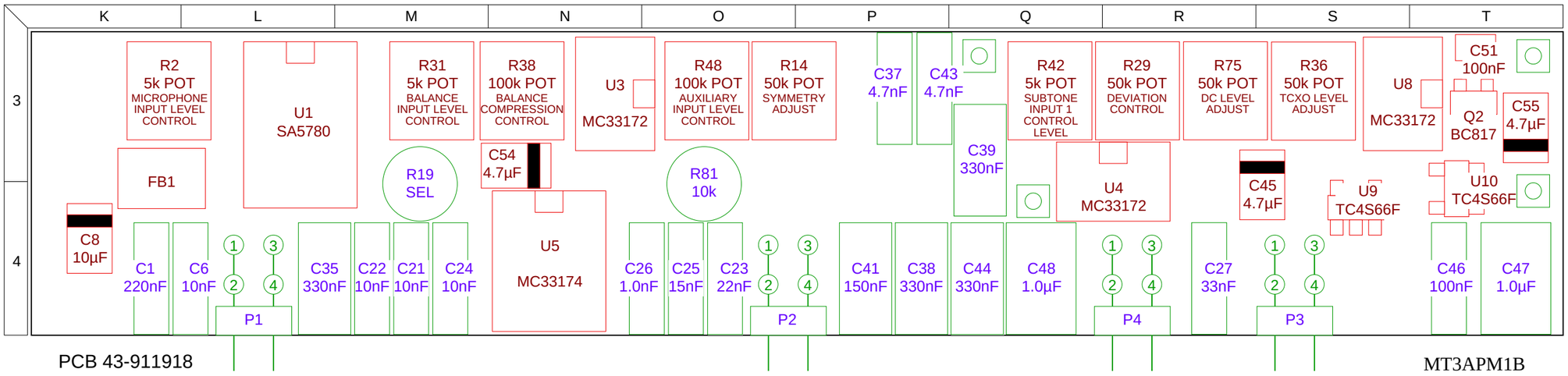
COMPONENT LOCATION TABLE

DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC
C1	K4	C36	G1	JU7	C1	JU32	A2	R9	B1	R34	G1	R74	C2
C2	I1	C37	F3	JU8	A2	JU33	A2	R10	H1	R35	G1	R75	R3
C3	F1	C38	P4	JU9	D1	JU34	A1	R11	G1	R36	S3	R76	B1
C4	J1	C39	Q3	JU10	D1	JU35	A1	R12	D1	R37	I2	R77	B2
C5	J2	C41	P4	JU11	H1	JU36	J1	R13	F2	R38	N3	R79	A2
C6	L4	C43	P3	JU12	F1	JU37	E1	R14	O3	R39	F1	R80	F2
C7	I1	C44	Q4	JU13	F1	JU38	B1	R15	E1	R40	E1	R81	O4
C8	K4	C45	S4	JU14	D1	JU39	C2	R16	D2	R41	E2	R84	I2
C9	I2	C46	T4	JU15	D1	JU40	J1	R17	G2	R42	Q3	R85	I2
C10	B1	C47	T4	JU16	C1	JU42	E1	R18	H2	R43	C2	R86	H2
C11	I1	C48	Q4	JU17	H2	JU43	C1	R19	K3	R44	E1	R87	H2
C12	G2	C49	C1	JU18	D2	JU44	C2	R20	I2	R45	G1	R88	F2
C15	G1	C50	B2	JU19	B2	P1	L4	R21	G1	R46	F1	R89	G2
C17	E1	C51	T3	JU20	A1	P2	O4	R22	G1	R47	C2	R90	B1
C18	C1	C52	C2	JU21	B2	P3	S4	R23	H2	R48	O3	TP1	D1
C20	H1	C53	G1	JU22	E2	P4	R4	R24	H2	R49	E2	TP2	E1
C21	M4	C54	N3	JU23	F1	Q2	T3	R25	H2	R50	E2	U1	L3
C22	M4	C55	T3	JU24	I2	R1	J1	R26	H2	R51	D1	U3	N3
C23	O4	FB1	K3	JU25	G2	R2	K3	R27	F2	R52	E2	U4	R3
C24	M4	JU1	B2	JU26	G2	R3	J2	R28	F2	R53	E1	U5	N4
C25	O4	JU2	F2	JU27	D2	R4	H1	R29	R3	R54	G1	U8	S3
C26	O4	JU3	J1	JU28	A2	R5	I1	R30	H1	R55	A2	U9	S4
C27	R4	JU4	D2	JU29	D2	R6	H1	R31	M3	R71	F1	U10	T4
C30	H1	JU5	E2	JU30	A1	R7	J1	R32	I1	R72	B1		
C35	L4	JU6	E1	JU31	A2	R8	C1	R33	I1	R73	C1		



- COMPONENTS NOT INSTALLED
- JUMPERS INSTALLED

Solder Side

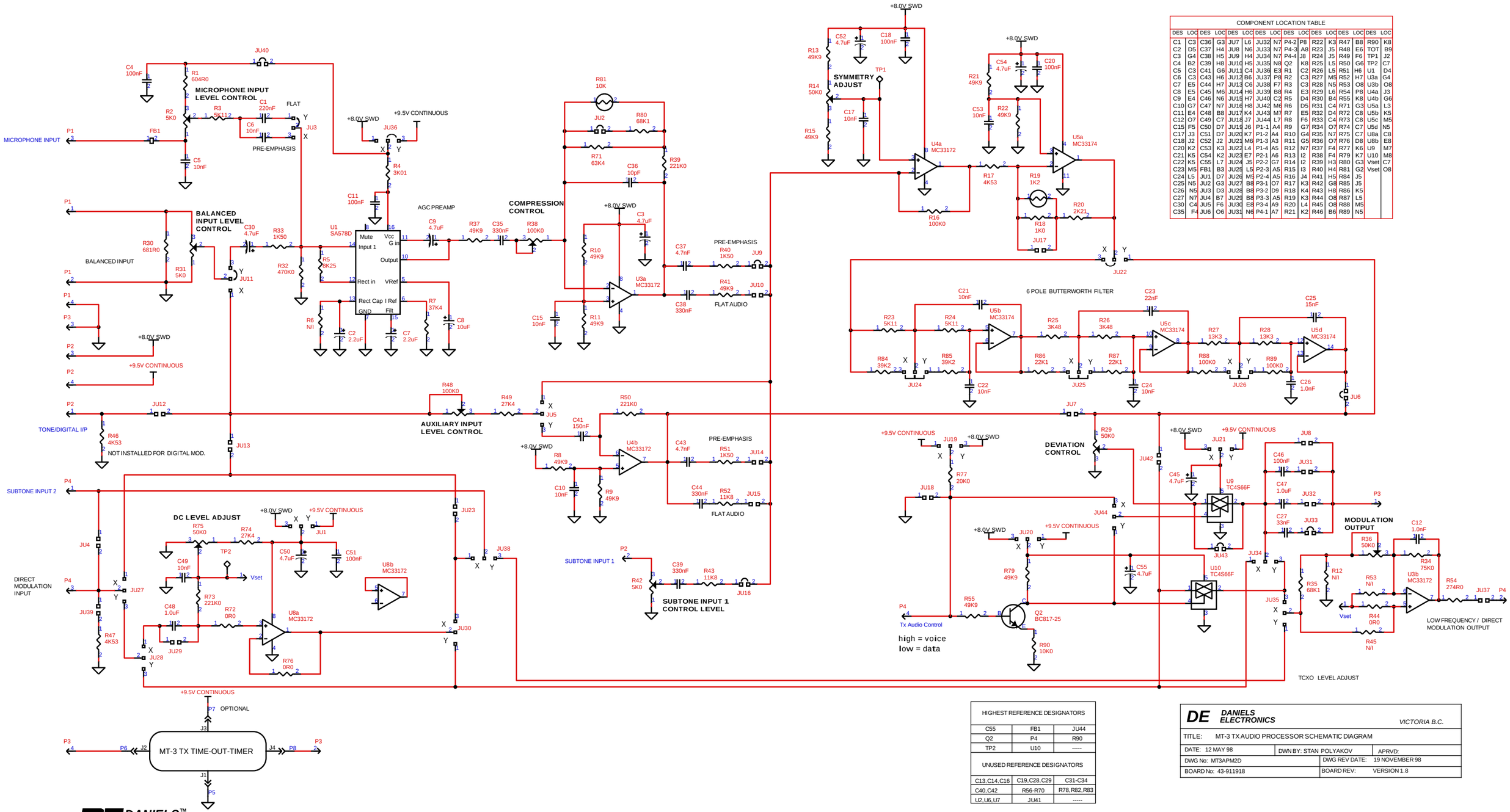


PCB 43-911918

MT3APM1B

Component Side

5.5.2 Audio Processor Schematic Diagram V1.8



COMPONENT LOCATION TABLE

DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC
C1	C3	C36	G3	JU7	L6	JU32	N7	P4-2	P8	R22	K3	R47	B8	R90	K8
C2	D5	C37	H4	JU8	N6	JU33	N7	P4-3	A8	R23	J5	R48	E6	TOT	B9
C3	G4	C38	H5	JU9	H4	JU34	N7	P4-4	J8	R24	J5	R49	F6	TP1	J2
C4	B2	C39	H8	JU10	H5	JU35	N8	Q2	K8	R25	L5	R50	G6	TP2	C7
C5	C3	C41	G6	JU11	C4	JU36	E3	R1	C2	R26	L5	R51	H6	U1	D4
C6	C3	C43	H6	JU12	B6	JU37	P8	R2	C3	R27	M5	R52	H7	U3a	G4
C7	E5	C44	H7	JU13	C6	JU38	F7	R3	C3	R28	N5	R53	O8	U3b	O8
C8	E5	C45	M6	JU14	H6	JU39	B8	R4	E3	R29	L6	R54	P8	U4a	J3
C9	E4	C46	N6	JU15	H7	JU40	C2	R5	D4	R30	B4	R55	K8	U4b	G6
C10	G7	C47	N7	JU16	H8	JU42	M6	R6	D5	R31	C4	R71	G3	U5a	L3
C11	E4	C48	B8	JU17	K4	JU43	M7	R7	E5	R32	D4	R72	C8	U5b	K5
C12	O7	C49	C7	JU18	J7	JU44	L7	R8	F6	R33	C4	R73	C8	U5c	M5
C15	F5	C50	D7	JU19	J6	P1-1	A4	R9	G7	R34	O7	R74	C7	U5d	N5
C17	J3	C51	D7	JU20	K7	P1-2	A4	R10	G4	R35	N7	R75	C7	U8a	C8
C18	J2	C52	J2	JU21	M6	P1-3	A3	R11	G5	R36	O7	R76	D8	U8b	E8
C20	K2	C53	K3	JU22	L4	P1-4	A5	R12	N7	R37	F4	R77	K6	U9	M7
C21	K5	C54	K2	JU23	E7	P2-1	A6	R13	I2	R38	F4	R79	K7	U10	M8
C22	K5	C55	L7	JU24	J5	P2-2	G7	R14	I2	R39	H3	R80	G3	Vset	C7
C23	M5	FB1	B3	JU25	L5	P2-3	A5	R15	I3	R40	H4	R81	G2	Vset	O8
C24	L5	JU1	D7	JU26	M5	P2-4	A5	R16	J4	R41	H5	R84	J5		
C25	N5	JU2	G3	JU27	B8	P3-1	O7	R17	K3	R42	G8	R85	J5		
C26	N5	JU3	D3	JU28	B8	P3-2	D9	R18	K4	R43	K4	R86	K5		
C27	N7	JU4	B7	JU29	B8	P3-3	A5	R19	K3	R44	O8	R87	L5		
C30	C4	JU5	F6	JU30	E8	P3-4	A9	R20	L4	R45	O8	R88	M5		
C35	F4	JU6	O6	JU31	N6	P4-1	A7	R21	K2	R46	B6	R89	N5		

HIGHEST REFERENCE DESIGNATORS

C55	FB1	JU44
Q2	P4	R90
TP2	U10	-----

UNUSED REFERENCE DESIGNATORS

C13,C14,C16	C19,C28,C29	C31-C34
C40,C42	R56-R70	R78,R82,R83
U2,U6,U7	JU41	-----

DANIELS ELECTRONICS — VICTORIA B.C.

TITLE: MT-3 TX AUDIO PROCESSOR SCHEMATIC DIAGRAM		
DATE: 12 MAY 98	DWN BY: STAN POLYAKOV	APRVD:
DWG No: MT3APM2D	DWG REV DATE:	19 NOVEMBER 98
BOARD No: 43-911918	BOARD REV:	VERSION 1.8

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6 PARTS LISTS

6.1 Transmitter Main Board Parts List

6.1.1 Transmitter Main Board Electrical Parts List

Ref Desig	Description	Part No.	
C1	CAP., SM, 10µF TANT., 10%, 35V	1055-6D106K35	
C2	CAP., SM, 1.0µF TANT., 20%, 35V	1055-5B105M35	
C3	CAP., SM, 10µF TANT., 20%, 16V	1055-6C106M16	
C4	CAP., SM, 1.0µF TANT., 20%, 16V	1055-5A105M16	
C5	CAP., SM, 100nF CER, 0805, X7R	1008-5A104K5R	
C6, C7	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C8	CAP., SM, 100nF CER, 0805, X7R	1008-5A104K5R	
C10	CAP., SM, 10µF CER/2225 50 X7R	1008-6H105J5R	
C12- C14	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C15	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C20	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C21, C22	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R	
C23	CAP., 100nF FILM, MMK5, 10%, 63V	1016-5A104K63	
D1 - D6	DIODE, BYD17J RECTIFIER, SOD-87	2101-BYD17J00	
D7, D8	DIODE, BAS16, SWITCHING, DO35	2100-BAS16000	
F1	FUSE, 3AMP FAST-BLO, 1-1/4 IN.	5604-5GAGC030	(Optional)
FH1,FH2	FUSE CLIP, O.250"DIAM., W/EAR	5609-C250P01B	(Optional)
FSW1-4	SWITCH, BCD-10 STEPS,5 PIN,PCB	5273-10BCD001	
JS1-1	SOCKET STRIP, 1 ROW X 12 PIN	5016-SL112G08	
JS1-13	SOCKET STRIP, 1 ROW X 9 PIN	5016-SL109G08	
JS2-1	SOCKET STRIP, 1 ROW X 6 PIN	5016-SL106G08	
JS3-1	SOCKET STRIP, 1 ROW X 2 PIN	5016-SL102G08	
LPF1-5	FILTER, SM. EMI/LPF, 360 PF, FER.	1306-T361F2D5	
LPF8	FILTER, SM. EMI/LPF, 360 PF, FER.	1306-T361F2D5	
LPF10	FILTER, SM. EMI/LPF, 360 PF, FER.	1306-T361F2D5	
LPF12	FILTER, SM. EMI/LPF, 360 PF, FER.	1306-T361F2D5	
LPF14-35	FILTER, SM. EMI/LPF, 360 PF, FER.	1306-T361F2D5	
PCB	MT-3 TRANSMITTER, MAIN, VER 1.7	4321-10920917	
Q1	TRANSISTOR, BC817-25 NPN, G.P., SOT-23	2120-BC817025	
Q3-Q4	TRANSISTOR, BC817-25 NPN, G.P., SOT-23	2120-BC817025	
Q5	MOSFET, D5P06V P-CHANNEL, DPAK	2144-D5P06V00	
Q6	TRANSISTOR, BC817-25 NPN, G.P., SOT-23	2120-BC817025	
Q7	MOSFET, D5P06V P-CHANNEL, DPAK	2144-D5P06V00	
Q8	TRANSISTOR, BC807-25 PNP, G.P., SOT-23	2120-BC807025	
Q9	MOSFET, D15N06V N-CHANNEL, DPAK	2144-D15N06V0	
Q10	TRANSISTOR, PZT2222A NPN, G.P., SOT-223	2120-PZT2222A	
Q11	TRANSISTOR, BC807-25 PNP,SOT23	2120-BC807025	

Ref Desig	Description	Part No.	
R1	RES., SM, 10R0 0805, 1%, 100 ppm	1150-1A10R0FP	
R2	RES., SM, 27k4 0805, 1%, 100 ppm	1150-4A2742FP	
R3	RES., SM, 1k00 0805, 1%, 100 ppm	1150-3A1001FP	
R4	RES., SM, 27k4 0805, 1%, 100 ppm	1150-4A2742FP	
R5	RES., SM, 10R0 0805, 1%, 100 ppm	1150-1A10R0FP	
R6	RES., SM, 27k4 0805, 1%, 100 ppm	1150-4A2742FP	
R7	RES., SM, 1k00 0805, 1%, 100 ppm	1150-3A1001FP	
R8	RES., SM, 27k4 0805, 1%, 100 ppm	1150-4A2742FP	
R9	RES., SM, 221k 0805, 1%, 100 ppm	1150-5A2213FP	
R10	RES., SM, 100k 0805, 1%, 100 ppm	1150-5A1003FP	
R11-R13	RES., SM, 27k4 0805, 1%, 100 ppm	1150-4A2742FP	
R14-R16	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R17	RES., SM, 1k00 0805, 1%, 100 ppm	1150-3A1001FP	
R18,R19	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R20	RES., SM, 68k1 0805, 1%, 100 ppm	1150-4A6812FP	
R21	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R22	RES., SM, 68k1 0805, 1%, 100 ppm	1150-4A6812FP	
R23	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R24	RES., SM, 68k1 0805, 1%, 100 ppm	1150-4A6812FP	
R25	RES., SM, 27k4 0805, 1%, 100 ppm	1150-4A2742FP	
R26	RES., SM, 1k00 0805, 1%, 100 ppm	1150-3A1001FP	
R28	RES., SM, 15K0 0805, 1%, 100ppm	1150-4A1502FP	
R29	RES., SM, 82k5 0805, 1%, 100 ppm	1150-4A8252FP	
R30	RES., SM, 15K0 0805, 1%, 100ppm	1150-4A1502FP	
R31	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP	
R32	RES., SM, 1k00 0805, 1%, 100ppm	1150-3A1001FP	
R33	RES., SM, 68k1 0805, 1%, 100ppm	1150-4A6812FP	
R34, R35	RES., SM, 27k4 0805, 1%, 100ppm	1150-4A2742FP	
R36	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP	
R37	RES., SM, 1k00 0805, 1%, 100ppm	1150-3A1001FP	
R38	RES., SM, 100k 0805, 1%, 100ppm	1150-5A1003FP	
R39	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP	
R40	RES., SM, 10k0 0805, 1%, 100ppm	1150-4A1002FP	
R41	RES., SM, 15k0 0805, 1%, 100ppm	1150-4A1502FP	
R42	RES., OPT METAL FILM, 5%,0.5W	OPTIONAL	
R43 - R46	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP	
R47	RES., SM, 1k00 0805, 1%, 100ppm	1150-3A1001FP	
RELAY1	RELAY, 9 Vdc, 2 FORM C, PCB MNT	5310-2C09P005	(Optional)
T1	TRANSFORMER, SPT-196 1:1 AUDIO XFMR	1280-600P6005	
U1	IC, MC33172 DUAL OP-AMP, S0-8	2302-33172N08	
U2	IC, 4081 QUAD 2 INPUT AND, S0-14	2375-40810N14	
U3, U4	IC, MMAD1108 8 DIODE ARRAY, S0-16	2331-11080N16	
U6	IC, LP2951, PROG, VOLT REG, SO-8	2305-29510N08	
U7	IC, MC33172 DUAL OP AMP, SO-8	2302-33172N08	
U8	IC, MC14536B PROGRAM TIMER, SO-16W	2375-45360W16	

6.1.2 Transmitter Main Board Mechanical Parts List

Description	Part No.	Qty.	
CABLE, SMB-SMB PLUG, RG316,12cm	$7910-WP0WP012	1	(Enhanced Synth and Crystal Control)
CABLE, SMA-SMB PLUG, RG316,15cm	$7910-SP0WP015	1	(Low Power Synth)
CABLE,SMA PL-SMB PL,RG316,11cm	$7910-SP0WP011	1	(Reference Input Opt. Enhanced Synth)
CABLE, SMA PLUG-PLUG, RG316, 19 cm	$7910-SP0SP019	1	(Reference Input Opt. Low Power Synth)
CONN, TYPE F 48 MALE, RA, PCB MTG	3720-6048M0RA	1	
CONN/RF, SMA JACK-JACK BULKHEAD	5118-J875BJ05	1	(Reference Input Opt. Low Power Synth)
PANEL, REAR, POS.4, 14HP EXTRSN.	3702-63002101	1	
FASTENER, QUICK RELEASE	3702-10000120	4	
GASKET, BeCu,3FINGER,.25",CLIP	5630-12023250	2	
HANDLE, FRONT PANEL, 14HP, GREY	3702-10000614	1	
HOLE PLUG, 0.25" HOLE, NYLON, BLACK	5671-250N062B	1	
LOCKWASHER, M3, SPLIT,A2 STEEL	5814-3M0LK00S	4	
MIC CONN, 4 PIN MALE, BLACK	5040-114ST0BK	1	
NAMEPLATE, BLANK, 14HP, ALUM.	3702-10001214	1	
NUT, M2.5, HEX, 5.0mm, STEEL/Ni	5813-2M5HX50N	2	
NUT, M2.5, SQUARE, 5.0mm, ZINC	5813-2M5SQ50Z	2	
NUT PRESS, M2.5, 5.6mm OD, PC MNT	5833-T2M55615	1	
PANEL/FRNT,W/IDENT:TX-EXTR.VER	3802-61002101	1	
PANEL, REAR,POS.4,14HP EXTRSN.	3702-63002101	1	
SCREW, M3 x 8, PAN/PHIL, BLACK	5812-3M0PP08T	4	
SCREW, M3 x8,OVAL C/S/PHIL,A2	5812-3M0VP08S	4	
SCREW, M2.5 X 10, CHEESE/SLOT, A2	5812-2M5CS10S	2	
SCREW, M2.5 X 12, FLAT/PHIL, Ni	5812-2M5FP12N	2	
SCREW, M3 X 6, OVAL C/S/PHIL, Ni	5812-3M0VP06N	2	
SCREW, M3 X 6 PAN/PHIL, A2	5812-3M0PP06S	4	
SCREW, M5 X 8 FLAT/PHIL, A2	5812-5M0FP08S	4	
TAB, GROUND, MT-3 SYNTH., BRASS	3702-67800905	2	(Low Power Synth)
WIRE, PVC-STRANDED, 22 AWG BLK., 10.5cm	7110-22S07300	1	
WIRE, PVC-STRANDED, 22 AWG BRN., 10cm	7110-22S07301	1	
WIRE, PVC-STRANDED, 22 AWG ORG., 9.5cm	7110-22S07303	1	
WIRE, PVC-STRANDED, 22 AWG RED, 13.5cm	7110-22S07302	1	
WIRE, PVC-STRANDED, 22 AWG YEL., 9.5cm	7110-22S07304	1	
WIRE, PVC-STRANDED, 22 AWG BLUE, 10cm	7110-22S07306	1	

6.1.3 MT-3 Front Panel Board Electrical Parts List

Ref Desig	Description	Part No.
D1	LED, RED, 5 mm OD, T-1 3/4	2010-503001RD
PF1	HEADER, 0.1", RA, 2 ROW X 2 PIN	5010-H202RA9T
PF2	HEADER, 0.1", RA, 2 ROW X 2 PIN	5010-H202RA9T
SW1	SWITCH, TOG/DPDT, ON-OFF-ON, PCB/STR	5215-T2031V02
PCB	MT-3 TX FRONT PANEL	4321-40921211

6.2 MT-3 Audio Processor Parts List (Version 1.6)

6.2.1 MT-3 Audio Processor Electrical Parts List (Version 1.6)

Ref Desig	Description	Part No.
C3	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C4	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C5 - C7	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C8	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16
C9	CAP., 100nF FILM, MMK5, 10%, 63V	1016-5A104K63
C10	CAP., SM, 2.2µF TANT., 10%, 20V	1055-5B225K20
C11	CAP., SM, 150pF CER, 0805, C0G	1008-2AI5IJIG
C12	CAP., 680nF FILM, MMK5, 10%, 50V	1016-5D684K50
C13	CAP., SM, 10pF CER, 0805, C0G	1008-1A100J1G
C14	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C15	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C16	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C17	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C18	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C19	CAP., SM, 150pF CER, 0805, C0G	1008-2AI5IJIG
C20	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C21, C22	CAP., 10nF FILM, MMK5, 10%, 63V	1016-4A103K63
C23	CAP., 22nF FILM, MMK5, 10%, 63V	1016-4A223K63
C24	CAP., 10nF FILM, MMK5, 10%, 63V	1016-4A103K63
C25	CAP., 15nF FILM, MMK5, 10%, 63V	1016-4A153K63
C26	CAP., 1.0nF FILM, MMK5, 10%, 63V	1016-3A102K63
C27	CAP., 33nF FILM, MMK5, 10%, 63V	1016-4A333K63
C28	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C29, C30	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C31	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16
C32	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C33	CAP., SM, 6.8µF TANT., 20%, 10V	1055-5B685M10
C34	CAP., SM, 150pF CER, 0805, C0G	1008-2AI5IJIG
C35	CAP., 330nF FILM, MMK5, 10%, 50V	1016-5B334K50
C36	CAP., SM, 10pF CER, 0805, C0G	1008-1A100J1G
C37	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C38, C39	CAP., 330nF FILM, MMK5, 10%, 50V	1016-5B334K50

Ref Desig	Description	Part No.
C40	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50
C41	CAP., 150nF FILM, MMK5, 10%, 63V	1016-5B154K63
C42	CAP., N/I	NOT INSTALLED
C43	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C44	CAP., 330nF FILM, MMK5, 10%, 50V	1016-5B334K50
C47, C48	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50
C49	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C50	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C51	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C52	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C53	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C54 - C56	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C57	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50
C58	CAP., SM, 150pF CER, 0805, C0G	1008-2AI5IJIG
FB1	FERRITE BEAD, 43 MIX 1812 PKG	1213-43181200
P1 - P4	HEADER, 0.1", R/A, 2 ROW X 2PIN	5010-H202RA9T
PCB	AUDIO PROCESSOR, MT-3 TX	4321-30911916
Q2	TRANSISTOR, BC817-25 NPN, SOT-23	2120-BC817025
R1	RES., SM, 604R 0805, 1%, 100ppm	1150-2A6040FP
R2	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R3	RES., SM, 6k81 0805, 1%, 100ppm	1150-3A6811FP
R4	RES., SM, 221k 0805, 1%, 100ppm	1150-4A2212FP
R5, R6	RES., SM, 1k00 0805, 1%, 100ppm	1150-3A1001FP
R7	RES., SM, 20k0 0805, 1%, 100ppm	1150-4A2002FP
R8	POT., SM/4mm SQ, 100k 11T, SIDE ADJUST	1174-DM4104J0
R9	RES., SM, 221k 0805, 1%, 100ppm	1150-4A2212FP
R10, R11	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R12	RES., SM, 11k8 0805, 1%, 100ppm	1150-4A1182FP
R13	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R14	POT., SM/4mm SQ, 50k 11T, SIDE ADJUST	1174-DM3503JO
R15	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R16	RES., SM, 100k 0805, 1%, 100ppm	1150-5A1003FP
R17	RES., SM, 4k53 0805, 1%, 100ppm	1150-3A45315P
R18	RES., SM, 681R 0805, 1%, 100ppm	1150-2A6810FP
R19	THERMISTOR, 10k NTC, 10%, RADL.	1180-4RDG103K
R20	RES., SM, 2k21 0805, 1%, 100ppm	1150-3A2211FP
R21, R22	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R23, R24	RES., SM, 5k11 0805, 1%, 100ppm	1150-3A5111FP
R25, R26	RES., SM, 3k48 0805, 1%, 100ppm	1150-3A3481FP
R27, R28	RES., SM, 13k3 0805, 1%, 100ppm	1150-4A1332FP
R29	POT., SM/4mm SQ, 50k 11T, SIDE ADJUST	1174-DM3503JO
R30	RES., SM, 681R 0805, 1%, 100ppm	1150-2A6810FP
R31	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R32, R33	RES., SM, 1k50 0805, 1%, 100ppm	1150-3A1501FP
R34	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R35, R36	RES., SM, 1k00 0805, 1%, 100ppm	1150-3A1001FP
R37	RES., SM, 20k0 0805, 1%, 100ppm	1150-4A2002FP

R38	POT., SM/4mm SQ, 100k 11T, SIDE ADJUST	1174-DM4104J0
R39	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R40	RES., SM, 1k50 0805, 1%, 100ppm	1150-3A1501FP
R41	RES., SM, 11k8 0805, 1%, 100ppm	1150-4A1182FP
R42	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R43	RES., SM, 11k8 0805, 1%, 100ppm	1150-4A1182FP
R44	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R45	RES., SM, 39k2 0805, 1%, 100ppm	1150-4A3922FP
R46, R47	RES., SM, 4k53 0805, 1%, 100ppm	1150-3A45315P
R48	POT., SM/4mm SQ, 100k 11T, SIDE ADJUST	1174-DM4104J0
R49	RES., SM, 27k4 0805, 1%, 100ppm	1150-4A2742FP
R50	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R51	RES., SM, 1k50 0805, 1%, 100ppm	1150-3A1501FP
R52	RES., SM, 11k8 0805, 1%, 100ppm	1150-4A1182FP
R61	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R71	RES., SM, 63k4 0805, 1%, 100ppm	1150-4A6342FP
R72	RES., SM, 39k2 0805, 1%, 100ppm	1150-4A3922FP
R73	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R74	RES., SM, 27k4 0805, 1%, 100ppm	1150-4A2742FP
R75	POT., SM/4mm SQ, 50k 11T, SIDE ADJUST	1174-DM3503JO
R76	Not Installed	1Not Installed
R77	RES., SM, 20k0 0805, 1%, 100ppm	1150-4A2002FP
R78, R79	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R80	RES., SM, 68k1 0805, 1%, 100ppm	1150-4A6812FP
R81	THERMISTOR, 10k NTC, 10%, RADL.	1180-4RDG103K
R82, R83	RES., SM, 27k4 0805, 1%, 100ppm	1150-4A2742FP
R84, R85	RES., SM, 39k2 0805, 1%, 100ppm	1150-4A3922FP
R86, R87	RES., SM, 22k1 0805, 1%, 100ppm	1150-4A2212FP
R88, R89	RES., SM, 100k 0805, 1%, 100ppm	1150-5A1003FP
R90	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
U1, U2	IC, SL6270 VOGAD, S0-8	2328-62700N08
U3, U4	IC, MC33172 DUAL OP AMP, SO-8	2302-33172N08
U5	IC, MC33174 QUAD OP AMP	2304-33174N14
U8	IC, MC33172 DUAL OP AMP, SO-8	2302-33172N08
U9, U10	IC, TC4S66F BILATERAL SWITCH, SMV	2375-4S66FSMV

6.3 MT-3 Audio Processor Parts List (Version 1.8)

6.3.1 MT-3 Audio Processor Electrical Parts List (Version 1.8)

Ref Desig	Description	Part No.
C1	CAP., 220nF FILM, MMK5,10%,50V	1016-5A224K50
C2	CAP., SM, 2.2uF TANT., 20%, 20V	1055-5B225K20
C3	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C4	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C5	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C6	CAP., 10nF FILM, MMK5, 10%, 63V	1016-4A103K63
C7	CAP., SM, 2.2uF TANT., 20%, 20V	1055-5B225K20
C8	CAP., SM, 10uF TANT., 20%, 16V	1055-6C106M16
C9	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C10	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R

Ref Desig	Description	Part No.
C11	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R
C12	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R
C15, C17	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C18, C20	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C21, C22	CAP., 10nF FILM, MMK5, 10%, 63V	1016-4A103K63
C23	CAP., 22nF FILM, MMK5, 10%, 63V	1016-4A223K63
C24	CAP., 10nF FILM, MMK5, 10%, 63V	1016-4A103K63
C25	CAP., 15nF FILM, MMK5, 10%, 63V	1016-4A153K63
C26	CAP., 1.0nF FILM, MMK5, 10%, 63V	1016-3A102K63
C27	CAP., 33nF FILM, MMK5, 10%, 63V	1016-4A333K63
C30	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C35	CAP., 330nF FILM, MMK5, 10%, 50V	1016-5B334K50
C36	CAP., SM, 10pF CER, 0805, C0G	1008-1A100J1G
C37	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C38, C39	CAP., 330nF FILM, MMK5, 10%, 50V	1016-5B334K50
C41	CAP., 150nF FILM, MMK5, 10%, 63V	1016-5B154K63
C43	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C44	CAP., 330nF FILM, MMK5, 10%, 50V	1016-5B334K50
C45	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C46	CAP., 100nF FILM, MMK5, 10%,63V	1016-5A104K63
C47, C48	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50
C49	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C50	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C51	CAP., SM, 100nF CER,0805,X7R,50V	1008-5A104K5R
C52	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C53	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C54 - C55	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
FB1	FERRITE BEAD, 43 MIX 1812 PKG	1213-43181200
P1 - P4	HEADER, 0.1", R/A, 2 ROW X 2PIN	5010-H202RA9T
PCB	AUDIO PROCESSOR, MT-3 TX	4321-30911918
Q2	TRANSISTOR, BC817-25 NPN, SOT-23	2120-BC817025
R1	RES., SM, 604R 0805, 1%, 100ppm	1150-2A6040FP
R2	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R3	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP
R4	RES., SM, 3K01 0805, 1%,100ppm	1150-3A3001FP
R5	RES., SM, 8K25 0805, 1%,100ppm	1150-3A8251FP
R6	RES., SM, N/I 0805, 1%,100ppm	1150-TBA
R7	RES., SM, 37K4 0805, 1%,100ppm	1150-4A3742FP
R8 - R11	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP
R12	RES., SM, N/I 0805, 1%,100ppm	1150-TBA
R13	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R14	POT., SM/4mm SQ, 50k 11T, SIDE ADJUST	1174-DM3503JO
R15	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R16	RES., SM, 100k 0805, 1%, 100ppm	1150-5A1003FP
R17	RES., SM, 4k53 0805, 1%, 100ppm	1150-3A45315P
R18	RES., SM, 1K0 0805, 1%,100ppm	1150-3A1001FP
R19	TEMPSISTOR, 1K2 PTC, 10%,AXIAL	1181-3AGD122K

Ref Desig	Description	Part No.
R20	RES., SM, 2k21 0805, 1%, 100ppm	1150-3A2211FP
R21, R22	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R23, R24	RES., SM, 5k11 0805, 1%, 100ppm	1150-3A5111FP
R25, R26	RES., SM, 3k48 0805, 1%, 100ppm	1150-3A3481FP
R27, R28	RES., SM, 13k3 0805, 1%, 100ppm	1150-4A1332FP
R29	POT., SM/4mm SQ, 50k 11T, SIDE ADJUST	1174-DM3503JO
R30	RES., SM, 681R 0805, 1%, 100ppm	1150-2A6810FP
R31	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R32	RES., SM, 470K0 0805, 1%,100ppm	1150-5A4703FP
R33	RES., SM, 1k50 0805, 1%, 100ppm	1150-3A1501FP
R34	RES., SM, 75K0 0805, 1%,100ppm	1150-4A7502FP
R35	RES., SM, 68K1 0805, 1%,100ppm	1150-4A6812FP
R36	POT., SM, 50K0 4mm SQ, 50K, 11T,SIDE	1174-DM3503J0
R37	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP
R38	POT., SM/4mm SQ, 100k 11T, SIDE ADJUST	1174-DM4104J0
R39	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R40	RES., SM, 1k50 0805, 1%, 100ppm	1150-3A1501FP
R41	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP
R42	POT., SM/4mm SQ, 5k 11T, SIDE ADJUST	1174-DM2502J0
R43	RES., SM, 11k8 0805, 1%, 100ppm	1150-4A1182FP
R44	RES., SM, 0R0 ZERO OHM JUMPER,0805	1150-0A0R0000
R45	RES., SM, N/I 0805, 1%,100ppm	1150-TBA
R46, R47	RES., SM, 4k53 0805, 1%, 100ppm	1150-3A45315P
R48	POT., SM/4mm SQ, 100k 11T, SIDE ADJUST	1174-DM4104J0
R49	RES., SM, 27k4 0805, 1%, 100ppm	1150-4A2742FP
R50	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R51	RES., SM, 1k50 0805, 1%, 100ppm	1150-3A1501FP
R52	RES., SM, 11k8 0805, 1%, 100ppm	1150-4A1182FP
R53	RES., SM, N/I 0805, 1%,100ppm	1150-TBA
R54	RES., SM, 274R0 0805, 1%,100ppm	1150-2A2740FP
R55	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP
R71	RES., SM, 63k4 0805, 1%, 100ppm	1150-4A6342FP
R72	RES., SM, 0R0 ZERO OHM JUMPER,0805	1150-0A0R0000
R73	RES., SM, 221k 0805, 1%, 100ppm	1150-5A2213FP
R74	RES., SM, 27k4 0805, 1%, 100ppm	1150-4A2742FP
R75	POT., SM/4mm SQ, 50k 11T, SIDE ADJUST	1174-DM3503JO
R76	RES., SM, 0R0 ZERO OHM JUMPER,0805	1150-0A0R0000
R77	RES., SM, 20k0 0805, 1%, 100ppm	1150-4A2002FP
R79	RES., SM, 49k9 0805, 1%, 100ppm	1150-4A4992FP
R80	RES., SM, 68k1 0805, 1%, 100ppm	1150-4A6812FP
R81	THERMISTOR, 10k NTC, 10%, RADL.	1180-4RDG103K
R84, R85	RES., SM, 39k2 0805, 1%, 100ppm	1150-4A3922FP
R86, R87	RES., SM, 22k1 0805, 1%, 100ppm	1150-4A2212FP
R88, R89	RES., SM, 100k 0805, 1%, 100ppm	1150-5A1003FP
R90	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
U1	IC, SA578D COMPANDOR, SO-16L	2327-SA571D00
U3, U4	IC, MC33172 DUAL OP AMP, SO-8	2302-33172N08
U5	IC, MC33174 QUAD OP AMP	2304-33174N14
U8	IC, MC33172 DUAL OP AMP, SO-8	2302-33172N08
U9, U10	IC, TC4S66F BILATERAL SWITCH, SMV	2375-4S66FSMV

7 REVISION HISTORY

ISSUE	DATE	REVISION
1	August 97	First Issue.
	Sept. 97	Included PCB version 1.4 Component Layout and Schematic diagrams.
2	Dec 97	Main PCB version now 1.7 (ECO 515). • BCD Switches changed from Surface Mount Part to Through Hole Part. • Audio Amplifier was removed because this option was never used. • Added Timer Out Timer circuitry to Main Tx Board. • TOT PCB no longer installed on Audio Processor. For A21-TX3-00 TX MAIN/FP, MT-3, STANDARD A21-TX3-30 TX MAIN/FP, MT-3, + REF. INPUT TUBING, TFE-260C,14AWG T/W,CLR 7610-260C14TW 18mm Long and Consummable Buss Wire 16 Awg 40mm Long NOW NOT INSTALLED
	Dec 97	For A21-TX3-01 TX MAIN/FP, MT-3, WITH FUSE A21-TX3-02 TX MAIN/FP, MT-3, + DC RELAY A21-TX3-03 TX MAIN/FP, MT-3, + FUSE,RELAY • Removed Jumpers J1, J5, J8, J10, J11. • Added Jumpers J22 - J29, J31 - J35. • Added Test Points TP28 - TP34
	Dec 97	Front Panel Board version now 1.2 (ECO 521). Modified MT-3 Tx Front Panel Board (FPB) to support all options on the New Transmitter Main Board . Also, the Front Panel Board is now easier to configure if new microphones (other than Daniels microphones) are used. The new FPB can be used on the old TX-3 main - all options will function. However, the old version of FPB will NOT work with the new version TX-3 Main PCB (unless you hard wire one of the microphone pins into the main PCB (13.8V line.) Added J2 SM Jumper. This jumper now selects Rx Audio or 13.8V to Pin 4 of the Microphone. This capability used to be selected by a jumper on the Main Tx Board. For Normal Opertion J2 'x' position must be installed Options - This is for future use (not used now). Added 2x4 header land pattern to Tx Front Panel Board. A 2x4 header can be installed to make other microphones compatible with Daniels Transmitters.
3	Nov 98	MT-3 FM Audio Processor now version 1.8 The MT-3 FM Audio Processor was re-designed because the IC, SL62070, VOGAD, SO-8 is no longer available from the supplier. Also, the new design improves the flat and 300Hz Pre-emphasis audio responses. Included PCB version 1.8 Component Layout, Schematic diagram, Parts List and Section 2.4, 3.9 and 3.10.

ISSUE	DATE	REVISION
3	Nov 98	Updated the DE logo and added the statuary trademark statement to the title page. Updated the Low Frequency Modulation section 3.11 to reflect the in house document A0361-06.

DANIELS™
ELECTRONICS LTD.

MT-3 RADIO SYSTEMS

Audio Processor
Instruction Manual
For AM/FM Transmitters

Covers the following
V 2.2 and V2.3 of the FM Audio Processor Board
used in the VT-3/xxx, UT-3/xxx, VT-3Hxxx and
A22-VAP130 AM Audio Processor Version 04

Issue:	2	Previous Issue:	1	
Issue Date:	November 2000	Previous Issue Date:	October 2000	Daniels Electronics Ltd.
Printing Date:	January 2001			Victoria, BC.
Part No.:	IM20-AP3			PRINTED IN CANADA

Reviewed By:

Quality Assurance:		
Larry Freeman	Larry Freeman	12 May 98
Name	Signature	Date

NOTE:

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. This equipment may incorporate minor changes in detail from the information contained in this manual.

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1 FM AUDIO PROCESSOR

1.1 Introduction

The MT-3 FM Audio Processor is a versatile circuit board that can provide several types of audio processing for voice or data transmission.
The following terms are defined**:**

Table 1 Bandwidth Definition

Term	Channel Spacing	Rated System Deviation
Wideband	25 kHz or 30 kHz	±5.00 kHz
Narrowband	12.5 kHz or 15 kHz	±2.50 kHz

LTR™ is a trademark of E.F. Johnson Co.

Features include:

- Automatic level control using a compression amplifier with a 25 dB dynamic range
- Limiter and Splatter filter that removes noise and harmonics
- Selectable pre-emphasis or flat audio response
- Temperature compensated audio output
- Ability to transmit data and voice switched by a single control line.
- Backwards compatible with Daniels Electronics MT-2 series transmitters.
- Direct modulation input for LTR™, DCS, paging and other digital modulations that require very low frequency modulation to the synthesizer or crystal oscillator module.
- Separate voice and direct modulation outputs, each individually configurable.
- Multiple jumpers that can be configured to allow maximum flexibility in routing signals from inputs to outputs, and disabling selected circuits to reduce operating current.
- Dual microphone and balanced audio compression circuits.
- On-board multi-configurable temperature compensation to correct for changes in transmitter deviation over temperature caused by changing characteristics of synthesizers and oscillators.
- A single chip 10th Order Linear Phase Lowpass splatter filter for increased cutoff attenuation responses needed in today's narrow band environment.
- The ability to switch between narrow and wideband through a single control line which can be externally controlled. This can be useful when configured as a multi-channel transmitter which uses mixed wide and narrowband frequencies.
- The ability to easily reconfigure fixed operations from narrow to wideband through simple jumper settings

A continuous +9.5 VDC supply and a switched +8.0 VDC supply are required to power the module which is normally supplied by the Main Transmitter Board.

The 6 audio inputs on the FM Audio Processor are:

- DYNAMIC MICROPHONE INPUT
- 600 OHM BALANCED INPUT
- subtone inputs
- auxiliary input.
- direct modulation input for data signals.

The Audio Processor's balanced input pins are isolated by a transformer (T1) on the Transmitter Main Board. Two audio outputs from the MT-3 Audio Processor are routed to the Synthesizer or Crystal Controlled Oscillator Modules.

1.2 Block Diagram (FM Audio Processor)

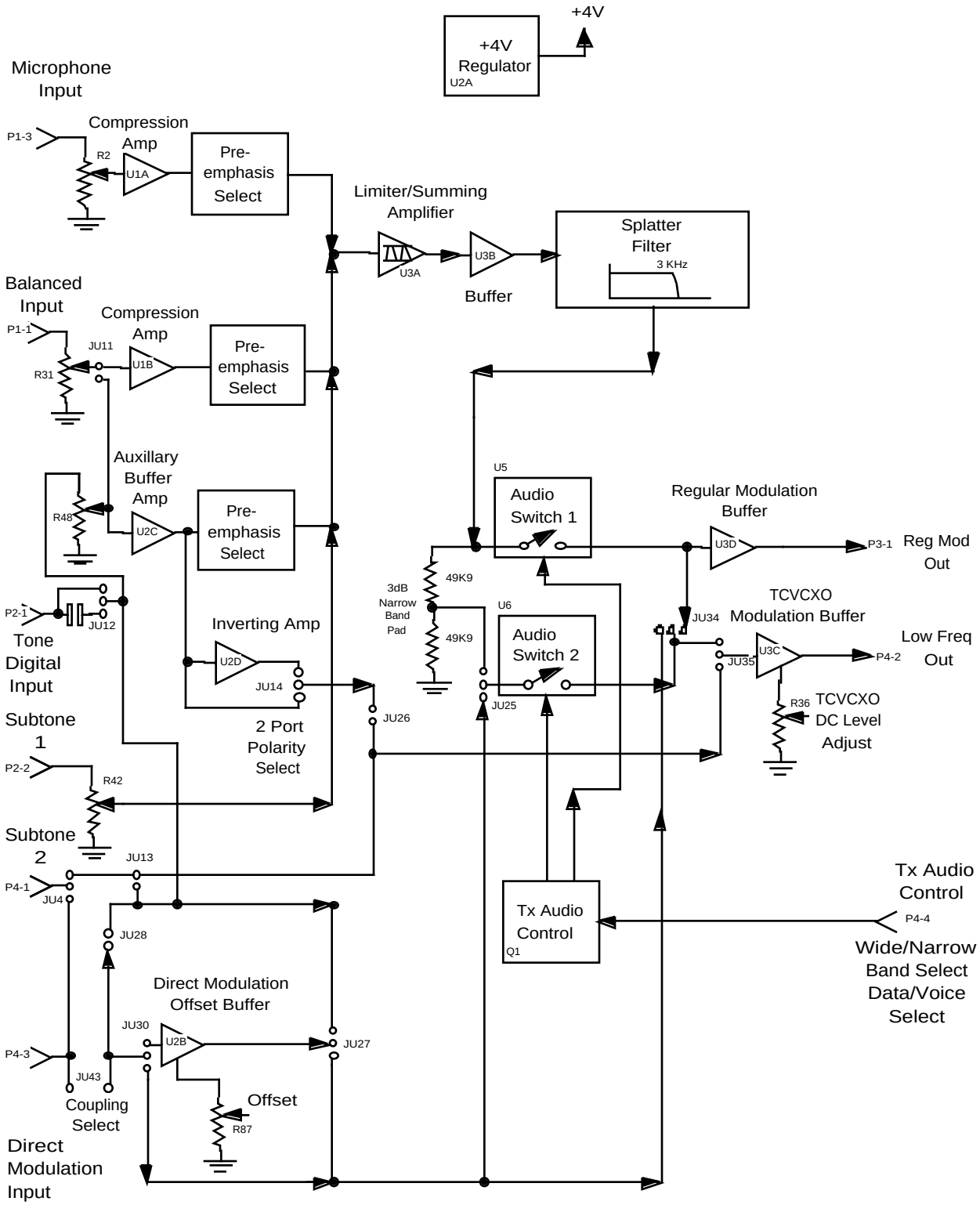

Figure 1 Block Diagram - Audio Processor

1.3 FM Audio Processor Board Pin Connections

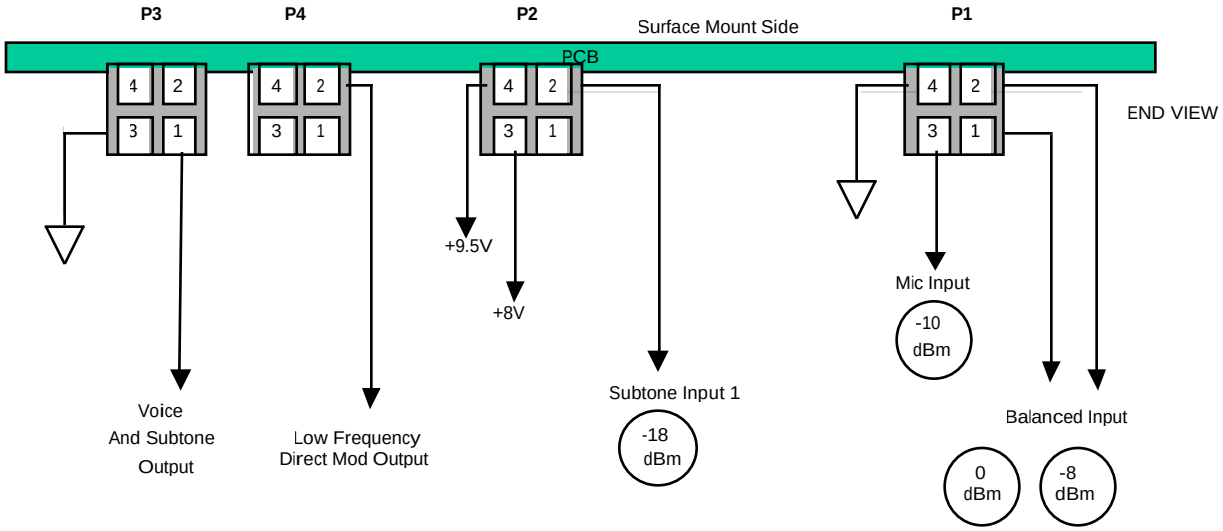

Figure 2 Pin Connection Diagram

1.4 Factory Configuration

The MT-3 FM Audio Processor is factory configured as follows:

Table 2 Factory Configuration

Parameter	Specification
Maximum Deviation	±2.5 kHz (Narrowband), ±5.0 kHz (Wideband).
Microphone Input	1 kHz signal at -10 dBm gives ±60% rated system deviation 1 kHz signal compression set at ±84% rated system deviation
Audio Balanced Input pre-emphasis response	1 kHz tone at -8 dBm gives ±60% rated system deviation 1 kHz signal compression set at ±84% rated system deviation
Subtone Input 1	100 Hz tone at -18 dBm gives ±500 Hz (Wideband) ±350 Hz (Narrowband) deviation
All other audio inputs	Disabled

1.5 Turn-on Time

This measurement is made with the standard factory settings with a 1 kHz tone applied to the balanced input. The turn-on time is the time it takes the FM Audio Processor to output a stable audio signal to P3-1 from the time its power (+8.0 VDC) is switched on.

The turn-on time can be virtually eliminated by configuring the FM Audio Processor for continuous audio standby (see section 1.7 Transmitter Standby Modes). The drawback is that more current is used to enable the audio circuits to minimize the turn on time. The bulk of the delay is in the powering of the compression amplifier. For applications that do not use the compression amplifier, the fast turn on times apply as in the case of data transmission, or audio with no compression.

Table 3 Turn On Time

Mode	Turn on time	Audio Processor Standby Current
Fast turn on – higher current	Approx 1mS	15 mA
Current save – slower response	Approx 150mS	450uA

1.6 Low Frequency Modulation

The transmitter has an additional option to address low frequency user modulation requirements. A phase modulated bandwidth from 0 (dc) to 100 Hz (PLL loop filter bandwidth) allows specialized applications such as paging or trunking where a separate low frequency digital/analog modulation channel is required. Low Frequency Modulation allows external access to the low frequency modulation capabilities of the synthesizer module. The DIRECT MODULATION inputs on the J1 control connector of the M-3 motherboard will be used (B20 for TX A, and A20 for TX B). Refer to "Data Modulation and Signalling Applications Manual", P/N AM20-DMS for specific FM Audio Processor configuration methods.

1.7 Transmitter Standby Modes

The MT-3 series transmitters has 8 different standby modes that trade-off standby current consumption for start-up speed.

Three of these jumpers are on the Transmitter Main Board :

- J6 which always turns on the '+9.5 VDC Switched' supply,
- J7 which selects the power source for the MT-3 FM Audio Processor
- J18 which selects the enable line for the OS-3 or OS-3H Synthesizer, or OC-3 Crystal Controlled Oscillator module.

Additionally, there is a jumper on the FM Audio Processor Board:

- JU36 which determines the power hookup for the dual compression amplifiers

Notes:

If FM Audio Processor JU36 is not installed, both microphone and balanced audio compression amplifiers will be disabled. This means that the front panel microphone jack will be disabled for local microphone operations. When in this condition, balanced audio is routed around the compression circuitry via JU11 (installed) with JU1 and JU2 removed.

Table 4 Mode Condition Table

MODE #	J6	J7	J18	Synthesizer/Osc State	Audio Processor State (8V Switched)	Audio Processor Compression JU36
1a	OUT	Y	Y	PTT Switched	PTT Switched	Switched +8.0V(X)
1b	OUT	Y	Y	PTT Switched	PTT Switched	Continuous 9.5V(Y)
1c	OUT	Y	Y	PTT Switched	PTT Switched	Disabled (Not Installed)
2a	IN	Y	X	Always enabled	PTT Switched	Switched +8.0V (X)
2b	IN	Y	X	Always enabled	PTT Switched	Continuous 9.5V (Y)
2c	IN	Y	X	Always enabled	PTT Switched	Disabled (Not Installed)
3	IN	X	Y	PTT Switched	Always enabled	Doesn't matter
4	IN	X	X	Always enabled	Always enabled	Doesn't matter

Table 5 Standby Mode Selection Table

MODE #	Total Xmtr Standby Current		Startup Time	
1a	13 mA	6 mA	150 mS	150 mS
1b	22 mA	15 mA	10 mS	10 mS
1c	13 mA	6 mA	10 mS	10 mS
2a	165 mA	25 mA	150 mS	150 mS
2b	174 mA	34 mA	10 mS	10 mS
2c	165 mA	25 mA	10 mS	10 mS
3	27 mA	20 mA	10 mS	10 mS
4	175 mA	34 mA	10 mS	10 mS

Table 6 FM Audio Processor Total Current Consumption.

Compression configuration	Audio Processor Current Draw keyed / unkeyed
Compression enabled (JU36X)	15 mA/0.45 mA
Compression and microphone disabled (JU36 Open)	9.2 mA/0.45 mA
Compression enabled (JU36Y)	15 mA /9.2 mA

2 SIGNALS

The MT-3 FM Audio Processor has six audio inputs, two audio outputs and one audio control input. Five of the audio inputs are used primarily for voice and tone signals. The sixth, the Direct modulation input, is used primarily for data signals. The audio control input is used to switch audio outputs so the transmitter can transmit voice or data.

2.1 FM Audio Processor Outputs

Both the audio outputs, Modulation Output (P3-1) and Low Frequency / Direct Modulation Output (P4-2), are gated by audio switches U5 and U6 respectively which are controlled by the Transmit Audio Control Input (P4-4). The audio switches can be operated complimentary to each other so there can ever only be one source modulating the transmitter. In standard configuration, the Modulation Output port is used so switch U5 is always on.

2.2 Modulation Output

The Modulation Output port is the output port used by all voice input signals. The voice inputs are passed to U1A and U1B, a dual programmable compandor which is configured as an automatic level control amplifier. Op-amp U3A provides the limiting action for the FM Audio Processor. After the audio signals have been combined limited and buffered, they are filtered by 10^{th} order Linear Phase Lowpass Filter (U4). The output signal from the filter is then level adjusted by the deviation control pot, R29, before buffer amplifier U3D.

In special applications, jumper JU6 can be disabled and JU7 enabled, this allows the transmitter to be modulated directly from the auxiliary input. This should not be done without external filtering since jumper JU7 bypasses the limiting and filter circuits.

2.3 Low Frequency / Direct Mod. Output

The Low Frequency / Direct Modulation Output port has two functions depending on whether the transmitter is synthesized or crystal controlled. In a synthesized transmitter, this port is used to modulate the synthesizer reference frequency. The frequency response of this port is typically DC to 300 Hz. In a crystal controlled transmitter, this port can be used by the Direct Modulation Input to directly modulate the crystal control oscillator module. The frequency response of this port is essentially flat from DC to 5 kHz with no limiting or filtering.

2.4 Microphone Input

The microphone input has an automatically level controlled (ALC) preamplifier U1 whose input level is controlled by R2. The microphone input level control (R2) can accommodate a -25 dBm to 0 dBm input signal. The microphone input is limited and filtered and is output at the standard modulation output port. The microphone input can have a standard 6dB/octave pre-emphasis response or a flat-audio response, jumper JU1 at 'y' and 'x' position respectively.

2.5 Balanced Input

The 600 ohm balanced input uses the ALC preamplifier U1B, with input level control pot (R31). The balanced input level control can accommodate a -25 dBm to 0 dBm input. (install JU17 when

using the lower input levels) Like the microphone input, the balance input is limited and filtered and is output at the standard modulation output port.
If no compression is required (i.e.: customer is providing their own), JU11 can be enabled providing a path through R48 (Auxiliary Input Level Control) to amplifier U2C where pre-emphasis or flat audio can then be selected from its output.

2.6 Auxiliary Input

The auxiliary input is a special input and does not have an ALC. This input can be configured for a pre-emphasis response (enable JU9Y) or a flat-audio response (enable JU9X). The level for this input is set by R48. The auxiliary output is normally summed with the voice signals by op-amp U3A, limited, then filtered and output at the standard modulation output port. When jumper JU6 is disabled and jumper JU7 is enabled, the auxiliary input can be used to directly modulate the transmitter. Care should be taken when directly modulating the transmitter with the auxiliary input because the MT-3 transmitters use direct FM modulation and there is no filtering or limiting action provided by the auxiliary input. The input level to the auxiliary input should be -18 dBm and can be driven by one of three inputs:

- the balanced input – JU11
- the tone/digital input – JU12 X or Y enabled
- the direct modulation input – through JU28

When the 600 ohm balanced input is connected to the auxiliary input, the balanced input level control can be used to adjust the level for the auxiliary input.

2.7 Subtone Inputs

There are two subtone inputs available on the FM Audio Processor. Both subtone inputs can be individually configured to be output from the standard Modulation Output port or to be output from the Low Frequency / Direct Modulation Output. In standard configuration, Subtone 1 is summed with the voice signals to be output from the standard Modulation Output port while Subtone 2 is used for DCS. Both subtone inputs have an input level control.

2.8 Direct Modulation Input

The Direct Modulation Input is an extremely versatile input. This port is designed to be used for data signals. Depending on the application, the signal can be amplified, AC or DC coupled and output to the Modulation Output or the Low Frequency / Direct Modulation Output port. Please consult the factory for specific jumper settings for your application.

3 THEORY OF OPERATION

Voice band audio normally enters the Balanced Input at P1-1 and P1-2 while microphone audio enters at P1-3. Potentiometer R31 sets the Balanced compression level of U1B while R2 sets the microphone compression level of U1A. Each amplifier has a dynamic range of 25 dB. Jumper JU17 is only installed when using very low input levels (-20 to –25 dBm) and allows better tuning range for R31. The output of the compression amplifiers are normally set for Pre-emphasis (6dB/Octave) but can be set for flat audio if required by jumpers JU1 and JU2.

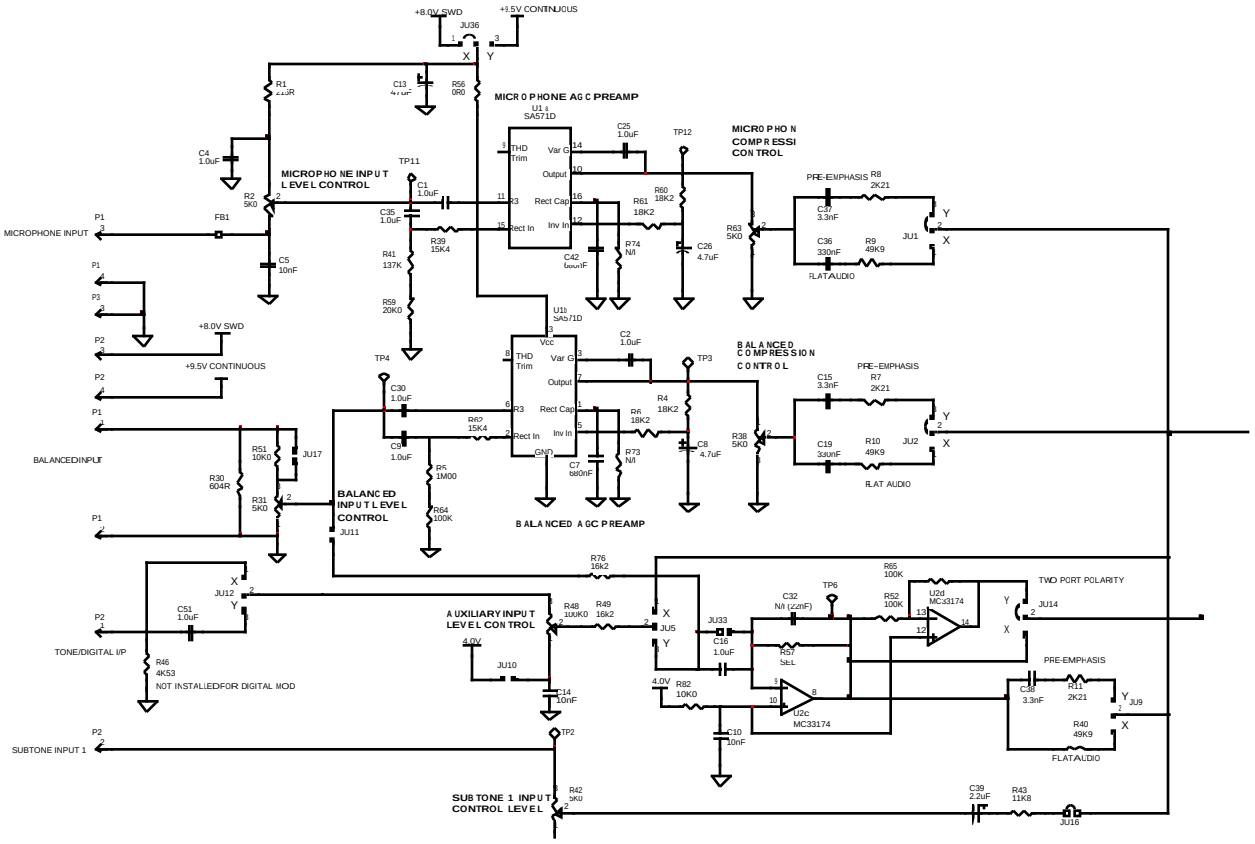

Figure 3 Microphone and Balanced Input Circuitry

The microphone and balanced audio signals are summed and limited by U3A. Op-amp U3B provides audio level temperature compensation (for synthesizer and crystal oscillator sensitivity variations). Due to the many different characteristics of the models of synthesizer and crystal oscillators, the components are marked "SELect" and are identified later in this document (section 6.)

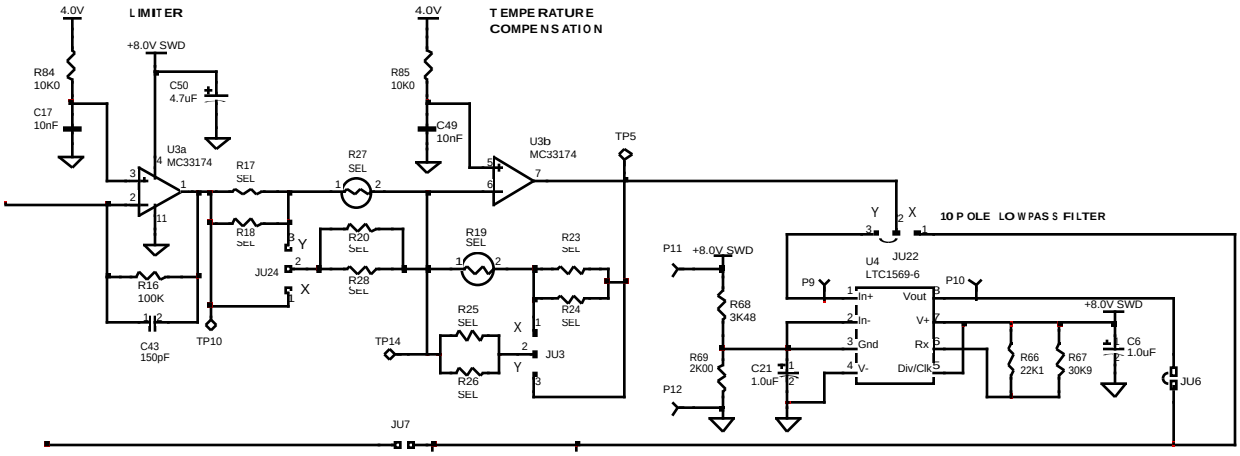

Figure 4 Limiter and Splatter Filter

The audio then is filtered by a 10th Order Linear Phase Lowpass splatter filter. This filter improves on the previous Butterworth filter design for data linearity and increased cutoff attenuation responses mandated in today's narrow band environment.

The filter output level is set by R29, the deviation control. From this point, the signal goes to U5 a bilateral audio switch. U5 is normally configured to be always on. The output of U5 goes to the final buffer amplifier U3D. By installing JU23 which lowers the audio level one half, a wideband transmitter can be quickly re-configured into a narrowband transmitter in the field. The output of U3D has many selectable capacitors which are chosen depending on the synthesizer or crystal oscillator module that is connected to this main modulation port.

If no compression circuitry is required, the balanced input signals can be routed around the compression circuitry by jumper JU11. Op-amp U2C then would provide the buffering/amplification. It's output would normally have pre-emphasis installed but could be changed to flat if required through jumper JU9. The audio signal is then normally routed to U3A, the summing amplifier/limiter and processed as mentioned in the previous paragraphs. Note however, if compression is bypassed, the THD may be higher due to the reduced dynamic input range causing more clipping.

If compression is bypassed and disabled by the removal of FM Audio Processor jumper JU36 which removes power from the compression IC, there will be 9mA of key down current saved. The disadvantage is that the microphone circuit will be disabled due to the removal of the common power to the compression IC.

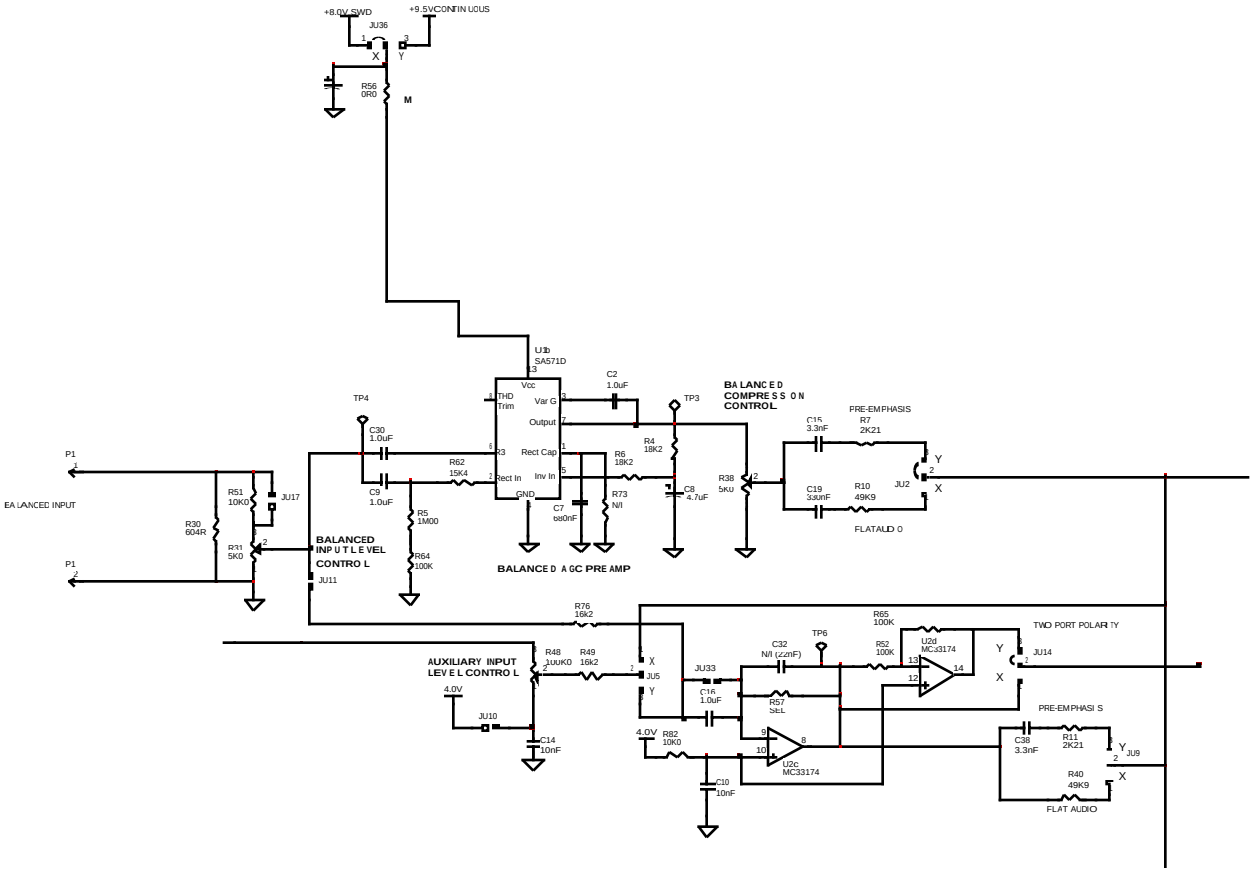

Figure 5 Bypassing Compression

A second way to route around audio compression if data is not being used is to use the direct modulation port P4-3 and go through JU28 to R48 and Op-amp U2C.

Subaudible tones enter at P2-2 where their level is controlled by R42. A single jumper JU16 enables the audio path to U3A, the summing amplifier/limiter.

Voltage regulator U2A provides regulated +4.0V to all Op-amp stages. Optional potentiometer R14 can be installed (and JU15 removed) for special applications which need a voltage different than +4.0V.

Data normally enters at P4-3, the Direct Modulation Input. From there, it has many routes that it can go. JU43 allows direct or on-board capacitive coupling. Op-amp U2B can be configured as a buffer with a DC offset to handle input data that has a positive DC voltage offset. The data signals can be sent to gain buffers U2C and U2D through potentiometer R48. Jumper JU14 is normally installed so that the output from U2D provides the correct data polarity when using two port modulation.

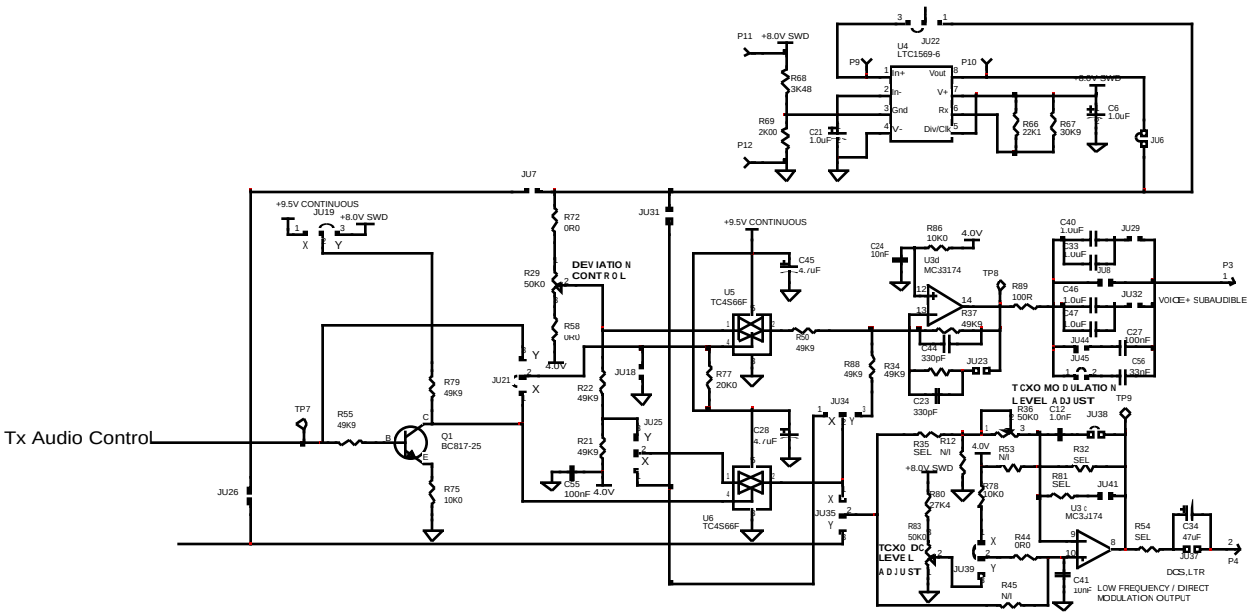

Figure 6 TX Audio Control Circuitry

A single TX Audio control line P4-4 has 2 functions. It can be configured to switch U3D inputs between data and voice. Alternately, it can be configured to remotely switch between wideband and narrowband applications by switching between the regular audio path and one carrying half the audio level as determined by resistive divider comprised of R22 and R21.

Due to the complex nature of data modulation methods, the actual configurations and values of SELected components for LTR, DCS, Paging are contained in a separate applications manual "AM20-DMS".

4 ALIGNMENT

Verify the standard factory settings for the MT-3 FM Audio Processor as given in section 1 before beginning the standard deviation adjustment procedure. If the transmitter's operating frequency is changed beyond the factory recommended bandwidth or if the synthesizer is changed, the FM Audio Processor should be realigned to optimize the transmitter's performance. The schematic diagram for the FM Audio Processor is shown in section 7-2 of this manual.
The settings tolerance is +/- 0.1 kHz.

4.1 Standard Deviation Adjustment

Set up the Communications Analyzer :

-Audio filter to LOW PASS 15 or 20 kHz

-To monitor transmit frequency and audio deviation level.

4.2 Balanced Input Setup

1 Connect audio generator output to the BALANCED INPUT (Transmitter Main Board edge connector pins B18, Z18).

2 Preset R31 (BALANCED INPUT LEVEL CONTROL)
R38 (COMPRESSION CONTROL)
R29 (DEVIATION CONTROL)
all maximum clockwise

3 Set audio generator to 2.4 kHz at 0 dBm.

4 Adjust R29 for ±4.8 kHz (Wideband) or ±2.4 kHz (Narrowband).

5 Set audio generator to 1 kHz at 0dBm

6 Set R38 for ±4.2 kHz (Wideband) or ±2.1 kHz (Narrowband).

7 Repeat steps c) to f) (slight interaction)

8 Set audio generator to 1 kHz at –8 dBm

9 Adjust R31 for ±3.0 kHz (Wideband) or ±1.5 kHz (Narrowband).

10 Set audio generator to 1 kHz at –18 dBm

11 Ensure deviation is at ±1.0 kHz (Wideband) or ±0.5 kHz (Narrowband).

12 Set audio generator to 1 kHz at –8 dBm. Set Communications Analyzer Audio Filter to BANDPASS 300-3400 Hz. Activate distortion analyzer. Confirm that the distortion is within specification.

4.3 Microphone Input Setup

1. Set R2 fully clockwise
2. Apply a 1 kHz tone at 0 dBm to the microphone audio input (PIN 1 on the front panel connector. Pin 2 is ground). Set R63 (MICROPHONE COMPRESSION for ±4.2 kHz (Wideband) or ±2.1 kHz (Narrowband).
3. Reduce the audio generator level to –10 dBm. Adjust R2 (MICROPHONE INPUT LEVEL) for ±3.0 kHz (Wideband) or ±1.5 kHz (Narrowband).

4.4 Subtone Input Setup

- Apply a 100 Hz tone at -18 dBm to the subtone 1 input .
- Adjust R42 (SUBTONE INPUT 1) to produce:
- ±500 Hz(Wideband) or ±350 Hz(Narrowband) deviation.
- Remove the signal.

4.5 Balanced Input Frequency Response

- Apply a 1 kHz tone at –18 dBm to the BALANCED INPUT (Transmitter Main Board edge connector pins B18, Z18).
- Record deviation and use this level as the 0 dB reference.
- Sweep frequency from 100 Hz to 5 kHz.
- The audio response should be within +/- 1dB from 300 Hz to 2500 Hz.

5 TROUBLESHOOTING - TEST EQUIPMENT NEEDED

1 Variable Power supply/supplies to supply 9.6V and 8.0V at the same time.
2 Digital Voltmeter to measure RMS AC Volts, DC Volts, DC Current and resistance.
3 20 MHz Oscilloscope, single channel.
4 Audio Signal Generator (600 Ohm Output Impedance) capable of frrequencies from 67 Hz to 5000 Hz.

Power Supply

- Connect a regulated power supply with +9.5V as follows:
  Positive to P2-4
  Negative to P1-4 (Ground)
- Connect a regulated power supply with +8.0V as follows:
  Positive to P2-3
  Negative to P1-4 (Ground)
- Measure total current from both power line inputs:

Table 7 Operating Current

Voltage Input	Current (mA)
8.0V	15.7
9.5V	0.47

5.1 Balanced Input Test

Connect an Audio Generator set for a 2.4 kHz tone @ 0 dBm (775 mV RMS) output to the Balanced Input (P1-1 and P1-2). Refer to Table 8 Waveform Levels for measurement points, levels and waveforms that should be present.
Change Audio Generator settings for a 1 kHz tone @ -8 dBm (309 mV RMS) output. Refer to Table 8 Waveform Levels for levels and waveforms that should be present.

5.2 Frequency Response Test

Reduce Audio Generator level to –18 dBm (98 mV RMS). Step frequency to 500, 1000, 2000 and 3000 Hz. Ensure that the results conform to the 6dB/octave +/- 1 dB from 300 Hz to 2500 Hz referenced to 1000 Hz. Measurements are made at JU8 with respect to ground.

5.3 Subtone Input Test

Change Audio Generator frequency to 100 Hz and maintain level at –18 dBm (98 mV RMS). Connect output to Subtone Input 1 (P2-2) and ground (P1-4). Refer to Table 8 Waveform Levels, for levels and waveforms that should be present.

5.4 Audio benchmarks

Set the audio generator to 2.4 kHz @ 0 dBm at the Balanced Input. Compare the waveform levels with those listed in table below.

Repeat for the various audio frequencies and levels and compare with the levels in the table below.

Table 8 Waveform Levels

	Limiting Test	**Std Level**	**Mic Test**	**Subtone**
Measured @	2.4kHz @0dBm	1 kHz @ -8dBm	1 kHz @ -10 dBm	100 Hz @ -18 dBm
TP3	5.2V P-P	3.8V P-P	N/A	N/A
TP12	N/A	N/A	3.8V P-P	N/A
TP10	6.5V P-P	4.9V P-P	4.8V P-P	1.1V P-P
TP5	2.4V P-P	1.3V P-P	1.9V P-P	0.4V P-P
JU6	5.5V P-P	1.7V P-P	1.8V P-P	0.4V P-P
TP8	1.5V	0.9V P-P	0.9V P-P	0.2V P-P

6 TEMPERATURE COMPENSATION

The FM Audio Processor includes temperature compensation circuitry to maintain constant transmitter audio deviation with a fixed level input signal. It is capable of not only compensating for temperature related level variations within the FM Audio Processor (typically –0.3 to –0.5 dB at –40C) but can also compensate for changes caused by the synthesizer or crystal oscillator module that is not equipped with its own temperature compensation.

The factory specification is as follows:

Wideband

When a 2.4 kHz tone is applied at a level of –8dBm to the balanced input of the transmitter, the transmitter deviation shall be ±4.8 kHz at room temperature and can vary from ±4.5 kHz to ±5.0 kHz from -40ºC to +60ºC.

Narrowband

When a 2.4 kHz tone is applied at a level of –8 dBm to the balanced input of the transmitter, the transmitter deviation shall be ±2.4 kHz at room temperature and can vary from ±2.25 kHz to ±2.5 kHz from -40ºC to +60ºC.

Since the specifications of the components used in the synthesizer or oscillator may change over time, changes to the temperature compensation circuit may be necessary even for the same type of equipment.

Contact the factory for more information on values used.

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7 ILLUSTRATIONS, TABLES AND SCHEMATIC DIAGRAMS

7.1 Special Jumper Configuration Table

				WB VHF	WB UHF	NB VHF	NB UHF
		Default		& CTCSS	& CTCSS	& CTCSS	& CTCSS
Jumper	Type	Position	Description				
1	XY	Y	Microphone Pre-Emphasis/Flat Audio	Y	Y	Y	Y
2	XY	Y	Balanced Audio Pre-Emphasis/Flat Audio	Y	Y	Y	Y
3	XY	*Factory*	Custom Temperature Compensation Network	*Contact Factory*	Contact Factory	Contact Factory	Contact Factory
4	XY	Open	Subtone 2				
5	XY	Open	Auxiliary Input routing				
6	Single	In	Splatter Filter Output	Installed	Installed	Installed	Installed
7	Single	Open	Auxiliary Input routing				
8	Single	Open	Direct Coupled final OP Amp O/P				
9	XY	Open	Auxiliary Output for Pre-Emphasis	Not Installed	Not Installed	Not Installed	Not Installed
10	Single	Open	4V AC Ground	Not Installed	Not Installed	Not Installed	Not Installed
11	Single	Open	Balanced Input Compression Bypass				
12	XY	Open	Tone/Digital Input audio routing				
13	Single	Open	Direct Modulation Audio Routing				
14	XY	Y	Two Port Polarity Select	Y default OK	Y default OK	Y default OK	Y default OK
15	XY	XY	4V Regulator adjust (Bypassed)	X and Y both	X and Y both	X and Y both	X and Y both
16	Single	In	Subaudible Enable	Installed	Installed	Installed	Installed
17	Single	Open	Balanced Input Adjust Range extend				
18	Single	Open	Audio Gate disable				
19	XY	Y	Voltage Select (+9.5V/8V) Audio gates	Y	Y	Y	Y
20	XY	Open	Direct Modulation Audio Routing				
21	XY	X	Audio Gate Switch	X	X	X	X
22	XY	Y	Splatter Filter Enable/Bypass	Y	Y	Y	Y
23	Single	Open	Narrow Band gain reduction	Not Installed	Not Installed	Installed	Installed
24	XY	*Factory*	Custom Temperature Compensation Network	*Contact Factory*	*Contact Factory*	*Contact Factory*	*Contact Factory*
25	XY	Open	Wide/Narrow Band switched select	Not Installed	X	Not Installed	X
26	Single	Open	Auxiliary output routing	Not Installed	Not Installed	Not Installed	Not Installed
27	XY	Open	Direct Modulation Input Offset Output				
28	Single	Open	Direct Modulation Input Routing	Not Installed	Not Installed	Not Installed	Not Installed
29	Single	Open	Coupling Capacitor selection	Not Installed	Not Installed	Not Installed	Not Installed
30	*N/A*	*N/A*	*This skipped designator has been deleted*				
31	Single	Open	Splatter Filter output routing	Not Installed	Installed	Not Installed	Installed
32	Single	Open	Coupling Capacitor selection	Not Installed	Not Installed	Not Installed	Not Installed
33	Single	Open	Direct Input Coupling - Auxiliary amplifier	Not Installed	Not Installed	Not Installed	Not Installed
34	XY	Open	Audio Routing				
35	XY	Open	Audio Routing	Not Installed	X	Not Installed	X
36	XY	X	AGC Preamp Power select	X	X	X	X
37	Single	Open	Direct Couple (TCXO)			Not Installed	Not installed
38	Single	In	Low pass enable	Installed	Installed	Installed	Installed
39	XY	X	Low Frequency amplfier bias select	X	X	X	X
40	*N/A*	*N/A*	*This skipped designator has been deleted*				
41	Single	Open	Narrow Band gain reduction	Not Installed	Not Installed	Installed	Installed
42	XY	Open	Direct Modulation input bias select				
43	Single	Open	Direct Modulation Direct/Cap couple				
44	Single	Open	Coupling Capacitor selection				
45	Single	In	Coupling Capacitor selection (Default)	Installed	Installed	Installed	Installed

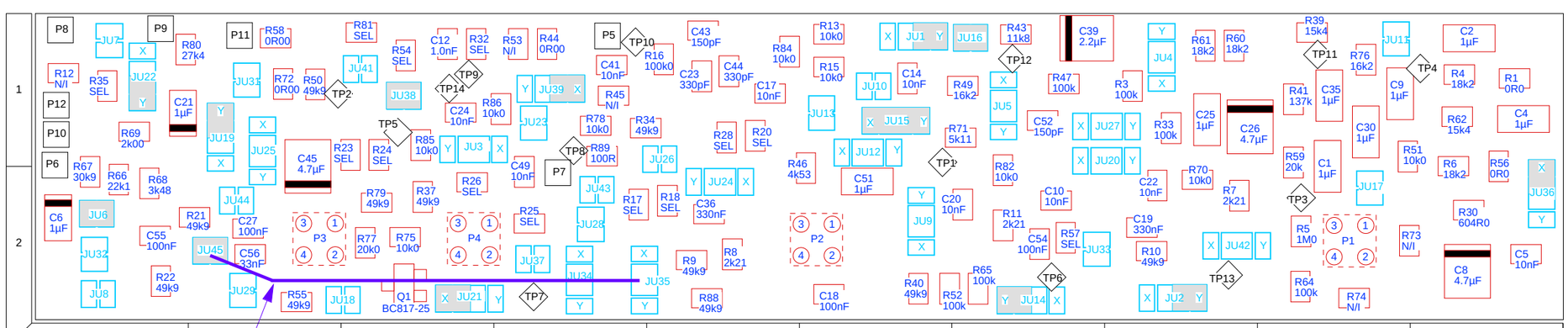
	WB VHF/CTCSS	WB UHF/CTCSS	NB VHF/CTCSS	NB UHF/CTCSS
TCXO Op Amp				
R35	Not Installed	O Ohms	Not Installed	0 Ohms
R32	Not Installed	51K Ohms	Not Installed	51K Ohms
R81	Not Installed	51K Ohms	Not Installed	51K Ohms
R54	Not Installed	100 Ohms	Not Installed	100 Ohms
Auxiliary Op Amp				
R57	Not Installed	Not Installed	Not Installed	Not Installed

7.2 FM Audio Processor Component Layout V2.3

COMPONENT LOCATION TABLE

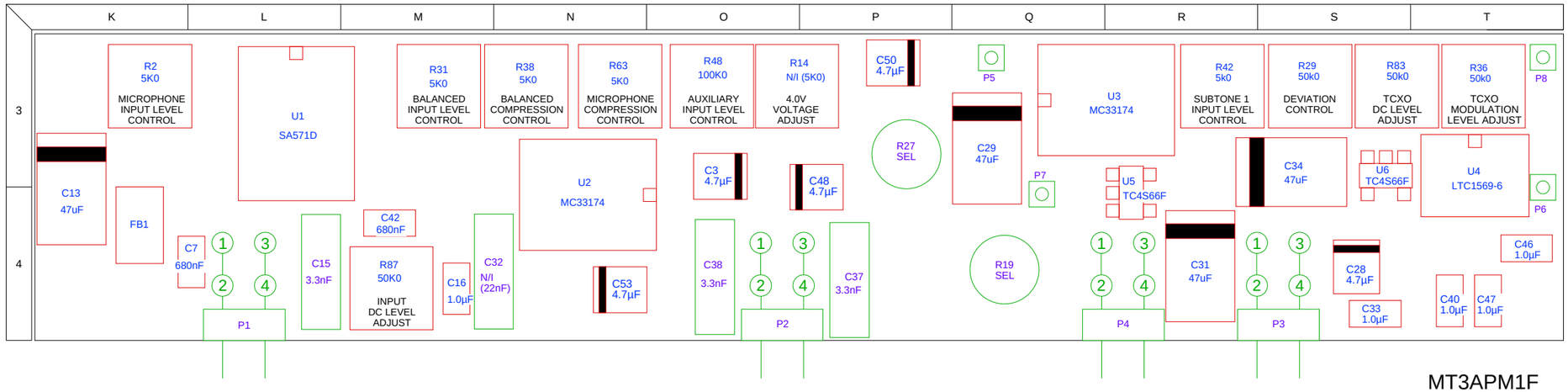
DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC	DES	LOC
C1	I1	C26	H1	C51	F2	JU1	F1	JU26	E1	P1	L4	R1	J1	R26	C2	R51	I1	R76	I1	TP1	F1	U1	L3
C2	J1	C27	B2	C52	G1	JU2	H2	JU27	H1	P2	O4	R2	K3	R27	P3	R52	F2	R77	C2	TP2	B1	U2	N3
C3	O3	C28	S4	C53	N4	JU3	C1	JU28	D2	P3	S4	R3	H1	R28	E1	R53	D1	R78	D1	TP3	I2	U3	R3
C4	J1	C29	Q3	C54	G2	JU4	H1	JU29	B2	P4	R4	R4	J1	R29	S3	R54	C1	R79	C2	TP4	J1	U4	T3
C5	J2	C30	I1	C55	A2	JU5	G1	JU30	N/A	P5	Q3	R5	I2	R30	J2	R55	B2	R80	A1	TP5	C1	U5	R3
C6	A2	C31	R4	C56	B2	JU6	A2	JU31	B1	P6	T4	R6	J2	R31	M3	R56	J1	R81	C1	TP6	G2	U6	S3
C7	L4	C32	M4			JU7	A1	JU32	A2	P7	Q4	R7	H2	R32	C1	R57	G2	R82	G2	TP7	D2		
C8	J2	C33	S4			JU8	A2	JU33	G2	P8	T3	R8	E2	R33	H1	R58	B1	R83	S3	TP8	D1		
C9	I1	C34	S3	FB1	K4	JU9	F2	JU34	D2	P9	A3	R9	E2	R34	D1	R59	I1	R84	E1	TP9	C1		
C10	G2	C35	I1			JU10	F1	JU35	D2	P10	A3	R10	H2	R35	A1	R60	H1	R85	C1	TP10	D1		
C11	N/A	C36	E2			JU11	I1	JU36	J2	P11	B1	R11	G2	R36	T3	R61	H1	R86	D1	TP11	I1		
C12	C1	C37	P4			JU12	F1	JU37	D2	P12	A1	R12	A1	R37	C2	R62	J1	R87	M4	TP12	G1		
C13	K4	C38	O4			JU13	F1	JU38	C1			R13	F1	R38	N3	R63	N3	R88	E2	TP13	H2		
C14	F1	C39	G1			JU14	G2	JU39	D1			R14	O3	R39	I1	R64	I2	R89	D1	TP14	C1		
C15	L4	C40	T4			JU15	F1	JU40	N/A	Q1	C2	R15	F1	R40	F2	R65	G2						
C16	M4	C41	D1			JU16	G1	JU41	C1			R16	E1	R41	I1	R66	A2						
C17	E1	C42	M4			JU17	I2	JU42	H2			R17	D2	R42	R3	R67	A2						
C18	F2	C43	E1			JU18	B2	JU43	D2			R18	E2	R43	G1	R68	A2						
C19	H2	C44	E1			JU19	B1	JU44	B2			R19	Q4	R44	D1	R69	A1						
C20	G2	C45	B1			JU20	H1	JU45	B2			R20	E1	R45	D1	R70	H2						
C21	A1	C46	T4			JU21	C2					R21	B2	R46	F2	R71	G1						
C22	H2	C47	T4			JU22	A1					R22	A2	R47	G1	R72	B1						
C23	E1	C48	P3			JU23	D1					R23	C1	R48	O3	R73	I2						
C24	C1	C49	D2			JU24	E2					R24	C1	R49	G1	R74	I2						
C25	H1	C50	P3			JU25	B1					R25	D2	R50	B1	R75	C2						

BOTTOM SIDE



- JUMPERS INSTALLED

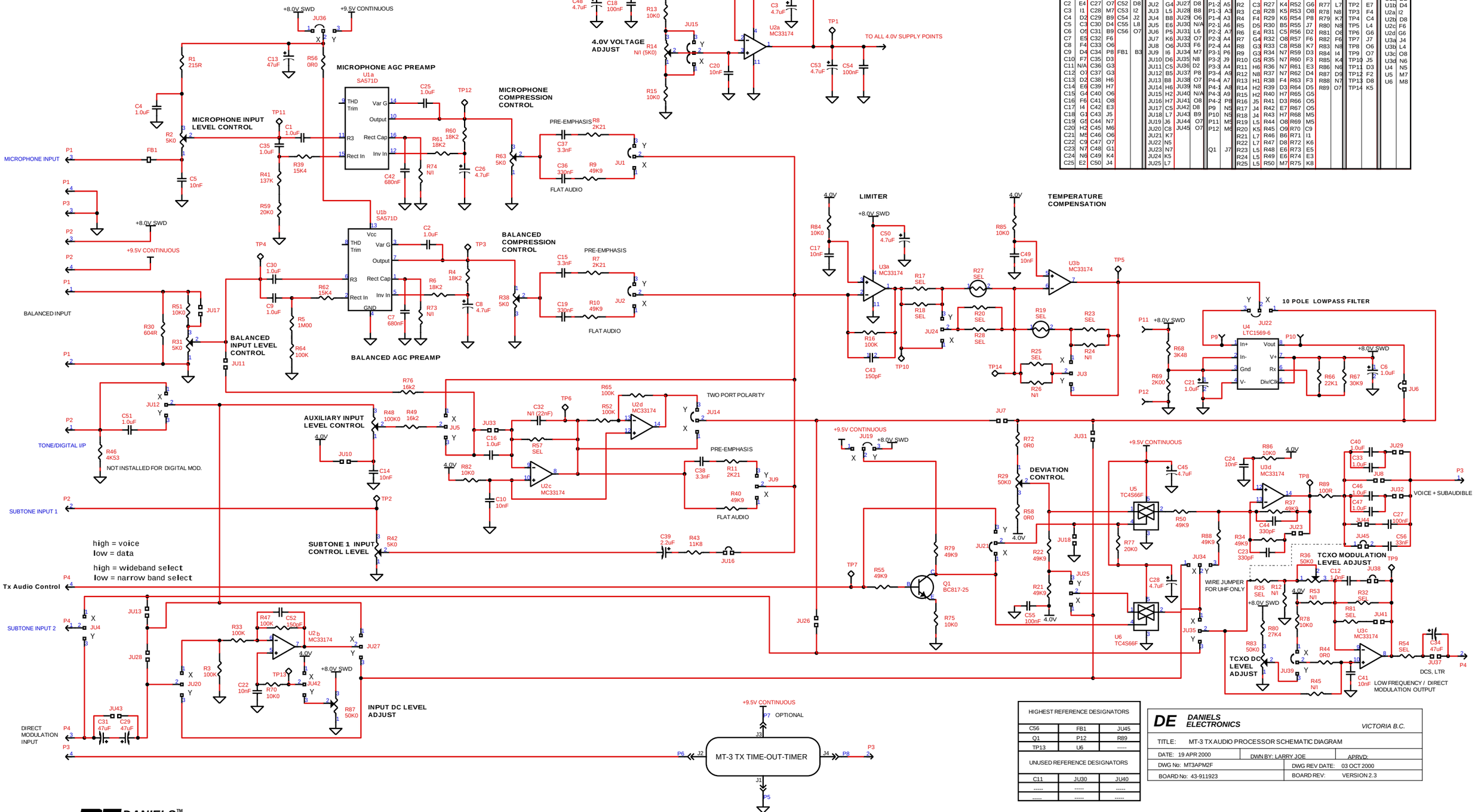
TOP SIDE



MT3APM1F

PCB 43-911923

7.3 FM Audio Processor Schematic Diagram V2.3



COMPONENT LOCATION TABLE

DES	LOC	DES	LOC	DES	LOC
C1	D3	C26	F3	C51	B6
C2	E4	C27	O7	C52	D8
C3	I1	C28	M7	C53	I2
C4	D2	C29	B9	C54	J2
C5	C3	C30	D4	C55	L8
C6	O6	C31	B9	C56	O7
C7	E5	C32	F6		
C8	F4	C33	O6		
C9	D4	C34	P8	FB1	B3
C10	F7	C35	D3		
C11	N/A	C36	G3		
C12	O3	C37	G3		
C13	D2	C38	H6		
C14	E6	C39	H7		
C15	G4	C40	O6		
C16	F6	C41	O8		
C17	I4	C42	E3		
C18	G1	C43	J5		
C19	G5	C44	N7		
C20	H2	C45	M6		
C21	M5	C46	O6		
C22	C9	C47	O7		
C23	N7	C48	G1		
C24	N6	C49	K4		
C25	E2	C50	J4		

DES	LOC	DES	LOC
JU1	G3	JU26	I8
JU2	G4	JU27	D8
JU3	L5	JU28	B8
JU4	B8	JU29	O6
JU5	E6	JU30	N/A
JU6	P5	JU31	L6
JU7	K6	JU32	O7
JU8	O6	JU33	F6
JU9	I6	JU34	M7
JU10	D6	JU35	N8
JU11	C5	JU36	D2
JU12	B5	JU37	P8
JU13	B8	JU38	O7
JU14	B8	JU39	N8
JU15	H2	JU40	N/A
JU16	H7	JU41	O8
JU17	C5	JU42	D8
JU18	L7	JU43	B9
JU19	J6	JU44	O7
JU20	C8	JU45	O7
JU21	K7		
JU22	N5		
JU23	N7		
JU24	K5		
JU25	L7		

DES	LOC	DES	LOC
P1-1	A4		
P1-2	A5		
P1-3	A3		
P1-4	A3		
P2-1	A6		
P2-2	A7		
P2-3	A4		
P2-4	A4		
P3-1	P6		
P3-2	J9		
P3-3	A4		
P3-4	A5		
P4-4	A7		
P4-1	A8		
P4-3	A9		
P4-2	P8		
P9	N5		
P10	N5		
P11	M5		
P12	M6		
Q1	J7		

DES	LOC	DES	LOC	DES	LOC
R1	C2	R26	L5	R51	C4
R2	C3	R27	K4	R52	G6
R3	C8	R28	K5	R53	O8
R4	F4	R29	K6	R54	P8
R5	D5	R30	B5	R55	J7
R6	E4	R31	C5	R56	D2
R7	G4	R32	O8	R57	F6
R8	G3	R33	C8	R58	K7
R9	G3	R34	N7	R59	D3
R10	G5	R35	N7	R60	F3
R11	H6	R36	N7	R61	E3
R12	N8	R37	N7	R62	D4
R13	H1	R38	F4	R63	F3
R14	H2	R39	D3	R64	D5
R15	H2	R40	H7	R65	G5
R16	J5	R41	D3	R66	O5
R17	J4	R42	E7	R67	O5
R18	J4	R43	H7	R68	M5
R19	L5	R44	O8	R69	M5
R20	K5	R45	O9	R70	C9
R21	L7	R46	B6	R71	I1
R22	L7	R47	D8	R72	K6
R23	L5	R48	E6	R73	E5
R24	L5	R49	E6	R74	E3
R25	L5	R50	M7	R75	K8

DES	LOC	DES	LOC	DES	LOC
R76	E5				
R77	L7				
R78	N8				
R79	K7				
R80	O7				
R81	O8				
R82	F6				
R83	N7				
R84	I4				
R85	K4				
R86	N7				
R87	D9				
R88	N7				
R89	O7				

DES	LOC
TP1	I2
TP2	E7
TP3	F4
TP4	C4
TP5	F6
TP6	G6
TP7	J7
TP8	L4
TP9	O6
TP10	O7
TP11	D3
TP12	F2
TP13	D8
TP14	K5

DES	LOC
U1a	D2
U1b	D4
U2a	I2
U2b	D8
U2c	F6
U2d	G6
U3a	J4
U3b	L4
U3c	O8
U3d	N6
U4	N5
U5	M7
U6	M8

HIGHEST REFERENCE DESIGNATORS		
C56	FB1	JU45
Q1	P12	R89
TP13	U6	-----
UNUSED REFERENCE DESIGNATORS		
C11	JU30	JU40
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DE DANIELS ELECTRONICS — VICTORIA B.C.

TITLE: MT-3 TX AUDIO PROCESSOR SCHEMATIC DIAGRAM		
DATE: 19 APR 2000	DWN BY: LARRY JOE	APRVD:
DWG No: MT3APM2F	DWG REV DATE:	03 OCT 2000
BOARD No: 43-911923	BOARD REV:	VERSION 2.3

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8 FM AUDIO PROCESSOR PARTS LIST

Ref Desig	Description	Part No.
C1	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C2	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C3	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C4	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C5	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C6	CAP., SM, 1.0uF TANT., 20%, 16V	1055-5A105M16
C7	CAP., SM, 680nF CER, 1206, X7R, 16V	1008-5B684M4R
C8	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C9	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C10	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C12	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R
C13	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16
C14	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C15	CAP., 3.3nF FILM, MMK5, 10%, 63V	1016-3A332K63
C16	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C17	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C18	CAP., SM, 100nF CER., 0805, X7R,	1008-5A104K5R
C19	CAP., SM, 330nF CER, 0805, X7R, 16V	1008-5A334M4R
C20	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C21	CAP., SM, 1.0uF TANT., 20%, 16V	1055-5A105M16
C22	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C23	CAP., SM, 330pF CER., 0805, X7R, 50V	1008-2A331J1G
C24	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C25	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C26	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C27	CAP., SM, 100nF CER., 0805, X7R,	1008-5A104K5R
C28	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C29	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16
C30	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C31	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16
C32	CAP., N/I (22nF) FILM, MMK5, 10%,63V	1016-4A223K63
C33	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C34	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16
C35	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C36	CAP., SM, 330nF CER, 0805, X7R, 16V	1008-5A334M4R
C37	CAP., 3.3nF FILM, MMK5, 10%, 63V	1016-3A332K63
C38	CAP., 3.3nF FILM, MMK5, 10%, 63V	1016-3A332K63
C39	CAP., SM, 2.2uF TANT., 10%, 20V	1055-5B225K20
C40	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C41	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C42	CAP., SM, 680nF CER, 1206, X7R, 16V	1008-5B684M4R
C43	CAP., SM, 150pF CER., 0805,C0G	1008-2A151J1G
C44	CAP., SM, 330pF CER., 0805, X7R, 50V	1008-2A331J1G
C45	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C46	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C47	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C48	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C49	CAP., SM, 10nF CER,0805,X7R,50V	1008-4A103K5R
C50	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C51	CAP., SM, 1.0uF CER, 1206, X7R, 16V	1008-6B105Z4R
C52	CAP., SM, 150pF CER., 0805,C0G	1008-2A151J1G
C53	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C54	CAP., SM, 100nF CER., 0805, X7R,	1008-5A104K5R
C55	CAP., SM, 100nF CER., 0805, X7R,	1008-5A104K5R

Ref Desig	Description	Part No.
C56	CAP., SM, 33nF CER, 0805, X7R, 50V	1008-4A333K5R
FB1	FERRITE BEAD, SM, 43MIX,.18x.12	1213-43181200
P1	HEADER 0.1", R/A, 2 ROW X 2PIN	5010-H202RA9T
P2	HEADER 0.1", R/A, 2 ROW X 2PIN	5010-H202RA9T
P3	HEADER 0.1", R/A, 2 ROW X 2PIN	5010-H202RA9T
P4	HEADER 0.1", R/A, 2 ROW X 2PIN	5010-H202RA9T
Q1	TRANSISTOR, BC817-25 NPN,SOT23	2120-BC817025
R1	RES., SM, 215R 0805, 1%, 100ppm	1150-2A2150FP
R2	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R3	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP
R4	RES., SM, 18K2 0805, 1%, 100ppm	1150-4A1822FP
R5	RES., SM, 1M00 0805, 1%, 100ppm	1150-6A1004FP
R6	RES., SM, 18K2 0805, 1%, 100ppm	1150-4A1822FP
R7	RES., SM, 2K21 0805, 1%, 100ppm	1150-3A2211FP
R8	RES., SM, 2K21 0805, 1%, 100ppm	1150-3A2211FP
R9	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R10	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R11	RES., SM, 2K21 0805, 1%, 100ppm	1150-3A2211FP
R12	RES., SM, N/I 0805, 1%,100ppm	1150-NOTINST
R13	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R14	POT., SM, N/I (5K0) 4mm SQ, 11T,SIDE	1174-DM2502J0
R15	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R16	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP
R17	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R18	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R19	THERMISTOR, SEL NTC,10%,AXIAL	1180-4RDG103K
R20	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R21	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R22	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R23	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R24	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R25	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R26	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R27	THERMISTOR, SEL NTC,10%,AXIAL	1180-4RDG103K
R28	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R29	POT., SM, 50K0 4mm SQ, 50K, 11T,SIDE	1174-DM3503J0
R30	RES., SM, 604R 0805, 1%, 100ppm	1150-2A6040FP
R31	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R32	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R33	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP
R34	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R35	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R36	POT., SM, 50K0 4mm SQ, 50K, 11T,SIDE	1174-DM3503J0
R37	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R38	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R39	RES., SM, 15K4 0805, 1%, 100ppm	1150-4A1542FP
R40	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R41	RES., SM, 137K 0805, 1%, 100ppm	1150-5A1373FP
R42	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R43	RES., SM, 11K8 0805, 1%, 100ppm	1150-4A1182FP
R44	RES., SM, 0R0 0805, 1%, 100ppm	1150-0A0R0000
R45	RES., SM, N/I 0805, 1%,100ppm	1150-NOTINST
R46	RES., SM, 4K53 0805, 1%,100ppm	1150-3A4531FP
R47	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP

Ref Desig	Description	Part No.
R48	POT., SM, 100K0 4mm SQ, 100K,11T,SIDE	1174-DM4104J0
R49	RES., SM, 16k2 0805, 1%, 100ppm	1150-TBA
R50	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R51	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R52	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP
R53	RES., SM, N/I 0805, 1%,100ppm	1150-NOTINST
R54	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R55	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R56	RES., SM, 0R0 0805, 1%, 100ppm	1150-0A0R0000
R57	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R58	RES., SM, 0R0 0805, 1%, 100ppm	1150-0A0R0000
R59	RES., SM, 20K0 0805, 1%, 100ppm	1150-4A2002FP
R60	RES., SM, 18K2 0805, 1%, 100ppm	1150-4A1822FP
R61	RES., SM, 18K2 0805, 1%, 100ppm	1150-4A1822FP
R62	RES., SM, 15K4 0805, 1%, 100ppm	1150-4A1542FP
R63	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R64	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP
R65	RES., SM, 100K 0805, 1%, 100ppm	1150-5A1003FP
R66	RES., SM, 22K1 0805, 1%, 100ppm	1150-4A2212FP
R67	RES., SM, 30K9 0805, 1%, 100ppm	1150-4A3092FP
R68	RES., SM, 3K48 0805, 1%, 100ppm	1150-3A3481FP
R69	RES., SM, 2K00 0805, 1%, 100ppm	1150-3A2001FP
R70	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R71	RES., SM, 5K11 0805, 1%, 100ppm	1150-3A5111FP
R72	RES., SM, 0R0 0805, 1%, 100ppm	1150-0A0R0000
R73	RES., SM, N/I 0805, 1%,100ppm	1150-NOTINST
R74	RES., SM, N/I 0805, 1%,100ppm	1150-NOTINST
R75	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R76	RES., SM, 16k2 0805, 1%, 100ppm	1150-TBA
R77	RES., SM, 20K0 0805, 1%,100ppm	1150-4A2002FP
R78	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R79	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R80	RES., SM, 27K4 0805, 1%, 100ppm	1150-4A2742FP
R81	RES., SM, SEL 0805, 1%, 100ppm	1150-TBA
R82	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R83	POT., SM, 50K0 4mm SQ, 50K, 11T,SIDE	1174-DM3503J0
R84	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R85	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R86	RES., SM, 10K0 0805, 1%, 100ppm	1150-4A1002FP
R87	POT., SM, 50K0 4mm SQ, 50K, 11T,SIDE	1174-DM3503J0
R88	RES., SM, 49K9 0805, 1%, 100ppm	1150-4A4992FP
R89	RES., SM, 100R 0805, 1%, 100ppm	1150-2A1000FP
U1	IC, SA571D COMPANDOR, SO-16L	2327-SA571D00
U2	IC, MC33174 QUAD OP AMP,SO-14	2304-33174N14
U3	IC, MC33174 QUAD OP AMP,SO-14	2304-33174N14
U4	IC, LTC1569I, LPF, 10TH ORD, S0-8	2326-15696N08
U5	IC, TC4S66F BILATERAL SWITCH,SMV	2375-4S66FSMV
U6	IC, TC4S66F BILATERAL SWITCH,SMV	2375-4S66FSMV
PCB	PCB, FM AUDIO PROCESSOR, MT-3 TX	4321-30911923

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9 AM AUDIO PROCESSOR

9.1 Introduction

The MT-3 AM Transmitter Main Board integrates the MT-3 Front Panel Board, MT-3 AM Audio Processor, Synthesizer or Crystal Control module and Amplifier module together to make a working MT-3 AM series transmitter. The Front Panel Board and the Audio Processor are soldered directly to the Transmitter Main Board while the Amplifier and the Synthesizer or Crystal Control module are frequency band sensitive, plug-in modules. Circuitry and jumpers on the Transmitter Main Board control the operation of the modules as well as the overall operation of the MT-3 transmitter. Power and signal connections are made to the 48 pin type 'F' connector on the rear of the Transmitter Main Board and are routed to the other modules. The front and rear back plates are attached to the Transmitter Main Board and together with the extruded aluminum shell, as discussed in the assembly section of the Transmitter Manual, form the transmitter enclosure.

9.2 Performance Specifications

Type:	MT-3 AM Series Transmitter
Compatibility:	VT-3A Series Amplifier, OCT-3 Crystal Oscillator, OST-3 Frequency Synthesizer.
Modulation:	6K00A3 (Amplitude Modulation)
Operating Temperature Range:	-30˚C to +60˚C, optional - 40˚C temperature test.
Operating Humidity:	95% RH (non-condensing) at +25˚C.
Operating Voltage:	+13.8Vdc , +9.5 Vdc Regulated.
Front Panel Control:	One 3 position switch • NORM (repeat mode) • OFF • KEY TX
PTT Activation:	• Active to ground with or without time-out-timer; • Microphone activated with or without time-out-timer; • Front Panel switch: KEY TX - without time-out-timer; • NORM - with or without time-out-timer. • Isolated (optional relay) with or without time-out-timer.
PTT Time-Out-Timer:	Selectable from 1 sec. to 8 hrs. (factory set 5 min.).

9.3 Audio Specifications

Audio Input:	-30 to 0 dBm into a 600Ω balanced load.
Audio Response:	Flat audio; +1/-3 dB: 300 Hz - 3 kHz
Audio Distortion:	Less than 3% -40˚C to +60˚C at 30% modulation,
	Less than 5% -40˚C to +60˚C at 90% modulation

9.4 Audio Circuits

All of the audio signal conditioning (e.g. limiting, filtering) is performed by the MT-3 AM Audio Processor. The transmitter board routes the audio lines from the backplane connector to the audio processor. The audio lines routed to the audio processor are: a 600 ohm balanced input (pins B18 and Z18), and a MIC AUDIO from the MT-3 FRONT PANEL BOARD. It is here that the MIC audio is processed in the same manner as the 600 ohm balanced audio. The audio processor's balanced input pins are isolated from pins B18 and Z18 by a transformer (T1). Two audio outputs from the MT-3 AM Audio Processor are routed to the VT-3A130 Amplifier.

The MT-3 AM Audio Processor is a versatile circuitboard that can provide several types of audio processing. The module also has an on-board programmable push-to-talk (PTT) time-out-timer (TOT) on an attached circuitboard. A continuous +9.5 Vdc supply and a continuous +13.8 Vdc supply together with a switched +8.0 Vdc supply are required to power the module. Refer to section 9.11 "MT-3 AM Audio Processor Component Layout" and to section 9.12 "MT-3 AM Audio Processor Schematic Diagram" for component location and designation references.

9.5 Power Requirements

The audio processor can be configured for continuous audio standby or for switched audio standby by the Transmitter Main Board. If fast audio risetime is desired, the transmitter should be operated in standby mode 3 or 4 as specified below. The current for the associated TOT is approximately 4 mA when the transmitter is keyed.

9.6 Transmitter Standby Modes

The VT-3A130 Transmitter has four different standby modes that trade-off standby current consumption for start-up speed. The standby modes are determined by three jumpers: jumper J6 which always turns on the '+9.5 Vdc Switched' supply, jumper J7 which selects the power source for the MT-3 AM Audio Processor and jumper J18 which selects the enable line for the OST-3A128 Synthesizer Module.

The actual current and start-up time may depend on the frequncy controlled source (crystal or synthesizer) and amplifier module. The current and start-up times given below are representative values intended only as a guideline.

MODE 1: Jumper J6 out
- the audio processor is switched by a PTT signal
- the synthesizer is switched by a PTT signal
- standby current typically 13 mA
- start-up time typically 40 ms

MODE 2: Jumper J6 in, jumper J7 in the 'y' position, jumper J18 in the 'x' position
- the audio processor is switched by a PTT signal
- the synthesizer is enabled all of the time
- standby current not used in this mode
- start-up time not used in this mode

MODE 3: Jumper J6 in, jumper J7 in the 'x' position, jumper J18 in the 'y' position
- the audio processor is enabled all of the time
- the synthesizer is switched by a PTT signal
- standby current typically 19 mA
- start-up time typically 40 ms

MODE 4: Jumper J6 in, jumper J7 in the 'x' position, jumper J18 in the 'x' position
- the audio processor is enabled all of the time
-the synthesizer is enabled all of the time
-standby current typically 163 mA
-start-up time typically 12 ms

9.7 Audio Circuitry

The MT-3 AM Tx Audio Processor refer to section 9.12 "MT-3 AM Audio Processor Schematic Diagram" has two audio inputs (Microphone input and Balanced input) which can be used to modulate the transmitter. The input signals are combined by R2 and R17 at a compandor U1. U1b controls the input level and makes gain inversely proportional to the input level (say a 20 dB drop in input level will produced a 20 dB increase in gain). The output will remain fixed at a constant level without clipping and distortion. (Automatic Level Control) The input signals are adjusted by the pots R1, R16. The variable gain cell in U1a is used as a voltage-controlled amplifier so that if the power supply (13.8Vdc) has changed the output level will change in order to keep the modulation of the RF output signal at the same level. The gain control can be adjust by the pot R4. (Automatic Modulation Control) The audio signal then amplifies and filters at U2. The output signal is adjusted by the pot R14.

9.8 AM Audio Processor Factory Configuration

The MT-3 AM Transmitter Audio Processor is factory configured as follows:

- Microphone Input: 1kHz tone at -10 dBm gives 50% maximum modulations.
- Audio Balanced Input: 1 kHz tone at -8 dBm gives 90% maximum modulations.
- Automatic Modulation Control enabled
- Automatic Level Control enabled

The corresponding jumper settings are:

- Jumper JU1: 'x' position Automatic Modulation Control disabled
- Jumper JU2: not installed Modulation configuration
- Jumper JU3: 'y' position Automatic Level Control enabled
- Jumper JU4: not installed Time-out-time power supply (optional)
- Jumper JU5: 'y' position Voice application
- Jumper JU6: 'y' position Voice application
- Jumper JU7: not installed Modulation configuration
- Jumper JU8: 'y' position Automatic Level Control enabled
- Jumper JU9: installed Power AMC and Microphone enabled

9.9 AM Audio Processor Alignment

Verify the standard factory settings for the MT-3 AM Audio Processor as given in section 9.8 before beginning the standard modulation adjustment procedure. If the transmitter's channel frequency changes, the audio processor should be realigned to optimize the transmitter's performance. The schematic diagram for the audio processor is shown in section 9.12 and the component layout is shown in section 9.11.

*Note: clockwise rotation of controls increases signal levels

1 Before adjusting the audio board, confirm that the transmitter frequency is correct.
2 Unscrew and slide out the case of the transmitter. Locate the Tx Audio Board.
3 Connect the transmitter RF Output to a Radio communications test set.
4 Connect the 600 ohm input to the incoming audio (pins B18, Z18). Set the audio frequency to 1 kHz at the desired level of -8 dBm.
5 Turn the transmitter on.
6 Adjust the pot R16, in order to achieve about 0.700 Vrms at TP4.
7 Adjust the pot R14, in order to achieve about 0.200 Vrms at TP8.
8 Tune the Audio Adjust pot R35 on the Power Amplifier board to obtain 90% modulation.
9 Apply a 1 kHz, -20 dBm input signal and adjust the pot R16 in order to obtain 30% modulation.

10 Apply a 1 kHz, -8 dBm input signal, the modulation should be 90%, observe that the distortion of the transmitted signal is within 5.0%.
11 Slowly increase the input audio signal level to 5 dBm and observe that the modulation does not go over 100%. This step verifies the correct operation of the ALC .
12 Change 13.8Vdc power supply to 10V and then to 17V, the modulation of the output RF signal should remain at the same level of 90% ±7% and distortion should be less then 3%. This step verifies the correct operation of the power regulator on the transmitter amplifier board.
13 Repeat steps 7 and 9 if required.
14 Supply a 1 kHz, -10 dBm signal to the microphone input. (Note the level restriction of -25 dBm to 0 dBm.)
15 Adjust the Microphone Input Level Adjust pot (R1) to achieve 50% of RF signal modulation. Observe that the distortion should be under 5%.
16 Turn off the transmitter. Remove the signal source and replace all the screws.

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9.10 AM Audio Processor Electrical Parts List

Ref Design	Description	Part No.
C1	CAP., SM, 4.7nF CER., 1206, X7R	1008-3B472K5R
C2	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63
C3	CAP., SM, 680nF TANT., 10%, 35V	1055-4B684K35
C5	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63
C6	CAP., SM, 100nF CER., 0805, X7R, 50	1008-5A104K5R
C7	CAP., SM, 10nF CER., 0805, X7R	1008-4B103K5R
C8	CAP., SM, 680nF TANT., 10%, 35V	1055-4B684K35
C9	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C10	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63
C11	CAP., SM, 2.2uF TANT., 20%, 20V	1055-5B225K20
C12	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C13	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R
C14	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R
C15	CAP., 4.7nF FILM, MMK5, 10%, 63V	1016-3A472K63
C16	CAP., 2.2nF FILM, MMK5, 10%, 63V	1016-3A222K63
C17	CAP., SM, 330pF CER., 0805,C0G	1008-2A331J1G
C18	CAP., SM, 220pF CER., 0805,C0G	1008-2A221J1G
C19	CAP., SM, 1.0uF TANT., 20%, 35V	1055-5B105M35
C20	CAP., SM, 220pF CER., 0805,C0G	1008-2A221J1G
C21	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16
C22	CAP., SM, 680pF CER., 1206,C0G	1008-2B681J1G
C23	CAP., SM, 220pF CER., 0805,C0G	1008-2A221J1G
C25	CAP., SM, 150pF CER., 0805,C0G	1008-2A151J1G
D1	DIODE, 1N5221B ZENER 3.9V,DO35	2002-1N5221B0
D2	DIODE, 1N5221B ZENER 3.9V,DO35	2002-1N5221B0
FB1	FERRITE BEAD, SM,FERRITE BEAD 43MIX,.18x.12	1213-43181200
P1-P5	HEADER 01", R/A, 2 ROW X 2PIN	5010-H202RA9T
PCB	AUDIO PROCESSOR, VT-3A130	4322-30500494

Ref Design	Description	Part No.
R1	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R2	RES., SM, 20K0 0805, 1%,100ppm	1150-4A2002FP
R3	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP
R4	POT., SM, 50K0 4mm SQ, 50K, 11T,SIDE	1174-DM3503J0
R5	RES., SM, 30K9 0805, 1%,100ppm	1150-4A3092FP
R6	RES., SM, 100K0 0805, 1%,100ppm	1150-5A1003FP
R7	TEMPSISTOR, 1K2 PTC, 10%,AXIAL	1181-3AGD122K
R8	RES., SM, 4K75 0805, 1%,100ppm	1150-3A4751FP
R9	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP
R10	RES., SM, 27K4 0805, 1%,100ppm	1150-4A2742FP
R11	RES., SM, 27K4 0805, 1%,100ppm	1150-4A2742FP
R13	RES., SM, 18K2 0805, 1%,100ppm	1150-4A1822FP
R14	POT., SM, 100K0 4mm SQ, 100K,11T,SIDE	1174-DM4104J0
R15	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP
R16	POT., SM, 5K0 4mm SQ, 11T,SIDE	1174-DM2502J0
R17	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP
R18	RES., SM, 470K0 0805, 1%,100ppm	1150-5A4703FP
R19	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP
R20	RES., SM, 39K2 0805, 1%,100ppm	1150-4A3922FP
R22	RES., SM, 3K48 0805, 1%,100ppm	1150-3A3481FP
R23	RES., SM, 51K1 0805, 1%,100ppm	1150-4A5112FP
R24	RES., SM, 15K4 0805, 1%,100ppm	1150-4A1542FP
R25	RES., SM, 82K5 1206, 1%,100ppm	1150-4B8252FP
R26	RES., SM, 3M30 0805, 5%,200ppm	1150-6A3304JL
R27	RES., SM, 681R0 0805, 1%,100ppm	1150-2A6810FP
R28	RES., SM, 82K5 1206, 1%,100ppm	1150-4B8252FP
R29	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP
R30	RES., SM, 47K5 0805, 1%,100ppm	1150-4A4752FP
R31	RES., SM, 15K4 0805, 1%,100ppm	1150-4A1542FP
R32	RES., SM, 51K1 0805, 1%,100ppm	1150-4A5112FP
U1	IC, SA571D COMPANDOR, SO-16L	2327-SA571D00
U2	IC, MC33174 QUAD OP AMP,SO-14	2304-33174N14

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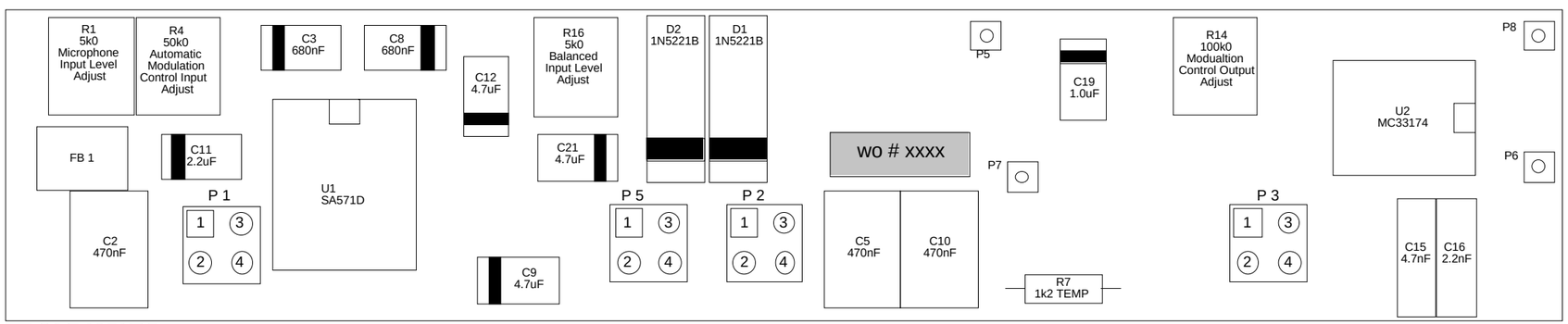
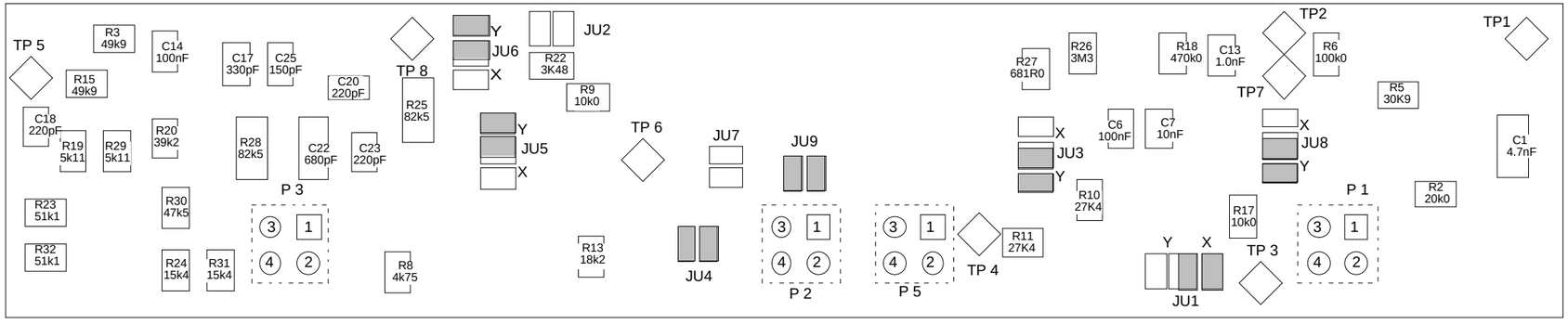
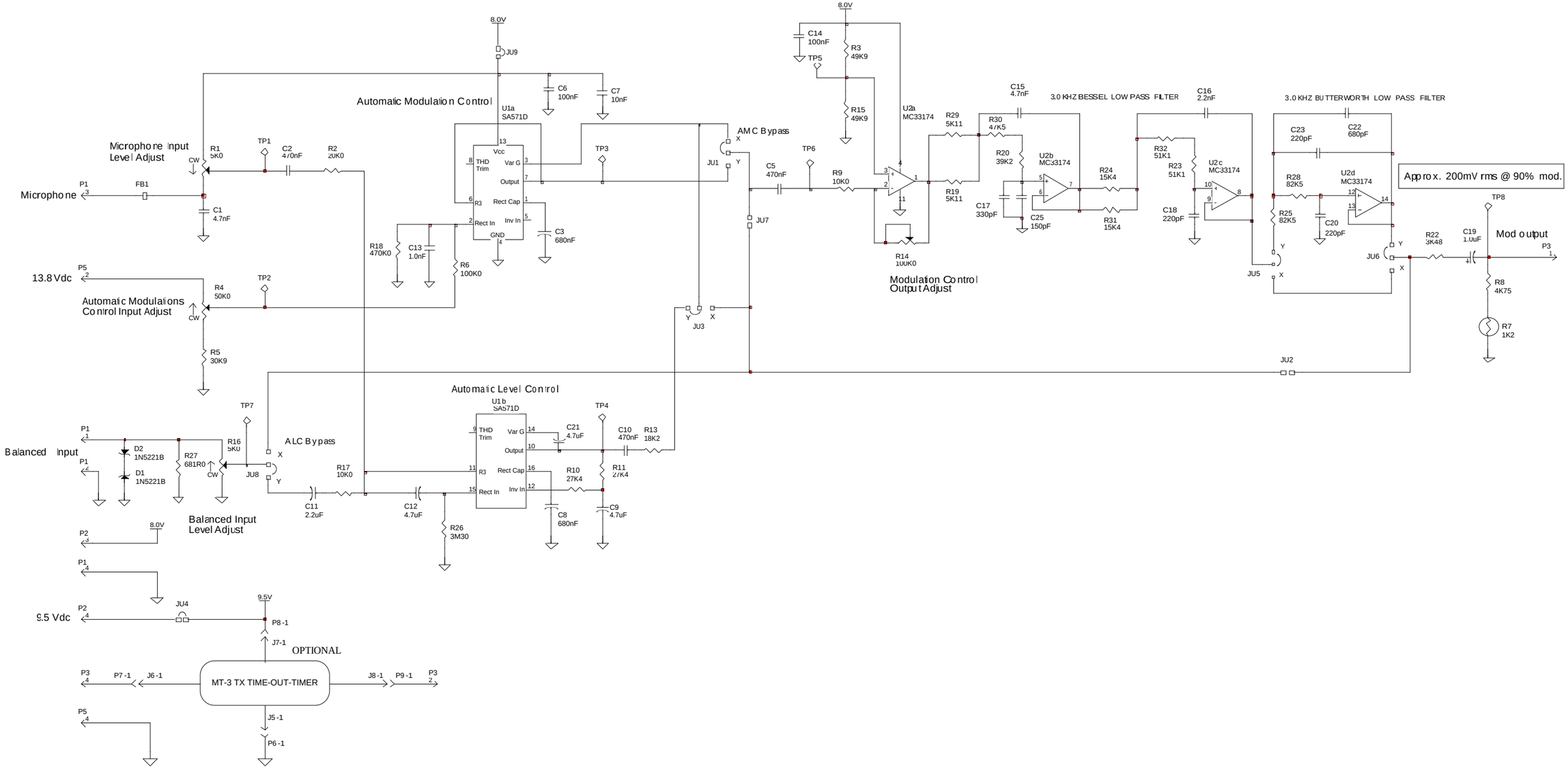
9.11 AM Audio Processor Component Layout





9.12 AM Audio Processor Schematic Diagram



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10 REVISION HISTORY

ISSUE	DATE	REVISION
1	Oct 2000	First Issue.
2	Nov 2000	Second Issue Incorporated the AM Audio Processor documentation into this manual. For specific AM revision history, see manual IM22-MT3AMTXMN-4IM

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DANIELS ELECTRONICS LTD. ®

MT-3 RADIO SYSTEMS

VHF AMPLIFIER INSTRUCTION MANUAL

VT-3

132 - 174 MHz

Covers models:
VT-3/150 Amplifier

Issue:	1	Previous Issue:	N/A	
Issue Date:	May 1998	Previous Issue Date:	N/A	Daniels Electronics Ltd.
Printing Date:	January 2001			Victoria, B.C.
Part No.:	IM21-VT3150AMP			PRINTED IN CANADA

Reviewed By:

Quality Assurance:		
Larry Freeman		12 May 98
Name	Signature	Date

NOTE:

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. This equipment may incorporate minor changes in detail from the information contained in this manual.

TABLE OF CONTENTS

RF Exposure Warning

This transmitting equipment conforms to SAR (Specific Absorption Rate) limits regarding exposure of human beings to radio frequency electromagnetic energy, as defined in the following national and international standards and guidelines:

1. Industry Canada Radio Standards Specification 102 (RSS-102), *Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields*;

2. Health Canada Safety Code 6, *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz*[1];

3. United States Federal Communications Commission, Code of Federal Regulations; 47 CFR Part 1, § 1.1310 *Radiofrequency radiation exposure limits*; and

4. American National Standards Institute (ANSI) criteria for localized SAR in Section 4.2 of "*IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*"[2].

Notes: A. The SAR limit for uncontrolled exposure of persons not classed as RF and microwave exposed workers (including the general public) for transmitter equipment operating below 10 GHz, as defined in the references above, is 2 W/m^2 (0.2 mW/cm^2).

B. This transmitting equipment is designed for use with an outdoor antenna with a characteristic antenna gain of 10 dBi, typically mounted at a significant height above ground to provide for adequate signal coverage. To ensure that the general public is not exposed to a power density above the recommended limit of 2 W/m^2 (0.2 mW/cm^2), the equipment must be installed such that the following minimum safe distances from the antenna are maintained:

6.3 m (20.7 ft)	when configured with	100 W PA
3.5 m (11.3 ft)	when configured with	30 W PA
1.8 m (5.9 ft)	standalone (i.e. no PA)	8 W

C. The following power density formula has been utilized in determining minimum safe distances:

$$S = \frac{PG}{4\pi R^2}$$

where: S = Power density (in appropriate units, e.g. mW/cm^2)
P = Power input to the Antenna (in appropriate units, e.g., mW)
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = Distance to the center of radiation of the antenna (appropriate units, e.g., cm)

[1] Minister of Public Works and Government Services, Canada 1999, Cat. H46- 2/ 99- 237E, ISBN 0- 662- 28032- 6
[2] ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017

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1 GENERAL

1.1 Introduction

The VT-3/150 Amplifier provides the final stage of RF amplification and filtering for the entire VHF Transmitter VT-3 132 - 174 MHz family. The amplifier has two distinct frequency ranges: 132 to 150 MHz, and 150 to 174 MHz with continuously adjustable 2.0 to 8.0 Watts output power. The VT-3/150 Amplifier is housed in a machined aluminum case that ensures optimum RF shielding, provides a good ground, and also acts as a heatsink.

Additionally, the VT-3/150 Amplifier is equipped with output power and VSWR sensing lines which can be individually configured as open collector or linear outputs. The internal VSWR sensor protects the amplifier from high antenna VSWR by approximately halving the amplifier's RF gain when a VSWR overload condition is present.

Output filtering for the VT-3/150 Amplifier is provided by the VT-3/150 Lowpass Filter Board. The lowpass filter assembly is mounted in a separate compartment of the amplifier case in order to provided maximum attenuation of harmonic and other spurious signals.

Refer to Section 4 for the VT-3 132 - 174 MHz VHF amplifier and lowpass filter component layouts and schematic diagrams

1.2 Performance Specification

Type:	MT-3 series VHF Amplifier module.
Compatibility:	MT-3 series Transmitter Main Board.
Frequency Range:	132 MHz to 150 MHz or 150 MHz to 174 MHz.
RF Power Output:	adjustable 2.0 to 8.0 Watts
RF power Input:	nominal level adjustable from +4 dBm to +10 dBm, held within +/- 2 dB of nominal.
Ouput Impedance and VSWR:	50 Ω, Type N connector; 3:1 max. VSWR.
Input /Output Isolation:	> 60 dB
Duty Cycle:	100%: Continuous operation from -40˚ C to +60˚C.
Harmonic Emissions:	Less than -80 dB_C .

Transmitter Mismatch Protection:	20:1 VSWR at all phase angles.
Transmitter Alarm:	Forward power sense and reverse VSWR; - open collector output (separate or 'OR'ed configuration); -linear output (separate lines only).
Operating Temperature Range:	-30˚ C to +60˚ C, optional -40˚ C temperature test.
Operating Humidity:	95% RH (non-condensing) at +25˚ C.
Operating Voltage:	+13.8 Vdc Nominal (range +11 to +16 Vdc), +9.5 Vdc Regulated.
Transmit Current:	0.7 Amp typical; 1.1 Amp maximum
Amplifier Standby Current:	less than 0.5 mA.
Amplifier Enable:	Active to ground.
Amplifier Enable Response:	typically overdamped, rising to within 90% of full power within 5 msec; maximum (underdamped) overshoot of 30%.

2 THEORY OF OPERATION

2.1 Amplifier Operation

A power control circuit monitors the RF output power of amplifier U4 and keeps the power constant. The output power from the high power amplifier will change as the unregulated +13.8 Vdc supply varies. Note that the frequency band does not change how the amplifier operates; it only changes a few component values in the RF circuitry.

Power for the VT-3/150 Amplifier is provided from the MT-3 Transmitter Board. The +13.8 Vdc supply (if required) is continuously connected to the amplifier; whereas, the +9.5 Vdc supply is always switched by the transmitter's PTT circuitry. The VT-3/150 Amplifier will not use any power from the +13.8 Vdc supply until the amplifier's +9.5 Vdc line is switched on and an RF input signal is present. The synthesizer or crystal control module controls the +9.5 Vdc to the amplifier's circuitry; switching it on by grounding the amplifier's input enable line. The synthesizer or crystal control module will ground the input enable line only when the RF signal from the synthesizer or crystal control module is phase locked. This prevents unwanted spurious emissions during transmitter start-up. A typical start-up sequence is shown below:

1) the transmitter is keyed on (+13.8 Vdc is always present)
2) +9.5 Vdc is switched on by the PTT circuitry and the synthesizer or crystal control module PTT line is pulled low
3) an RF signal is output to the amplifier
4) the amplifier's input enable line is activated
5) the amplifier outputs RF power

2.2 Power Requirements

Typical current requirements for the VT-3/150 Amplifier at different power levels are given in the Table 2-3 below. The current drawn from the +9.5 Vdc supply should never exceed 1.2 Amps and the current drawn from the +13.8 Vdc supply should never exceed 1.5 Amps.

Table 2-1 VT-3/150 Amplifier Current Consumption

Output Power	+9.5 Vdc Supply Current	+13.8 Vdc Supply Current
2.0 W	0.64 A	0.51 A
4.0 W	0.79 A	0.75 A
6.0 W	0.89 A	0.93 A
8.0 W	1.04 A	1.10 A

Note: Current consumption measured at 153 MHz

2.3 RF Circuitry

The RF circuitry consists of several blocks: a 7 dB input pad (R1, R2, and R3), an RF amplifier module (U4), an output power boosting transistor (Q7), three directional couplers (TL1, TL3, and TL4), and the VT-3/150 Lowpass Filter. The heart of the VT-3/150 Amplifier is RF amplifier module U4. The output of U4 is further amplified by Q1 to a maximum of 8.0 Watts at the antenna connector. The frequency band of the VT-3/150 Amplifier is determined by the operating frequency range of the RF amplifier module U4. Directional couplers (TL1, TL3, and TL4) are used to sample forward and reverse power. The sampled power is used by the sensing and power control circuits to control the amplifier's operation. The final step in the RF path is output filtering and, as mentioned earlier, this is done by the VT-3/150 Lowpass Filter.

2.3.1 VT-3/150 Lowpass Filter

The VT-3/150 Lowpass Filter is a 50 ohm, 9 pole, reciprocal filter with a 3 dB cutoff frequency of approximately 185 MHz. The lowpass filter assembly attenuates the desired signal's harmonics as well as any other out-of-band emissions so that a 'clean' RF signal is output to the antenna connector.

2.4 Power Control Circuitry

The VT-3/150 Amplifier employs a closed loop power control which uses a sample of the forward RF power to control the gain of RF amplifier U4. Op-amp U1b compares the sampled RF voltage to the output power setpoint and generates an error signal which Q3 uses to control the voltage on U4's gain control pin. The output power setpoint is determined by R7, the Output Power Adjust potentiometer.

The forward power is sampled by TL1, D5, C14, R13, L6, R12, and C15. The power control circuitry keeps the output power of U4 constant. Therefore the amplifier's output power will fluctuate with variations in the +13.8 Vdc supply voltage.

2.5 Power Sensing Circuitry

The VT-3/150 Amplifier is equipped with output power and VSWR sensing lines which can be individually configured as open collector or linear outputs. In open collector configuration, the output is active low, that is, when a fail condition is detected (not enough output power or too high antenna VSWR) the open collector transistor is turned on. In linear configuration, a voltage proportional to the sensed output power or antenna VSWR is output.

Both the Output Power Alarm setpoint and the VSWR Alarm setpoint are individually adjustable; however, the Output Power Alarm setpoint must always be adjusted before the VSWR Alarm setpoint. This is because the Output Power Alarm setpoint is used as a reference by the VSWR Alarm circuitry.

2.5.1 Output Power Sense

The output power sense circuitry uses directional coupler TL2 to sample some of the forward power. The sampled power is rectified by diode D6 and capacitor C20 and then amplified by op-amp U3b. Op-amp U3b's amplification is controlled by R21, the output power alarm adjust potentiometer. The amplified voltage is then output directly in linear operation (JU1 installed, JU2 not installed) or compared by op-amp U1a which then drives transistors Q4 and Q3 for open collector operation (JU1 not installed, JU2 installed).

In open collector configuration, Q3 (the open collector output transistor) is turned on when an alarm condition occurs. The adjustment range for the output power alarm can vary depending on the setting of R21 (the Output Power Alarm Adjust potentiometer).

2.5.2 VSWR Sense

The VSWR sense circuitry uses directional coupler TL3 to sample some of the power reflected from the antenna terminal. The reflected power is rectified by diode D7 and capacitor C25 and then amplified by op-amp U2b. Op-amp U2b's amplification is controlled by R36, the VSWR Alarm Adjust potentiometer. The amplified voltage is then output directly in linear operation (JU4 installed, JU3 not installed) or compared to the output power alarm setpoint by op-amp U3a which then drives transistor Q5 for open collector operation (JU4 not installed, JU3 installed).
In open collector configuration, Q5 (the open collector output transistor) is turned on when an alarm condition occurs. The adjustment range for the VSWR Alarm can depending on the setting of R36 (the VSWR Alarm Adjust potentiometer).

2.5.3 VSWR Overload

The VSWR overload circuit protects the VT-3/150 Amplifier from excessive antenna VSWR by reducing the amplifier's gain (output power) when an overload condition occurs. The VSWR overload circuit (R14, R37, R39, R40, U2a, and Q6) is an extension of the VSWR sense circuit and operates the same as the VSWR sense open collector circuit. The VSWR Overload Adjust potentiometer (R37) reduces the voltage level of the VSWR Alarm Setpoint. The voltage set by R37 is the compared to the output power alarm setpoint by op-amp U2a which then drives transistor Q6. When transistor Q6 turns on, signaling an overload condition, resistor R14 is grounded which reduces the output power setpoint. Reducing the output power setpoint lowers the VT-3/150 Amplifier's gain and protects the amplifiers from excessive current draw resulting from high antenna VSWR.

The VSWR overload circuit's range of adjustment depends on the setting of the VSWR Alarm Adjust potentiometer (R36). The VSWR overload transistor Q6 can be activated at the same point at which the VSWR alarm becomes active or the VSWR overload circuit can be disabled by turning R37 completely counterclockwise.

3 VT-3/150 AMPLIFIER ALIGNMENT

3.1 General

Connections to the power supply, alarm and transmit enable lines (ENA), are clearly marked on the amplifier case. The amplifier is enabled when the enable line (ENA) is grounded.
If the amplifier is installed in the transmitter, alignment is simplified by using an SR-3 Subrack, SM-3 System Monitor, and RF extender cable to provide transmitter power and signal interconnection (see the Transmitter Main Board Manual for details). For complete transmitter alignment, the Transmitter Main Board, Synthesizer, Amplifier, and Audio Processor should be tuned in the aforementioned order. Please refer the corresponding manuals for each module.

If the input RF level is not changed, adjustments to the output power and alarm thresholds may be made without removing the amplifier cover. However, in the case of a complete amplifier alignment, the amplifier should be separated from the Transmitter Main Board and the amplifier cover removed to expose all amplifier circuitry. All jumpers and test points are clearly marked.

3.2 Repair Note

The VT-3/150 Amplifier is mainly made up of surface mount devices which should not be removed or replaced using an ordinary soldering iron. Removal and replacement of surface mount components should be performed only with specifically designed surface mount rework and repair stations complete with ElectroStatic Dissipative (ESD) protection.

When removing Surface Mount Solder Jumpers, it is recommended to use solder braid in place of manual vacuum type desoldering tools when removing jumpers. This will help prevent damage to the circuitboards.

3.3 Recommended Test Equipment List

Alignment of the transmitter requires the following test equipment or its equivalent.

Dual Power Supply:	Regulated +9.5 Vdc at 0.1 A.
	Regulated +13.8 Vdc at 2 A - Topward TPS-4000
Oscilloscope / Multimeter:	Fluke 97 Scopemeter
Current Meter:	Fluke 75 multimeter
Radio communications test set :	Marconi Instruments 2955R
VSWR 3:1 mismatch load:	JFW 50T-035-3.0:1
coaxial test cable set	three 50 Ω cables of incremental length 20 to 40 cm
Alignment Tool:	Johanson 4192

It is recommended that the radio communications test set be frequency locked to an external reference (WWVH, GPS, Loran C) so that the high stability oscillator may be accurately set to within its ±1 ppm frequency tolerance.

3.4 Printed Circuitboard Numbering Convention

To ease troubleshooting and maintenance procedures, Daniels Electronics Limited has adopted a printed circuitboard (PCB) numbering convention in which the last two digits of the circuitboard number represent the circuitboard version. For example:

- PCB number 43-912010 indicates circuitboard version 1.0;
- PCB number 50002-02 indicates circuitboard version 2.0.

All PCB's manufactured by Daniels Electronics are identified by one of the above conventions.

3.5 Standard Factory Settings and Jumper Configuration

The VT-3/150 Amplifier is factory configured as follows:

- Open collector configuration for Output Power Alarm.
- Open collector configuration for Antenna VSWR Alarm.

The corresponding jumper settings are:

• Jumper JU1:	not installed	Output power alarm - linear output
• Jumper JU2:	installed	Output power alarm - open collector output
• Jumper JU3:	installed	Antenna VSWR alarm - open collector output
• Jumper JU4:	not installed	Antenna VSWR alarm - linear output

3.6 VT-3/150 Amplifier Alignment

3.6.1 General

The VT-3/150 Amplifier is a frequency sensitive module that is factory assembled to operate in one of two frequency bands: 132 to 150 MHz or 150 to 174 MHz. The amplifier requires 7 dBm of input power and is continuously adjustable over the its power range of 2.0 to 8.0 Watts. The VT-3/150 Amplifier provides Output Power and Antenna VSWR Alarm outputs which can be configured for open collector output or linear operation. The amplifier's output power level and alarm levels can be set without detaching the amplifier from the transmitter board. However, to change the configuration of the output power alarm or the Antenna VSWR alarm, the VT-3/150 Amplifier must be detached from the MT-3 Transmitter Board. Refer to page 4-2 "VT-3/150 VHF Amplifier Component Layout" for the location of solder jumpers JU1 to JU4.

3.6.2 VT-3/150 Amplifier Adjustment

The Amplifier alignment consists of two adjustment procedures; (i) a general set up (section 3.6.2.1) procedure which sets up the proper bias conditions for the RF transistors and (ii) the RF threshold adjustments which set up the desired alarm threshold levels as well as the RF output power. The general alignment procedure is required following major repair operations, changes in RF input levels or large changes in operating frequency (greater than ± 1.0 MHz).

The RF output and alarm threshold level adjustments are more easily accessible so that fine adjustments can be made in the field. Depending on user requirements, the RF alarm threshold levels should be checked whenever a significant change in operating frequency (± 0.5 MHz) is made. As the antenna VSWR alarm is dependent on the output power alarm, the output power alarm should always be set first. The order of adjustment should be:

1) Set the desired output power alarm level (section 3.6.2.2).
2) Set the output power (section 3.6.2.3).
3) Set the desired Antenna VSWR alarm level (section 3.6.2.4).
4) Set the desired overload condition level (section 3.6.2.5).

Details for the alignment steps are outlined below.

3.6.2.1 General Set-Up

All of the setup steps detailed below are performed at the factory as part of the initial Transmitter alignment. A general realignment of the Amplifier Module will be required under the following conditions:

(i) the nominal RF input power applied to the amplifier is changed from that which the amplifier was intially set up for, and
(ii) components, particularly the RF transistors Q1 and Q2, are replaced during a repair operation.

1. Connect the transmitter's antenna output connector to the type N input of the radio communications test set through a short section of low loss 50 Ω coaxial cable.

2. Turn all four (4) of the adjustment potentiometers (R7, R21, R36, and R37) fully counterclockwise.

3. Turn on the power to the transmitter.

4. Monitor the +9.5 Vdc and 13.8 Vdc supply current and adjust R7, the output power adjustment, so that approximately 1 Amp is being drawn on the +9.5 Vdc line and 1.3 Amps or less is being drawn on the 13.8 Vdc line. This should produce approximately 8 Watts.

5. If only a 6 or 7 watt output is obtained, adjust the low pass filter coil pairs L2/L3 and L1/L4 to obtain 8 watts.

3.6.2.2 Output Power Alarm (Forward Power)

Open Collector Output

* note: the output power alarm output is factory configured as an open collector output so a pull-up resistor may be required on transmitter pin B26 if one is not already present.

1. Adjust R7, the output power adjustment, to the output power at which the Output Power Alarm is to be activated.

2. Monitor transmitter pin B26, the Output Power Alarm line, and slowly turn R21, the output power alarm adjustment, clockwise until pin B26 goes low. The alarm is now set for the current output power of the transmitter.

Linear Output

1. Open the amplifier case to disable (open circuit) jumper JU2 and enable (short) jumper JU1.

2. Monitor transmitter pin B26 with a voltmeter.

3. Adjust R7, the output power adjustment, for full transmitter output power.

4. Adjust R21, the output power alarm adjustment, so that the voltmeter indicates +7.5 Vdc for full transmitter output power.

5. Turn R7, the output power adjustment, fully counterclockwise. The voltmeter should read approximately +3 Vdc.

6. Disconnect the voltmeter.

3.6.2.3 Output Power

1. Turn R7, the output power adjustment, clockwise to the desired transmitter output power.

3.6.2.4 Antenna VSWR Alarm (Reverse Power)

Open Collector Output

* note: the antenna VSWR alarm output is factory configured as an open collector output so a pull-up resistor may be required on transmitter pin Z26 if one is not already present. The output power alarm must be set first before the antenna VSWR alarm can be set.

1. Disconnect the radio communications test and terminate the transmitter with the 3:1 mismatch load.

2. Monitor pin Z26, the Antenna VSWR Alarm line, and turn R36 fully counterclockwise. Pin Z26 should be high. Slowly turn R36 clockwise until pin Z26 is pulled low. Put the 50 ohm load back on again, Pin Z26 should go high. The reverse power trip point is now set for a VSWR of 3:1.

Linear Output

1. Open the amplifier case to disable (open circuit) jumper JU3 and enable (short) jumper JU4.

2. Monitor transmitter pin Z26 with a voltmeter.

3. Disconnect the radio communications test set and terminate the transmitter with the 3:1 mismatch load.

4. Adjust R36, the VSWR alarm adjustment, so that the voltmeter indicates +5 Vdc for a 3:1 mismatch.

5. Put the 50 ohm load back on again. The voltmeter should read approximately 0 Vdc.

6. Disconnect the voltmeter.

3.6.2.5 Antenna VSWR Overload

1. Disconnect the radio communications test set and so that the amplifier is terminated with an open circuit.

2. Monitor the current from the +9.5 Vdc supply.

3. Adjust R37, the VSWR overload adjustment, clockwise until a noticeable drop in the +9.5 Vdc current occurs.

4. Reconnect the radio communications test set and, the +9.5 Vdc current should return to the previous level.

3.6.2.6 Procedure Verification

1. Verify that the current drawn from the +13.8 Vdc supply is less than 1.5 A and from the +9.5 Vdc supply is less than 1.2 A when transmitting full RF output power (8 Watts).

2. Turn off the power to the transmitter.

4 ILLUSTRATIONS AND SCHEMATIC DIAGRAMS

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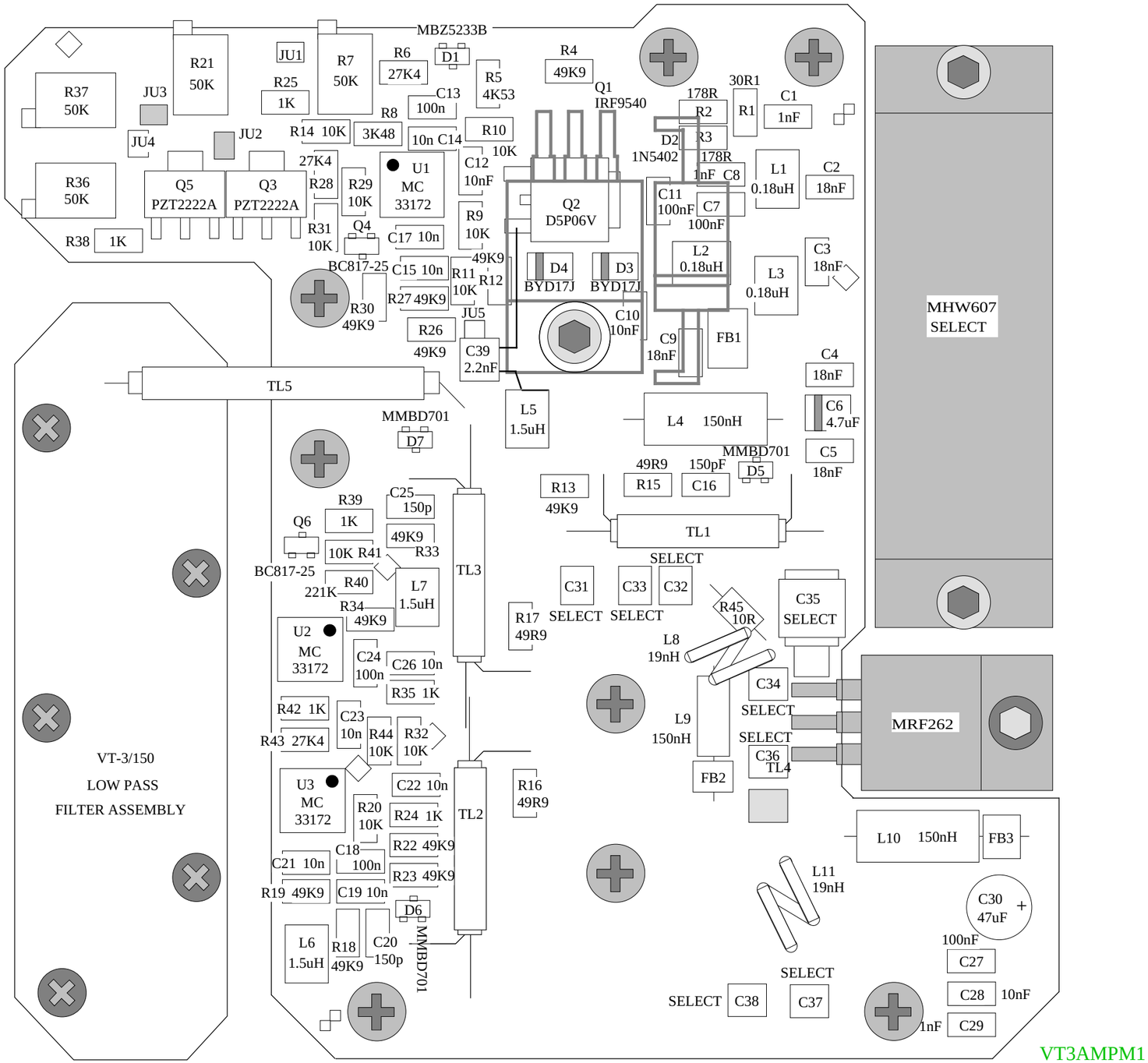
4.1 VT-3/150 VHF Amplifier Component Layout



COMPONENT INSTALLED ON BOTTOM OF BOARD

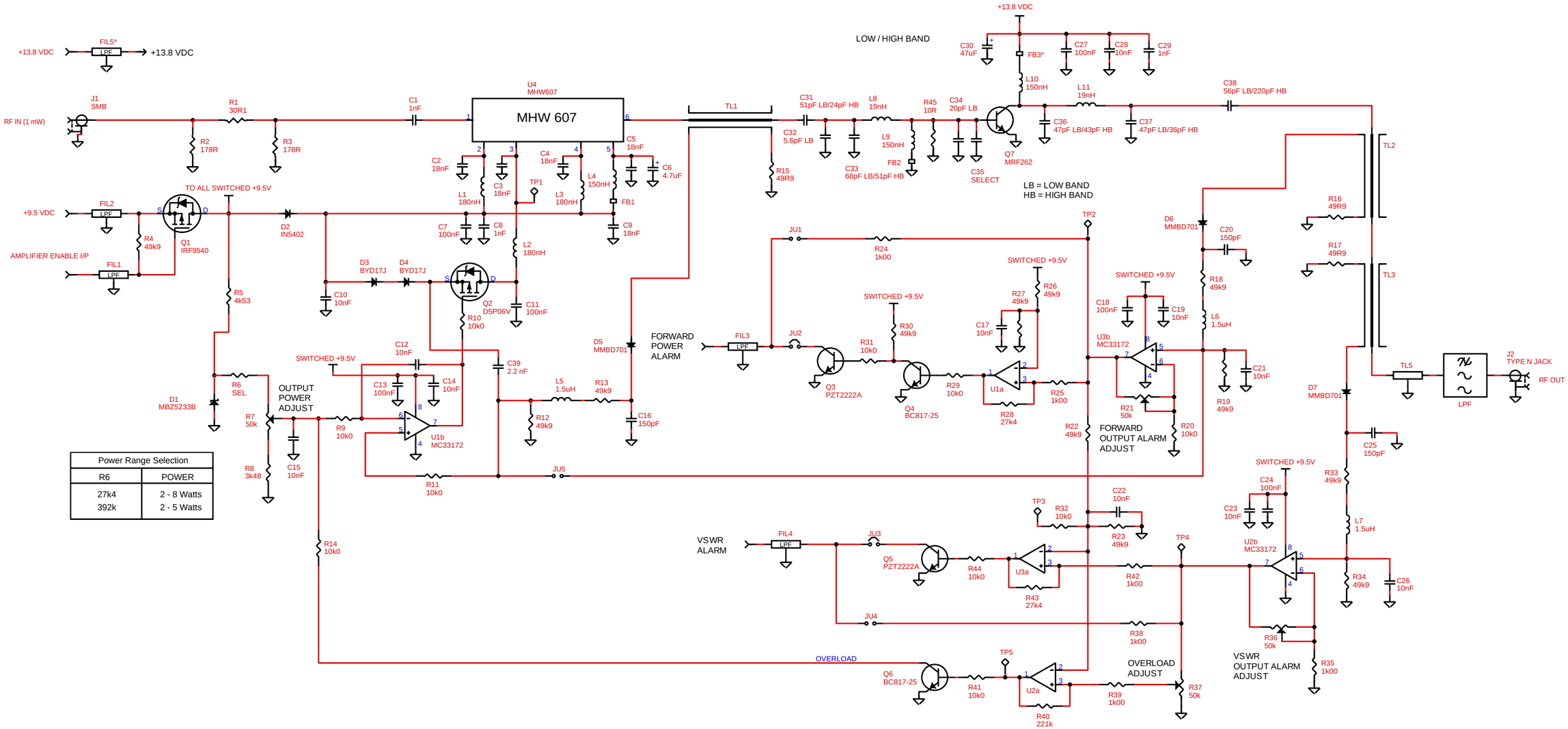
COMPONENT NOT INSTALLED

COMPONENT MOUNTED ON CASE

NOTE Q1 MOUNTED ON CASE WITH LEADS INSERTED TO BOTTOM OF BOARD

VT3AMPM1

4.2 VT-3/150 VHF Amplifier Schematic Diagram



Power Range Selection	
R6	POWER
27k4	2 - 8 Watts
392k	2 - 5 Watts

HIGHEST REFERENCE DESIGNATORS		
C39	J2, JU5	R45
D7	L11	TL5, TP5
FB3, FIL5	Q7	U4
UNUSED REFERENCE DESIGNATORS		
-----	-----	-----
-----	-----	-----
-----	-----	-----

DE DANIELS ELECTRONICS VICTORIA B.C.		
TITLE: VT-3/150 VHF AMPLIFIER SCHEMATIC DIAGRAM		
DATE: 4 MARCH 1994	DWN BY: REX WONG	APRVD:
DWG No: VT3AMPM2A	DWG REV DATE: 10 DECEMBER 1995	
BOARD No: 43-932611	BOARD REV: 1.1	

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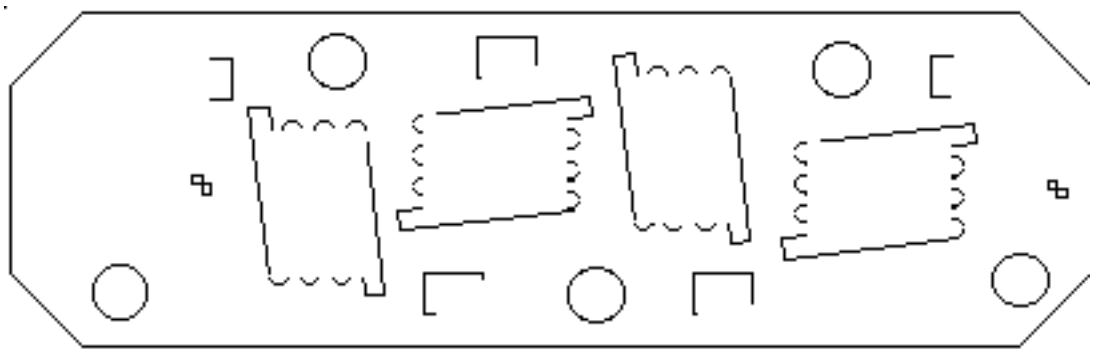
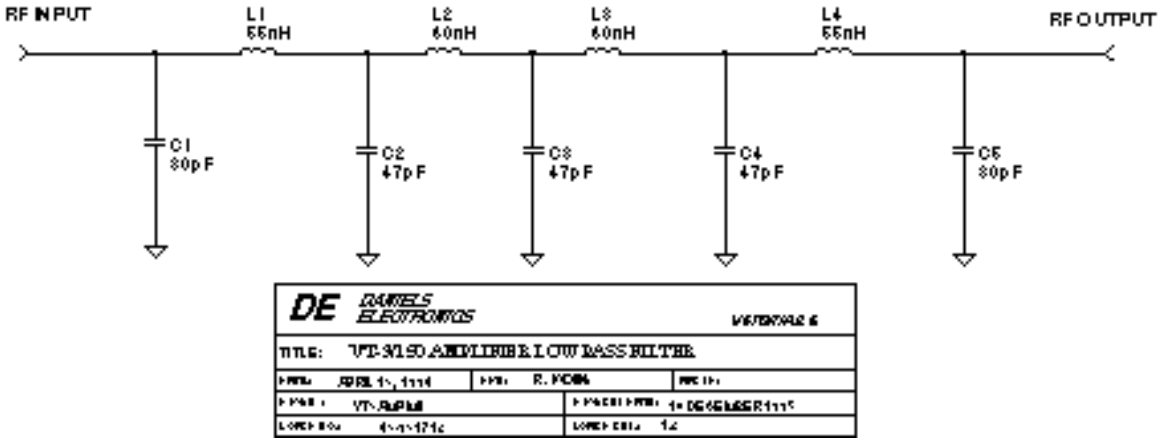
4.3 VT-3/150 VHF Lowpass Filter Component Layout



4.4 VT-3/150 VHF Lowpass Filter Schematic Diagram



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5 PARTS LISTS

5.1 VT-3/150 Amplifier Electrical Parts List

Ref Desig	Description	Part No.	
C1	CAP., SM, 1nF CER, 1206, C0G	1008-3B102K1G	
C2-C5	CAP., SM, 18nF CER, 1206, X7R	1008-4B183K5R	
C6	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C7	CAP., SM, 100nF CER, 1206, X7R	1008-5B104K5R	
C8	CAP., SM, 1nF CER, 1206, C0G	1008-3B102K1G	
C9	CAP., SM, 18nF CER, 1206, X7R	1008-4B183K5R	
C10	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C11	CAP., SM, 100nF CER, 1206, X7R	1008-5B104K5R	
C12	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C13	CAP., SM, 100nF CER, 1206, X7R	1008-5B104K5R	
C14, C15	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C16	CAP., SM, 150pF CER, 1206, C0G	1008-2B151J1G	
C17	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C18	CAP., SM, 100nF CER, 1206, X7R	1008-5B104K5R	
C19	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C20	CAP., SM, 150pF CER, 1206, C0G	1008-2B151J1G	
C21-C23	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C24	CAP., SM, 100nF CER, 1206, X7R	1008-5B104K5R	
C25	CAP., SM, 150pF CER, 1206, C0G	1008-2B151J1G	
C26	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C27	CAP., SM, 100nF CER, 1206, X7R	1008-5B104K5R	
C28	CAP., SM, 10nF CER, 1206, X7R	1008-4B103K5R	
C29	CAP., SM, 1nF CER, 1206, C0G	1008-3B102K1G	
C30	CAP., 47µF DIP. TANT., 20%, 35V	1054-6M476M35	
C31	CAP.,SM, 51pF PORCEL., 5% 500V	1036-1B2510J5	(132 - 150 MHz)
C31	CAP.,SM, 24pF PORCEL., 5% 500V	1036-1B2240J5	(150 - 174 MHz)
C32	CAP.,SM, 5.6pF PORCEL., ±0.25pF 500V	1036-0B2569C5	(132 - 150 MHz)
C32	CAP.,SM, NOT INSTALLED	NOT INSTALLED	(150 - 174 MHz)
C33	CAP.,SM, 68pF PORCEL., 5% 500V	1036-1B2680J5	(132 - 150 MHz)
C33	CAP.,SM, 51pF PORCEL., 5% 500V	1036-1B2510J5	(150 - 174 MHz)
C34	CAP.,SM, 20pF PORCEL., 5% 500V	1036-1B2200J5	(132 - 150 MHz)
C34	CAP.,SM, NOT INSTALLED	NOT INSTALLED	(150 - 174 MHz)
C35	CAP., 330pF METAL CLAD,1% 250V	1046-2A331FDB	(132 - 150 MHz)
C35	CAP., 270pF METAL CLAD, 1% 250V	1046-2A27TFDB	(150 - 174 MHz)
C36	CAP.,SM, 47pF PORCEL., 5% 500V	1036-1B2470J5	(132 - 150 MHz)
C36	CAP.,SM, 43pF PORCEL., 5% 500V	1036-1B2430J5	(150 - 174 MHz)
C37	CAP.,SM, 47pF PORCEL., 5% 500V	1036-1B2470J5	(132 - 150 MHz)
C37	CAP.,SM, 36pF PORCEL., 5% 500V	1036-1B2360J5	(150 - 174 MHz)
C38	CAP.,SM, 56pF PORCEL., 5% 500V	1036-1B2560J5	(132 - 150 MHz)
C38	CAP.,SM, 220pF PORCEL., 5% 200V	1036-2B2221J2	(150 - 174 MHz)
C39	CAP., 2.2nF FILM, MMK5,10%,63V	1016-3A222K63	
D1	DIODE, MBZ5233B 6.0V ZENER, SOT-23	2102-MBZ5233B	
D2	DIODE, IN5402 3A RECT, DO-201AD	2001-1N540200	
D3, D4	DIODE, BYD17J RECTIFIER, SOD-87	2101-BYD17J00	
D5	DIODE, MMBD701 HOT CARRIER, SOT-23	2105-MMBD7010	
D6, D7	DIODE, MMBD701 HOT CARRIER, SOT-23	2105-MMBD7010	

Ref Desig	Description	Part No.	
FB1	FERRITE BEAD, SM, 43 MIX 1812 PKG	1213-43181200	
FB2, FB3	FERRITE BEAD, 64MIX 3X3.5mm OD	1210-64030350	
FIL1-FIL5	FILTER, EMI PI/5500pF, 8-32 UNC	1302-P552D10D	
J1	CONNECTOR, SMB, JACK,2 HOLE FLANGE	5120-J2SC01BG	
J2	CONNECTOR, N JACK PANEL MNT, C/SNK	5184-10923011	
L1-L3	INDUCTOR, SM., 180nH 20%, 1812	1255-2GR1800M	
L4	CHOKE, RF/MOULD., 150nH 10%, .37	1251-2B00R15K	
L5	INDUCTOR, SM, 1.5µH 10%, 1812	1255-3G1R500K	
L6, L7	INDUCTOR, SM, 1.5µH 10%, 1812	1255-3G1R500K	
L8	COIL, 1.5 TURNS, 18AWG, 3.83mmID	1220-1T501812	
L9	CHOKE, RF/MOULD., 150nH 10%, .25	1251-2A00R15K	
L10	CHOKE, RF/MOULD., 150nH 10%, .37	1251-2B00R15K	
L11	COIL, 1.5 TURNS, 18AWG, 3.83mmID	1220-1T501812	
LPF1	LPF, ASSEMBLY VT-3/150 AMPLIFIER	A21-LPF3/150	
PCB	PCB, VT-3/150 TX AMPLIFIER	4321-15932611	
Q1	MOSFET, IRF9540 P-CHANNEL, TO-220	2044-IRF95400	
Q2	MOSFET, D5P06V P-CHAN., DPAK	2144-D5P06V00	
Q3	TRANSISTOR, PZT2222A NPN, SOT-223	2120-PZT2222A	
Q4	TRANSISTOR, BC817-25 NPN, SOT-23	2120-BC817025	
Q5	TRANSISTOR, PZT2222A NPN, SOT-223	2120-PZT2222A	
Q6	TRANSISTOR, BC817-25 NPN, SOT-23	2120-BC817025	
Q7	TRANSISTOR, MRF262 VHF, TO-220	2025-MRF26200	
R1	RES., SM, 30R1 1206, 1%,100ppm	1150-1B30R1FP	
R2, R3	RES., SM, 178R 1206, 1%,100ppm	1150-2B1780FP	
R4	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R5	RES., SM, 4k53 1206, 1%, 100ppm	1150-3B4531FP	
R6	RES., SM, 27k4 1206, 1%, 100ppm	1150-4B2742FP	(Default)
R6	RES., SM, 392k 1206, 1%, 100ppm	1150-4B3922FP	(Exciter for VT-30)
R7	POT., SM, 50k 12 TURN, SIDE ADJUST	1172-M30503X5	
R8	RES., SM, 3k48 1206, 1%, 100ppm	1150-3B3481FP	
R9-R11	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R12, R13	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R14	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R15-R17	RES., SM, 49R9 1206, 1%, 100ppm	1150-1B49R9FP	
R18, R19	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R20	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R21	POT., SM, 50k 12 TURN, SIDE ADJUST	1172-M30503X5	
R22, R23	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R24, R25	RES., SM, 1k00 1206, 1%, 100ppm	1150-3B1001FP	
R26, R27	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R28	RES., SM, 27k4 1206, 1%, 100ppm	1150-4B2742FP	
R29	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R30	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R31, R32	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R33, R34	RES., SM, 49k9 1206, 1%, 100ppm	1150-4B4992FP	
R35	RES., SM, 1k00 1206, 1%, 100ppm	1150-3B1001FP	
R36, R37	POT., SM, 50k 12 TURN, SIDE ADJUST	1172-M30503X5	

Ref Desig	Description	Part No.	
R38, R39	RES., SM, 1k00 1206, 1%, 100ppm	1150-3B1001FP	
R40	RES., SM, 221k 1206, 1%, 100ppm	1150-5B2213FP	
R41	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R42	RES., SM, 1k00 1206, 1%, 100ppm	1150-3B1001FP	
R43	RES., SM, 27k4 1206, 1%, 100ppm	1150-4B2742FP	
R44	RES., SM, 10k0 1206, 1%, 100ppm	1150-4B1002FP	
R45	RES., 10R METAL FILM, 5%, 0.5W	1101-1A0100JP	
TL1	COAX, DIRECTIONAL COUPLER 0.5"	7496-30CR005T	
TL2, TL3	COAX, DIRECTIONAL COUPLER 0.5"	7496-30CR005T	
TL5	COAX, CONFORMABLE 31.5mm, 50 OHM, 0.083	7482-5024T083	
U1-U3	I.C., MC33172 DUAL OP AMP, S0-8	2302-33172N08	
U4	AMP, RF,MHW607-1,7W,136-154MHz	2256-MHW60701	(132 - 150 MHz)
U4	AMP, RF,MHW607-2,7W,146-174MHz	2256-MHW60702	(150 - 174 MHz)

5.2 VT-3/150 Low Pass Filter Electrical Parts List

Ref Desig	Description	Part No.
C1	CAP., SM, 30pF PORCEL., 5%, 500V	1036-1B2300J5
C2-C4	CAP., SM, 47pF PORCEL., 5%, 500V	1036-1B2470J5
C5	CAP., SM, 30pF PORCEL., 5%, 500V	1036-1B2300J5
L1	COIL, 55nH 3.0 TURNS, 18AWG, 6.70mm ID	1220-3T001822
L2, L3	COIL, 60nH 3.0 TURNS, 18AWG, 6.70mm ID	1220-3T001822
L4	COIL, 55nH 3.0 TURNS, 18AWG, 6.70mm ID	1220-3T001822
PCB	PCB, LPF VT-3/150, UT-3/400 AMP	4321-16931712

5.3 VT-3/150 Amplifier Mechanical Parts List

Description	Part No.	Qty.
CASE, MT-3 VHF/UHF AMPLIFIER, ALUMINUM	3702-66102130	1
HEATSHRINK, 1/8" DIA, RED, 1" LENGTH	CONSUMABLE	1
INSULATOR, THERM. COND. TO-220	5622-1T220701	1
LABEL, MTL/PE, VT-3/150 AMP ID	3508-21002010	1
LID, CASE MT-3 AMPLIFIER, ALUMINUM	3702-66102151	1
SCREW, M2 X 6, PAN/PHILLIPS,A2	5812-2M0PP06S	2
SCREW, M2 X 4, PAN/PHIL., S/S	5812-2M0PP04S	10
SCREW, M2.5 X 6, PAN/PHIL., S/S	5812-2M5PP06S	3
SCREW, M3 X 6, FLAT/PHIL., S/S	5812-3M0FP06S	4
SCREW, M3 X 8, PAN/PHIL., S/S	5812-3M0PP08S	9

Description	Part No.	Qty.
SCREW, M3 X 8, CAP SOCK-M2.5, S/S	5812-3M0SA08S	3
SCREW, M3 X 8, CAP SOCK-M2.5, S/S	5812-3M0SA08S	2
SET SCREW, M3 X 3, HEX SOCKET, A2	5817-3M0AC03S	1
SHOULDER WASHER, M3 0.24" OD, NYLON	5674-120N2440	1
TUBING, TFE-260C, 22AWG,Thin 5mm	7610-260C22TW	1
TURRET TERMINAL, 4-40 0.188L, Tn	5053-144M188T	1
WIRE, PVC/STRANDED 16AWG, RED, 70 mm	7110-16S26302	1

6 REVISION HISTORY

ISSUE	DATE	REVISION
1	Jul 97	First Issue.

DANIELS™
ELECTRONICS LTD.

MT-3 RADIO SYSTEMS

ENHANCED AM/FM SYNTHESIZER INSTRUCTION MANUAL

OS(R/T)-3(A/H) 29 - 470 MHz

Covers models:
OST-3H035, OST-3H045, OSR-3H061
OST-3A128, OSR-3A149
OST-3H141, OST-3H162, OSR-3H141, OSR-3H162
OST-3H440, OSR-3H440

Issue:	4	Previous Issue:	3	
Issue Date:	September 2000	Previous Issue Date:	March 2000	Daniels Electronics Ltd.
Printing Date:	January 2001			Victoria, BC.
Part No.:	IM10-OS3AH			PRINTED IN CANADA

Reviewed By:

Quality Assurance:

Name	Signature	Date
Larry Freeman	Larry Freeman	12 May 98

NOTE:

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. The equipment covered by this manual may incorporate minor changes in detail from the information contained in this manual.

TABLE OF CONTENTS

1. GENERAL

1.1 Introduction

The OS-3A/H Synthesizer is a compact, fully shielded and environmentally rugged frequency synthesis module that is the nucleus of every MT-3 synthesized Receiver and Transmitter radio module. The OS-3A/H generates a high stability, low distortion radio frequency signal in one of several frequency bands, including 29 - 50 MHz, 118 - 159.4 MHz, 118 - 174 MHz and 406 - 470 MHz. The OS-3A/H utilizes an internal temperature compensated 9.6 MHz reference to produce a signal stable to ±1 ppm within the temperature range of -40°C to +60°C. Alternately, the OS-3A/H can be disciplined by an external 9.6 MHz or 10 MHz reference of higher stability. The OS-3A/H Synthesizer Module is manufactured in twelve distinct models which cover three primary frequency bands (see section 1.2 below). All synthesizer modules are designed to be easily removed for programming, calibration and/or repair. The synthesizer circuitry is distributed between two printed circuit boards (PCBs) which are isolated yet interconnected via photo-logic optical transceivers that effectively eliminate residual electrical noise between digital and analog circuitry. Further shielding of the synthesizer's RF filter circuitry is provided by an internal shielded enclosure.

1.2 OS(R/T)-3(A/H) Enhanced Synthesizer Family Models

The OS-3A/H Synthesizer Module is utilized in both the MT-3 Receiver and Transmitter product lines. In MT-3 Transmitters, the OS-3A/H synthesizer provides a modulated, low-level RF signal to the Power Amplifier module. In MT-3 Receivers, the OS-3A/H synthesizer provides a low noise local oscillator (LO) signal that either directly drives the mixer circuitry or first drives a buffer amplifier which precedes the mixer circuitry (if a higher LO drive signal is required for enhanced intermodulation capability). There are twelve distinct models within the OS-3A/H Enhanced Synthesizer Family. Note that this manual provides service and operating information for all twelve synthesizer modules. It is extremely important to establish the correct synthesizer model number, as documentation is model-specific. The model number can be found on the synthesizer label, located on the synthesizer module top cover.

The twelve synthesizer models that comprise the OS-3A/H Synthesizer family are follows:

Frequency Band: 29 - 50 MHz, Common OS-3H0xx Analog Board

- OST-3H035 - installed in FM transmitter, 29 - 38 MHz RF output.
- OST-3H045 - installed in FM transmitter, 38 - 50 MHz RF output.
- OSR-3H061 - installed in FM receiver, 50.4 - 71.4 MHz RF output.

Frequency Band: 118 - 159.4 MHz, AM Multichannel OS-3H1xx Analog Board

- OST-3A128 - installed in AM transmitter, 118 - 138 MHz RF output.
- OSR-3A149 - installed in AM receiver, 139.4 - 159.4 MHz RF output.

Frequency Band: 128 - 174 MHz, Common OS-3H1xx Analog Board

- OST-3H141 - installed in FM transmitter, 128 - 152.6 MHz RF output.
- OST-3H162 - installed in FM transmitter, 150 - 174 MHz RF output.
- OSR-3H141 - installed in FM receiver, 128 - 152.6 MHz RF output.
- OSR-3H162 - installed in FM receiver, 150 - 174 MHz RF output.

Frequency Band: 406 - 470 MHz, Common OS-3H4xx Analog Board

- OST-3H418 - installed in FM transmitter, 406 - 430 MHz RF output.
- OST-3H460 - installed in FM transmitter, 450 - 470 MHz RF output
- OSR-3H440 - installed in FM receiver, 427.4 - 451.4 MHz RF output.

All OS-3A/H Enhanced Synthesizer Modules, regardless of the frequency band, use the same digital PCB and mechanical construction. There are, however, significant differences between the various models when it comes to the analog PCB. There are four different analog PCBs, designed to cover the four frequency bands of 29 - 50 MHz, 118 - 159.4 MHz, 128 - 174 MHz and 406 - 470 MHz. Each model's specific sub-band of operation within a given frequency band is determined through SELECT components on the corresponding analog board.

1.3 Performance Specifications

Type: Narrow band FM, Single loop synthesizer module utilizing low noise VCO and PLL technology.
Compatible with Daniels MT-3 series Transmitter and Receiver modules.

Frequency Range: 29 MHz - 38 MHz [±0.5 MHz] (OST-3H035)

(Tuning range with no adjustment 38 MHz - 50 MHz [±1.0 MHz] (OST-3H045)

is shown in [ ] brackets.) 50.4 MHz - 71.4 MHz [±1.0 MHz] (OSR-3H061)

118 MHz -138 MHz [Full band] (OST-3A128)

128 MHz - 152.6 MHz [±2.0 MHz] (OST-3H141, OSR-3H141)

139.4 MHz - 159.4 MHz [Full band] (OSR-3A149)

150 MHz - 174 MHz [±2.0 MHz] (OST-3H162, OSR-3H162)

406 MHz - 430 MHz [Full band] (OST-3H418)

427.4 MHz - 451.4 MHz [Full band] (OSR-3H440)

450 MHz - 470 MHz [Full band] (OST-3H460)

Output Power: +5 dBm ±2 dBm into 50Ω

Harmonics: <-30 dBc

Spurious: <-90 dBc

<-70 dBc above 400 MHz

Attack Time: <10 ms (Normal Mode)

<50 ms (Low Current Standby Mode)

Hum and Noise: -55 dB

Modulation Sensitivity: 3.0 kHz peak deviation (400 mVrms input)

External Reference Input: External reference input signal via SMB connector J1

Input level 0 dBm ±3 dB

Input impedance 50Ω

Input frequency 10.0 MHz or 9.6 MHz (selectable through

digital board jumper JU1)

Power Requirements: Normal Configuration:

+9.5 Vdc @ 160 mA for FM and 65 mA for AM

Low Current Standby Mode (TCXO enabled):

+9.5 Vdc @ 14 mA for FM and 4 mA for AM

1.4 Printed Circuit Board Numbering Convention

To expedite troubleshooting and maintenance procedures, Daniels Electronics Ltd. has adopted a printed circuit board (PCB) numbering convention in which the last two digits of the circuit board number represent the circuit board version. All PCB's manufactured by Daniels Electronics Ltd. are identified by one of the following numbering conventions:

- PCB number 43-912010 indicates circuit board version 1.0; or
- PCB number 50002-02 indicates circuit board version 2.0

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2. THEORY OF OPERATION

2.1 Internal Power and Control (Digital Board)

Refer to "OS(R/T)-3(A/H) Digital Board Schematic Diagram" on page 4-19 of this manual. The synthesizer operates from a +9.5 Vdc power source applied to connector pin P1-2. Total current draw is approximately 160 mA for FM synthesizers and 65 mA for AM synthesizers. POWER DOWN control line P2-4 controls the +5.0 Vdc microcontroller regulator U2 through power MOSFET switch U1. For receiver applications the synthesizer is always ON, with the enable line P2-4 directly connected to +9.5 Vdc. For transmitter applications, pin P2-4 is controlled by MT-3 Transmitter Board jumper J18 which selects the synthesizer standby mode. In Low Current Standby Mode, less than 14 mA current is drawn (for FM, < 4 mA for AM) however, a delay of approximately 50 ms from PTT activation to transmitter turn is then required to allow for synthesizer lock time. In Normal Mode, with the synthesizer ON continuously, less than 10 ms delay is encountered. This capability comes at the expense of additional standby current (160 mA for FM, 65 mA for AM).

2.2 Synthesizer Analog Circuitry (Analog Board)

There are four separate analog circuit boards covering the four frequency bands of 29 - 50 MHz, 118 - 159.4 MHz, 128 - 174 MHz and 406 - 470 MHz respectively. All four analog boards are similar in operation and circuit topology with the VCO, Loop Filter and Output Low-pass Filter sections being band specific.

2.2.1 Common Analog Board Circuitry

This section describes the circuitry common to all versions of the FM Synthesizer Analog Board.

The Analog Board utilizes four optical receivers (U1 - U4) and one optical transmitter (U5) to provide an isolated data interface to the digital board. In normal operating modes, +9.5 Vdc Regulator IC U8 provides continuous +5.0 Vdc to the internal TCXO and power control optical receiver U1. This results in a standby current level of ≈ 14 mA for FM and 4 mA for AM. Primary power is controlled through activation of optical receiver U1 under control of the digital board micro controller U4. Regulator U6 provides switched +8.0 Vdc with regulator U7 providing switched +5.0 Vdc to all analog supply points. Power MOSFET IC U9 works as a clamping circuit to quickly discharge VCO filter capacitors C32 and C33 when powered down, resulting in immediate suppression of RF output from the VCO.

The heart of the OS-3A/H Enhanced Synthesizer is U10 - a low power, single chip synthesizer IC. A 9.6 MHz reference signal is provided either from the internal TCXO (JU1-B Analog Board) or from an external source via SMB connector J1 with jumper JU1-A (Analog Board) and jumper JU2 (AM Analog Board only) installed. The external reference source may be 9.6 MHz or

10.0 MHz and is selected via jumper JU2 on the Digital Board (9.6 MHz with JU2 not installed, 10.0 MHz with JU2 installed). If an external signal is used as the reference source, it must be a sinusoidal, low phase noise, high stability signal of 0 dBm ±3 dB level. A poor quality reference source will degrade receiver /transmitter performance to unacceptable levels. Transistor Q2 forms a buffer amplifier having 50Ω input impedance at 10.0 MHz. The internal 9.6 MHz TCXO provides better than ±1 ppm frequency stability from -30°C to +60°C (-40°C to +60°C optional). Fine frequency adjustment is made through frequency control potentiometer RV1, which is accessible through the synthesizer top cover.

The 9.6 MHz reference source is divided down to establish a channel selection step size of 5.0/6.25, 12.5, or 25.0 kHz depending on the particular synthesizer model type. A third order passive loop filter comprised of C37, C38, C39, C45, C49, R36 and R32 is employed to achieve the required noise performance, modulation and worst case switching time of 50 ms. A small sample of RF energy is coupled from the VCO output buffer U16 on the FM analog board or from Q6 on the AM analog board to the synthesizer IC U10 prescaler input (pin 11). FM modulation of the VCO from ≈ 100 Hz to 3 kHz is achieved through the baseband input pin P1-1 on the Digital Board. A 1 kHz sine wave with a level of approximately 400 mVrms at P1-1 provides FM deviation of 3.0 kHz. SMB connector J2 provides an RF output level of approximately +5 dBm into a 50Ω load.

An optional modulation input is provided through connector P1-18 (Digital Board) and routed to the Analog board via connector P3. This connection must be coupled to a low impedance, dc coupled source and provides a phase modulated bandwidth from 0 Hz (DC) to ≈ 50 Hz (PLL loop filter bandwidth) allowing for specialized applications such as paging or trunking where a separate low frequency digital/analog modulation channel is required. Phase modulation input pin P1-18 is routed to the transmitter audio processor spare pin P4-2 via JA4-2 on the MT-3 transmitter main board. It should be noted that any application of the direct TCXO modulation port transfers control of the synthesizer steady state frequency setting to the external modulating source. Frequency control potentiometer RV1 is then effectively removed from the frequency adjust circuitry.

A lock detect LED (LED1) indicates an unlocked PLL condition. An unlocked PLL condition normally indicates that the VCO is not tuned within the lock-in range of the desired channel frequency. In a transmitter, the loss of lock will prevent PTT from keying the power amplifier module, thus preventing transmission of a spurious output signal. Adjustment of tuning capacitor C24 will normally reestablish frequency lock within the synthesizer's frequency range. Optical transmitter U5 is additionally activated in unlocked conditions and enables the micro-controller (Digital Board) to respond to the unlocked PLL condition. Note that the 118 - 159.4 MHz and the 406 - 470 MHz Analog Boards do not incorporate a VCO tuning capacitor; the VCO covers the full frequency range without tuning. An unlocked condition in either of these synthesizers would indicate an attempt to synthesize an invalid channel frequency outside the installed VCO frequency range.

2.2.2 29 - 71.4 MHz Analog Board Circuitry

Refer to the "OS(R/T)-3H 29 - 71.4 MHz Analog Board Schematic Diagram" on page 4-3 of this manual.

Field effect transistor Q5 forms part of the negative resistance VHF amplifier oscillator that is tuned on-frequency by the combination of resonator L5 and the total capacitive reactance presented across L5 through capacitors C62, C63, C64, C23 (Select), variable capacitor C24 and varactor diodes D1 and D2. Fine frequency adjustment is obtained via multi-turn trimmer capacitor C24 in conjunction with coarse frequency jumper selections JU2, JU3 and JU4. Select capacitor values are chosen to position the operating frequency in one of three bands: 29 - 38 MHz, 38 - 50 MHz or 50.4 - 71.4 MHz. Varactor diodes D1 and D2 provide oscillator frequency control. PLL feedback control voltage, at the output of the low-pass loop filter, controls the VCO frequency through the reverse biasing of varactor diodes D1 and D2. The PLL control voltage can range between ≈ +1.0 Vdc and +7.0 Vdc and is nominally set to ≈ +4.5 Vdc at the synthesizer centre frequency. Setting of the PLL control voltage set point (TP4) is achieved by adjusting fine frequency variable capacitor C24 combined with binary weighted lumped capacitor coarse frequency jumpers (JU2, JU3, JU4). External baseband frequency modulation is provided through connection P1 and a voltage divider network formed by R21 and R22. A large signal division ratio, established by the resistive dividers R21 and R22, allows low deviation (less than 5 kHz) direct frequency modulation of the VCO output signal.

The PLL low-pass filter is formed by SELECT components C37, C38, C39, C45, R32 and R36. The loop filter response is optimized for switching time, noise and modulation requirements specific to each sub-band within the 29 - 71.4 MHz frequency range. The SELECT components (including the loop filter) can be found in tabular format on the VHF OS-3H 29 - 71.4 MHz Analog Board Schematic diagram.

RF output power is taken from the source of Q5 and amplified/buffered by U11. U15 provides further amplification and isolation while delivering ≈ +10 dBm into a six-pole low-pass/notch output filter formed by C53, C57, C58, C59, L11 and L13. The six pole output filter, with a cutoff frequency of 50 MHz (OST-3H035, OST-3H045 TX) or 80 MHz (OSR-3H061 RX) effectively eliminates output harmonics. SMB connector J2 provides interconnection to the companion transmitter or receiver with an output level of ≈ +5 dBm.

2.2.3 118 - 159.4 MHz Multichannel AM Analog Board Circuitry

Refer to the "OS(R/T)-3H 118 - 159.4 MHz Analog Board Schematic Diagram" on page 4-7 of this manual.

Field effect transistor Q5 forms part of the negative resistance VHF amplifier oscillator that is tuned on-frequency by the combination of resonator L5 and the total capacitive reactance presented across L5 through capacitors C40 and/or C23 (SELECT), varactor diodes D6, D7 and varactor diodes D1

and D2. Coarse frequency adjustment is provided by varactor diodes D6, D7. SELECT capacitor values C40 and/or C23 are chosen to position the operating frequency in one of two bands; 118 - 138 MHz or 139.4 - 159.4.MHz. Varactor diodes D1 and D2 provide fine oscillator frequency control. PLL feedback control voltage, at the output of the low-pass loop filter, controls the VCO frequency through the reverse biasing of diodes D1 and D2. The PLL control voltage can range between ≈ +1.0 Vdc and +4.7 Vdc and is nominally set to ≈ +3.3 Vdc for all synthesizer frequencies. Setting of the PLL control voltage set point (TP4) is achieved by adjusting the capacitance of varactor diodes D6 and D7, which are controlled by microcontroller U18 through digital-to-analog converter U17. Microcontroller U18 controls the output of the PLL Low-pass Filter and adjusts the output voltage of the D/A converter so that PLL control voltage set point (TP4) is approximately 3.3Vdc at all synthesizer frequencies. The microcontroller then goes to sleep in a low-power mode.

The PLL low-pass filter is formed by SELECT components C37, C38, C39, C45, R32 and R36. The loop filter response is optimized for switching time, noise and modulation requirements specific to each sub-band within the 118 - 159.4 MHz frequency range. SELECT components (including the loop filter) can be found in tabular format on the VHF OS(R/T)-3(A/H) 118 - 159.4 MHz Analog Board Schematic diagram.

RF output power is taken from the source of Q5 and amplified/buffered by Q6. U11 provides further amplification and isolation while delivering ≈ +10 dBm into a five-pole low-pass output filter formed by C53, C58, C59, L11 and L12. The five-pole low-pass output filter, with a cutoff frequency of 190 MHz, effectively eliminates output harmonics. SMB connector J2 provides interconnection to the companion transmitter or receiver with an output level of ≈ +5 dBm.

2.2.4 128 - 174 MHz Analog Board Circuitry

Refer to the "OS(R/T)-3(A/H) 128 - 174 MHz Analog Board Schematic Diagram" on page 4-11 of this manual.

Field effect transistor Q5 forms part of the negative resistance VHF amplifier oscillator that is tuned on-frequency by the combination of resonator L5 and the total capacitive reactance presented across L5 through capacitors C40 and/or C23 (SELECT), variable capacitor C24 and varactor diodes D1 and D2. Fine frequency adjustment is obtained via multi-turn trimmer capacitor C24. SELECT capacitor values C40 and/or C23 are chosen to position the operating frequency in one of two bands; 128 - 152.6 MHz or 150 - 174 MHz. Varactor diodes D1 and D2 provide oscillator frequency control. PLL feedback control voltage, at the output of the low-pass loop filter, controls the VCO frequency through the reverse biasing of diodes D1 and D2. The PLL control voltage can range between ≈ +1.0 Vdc to +7.0 Vdc and is nominally set to ≈ +4.5 Vdc at the synthesizer centre frequency. Setting of the PLL control voltage set point (TP4) is achieved by adjusting fine frequency variable capacitor C24. External baseband frequency modulation is provided through connector P1 and a voltage divider network formed by R21 and R22. A large signal division ratio,

established by the resistive dividers R21 and R22, allows low deviation (less than 5 kHz) direct frequency modulation of the VCO output signal.

The PLL low-pass filter is formed by SELECT components C37, C38, C39, C45, R32 and R36. The loop filter response is optimized for switching time, noise and modulation requirements specific to each sub-band within the 128 - 174 MHz frequency range. The SELECT components (including the loop filter) can be found in tabular format on the VHF OS(R/T)-3(A/H) 128 - 174 MHz Analog Board Schematic diagram.

RF output power is taken from the source of Q5 and amplified/buffered by U11. U15 provides further amplification and isolation while delivering ≈ +10 dBm into a five pole low-pass output filter formed by C53, C58, C59, L11 and L12. The five-pole low-pass output filter, with a cutoff frequency of 190 MHz, effectively eliminates output harmonics. SMB connector J2 provides interconnection to the companion transmitter or receiver with an output level of ≈ +5 dBm.

2.2.5 406 - 470 MHz Analog Board Circuitry

Refer to the "OS(R/T)-3H 406 - 470 MHz Analog Board Schematic Diagram" on page 4-15 of this manual.

The UHF OS(R/T)-3H 406 - 470 MHz synthesizer employs an integrated surface mount VCO module (U17) capable of full frequency band coverage. Two VCO modules are used to cover the 406 - 470 MHz frequencies in the Transmitter module and the 427.4 - 451.4 MHz frequencies in the Receiver module. The VCO modules are optimized for low phase noise, however the transmitter VCO is additionally configured with modulation input capability. PLL feedback control voltage, at the output of the low-pass loop filter, controls the VCO frequency through pin 2;the modulation input (Mod I/P) port. The PLL control voltage can range between ≈ +1.0 Vdc and +7.0 Vdc depending on the selected operating frequency. External baseband frequency modulation is provided through connector P1 and VCO Mod input pin 6.

The PLL low-pass filter is formed by SELECT components C37, C38, C39, C45, R32 and R36. The loop filter response is optimized for switching time, noise and modulation requirements specific to each sub-band within the 406 - 470 MHz frequency range. The SELECT components (including the loop filter and VCO type) can be found in tabular format on the UHF OS(R/T)-3H 406 - 470 MHz Analog Board Schematic diagram.

RF output power is taken from the VCO RF output and amplified/buffered by U11. U15 provides further amplification and isolation while delivering ≈ +10 dBm to a five pole low-pass output filter formed by C53, C58, C59, L11 and L12. The five-pole low-pass output filter, with a cutoff frequency of 530 MHz, effectively eliminates output harmonics. SMB connector J2 provides interconnection to the companion transmitter or receiver with an output level of ≈ +5 dBm.

2.3 Synthesizer Digital Circuitry (Digital Board)

Refer to the "OS(R/T)-3(A/H) Digital Board Schematic Diagram" on page 4-19 of this manual.

Microcontroller U4 generates control signals utilized within the synthesizer module. U4 communicates with synthesizer IC U10, monitors the synthesizer lock detect, manages PTT input and output and determines the operating frequency by reading channel number information from either the four rotary Binary Coded Decimal (BCD) switches mounted on the main Transmitter and Receiver PCB, or by reading four externally driven CHANNEL SELECT lines. Microcontroller U4 is also designed to communicate with Daniels SYNTHESIZER CHANNEL PROGRAMMER (CP-SC-3) through I/O lines TX DATA (P1-17), RX DATA (P1-9) and BOOTSTRAP (P2-2). This external programmer places the operating program in non-volatile microprocessor memory and programs up to 15 user defined channel selections. An internal "watchdog" timer provides robust software protection in all operating modes.

Data communication between the digital and analog circuit boards is achieved through four optical transmitters (U5 through U8) and one optical receiver (U9). The optical interface provides a fully isolated inter-board data communications link designed to prevent digital noise from interfering with sensitive PLL circuitry.

2.4 Frequency Control

2.4.1 BCD Switch Frequency Control

Selection of the desired synthesizer output frequency is straightforward. If all four of the CHANNEL SELECT lines (CHAN SEL3 - CHAN SEL0) are pulled low (to GND), the synthesizer will scan the four BCD switches (FSW1 - FSW4) located on the receiver and transmitter main circuit boards via connections SW1 COM - SW4 COM and PC4 - PC7 and establish the operating frequency from these switches. The four CHANNEL SELECT lines, CHAN SEL3 - CHAN SEL0, are connected via the MT-3 transmitter or receiver main board module connector to the M3 motherboard subrack. These lines are by default normally pulled low (to GND) via jumpers located on the M3 motherboard subrack.

If any one of the CHANNEL SELECT lines are pulled high (to +9.5 Vdc), then the synthesizer's frequency of operation will be determined by the CHANNEL SELECT lines and not the BCD switches. Up to 15 separate channel frequencies can be pre-programmed into a 'table' in non-volatile microprocessor memory and accessed through binary interpretation of the CHANNEL SELECT lines. The most significant bit (MSB) in the CHANNEL SELECT binary code is represented by CHAN SEL3 and the least significant bit (LSB) is represented by CHAN SEL0. For example, if all CHANNEL SELECT lines are pulled high, (i.e. binary '1111') then the 15th frequency entry in the internal channel table will be selected. The channel table is normally pre-programmed at the factory to user specifications, but may be programmed in the field using Daniels SYNTHESIZER CHANNEL PROGRAMMER (CP-SC-3).

In transmitters, the synthesizer operating frequency is the transmitter operating frequency; however, for receivers, an IF Offset correction factor must be added to or subtracted from the synthesizer operating frequency in order to determine the actual receive frequency. For VHF and UHF Receivers, the IF Offset correction factor is 21.4 MHz, while for 800 and 900 MHz Receivers it is 45 MHz. Refer to Channel Designation Table documentation for simplified channel number and frequency information.

2.4.2 Frequency Select Handle Frequency Control

In AM Receiver and Transmitter modules so equipped, the Frequency Select Handle (FSH) replaces the normal Front Panel handle and allows direct Front Panel selection of the operating frequency. Operation of the FSH is enabled by setting all external CHANNEL SELECT lines to '1111' (i.e. all lines jumpered to +9.5 Vdc). The FSH user interface consists of three pushbuttons plus an 8-digit dot matrix display. The FSH module communicates with the synthesizer through a standard 2-wire serial interface (9600 Baud, 8 bits, no parity, 1 stop bit) using simple ASCII command protocols. On power up or on any key press, the synthesizer is interrogated by the FSH for the current channel number and corresponding channel frequency, and this information is then briefly displayed on the FSH display. The frequency may be either incremented or decremented from the displayed value by pressing the **Frequency Increase** È or **Frequency Decrease** Í button, as appropriate. For more detailed operating information, refer to the "Frequency Select Handle Instruction Manual".

2.5 Synthesizer Base and Frequency Increment Table

The OS-3A/H Synthesizer operates in frequency increments of 5.0/6.25 kHz, 12.5 kHz or 25 kHz depending on the particular model and band of operation. The Base Frequency for any given synthesizer model is the lowest frequency generated.

Model Number	Freq. Range	Base Frequency	Freq. Increment
OST-3H035	29 - 38 MHz	29 MHz	5.0/6.25 kHz
OST-3H045	38 - 50 MHz	29 MHz	5.0/6.25 kHz
OSR-3H061	50.4 - 71.4 MHz	50.4 MHz	5.0/6.25 kHz
OST-3A128	118 - 138 MHz	118 MHz	25/8.333 kHz
OSR-3A149	139.4 - 159.4 MHz	139.4 MHz	25/8.333 kHz
OST-3H141	128 - 152.6 MHz	128 MHz	5.0/6.25 kHz
OST-3H162	150 - 174 MHz	150 MHz	5.0/6.25 kHz
OSR-3H141	128 - 153 MHz	128 MHz	5.0/6.25 kHz
OSR-3H162	150 - 174 MHz	150 MHz	5.0/6.25 kHz
OST-3H418	406 - 430 MHz	406 MHz	12.5 kHz
OST-3H460	450 - 470 MHz	406 MHz	12.5 kHz
OSR-3H440	427.4 - 451.4 MHz	427.4 MHz	12.5 kHz

2.6 5.0/6.25 kHz Channelization.

All Daniels VHF synthesizers (excluding AM synthesizers) have been designed to generate frequencies in both 5.0 kHz and 6.25 kHz channel increments. BCD channel switch settings from **0000 to 4999** will therefore select operating frequencies with **5.0 kHz** increments, while BCD switch settings from **5000 to 9999** will select operating frequencies with **6.25 kHz** increments. Calculation of the operating frequency for VHF synthesizers capable of 5.0/6.25 kHz channelization is determined as follows:

- BCD switch settings from **0000 to 4999**: Multiply the switch setting by 5.0 kHz and add the result to the synthesizer base frequency.

  Example: An OST-3H141 synthesizer has a base frequency of 128 MHz. The selected channel number is 0988. The synthesizer output frequency is:

  ((988 x 5 kHz) + 128 MHz) = 132.940 MHz

- BCD switch settings from **5000 to 9999**: Subtract 5000 from the switch setting. Multiply the result by 6.25 kHz and add the result to the synthesizer base frequency.

  Example: An OSR-3H162 synthesizer has a base frequency of 150 MHz. The selected channel number is 7205. The synthesizer output frequency is:

  ((7205-5000) x 6.25 kHz) + 150 MHz) = 163.78125 MHz

2.7 8.333 kHz Channelization.

Daniels AM synthesizers have been designed to generate frequencies in 8.333 kHz increments. In North America, AM channels and operating frequencies are allocated in triples of 8.333 kHz (i.e. 25 kHz steps). The operating frequency for synthesizers having 8.333 kHz channelization is determined as follows:

- Multiply the BCD switch setting by 8.333 kHz and add the result to the synthesizer base frequency.

  Example: An OST-3A128 synthesizer has a base frequency of 118 MHz. The selected channel number is 0231. The synthesizer output frequency is:

  [(1200 x 8.333 kHz) + 118 MHz] = 128.000 MHz

2.8 12.5 kHz Channelization.

The operating frequency for Synthesizers having 12.5 kHz channelization is determined as follows:

- Multiply the BCD switch setting by 12.5 kHz and add the result to the synthesizer base frequency.

  Example: An OST-3H418 synthesizer has a base frequency of 406 MHz. The selected channel number is 1660. The synthesizer output frequency is:

  ((1660 x 12.5 kHz) + 406 MHz) = 426.7500 MHz

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3. SYNTHESIZER ALIGNMENT

3.1 General

OS(R/T)-3(A/H) enhanced synthesizer alignment is simplified by using a Type 84 subrack and RF extender card/cable of providing receiver or transmitter power and signal interconnection. Alternately, +9.5 Vdc may be directly connected to a receiver or transmitter module with the positive connection on pins B6 / Z6 and the negative connection on pins B30 / Z30 / B32 / Z32. Receiver balanced audio (600 Ω) is available at pins B26 and Z26.

3.2 Repair Note

The OS(R/T)-3(A/H) synthesizer employs a large number of surface mount components. Removal and/or replacement of surface mount components should never be performed using an ordinary soldering iron but should only be performed at surface mount rework and repair stations equipped with Electro Static Dissipative (ESD) protection.

When removing Surface Mount Solder Jumpers, it is recommended that solder wick braid be used in lieu of vacuum type de-soldering tools to help prevent damage to the printed circuit boards.

3.3 Recommended Test Equipment

Alignment of the synthesizer requires the following test equipment, or its equivalent:

Power supply - Regulated +9.5 Vdc at 2 A. Phillips PM 2811
Oscilloscope / Multimeter - Fluke 97 Scopemeter
Radio communications test set - Marconi Instruments 2965A

It is recommended that the radio communications test set be referenced to an external high stability frequency source (WWVH, GPS, Loran C) so that the OS-3A/H internal high stability local oscillator may be accurately set to within its ±1 ppm frequency tolerance.

3.4 OS(R/T)-3(A/H) Synthesizer Factory Configuration

The OS(R/T)-3(A/H) Synthesizer is factory configured as follows:

- Internal 9.6 MHz reference selected.
- VCO modulation (via audio processor) enabled (OST TX versions only)

The corresponding internal synthesizer jumper settings are:

Digital Board

- Jumper JU2 not installed 9.6 MHz internal frequency reference selected
- Jumper JU1 installed AM Multichannel mode selected

Analog Board

- Jumper JU1: 'B' position Internal frequency reference selected
- Jumper JU2 not installed Internal frequency reference selected

3.5 OS(R/T)-3(A/H) Synthesizer Alignment

3.5.1 General

Under normal circumstances (i.e. a change in operating frequency within the synthesizer's maximum tuning range), synthesizer alignment is accomplished with the synthesizer installed in the MT-3 Receiver IF/Audio Board or the MT-3 Transmitter Main Board. The alignment procedure involves setting the internal TCXO reference frequency (if one is installed and the internal reference option is enabled). This step is described in "Reference Frequency Alignment", section 3.5.5.5. A change in operating frequency from the initial factory setting that exceeds the synthesizer's maximum tuning range (Refer to Specifications section 1.3) requires a more involved alignment procedure as described in sections 3.5.2 to 3.5.5. Conversion of a synthesizer from internal reference to external reference or vice-versa is accomplished through selection of jumper JU1 A or B, as appropriate and JU2 (Refer to section 3.5.6).

3.5.2 Synthesizer Test Points

Analog Board Component Layout (Top)
Common to all synthesizer family members.

TP1 +8.0 ±0.3 Vdc. U6 positive regulator output.
TP2 +5.0 ±0.1 Vdc. U7 positive regulator output.
TP3 +5.0 ±0.1 Vdc. U8 positive regulator output (always on).
TP4 PLL error voltage. Normal range is +0.5 to +4.5 Vdc (depending on frequency). Nominally adjusted for +2.3 Vdc (via C24) for center channel. UHF/VHF versions employing integrated VCO modules (OSR-3H440, OST-3H418, OST-3H460, OSR-3A149, OST-3A128) require no adjustment.

Digital Board Component Layout (Bottom)

TP1 +5.0 ±0.1 Vdc. U2 positive regulator output (controlled via pin P2-4).
TP2 Microcontroller E clock. 2 MHz logic level square wave.

3.5.3 Synthesizer Removal and Installation

The synthesizer module is secured to the main board (MT-3 Receiver IF/Audio Board or MT-3 Transmitter Main board) with a single counter sunk Phillips machine screw accessible from the top cover. Remove this screw to remove the synthesizer module. Using a plastic coated lifting tool, such as a small screwdriver with the tip covered in heat shrink material, gently lift the synthesizer module from the main circuit board by applying pressure in a rotating fashion about the four corners of the synthesizer module. It is important to gently remove the synthesizer module "straight out" in order to prevent damage to the connector pins. Installation of the synthesizer is performed in a reverse fashion. It is important to ensure complete connector pin alignment prior to any application of reinsertion force. Four corner locating pins on the synthesizer housing assist in connector pin alignment during installation and removal.

Note: Complete synthesizer alignment can be performed without removing the synthesizer.

The alignment procedure starting in section 3.5.5 may now be performed.

3.5.4 Circuit Board Removal

Note: Circuit board removal is not required for tuning purposes.

Using a vacuum de-soldering station, de-solder connections P1, P2 and P3. Remove SMB connectors J1 and J2 by de-soldering the center pins and removing four M2.0 machine screws. These connection points are shown in the "OS(R/T)-3(A/H) XXX - XXX MHz Analog Board Component Layout (Top)" diagrams. Remove seven M2.0 machine screws and carefully remove the analog circuit board. Removal of the analog circuit board will expose three inter-board wire connections. Carefully remove three ferrite beads and six Teflon washers from the inter-board connection wires. Attempt to maintain the position of the three inter-board wires in order to simplify re-assembly. The digital board may now be extracted by removing four M2.0 machine screws. Follow a reverse procedure to re-assemble.

3.5.5 Frequency Adjustment and Channel Selection

Connect a radio communications test set through a short section of low loss 50 Ω coaxial cable to the synthesizer module SMB RF output jack (J2). Select the desired channel number via the BCD frequency selection switches on the MT-3 Transmitter Main board or the MT-3 Receiver IF/Audio board (or through .the Frequency Programming Module). Turn the power off and back on and wait a few minutes for the oscillator to completely stabilize. It should be noted that the internal synthesizer TCXO, if installed, operates continuously (regardless of the TX PTT state) when installed in a transmitter.

The measured RF output signal should be within ±1.0 ppm of the specified oscillator frequency at an output level of +5 dBm. Note that unlocked synthesizer operation will be indicated by an unstable or spurious RF output signal. The "Unlocked" red LED will also be illuminated when the PLL is unlocked. Check that the requested channel number is within the frequency range of the particular synthesizer model. An unlocked condition may be rectified by adjusting the VCO tuning elements as described in the following procedures (no adjustment required for the Multichannel AM Synthesizers). Note that there are variations in alignment procedures between the three synthesizer family members as described in the following sections.

3.5.5.1 VHF OS(R/T)-3H 29 - 71.4 MHz VCO Alignment

Refer to the "OS(R/T)-3H 29 - 71.4 MHz Analog Board Component Layout" diagrams and the "OS(R/T)-3H 29 - 71.4 MHz Analog Board Schematic Diagram" on pages 4-1, 4-2 and 4-3 of this manual.

Using a high impedance (10 MΩ) DC Voltmeter, measure the PLL control voltage at TP4 located on the synthesizer module analog board (top). Access to TP4 is available through the synthesizer top cover. Using a small standard blade screwdriver, carefully adjust the VCO fine frequency "TUNE" trimmer capacitor C24 until a test point (TP4) voltage of approximately +2.3 Vdc is obtained. PLL loop control voltages below approximately +0.5 Vdc and above approximately +4.5 Vdc will indicate an "out of lock" synthesizer condition.

If a test point (TP4) reading of approximately +2.3 Vdc is unattainable through adjustment of C24, then the coarse frequency jumpers, JU2-JU4 require modification in order to pull the VCO tune range within the adjustment range of fine tuning capacitor C24. The top synthesizer cover must be removed in order to gain access to the coarse frequency jumpers. The coarse frequency jumpers (JU2-JU4) may be considered to be a selectable binary weighted capacitor element with JU2 being the most significant "bit" and JU4 being the least significant "bit". The tuning resolution size is ≈12 pF (JU4). If the tuning voltage remains higher than +2.3 Vdc, decrease the tuning jumper setting by 1 "bit" position and re-adjust C24 in an attempt to achieve +2.3 Vdc at TP4. For example, if coarse frequency jumpers JU2-JU4 are all installed and represented by 111 then a decrease by 1 "bit" position (12 pF) is represented by a binary jumper selection of 110; jumper JU4 is not installed and jumpers JU2, JU3 are installed. Continue to decrease the jumper position one "bit" at a time until the synthesizer regains lock with TP4 adjusted (C24) for +2.3 Vdc. If the tuning voltage remains lower than +2.3 Vdc, increase the jumper setting by 1 "bit" position and re-adjust C24 in an attempt to achieve +2.3 Vdc at TP4. Repeat this procedure until +2.3 Vdc is achieved at TP4.

It is important to check the loop control voltage at TP4 when multiple synthesizer channels have been programmed. All channel selections should result in a TP4 voltage within a +1.0 to +4.0 Vdc range. Adjust the fine-tuning capacitor C24 to center multiple channel voltages symmetrically about +2.3 Vdc. Channel selections beyond the tuning range capability of the synthesizer will result in

unlocked operation. The tuning range capability of all synthesizer models is listed in the Specifications section (1.3) of this manual.

3.5.5.2 VHF OS(R/T)-3A 118 - 159.4 MHz Alignment

Refer to the "OS(R/T)-3A 118 - 159.4 MHz Analog Board Component Layout" diagram and the "OS(R/T)-3A 118 - 159.4 MHz Analog Board Schematic Diagram" on pages 4-5, 4-6 and 4-7 of this manual.

Using a high impedance (10 MΩ) DC Voltmeter, measure the PLL control voltage at TP4 located on the synthesizer module analog board (top). Access to TP4 is available through the synthesizer top cover. VHF synthesizers operating in the 118 - 159.4 MHz frequency range require no frequency adjustment as tuning is microprocessor controlled. (The OST-3A128 and OSR-3A149, covering 118-138 MHz and 139.4 - 159.4 MHz respectively, provide full band coverage without tuning adjustment.)

All channel selections should result in a TP4 voltage between +3.1 and +3.5 Vdc. Channel selections beyond the tuning range capability of the synthesizer will result in unlocked operation over the temperature range -40C to +60C. The tuning range capability of all synthesizer models is listed in the Specifications section of this manual.

3.5.5.3 VHF OS(R/T)-3H 128 - 174 MHz VCO Alignment

Refer to the "OS(R/T)-3H 128 - 174 MHz Analog Board Component Layout" diagram and the "OS(R/T)-3H 128 - 174 MHz Analog Board Schematic Diagram" on pages 4-9, 4-10 and 4-11 of this manual.

Using a high impedance (10 MΩ) DC Voltmeter, measure the PLL control voltage at TP4 located on the synthesizer module analog board (top). Access to TP4 is available through the synthesizer top cover. Using a small standard blade screwdriver, carefully adjust the VCO fine frequency "TUNE" trimmer capacitor C24 until a test point (TP4) voltage of approximately +2.3 Vdc is obtained. Measured PLL loop control voltages below approximately +0.5 Vdc and above approximately +4.5 Vdc will indicate an "out of lock" synthesizer condition.

It is important to check the loop control voltage at TP4 when multiple synthesizer channels have been programmed. All channel selections should result in a TP4 voltage within the +1.0 to +4.0 Vdc range. Adjust the fine-tuning capacitor C24 to center multiple channel voltages symmetrically about +2.3 Vdc. Channel selections beyond the tuning range capability of the synthesizer will result in unlocked operation. The tuning range capability of all synthesizer models is listed in the Specifications section of this manual.

3.5.5.4 UHF OS(R/T)-3H 406 - 470 MHz VCO Alignment

Refer to the "OS(R/T)-3H 406 - 470 MHz Analog Board Component Layout" diagram and the "OS(R/T)-3H 406 - 470 MHz Analog Board Schematic Diagram" on pages 4-13, 4-14 and 4-15 of this manual.

Using a high impedance (10 MΩ) DC Voltmeter, measure the PLL control voltage at TP4 located on the synthesizer module analog board (top). Access to TP4 is available through the synthesizer top cover. The UHF synthesizers operating in the 406 - 470 MHz frequency range employ integrated VCO modules having no external frequency adjustment capability. The OST-3H418, OST-3H460 and OSR-3H440 models cover frequencies from 406 - 430 MHz, 450 - 470 MHz and 427.4 - 451.4 MHz respectively and provide full band coverage without tuning adjustment. For the OST-3H418, measured PLL control voltages below approximately +0.5 Vdc and above approximately +4.5 Vdc will indicate an "out of lock" condition. For the OSR-3H440 and the OST-3H460, measured PLL control voltages below approximately +1.0 Vdc and above approximately +7.0 Vdc will indicate an "out of lock" condition.

It is important to check the loop control voltage at TP4 when multiple synthesizer channels have been programmed. All channel selections should result in a TP4 voltage within the +0.5 to +4.5 Vdc range for the OST-3H418. The TP4 voltage for the OSR-3H440 and the OST-3H460 should be within the +1.0 to +7.0 Vdc range. Channel selections beyond the tuning range capability of the synthesizer will result in unlocked operation. The tuning range capability of all synthesizer models is listed in the Specifications section of this manual.

3.5.5.5 Reference Frequency Alignment

Adjust the synthesizer TCXO fine frequency potentiometer RV1 until the correct output frequency is achieved. Access to this potentiometer is through an opening in the synthesizer top cover. A RF power level of approximately +5 dBm should be measured at the synthesizer module output connector and the frequency should be within ±1 ppm of the desired operating frequency. Reference frequency adjustments should be made at room temperature (+25°C) after a ten minute stabilization period.

3.5.6 Jumper Configuration

Solder jumpers are clearly marked on both synthesizer digital and analog circuit boards. Refer to the "OS(R/T)-3(A/H) Digital Board Component Layout (Bottom)" diagram on page 4-17 of this manual and the applicable "OS(R/T)-3(A/H) Analog Board Component Layout (Top)" diagram on page 4-18 for jumper locations. The following list details the required jumper configuration for the two synthesizer operating modes:

1) Internal reference. Install jumper JU1-B, on the Analog Board (Standard). The internal temperature compensated crystal oscillator (TCXO) provides the reference signal with a stability of ±1 ppm from -30°C (Optional -40°C) to +60°C.

2) External reference input. Install jumper JU1-A and JU2 on the Analog Board. This mode is used in applications requiring better than ±1 ppm frequency stability. An external reference signal must be provided at synthesizer SMB connector J1.

3) Reference Frequency Select. Install jumper JU2 on the Digital Board to select a 10.0 MHz reference frequency. When not installed, the reference frequency is by default 9.6 MHz. JU2 must not be installed when using the internal 9.6 MHz TCXO reference. JU2 is used by the microcontroller to establish the correct reference frequency division ratio. (Located on the Digital Board; The Synthesizer module must be removed to change jumper JU2.)

4) AM Multichannel Synthesizer Select. Install jumper JU1 on the Digital Board to select and enable the AM Multichannel Synthesizer with Frequency Select Handle.

Caution: Care must be exercised when reinstalling the synthesizer module on the Transmitter Main board or the IF/Audio board. Pay careful attention to pin alignment before pressing the synthesizer module into its mating sockets.

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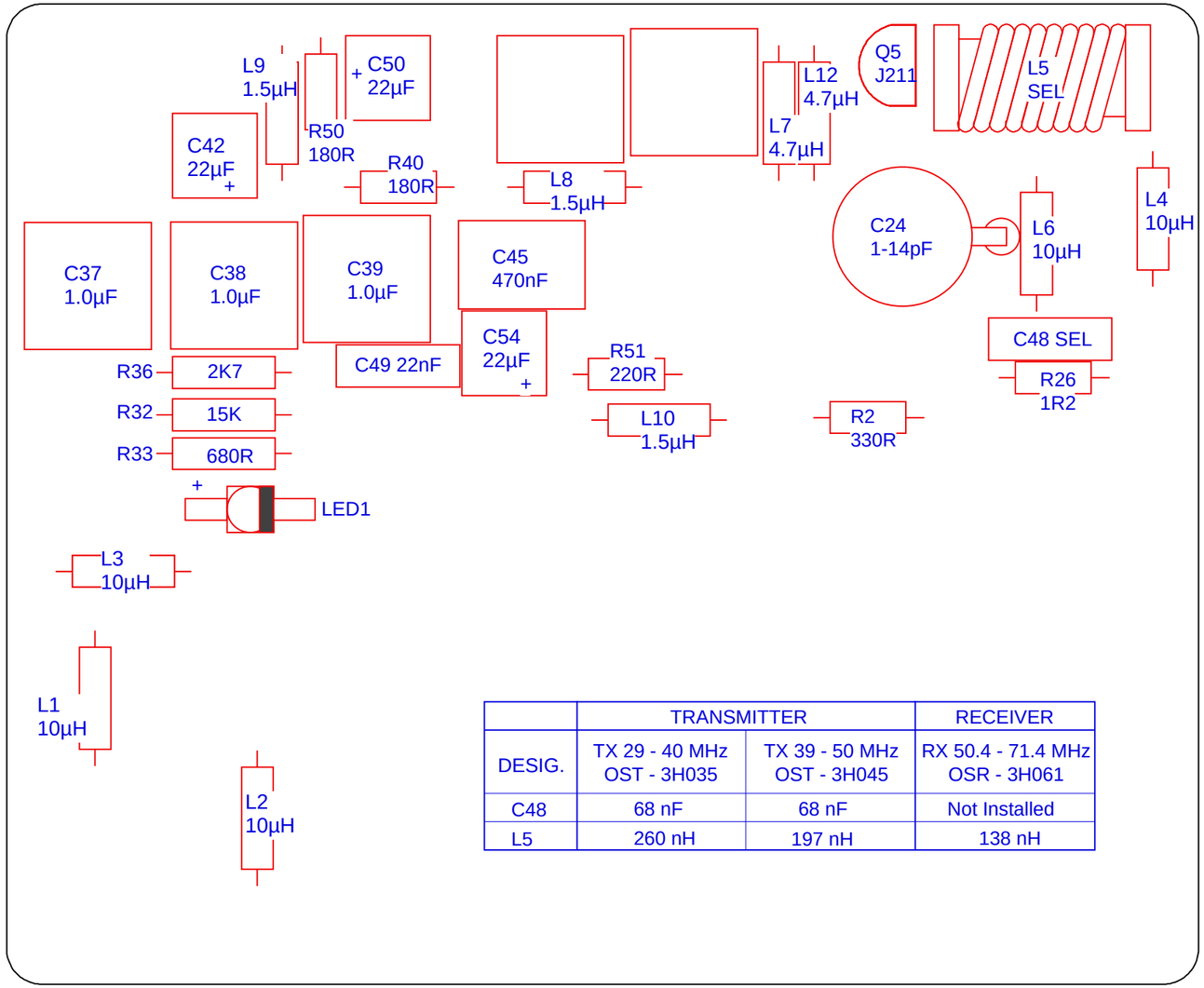
4 ILLUSTRATIONS AND SCHEMATIC DIAGRAMS

4.1 OS(R/T)-3H 29 - 71.4 MHz Analog Board Diagrams

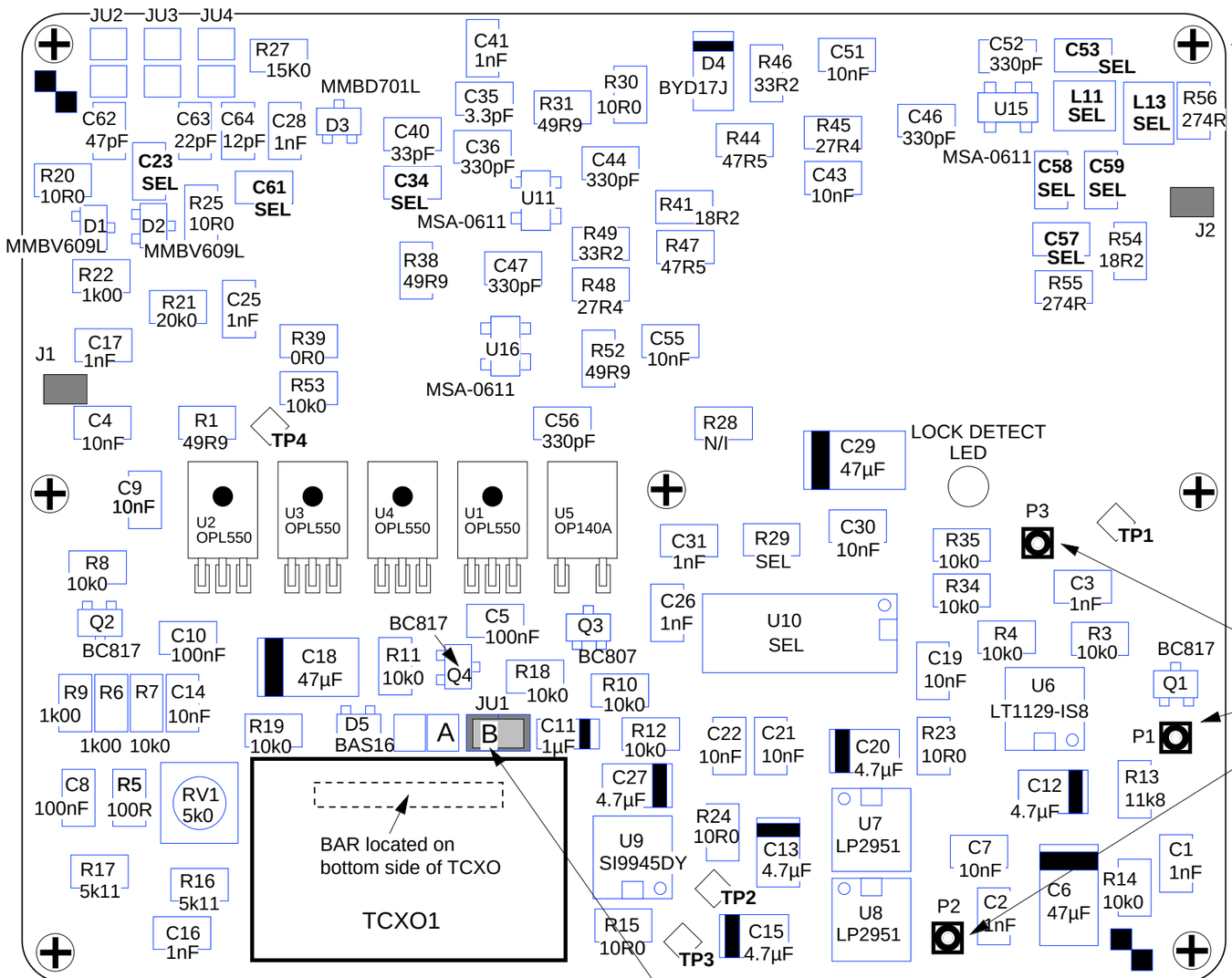
4.1.1 OS(R/T)-3H 29 - 71.4 MHz Analog Board Component Layout (Bottom)



	TRANSMITTER		RECEIVER
DESIG.	TX 29 - 40 MHz OST - 3H035	TX 39 - 50 MHz OST - 3H045	RX 50.4 - 71.4 MHz OSR - 3H061
C48	68 nF	68 nF	Not Installed
L5	260 nH	197 nH	138 nH

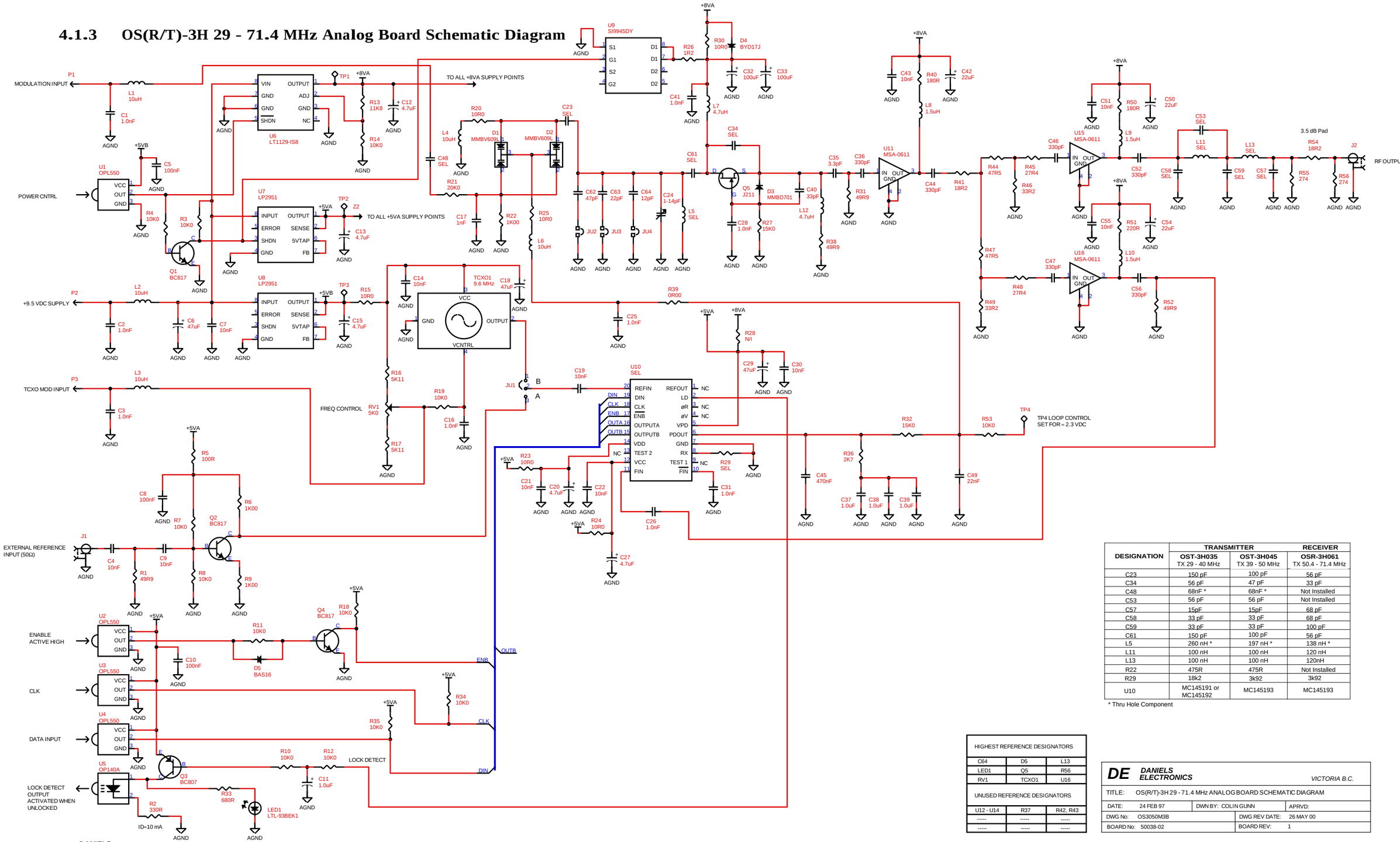
PCB 50038-02 OS3050M1

4.1.2 OS(R/T)-3H 29 - 71.4 MHz Analog Board Component Layout (Top)



DESIG.	TRANSMITTER		RECEIVER
	TX 29 - 40 MHz OST - 3H035	TX 39 - 50 MHz OST - 3H045	RX 50.4 - 71.4 MHz OSR - 3H061
C23	150 pF	100 pF	56 pF
C34	56 pF	47 pF	33 pF
C53	56 pF	56 pF	Not Installed
C57	15 pF	15 pF	68 pF
C58	33 pF	33 pF	68 pF
C59	33 pF	33 pF	100 pF
C61	150 pF	100 pF	56 pF
L11	100 nH	100 nH	120 nH
L13	100 nH	100 nH	120 nH
R29	18k2	3k92	3k92
U10	MC145191 or MC145192	MC145193	MC145193

4.1.3 OS(R/T)-3H 29 - 71.4 MHz Analog Board Schematic Diagram



DESIGNATION	TRANSMITTER		RECEIVER
	OST-3H035 TX 29 - 40 MHz	OST-3H045 TX 39 - 50 MHz	OSR-3H061 TX 50.4 - 71.4 MHz
C23	150 pF	100 pF	56 pF
C34	56 pF	47 pF	33 pF
C48	68nF *	68nF *	Not Installed
C53	56 pF	56 pF	Not Installed
C57	15pF	15pF	68 pF
C58	33 pF	33 pF	68 pF
C59	33 pF	33 pF	100 pF
C61	150 pF	100 pF	56 pF
L5	260 nH *	197 nH *	138 nH *
L11	100 nH	100 nH	120 nH
L13	100 nH	100 nH	120nH
R22	475R	475R	Not Installed
R29	18k2	3k92	3k92
U10	MC145191 or MC145192	MC145193	MC145193

* Thru Hole Component

HIGHEST REFERENCE DESIGNATORS		
C64	D5	L13
LED1	Q5	R56
RV1	TCXO1	U16
UNUSED REFERENCE DESIGNATORS		
U12 - U14	R37	R42, R43
-----	-----	-----
-----	-----	-----

DE DANIELS ELECTRONICS *VICTORIA B.C.*

TITLE: OS(R/T)-3H 29 - 71.4 MHz ANALOG BOARD SCHEMATIC DIAGRAM

DATE: 24 FEB 97	DWN BY: COLIN GUNN	APRVD:
DWG No: OS3050M3B	DWG REV DATE: 26 MAY 00	
BOARD No: 50038-02	BOARD REV: 1	

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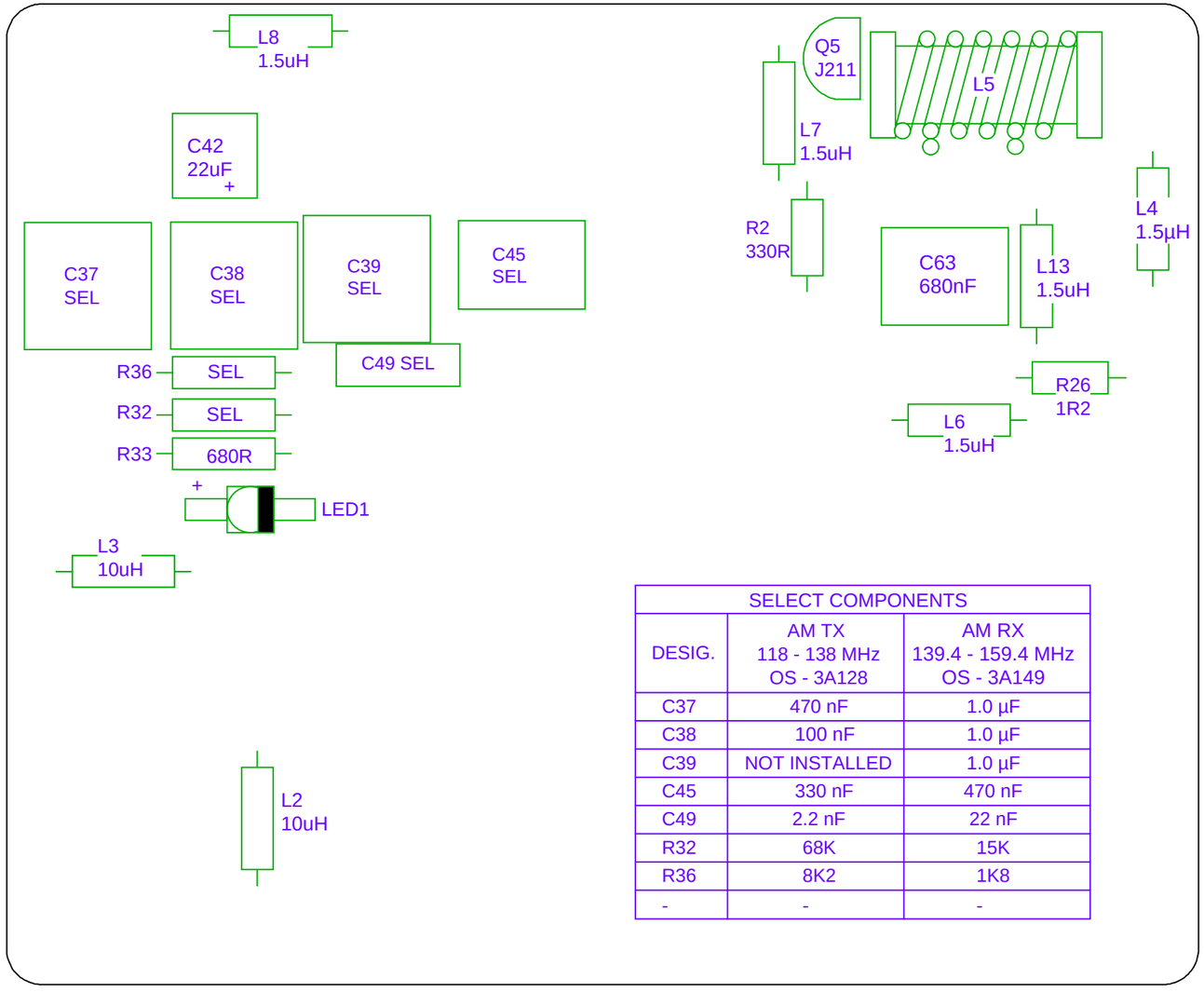
4.2 OS(R/T)-3A 118 - 159.4 MHz Analog Board Diagrams

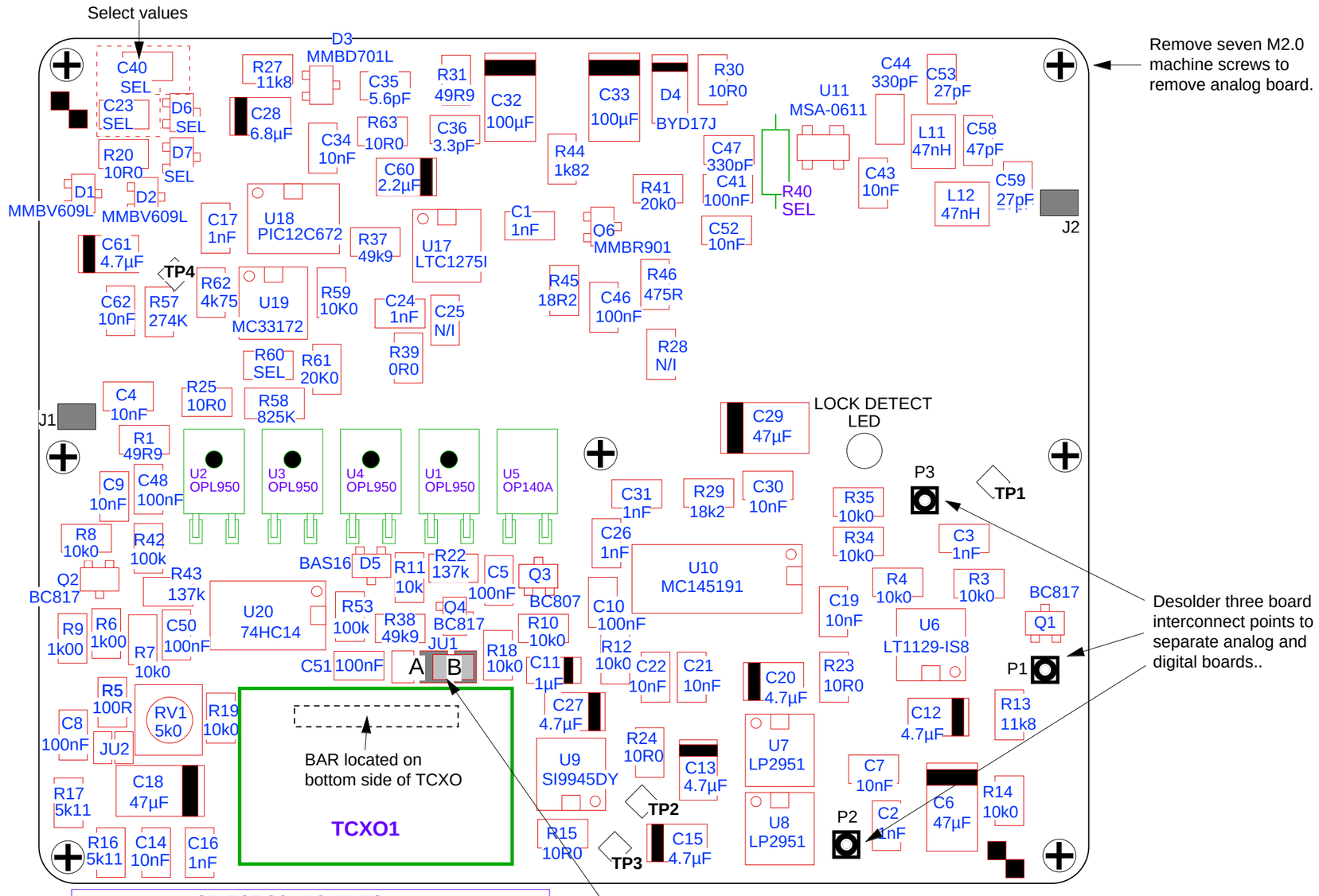
4.2.1 OS(R/T)-3A 118 - 159.4 MHz Analog Board Component Layout (Bottom) PCB 50082-04



SELECT COMPONENTS		
DESIG.	AM TX 118 - 138 MHz OS - 3A128	AM RX 139.4 - 159.4 MHz OS - 3A149
C37	470 nF	1.0 µF
C38	100 nF	1.0 µF
C39	NOT INSTALLED	1.0 µF
C45	330 nF	470 nF
C49	2.2 nF	22 nF
R32	68K	15K
R36	8K2	1K8
-	-	-

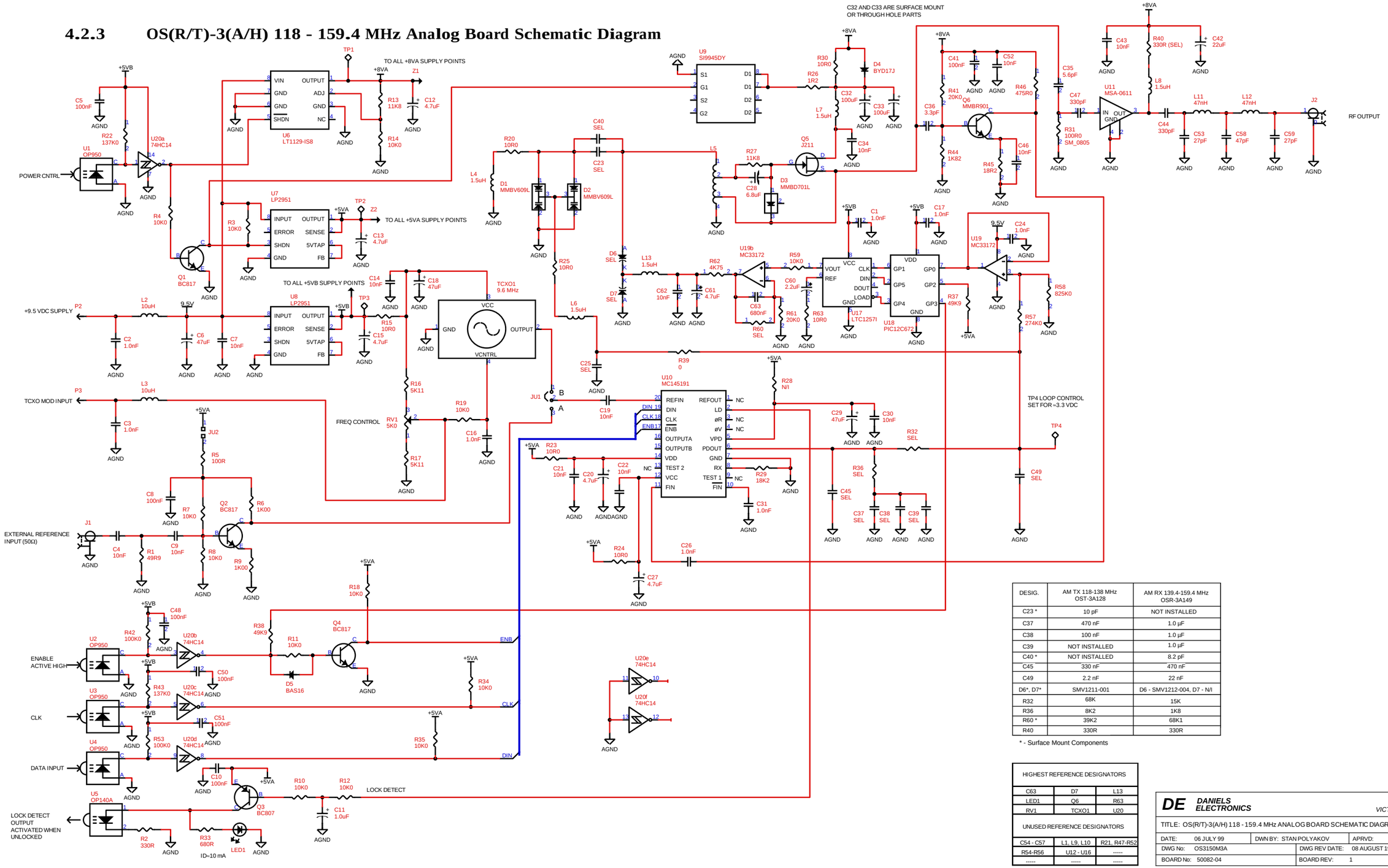
OS3150M1A

4.2.2 OS(R/T)-3A 118 - 159.4 MHz Analog Board Component Layout (Top) PCB 50082-04



SELECT COMPONENTS		
	AM TX 118 -138 MHz OST - 3A128	AM RX 118 -138 MHz OSR - 3A149
C23	3.3pF	Not Installed
C40	Not Installed	8.2pF
D6,D7	SMV1211-001	D6-SMV1212-004, D7-N/I
R40	220Ω	330Ω
R60	39K2	68K1

4.2.3 OS(R/T)-3(A/H) 118 - 159.4 MHz Analog Board Schematic Diagram



DESIG.	AM TX 118-138 MHz OST-3A128	AM RX 139.4-159.4 MHz OSR-3A149
C23 *	10 pF	NOT INSTALLED
C37	470 nF	1.0 µF
C38	100 nF	1.0 µF
C39	NOT INSTALLED	1.0 µF
C40 *	NOT INSTALLED	8.2 pF
C45	330 nF	470 nF
C49	2.2 nF	22 nF
D6*, D7*	SMV1211-001	D6 - SMV1212-004, D7 - N/I
R32	68K	15K
R36	8K2	1K8
R60 *	39K2	68K1
R40	330R	330R

* - Surface Mount Components

HIGHEST REFERENCE DESIGNATORS		
C63	D7	L13
LED1	Q6	R63
RV1	TCXO1	U20
UNUSED REFERENCE DESIGNATORS		
C54 - C57	L1, L9, L10	R21, R47-R52
R54-R56	U12 - U16	-----
-----	-----	-----

DE DANIELS ELECTRONICS			VICTORIA B.C.
TITLE: OS(R/T)-3(A/H) 118 - 159.4 MHz ANALOG BOARD SCHEMATIC DIAGRAM			
DATE: 06 JULY 99	DWN BY: STAN POLYAKOV		APRVD:
DWG No: OS3150M3A		DWG REV DATE:	08 AUGUST 1999
BOARD No: 50082-04		BOARD REV:	1

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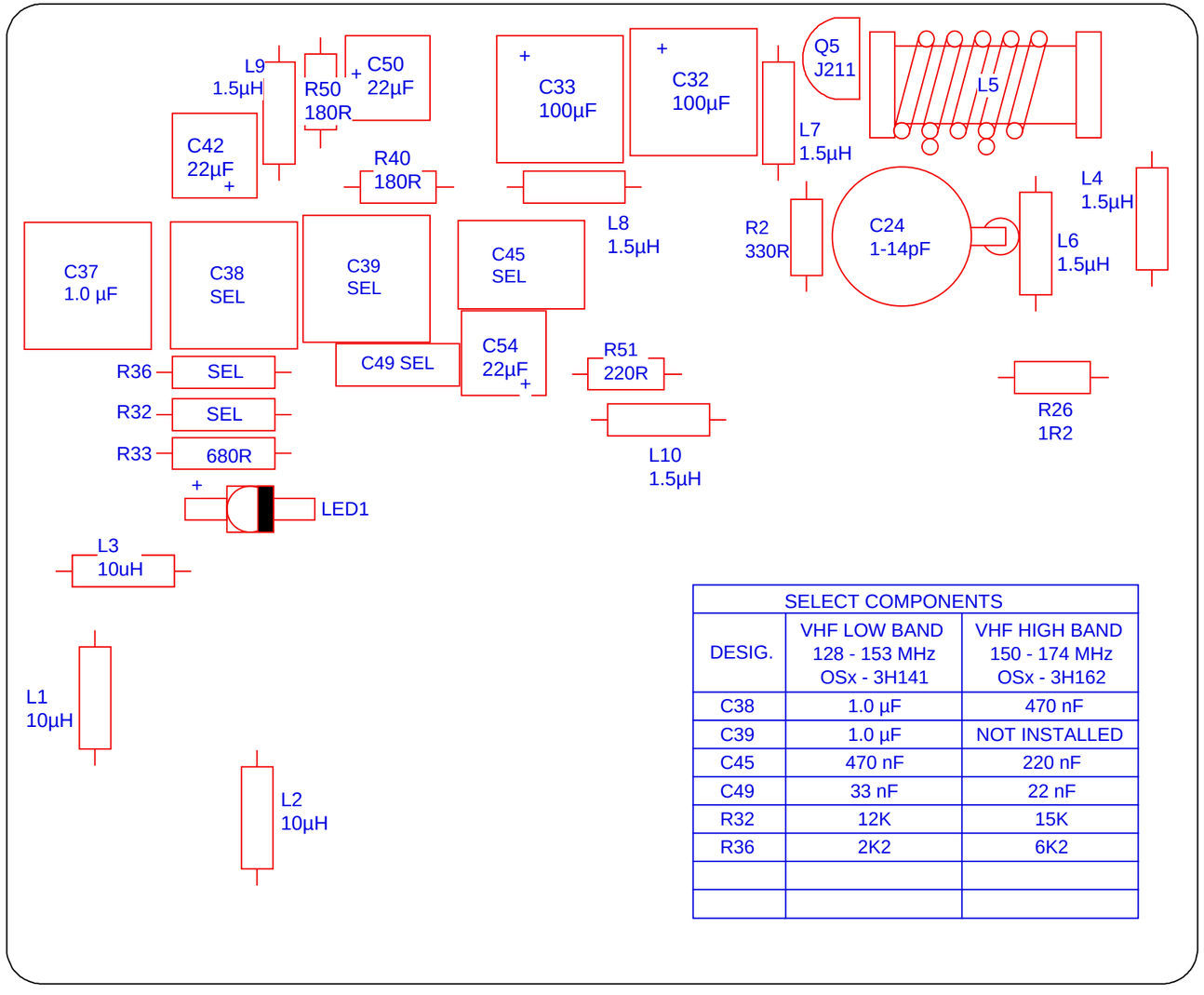
4.3 OS(R/T)-3H 128 - 174 MHz Analog Board Diagrams

4.3.1 OS(R/T)-3H 128 - 174 MHz Analog Board Component Layout (Bottom)



SELECT COMPONENTS		
DESIG.	VHF LOW BAND 128 - 153 MHz OSx - 3H141	VHF HIGH BAND 150 - 174 MHz OSx - 3H162
C38	1.0 µF	470 nF
C39	1.0 µF	NOT INSTALLED
C45	470 nF	220 nF
C49	33 nF	22 nF
R32	12K	15K
R36	2K2	6K2

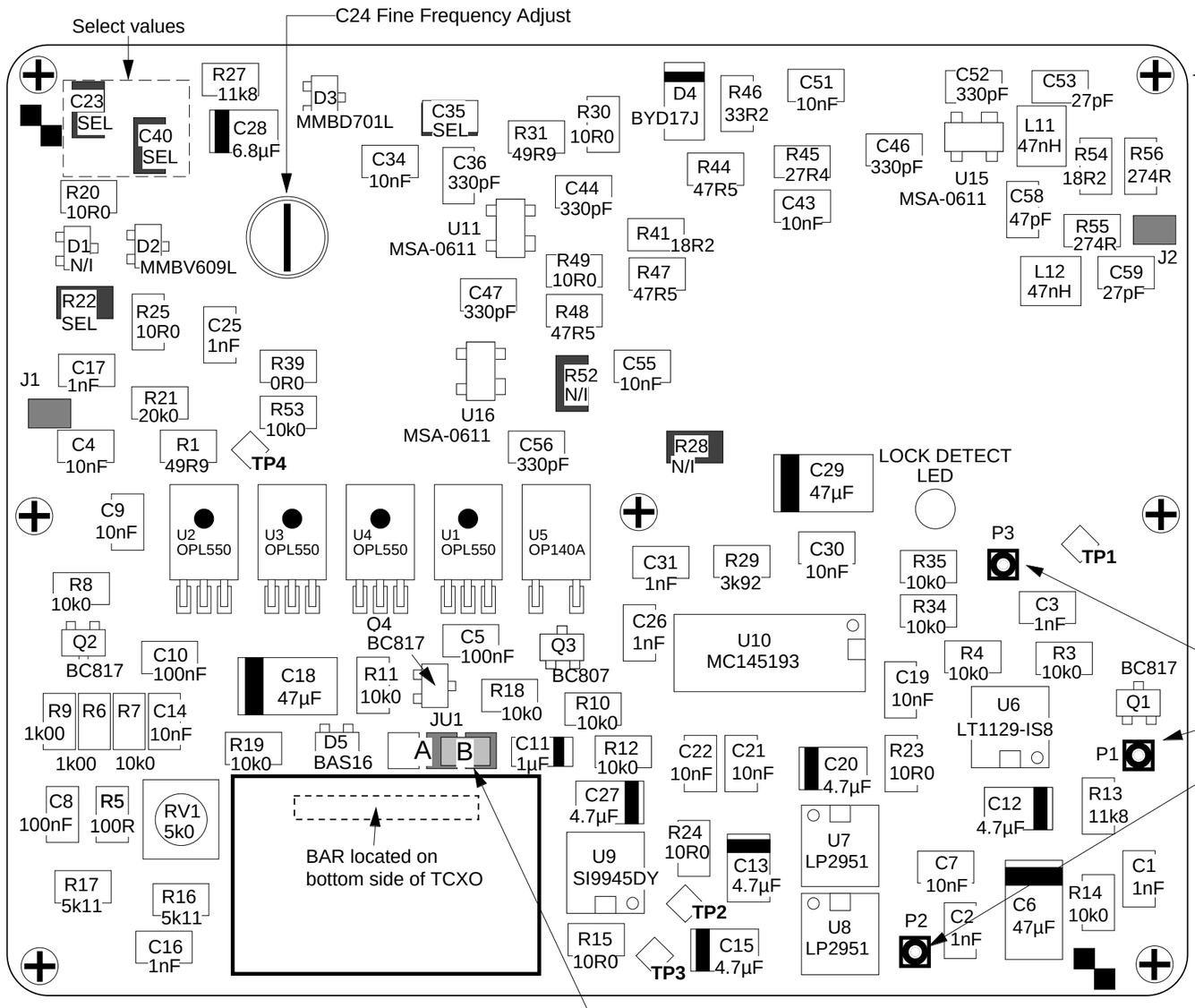
PCB 50025-02

OS3150M1B

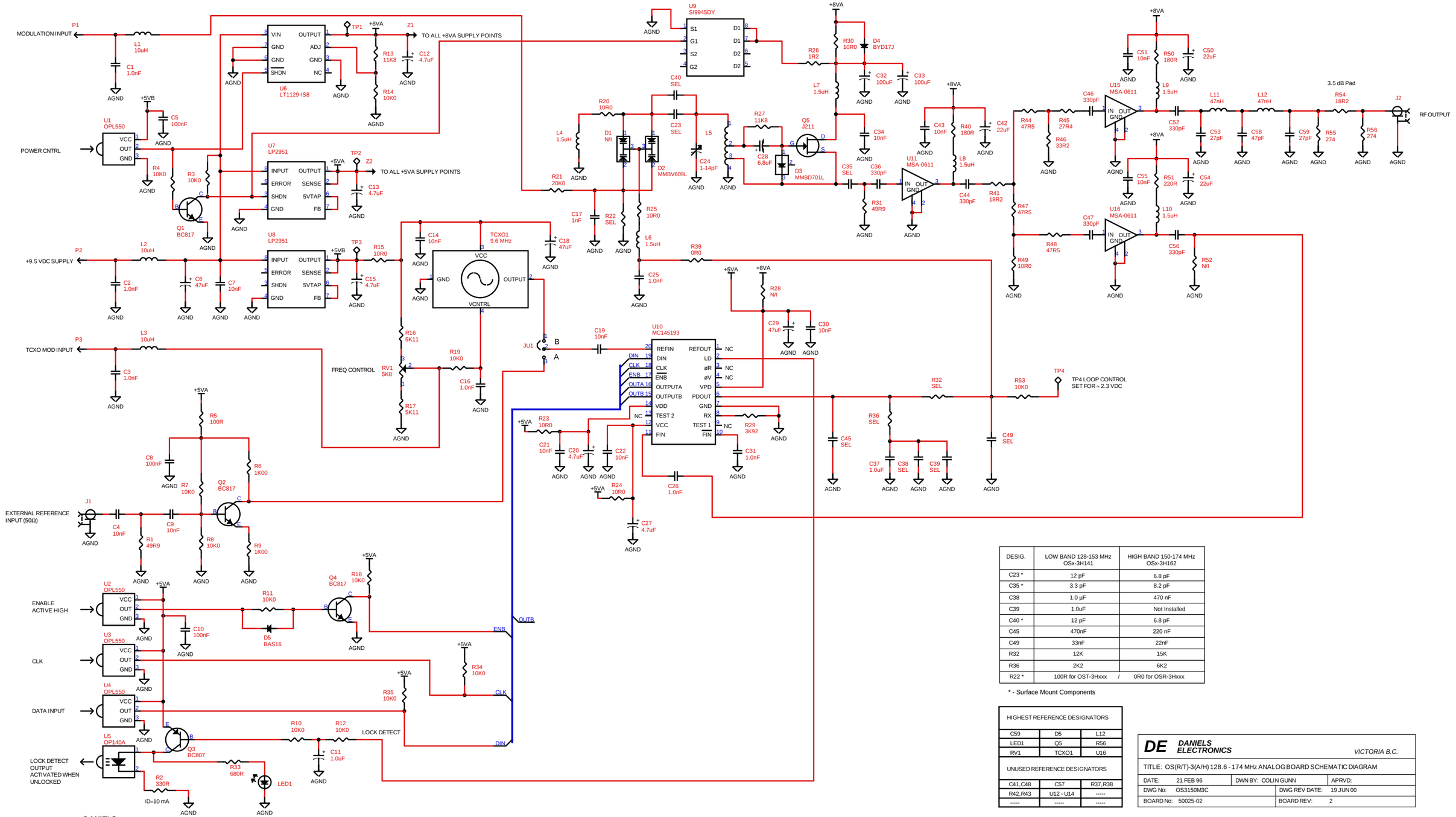
4.3.2 OS(R/T)-3H 128 - 174 MHz Analog Board Component Layout (Top)

SELECT COMPONENTS		
	Transmitter 128 - 174 MHz OST - 3Hxxx	Receiver 128 - 174 MHz OSR - 3Hxxx
R22	100R	0R0

SELECT COMPONENTS		
	VHF LOW BAND 128 - 153 MHz OSx - 3H141	VHF HIGH BAND 150 - 174 MHz OSx - 3H162
C23	12 pF	6.8 pF
C35	3.3 pF	8.2 pF
C40	12 pF	6.8 pF



4.3.3 OS(R/T)-3H 128 - 174 MHz Analog Board Schematic Diagram



DESIG.	LOW BAND 128-153 MHz OSx-3H141	HIGH BAND 150-174 MHz OSx-3H162
C23 *	12 pF	6.8 pF
C35 *	3.3 pF	8.2 pF
C38	1.0 µF	470 nF
C39	1.0uF	Not Installed
C40 *	12 pF	6.8 pF
C45	470nF	220 nF
C49	33nF	22nF
R32	12K	15K
R36	2K2	6K2
R22 *	100R for OST-3Hxxx /	0R0 for OSR-3Hxxx

* - Surface Mount Components

HIGHEST REFERENCE DESIGNATORS		
C59	D5	L12
LED1	Q5	R56
RV1	TCXO1	U16

UNUSED REFERENCE DESIGNATORS		
C41,C48	C57	R37,R38
R42,R43	U12 - U14	-----
-----	-----	-----

DE DANIELS ELECTRONICS VICTORIA B.C.

TITLE: OS(R/T)-3(A/H) 128.6 - 174 MHz ANALOG BOARD SCHEMATIC DIAGRAM

DATE:	21 FEB 96	DWN BY: COLIN GUNN	APRVD:
DWG No:	OS3150M3C	DWG REV DATE:	19 JUN 00
BOARD No:	50025-02	BOARD REV:	2

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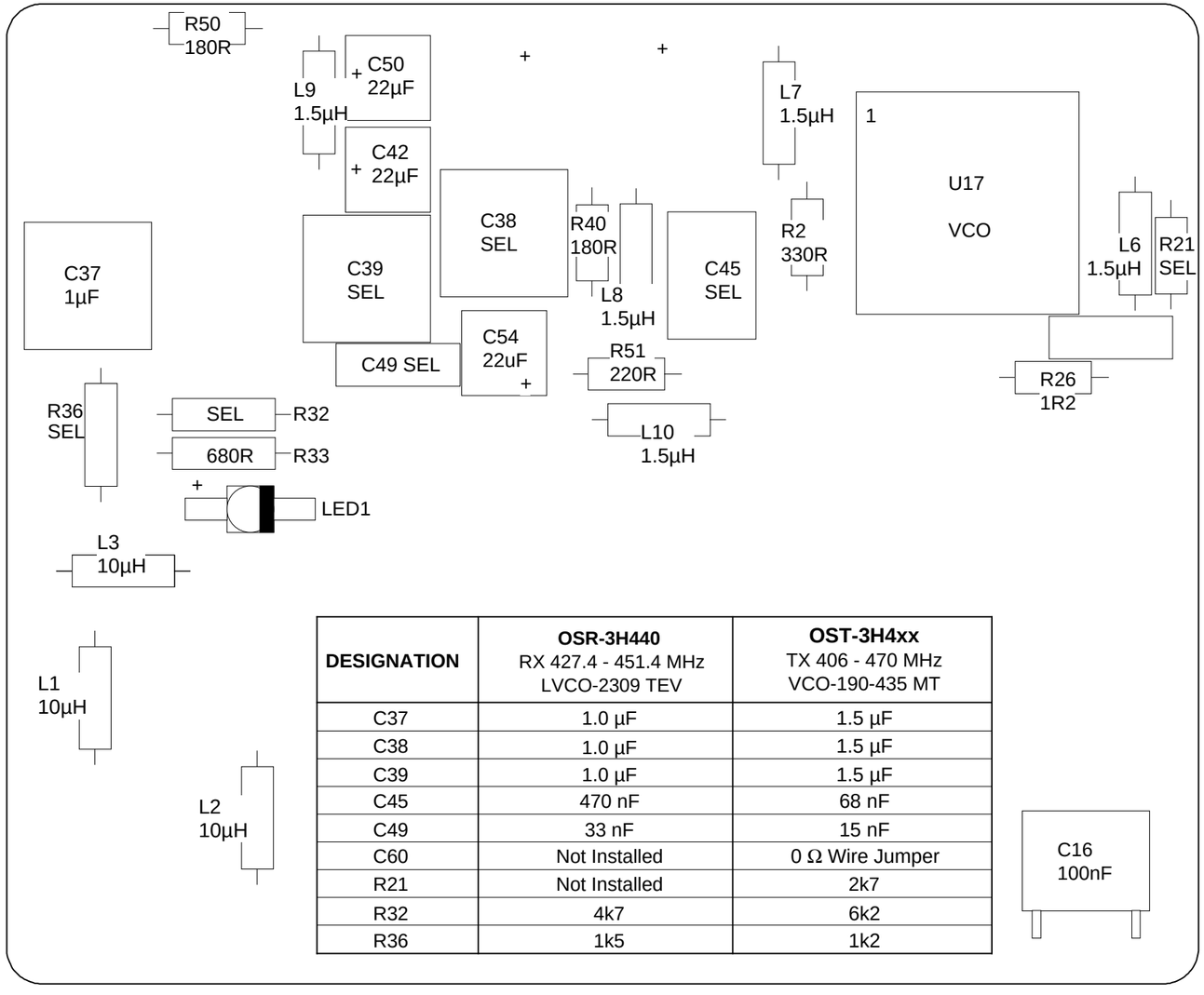
4.4 OS(R/T)-3H 406 - 470 MHz Analog Board Diagrams

4.4.1 OS(R/T)-3H 406 - 470 MHz Analog Board Component Layout (Bottom)



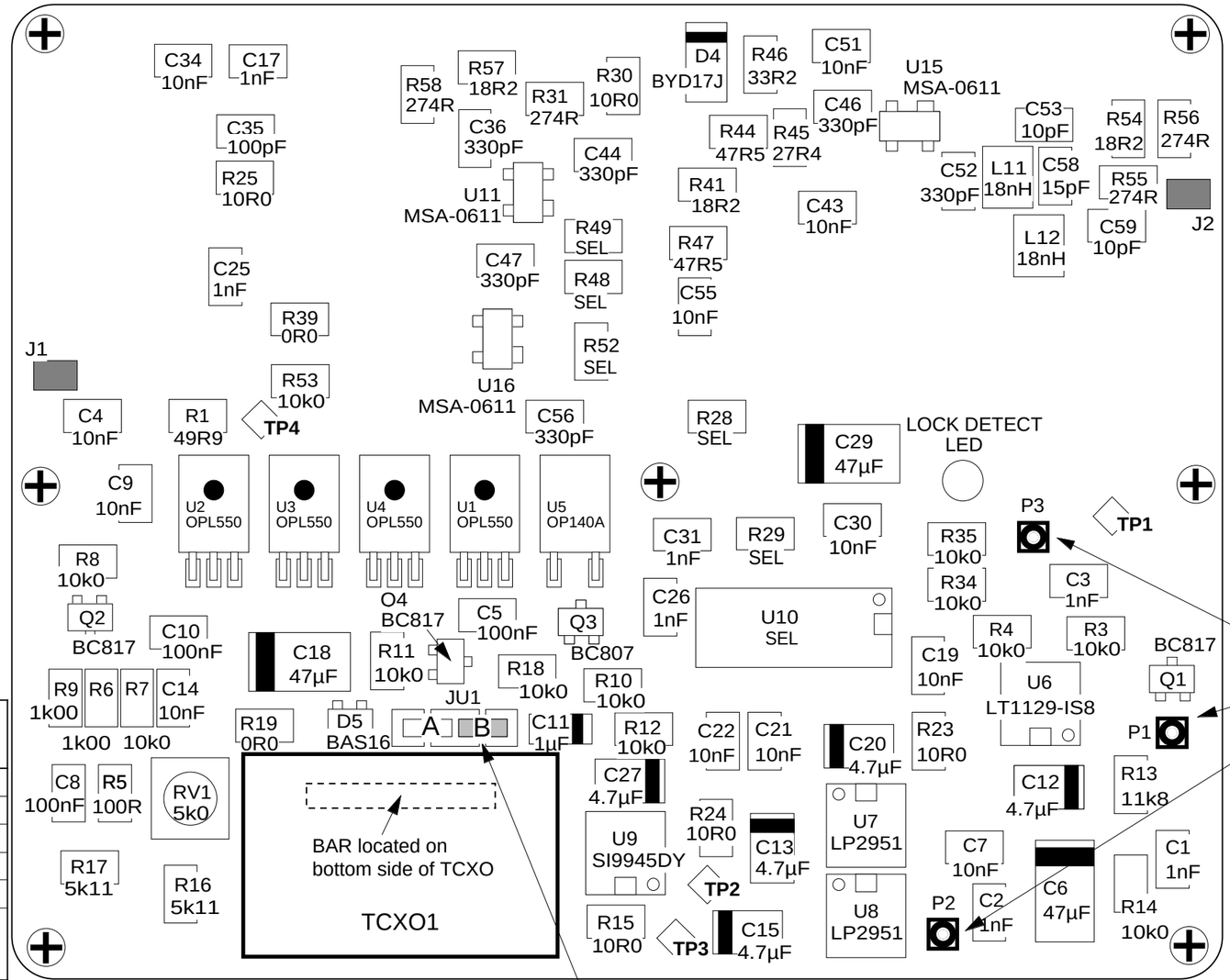
VCO INSTALLED (U17)	
RX 427.4 - 451.4 MHz	TX 406 - 470 MHz
LVCO-2309 TEV	VCO-190-435 MT

DESIGNATION	**OSR-3H440** RX 427.4 - 451.4 MHz LVCO-2309 TEV	**OST-3H4xx** TX 406 - 470 MHz VCO-190-435 MT
C37	1.0 µF	1.5 µF
C38	1.0 µF	1.5 µF
C39	1.0 µF	1.5 µF
C45	470 nF	68 nF
C49	33 nF	15 nF
C60	Not Installed	0 Ω Wire Jumper
R21	Not Installed	2k7
R32	4k7	6k2
R36	1k5	1k2

PCB 50028-02

OS3450M1C

4.4.2 OS(R/T)-3H 406 - 470 MHz Analog Board Component Layout (Top)



DESIG	**OSR-3H440** RX 427.4-451.4 MHz	**OST-3H418** TX 406 - 430 MHz	**OST-3H460** TX 450 - 470 MHz
R28	10R0	Not Installed *	10R0
R29	36k5	3k92	36k5
R48	27R4	47R5	27R4
R49	33R2	10R0	33R2
R52	49R9	Not Installed	49R9
U10	MC145190	MC145202F* or MC145193F*	MC145190

* - INDICATES JUMPERED TO 5VA

PCB 50028-02

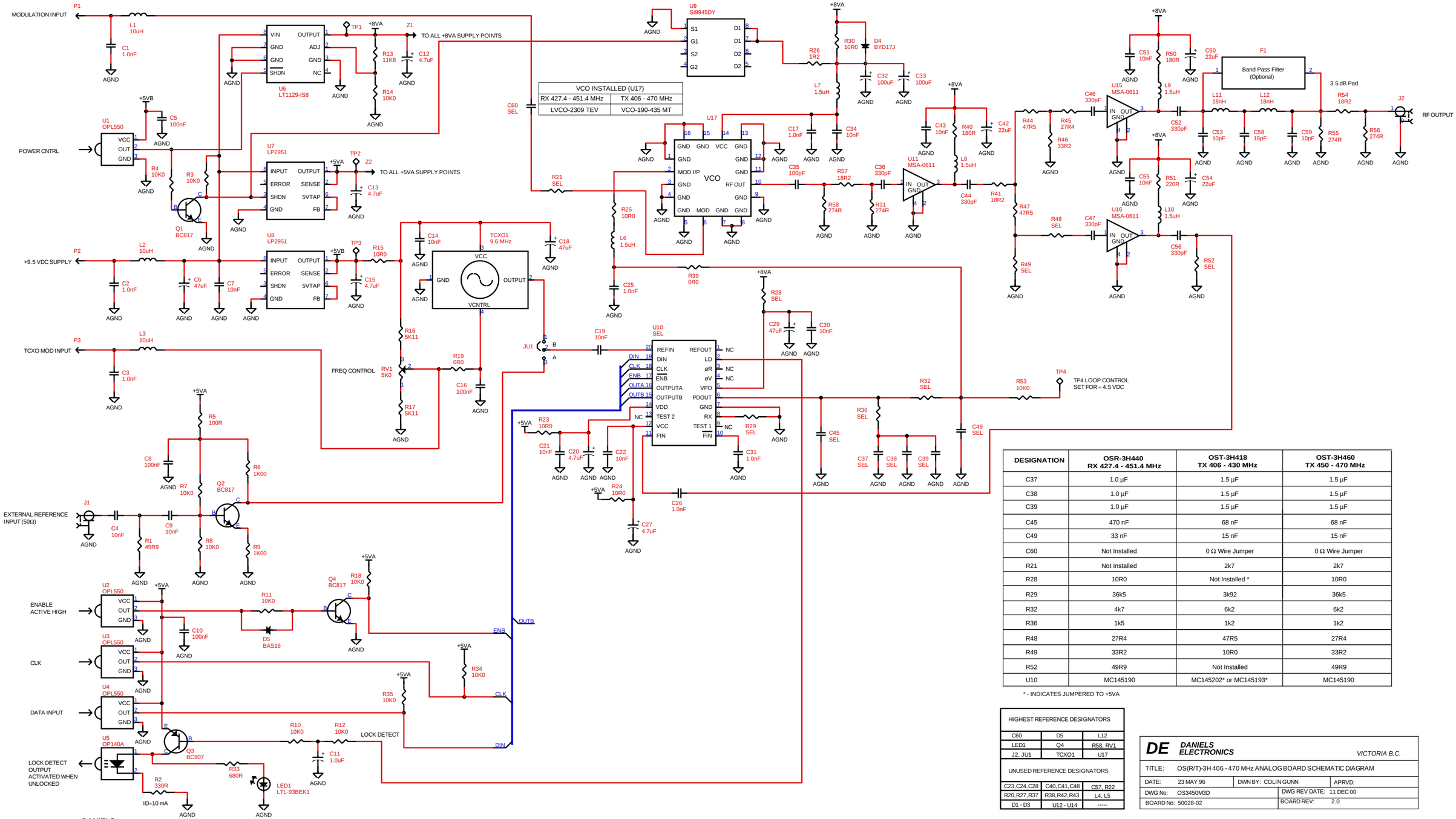
JU1 position B selected for internal 9.6 MHz

Desolder three board interconnect points to separate analog and digital boards..

Factory Installed Jumpers

OS3450M2B

4.4.3 OS(R/T)-3H 406 - 470 MHz Analog Board Schematic Diagram



DESIGNATION	OSR-3H440 RX 427.4 - 451.4 MHz	OST-3H418 TX 406 - 430 MHz	OST-3H460 TX 450 - 470 MHz
C37	1.0 µF	1.5 µF	1.5 µF
C38	1.0 µF	1.5 µF	1.5 µF
C39	1.0 µF	1.5 µF	1.5 µF
C45	470 nF	68 nF	68 nF
C49	33 nF	15 nF	15 nF
C60	Not Installed	0 Ω Wire Jumper	0 Ω Wire Jumper
R21	Not Installed	2k7	2k7
R28	10R0	Not Installed *	10R0
R29	36k5	3k92	36k5
R32	4k7	6k2	6k2
R36	1k5	1k2	1k2
R48	27R4	47R5	27R4
R49	33R2	10R0	33R2
R52	49R9	Not Installed	49R9
U10	MC145190	MC145202* or MC145193*	MC145190

* - INDICATES JUMPERED TO +5VA

HIGHEST REFERENCE DESIGNATORS		
C60	D5	L12
LED1	Q4	R58, RV1
J2, JU1	TCXO1	U17

UNUSED REFERENCE DESIGNATORS		
C23,C24,C28	C40,C41,C48	C57, R22
R20,R27,R37	R38,R42,R43	L4, L5
D1 - D3	U12 - U14	-----

DE DANIELS ELECTRONICS — VICTORIA B.C.

TITLE: OS(R/T)-3H 406 - 470 MHz ANALOG BOARD SCHEMATIC DIAGRAM		
DATE: 23 MAY 96	DWN BY: COLIN GUNN	APRVD:
DWG No: OS3450M3D	DWG REV DATE: 11 DEC 00	
BOARD No: 50028-02	BOARD REV: 2.0	

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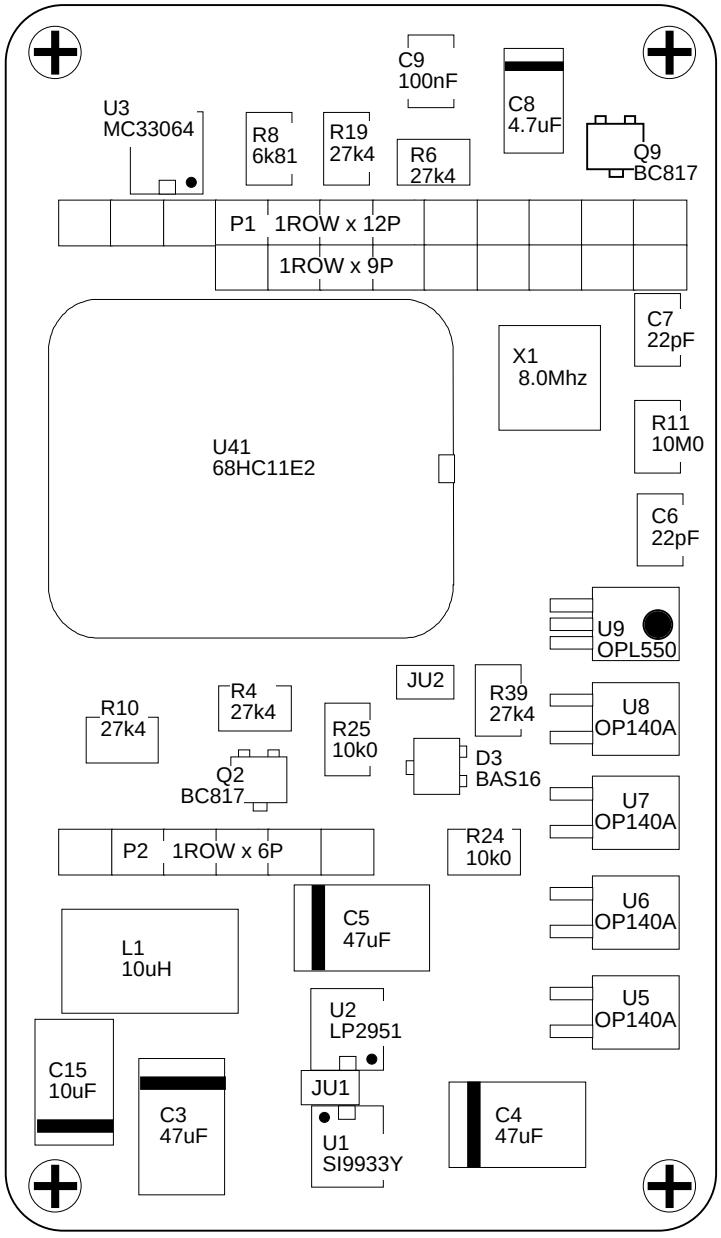
4.5 OS(R/T)-3(A/H) Digital Board Diagrams

4.5.1 OS(R/T)-3(A/H) Digital Board Component Layout (Bottom)

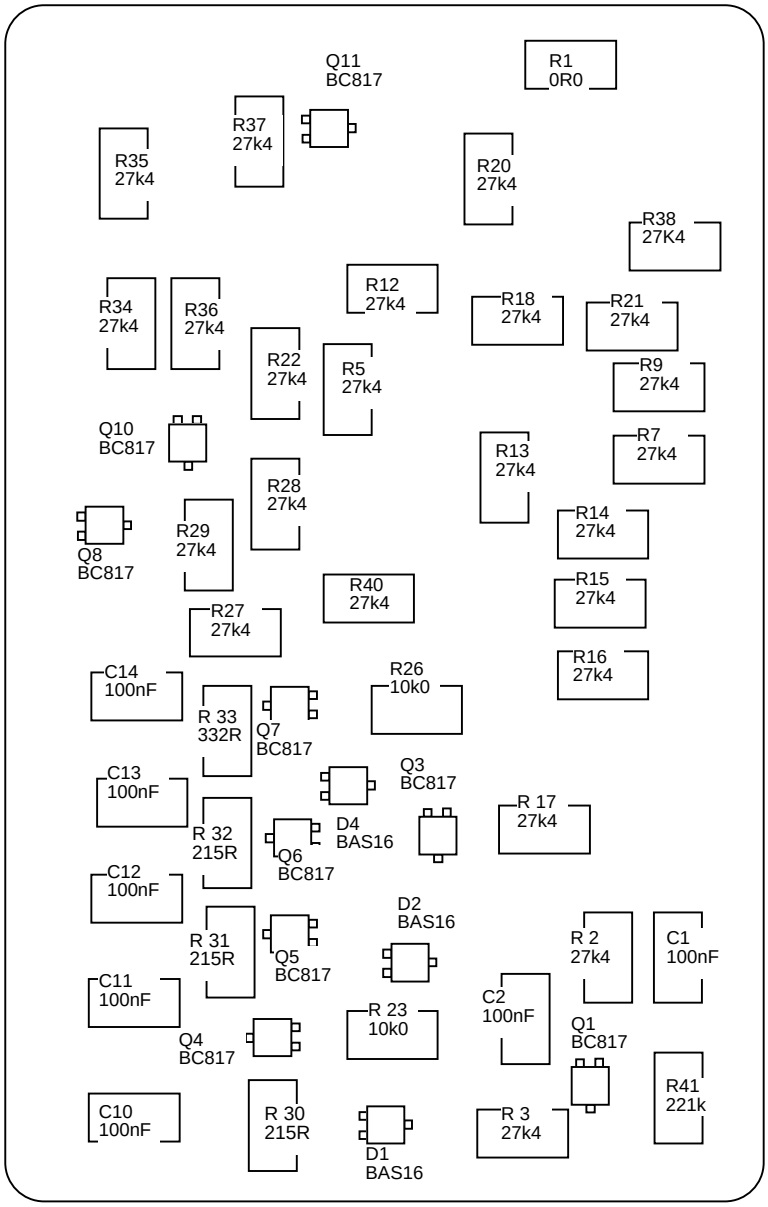


PCB 50021-03 OS3150M4A

	OSx-3H 29-470 MHz	OSx-3A 118-159.6 MHz
JU1	NOT INSTALLED	INSTALLED

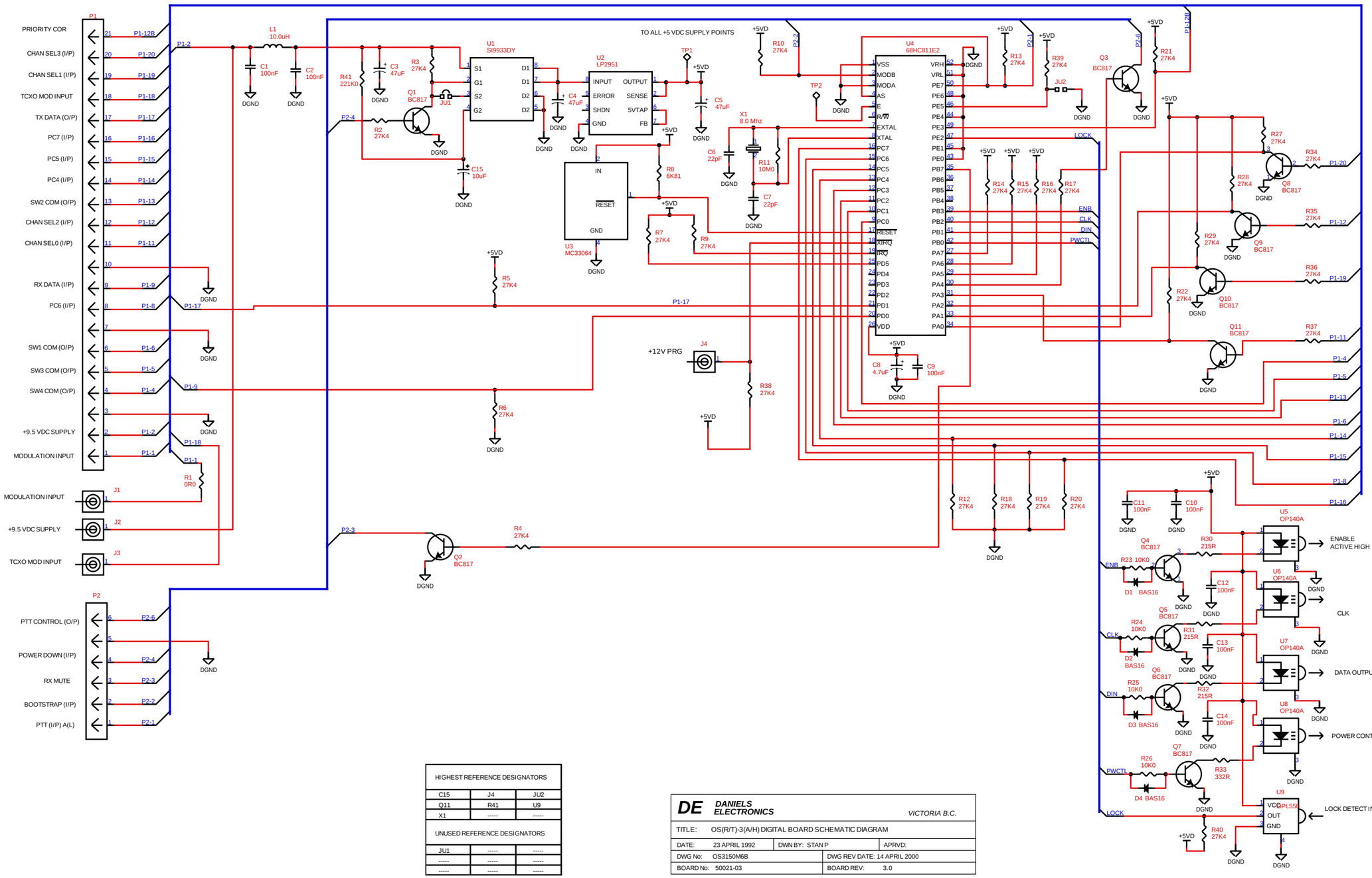
	9.6 MHz REFERENCE	10 MHz REFERENCE
JU2	NOT INSTALLED	INSTALLED

4.5.2 OS(R/T)-3(A/H) Digital Board Component Layout (Top)



PCB 50021-03 OS3150M5B

4.5.3 OS(R/T)-3(A/H) Digital Board Schematic Diagram



HIGHEST REFERENCE DESIGNATORS		
C15	J4	JU2
Q11	R41	U9
X1	-----	-----
UNUSED REFERENCE DESIGNATORS		
JU1	-----	-----
-----	-----	-----
-----	-----	-----

DE DANIELS ELECTRONICS — *VICTORIA B.C.*

TITLE: OS(R/T)-3(A/H) DIGITAL BOARD SCHEMATIC DIAGRAM		
DATE: 23 APRIL 1992	DWN BY: STAN P	APRVD:
DWG No: OS3150M6B	DWG REV DATE: 14 APRIL 2000	
BOARD No: 50021-03	BOARD REV: 3.0	

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5. PARTS LISTS

5.1 OS(R/T)-3H 29 - 71.4 MHz Analog Board Electrical Parts List

Ref. Desig	Description	Part No.	
C1 - C3	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C4	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C5	CAP., SM 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C6	CAP., SM 47uF TANT., 20%, 16V	1055-6D476M16	
C7	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C8	CAP., SM 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C9	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C10	CAP., SM 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C11	CAP., SM 1.0uF TANT., 10%, 16V	1055-5A105M16	
C12	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C13	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C14	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C15	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C16	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C17	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C18	CAP., SM 47uF TANT., 20%, 16V	1055-6D476M16	
C19	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C21	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C20	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C22	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C23	CAP., SM, 150pF CER., 0805,C0G	1008-2A151J1G	OST-3H035
C23	CAP., SM, 100pF CER., 0805,C0G	1008-2A101J1G	OST-3H045
C23	CAP., SM, 56pF CER., 0805, C0G	1008-1A560J1G	OSR-3H061
C24	CAP., 1-14pF TRIM., STAND. >6	1082-A1R0014J	
C25	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C26	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C27	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C28	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C29	CAP., SM 47uF TANT., 20%, 16V	1055-6D476M16	
C30	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C31	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C32, C33	CAP., SM, 100uF TANT., 20%,16V	1055-7D107M16	
C34	CAP., SM, 56pF CER., 0805, C0G	1008-1A560J1G	OST-3H035
C34	CAP., SM, 47pF CER., 0805, C0G	1008-1A470J1G	OST-3H045
C34	CAP., SM, 33pF CER., 0805, C0G	1008-1A330J1G	OSR-3H061
C35	CAP., SM 10pF CER., 0805, COG	1008-1A100J1G	
C36	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C37, C38	CAP., 1.0uF FILM, MMK5, 10%, 63V	1016-6D105K50	
C39	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	
C40	CAP., SM 33pF CER., 0805, COG	1008-1A330J1G	
C41	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C42	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C43	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C44	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C45	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63	
C46	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C47	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	

Ref. Desig	Description	Part No.	
C48	CAP., 68nF FILM, MMK5, 10%,63V	1016-4A683K63	OST-3H035
C48	CAP., 68nF FILM, MMK5, 10%,63V	1016-4A683K63	OST-3H045
C48	CAP., Not Installed	Not Installed	OSR-3H061
C49	CAP., 22nF FILM, MMK5, 10%,63V	1016-4A223K63	
C50	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C51	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C52	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C53	CAP., SM, 56pF CER., 0805, C0G	1008-1A560J1G	OST-3H035
C53	CAP., SM, 56pF CER., 0805, C0G	1008-1A560J1G	OST-3H045
C53	CAP., SM, Not Installed	Not Installed	OSR-3H061
C54	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C55	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C56	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C57	CAP., SM, 15pF CER., 0805, COG	1008-1A150J1G	OST-3H035
C57	CAP., SM, 15pF CER., 0805, COG	1008-1A150J1G	OST-3H045
C57	CAP., SM, 68pF CER., 0805, C0G	1008-1A680J1G	OSR-3H061
C58	CAP., SM, 33pF CER., 0805, C0G	1008-1A330J1G	OST-3H035
C58	CAP., SM, 33pF CER., 0805, C0G	1008-1A330J1G	OST-3H045
C58	CAP., SM, 68pF CER., 0805, C0G	1008-1A680J1G	OSR-3H061
C59	CAP., SM, 33pF CER., 0805, C0G	1008-1A330J1G	OST-3H035
C59	CAP., SM, 33pF CER., 0805, C0G	1008-1A330J1G	OST-3H045
C59	CAP., SM, 100pF CER., 0805,C0G	1008-2A101J1G	OSR-3H061
C61	CAP., SM, 150pF CER., 0805,C0G	1008-2A151J1G	OST-3H035
C61	CAP., SM, 100pF CER., 0805,C0G	1008-2A101J1G	OST-3H045
C61	CAP., SM, 56pF CER., 0805, C0G	1008-1A560J1G	OSR-3H061
C62	CAP., SM, 47pF CER., 0805, C0G	1008-1A470J1G	
C63	CAP., SM, 22pF CER., 0805, C0G	1008-1A220J1G	
C64	CAP., SM, 12pF CER., 0805, C0G	1008-1A120J1G	
D1, D2	DIODE, MMBV609L VARICAP, SOT-23	2106-MMBV609L	
D3	DIODE, MMBD701 HOT_CARR. SOT23	2105-MMBD7010	
D4	DIODE, BYD17J RECTIFIER, SOD87	2101-BYD17J00	
D5	DIODE, BAS16 SWITCHING, SOT23	2100-BAS16000	
L1 - L4	CHOKE, RF/MOULD.10uH 10%,.25	1251-4A00100K	
L5	INDUCTOR,13.5T/260nH,MOLD.,ORG	1253-A1352603	OST-3H035
L5	INDUCTOR,11.5T/197nH,MOLD.,BRN	1253-A1151971	OST-3H045
L5	INDUCTOR, 9.5T/138nH,MOLD.,WHT	1253-A0951389	OSR-3H061
L6	CHOKE, RF/MOULD.10uH 10%,.25	1251-4A00100K	
L7	CHOKE, RF/MOULD.4.7uH 10%,.25	1251-TBA	
L8 - L10	CHOKE, RF/MOULD.1.5uH 10%,.25	1251-3A001R5K	
L11	INDUCTOR,SM,100nH CER,10%,1008	1256-2BR1000K	OST-3H035
L11	INDUCTOR,SM,100nH CER,10%,1008	1256-2BR1000K	OST-3H045
L11	INDUCTOR,SM,120nH CER,10%,1008	1256-2BR12OOK	OSR-3H061
L12	CHOKE, RF/MOULD.,4.7uH,10%,.25	1251-3A004R7K	
L13	INDUCTOR,SM,100nH CER,10%,1008	1256-2BR1000K	OST-3H035
L13	INDUCTOR,SM,100nH CER,10%,1008	1256-2BR1000K	OST-3H045
L13	INDUCTOR,SM,120nH CER,10%,1008	1256-2BR12OOK	OSR-3H061
LED1	LED, SUB-MIN., 2mm SQ,AXIAL,ORG	2012-S229013C	
PCB	PCB, ANALOG,OS-3H VHF 30-50MHz	4309-26500382	

Ref. Desig	Description	Part No.
Q1, Q2	TRANSISTORBC817 NPN, SOT23	2120-BC817025
Q3	TRANSISTORBC807 PNP, SOT23	2120-BC807025
Q4	TRANSISTORBC817 NPN, SOT23	2120-BC817025
Q5	JFET, J211 RF N-CHAN. TO-92	2041-J2110000
RV1	POT., SM 5K0 1T, TOP ADJ	1174-AS2502J1
R1	RES., SM 49R9 0805, 1%,100ppm	1150-1A49R9FP
R2	RES.330R METAL FILM, 5%, 0.5W	1101-2A0331JP
R3, R4	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP
R5	RES., SM 100R 0805, 1%,100ppm	1150-2A1000FP
R6	RES., SM 1K00 0805, 1%,100ppm	1150-3A1001FP
R7, R8	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP
R9	RES., SM 1K00 0805, 1%,100ppm	1150-3A1001FP
R10 - R12	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP
R13	RES., SM 11K8 0805, 1%,100ppm	1150-4A1182FP
R14	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP
R15	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP
R16, R17	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP
R18, R19	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP
R20	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP
R21	RES., SM 20K0 0805, 1%,100ppm	1150-4A2002FP
R22	RES., SM, 475R 0805, 1%,100ppm	1150-2A4750FP
R23 - R25	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP
R26	RES.1R2 METAL FILM, 5%, 0.5W	1101-0A01R2JI
R27	RES., SM 15K0 0805, 1%,100ppm	1150-4A1502FP
R28	RES., NOT INSTALLED	NOT INSTALLED
R29	RES., SM 18K2 0805, 1%,100ppm	1150-4A1822FP
R30	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP
R31	RES., SM 49R9 0805, 1%,100ppm	1150-1A49R9FP
R32	RES., 15K METAL FILM, 5%, 0.5W	1101-4A0153JP
R33	RES.680R METAL FILM, 5%, 0.5W	1101-2A0681JP
R34, R35	RES.10K0 METAL FILM, 5%, 0.5W	1101-4A0103JP
R36	RES., 2K7 METAL FILM, 5%, 0.5W	1101-3A0272JP
R38	RES., SM 56R2 0805, 1%,100ppm	1150-4A5622FP
R39	RES., SM 0R00 0805, ZERO OHM JUMPER	1150-0A0R0000
R40	RES.180R METAL FILM, 5%, 0.5W	1101-2A0181JP
R41	RES., SM 18R2 0805, 1%,100ppm	1150-1A18R2FP
R44	RES., SM 47R5 0805, 1%,100ppm	1150-1A47R5FP
R45	RES., SM 27R4 0805, 1%,100ppm	1150-1A27R4FP
R46	RES., SM 33R2 0805, 1%,100ppm	1150-1A33R2FP
R47	RES., SM 47R5 0805, 1%,100ppm	1150-1A47R5FP
R48	RES., SM 27R4 0805, 1%,100ppm	1150-1A27R4FP
R49	RES., SM 33R2 0805, 1%,100ppm	1150-1A33R2FP
R50	RES.180R METAL FILM, 5%, 0.5W	1101-2A0181JP
R51	RES.220R METAL FILM, 5%, 0.5W	1101-2A0221JP
R52	RES., SM 49R9 0805, 1%,100ppm	1150-1A49R9FP
R53	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP
R54	RES., SM 18R2 0805, 1%,100ppm	1150-1A18R2FP
R55 R56	RES., SM 274 0805, 1%,100ppm	1150-2A2740FP
TCXO1	VTCXO MODULE9.6 MHz 4 PIN, +- 1ppm	2641-09600BM5

Ref. Desig	Description	Part No.
U1 - U4	DIODE, OPL550 I/R SENSOR,TTL O/P,PLST	2014-1L18230T
U5	LED, OP140A I/R,GaAs,.81 x .23,PLAST.	2013-1G18230A
U6	I.C., LT1129-IS8, PROG. VOLT REG, SO8	2305-11290N08
U7, U8	I.C., LP2951 PROG. VOLT REG, SO-8	2305-29510N08
U9	MOSFET, SI9945DY, N CHAN.,SO-8	2142-SI9945DY
U10	I.C., MC145191, PLL FREQ/SYNTH, SO-20	2355-45191N20
U11	I.C., MSA-0611, MM1C AMP, SOT-143	2354-MSA06110
U15 U16	I.C., MSA-0611, MM1C AMP, SOT-143	2354-MSA06110

5.2 OS(R/T)-3A 118 - 159.4 MHz Analog Board Electrical Parts List

Ref. Desig	Description	Part No.	
C1- C3	CAP., SM ,1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C4	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C5	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C6	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16	
C7	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C8	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C9	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C10	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C11	CAP., SM, 1.0uF TANT., 10%, 16V	1055-5A105M16	
C12	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16	
C13	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16	
C14	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C15	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16	
C16, C17	CAP., SM ,1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C18	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16	
C19	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C20	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16	
C21, C22	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C23	CAP., SM, 10pF CER., 0805, C0G	1008-1A100J1G	(OST-3A128)
C23	CAP., NOT INSTALLED	NOT INSTALLED	(OSR-3A149)
C24	CAP., SM ,1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C25	CAP., NOT INSTALLED	NOT INSTALLED	
C26	CAP., SM ,1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C27	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16	
C28	CAP., SM, 6.8uF TANT., 20%, 10V	1055-5B685M10	
C29	CAP., SM, 47uF TANT., 20%, 16V	1055-6D476M16	
C30	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C31	CAP., SM ,1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C32, C33	CAP., SM, 100uF TANT., 20%,16V	1055-7D107M16	
C34	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C35	CAP., SM, 5.6pF CER., 0805, C0G	1008-0A569D1G	
C36	CAP., SM, 3.3pF CER., 0805,C0G	1008-0A339J1G	
C37	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63	(OST-3A128)
C37	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	(OSR-3A149)
C38	CAP., 100nF FILM, MMK5,10%,63V	1016-5A104K63	(OST-3A128)
C38	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	(OSR-3A149)
C39	CAP., NOT INSTALLED	NOT INSTALLED	(OST-3A128)
C39	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	(OSR-3A149)
C40	CAP., SM, 8.2pF CER., 0805,C0G	1008-0A829J1G	(OSR-3A149)
C40	CAP., NOT INSTALLED	NOT INSTALLED	(OST-3A128)
C41	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C42	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C43	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C44	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	
C45	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63	(OSR-3A149)
C45	CAP., 330nF FILM, MMK5,10%,50V	1016-5B334K50	(OST-3A128)
C46	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C47	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	
C48	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	

Ref.

Desig	Description	Part No.	
C49	CAP., 22nF FILM, MMK5, 10%,63V	1016-4A223K63	(OSR-3A149)
C49	CAP., 2.2nF FILM, MMK5,10%,63V	1016-3A222K63	(OST-3A128)
C50, C51	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C52	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C53	CAP., SM, 27pF CER., 0805, COG	1008-1A270J1G	
C58	CAP., SM, 47pF CER., 0805, COG	1008-1A470J1G	
C59	CAP., SM, 27pF CER., 0805, COG	1008-1A270J1G	
C60	CAP., SM, 2.2uF TANT., 20%, 20V	1055-5B225K20	
C61	CAP., SM, 4.7uF TANT., 10%, 16V	1055-5B475K16	
C62	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C63	CAP., 680nF FILM, MMK5,10%,50V	1016-5D684K50	
D1, D2	DIODE, MMBV609L VARICAP, SOT-23	2106-MMBV609L	
D3	DIODE, MMBD701L HOT CARR., SOT23	2105-MMBD7010	
D4	DIODE, BYD17J RECTIFIER, SOD87	2101-BYD17J00	
D5	DIODE, BAS16 SWITCHING, SOT23	2100-BAS16000	
D6, D7	DIODE, SMV1211, VARACTOR,SOT2	2106-SMV12111	(OSR-3A149)
D6	DIODE,SMV1212-4,VARACTOR,SOT23	2106-SMV12124	(OST-3A128)
D7	DIODE, SMV1211, VARACTOR,SOT2	2106-SMV12111	(OSR-3A149)
D7	DIODE, NOT INSTALLED	NOT INSTALLED	(OST-3A128)
L2, L3	CHOKE, RF/MOULD., 10uH 10%,.25	1251-4A00100K	
L4	CHOKE, RF/MOULD., 3.9uH 10%,.25	1251-3A003R9K	
L5	BOBBIN 5.5 TURNS, 1.59 mm pitch	5791-A1010300	
	WIRE, COPPER, 20AWG, SILVER PLD, 10.2cm	7140-30002000(1pc 10cm, 2pcs	
10mm)			
L6 - L8	CHOKE, RF/MOULD., 1.5uH 10%,.25	1251-3A001R5K	
L11, L12	INDUCTOR, SM, 47nH CER,10%,1008	1256-1B47N00K	
L13	CHOKE, RF/MOULD., 1.5uH 10%,.25	1251-3A001R5K	
LED1	LED, SUB-MIN.,2mm SQ,AXIAL,ORG	2012-S229013C	
PCB	PCB, ANALOG,OS-3H AM/WB SYNTH.	4309-26500825	
Q1, Q2	TRANSISTOR, BC817 NPN, SOT23	2120-BC817025	
Q3	TRANSISTOR, BC807 PNP, SOT23	2120-BC807025	
Q4	TRANSISTOR, BC817 NPN, SOT23	2120-BC817025	
Q5	JFET, J211 RF, N-CHAN., TO-92A	2041-J2110000	
Q6	TRANSISTOR, MMBR901 HIGH FREQ.	2124-MMBR9010	
R1	RES., SM, 49R9 0805, 1%,100ppm	1150-1A49R9FP	
R2	RES., 330R METAL FILM, 5%, 0.5W	1101-2A0331JP	
R3, R4	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R5	RES., SM, 100R 0805, 1%,100ppm	1150-2A1000FP	
R6	RES., SM, 1K00 0805, 1%,100ppm	1150-3A1001FP	
R7, R8	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R9	RES., SM, 1K00 0805, 1%,100ppm	1150-3A1001FP	
R10 - R12	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R13	RES., SM, 11K8 0805, 1%,100ppm	1150-4A1182FP	
R14	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R15	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R16, R17	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP	
R18, R19	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	

Ref. Desig	Description	Part No.	
R20	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R22	RES., SM, 137K0 0805, 1%,100ppm	1150-5A1373FP	
R23 - R25	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R26	RES., 1R2 METAL FILM, 5%, 0.5W	1101-0A01R2JI	
R27	RES., SM, 11K8 0805, 1%,100ppm	1150-4A1182FP	
R28	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R29	RES., SM, 18K2 0805, 1%,100ppm	1150-4A1822FP	
R30	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R31	RES., SM, 100R 0805, 1%,100ppm	1150-2A1000FP	
R32	RES., 15K METAL FILM, 5%, 0.5W	1101-4A0153JP	(OSR-3A149)
R32	RES., 68K METAL FILM, 5%, 0.5W	1101-4A0683JP	(OST-3A128)
R33	RES., 680R METAL FILM, 5%, 0.5W	1101-2A0681JP	
R34, R35	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R36	RES., 1K8 METAL FILM, 5%, 0.5W	1101-3A0182JP	(OSR-3A149)
R36	RES., 8K2 METAL FILM, 5%, 0.5W	1101-3A0822JP	(OST-3A128)
R37, R38	RES., SM, 49K9 0805, 1%,100ppm	1150-4A4992FP	
R39	RES., SM, 0R00 0805, ZERO OHM JUMPER	1150-0A0R0000	
R40	RES., 330R METAL FILM, 5%,0.5W	1101-2A0391JP	
R41	RES., SM, 20K0 0805, 1%,100ppm	1150-4A2002FP	
R42	RES., SM, 100K 0805, 1%,100ppm	1150-5A1003FP	
R43	RES., SM, 137K0 0805, 1%,100ppm	1150-5A1373FP	
R44	RES., SM, 1K82 0805, 1%,100ppm	1150-3A1821FP	
R45	RES., SM, 18R2 0805, 1%,100ppm	1150-1A18R2FP	
R46	RES., SM, 475R0 0805, 1%,100ppm	1150-2A4750FP	
R53	RES., SM, 100K 0805, 1%,100ppm	1150-5A1003FP	
R57	RES., SM, 274K 0805, 1%, 100ppm	1150-5A2743FP	
R58	RES., SM, 825K0 1206, 1%,100ppm	1150-5B8253FP	
R59	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R60	RES., SM, 68K1 0805, 1%,100ppm	1150-4A6812FP	(OSR-3A149)
R60	RES., SM, 39K2 0805, 1%,100ppm	1150-4A3922FP	(OST-3A128)
R61	RES., SM, 20K0 0805, 1%,100ppm	1150-4A2002FP	
R62	RES., SM, 4K75 0805, 1%,100ppm	1150-3A4751FP	
R63	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
RV1	POT., SM, 5K0 1T, TOP ADJ	1174-AS2502J1	
TCXO1	VTCXO MODULE9.6 MHz 4 PIN, +- 1ppm	2641-09600BM5	
U1 - U4	DIODE, OP950 I/R SENSOR,TTL O/P,PLST	TBA	
U5	LED, OP140A I/R,GaAs,.81 x .23,PLAST.	2013-1G18230A	
U6	IC, LT1129-IS8, PROG. VOLT REG,SO-8	2305-11290N08	
U7, U8	IC, LP2951 PROG. VOLT REG, SO-8	2305-29510N08	
U9	MOSFET, SI9945DY, N CHAN.,SO-8	2142-SI9945DY	
U10	IC, MC145190,PLL FREQ/SYNTH,SO-20	2355-45190N20	
U11	IC, MSA-0611, MM1C AMP,SOT-143	2354-MSA06110	
U17	IC, LTC1257I 12BIT SER.DA,S0-8	2387-12570N08	
U18	IC, PIC12C672 MICROCONTROLLER, SO-8	TBA	
U19	IC, MC33172 DUAL OP AMP, SO-8	2302-33172N08	
U20	IC, 74HC14 HEX SCHMITT, SO-14	2376-00140N14	

5.3 OS(R/T)-3H 128 - 174 MHz Analog Board Electrical Parts List

Ref. Desig	Description	Part No.	
C1-C3	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C4	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C5	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C6	CAP., SM, 47µF TANT., 20%, 16V	1055-6D476M16	
C7	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C8	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C9	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C10	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C11	CAP., SM, 1.0µF TANT., 10%, 16V	1055-5A105M16	
C12	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C13	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C14	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C15	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C16	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C17	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C18	CAP., SM, 47µF TANT., 20%, 16V	1055-6D476M16	
C19	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C20	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C21,C22	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C23	CAP., SM, 12pF CER., 0805, COG	1008-1A120J1G	(OS-3H141)
C23	CAP., SM, 6.8pF CER., 0805,C0G	1008-0A689J1G	(OS-3H162)
C24	CAP., TRIM., 1-14pF STAN. >6T	1082-A1R0014J	
C25	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	(OS-3H141)
C25	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	(OS-3H162)
C26	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C27	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16	
C28	CAP., SM, 6.8µF TANT., 20%, 10V	1055-5B685M10	
C29	CAP., SM, 47µF TANT., 20%, 16V	1055-6D476M16	
C30	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C31	CAP., SM, 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C32, C33	CAP., SM, 100uF TANT., 20%,16V	1055-7D107M16	
C34	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C35	CAP., SM, 3.3pF CER., 0805,C0G	1008-0A339J1G	(OS-3H141)
C35	CAP., SM, 8.2pF CER., 0805,C0G	1008-0A829J1G	(OS-3H162)
C36	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	
C37	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50	(OS-3H141)
C37	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50	(OS-3H162)
C38	CAP., 1.0µF FILM, MMK5, 10%, 50V	1016-6D105K50	(OS-3H141)
C38	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63	(OS-3H162)
C39	CAP., 1.0µF FILM, MMK5, 10%, 63V	1016-6D105K50	(OS-3H141)
C39	CAP., NOT INSTALLED	NOT INSTALLED	(OS-3H162)
C40	CAP., SM, 12pF CER., 0805, C0G	1008-1A120J1G	(OS-3H141)
C40	CAP., SM, 6.8pF CER., 0805,C0G	1008-0A689J1G	(OS-3H162)
C42	CAP., 22µF DIP. TANT., 20%, 20V	1054-6G226M20	
C43	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C44	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	
C45	CAP., 470nF FILM, MMK5,10%,63V	1016-5D474K63	(OS-3H141)
C45	CAP., 220nF FILM, MMK5,10%,50V	1016-5A224K50	(OS-3H162)
C46,C47	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	

Ref.

Desig	Description	Part No.	
C49	CAP., 33nF FILM, MMK5, 10%, 63V	1016-4A333K63	(OS-3H141)
C49	CAP., 22nF FILM, MMK5, 10%, 63V	1016-4A223K63	(OS-3H162)
C50	CAP., 22µF DIP. TANT., 20%, 20V	1054-6G226M20	
C51	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C52	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	
C53	CAP., SM, 27pF CER., 0805, COG	1008-1A270J1G	
C54	CAP., 22µF DIP. TANT., 20%, 20V	1054-6G226M20	
C55	CAP., SM, 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C56	CAP., SM, 330pF CER., 0805, COG	1008-2A331J1G	
C58	CAP., SM, 47pF CER., 0805, COG	1008-1A470J1G	
C59	CAP., SM, 27pF CER., 0805, COG	1008-1A270J1G	
D1	DIODE, NOT INSTALLED	NOT INSTALLED	
D2	DIODE, MMBV609L VARICAP, SOT-23	2106-MMBV609L	
D3	DIODE, MMBD701L HOT CARR., SOT23	2105-MMBD7010	
D4	DIODE, BYD17J RECTIFIER,SOD87	2101-BYD17J00	
D5	DIODE, BAS16 SWITCHING, SOT23	2100-BAS16000	
L1-L3	CHOKE, RF/MOULD., 10uH 10%,.25	1251-4A00100K	
L4	CHOKE, RF/MOULD., 1.5uH 10%,.25	1251-3A001R5K	
L5	BOBBIN, 5.5 TURNS, 1.59 mm pitch	5791-A1010300	
	WIRE, COPPER, 20AWG, Ag PLATED, 11cm	7140-30002000(1pc 9cm, 2pcs 1cm)	
L6-L10	CHOKE, RF/MOULD., 1.5uH 10%,.25	1251-3A001R5K	
L11,L12	INDUCTOR, SM, 47nH CER,10%,1008	1256-1B47N00K	
L12	INDUCTOR, SM, 47nH CER,10%,1008	1256-1B47N00K	
LED1	LED, SUB-MIN.,2mm SQ,AXIAL,ORG	2012-S229013C	
PCB	PCB, ANALOG, OS-3H H/P SYNTH.	4309-26500252	
Q1,Q2	TRANSISTOR, BC817-25,NPN,SOT23	2120-BC817025	
Q3	TRANSISTOR, BC807 PNP, SOT23	2120-BC807025	
Q4	TRANSISTOR, BC817 NPN, SOT23	2120-BC817025	
Q5	JFET, J211 RF, N-CHAN., TO-92A	2041-J2110000	
R1	RES., SM, 49R9 0805, 1%,100ppm	1150-1A49R9FP	
R2	RES., 330R METAL FILM, 5%, 0.5W	1101-2A0331JP	
R3,R4	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R5	RES., SM, 100R 0805, 1%,100ppm	1150-2A1000FP	
R6	RES., SM, 1K00 0805, 1%,100ppm	1150-3A1001FP	
R7,R8	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R9	RES., SM, 1K00 0805, 1%,100ppm	1150-3A1001FP	
R10-R12	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R13	RES., SM, 11K8 0805, 1%,100ppm	1150-4A1182FP	
R14	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R15	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R16, R17	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP	
R18, R19	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R20	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R21	RES., SM, 20K0 0805, 1%,100ppm	1150-4A2002FP	
R22	RES., SM, ZERO OHM JUMPER,0805	1150-0A0R0000	(OSR-3H1xx)
R22	RES., SM, 100R 0805, 1%,100ppm	1150-2A1000FP	(OST-3H1xx)

Ref. Desig	Description	Part No.	
R23-R25	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R26	RES., 1R2 METAL FILM, 5%, 0.5W	1101-0A01R2JI	
R27	RES., SM, 11K8 0805, 1%,100ppm	1150-4A1182FP	
R28	RES., NOT INSTALLED	NOT INSTALLED	
R29	RES., SM, 3K92 0805, 1%,100ppm	1150-3A3921FP	
R30	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R31	RES., SM, 49R9 0805, 1%,100ppm	1150-1A49R9FP	
R32	RES., 12K METAL FILM, 5%, 0.5W	1101-4A0123JP	(OS-3H141)
R32	RES., 15K METAL FILM, 5%, 0.5W	1101-4A0153JP	(OS-3H162)
R33	RES., 680R METAL FILM, 5%, 0.5W	1101-2A0681JP	
R34,R35	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R36	RES., 2K2 METAL FILM, 5%, 0.5W	1101-3A0222JP	(OS-3H141)
R36	RES., 6K2 METAL FILM, 5%, 0.5W	1101-3A0622JP	(OS-3H162)
R39	RES., SM, 0 0805, ZERO OHM JUMPER	1150-0A0R0000	
R40	RES., 180R METAL FILM, 5%, 0.5W	1101-2A0181JP	
R41	RES., SM, 18R2 0805, 1%,100ppm	1150-1A18R2FP	
R44	RES., SM, 47R5 0805, 1%,100ppm	1150-1A47R5FP	
R45	RES., SM, 27R4 0805, 1%,100ppm	1150-1A27R4FP	
R46	RES., SM, 33R2 0805, 1%,100ppm	1150-1A33R2FP	
R47, R48	RES., SM, 47R5 0805, 1%,100ppm	1150-1A47R5FP	
R49	RES., SM, 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R50	RES., 180R METAL FILM, 5%, 0.5W	1101-2A0181JP	
R51	RES., NOT INSTALLED	NOT INSTALLED	
R52	RES., SM, 49R9 0805, 1%,100ppm	1150-1A49R9FP	
R53	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP	
R54	RES., SM, 18R2 0805, 1%,100ppm	1150-1A18R2FP	
R55	RES., SM, 274 0805, 1%,100ppm	1150-2A2740FP	
R56	RES., SM, 274 0805, 1%,100ppm	1150-2A2740FP	
RV1	POT., SM, 5K0 1T, TOP ADJ	1174-AS2502J1	
TCXO1	VTCXO MODULE, 9.6 MHz 4 PIN, +- 1ppm	2641-09600BM5	
U1-U4	DIODE, I/R SENSOR,TTL O/P,PLST	2014-1L18230T	
U5	LED, I/R,GaAs,.81 x .23,PLAST.	2013-1G18230A	
U6	I.C., LT1129-IS8 ,PROG. VOLT REG,SO8	2305-11290N08	
U7,U8	I.C., LP2951 PROG. VOLT REG, SO-8	2305-29510N08	
U9	MOSFET, SI9945DY, N CHAN.,SO-8	2142-SI9945DY	
U10	IC, 45193,PLL FREQ/SYNTH,SO-20	2355-45193N20	
U11	IC, MSA-0611, MM1C AMP,SOT-143	2354-MSA06110	
U15,U16	IC, MSA-0611, MM1C AMP,SOT-143	2354-MSA06110	

5.4 OS(R/T)-3H 406 - 470 MHz Analog Board Electrical Parts List

Ref. Desig	Description	Part No.	
C1 - C3	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C4	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C5	CAP., SM 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C6	CAP., SM 47uF TANT., 20%, 16V	1055-6D476M16	
C7	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C8	CAP., SM 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C9	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C10	CAP., SM 100nF CER., 0805, X7R, 50V	1008-5A104K5R	
C11	CAP., SM 1.0uF TANT., 10%, 16V	1055-5A105M16	
C12, C13	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C14	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C15	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C16	CAP., 100nF FILM, MMK5, 10%, 63V	1016-5A104K63	
C17	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C18	CAP., SM 47uF TANT., 20%, 16V	1055-6D476M16	
C19	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C20	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C21, C22	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C25, C26	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C27	CAP., SM 4.7uF TANT., 10%, 16V	1055-5B475K16	
C29	CAP., SM 47uF TANT., 20%, 16V	1055-6D476M16	
C30	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C31	CAP., SM 1.0nF CER., 0805, X7R, 50V	1008-3A102K5R	
C32, C33	CAP., SM, 100uF TANT., 20%,16V	1055-7D107M16	
C34	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C35	CAP., SM 100pF CER., 0805, COG	1008-2A101J1G	
C36	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C37	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	
C38	CAP., NOT INSTALLED	NOT INSTALLED	OST-3H4xx
C38	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	OSR-3H440
C39	CAP., NOT INSTALLED	NOT INSTALLED	OST-3H4xx
C39	CAP., 1.0uF FILM, MMK5,10%,50V	1016-6D105K50	OSR-3H440
C42	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C43	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C44	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C45	CAP., 220nF FILM, MMK5,10%,50V	1016-5A224K50	OST-3H4xx
C45	CAP., 470nF FILM, MMK5,10%,50V	1016-5C474K50	OSR-3H440
C46	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C47	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C49	CAP., 22nF FILM, MMK5, 10%,63V	1016-4A223K63	OST-3H4xx
C49	CAP., 33nF FILM, MMK5, 10%,63V	1016-4A333K63	OSR-3H440
C50	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C51	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C52	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C53	CAP., SM, 10pF CER., 0805, C0G	1008-1A100J1G	
C54	CAP., 22uF DIP. TANT., 20%, 20V	1054-6G226M20	
C55	CAP., SM 10nF CER, 0805, X7R, 50V	1008-4A103K5R	
C56	CAP., SM 330pF CER., 0805, COG	1008-2A331J1G	
C58	CAP., SM, 15pF CER., 0805, C0G	1008-1A150J1G	

Ref.

Desig	Description	Part No.	
C59	CAP., SM, 10pF CER., 0805, C0G	1008-1A100J1G	
C60	CAP., 100nF FILM, MMK5, 10%, 63V	1016-5A104K63	OST-3H4xx
C60	CAP., NOT INSTALLED	NOT INSTALLED	OSR-3H440
D4	DIODE, BYD17J RECTIFIER,SOD87	2101-BYD17J00	
D5	DIODE, BAS16 SWITCHING, SOT23	2100-BAS16000	
L1 - L3	CHOKE, RF/MOULD.10uH 10%,.25	1251-4A00100K	
L6 - L10	CHOKE, RF/MOULD.1.5uH 10%,.25	1251-3A001R5K	
L11 L12	INDUCTOR, SM18nH CER,10%,1008	1256-1B18N00K	
LED1	LED, SUB-MIN.,2mm SQ,AXIAL,ORG	2012-S229013C	
PCB	PCB, ANALOG, OS-3H UHF SYNTH.	4309-27500282	
Q1, Q2	TRANSISTOR, BC817 NPN, SOT23	2120-BC817025	
Q3	TRANSISTOR, BC807 PNP, SOT23	2120-BC807025	
Q4	TRANSISTOR, BC817 NPN, SOT23	2120-BC817025	
R1	RES., SM 49R9 0805, 1%,100ppm	1150-1A49R9FP	
R2	RES.330R METAL FILM, 5%, 0.5W	1101-2A0331JP	
R3 R4	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R5	RES., SM 100R 0805, 1%,100ppm	1150-2A1000FP	
R6	RES., SM 1K00 0805, 1%,100ppm	1150-3A1001FP	
R7 R8	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R9	RES., SM 1K00 0805, 1%,100ppm	1150-3A1001FP	
R10 - R12	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R13	RES., SM 11K8 0805, 1%,100ppm	1150-4A1182FP	
R14	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R15	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R16, R17	RES., SM, 5K11 0805, 1%,100ppm	1150-3A5111FP	
R18, R19	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R21	RES., 2K7 METAL FILM, 5%, 0.5W	1101-3A0272JP	OST-3H4xx
R21	RES., NOT INSTALLED	NOT INSTALLED	OSR-3H440
R23	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R24, R25	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R26	RES.1R2 METAL FILM, 5%, 0.5W	1101-0A01R2JI	
R28	NOT INSTALLED	NOT INSTALLED	OST-3H418
R28	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	OSR-3H440
R28	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	OST-3H460
R29	RES., SM 3K92 0805, 1%,100ppm	1150-3A3921FP	OST-3H418
R29	RES., SM 36K5 0805, 1%,100ppm	1150-4A3652FP	OSR-3H440
R29	RES., SM 36K5 0805, 1%,100ppm	1150-4A3652FP	OST-3H460
R30	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	
R31	RES., SM 274R 0805, 1%,100ppm	1150-2A2740FP	
R32	RES., 4K7 METAL FILM, 5%, 0.5W	1101-3A0472JP	OSR-3H440
R32	RES., 5K6 METAL FILM, 5%, 0.5W	1101-3A0562JP	OST-3H4xx
R33	RES.680R METAL FILM, 5%, 0.5W	1101-2A0681JP	
R34, R35	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R36	RES., 2K2 METAL FILM, 5%, 0.5W	1101-3A0222JP	OST-3H4xx
R36	RES., 1K5 METAL FILM, 5%, 0.5W	1101-3A0152JP	OSR-3H440
R39	RES., SM 0R0 0805, ZERO OHM JUMPER	1150-0A0R0000	
Ref.			

Desig	Description	Part No.	
R40	RES.180R METAL FILM, 5%, 0.5W	1101-2A0181JP	
R41	RES., SM 18R2 0805, 1%,100ppm	1150-1A18R2FP	
R44	RES., SM 47R5 0805, 1%,100ppm	1150-1A47R5FP	
R45	RES., SM 27R4 0805, 1%,100ppm	1150-1A27R4FP	
R46	RES., SM 33R2 0805, 1%,100ppm	1150-1A33R2FP	
R47	RES., SM 47R5 0805, 1%,100ppm	1150-1A47R5FP	
R48	RES., SM 47R5 0805, 1%,100ppm	1150-1A47R5FP	OST-3H418
R48	RES., SM 27R4 0805, 1%,100ppm	1150-1A27R4FP	OSR-3H440
R48	RES., SM 27R4 0805, 1%,100ppm	1150-1A27R4FP	OST-3H460
R49	RES., SM 10R0 0805, 1%,100ppm	1150-1A10R0FP	OST-3H418
R49	RES., SM 33R2 0805, 1%,100ppm	1150-1A33R2FP	OSR-3H440
R49	RES., SM 33R2 0805, 1%,100ppm	1150-1A33R2FP	OST-3H460
R50	RES.180R METAL FILM, 5%, 0.5W	1101-2A0181JP	
R51	RES.220R METAL FILM, 5%, 0.5W	1101-2A0221JP	
R52	NOT INSTALLED	NOT INSTALLED	OST-3H418
R52	RES., SM 49R9 0805, 1%,100ppm	1150-1A49R9FP	OSR-3H440
R52	RES., SM 49R9 0805, 1%,100ppm	1150-1A49R9FP	OST-3H460
R53	RES., SM 10K0 0805, 1%,100ppm	1150-4A1002FP	
R54	RES., SM 18R2 0805, 1%,100ppm	1150-1A18R2FP	
R55, R56	RES., SM 274R 0805, 1%,100ppm	1150-2A2740FP	
R57	RES., SM 18R2 0805, 1%,100ppm	1150-1A18R2FP	
R58	RES., SM 274R 0805, 1%,100ppm	1150-2A2740FP	
RV1	POT., SM5K0 1T, TOP ADJ	1174-AS2502J1	
TCXO1	VTCXO MODULE 9.6 MHz 4 PIN, +- 1ppm	2641-09600BM5	
U1 - U4	DIODE, OPL550 I/R SENSOR,TTL O/P,PLST	2014-1L18230T	
U5	LED, OP140A I/R,GaAs,.81 x .23,PLAST.	2013-1G18230A	
U6	I.C., LT1129-IS8,PROG. VOLT REG, SO8	2305-11290N08	
U7, U8	I.C.LP2951 PROG. VOLT REG, SO-8	2305-29510N08	
U9	MOSFET, SI9945DY, N CHAN.,SO-8	2142-SI9945DY	
U10	I.C., MC145193, PLL FREQ/SYNTH, SO-20	2355-45193N20	OST-3H418
U10	I.C., MC145190, PLL FREQ/SYNTH, SO-20	2355-45190N20	OSR-3H440
U10	I.C., MC145190, PLL FREQ/SYNTH, SO-20	2355-45190N20	OST-3H460
U11	I.C., MSA-0611, MM1C AMP, SOT-143	2354-MSA06110	
U15, U16	I.C., MSA-0611, MM1C AMP, SOT-143	2354-MSA06110	
U17	VCO MODULE,427.4-451.4MHz,T-PK	2621-L002309T	OSR-3H440
U17	VCO MODULE, 406-470 MHz,T-PKG.	2621-190435MT	OST-3H4xx

5.5 OS(R/T)-3(A/H) Digital Board Electrical Parts List

Ref. Desig	Description	Part No.
C1,C2	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R
C3-C5	CAP., SM, 47µF TANT., 20%, 16V	1055-6D476M16
C6,C7	CAP., SM, 22pF CER., 0805, COG	1008-1A220J1G
C8	CAP., SM, 4.7µF TANT., 10%, 16V	1055-5B475K16
C9-C14	CAP., SM, 100nF CER., 0805, X7R, 50V	1008-5A104K5R
C15	CAP., SM, 10µF TANT., 20%, 16V	1055-6C106M16
P1	INTERCONNECT/STD,1ROW x 12P,Au	5015-IS112G21
	INTERCONNECT/STD,1ROW x9PIN,Au	5015-IS109G21
P2	INTERCONNECT/STD,1ROW x6PIN,Au	5015-IS106G21
D1 - D4	DIODE, BAS16 SWITCHING, SOT23	2100-BAS16000
L1	INDUCTOR, SM, 10.0uH, 10%,1812	1255-4G10000K
PCB	PCB, DIGITAL, OS-3H H/P SYNTH.	4309-26500213
Q1 - Q11	TRANSISTOR, BC817-25,NPN,SOT23	2120-BC817025
R1	RES., SM, 0 0805, ZERO OHM JUMPER	1150-0A0R0000
R2-R7	RES., SM, 47K5 0805, 1%,100ppm	1150-4A4752FP
R8	RES., SM, 6K81 0805, 1%,100ppm	1150-3A6811FP
R9,R10	RES., SM, 47K5 0805, 1%,100ppm	1150-4A4752FP
R11	RES., SM, 10M0 1206, 5%,400ppm	1151-7B0106JG
R12-R22	RES., SM, 47K5 0805, 1%,100ppm	1150-4A4752FP
R23-R26	RES., SM, 10K0 0805, 1%,100ppm	1150-4A1002FP
R27-R29	RES., SM, 47K5 0805, 1%,100ppm	1150-4A4752FP
R30-R32	RES., SM, 215R 0805, 1%,100ppm	1150-2A2150FP
R33	RES., SM, 332R 0805, 1%,100ppm	1150-2A3320FP
R34-R40	RES., SM, 47K5 0805, 1%,100ppm	1150-4A4752FP
R41	RES., SM, 221K 0805, 1%, 100ppm	1150-5A2213FP
U1	MOSFET, SI9933DY, P CHAN.,SO-8	2142-SI9933DY
U2	IC, LP2951,PROG. VOLT REG,SO-8	2305-29510N08
U3	IC, MC33064,UNDR/VOLT SEN.SO-8	2308-33064N08
U4	IC, 68HC811E2, MIC/CTR, PLCC52	2380-68811P52
U5-U8	LED, I/R,GaAs,.81 x .23,PLAST.	2013-1G18230A
U9	DIODE, I/R SENSOR,TTL O/P,PLST	2014-1L18230T
X1	RESONATOR, SM, 8.0MHz, CERAMIC	1575-8001816A

5.6 OS(R/T)-3(A/H) Synthesizer Mechanical Parts List

Description	Part No.	Qty.	
CASE, OS-3H SYNTH. MODULE,ALUM	3702-66100920	1	
CONN., SMB, JACK,2 HOLE FLANGE	5120-J2SC01BG	2	
FERRITE, BEAD,73 MIX, 3X3.5mm OD (CON3-CON5)	1210-73030350	3	OS-3H050
FERRITE, BEAD,43 MIX, 3X3.5mm OD (CON3-CON5)	1210-43030350	3	OS-3A130
FERRITE, BEAD,43 MIX, 3X3.5mm OD (CON3-CON5)	1210-43030350	3	OS-3H150
FERRITE, BEAD,61 MIX, 3X3.5mm OD (CON3-CON5)	1210-61030350	3	OS-3H440
HEADER, .1", 1 ROWX3PIN, AU	5010-H103ST7L	2	
LABEL, FOIL,FRQ/SN,OS-3H SYNTH	3501-13091006	1	
LID, CASE,OS-3H SYNTH/MODL.,AL	3702-66100921	1	
PIN, 2 x 10mm, GROOVED W/PILOT	5876-D1470210	4	
SCREW, M2.0 x 4, FLAT/PHIL, A2	5812-2M0FP04S	8	
SCREW, M2 X 4, PAN/PHILLIPS,A2	5812-2M0PP04S	15	
SCREW, M2.5 x 24.5 FLAT/PHIL, A2	5812-2M5FP24S	1	
WASHER, TFE,0.036ID,1/8OD,.02T	5805-T3612F20	6	

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6. REVISION HISTORY

ISSUE	DATE	REVISION
1	May 97	• Issue 1
2	Mar 98	• Changes to the AM Analog board (OST-3A128) to improve performance ECO #547. C37 was 220nF is now 100nF and C40 was 8.2pF is now not installed C45 was 33nF is now 22nF and C49 was 2.2nF is now 1.5nF R32 was 33kΩ is now 56kΩand R36 was 3k3Ω is now 5k6Ω
3	Mar 00	• Changes to the AM Analog board to improve performance at -40˚C. ECO #565. L4 was 1.5µH is now 3.9 µH
		• Changes to the FM Analog boards to improve manufacturing. ECO #572 C32 & C33 were 100µF through hole tantalums are now 100µF surface mount tantalums
		• Changes to the OS-3A/H Digital board for compatibility with the new AM wideband Synthesizers. ECO #579. Added C15 (10µF) and R41 (221kΩ). JU1 was added and is installed for AM modules only. PCB, DIGITAL, OS-3H/P SYNTH was version 2 now version 3.
		• Added the new component layouts, schematic diagram and parts lists for the new AM wideband synthesizer. Wideband referring to only having to be tune once and working over the whole AM band (118-138 MHz).
4	May 00	• Changes to the OS-3H 128-174 MHz Analog board. ECO #603. R29 was 18k2 is now 3k92, U10 was MC145191 is now MC145193.
		• Changes to the OSR-3H 128-174 MHz Analog board. ECO #609. R22 was 100R is now 0R0.
		• Changes to the OS-3A 118-159.4 Analog board. ECO #601. R42 & r53 were 137kΩ are now 100kΩ.
	Jul 00	• Corrected the SELECT table on the OS(R/T)-3H 128-174 MHz Schematic diagram (section 4.3.3).

4 Aug 00 • Changes to the OS(R/T)-3(A/H) Digital board. ECO #599.
R30, R31 & R32 were 332R are now 215R.

• Changes to the OS-3H 406-470 MHz Analog board. ECO # 597.
R48 was 27R4 is now 47R5, R49 was 33R2 is now 10R.
R52 was 49R9 is now Not Installed.

DANIELS ELECTRONICS LTD. ®

MT-3 RADIO SYSTEMS

VHF TRANSMITTER CHANNEL DESIGNATION TABLES

VT-3 132-174 MHz

Covers model: VT-3/140-SWA2, VT-3/160-SWA2
VT-3/140-SWA8, VT-3/160-SWA8
VT-3/140-SNA2, VT-3/160-SNA2
VT-3/140-SNA8, VT-3/160-SNA8

Issue:	1	Previous Issue:	N/A	
Issue Date:	May 1998	Previous Issue Date:	N/A	Daniels Electronics Ltd.
Printing Date:	January 2001			Victoria, BC.
Part No.:	IM21-VT3150CT			PRINTED IN CANADA

Reviewed By:

Quality Assurance:		
Larry Freeman	Larry Freeman	12 May 98
Name	Signature	Date

NOTE:

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. This equipment may incorporate minor changes in detail from the information contained in this manual.

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1. VT-3/140 Channel Designation Table: 132-150MHz, 5kHz Increments

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
800	132.00000	875	132.37500	950	132.75000	1025	133.12500	1100	133.50000	1175	133.87500	1250	134.25000
801	.00500	876	.38000	951	.75500	1026	.13000	1101	.50500	1176	.88000	1251	.25500
802	.01000	877	.38500	952	.76000	1027	.13500	1102	.51000	1177	.88500	1252	.26000
803	.01500	878	.39000	953	.76500	1028	.14000	1103	.51500	1178	.89000	1253	.26500
804	.02000	879	.39500	954	.77000	1029	.14500	1104	.52000	1179	.89500	1254	.27000
805	.02500	880	.40000	955	.77500	1030	.15000	1105	.52500	1180	.90000	1255	.27500
806	.03000	881	.40500	956	.78000	1031	.15500	1106	.53000	1181	.90500	1256	.28000
807	.03500	882	.41000	957	.78500	1032	.16000	1107	.53500	1182	.91000	1257	.28500
808	.04000	883	.41500	958	.79000	1033	.16500	1108	.54000	1183	.91500	1258	.29000
809	.04500	884	.42000	959	.79500	1034	.17000	1109	.54500	1184	.92000	1259	.29500
810	.05000	885	.42500	960	.80000	1035	.17500	1110	.55000	1185	.92500	1260	.30000
811	.05500	886	.43000	961	.80500	1036	.18000	1111	.55500	1186	.93000	1261	.30500
812	.06000	887	.43500	962	.81000	1037	.18500	1112	.56000	1187	.93500	1262	.31000
813	.06500	888	.44000	963	.81500	1038	.19000	1113	.56500	1188	.94000	1263	.31500
814	.07000	889	.44500	964	.82000	1039	.19500	1114	.57000	1189	.94500	1264	.32000
815	.07500	890	.45000	965	.82500	1040	.20000	1115	.57500	1190	.95000	1265	.32500
816	.08000	891	.45500	966	.83000	1041	.20500	1116	.58000	1191	.95500	1266	.33000
817	.08500	892	.46000	967	.83500	1042	.21000	1117	.58500	1192	.96000	1267	.33500
818	.09000	893	.46500	968	.84000	1043	.21500	1118	.59000	1193	.96500	1268	.34000
819	.09500	894	.47000	969	.84500	1044	.22000	1119	.59500	1194	.97000	1269	.34500
820	.10000	895	.47500	970	.85000	1045	.22500	1120	.60000	1195	.97500	1270	.35000
821	.10500	896	.48000	971	.85500	1046	.23000	1121	.60500	1196	.98000	1271	.35500
822	.11000	897	.48500	972	.86000	1047	.23500	1122	.61000	1197	.98500	1272	.36000
823	.11500	898	.49000	973	.86500	1048	.24000	1123	.61500	1198	.99000	1273	.36500
824	.12000	899	.49500	974	.87000	1049	.24500	1124	.62000	1199	.99500	1274	.37000
825	.12500	900	132.50000	975	.87500	1050	133.25000	1125	.62500	1200	134.00000	1275	.37500
826	.13000	901	.50500	976	.88000	1051	.25500	1126	.63000	1201	.00500	1276	.38000
827	.13500	902	.51000	977	.88500	1052	.26000	1127	.63500	1202	.01000	1277	.38500
828	.14000	903	.51500	978	.89000	1053	.26500	1128	.64000	1203	.01500	1278	.39000
829	.14500	904	.52000	979	.89500	1054	.27000	1129	.64500	1204	.02000	1279	.39500
830	.15000	905	.52500	980	.90000	1055	.27500	1130	.65000	1205	.02500	1280	.40000
831	.15500	906	.53000	981	.90500	1056	.28000	1131	.65500	1206	.03000	1281	.40500
832	.16000	907	.53500	982	.91000	1057	.28500	1132	.66000	1207	.03500	1282	.41000
833	.16500	908	.54000	983	.91500	1058	.29000	1133	.66500	1208	.04000	1283	.41500
834	.17000	909	.54500	984	.92000	1059	.29500	1134	.67000	1209	.04500	1284	.42000
835	.17500	910	.55000	985	.92500	1060	.30000	1135	.67500	1210	.05000	1285	.42500
836	.18000	911	.55500	986	.93000	1061	.30500	1136	.68000	1211	.05500	1286	.43000
837	.18500	912	.56000	987	.93500	1062	.31000	1137	.68500	1212	.06000	1287	.43500
838	.19000	913	.56500	988	.94000	1063	.31500	1138	.69000	1213	.06500	1288	.44000
839	.19500	914	.57000	989	.94500	1064	.32000	1139	.69500	1214	.07000	1289	.44500
840	.20000	915	.57500	990	.95000	1065	.32500	1140	.70000	1215	.07500	1290	.45000
841	.20500	916	.58000	991	.95500	1066	.33000	1141	.70500	1216	.08000	1291	.45500
842	.21000	917	.58500	992	.96000	1067	.33500	1142	.71000	1217	.08500	1292	.46000
843	.21500	918	.59000	993	.96500	1068	.34000	1143	.71500	1218	.09000	1293	.46500
844	.22000	919	.59500	994	.97000	1069	.34500	1144	.72000	1219	.09500	1294	.47000
845	.22500	920	.60000	995	.97500	1070	.35000	1145	.72500	1220	.10000	1295	.47500
846	.23000	921	.60500	996	.98000	1071	.35500	1146	.73000	1221	.10500	1296	.48000
847	.23500	922	.61000	997	.98500	1072	.36000	1147	.73500	1222	.11000	1297	.48500
848	.24000	923	.61500	998	.99000	1073	.36500	1148	.74000	1223	.11500	1298	.49000
849	.24500	924	.62000	999	.99500	1074	.37000	1149	.74500	1224	.12000	1299	.49500
850	132.25000	925	.62500	1000	133.00000	1075	.37500	1150	133.75000	1225	.12500	1300	134.50000
851	.25500	926	.63000	1001	.00500	1076	.38000	1151	.75500	1226	.13000	1301	.50500
852	.26000	927	.63500	1002	.01000	1077	.38500	1152	.76000	1227	.13500	1302	.51000
853	.26500	928	.64000	1003	.01500	1078	.39000	1153	.76500	1228	.14000	1303	.51500
854	.27000	929	.64500	1004	.02000	1079	.39500	1154	.77000	1229	.14500	1304	.52000
855	.27500	930	.65000	1005	.02500	1080	.40000	1155	.77500	1230	.15000	1305	.52500
856	.28000	931	.65500	1006	.03000	1081	.40500	1156	.78000	1231	.15500	1306	.53000
857	.28500	932	.66000	1007	.03500	1082	.41000	1157	.78500	1232	.16000	1307	.53500
858	.29000	933	.66500	1008	.04000	1083	.41500	1158	.79000	1233	.16500	1308	.54000
859	.29500	934	.67000	1009	.04500	1084	.42000	1159	.79500	1234	.17000	1309	.54500
860	.30000	935	.67500	1010	.05000	1085	.42500	1160	.80000	1235	.17500	1310	.55000
861	.30500	936	.68000	1011	.05500	1086	.43000	1161	.80500	1236	.18000	1311	.55500
862	.31000	937	.68500	1012	.06000	1087	.43500	1162	.81000	1237	.18500	1312	.56000
863	.31500	938	.69000	1013	.06500	1088	.44000	1163	.81500	1238	.19000	1313	.56500
864	.32000	939	.69500	1014	.07000	1089	.44500	1164	.82000	1239	.19500	1314	.57000
865	.32500	940	.70000	1015	.07500	1090	.45000	1165	.82500	1240	.20000	1315	.57500
866	.33000	941	.70500	1016	.08000	1091	.45500	1166	.83000	1241	.20500	1316	.58000
867	.33500	942	.71000	1017	.08500	1092	.46000	1167	.83500	1242	.21000	1317	.58500
868	.34000	943	.71500	1018	.09000	1093	.46500	1168	.84000	1243	.21500	1318	.59000
869	.34500	944	.72000	1019	.09500	1094	.47000	1169	.84500	1244	.22000	1319	.59500
870	.35000	945	.72500	1020	.10000	1095	.47500	1170	.85000	1245	.22500	1320	.60000
871	.35500	946	.73000	1021	.10500	1096	.48000	1171	.85500	1246	.23000	1321	.60500
872	.36000	947	.73500	1022	.11000	1097	.48500	1172	.86000	1247	.23500	1322	.61000
873	.36500	948	.74000	1023	.11500	1098	.49000	1173	.86500	1248	.24000	1323	.61500
874	.37000	949	.74500	1024	.12000	1099	.49500	1174	.87000	1249	.24500	1324	.62000

VT-3/140 Channel Designation Table: 132 to 150 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
1325	134.62500	1400	135.00000	1475	135.37500	1550	135.75000	1625	136.12500	1700	136.50000	1775	136.87500
1326	.63000	1401	.00500	1476	.38000	1551	.75500	1626	.13000	1701	.50500	1776	.88000
1327	.63500	1402	.01000	1477	.38500	1552	.76000	1627	.13500	1702	.51000	1777	.88500
1328	.64000	1403	.01500	1478	.39000	1553	.76500	1628	.14000	1703	.51500	1778	.89000
1329	.64500	1404	.02000	1479	.39500	1554	.77000	1629	.14500	1704	.52000	1779	.89500
1330	.65000	1405	.02500	1480	.40000	1555	.77500	1630	.15000	1705	.52500	1780	.90000
1331	.65500	1406	.03000	1481	.40500	1556	.78000	1631	.15500	1706	.53000	1781	.90500
1332	.66000	1407	.03500	1482	.41000	1557	.78500	1632	.16000	1707	.53500	1782	.91000
1333	.66500	1408	.04000	1483	.41500	1558	.79000	1633	.16500	1708	.54000	1783	.91500
1334	.67000	1409	.04500	1484	.42000	1559	.79500	1634	.17000	1709	.54500	1784	.92000
1335	.67500	1410	.05000	1485	.42500	1560	.80000	1635	.17500	1710	.55000	1785	.92500
1336	.68000	1411	.05500	1486	.43000	1561	.80500	1636	.18000	1711	.55500	1786	.93000
1337	.68500	1412	.06000	1487	.43500	1562	.81000	1637	.18500	1712	.56000	1787	.93500
1338	.69000	1413	.06500	1488	.44000	1563	.81500	1638	.19000	1713	.56500	1788	.94000
1339	.69500	1414	.07000	1489	.44500	1564	.82000	1639	.19500	1714	.57000	1789	.94500
1340	.70000	1415	.07500	1490	.45000	1565	.82500	1640	.20000	1715	.57500	1790	.95000
1341	.70500	1416	.08000	1491	.45500	1566	.83000	1641	.20500	1716	.58000	1791	.95500
1342	.71000	1417	.08500	1492	.46000	1567	.83500	1642	.21000	1717	.58500	1792	.96000
1343	.71500	1418	.09000	1493	.46500	1568	.84000	1643	.21500	1718	.59000	1793	.96500
1344	.72000	1419	.09500	1494	.47000	1569	.84500	1644	.22000	1719	.59500	1794	.97000
1345	.72500	1420	.10000	1495	.47500	1570	.85000	1645	.22500	1720	.60000	1795	.97500
1346	.73000	1421	.10500	1496	.48000	1571	.85500	1646	.23000	1721	.60500	1796	.98000
1347	.73500	1422	.11000	1497	.48500	1572	.86000	1647	.23500	1722	.61000	1797	.98500
1348	.74000	1423	.11500	1498	.49000	1573	.86500	1648	.24000	1723	.61500	1798	.99000
1349	.74500	1424	.12000	1499	.49500	1574	.87000	1649	.24500	1724	.62000	1799	.99500
1350	134.75000	1425	.12500	1500	135.50000	1575	.87500	1650	136.25000	1725	.62500	1800	137.00000
1351	.75500	1426	.13000	1501	.50500	1576	.88000	1651	.25500	1726	.63000	1801	.00500
1352	.76000	1427	.13500	1502	.51000	1577	.88500	1652	.26000	1727	.63500	1802	.01000
1353	.76500	1428	.14000	1503	.51500	1578	.89000	1653	.26500	1728	.64000	1803	.01500
1354	.77000	1429	.14500	1504	.52000	1579	.89500	1654	.27000	1729	.64500	1804	.02000
1355	.77500	1430	.15000	1505	.52500	1580	.90000	1655	.27500	1730	.65000	1805	.02500
1356	.78000	1431	.15500	1506	.53000	1581	.90500	1656	.28000	1731	.65500	1806	.03000
1357	.78500	1432	.16000	1507	.53500	1582	.91000	1657	.28500	1732	.66000	1807	.03500
1358	.79000	1433	.16500	1508	.54000	1583	.91500	1658	.29000	1733	.66500	1808	.04000
1359	.79500	1434	.17000	1509	.54500	1584	.92000	1659	.29500	1734	.67000	1809	.04500
1360	.80000	1435	.17500	1510	.55000	1585	.92500	1660	.30000	1735	.67500	1810	.05000
1361	.80500	1436	.18000	1511	.55500	1586	.93000	1661	.30500	1736	.68000	1811	.05500
1362	.81000	1437	.18500	1512	.56000	1587	.93500	1662	.31000	1737	.68500	1812	.06000
1363	.81500	1438	.19000	1513	.56500	1588	.94000	1663	.31500	1738	.69000	1813	.06500
1364	.82000	1439	.19500	1514	.57000	1589	.94500	1664	.32000	1739	.69500	1814	.07000
1365	.82500	1440	.20000	1515	.57500	1590	.95000	1665	.32500	1740	.70000	1815	.07500
1366	.83000	1441	.20500	1516	.58000	1591	.95500	1666	.33000	1741	.70500	1816	.08000
1367	.83500	1442	.21000	1517	.58500	1592	.96000	1667	.33500	1742	.71000	1817	.08500
1368	.84000	1443	.21500	1518	.59000	1593	.96500	1668	.34000	1743	.71500	1818	.09000
1369	.84500	1444	.22000	1519	.59500	1594	.97000	1669	.34500	1744	.72000	1819	.09500
1370	.85000	1445	.22500	1520	.60000	1595	.97500	1670	.35000	1745	.72500	1820	.10000
1371	.85500	1446	.23000	1521	.60500	1596	.98000	1671	.35500	1746	.73000	1821	.10500
1372	.86000	1447	.23500	1522	.61000	1597	.98500	1672	.36000	1747	.73500	1822	.11000
1373	.86500	1448	.24000	1523	.61500	1598	.99000	1673	.36500	1748	.74000	1823	.11500
1374	.87000	1449	.24500	1524	.62000	1599	.99500	1674	.37000	1749	.74500	1824	.12000
1375	.87500	1450	135.25000	1525	.62500	1600	136.00000	1675	.37500	1750	136.75000	1825	.12500
1376	.88000	1451	.25500	1526	.63000	1601	.00500	1676	.38000	1751	.75500	1826	.13000
1377	.88500	1452	.26000	1527	.63500	1602	.01000	1677	.38500	1752	.76000	1827	.13500
1378	.89000	1453	.26500	1528	.64000	1603	.01500	1678	.39000	1753	.76500	1828	.14000
1379	.89500	1454	.27000	1529	.64500	1604	.02000	1679	.39500	1754	.77000	1829	.14500
1380	.90000	1455	.27500	1530	.65000	1605	.02500	1680	.40000	1755	.77500	1830	.15000
1381	.90500	1456	.28000	1531	.65500	1606	.03000	1681	.40500	1756	.78000	1831	.15500
1382	.91000	1457	.28500	1532	.66000	1607	.03500	1682	.41000	1757	.78500	1832	.16000
1383	.91500	1458	.29000	1533	.66500	1608	.04000	1683	.41500	1758	.79000	1833	.16500
1384	.92000	1459	.29500	1534	.67000	1609	.04500	1684	.42000	1759	.79500	1834	.17000
1385	.92500	1460	.30000	1535	.67500	1610	.05000	1685	.42500	1760	.80000	1835	.17500
1386	.93000	1461	.30500	1536	.68000	1611	.05500	1686	.43000	1761	.80500	1836	.18000
1387	.93500	1462	.31000	1537	.68500	1612	.06000	1687	.43500	1762	.81000	1837	.18500
1388	.94000	1463	.31500	1538	.69000	1613	.06500	1688	.44000	1763	.81500	1838	.19000
1389	.94500	1464	.32000	1539	.69500	1614	.07000	1689	.44500	1764	.82000	1839	.19500
1390	.95000	1465	.32500	1540	.70000	1615	.07500	1690	.45000	1765	.82500	1840	.20000
1391	.95500	1466	.33000	1541	.70500	1616	.08000	1691	.45500	1766	.83000	1841	.20500
1392	.96000	1467	.33500	1542	.71000	1617	.08500	1692	.46000	1767	.83500	1842	.21000
1393	.96500	1468	.34000	1543	.71500	1618	.09000	1693	.46500	1768	.84000	1843	.21500
1394	.97000	1469	.34500	1544	.72000	1619	.09500	1694	.47000	1769	.84500	1844	.22000
1395	.97500	1470	.35000	1545	.72500	1620	.10000	1695	.47500	1770	.85000	1845	.22500
1396	.98000	1471	.35500	1546	.73000	1621	.10500	1696	.48000	1771	.85500	1846	.23000
1397	.98500	1472	.36000	1547	.73500	1622	.11000	1697	.48500	1772	.86000	1847	.23500
1398	.99000	1473	.36500	1548	.74000	1623	.11500	1698	.49000	1773	.86500	1848	.24000
1399	.99500	1474	.37000	1549	.74500	1624	.12000	1699	.49500	1774	.87000	1849	.24500

VT-3/140 Channel Designation Table: 132 to 150 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
1850	137.25000	1925	137.62500	2000	138.00000	2075	138.37500	2150	138.75000	2225	139.12500	2300	139.50000
1851	.25500	1926	.63000	2001	.00500	2076	.38000	2151	.75500	2226	.13000	2301	.50500
1852	.26000	1927	.63500	2002	.01000	2077	.38500	2152	.76000	2227	.13500	2302	.51000
1853	.26500	1928	.64000	2003	.01500	2078	.39000	2153	.76500	2228	.14000	2303	.51500
1854	.27000	1929	.64500	2004	.02000	2079	.39500	2154	.77000	2229	.14500	2304	.52000
1855	.27500	1930	.65000	2005	.02500	2080	.40000	2155	.77500	2230	.15000	2305	.52500
1856	.28000	1931	.65500	2006	.03000	2081	.40500	2156	.78000	2231	.15500	2306	.53000
1857	.28500	1932	.66000	2007	.03500	2082	.41000	2157	.78500	2232	.16000	2307	.53500
1858	.29000	1933	.66500	2008	.04000	2083	.41500	2158	.79000	2233	.16500	2308	.54000
1859	.29500	1934	.67000	2009	.04500	2084	.42000	2159	.79500	2234	.17000	2309	.54500
1860	.30000	1935	.67500	2010	.05000	2085	.42500	2160	.80000	2235	.17500	2310	.55000
1861	.30500	1936	.68000	2011	.05500	2086	.43000	2161	.80500	2236	.18000	2311	.55500
1862	.31000	1937	.68500	2012	.06000	2087	.43500	2162	.81000	2237	.18500	2312	.56000
1863	.31500	1938	.69000	2013	.06500	2088	.44000	2163	.81500	2238	.19000	2313	.56500
1864	.32000	1939	.69500	2014	.07000	2089	.44500	2164	.82000	2239	.19500	2314	.57000
1865	.32500	1940	.70000	2015	.07500	2090	.45000	2165	.82500	2240	.20000	2315	.57500
1866	.33000	1941	.70500	2016	.08000	2091	.45500	2166	.83000	2241	.20500	2316	.58000
1867	.33500	1942	.71000	2017	.08500	2092	.46000	2167	.83500	2242	.21000	2317	.58500
1868	.34000	1943	.71500	2018	.09000	2093	.46500	2168	.84000	2243	.21500	2318	.59000
1869	.34500	1944	.72000	2019	.09500	2094	.47000	2169	.84500	2244	.22000	2319	.59500
1870	.35000	1945	.72500	2020	.10000	2095	.47500	2170	.85000	2245	.22500	2320	.60000
1871	.35500	1946	.73000	2021	.10500	2096	.48000	2171	.85500	2246	.23000	2321	.60500
1872	.36000	1947	.73500	2022	.11000	2097	.48500	2172	.86000	2247	.23500	2322	.61000
1873	.36500	1948	.74000	2023	.11500	2098	.49000	2173	.86500	2248	.24000	2323	.61500
1874	.37000	1949	.74500	2024	.12000	2099	.49500	2174	.87000	2249	.24500	2324	.62000
1875	.37500	1950	137.75000	2025	.12500	2100	138.50000	2175	.87500	2250	139.25000	2325	.62500
1876	.38000	1951	.75500	2026	.13000	2101	.50500	2176	.88000	2251	.25500	2326	.63000
1877	.38500	1952	.76000	2027	.13500	2102	.51000	2177	.88500	2252	.26000	2327	.63500
1878	.39000	1953	.76500	2028	.14000	2103	.51500	2178	.89000	2253	.26500	2328	.64000
1879	.39500	1954	.77000	2029	.14500	2104	.52000	2179	.89500	2254	.27000	2329	.64500
1880	.40000	1955	.77500	2030	.15000	2105	.52500	2180	.90000	2255	.27500	2330	.65000
1881	.40500	1956	.78000	2031	.15500	2106	.53000	2181	.90500	2256	.28000	2331	.65500
1882	.41000	1957	.78500	2032	.16000	2107	.53500	2182	.91000	2257	.28500	2332	.66000
1883	.41500	1958	.79000	2033	.16500	2108	.54000	2183	.91500	2258	.29000	2333	.66500
1884	.42000	1959	.79500	2034	.17000	2109	.54500	2184	.92000	2259	.29500	2334	.67000
1885	.42500	1960	.80000	2035	.17500	2110	.55000	2185	.92500	2260	.30000	2335	.67500
1886	.43000	1961	.80500	2036	.18000	2111	.55500	2186	.93000	2261	.30500	2336	.68000
1887	.43500	1962	.81000	2037	.18500	2112	.56000	2187	.93500	2262	.31000	2337	.68500
1888	.44000	1963	.81500	2038	.19000	2113	.56500	2188	.94000	2263	.31500	2338	.69000
1889	.44500	1964	.82000	2039	.19500	2114	.57000	2189	.94500	2264	.32000	2339	.69500
1890	.45000	1965	.82500	2040	.20000	2115	.57500	2190	.95000	2265	.32500	2340	.70000
1891	.45500	1966	.83000	2041	.20500	2116	.58000	2191	.95500	2266	.33000	2341	.70500
1892	.46000	1967	.83500	2042	.21000	2117	.58500	2192	.96000	2267	.33500	2342	.71000
1893	.46500	1968	.84000	2043	.21500	2118	.59000	2193	.96500	2268	.34000	2343	.71500
1894	.47000	1969	.84500	2044	.22000	2119	.59500	2194	.97000	2269	.34500	2344	.72000
1895	.47500	1970	.85000	2045	.22500	2120	.60000	2195	.97500	2270	.35000	2345	.72500
1896	.48000	1971	.85500	2046	.23000	2121	.60500	2196	.98000	2271	.35500	2346	.73000
1897	.48500	1972	.86000	2047	.23500	2122	.61000	2197	.98500	2272	.36000	2347	.73500
1898	.49000	1973	.86500	2048	.24000	2123	.61500	2198	.99000	2273	.36500	2348	.74000
1899	.49500	1974	.87000	2049	.24500	2124	.62000	2199	.99500	2274	.37000	2349	.74500
1900	137.50000	1975	.87500	2050	138.25000	2125	.62500	2200	139.00000	2275	.37500	2350	139.75000
1901	.50500	1976	.88000	2051	.25500	2126	.63000	2201	.00500	2276	.38000	2351	.75500
1902	.51000	1977	.88500	2052	.26000	2127	.63500	2202	.01000	2277	.38500	2352	.76000
1903	.51500	1978	.89000	2053	.26500	2128	.64000	2203	.01500	2278	.39000	2353	.76500
1904	.52000	1979	.89500	2054	.27000	2129	.64500	2204	.02000	2279	.39500	2354	.77000
1905	.52500	1980	.90000	2055	.27500	2130	.65000	2205	.02500	2280	.40000	2355	.77500
1906	.53000	1981	.90500	2056	.28000	2131	.65500	2206	.03000	2281	.40500	2356	.78000
1907	.53500	1982	.91000	2057	.28500	2132	.66000	2207	.03500	2282	.41000	2357	.78500
1908	.54000	1983	.91500	2058	.29000	2133	.66500	2208	.04000	2283	.41500	2358	.79000
1909	.54500	1984	.92000	2059	.29500	2134	.67000	2209	.04500	2284	.42000	2359	.79500
1910	.55000	1985	.92500	2060	.30000	2135	.67500	2210	.05000	2285	.42500	2360	.80000
1911	.55500	1986	.93000	2061	.30500	2136	.68000	2211	.05500	2286	.43000	2361	.80500
1912	.56000	1987	.93500	2062	.31000	2137	.68500	2212	.06000	2287	.43500	2362	.81000
1913	.56500	1988	.94000	2063	.31500	2138	.69000	2213	.06500	2288	.44000	2363	.81500
1914	.57000	1989	.94500	2064	.32000	2139	.69500	2214	.07000	2289	.44500	2364	.82000
1915	.57500	1990	.95000	2065	.32500	2140	.70000	2215	.07500	2290	.45000	2365	.82500
1916	.58000	1991	.95500	2066	.33000	2141	.70500	2216	.08000	2291	.45500	2366	.83000
1917	.58500	1992	.96000	2067	.33500	2142	.71000	2217	.08500	2292	.46000	2367	.83500
1918	.59000	1993	.96500	2068	.34000	2143	.71500	2218	.09000	2293	.46500	2368	.84000
1919	.59500	1994	.97000	2069	.34500	2144	.72000	2219	.09500	2294	.47000	2369	.84500
1920	.60000	1995	.97500	2070	.35000	2145	.72500	2220	.10000	2295	.47500	2370	.85000
1921	.60500	1996	.98000	2071	.35500	2146	.73000	2221	.10500	2296	.48000	2371	.85500
1922	.61000	1997	.98500	2072	.36000	2147	.73500	2222	.11000	2297	.48500	2372	.86000
1923	.61500	1998	.99000	2073	.36500	2148	.74000	2223	.11500	2298	.49000	2373	.86500
1924	.62000	1999	.99500	2074	.37000	2149	.74500	2224	.12000	2299	.49500	2374	.87000

VT-3/140 Channel Designation Table: 132 to 150 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
2375	139.87500	2450	140.25000	2525	140.62500	2600	141.00000	2675	141.37500	2750	141.75000	2825	142.12500
2376	.88000	2451	.25500	2526	.63000	2601	.00500	2676	.38000	2751	.75500	2826	.13000
2377	.88500	2452	.26000	2527	.63500	2602	.01000	2677	.38500	2752	.76000	2827	.13500
2378	.89000	2453	.26500	2528	.64000	2603	.01500	2678	.39000	2753	.76500	2828	.14000
2379	.89500	2454	.27000	2529	.64500	2604	.02000	2679	.39500	2754	.77000	2829	.14500
2380	.90000	2455	.27500	2530	.65000	2605	.02500	2680	.40000	2755	.77500	2830	.15000
2381	.90500	2456	.28000	2531	.65500	2606	.03000	2681	.40500	2756	.78000	2831	.15500
2382	.91000	2457	.28500	2532	.66000	2607	.03500	2682	.41000	2757	.78500	2832	.16000
2383	.91500	2458	.29000	2533	.66500	2608	.04000	2683	.41500	2758	.79000	2833	.16500
2384	.92000	2459	.29500	2534	.67000	2609	.04500	2684	.42000	2759	.79500	2834	.17000
2385	.92500	2460	.30000	2535	.67500	2610	.05000	2685	.42500	2760	.80000	2835	.17500
2386	.93000	2461	.30500	2536	.68000	2611	.05500	2686	.43000	2761	.80500	2836	.18000
2387	.93500	2462	.31000	2537	.68500	2612	.06000	2687	.43500	2762	.81000	2837	.18500
2388	.94000	2463	.31500	2538	.69000	2613	.06500	2688	.44000	2763	.81500	2838	.19000
2389	.94500	2464	.32000	2539	.69500	2614	.07000	2689	.44500	2764	.82000	2839	.19500
2390	.95000	2465	.32500	2540	.70000	2615	.07500	2690	.45000	2765	.82500	2840	.20000
2391	.95500	2466	.33000	2541	.70500	2616	.08000	2691	.45500	2766	.83000	2841	.20500
2392	.96000	2467	.33500	2542	.71000	2617	.08500	2692	.46000	2767	.83500	2842	.21000
2393	.96500	2468	.34000	2543	.71500	2618	.09000	2693	.46500	2768	.84000	2843	.21500
2394	.97000	2469	.34500	2544	.72000	2619	.09500	2694	.47000	2769	.84500	2844	.22000
2395	.97500	2470	.35000	2545	.72500	2620	.10000	2695	.47500	2770	.85000	2845	.22500
2396	.98000	2471	.35500	2546	.73000	2621	.10500	2696	.48000	2771	.85500	2846	.23000
2397	.98500	2472	.36000	2547	.73500	2622	.11000	2697	.48500	2772	.86000	2847	.23500
2398	.99000	2473	.36500	2548	.74000	2623	.11500	2698	.49000	2773	.86500	2848	.24000
2399	.99500	2474	.37000	2549	.74500	2624	.12000	2699	.49500	2774	.87000	2849	.24500
2400	140.00000	2475	.37500	2550	140.75000	2625	.12500	2700	141.50000	2775	.87500	2850	142.25000
2401	.00500	2476	.38000	2551	.75500	2626	.13000	2701	.50500	2776	.88000	2851	.25500
2402	.01000	2477	.38500	2552	.76000	2627	.13500	2702	.51000	2777	.88500	2852	.26000
2403	.01500	2478	.39000	2553	.76500	2628	.14000	2703	.51500	2778	.89000	2853	.26500
2404	.02000	2479	.39500	2554	.77000	2629	.14500	2704	.52000	2779	.89500	2854	.27000
2405	.02500	2480	.40000	2555	.77500	2630	.15000	2705	.52500	2780	.90000	2855	.27500
2406	.03000	2481	.40500	2556	.78000	2631	.15500	2706	.53000	2781	.90500	2856	.28000
2407	.03500	2482	.41000	2557	.78500	2632	.16000	2707	.53500	2782	.91000	2857	.28500
2408	.04000	2483	.41500	2558	.79000	2633	.16500	2708	.54000	2783	.91500	2858	.29000
2409	.04500	2484	.42000	2559	.79500	2634	.17000	2709	.54500	2784	.92000	2859	.29500
2410	.05000	2485	.42500	2560	.80000	2635	.17500	2710	.55000	2785	.92500	2860	.30000
2411	.05500	2486	.43000	2561	.80500	2636	.18000	2711	.55500	2786	.93000	2861	.30500
2412	.06000	2487	.43500	2562	.81000	2637	.18500	2712	.56000	2787	.93500	2862	.31000
2413	.06500	2488	.44000	2563	.81500	2638	.19000	2713	.56500	2788	.94000	2863	.31500
2414	.07000	2489	.44500	2564	.82000	2639	.19500	2714	.57000	2789	.94500	2864	.32000
2415	.07500	2490	.45000	2565	.82500	2640	.20000	2715	.57500	2790	.95000	2865	.32500
2416	.08000	2491	.45500	2566	.83000	2641	.20500	2716	.58000	2791	.95500	2866	.33000
2417	.08500	2492	.46000	2567	.83500	2642	.21000	2717	.58500	2792	.96000	2867	.33500
2418	.09000	2493	.46500	2568	.84000	2643	.21500	2718	.59000	2793	.96500	2868	.34000
2419	.09500	2494	.47000	2569	.84500	2644	.22000	2719	.59500	2794	.97000	2869	.34500
2420	.10000	2495	.47500	2570	.85000	2645	.22500	2720	.60000	2795	.97500	2870	.35000
2421	.10500	2496	.48000	2571	.85500	2646	.23000	2721	.60500	2796	.98000	2871	.35500
2422	.11000	2497	.48500	2572	.86000	2647	.23500	2722	.61000	2797	.98500	2872	.36000
2423	.11500	2498	.49000	2573	.86500	2648	.24000	2723	.61500	2798	.99000	2873	.36500
2424	.12000	2499	.49500	2574	.87000	2649	.24500	2724	.62000	2799	.99500	2874	.37000
2425	.12500	2500	140.50000	2575	.87500	2650	141.25000	2725	.62500	2800	142.00000	2875	.37500
2426	.13000	2501	.50500	2576	.88000	2651	.25500	2726	.63000	2801	.00500	2876	.38000
2427	.13500	2502	.51000	2577	.88500	2652	.26000	2727	.63500	2802	.01000	2877	.38500
2428	.14000	2503	.51500	2578	.89000	2653	.26500	2728	.64000	2803	.01500	2878	.39000
2429	.14500	2504	.52000	2579	.89500	2654	.27000	2729	.64500	2804	.02000	2879	.39500
2430	.15000	2505	.52500	2580	.90000	2655	.27500	2730	.65000	2805	.02500	2880	.40000
2431	.15500	2506	.53000	2581	.90500	2656	.28000	2731	.65500	2806	.03000	2881	.40500
2432	.16000	2507	.53500	2582	.91000	2657	.28500	2732	.66000	2807	.03500	2882	.41000
2433	.16500	2508	.54000	2583	.91500	2658	.29000	2733	.66500	2808	.04000	2883	.41500
2434	.17000	2509	.54500	2584	.92000	2659	.29500	2734	.67000	2809	.04500	2884	.42000
2435	.17500	2510	.55000	2585	.92500	2660	.30000	2735	.67500	2810	.05000	2885	.42500
2436	.18000	2511	.55500	2586	.93000	2661	.30500	2736	.68000	2811	.05500	2886	.43000
2437	.18500	2512	.56000	2587	.93500	2662	.31000	2737	.68500	2812	.06000	2887	.43500
2438	.19000	2513	.56500	2588	.94000	2663	.31500	2738	.69000	2813	.06500	2888	.44000
2439	.19500	2514	.57000	2589	.94500	2664	.32000	2739	.69500	2814	.07000	2889	.44500
2440	.20000	2515	.57500	2590	.95000	2665	.32500	2740	.70000	2815	.07500	2890	.45000
2441	.20500	2516	.58000	2591	.95500	2666	.33000	2741	.70500	2816	.08000	2891	.45500
2442	.21000	2517	.58500	2592	.96000	2667	.33500	2742	.71000	2817	.08500	2892	.46000
2443	.21500	2518	.59000	2593	.96500	2668	.34000	2743	.71500	2818	.09000	2893	.46500
2444	.22000	2519	.59500	2594	.97000	2669	.34500	2744	.72000	2819	.09500	2894	.47000
2445	.22500	2520	.60000	2595	.97500	2670	.35000	2745	.72500	2820	.10000	2895	.47500
2446	.23000	2521	.60500	2596	.98000	2671	.35500	2746	.73000	2821	.10500	2896	.48000
2447	.23500	2522	.61000	2597	.98500	2672	.36000	2747	.73500	2822	.11000	2897	.48500
2448	.24000	2523	.61500	2598	.99000	2673	.36500	2748	.74000	2823	.11500	2898	.49000
2449	.24500	2524	.62000	2599	.99500	2674	.37000	2749	.74500	2824	.12000	2899	.49500

VT-3/140 Channel Designation Table: 132 to 150 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
2900	142.50000	2975	142.87500	3050	143.25000	3125	143.62500	3200	144.00000	3275	144.37500	3350	144.75000
2901	.50500	2976	.88000	3051	.25500	3126	.63000	3201	.00500	3276	.38000	3351	.75500
2902	.51000	2977	.88500	3052	.26000	3127	.63500	3202	.01000	3277	.38500	3352	.76000
2903	.51500	2978	.89000	3053	.26500	3128	.64000	3203	.01500	3278	.39000	3353	.76500
2904	.52000	2979	.89500	3054	.27000	3129	.64500	3204	.02000	3279	.39500	3354	.77000
2905	.52500	2980	.90000	3055	.27500	3130	.65000	3205	.02500	3280	.40000	3355	.77500
2906	.53000	2981	.90500	3056	.28000	3131	.65500	3206	.03000	3281	.40500	3356	.78000
2907	.53500	2982	.91000	3057	.28500	3132	.66000	3207	.03500	3282	.41000	3357	.78500
2908	.54000	2983	.91500	3058	.29000	3133	.66500	3208	.04000	3283	.41500	3358	.79000
2909	.54500	2984	.92000	3059	.29500	3134	.67000	3209	.04500	3284	.42000	3359	.79500
2910	.55000	2985	.92500	3060	.30000	3135	.67500	3210	.05000	3285	.42500	3360	.80000
2911	.55500	2986	.93000	3061	.30500	3136	.68000	3211	.05500	3286	.43000	3361	.80500
2912	.56000	2987	.93500	3062	.31000	3137	.68500	3212	.06000	3287	.43500	3362	.81000
2913	.56500	2988	.94000	3063	.31500	3138	.69000	3213	.06500	3288	.44000	3363	.81500
2914	.57000	2989	.94500	3064	.32000	3139	.69500	3214	.07000	3289	.44500	3364	.82000
2915	.57500	2990	.95000	3065	.32500	3140	.70000	3215	.07500	3290	.45000	3365	.82500
2916	.58000	2991	.95500	3066	.33000	3141	.70500	3216	.08000	3291	.45500	3366	.83000
2917	.58500	2992	.96000	3067	.33500	3142	.71000	3217	.08500	3292	.46000	3367	.83500
2918	.59000	2993	.96500	3068	.34000	3143	.71500	3218	.09000	3293	.46500	3368	.84000
2919	.59500	2994	.97000	3069	.34500	3144	.72000	3219	.09500	3294	.47000	3369	.84500
2920	.60000	2995	.97500	3070	.35000	3145	.72500	3220	.10000	3295	.47500	3370	.85000
2921	.60500	2996	.98000	3071	.35500	3146	.73000	3221	.10500	3296	.48000	3371	.85500
2922	.61000	2997	.98500	3072	.36000	3147	.73500	3222	.11000	3297	.48500	3372	.86000
2923	.61500	2998	.99000	3073	.36500	3148	.74000	3223	.11500	3298	.49000	3373	.86500
2924	.62000	2999	.99500	3074	.37000	3149	.74500	3224	.12000	3299	.49500	3374	.87000
2925	.62500	3000	143.00000	3075	.37500	3150	143.75000	3225	.12500	3300	144.50000	3375	.87500
2926	.63000	3001	.00500	3076	.38000	3151	.75500	3226	.13000	3301	.50500	3376	.88000
2927	.63500	3002	.01000	3077	.38500	3152	.76000	3227	.13500	3302	.51000	3377	.88500
2928	.64000	3003	.01500	3078	.39000	3153	.76500	3228	.14000	3303	.51500	3378	.89000
2929	.64500	3004	.02000	3079	.39500	3154	.77000	3229	.14500	3304	.52000	3379	.89500
2930	.65000	3005	.02500	3080	.40000	3155	.77500	3230	.15000	3305	.52500	3380	.90000
2931	.65500	3006	.03000	3081	.40500	3156	.78000	3231	.15500	3306	.53000	3381	.90500
2932	.66000	3007	.03500	3082	.41000	3157	.78500	3232	.16000	3307	.53500	3382	.91000
2933	.66500	3008	.04000	3083	.41500	3158	.79000	3233	.16500	3308	.54000	3383	.91500
2934	.67000	3009	.04500	3084	.42000	3159	.79500	3234	.17000	3309	.54500	3384	.92000
2935	.67500	3010	.05000	3085	.42500	3160	.80000	3235	.17500	3310	.55000	3385	.92500
2936	.68000	3011	.05500	3086	.43000	3161	.80500	3236	.18000	3311	.55500	3386	.93000
2937	.68500	3012	.06000	3087	.43500	3162	.81000	3237	.18500	3312	.56000	3387	.93500
2938	.69000	3013	.06500	3088	.44000	3163	.81500	3238	.19000	3313	.56500	3388	.94000
2939	.69500	3014	.07000	3089	.44500	3164	.82000	3239	.19500	3314	.57000	3389	.94500
2940	.70000	3015	.07500	3090	.45000	3165	.82500	3240	.20000	3315	.57500	3390	.95000
2941	.70500	3016	.08000	3091	.45500	3166	.83000	3241	.20500	3316	.58000	3391	.95500
2942	.71000	3017	.08500	3092	.46000	3167	.83500	3242	.21000	3317	.58500	3392	.96000
2943	.71500	3018	.09000	3093	.46500	3168	.84000	3243	.21500	3318	.59000	3393	.96500
2944	.72000	3019	.09500	3094	.47000	3169	.84500	3244	.22000	3319	.59500	3394	.97000
2945	.72500	3020	.10000	3095	.47500	3170	.85000	3245	.22500	3320	.60000	3395	.97500
2946	.73000	3021	.10500	3096	.48000	3171	.85500	3246	.23000	3321	.60500	3396	.98000
2947	.73500	3022	.11000	3097	.48500	3172	.86000	3247	.23500	3322	.61000	3397	.98500
2948	.74000	3023	.11500	3098	.49000	3173	.86500	3248	.24000	3323	.61500	3398	.99000
2949	.74500	3024	.12000	3099	.49500	3174	.87000	3249	.24500	3324	.62000	3399	.99500
2950	142.75000	3025	.12500	3100	143.50000	3175	.87500	3250	144.25000	3325	.62500	3400	145.00000
2951	.75500	3026	.13000	3101	.50500	3176	.88000	3251	.25500	3326	.63000	3401	.00500
2952	.76000	3027	.13500	3102	.51000	3177	.88500	3252	.26000	3327	.63500	3402	.01000
2953	.76500	3028	.14000	3103	.51500	3178	.89000	3253	.26500	3328	.64000	3403	.01500
2954	.77000	3029	.14500	3104	.52000	3179	.89500	3254	.27000	3329	.64500	3404	.02000
2955	.77500	3030	.15000	3105	.52500	3180	.90000	3255	.27500	3330	.65000	3405	.02500
2956	.78000	3031	.15500	3106	.53000	3181	.90500	3256	.28000	3331	.65500	3406	.03000
2957	.78500	3032	.16000	3107	.53500	3182	.91000	3257	.28500	3332	.66000	3407	.03500
2958	.79000	3033	.16500	3108	.54000	3183	.91500	3258	.29000	3333	.66500	3408	.04000
2959	.79500	3034	.17000	3109	.54500	3184	.92000	3259	.29500	3334	.67000	3409	.04500
2960	.80000	3035	.17500	3110	.55000	3185	.92500	3260	.30000	3335	.67500	3410	.05000
2961	.80500	3036	.18000	3111	.55500	3186	.93000	3261	.30500	3336	.68000	3411	.05500
2962	.81000	3037	.18500	3112	.56000	3187	.93500	3262	.31000	3337	.68500	3412	.06000
2963	.81500	3038	.19000	3113	.56500	3188	.94000	3263	.31500	3338	.69000	3413	.06500
2964	.82000	3039	.19500	3114	.57000	3189	.94500	3264	.32000	3339	.69500	3414	.07000
2965	.82500	3040	.20000	3115	.57500	3190	.95000	3265	.32500	3340	.70000	3415	.07500
2966	.83000	3041	.20500	3116	.58000	3191	.95500	3266	.33000	3341	.70500	3416	.08000
2967	.83500	3042	.21000	3117	.58500	3192	.96000	3267	.33500	3342	.71000	3417	.08500
2968	.84000	3043	.21500	3118	.59000	3193	.96500	3268	.34000	3343	.71500	3418	.09000
2969	.84500	3044	.22000	3119	.59500	3194	.97000	3269	.34500	3344	.72000	3419	.09500
2970	.85000	3045	.22500	3120	.60000	3195	.97500	3270	.35000	3345	.72500	3420	.10000
2971	.85500	3046	.23000	3121	.60500	3196	.98000	3271	.35500	3346	.73000	3421	.10500
2972	.86000	3047	.23500	3122	.61000	3197	.98500	3272	.36000	3347	.73500	3422	.11000
2973	.86500	3048	.24000	3123	.61500	3198	.99000	3273	.36500	3348	.74000	3423	.11500
2974	.87000	3049	.24500	3124	.62000	3199	.99500	3274	.37000	3349	.74500	3424	.12000

VT-3/140 Channel Designation Table: 132 to 150 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
3425	145.12500	3500	145.50000	3575	145.87500	3650	146.25000	3725	146.62500	3800	147.00000	3875	147.37500
3426	.13000	3501	.50500	3576	.88000	3651	.25500	3726	.63000	3801	.00500	3876	.38000
3427	.13500	3502	.51000	3577	.88500	3652	.26000	3727	.63500	3802	.01000	3877	.38500
3428	.14000	3503	.51500	3578	.89000	3653	.26500	3728	.64000	3803	.01500	3878	.39000
3429	.14500	3504	.52000	3579	.89500	3654	.27000	3729	.64500	3804	.02000	3879	.39500
3430	.15000	3505	.52500	3580	.90000	3655	.27500	3730	.65000	3805	.02500	3880	.40000
3431	.15500	3506	.53000	3581	.90500	3656	.28000	3731	.65500	3806	.03000	3881	.40500
3432	.16000	3507	.53500	3582	.91000	3657	.28500	3732	.66000	3807	.03500	3882	.41000
3433	.16500	3508	.54000	3583	.91500	3658	.29000	3733	.66500	3808	.04000	3883	.41500
3434	.17000	3509	.54500	3584	.92000	3659	.29500	3734	.67000	3809	.04500	3884	.42000
3435	.17500	3510	.55000	3585	.92500	3660	.30000	3735	.67500	3810	.05000	3885	.42500
3436	.18000	3511	.55500	3586	.93000	3661	.30500	3736	.68000	3811	.05500	3886	.43000
3437	.18500	3512	.56000	3587	.93500	3662	.31000	3737	.68500	3812	.06000	3887	.43500
3438	.19000	3513	.56500	3588	.94000	3663	.31500	3738	.69000	3813	.06500	3888	.44000
3439	.19500	3514	.57000	3589	.94500	3664	.32000	3739	.69500	3814	.07000	3889	.44500
3440	.20000	3515	.57500	3590	.95000	3665	.32500	3740	.70000	3815	.07500	3890	.45000
3441	.20500	3516	.58000	3591	.95500	3666	.33000	3741	.70500	3816	.08000	3891	.45500
3442	.21000	3517	.58500	3592	.96000	3667	.33500	3742	.71000	3817	.08500	3892	.46000
3443	.21500	3518	.59000	3593	.96500	3668	.34000	3743	.71500	3818	.09000	3893	.46500
3444	.22000	3519	.59500	3594	.97000	3669	.34500	3744	.72000	3819	.09500	3894	.47000
3445	.22500	3520	.60000	3595	.97500	3670	.35000	3745	.72500	3820	.10000	3895	.47500
3446	.23000	3521	.60500	3596	.98000	3671	.35500	3746	.73000	3821	.10500	3896	.48000
3447	.23500	3522	.61000	3597	.98500	3672	.36000	3747	.73500	3822	.11000	3897	.48500
3448	.24000	3523	.61500	3598	.99000	3673	.36500	3748	.74000	3823	.11500	3898	.49000
3449	.24500	3524	.62000	3599	.99500	3674	.37000	3749	.74500	3824	.12000	3899	.49500
3450	145.25000	3525	.62500	3600	146.00000	3675	.37500	3750	146.75000	3825	.12500	3900	147.50000
3451	.25500	3526	.63000	3601	.00500	3676	.38000	3751	.75500	3826	.13000	3901	.50500
3452	.26000	3527	.63500	3602	.01000	3677	.38500	3752	.76000	3827	.13500	3902	.51000
3453	.26500	3528	.64000	3603	.01500	3678	.39000	3753	.76500	3828	.14000	3903	.51500
3454	.27000	3529	.64500	3604	.02000	3679	.39500	3754	.77000	3829	.14500	3904	.52000
3455	.27500	3530	.65000	3605	.02500	3680	.40000	3755	.77500	3830	.15000	3905	.52500
3456	.28000	3531	.65500	3606	.03000	3681	.40500	3756	.78000	3831	.15500	3906	.53000
3457	.28500	3532	.66000	3607	.03500	3682	.41000	3757	.78500	3832	.16000	3907	.53500
3458	.29000	3533	.66500	3608	.04000	3683	.41500	3758	.79000	3833	.16500	3908	.54000
3459	.29500	3534	.67000	3609	.04500	3684	.42000	3759	.79500	3834	.17000	3909	.54500
3460	.30000	3535	.67500	3610	.05000	3685	.42500	3760	.80000	3835	.17500	3910	.55000
3461	.30500	3536	.68000	3611	.05500	3686	.43000	3761	.80500	3836	.18000	3911	.55500
3462	.31000	3537	.68500	3612	.06000	3687	.43500	3762	.81000	3837	.18500	3912	.56000
3463	.31500	3538	.69000	3613	.06500	3688	.44000	3763	.81500	3838	.19000	3913	.56500
3464	.32000	3539	.69500	3614	.07000	3689	.44500	3764	.82000	3839	.19500	3914	.57000
3465	.32500	3540	.70000	3615	.07500	3690	.45000	3765	.82500	3840	.20000	3915	.57500
3466	.33000	3541	.70500	3616	.08000	3691	.45500	3766	.83000	3841	.20500	3916	.58000
3467	.33500	3542	.71000	3617	.08500	3692	.46000	3767	.83500	3842	.21000	3917	.58500
3468	.34000	3543	.71500	3618	.09000	3693	.46500	3768	.84000	3843	.21500	3918	.59000
3469	.34500	3544	.72000	3619	.09500	3694	.47000	3769	.84500	3844	.22000	3919	.59500
3470	.35000	3545	.72500	3620	.10000	3695	.47500	3770	.85000	3845	.22500	3920	.60000
3471	.35500	3546	.73000	3621	.10500	3696	.48000	3771	.85500	3846	.23000	3921	.60500
3472	.36000	3547	.73500	3622	.11000	3697	.48500	3772	.86000	3847	.23500	3922	.61000
3473	.36500	3548	.74000	3623	.11500	3698	.49000	3773	.86500	3848	.24000	3923	.61500
3474	.37000	3549	.74500	3624	.12000	3699	.49500	3774	.87000	3849	.24500	3924	.62000
3475	.37500	3550	145.75000	3625	.12500	3700	146.50000	3775	.87500	3850	147.25000	3925	.62500
3476	.38000	3551	.75500	3626	.13000	3701	.50500	3776	.88000	3851	.25500	3926	.63000
3477	.38500	3552	.76000	3627	.13500	3702	.51000	3777	.88500	3852	.26000	3927	.63500
3478	.39000	3553	.76500	3628	.14000	3703	.51500	3778	.89000	3853	.26500	3928	.64000
3479	.39500	3554	.77000	3629	.14500	3704	.52000	3779	.89500	3854	.27000	3929	.64500
3480	.40000	3555	.77500	3630	.15000	3705	.52500	3780	.90000	3855	.27500	3930	.65000
3481	.40500	3556	.78000	3631	.15500	3706	.53000	3781	.90500	3856	.28000	3931	.65500
3482	.41000	3557	.78500	3632	.16000	3707	.53500	3782	.91000	3857	.28500	3932	.66000
3483	.41500	3558	.79000	3633	.16500	3708	.54000	3783	.91500	3858	.29000	3933	.66500
3484	.42000	3559	.79500	3634	.17000	3709	.54500	3784	.92000	3859	.29500	3934	.67000
3485	.42500	3560	.80000	3635	.17500	3710	.55000	3785	.92500	3860	.30000	3935	.67500
3486	.43000	3561	.80500	3636	.18000	3711	.55500	3786	.93000	3861	.30500	3936	.68000
3487	.43500	3562	.81000	3637	.18500	3712	.56000	3787	.93500	3862	.31000	3937	.68500
3488	.44000	3563	.81500	3638	.19000	3713	.56500	3788	.94000	3863	.31500	3938	.69000
3489	.44500	3564	.82000	3639	.19500	3714	.57000	3789	.94500	3864	.32000	3939	.69500
3490	.45000	3565	.82500	3640	.20000	3715	.57500	3790	.95000	3865	.32500	3940	.70000
3491	.45500	3566	.83000	3641	.20500	3716	.58000	3791	.95500	3866	.33000	3941	.70500
3492	.46000	3567	.83500	3642	.21000	3717	.58500	3792	.96000	3867	.33500	3942	.71000
3493	.46500	3568	.84000	3643	.21500	3718	.59000	3793	.96500	3868	.34000	3943	.71500
3494	.47000	3569	.84500	3644	.22000	3719	.59500	3794	.97000	3869	.34500	3944	.72000
3495	.47500	3570	.85000	3645	.22500	3720	.60000	3795	.97500	3870	.35000	3945	.72500
3496	.48000	3571	.85500	3646	.23000	3721	.60500	3796	.98000	3871	.35500	3946	.73000
3497	.48500	3572	.86000	3647	.23500	3722	.61000	3797	.98500	3872	.36000	3947	.73500
3498	.49000	3573	.86500	3648	.24000	3723	.61500	3798	.99000	3873	.36500	3948	.74000
3499	.49500	3574	.87000	3649	.24500	3724	.62000	3799	.99500	3874	.37000	3949	.74500

VT-3/140 Channel Designation Table: 132 to 150 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
3950	147.75000	4025	148.12500	4100	148.50000	4175	148.87500	4250	149.25000	4325	149.62500	4400	150.00000
3951	.75500	4026	.13000	4101	.50500	4176	.88000	4251	.25500	4326	.63000		
3952	.76000	4027	.13500	4102	.51000	4177	.88500	4252	.26000	4327	.63500		
3953	.76500	4028	.14000	4103	.51500	4178	.89000	4253	.26500	4328	.64000		
3954	.77000	4029	.14500	4104	.52000	4179	.89500	4254	.27000	4329	.64500		
3955	.77500	4030	.15000	4105	.52500	4180	.90000	4255	.27500	4330	.65000		
3956	.78000	4031	.15500	4106	.53000	4181	.90500	4256	.28000	4331	.65500		
3957	.78500	4032	.16000	4107	.53500	4182	.91000	4257	.28500	4332	.66000		
3958	.79000	4033	.16500	4108	.54000	4183	.91500	4258	.29000	4333	.66500		
3959	.79500	4034	.17000	4109	.54500	4184	.92000	4259	.29500	4334	.67000		
3960	.80000	4035	.17500	4110	.55000	4185	.92500	4260	.30000	4335	.67500		
3961	.80500	4036	.18000	4111	.55500	4186	.93000	4261	.30500	4336	.68000		
3962	.81000	4037	.18500	4112	.56000	4187	.93500	4262	.31000	4337	.68500		
3963	.81500	4038	.19000	4113	.56500	4188	.94000	4263	.31500	4338	.69000		
3964	.82000	4039	.19500	4114	.57000	4189	.94500	4264	.32000	4339	.69500		
3965	.82500	4040	.20000	4115	.57500	4190	.95000	4265	.32500	4340	.70000		
3966	.83000	4041	.20500	4116	.58000	4191	.95500	4266	.33000	4341	.70500		
3967	.83500	4042	.21000	4117	.58500	4192	.96000	4267	.33500	4342	.71000		
3968	.84000	4043	.21500	4118	.59000	4193	.96500	4268	.34000	4343	.71500		
3969	.84500	4044	.22000	4119	.59500	4194	.97000	4269	.34500	4344	.72000		
3970	.85000	4045	.22500	4120	.60000	4195	.97500	4270	.35000	4345	.72500		
3971	.85500	4046	.23000	4121	.60500	4196	.98000	4271	.35500	4346	.73000		
3972	.86000	4047	.23500	4122	.61000	4197	.98500	4272	.36000	4347	.73500		
3973	.86500	4048	.24000	4123	.61500	4198	.99000	4273	.36500	4348	.74000		
3974	.87000	4049	.24500	4124	.62000	4199	.99500	4274	.37000	4349	.74500		
3975	.87500	4050	148.25000	4125	.62500	4200	149.00000	4275	.37500	4350	149.75000		
3976	.88000	4051	.25500	4126	.63000	4201	.00500	4276	.38000	4351	.75500		
3977	.88500	4052	.26000	4127	.63500	4202	.01000	4277	.38500	4352	.76000		
3978	.89000	4053	.26500	4128	.64000	4203	.01500	4278	.39000	4353	.76500		
3979	.89500	4054	.27000	4129	.64500	4204	.02000	4279	.39500	4354	.77000		
3980	.90000	4055	.27500	4130	.65000	4205	.02500	4280	.40000	4355	.77500		
3981	.90500	4056	.28000	4131	.65500	4206	.03000	4281	.40500	4356	.78000		
3982	.91000	4057	.28500	4132	.66000	4207	.03500	4282	.41000	4357	.78500		
3983	.91500	4058	.29000	4133	.66500	4208	.04000	4283	.41500	4358	.79000		
3984	.92000	4059	.29500	4134	.67000	4209	.04500	4284	.42000	4359	.79500		
3985	.92500	4060	.30000	4135	.67500	4210	.05000	4285	.42500	4360	.80000		
3986	.93000	4061	.30500	4136	.68000	4211	.05500	4286	.43000	4361	.80500		
3987	.93500	4062	.31000	4137	.68500	4212	.06000	4287	.43500	4362	.81000		
3988	.94000	4063	.31500	4138	.69000	4213	.06500	4288	.44000	4363	.81500		
3989	.94500	4064	.32000	4139	.69500	4214	.07000	4289	.44500	4364	.82000		
3990	.95000	4065	.32500	4140	.70000	4215	.07500	4290	.45000	4365	.82500		
3991	.95500	4066	.33000	4141	.70500	4216	.08000	4291	.45500	4366	.83000		
3992	.96000	4067	.33500	4142	.71000	4217	.08500	4292	.46000	4367	.83500		
3993	.96500	4068	.34000	4143	.71500	4218	.09000	4293	.46500	4368	.84000		
3994	.97000	4069	.34500	4144	.72000	4219	.09500	4294	.47000	4369	.84500		
3995	.97500	4070	.35000	4145	.72500	4220	.10000	4295	.47500	4370	.85000		
3996	.98000	4071	.35500	4146	.73000	4221	.10500	4296	.48000	4371	.85500		
3997	.98500	4072	.36000	4147	.73500	4222	.11000	4297	.48500	4372	.86000		
3998	.99000	4073	.36500	4148	.74000	4223	.11500	4298	.49000	4373	.86500		
3999	.99500	4074	.37000	4149	.74500	4224	.12000	4299	.49500	4374	.87000		
4000	148.00000	4075	.37500	4150	148.75000	4225	.12500	4300	149.50000	4375	.87500		
4001	.00500	4076	.38000	4151	.75500	4226	.13000	4301	.50500	4376	.88000		
4002	.01000	4077	.38500	4152	.76000	4227	.13500	4302	.51000	4377	.88500		
4003	.01500	4078	.39000	4153	.76500	4228	.14000	4303	.51500	4378	.89000		
4004	.02000	4079	.39500	4154	.77000	4229	.14500	4304	.52000	4379	.89500		
4005	.02500	4080	.40000	4155	.77500	4230	.15000	4305	.52500	4380	.90000		
4006	.03000	4081	.40500	4156	.78000	4231	.15500	4306	.53000	4381	.90500		
4007	.03500	4082	.41000	4157	.78500	4232	.16000	4307	.53500	4382	.91000		
4008	.04000	4083	.41500	4158	.79000	4233	.16500	4308	.54000	4383	.91500		
4009	.04500	4084	.42000	4159	.79500	4234	.17000	4309	.54500	4384	.92000		
4010	.05000	4085	.42500	4160	.80000	4235	.17500	4310	.55000	4385	.92500		
4011	.05500	4086	.43000	4161	.80500	4236	.18000	4311	.55500	4386	.93000		
4012	.06000	4087	.43500	4162	.81000	4237	.18500	4312	.56000	4387	.93500		
4013	.06500	4088	.44000	4163	.81500	4238	.19000	4313	.56500	4388	.94000		
4014	.07000	4089	.44500	4164	.82000	4239	.19500	4314	.57000	4389	.94500		
4015	.07500	4090	.45000	4165	.82500	4240	.20000	4315	.57500	4390	.95000		
4016	.08000	4091	.45500	4166	.83000	4241	.20500	4316	.58000	4391	.95500		
4017	.08500	4092	.46000	4167	.83500	4242	.21000	4317	.58500	4392	.96000		
4018	.09000	4093	.46500	4168	.84000	4243	.21500	4318	.59000	4393	.96500		
4019	.09500	4094	.47000	4169	.84500	4244	.22000	4319	.59500	4394	.97000		
4020	.10000	4095	.47500	4170	.85000	4245	.22500	4320	.60000	4395	.97500		
4021	.10500	4096	.48000	4171	.85500	4246	.23000	4321	.60500	4396	.98000		
4022	.11000	4097	.48500	4172	.86000	4247	.23500	4322	.61000	4397	.98500		
4023	.11500	4098	.49000	4173	.86500	4248	.24000	4323	.61500	4398	.99000		
4024	.12000	4099	.49500	4174	.87000	4249	.24500	4324	.62000	4399	.99500		

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2 VT-3/140 Channel Designation Table: 132-150MHz, 6.25kHz Increments

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
5640	132.00000	5715	132.46875	5790	132.93750	5865	133.40625	5940	133.87500	6015	134.34375	6090	134.81250
5641	.00625	5716	.47500	5791	.94375	5866	.41250	5941	.88125	6016	.35000	6091	.81875
5642	.01250	5717	.48125	5792	.95000	5867	.41875	5942	.88750	6017	.35625	6092	.82500
5643	.01875	5718	.48750	5793	.95625	5868	.42500	5943	.89375	6018	.36250	6093	.83125
5644	.02500	5719	.49375	5794	.96250	5869	.43125	5944	.90000	6019	.36875	6094	.83750
5645	.03125	5720	132.50000	5795	.96875	5870	.43750	5945	.90625	6020	.37500	6095	.84375
5646	.03750	5721	.50625	5796	.97500	5871	.44375	5946	.91250	6021	.38125	6096	.85000
5647	.04375	5722	.51250	5797	.98125	5872	.45000	5947	.91875	6022	.38750	6097	.85625
5648	.05000	5723	.51875	5798	.98750	5873	.45625	5948	.92500	6023	.39375	6098	.86250
5649	.05625	5724	.52500	5799	.99375	5874	.46250	5949	.93125	6024	.40000	6099	.86875
5650	.06250	5725	.53125	5800	133.00000	5875	.46875	5950	.93750	6025	.40625	6100	.87500
5651	.06875	5726	.53750	5801	.00625	5876	.47500	5951	.94375	6026	.41250	6101	.88125
5652	.07500	5727	.54375	5802	.01250	5877	.48125	5952	.95000	6027	.41875	6102	.88750
5653	.08125	5728	.55000	5803	.01875	5878	.48750	5953	.95625	6028	.42500	6103	.89375
5654	.08750	5729	.55625	5804	.02500	5879	.49375	5954	.96250	6029	.43125	6104	.90000
5655	.09375	5730	.56250	5805	.03125	5880	133.50000	5955	.96875	6030	.43750	6105	.90625
5656	.10000	5731	.56875	5806	.03750	5881	.50625	5956	.97500	6031	.44375	6106	.91250
5657	.10625	5732	.57500	5807	.04375	5882	.51250	5957	.98125	6032	.45000	6107	.91875
5658	.11250	5733	.58125	5808	.05000	5883	.51875	5958	.98750	6033	.45625	6108	.92500
5659	.11875	5734	.58750	5809	.05625	5884	.52500	5959	.99375	6034	.46250	6109	.93125
5660	.12500	5735	.59375	5810	.06250	5885	.53125	5960	134.00000	6035	.46875	6110	.93750
5661	.13125	5736	.60000	5811	.06875	5886	.53750	5961	.00625	6036	.47500	6111	.94375
5662	.13750	5737	.60625	5812	.07500	5887	.54375	5962	.01250	6037	.48125	6112	.95000
5663	.14375	5738	.61250	5813	.08125	5888	.55000	5963	.01875	6038	.48750	6113	.95625
5664	.15000	5739	.61875	5814	.08750	5889	.55625	5964	.02500	6039	.49375	6114	.96250
5665	.15625	5740	.62500	5815	.09375	5890	.56250	5965	.03125	6040	134.50000	6115	.96875
5666	.16250	5741	.63125	5816	.10000	5891	.56875	5966	.03750	6041	.50625	6116	.97500
5667	.16875	5742	.63750	5817	.10625	5892	.57500	5967	.04375	6042	.51250	6117	.98125
5668	.17500	5743	.64375	5818	.11250	5893	.58125	5968	.05000	6043	.51875	6118	.98750
5669	.18125	5744	.65000	5819	.11875	5894	.58750	5969	.05625	6044	.52500	6119	.99375
5670	.18750	5745	.65625	5820	.12500	5895	.59375	5970	.06250	6045	.53125	6120	135.00000
5671	.19375	5746	.66250	5821	.13125	5896	.60000	5971	.06875	6046	.53750	6121	.00625
5672	.20000	5747	.66875	5822	.13750	5897	.60625	5972	.07500	6047	.54375	6122	.01250
5673	.20625	5748	.67500	5823	.14375	5898	.61250	5973	.08125	6048	.55000	6123	.01875
5674	.21250	5749	.68125	5824	.15000	5899	.61875	5974	.08750	6049	.55625	6124	.02500
5675	.21875	5750	.68750	5825	.15625	5900	.62500	5975	.09375	6050	.56250	6125	.03125
5676	.22500	5751	.69375	5826	.16250	5901	.63125	5976	.10000	6051	.56875	6126	.03750
5677	.23125	5752	.70000	5827	.16875	5902	.63750	5977	.10625	6052	.57500	6127	.04375
5678	.23750	5753	.70625	5828	.17500	5903	.64375	5978	.11250	6053	.58125	6128	.05000
5679	.24375	5754	.71250	5829	.18125	5904	.65000	5979	.11875	6054	.58750	6129	.05625
5680	132.25000	5755	.71875	5830	.18750	5905	.65625	5980	.12500	6055	.59375	6130	.06250
5681	.25625	5756	.72500	5831	.19375	5906	.66250	5981	.13125	6056	.60000	6131	.06875
5682	.26250	5757	.73125	5832	.20000	5907	.66875	5982	.13750	6057	.60625	6132	.07500
5683	.26875	5758	.73750	5833	.20625	5908	.67500	5983	.14375	6058	.61250	6133	.08125
5684	.27500	5759	.74375	5834	.21250	5909	.68125	5984	.15000	6059	.61875	6134	.08750
5685	.28125	5760	132.75000	5835	.21875	5910	.68750	5985	.15625	6060	.62500	6135	.09375
5686	.28750	5761	.75625	5836	.22500	5911	.69375	5986	.16250	6061	.63125	6136	.10000
5687	.29375	5762	.76250	5837	.23125	5912	.70000	5987	.16875	6062	.63750	6137	.10625
5688	.30000	5763	.76875	5838	.23750	5913	.70625	5988	.17500	6063	.64375	6138	.11250
5689	.30625	5764	.77500	5839	.24375	5914	.71250	5989	.18125	6064	.65000	6139	.11875
5690	.31250	5765	.78125	5840	133.25000	5915	.71875	5990	.18750	6065	.65625	6140	.12500
5691	.31875	5766	.78750	5841	.25625	5916	.72500	5991	.19375	6066	.66250	6141	.13125
5692	.32500	5767	.79375	5842	.26250	5917	.73125	5992	.20000	6067	.66875	6142	.13750
5693	.33125	5768	.80000	5843	.26875	5918	.73750	5993	.20625	6068	.67500	6143	.14375
5694	.33750	5769	.80625	5844	.27500	5919	.74375	5994	.21250	6069	.68125	6144	.15000
5695	.34375	5770	.81250	5845	.28125	5920	133.75000	5995	.21875	6070	.68750	6145	.15625
5696	.35000	5771	.81875	5846	.28750	5921	.75625	5996	.22500	6071	.69375	6146	.16250
5697	.35625	5772	.82500	5847	.29375	5922	.76250	5997	.23125	6072	.70000	6147	.16875
5698	.36250	5773	.83125	5848	.30000	5923	.76875	5998	.23750	6073	.70625	6148	.17500
5699	.36875	5774	.83750	5849	.30625	5924	.77500	5999	.24375	6074	.71250	6149	.18125
5700	.37500	5775	.84375	5850	.31250	5925	.78125	6000	134.25000	6075	.71875	6150	.18750
5701	.38125	5776	.85000	5851	.31875	5926	.78750	6001	.25625	6076	.72500	6151	.19375
5702	.38750	5777	.85625	5852	.32500	5927	.79375	6002	.26250	6077	.73125	6152	.20000
5703	.39375	5778	.86250	5853	.33125	5928	.80000	6003	.26875	6078	.73750	6153	.20625
5704	.40000	5779	.86875	5854	.33750	5929	.80625	6004	.27500	6079	.74375	6154	.21250
5705	.40625	5780	.87500	5855	.34375	5930	.81250	6005	.28125	6080	134.75000	6155	.21875
5706	.41250	5781	.88125	5856	.35000	5931	.81875	6006	.28750	6081	.75625	6156	.22500
5707	.41875	5782	.88750	5857	.35625	5932	.82500	6007	.29375	6082	.76250	6157	.23125
5708	.42500	5783	.89375	5858	.36250	5933	.83125	6008	.30000	6083	.76875	6158	.23750
5709	.43125	5784	.90000	5859	.36875	5934	.83750	6009	.30625	6084	.77500	6159	.24375
5710	.43750	5785	.90625	5860	.37500	5935	.84375	6010	.31250	6085	.78125	6160	135.25000
5711	.44375	5786	.91250	5861	.38125	5936	.85000	6011	.31875	6086	.78750	6161	.25625
5712	.45000	5787	.91875	5862	.38750	5937	.85625	6012	.32500	6087	.79375	6162	.26250
5713	.45625	5788	.92500	5863	.39375	5938	.86250	6013	.33125	6088	.80000	6163	.26875
5714	.46250	5789	.93125	5864	.40000	5939	.86875	6014	.33750	6089	.80625	6164	.27500

VT-3/140 Channel Designation Table: 132 to 150 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
6165	135.28125	6240	135.75000	6315	136.21875	6390	136.68750	6465	137.15625	6540	137.62500	6615	138.09375
6166	.28750	6241	.75625	6316	.22500	6391	.69375	6466	.16250	6541	.63125	6616	.10000
6167	.29375	6242	.76250	6317	.23125	6392	.70000	6467	.16875	6542	.63750	6617	.10625
6168	.30000	6243	.76875	6318	.23750	6393	.70625	6468	.17500	6543	.64375	6618	.11250
6169	.30625	6244	.77500	6319	.24375	6394	.71250	6469	.18125	6544	.65000	6619	.11875
6170	.31250	6245	.78125	6320	136.25000	6395	.71875	6470	.18750	6545	.65625	6620	.12500
6171	.31875	6246	.78750	6321	.25625	6396	.72500	6471	.19375	6546	.66250	6621	.13125
6172	.32500	6247	.79375	6322	.26250	6397	.73125	6472	.20000	6547	.66875	6622	.13750
6173	.33125	6248	.80000	6323	.26875	6398	.73750	6473	.20625	6548	.67500	6623	.14375
6174	.33750	6249	.80625	6324	.27500	6399	.74375	6474	.21250	6549	.68125	6624	.15000
6175	.34375	6250	.81250	6325	.28125	6400	136.75000	6475	.21875	6550	.68750	6625	.15625
6176	.35000	6251	.81875	6326	.28750	6401	.75625	6476	.22500	6551	.69375	6626	.16250
6177	.35625	6252	.82500	6327	.29375	6402	.76250	6477	.23125	6552	.70000	6627	.16875
6178	.36250	6253	.83125	6328	.30000	6403	.76875	6478	.23750	6553	.70625	6628	.17500
6179	.36875	6254	.83750	6329	.30625	6404	.77500	6479	.24375	6554	.71250	6629	.18125
6180	.37500	6255	.84375	6330	.31250	6405	.78125	6480	137.25000	6555	.71875	6630	.18750
6181	.38125	6256	.85000	6331	.31875	6406	.78750	6481	.25625	6556	.72500	6631	.19375
6182	.38750	6257	.85625	6332	.32500	6407	.79375	6482	.26250	6557	.73125	6632	.20000
6183	.39375	6258	.86250	6333	.33125	6408	.80000	6483	.26875	6558	.73750	6633	.20625
6184	.40000	6259	.86875	6334	.33750	6409	.80625	6484	.27500	6559	.74375	6634	.21250
6185	.40625	6260	.87500	6335	.34375	6410	.81250	6485	.28125	6560	137.75000	6635	.21875
6186	.41250	6261	.88125	6336	.35000	6411	.81875	6486	.28750	6561	.75625	6636	.22500
6187	.41875	6262	.88750	6337	.35625	6412	.82500	6487	.29375	6562	.76250	6637	.23125
6188	.42500	6263	.89375	6338	.36250	6413	.83125	6488	.30000	6563	.76875	6638	.23750
6189	.43125	6264	.90000	6339	.36875	6414	.83750	6489	.30625	6564	.77500	6639	.24375
6190	.43750	6265	.90625	6340	.37500	6415	.84375	6490	.31250	6565	.78125	6640	138.25000
6191	.44375	6266	.91250	6341	.38125	6416	.85000	6491	.31875	6566	.78750	6641	.25625
6192	.45000	6267	.91875	6342	.38750	6417	.85625	6492	.32500	6567	.79375	6642	.26250
6193	.45625	6268	.92500	6343	.39375	6418	.86250	6493	.33125	6568	.80000	6643	.26875
6194	.46250	6269	.93125	6344	.40000	6419	.86875	6494	.33750	6569	.80625	6644	.27500
6195	.46875	6270	.93750	6345	.40625	6420	.87500	6495	.34375	6570	.81250	6645	.28125
6196	.47500	6271	.94375	6346	.41250	6421	.88125	6496	.35000	6571	.81875	6646	.28750
6197	.48125	6272	.95000	6347	.41875	6422	.88750	6497	.35625	6572	.82500	6647	.29375
6198	.48750	6273	.95625	6348	.42500	6423	.89375	6498	.36250	6573	.83125	6648	.30000
6199	.49375	6274	.96250	6349	.43125	6424	.90000	6499	.36875	6574	.83750	6649	.30625
6200	135.50000	6275	.96875	6350	.43750	6425	.90625	6500	.37500	6575	.84375	6650	.31250
6201	.50625	6276	.97500	6351	.44375	6426	.91250	6501	.38125	6576	.85000	6651	.31875
6202	.51250	6277	.98125	6352	.45000	6427	.91875	6502	.38750	6577	.85625	6652	.32500
6203	.51875	6278	.98750	6353	.45625	6428	.92500	6503	.39375	6578	.86250	6653	.33125
6204	.52500	6279	.99375	6354	.46250	6429	.93125	6504	.40000	6579	.86875	6654	.33750
6205	.53125	6280	136.00000	6355	.46875	6430	.93750	6505	.40625	6580	.87500	6655	.34375
6206	.53750	6281	.00625	6356	.47500	6431	.94375	6506	.41250	6581	.88125	6656	.35000
6207	.54375	6282	.01250	6357	.48125	6432	.95000	6507	.41875	6582	.88750	6657	.35625
6208	.55000	6283	.01875	6358	.48750	6433	.95625	6508	.42500	6583	.89375	6658	.36250
6209	.55625	6284	.02500	6359	.49375	6434	.96250	6509	.43125	6584	.90000	6659	.36875
6210	.56250	6285	.03125	6360	136.50000	6435	.96875	6510	.43750	6585	.90625	6660	.37500
6211	.56875	6286	.03750	6361	.50625	6436	.97500	6511	.44375	6586	.91250	6661	.38125
6212	.57500	6287	.04375	6362	.51250	6437	.98125	6512	.45000	6587	.91875	6662	.38750
6213	.58125	6288	.05000	6363	.51875	6438	.98750	6513	.45625	6588	.92500	6663	.39375
6214	.58750	6289	.05625	6364	.52500	6439	.99375	6514	.46250	6589	.93125	6664	.40000
6215	.59375	6290	.06250	6365	.53125	6440	137.00000	6515	.46875	6590	.93750	6665	.40625
6216	.60000	6291	.06875	6366	.53750	6441	.00625	6516	.47500	6591	.94375	6666	.41250
6217	.60625	6292	.07500	6367	.54375	6442	.01250	6517	.48125	6592	.95000	6667	.41875
6218	.61250	6293	.08125	6368	.55000	6443	.01875	6518	.48750	6593	.95625	6668	.42500
6219	.61875	6294	.08750	6369	.55625	6444	.02500	6519	.49375	6594	.96250	6669	.43125
6220	.62500	6295	.09375	6370	.56250	6445	.03125	6520	137.50000	6595	.96875	6670	.43750
6221	.63125	6296	.10000	6371	.56875	6446	.03750	6521	.50625	6596	.97500	6671	.44375
6222	.63750	6297	.10625	6372	.57500	6447	.04375	6522	.51250	6597	.98125	6672	.45000
6223	.64375	6298	.11250	6373	.58125	6448	.05000	6523	.51875	6598	.98750	6673	.45625
6224	.65000	6299	.11875	6374	.58750	6449	.05625	6524	.52500	6599	.99375	6674	.46250
6225	.65625	6300	.12500	6375	.59375	6450	.06250	6525	.53125	6600	138.00000	6675	.46875
6226	.66250	6301	.13125	6376	.60000	6451	.06875	6526	.53750	6601	.00625	6676	.47500
6227	.66875	6302	.13750	6377	.60625	6452	.07500	6527	.54375	6602	.01250	6677	.48125
6228	.67500	6303	.14375	6378	.61250	6453	.08125	6528	.55000	6603	.01875	6678	.48750
6229	.68125	6304	.15000	6379	.61875	6454	.08750	6529	.55625	6604	.02500	6679	.49375
6230	.68750	6305	.15625	6380	.62500	6455	.09375	6530	.56250	6605	.03125	6680	138.50000
6231	.69375	6306	.16250	6381	.63125	6456	.10000	6531	.56875	6606	.03750	6681	.50625
6232	.70000	6307	.16875	6382	.63750	6457	.10625	6532	.57500	6607	.04375	6682	.51250
6233	.70625	6308	.17500	6383	.64375	6458	.11250	6533	.58125	6608	.05000	6683	.51875
6234	.71250	6309	.18125	6384	.65000	6459	.11875	6534	.58750	6609	.05625	6684	.52500
6235	.71875	6310	.18750	6385	.65625	6460	.12500	6535	.59375	6610	.06250	6685	.53125
6236	.72500	6311	.19375	6386	.66250	6461	.13125	6536	.60000	6611	.06875	6686	.53750
6237	.73125	6312	.20000	6387	.66875	6462	.13750	6537	.60625	6612	.07500	6687	.54375
6238	.73750	6313	.20625	6388	.67500	6463	.14375	6538	.61250	6613	.08125	6688	.55000
6239	.74375	6314	.21250	6389	.68125	6464	.15000	6539	.61875	6614	.08750	6689	.55625

VT-3/140 Channel Designation Table: 132 to 150 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
6690	138.56250	6765	139.03125	6840	139.50000	6915	139.96875	6990	140.43750	7065	140.90625	7140	141.37500
6691	.56875	6766	.03750	6841	.50625	6916	.97500	6991	.44375	7066	.91250	7141	.38125
6692	.57500	6767	.04375	6842	.51250	6917	.98125	6992	.45000	7067	.91875	7142	.38750
6693	.58125	6768	.05000	6843	.51875	6918	.98750	6993	.45625	7068	.92500	7143	.39375
6694	.58750	6769	.05625	6844	.52500	6919	.99375	6994	.46250	7069	.93125	7144	.40000
6695	.59375	6770	.06250	6845	.53125	6920	140.00000	6995	.46875	7070	.93750	7145	.40625
6696	.60000	6771	.06875	6846	.53750	6921	.00625	6996	.47500	7071	.94375	7146	.41250
6697	.60625	6772	.07500	6847	.54375	6922	.01250	6997	.48125	7072	.95000	7147	.41875
6698	.61250	6773	.08125	6848	.55000	6923	.01875	6998	.48750	7073	.95625	7148	.42500
6699	.61875	6774	.08750	6849	.55625	6924	.02500	6999	.49375	7074	.96250	7149	.43125
6700	.62500	6775	.09375	6850	.56250	6925	.03125	7000	140.50000	7075	.96875	7150	.43750
6701	.63125	6776	.10000	6851	.56875	6926	.03750	7001	.50625	7076	.97500	7151	.44375
6702	.63750	6777	.10625	6852	.57500	6927	.04375	7002	.51250	7077	.98125	7152	.45000
6703	.64375	6778	.11250	6853	.58125	6928	.05000	7003	.51875	7078	.98750	7153	.45625
6704	.65000	6779	.11875	6854	.58750	6929	.05625	7004	.52500	7079	.99375	7154	.46250
6705	.65625	6780	.12500	6855	.59375	6930	.06250	7005	.53125	7080	141.00000	7155	.46875
6706	.66250	6781	.13125	6856	.60000	6931	.06875	7006	.53750	7081	.00625	7156	.47500
6707	.66875	6782	.13750	6857	.60625	6932	.07500	7007	.54375	7082	.01250	7157	.48125
6708	.67500	6783	.14375	6858	.61250	6933	.08125	7008	.55000	7083	.01875	7158	.48750
6709	.68125	6784	.15000	6859	.61875	6934	.08750	7009	.55625	7084	.02500	7159	.49375
6710	.68750	6785	.15625	6860	.62500	6935	.09375	7010	.56250	7085	.03125	7160	141.50000
6711	.69375	6786	.16250	6861	.63125	6936	.10000	7011	.56875	7086	.03750	7161	.50625
6712	.70000	6787	.16875	6862	.63750	6937	.10625	7012	.57500	7087	.04375	7162	.51250
6713	.70625	6788	.17500	6863	.64375	6938	.11250	7013	.58125	7088	.05000	7163	.51875
6714	.71250	6789	.18125	6864	.65000	6939	.11875	7014	.58750	7089	.05625	7164	.52500
6715	.71875	6790	.18750	6865	.65625	6940	.12500	7015	.59375	7090	.06250	7165	.53125
6716	.72500	6791	.19375	6866	.66250	6941	.13125	7016	.60000	7091	.06875	7166	.53750
6717	.73125	6792	.20000	6867	.66875	6942	.13750	7017	.60625	7092	.07500	7167	.54375
6718	.73750	6793	.20625	6868	.67500	6943	.14375	7018	.61250	7093	.08125	7168	.55000
6719	.74375	6794	.21250	6869	.68125	6944	.15000	7019	.61875	7094	.08750	7169	.55625
6720	138.75000	6795	.21875	6870	.68750	6945	.15625	7020	.62500	7095	.09375	7170	.56250
6721	.75625	6796	.22500	6871	.69375	6946	.16250	7021	.63125	7096	.10000	7171	.56875
6722	.76250	6797	.23125	6872	.70000	6947	.16875	7022	.63750	7097	.10625	7172	.57500
6723	.76875	6798	.23750	6873	.70625	6948	.17500	7023	.64375	7098	.11250	7173	.58125
6724	.77500	6799	.24375	6874	.71250	6949	.18125	7024	.65000	7099	.11875	7174	.58750
6725	.78125	6800	139.25000	6875	.71875	6950	.18750	7025	.65625	7100	.12500	7175	.59375
6726	.78750	6801	.25625	6876	.72500	6951	.19375	7026	.66250	7101	.13125	7176	.60000
6727	.79375	6802	.26250	6877	.73125	6952	.20000	7027	.66875	7102	.13750	7177	.60625
6728	.80000	6803	.26875	6878	.73750	6953	.20625	7028	.67500	7103	.14375	7178	.61250
6729	.80625	6804	.27500	6879	.74375	6954	.21250	7029	.68125	7104	.15000	7179	.61875
6730	.81250	6805	.28125	6880	139.75000	6955	.21875	7030	.68750	7105	.15625	7180	.62500
6731	.81875	6806	.28750	6881	.75625	6956	.22500	7031	.69375	7106	.16250	7181	.63125
6732	.82500	6807	.29375	6882	.76250	6957	.23125	7032	.70000	7107	.16875	7182	.63750
6733	.83125	6808	.30000	6883	.76875	6958	.23750	7033	.70625	7108	.17500	7183	.64375
6734	.83750	6809	.30625	6884	.77500	6959	.24375	7034	.71250	7109	.18125	7184	.65000
6735	.84375	6810	.31250	6885	.78125	6960	140.25000	7035	.71875	7110	.18750	7185	.65625
6736	.85000	6811	.31875	6886	.78750	6961	.25625	7036	.72500	7111	.19375	7186	.66250
6737	.85625	6812	.32500	6887	.79375	6962	.26250	7037	.73125	7112	.20000	7187	.66875
6738	.86250	6813	.33125	6888	.80000	6963	.26875	7038	.73750	7113	.20625	7188	.67500
6739	.86875	6814	.33750	6889	.80625	6964	.27500	7039	.74375	7114	.21250	7189	.68125
6740	.87500	6815	.34375	6890	.81250	6965	.28125	7040	140.75000	7115	.21875	7190	.68750
6741	.88125	6816	.35000	6891	.81875	6966	.28750	7041	.75625	7116	.22500	7191	.69375
6742	.88750	6817	.35625	6892	.82500	6967	.29375	7042	.76250	7117	.23125	7192	.70000
6743	.89375	6818	.36250	6893	.83125	6968	.30000	7043	.76875	7118	.23750	7193	.70625
6744	.90000	6819	.36875	6894	.83750	6969	.30625	7044	.77500	7119	.24375	7194	.71250
6745	.90625	6820	.37500	6895	.84375	6970	.31250	7045	.78125	7120	141.25000	7195	.71875
6746	.91250	6821	.38125	6896	.85000	6971	.31875	7046	.78750	7121	.25625	7196	.72500
6747	.91875	6822	.38750	6897	.85625	6972	.32500	7047	.79375	7122	.26250	7197	.73125
6748	.92500	6823	.39375	6898	.86250	6973	.33125	7048	.80000	7123	.26875	7198	.73750
6749	.93125	6824	.40000	6899	.86875	6974	.33750	7049	.80625	7124	.27500	7199	.74375
6750	.93750	6825	.40625	6900	.87500	6975	.34375	7050	.81250	7125	.28125	7200	141.75000
6751	.94375	6826	.41250	6901	.88125	6976	.35000	7051	.81875	7126	.28750	7201	.75625
6752	.95000	6827	.41875	6902	.88750	6977	.35625	7052	.82500	7127	.29375	7202	.76250
6753	.95625	6828	.42500	6903	.89375	6978	.36250	7053	.83125	7128	.30000	7203	.76875
6754	.96250	6829	.43125	6904	.90000	6979	.36875	7054	.83750	7129	.30625	7204	.77500
6755	.96875	6830	.43750	6905	.90625	6980	.37500	7055	.84375	7130	.31250	7205	.78125
6756	.97500	6831	.44375	6906	.91250	6981	.38125	7056	.85000	7131	.31875	7206	.78750
6757	.98125	6832	.45000	6907	.91875	6982	.38750	7057	.85625	7132	.32500	7207	.79375
6758	.98750	6833	.45625	6908	.92500	6983	.39375	7058	.86250	7133	.33125	7208	.80000
6759	.99375	6834	.46250	6909	.93125	6984	.40000	7059	.86875	7134	.33750	7209	.80625
6760	139.00000	6835	.46875	6910	.93750	6985	.40625	7060	.87500	7135	.34375	7210	.81250
6761	.00625	6836	.47500	6911	.94375	6986	.41250	7061	.88125	7136	.35000	7211	.81875
6762	.01250	6837	.48125	6912	.95000	6987	.41875	7062	.88750	7137	.35625	7212	.82500
6763	.01875	6838	.48750	6913	.95625	6988	.42500	7063	.89375	7138	.36250	7213	.83125
6764	.02500	6839	.49375	6914	.96250	6989	.43125	7064	.90000	7139	.36875	7214	.83750

VT-3/140 Channel Designation Table: 132 to 150 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
7215	141.84375	7290	142.31250	7365	142.78125	7440	143.25000	7515	143.71875	7590	144.18750	7665	144.65625
7216	.85000	7291	.31875	7366	.78750	7441	.25625	7516	.72500	7591	.19375	7666	.66250
7217	.85625	7292	.32500	7367	.79375	7442	.26250	7517	.73125	7592	.20000	7667	.66875
7218	.86250	7293	.33125	7368	.80000	7443	.26875	7518	.73750	7593	.20625	7668	.67500
7219	.86875	7294	.33750	7369	.80625	7444	.27500	7519	.74375	7594	.21250	7669	.68125
7220	.87500	7295	.34375	7370	.81250	7445	.28125	7520	143.75000	7595	.21875	7670	.68750
7221	.88125	7296	.35000	7371	.81875	7446	.28750	7521	.75625	7596	.22500	7671	.69375
7222	.88750	7297	.35625	7372	.82500	7447	.29375	7522	.76250	7597	.23125	7672	.70000
7223	.89375	7298	.36250	7373	.83125	7448	.30000	7523	.76875	7598	.23750	7673	.70625
7224	.90000	7299	.36875	7374	.83750	7449	.30625	7524	.77500	7599	.24375	7674	.71250
7225	.90625	7300	.37500	7375	.84375	7450	.31250	7525	.78125	7600	144.25000	7675	.71875
7226	.91250	7301	.38125	7376	.85000	7451	.31875	7526	.78750	7601	.25625	7676	.72500
7227	.91875	7302	.38750	7377	.85625	7452	.32500	7527	.79375	7602	.26250	7677	.73125
7228	.92500	7303	.39375	7378	.86250	7453	.33125	7528	.80000	7603	.26875	7678	.73750
7229	.93125	7304	.40000	7379	.86875	7454	.33750	7529	.80625	7604	.27500	7679	.74375
7230	.93750	7305	.40625	7380	.87500	7455	.34375	7530	.81250	7605	.28125	7680	144.75000
7231	.94375	7306	.41250	7381	.88125	7456	.35000	7531	.81875	7606	.28750	7681	.75625
7232	.95000	7307	.41875	7382	.88750	7457	.35625	7532	.82500	7607	.29375	7682	.76250
7233	.95625	7308	.42500	7383	.89375	7458	.36250	7533	.83125	7608	.30000	7683	.76875
7234	.96250	7309	.43125	7384	.90000	7459	.36875	7534	.83750	7609	.30625	7684	.77500
7235	.96875	7310	.43750	7385	.90625	7460	.37500	7535	.84375	7610	.31250	7685	.78125
7236	.97500	7311	.44375	7386	.91250	7461	.38125	7536	.85000	7611	.31875	7686	.78750
7237	.98125	7312	.45000	7387	.91875	7462	.38750	7537	.85625	7612	.32500	7687	.79375
7238	.98750	7313	.45625	7388	.92500	7463	.39375	7538	.86250	7613	.33125	7688	.80000
7239	.99375	7314	.46250	7389	.93125	7464	.40000	7539	.86875	7614	.33750	7689	.80625
7240	142.00000	7315	.46875	7390	.93750	7465	.40625	7540	.87500	7615	.34375	7690	.81250
7241	.00625	7316	.47500	7391	.94375	7466	.41250	7541	.88125	7616	.35000	7691	.81875
7242	.01250	7317	.48125	7392	.95000	7467	.41875	7542	.88750	7617	.35625	7692	.82500
7243	.01875	7318	.48750	7393	.95625	7468	.42500	7543	.89375	7618	.36250	7693	.83125
7244	.02500	7319	.49375	7394	.96250	7469	.43125	7544	.90000	7619	.36875	7694	.83750
7245	.03125	7320	142.50000	7395	.96875	7470	.43750	7545	.90625	7620	.37500	7695	.84375
7246	.03750	7321	.50625	7396	.97500	7471	.44375	7546	.91250	7621	.38125	7696	.85000
7247	.04375	7322	.51250	7397	.98125	7472	.45000	7547	.91875	7622	.38750	7697	.85625
7248	.05000	7323	.51875	7398	.98750	7473	.45625	7548	.92500	7623	.39375	7698	.86250
7249	.05625	7324	.52500	7399	.99375	7474	.46250	7549	.93125	7624	.40000	7699	.86875
7250	.06250	7325	.53125	7400	143.00000	7475	.46875	7550	.93750	7625	.40625	7700	.87500
7251	.06875	7326	.53750	7401	.00625	7476	.47500	7551	.94375	7626	.41250	7701	.88125
7252	.07500	7327	.54375	7402	.01250	7477	.48125	7552	.95000	7627	.41875	7702	.88750
7253	.08125	7328	.55000	7403	.01875	7478	.48750	7553	.95625	7628	.42500	7703	.89375
7254	.08750	7329	.55625	7404	.02500	7479	.49375	7554	.96250	7629	.43125	7704	.90000
7255	.09375	7330	.56250	7405	.03125	7480	143.50000	7555	.96875	7630	.43750	7705	.90625
7256	.10000	7331	.56875	7406	.03750	7481	.50625	7556	.97500	7631	.44375	7706	.91250
7257	.10625	7332	.57500	7407	.04375	7482	.51250	7557	.98125	7632	.45000	7707	.91875
7258	.11250	7333	.58125	7408	.05000	7483	.51875	7558	.98750	7633	.45625	7708	.92500
7259	.11875	7334	.58750	7409	.05625	7484	.52500	7559	.99375	7634	.46250	7709	.93125
7260	.12500	7335	.59375	7410	.06250	7485	.53125	7560	144.00000	7635	.46875	7710	.93750
7261	.13125	7336	.60000	7411	.06875	7486	.53750	7561	.00625	7636	.47500	7711	.94375
7262	.13750	7337	.60625	7412	.07500	7487	.54375	7562	.01250	7637	.48125	7712	.95000
7263	.14375	7338	.61250	7413	.08125	7488	.55000	7563	.01875	7638	.48750	7713	.95625
7264	.15000	7339	.61875	7414	.08750	7489	.55625	7564	.02500	7639	.49375	7714	.96250
7265	.15625	7340	.62500	7415	.09375	7490	.56250	7565	.03125	7640	144.50000	7715	.96875
7266	.16250	7341	.63125	7416	.10000	7491	.56875	7566	.03750	7641	.50625	7716	.97500
7267	.16875	7342	.63750	7417	.10625	7492	.57500	7567	.04375	7642	.51250	7717	.98125
7268	.17500	7343	.64375	7418	.11250	7493	.58125	7568	.05000	7643	.51875	7718	.98750
7269	.18125	7344	.65000	7419	.11875	7494	.58750	7569	.05625	7644	.52500	7719	.99375
7270	.18750	7345	.65625	7420	.12500	7495	.59375	7570	.06250	7645	.53125	7720	145.00000
7271	.19375	7346	.66250	7421	.13125	7496	.60000	7571	.06875	7646	.53750	7721	.00625
7272	.20000	7347	.66875	7422	.13750	7497	.60625	7572	.07500	7647	.54375	7722	.01250
7273	.20625	7348	.67500	7423	.14375	7498	.61250	7573	.08125	7648	.55000	7723	.01875
7274	.21250	7349	.68125	7424	.15000	7499	.61875	7574	.08750	7649	.55625	7724	.02500
7275	.21875	7350	.68750	7425	.15625	7500	.62500	7575	.09375	7650	.56250	7725	.03125
7276	.22500	7351	.69375	7426	.16250	7501	.63125	7576	.10000	7651	.56875	7726	.03750
7277	.23125	7352	.70000	7427	.16875	7502	.63750	7577	.10625	7652	.57500	7727	.04375
7278	.23750	7353	.70625	7428	.17500	7503	.64375	7578	.11250	7653	.58125	7728	.05000
7279	.24375	7354	.71250	7429	.18125	7504	.65000	7579	.11875	7654	.58750	7729	.05625
7280	142.25000	7355	.71875	7430	.18750	7505	.65625	7580	.12500	7655	.59375	7730	.06250
7281	.25625	7356	.72500	7431	.19375	7506	.66250	7581	.13125	7656	.60000	7731	.06875
7282	.26250	7357	.73125	7432	.20000	7507	.66875	7582	.13750	7657	.60625	7732	.07500
7283	.26875	7358	.73750	7433	.20625	7508	.67500	7583	.14375	7658	.61250	7733	.08125
7284	.27500	7359	.74375	7434	.21250	7509	.68125	7584	.15000	7659	.61875	7734	.08750
7285	.28125	7360	142.75000	7435	.21875	7510	.68750	7585	.15625	7660	.62500	7735	.09375
7286	.28750	7361	.75625	7436	.22500	7511	.69375	7586	.16250	7661	.63125	7736	.10000
7287	.29375	7362	.76250	7437	.23125	7512	.70000	7587	.16875	7662	.63750	7737	.10625
7288	.30000	7363	.76875	7438	.23750	7513	.70625	7588	.17500	7663	.64375	7738	.11250
7289	.30625	7364	.77500	7439	.24375	7514	.71250	7589	.18125	7664	.65000	7739	.11875

VT-3/140 Channel Designation Table: 132 to 150 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
7740	145.12500	7815	145.59375	7890	146.06250	7965	146.53125	8040	147.00000	8115	147.46875	8190	147.93750
7741	.13125	7816	.60000	7891	.06875	7966	.53750	8041	.00625	8116	.47500	8191	.94375
7742	.13750	7817	.60625	7892	.07500	7967	.54375	8042	.01250	8117	.48125	8192	.95000
7743	.14375	7818	.61250	7893	.08125	7968	.55000	8043	.01875	8118	.48750	8193	.95625
7744	.15000	7819	.61875	7894	.08750	7969	.55625	8044	.02500	8119	.49375	8194	.96250
7745	.15625	7820	.62500	7895	.09375	7970	.56250	8045	.03125	8120	147.50000	8195	.96875
7746	.16250	7821	.63125	7896	.10000	7971	.56875	8046	.03750	8121	.50625	8196	.97500
7747	.16875	7822	.63750	7897	.10625	7972	.57500	8047	.04375	8122	.51250	8197	.98125
7748	.17500	7823	.64375	7898	.11250	7973	.58125	8048	.05000	8123	.51875	8198	.98750
7749	.18125	7824	.65000	7899	.11875	7974	.58750	8049	.05625	8124	.52500	8199	.99375
7750	.18750	7825	.65625	7900	.12500	7975	.59375	8050	.06250	8125	.53125	8200	148.00000
7751	.19375	7826	.66250	7901	.13125	7976	.60000	8051	.06875	8126	.53750	8201	.00625
7752	.20000	7827	.66875	7902	.13750	7977	.60625	8052	.07500	8127	.54375	8202	.01250
7753	.20625	7828	.67500	7903	.14375	7978	.61250	8053	.08125	8128	.55000	8203	.01875
7754	.21250	7829	.68125	7904	.15000	7979	.61875	8054	.08750	8129	.55625	8204	.02500
7755	.21875	7830	.68750	7905	.15625	7980	.62500	8055	.09375	8130	.56250	8205	.03125
7756	.22500	7831	.69375	7906	.16250	7981	.63125	8056	.10000	8131	.56875	8206	.03750
7757	.23125	7832	.70000	7907	.16875	7982	.63750	8057	.10625	8132	.57500	8207	.04375
7758	.23750	7833	.70625	7908	.17500	7983	.64375	8058	.11250	8133	.58125	8208	.05000
7759	.24375	7834	.71250	7909	.18125	7984	.65000	8059	.11875	8134	.58750	8209	.05625
7760	145.25000	7835	.71875	7910	.18750	7985	.65625	8060	.12500	8135	.59375	8210	.06250
7761	.25625	7836	.72500	7911	.19375	7986	.66250	8061	.13125	8136	.60000	8211	.06875
7762	.26250	7837	.73125	7912	.20000	7987	.66875	8062	.13750	8137	.60625	8212	.07500
7763	.26875	7838	.73750	7913	.20625	7988	.67500	8063	.14375	8138	.61250	8213	.08125
7764	.27500	7839	.74375	7914	.21250	7989	.68125	8064	.15000	8139	.61875	8214	.08750
7765	.28125	7840	145.75000	7915	.21875	7990	.68750	8065	.15625	8140	.62500	8215	.09375
7766	.28750	7841	.75625	7916	.22500	7991	.69375	8066	.16250	8141	.63125	8216	.10000
7767	.29375	7842	.76250	7917	.23125	7992	.70000	8067	.16875	8142	.63750	8217	.10625
7768	.30000	7843	.76875	7918	.23750	7993	.70625	8068	.17500	8143	.64375	8218	.11250
7769	.30625	7844	.77500	7919	.24375	7994	.71250	8069	.18125	8144	.65000	8219	.11875
7770	.31250	7845	.78125	7920	146.25000	7995	.71875	8070	.18750	8145	.65625	8220	.12500
7771	.31875	7846	.78750	7921	.25625	7996	.72500	8071	.19375	8146	.66250	8221	.13125
7772	.32500	7847	.79375	7922	.26250	7997	.73125	8072	.20000	8147	.66875	8222	.13750
7773	.33125	7848	.80000	7923	.26875	7998	.73750	8073	.20625	8148	.67500	8223	.14375
7774	.33750	7849	.80625	7924	.27500	7999	.74375	8074	.21250	8149	.68125	8224	.15000
7775	.34375	7850	.81250	7925	.28125	8000	146.75000	8075	.21875	8150	.68750	8225	.15625
7776	.35000	7851	.81875	7926	.28750	8001	.75625	8076	.22500	8151	.69375	8226	.16250
7777	.35625	7852	.82500	7927	.29375	8002	.76250	8077	.23125	8152	.70000	8227	.16875
7778	.36250	7853	.83125	7928	.30000	8003	.76875	8078	.23750	8153	.70625	8228	.17500
7779	.36875	7854	.83750	7929	.30625	8004	.77500	8079	.24375	8154	.71250	8229	.18125
7780	.37500	7855	.84375	7930	.31250	8005	.78125	8080	147.25000	8155	.71875	8230	.18750
7781	.38125	7856	.85000	7931	.31875	8006	.78750	8081	.25625	8156	.72500	8231	.19375
7782	.38750	7857	.85625	7932	.32500	8007	.79375	8082	.26250	8157	.73125	8232	.20000
7783	.39375	7858	.86250	7933	.33125	8008	.80000	8083	.26875	8158	.73750	8233	.20625
7784	.40000	7859	.86875	7934	.33750	8009	.80625	8084	.27500	8159	.74375	8234	.21250
7785	.40625	7860	.87500	7935	.34375	8010	.81250	8085	.28125	8160	147.75000	8235	.21875
7786	.41250	7861	.88125	7936	.35000	8011	.81875	8086	.28750	8161	.75625	8236	.22500
7787	.41875	7862	.88750	7937	.35625	8012	.82500	8087	.29375	8162	.76250	8237	.23125
7788	.42500	7863	.89375	7938	.36250	8013	.83125	8088	.30000	8163	.76875	8238	.23750
7789	.43125	7864	.90000	7939	.36875	8014	.83750	8089	.30625	8164	.77500	8239	.24375
7790	.43750	7865	.90625	7940	.37500	8015	.84375	8090	.31250	8165	.78125	8240	148.25000
7791	.44375	7866	.91250	7941	.38125	8016	.85000	8091	.31875	8166	.78750	8241	.25625
7792	.45000	7867	.91875	7942	.38750	8017	.85625	8092	.32500	8167	.79375	8242	.26250
7793	.45625	7868	.92500	7943	.39375	8018	.86250	8093	.33125	8168	.80000	8243	.26875
7794	.46250	7869	.93125	7944	.40000	8019	.86875	8094	.33750	8169	.80625	8244	.27500
7795	.46875	7870	.93750	7945	.40625	8020	.87500	8095	.34375	8170	.81250	8245	.28125
7796	.47500	7871	.94375	7946	.41250	8021	.88125	8096	.35000	8171	.81875	8246	.28750
7797	.48125	7872	.95000	7947	.41875	8022	.88750	8097	.35625	8172	.82500	8247	.29375
7798	.48750	7873	.95625	7948	.42500	8023	.89375	8098	.36250	8173	.83125	8248	.30000
7799	.49375	7874	.96250	7949	.43125	8024	.90000	8099	.36875	8174	.83750	8249	.30625
7800	145.50000	7875	.96875	7950	.43750	8025	.90625	8100	.37500	8175	.84375	8250	.31250
7801	.50625	7876	.97500	7951	.44375	8026	.91250	8101	.38125	8176	.85000	8251	.31875
7802	.51250	7877	.98125	7952	.45000	8027	.91875	8102	.38750	8177	.85625	8252	.32500
7803	.51875	7878	.98750	7953	.45625	8028	.92500	8103	.39375	8178	.86250	8253	.33125
7804	.52500	7879	.99375	7954	.46250	8029	.93125	8104	.40000	8179	.86875	8254	.33750
7805	.53125	7880	146.00000	7955	.46875	8030	.93750	8105	.40625	8180	.87500	8255	.34375
7806	.53750	7881	.00625	7956	.47500	8031	.94375	8106	.41250	8181	.88125	8256	.35000
7807	.54375	7882	.01250	7957	.48125	8032	.95000	8107	.41875	8182	.88750	8257	.35625
7808	.55000	7883	.01875	7958	.48750	8033	.95625	8108	.42500	8183	.89375	8258	.36250
7809	.55625	7884	.02500	7959	.49375	8034	.96250	8109	.43125	8184	.90000	8259	.36875
7810	.56250	7885	.03125	7960	146.50000	8035	.96875	8110	.43750	8185	.90625	8260	.37500
7811	.56875	7886	.03750	7961	.50625	8036	.97500	8111	.44375	8186	.91250	8261	.38125
7812	.57500	7887	.04375	7962	.51250	8037	.98125	8112	.45000	8187	.91875	8262	.38750
7813	.58125	7888	.05000	7963	.51875	8038	.98750	8113	.45625	8188	.92500	8263	.39375
7814	.58750	7889	.05625	7964	.52500	8039	.99375	8114	.46250	8189	.93125	8264	.40000

VT-3/140 Channel Designation Table: 132 to 150 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
8265	148.40625	8340	148.87500	8415	149.34375	8490	149.81250						
8266	.41250	8341	.88125	8416	.35000	8491	.81875						
8267	.41875	8342	.88750	8417	.35625	8492	.82500						
8268	.42500	8343	.89375	8418	.36250	8493	.83125						
8269	.43125	8344	.90000	8419	.36875	8494	.83750						
8270	.43750	8345	.90625	8420	.37500	8495	.84375						
8271	.44375	8346	.91250	8421	.38125	8496	.85000						
8272	.45000	8347	.91875	8422	.38750	8497	.85625						
8273	.45625	8348	.92500	8423	.39375	8498	.86250						
8274	.46250	8349	.93125	8424	.40000	8499	.86875						
8275	.46875	8350	.93750	8425	.40625	8500	.87500						
8276	.47500	8351	.94375	8426	.41250	8501	.88125						
8277	.48125	8352	.95000	8427	.41875	8502	.88750						
8278	.48750	8353	.95625	8428	.42500	8503	.89375						
8279	.49375	8354	.96250	8429	.43125	8504	.90000						
8280	148.50000	8355	.96875	8430	.43750	8505	.90625						
8281	.50625	8356	.97500	8431	.44375	8506	.91250						
8282	.51250	8357	.98125	8432	.45000	8507	.91875						
8283	.51875	8358	.98750	8433	.45625	8508	.92500						
8284	.52500	8359	.99375	8434	.46250	8509	.93125						
8285	.53125	8360	149.00000	8435	.46875	8510	.93750						
8286	.53750	8361	.00625	8436	.47500	8511	.94375						
8287	.54375	8362	.01250	8437	.48125	8512	.95000						
8288	.55000	8363	.01875	8438	.48750	8513	.95625						
8289	.55625	8364	.02500	8439	.49375	8514	.96250						
8290	.56250	8365	.03125	8440	149.50000	8515	.96875						
8291	.56875	8366	.03750	8441	.50625	8516	.97500						
8292	.57500	8367	.04375	8442	.51250	8517	.98125						
8293	.58125	8368	.05000	8443	.51875	8518	.98750						
8294	.58750	8369	.05625	8444	.52500	8519	.99375						
8295	.59375	8370	.06250	8445	.53125	8520	150.00000						
8296	.60000	8371	.06875	8446	.53750								
8297	.60625	8372	.07500	8447	.54375								
8298	.61250	8373	.08125	8448	.55000								
8299	.61875	8374	.08750	8449	.55625								
8300	.62500	8375	.09375	8450	.56250								
8301	.63125	8376	.10000	8451	.56875								
8302	.63750	8377	.10625	8452	.57500								
8303	.64375	8378	.11250	8453	.58125								
8304	.65000	8379	.11875	8454	.58750								
8305	.65625	8380	.12500	8455	.59375								
8306	.66250	8381	.13125	8456	.60000								
8307	.66875	8382	.13750	8457	.60625								
8308	.67500	8383	.14375	8458	.61250								
8309	.68125	8384	.15000	8459	.61875								
8310	.68750	8385	.15625	8460	.62500								
8311	.69375	8386	.16250	8461	.63125								
8312	.70000	8387	.16875	8462	.63750								
8313	.70625	8388	.17500	8463	.64375								
8314	.71250	8389	.18125	8464	.65000								
8315	.71875	8390	.18750	8465	.65625								
8316	.72500	8391	.19375	8466	.66250								
8317	.73125	8392	.20000	8467	.66875								
8318	.73750	8393	.20625	8468	.67500								
8319	.74375	8394	.21250	8469	.68125								
8320	148.75000	8395	.21875	8470	.68750								
8321	.75625	8396	.22500	8471	.69375								
8322	.76250	8397	.23125	8472	.70000								
8323	.76875	8398	.23750	8473	.70625								
8324	.77500	8399	.24375	8474	.71250								
8325	.78125	8400	149.25000	8475	.71875								
8326	.78750	8401	.25625	8476	.72500								
8327	.79375	8402	.26250	8477	.73125								
8328	.80000	8403	.26875	8478	.73750								
8329	.80625	8404	.27500	8479	.74375								
8330	.81250	8405	.28125	8480	149.75000								
8331	.81875	8406	.28750	8481	.75625								
8332	.82500	8407	.29375	8482	.76250								
8333	.83125	8408	.30000	8483	.76875								
8334	.83750	8409	.30625	8484	.77500								
8335	.84375	8410	.31250	8485	.78125								
8336	.85000	8411	.31875	8486	.78750								
8337	.85625	8412	.32500	8487	.79375								
8338	.86250	8413	.33125	8488	.80000								
8339	.86875	8414	.33750	8489	.80625								

3 VT-3/160 Channel Designation Table: 150-174MHz, 5kHz Increments

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
000	150.00000	075	150.37500	150	150.75000	225	151.12500	300	151.50000	375	151.87500	450	152.25000
001	.00500	076	.38000	151	.75500	226	.13000	301	.50500	376	.88000	451	.25500
002	.01000	077	.38500	152	.76000	227	.13500	302	.51000	377	.88500	452	.26000
003	.01500	078	.39000	153	.76500	228	.14000	303	.51500	378	.89000	453	.26500
004	.02000	079	.39500	154	.77000	229	.14500	304	.52000	379	.89500	454	.27000
005	.02500	080	.40000	155	.77500	230	.15000	305	.52500	380	.90000	455	.27500
006	.03000	081	.40500	156	.78000	231	.15500	306	.53000	381	.90500	456	.28000
007	.03500	082	.41000	157	.78500	232	.16000	307	.53500	382	.91000	457	.28500
008	.04000	083	.41500	158	.79000	233	.16500	308	.54000	383	.91500	458	.29000
009	.04500	084	.42000	159	.79500	234	.17000	309	.54500	384	.92000	459	.29500
010	.05000	085	.42500	160	.80000	235	.17500	310	.55000	385	.92500	460	.30000
011	.05500	086	.43000	161	.80500	236	.18000	311	.55500	386	.93000	461	.30500
012	.06000	087	.43500	162	.81000	237	.18500	312	.56000	387	.93500	462	.31000
013	.06500	088	.44000	163	.81500	238	.19000	313	.56500	388	.94000	463	.31500
014	.07000	089	.44500	164	.82000	239	.19500	314	.57000	389	.94500	464	.32000
015	.07500	090	.45000	165	.82500	240	.20000	315	.57500	390	.95000	465	.32500
016	.08000	091	.45500	166	.83000	241	.20500	316	.58000	391	.95500	466	.33000
017	.08500	092	.46000	167	.83500	242	.21000	317	.58500	392	.96000	467	.33500
018	.09000	093	.46500	168	.84000	243	.21500	318	.59000	393	.96500	468	.34000
019	.09500	094	.47000	169	.84500	244	.22000	319	.59500	394	.97000	469	.34500
020	.10000	095	.47500	170	.85000	245	.22500	320	.60000	395	.97500	470	.35000
021	.10500	096	.48000	171	.85500	246	.23000	321	.60500	396	.98000	471	.35500
022	.11000	097	.48500	172	.86000	247	.23500	322	.61000	397	.98500	472	.36000
023	.11500	098	.49000	173	.86500	248	.24000	323	.61500	398	.99000	473	.36500
024	.12000	099	.49500	174	.87000	249	.24500	324	.62000	399	.99500	474	.37000
025	.12500	100	150.50000	175	.87500	250	151.25000	325	.62500	400	152.00000	475	.37500
026	.13000	101	.50500	176	.88000	251	.25500	326	.63000	401	.00500	476	.38000
027	.13500	102	.51000	177	.88500	252	.26000	327	.63500	402	.01000	477	.38500
028	.14000	103	.51500	178	.89000	253	.26500	328	.64000	403	.01500	478	.39000
029	.14500	104	.52000	179	.89500	254	.27000	329	.64500	404	.02000	479	.39500
030	.15000	105	.52500	180	.90000	255	.27500	330	.65000	405	.02500	480	.40000
031	.15500	106	.53000	181	.90500	256	.28000	331	.65500	406	.03000	481	.40500
032	.16000	107	.53500	182	.91000	257	.28500	332	.66000	407	.03500	482	.41000
033	.16500	108	.54000	183	.91500	258	.29000	333	.66500	408	.04000	483	.41500
034	.17000	109	.54500	184	.92000	259	.29500	334	.67000	409	.04500	484	.42000
035	.17500	110	.55000	185	.92500	260	.30000	335	.67500	410	.05000	485	.42500
036	.18000	111	.55500	186	.93000	261	.30500	336	.68000	411	.05500	486	.43000
037	.18500	112	.56000	187	.93500	262	.31000	337	.68500	412	.06000	487	.43500
038	.19000	113	.56500	188	.94000	263	.31500	338	.69000	413	.06500	488	.44000
039	.19500	114	.57000	189	.94500	264	.32000	339	.69500	414	.07000	489	.44500
040	.20000	115	.57500	190	.95000	265	.32500	340	.70000	415	.07500	490	.45000
041	.20500	116	.58000	191	.95500	266	.33000	341	.70500	416	.08000	491	.45500
042	.21000	117	.58500	192	.96000	267	.33500	342	.71000	417	.08500	492	.46000
043	.21500	118	.59000	193	.96500	268	.34000	343	.71500	418	.09000	493	.46500
044	.22000	119	.59500	194	.97000	269	.34500	344	.72000	419	.09500	494	.47000
045	.22500	120	.60000	195	.97500	270	.35000	345	.72500	420	.10000	495	.47500
046	.23000	121	.60500	196	.98000	271	.35500	346	.73000	421	.10500	496	.48000
047	.23500	122	.61000	197	.98500	272	.36000	347	.73500	422	.11000	497	.48500
048	.24000	123	.61500	198	.99000	273	.36500	348	.74000	423	.11500	498	.49000
049	.24500	124	.62000	199	.99500	274	.37000	349	.74500	424	.12000	499	.49500
050	150.25000	125	.62500	200	151.00000	275	.37500	350	151.75000	425	.12500	500	152.50000
051	.25500	126	.63000	201	.00500	276	.38000	351	.75500	426	.13000	501	.50500
052	.26000	127	.63500	202	.01000	277	.38500	352	.76000	427	.13500	502	.51000
053	.26500	128	.64000	203	.01500	278	.39000	353	.76500	428	.14000	503	.51500
054	.27000	129	.64500	204	.02000	279	.39500	354	.77000	429	.14500	504	.52000
055	.27500	130	.65000	205	.02500	280	.40000	355	.77500	430	.15000	505	.52500
056	.28000	131	.65500	206	.03000	281	.40500	356	.78000	431	.15500	506	.53000
057	.28500	132	.66000	207	.03500	282	.41000	357	.78500	432	.16000	507	.53500
058	.29000	133	.66500	208	.04000	283	.41500	358	.79000	433	.16500	508	.54000
059	.29500	134	.67000	209	.04500	284	.42000	359	.79500	434	.17000	509	.54500
060	.30000	135	.67500	210	.05000	285	.42500	360	.80000	435	.17500	510	.55000
061	.30500	136	.68000	211	.05500	286	.43000	361	.80500	436	.18000	511	.55500
062	.31000	137	.68500	212	.06000	287	.43500	362	.81000	437	.18500	512	.56000
063	.31500	138	.69000	213	.06500	288	.44000	363	.81500	438	.19000	513	.56500
064	.32000	139	.69500	214	.07000	289	.44500	364	.82000	439	.19500	514	.57000
065	.32500	140	.70000	215	.07500	290	.45000	365	.82500	440	.20000	515	.57500
066	.33000	141	.70500	216	.08000	291	.45500	366	.83000	441	.20500	516	.58000
067	.33500	142	.71000	217	.08500	292	.46000	367	.83500	442	.21000	517	.58500
068	.34000	143	.71500	218	.09000	293	.46500	368	.84000	443	.21500	518	.59000
069	.34500	144	.72000	219	.09500	294	.47000	369	.84500	444	.22000	519	.59500
070	.35000	145	.72500	220	.10000	295	.47500	370	.85000	445	.22500	520	.60000
071	.35500	146	.73000	221	.10500	296	.48000	371	.85500	446	.23000	521	.60500
072	.36000	147	.73500	222	.11000	297	.48500	372	.86000	447	.23500	522	.61000
073	.36500	148	.74000	223	.11500	298	.49000	373	.86500	448	.24000	523	.61500
074	.37000	149	.74500	224	.12000	299	.49500	374	.87000	449	.24500	524	.62000

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
525	152.62500	600	153.00000	675	153.37500	750	153.75000	825	154.12500	900	154.50000	975	154.87500
526	.63000	601	.00500	676	.38000	751	.75500	826	.13000	901	.50500	976	.88000
527	.63500	602	.01000	677	.38500	752	.76000	827	.13500	902	.51000	977	.88500
528	.64000	603	.01500	678	.39000	753	.76500	828	.14000	903	.51500	978	.89000
529	.64500	604	.02000	679	.39500	754	.77000	829	.14500	904	.52000	979	.89500
530	.65000	605	.02500	680	.40000	755	.77500	830	.15000	905	.52500	980	.90000
531	.65500	606	.03000	681	.40500	756	.78000	831	.15500	906	.53000	981	.90500
532	.66000	607	.03500	682	.41000	757	.78500	832	.16000	907	.53500	982	.91000
533	.66500	608	.04000	683	.41500	758	.79000	833	.16500	908	.54000	983	.91500
534	.67000	609	.04500	684	.42000	759	.79500	834	.17000	909	.54500	984	.92000
535	.67500	610	.05000	685	.42500	760	.80000	835	.17500	910	.55000	985	.92500
536	.68000	611	.05500	686	.43000	761	.80500	836	.18000	911	.55500	986	.93000
537	.68500	612	.06000	687	.43500	762	.81000	837	.18500	912	.56000	987	.93500
538	.69000	613	.06500	688	.44000	763	.81500	838	.19000	913	.56500	988	.94000
539	.69500	614	.07000	689	.44500	764	.82000	839	.19500	914	.57000	989	.94500
540	.70000	615	.07500	690	.45000	765	.82500	840	.20000	915	.57500	990	.95000
541	.70500	616	.08000	691	.45500	766	.83000	841	.20500	916	.58000	991	.95500
542	.71000	617	.08500	692	.46000	767	.83500	842	.21000	917	.58500	992	.96000
543	.71500	618	.09000	693	.46500	768	.84000	843	.21500	918	.59000	993	.96500
544	.72000	619	.09500	694	.47000	769	.84500	844	.22000	919	.59500	994	.97000
545	.72500	620	.10000	695	.47500	770	.85000	845	.22500	920	.60000	995	.97500
546	.73000	621	.10500	696	.48000	771	.85500	846	.23000	921	.60500	996	.98000
547	.73500	622	.11000	697	.48500	772	.86000	847	.23500	922	.61000	997	.98500
548	.74000	623	.11500	698	.49000	773	.86500	848	.24000	923	.61500	998	.99000
549	.74500	624	.12000	699	.49500	774	.87000	849	.24500	924	.62000	999	.99500
550	152.75000	625	.12500	700	153.50000	775	.87500	850	154.25000	925	.62500	1000	155.00000
551	.75500	626	.13000	701	.50500	776	.88000	851	.25500	926	.63000	1001	.00500
552	.76000	627	.13500	702	.51000	777	.88500	852	.26000	927	.63500	1002	.01000
553	.76500	628	.14000	703	.51500	778	.89000	853	.26500	928	.64000	1003	.01500
554	.77000	629	.14500	704	.52000	779	.89500	854	.27000	929	.64500	1004	.02000
555	.77500	630	.15000	705	.52500	780	.90000	855	.27500	930	.65000	1005	.02500
556	.78000	631	.15500	706	.53000	781	.90500	856	.28000	931	.65500	1006	.03000
557	.78500	632	.16000	707	.53500	782	.91000	857	.28500	932	.66000	1007	.03500
558	.79000	633	.16500	708	.54000	783	.91500	858	.29000	933	.66500	1008	.04000
559	.79500	634	.17000	709	.54500	784	.92000	859	.29500	934	.67000	1009	.04500
560	.80000	635	.17500	710	.55000	785	.92500	860	.30000	935	.67500	1010	.05000
561	.80500	636	.18000	711	.55500	786	.93000	861	.30500	936	.68000	1011	.05500
562	.81000	637	.18500	712	.56000	787	.93500	862	.31000	937	.68500	1012	.06000
563	.81500	638	.19000	713	.56500	788	.94000	863	.31500	938	.69000	1013	.06500
564	.82000	639	.19500	714	.57000	789	.94500	864	.32000	939	.69500	1014	.07000
565	.82500	640	.20000	715	.57500	790	.95000	865	.32500	940	.70000	1015	.07500
566	.83000	641	.20500	716	.58000	791	.95500	866	.33000	941	.70500	1016	.08000
567	.83500	642	.21000	717	.58500	792	.96000	867	.33500	942	.71000	1017	.08500
568	.84000	643	.21500	718	.59000	793	.96500	868	.34000	943	.71500	1018	.09000
569	.84500	644	.22000	719	.59500	794	.97000	869	.34500	944	.72000	1019	.09500
570	.85000	645	.22500	720	.60000	795	.97500	870	.35000	945	.72500	1020	.10000
571	.85500	646	.23000	721	.60500	796	.98000	871	.35500	946	.73000	1021	.10500
572	.86000	647	.23500	722	.61000	797	.98500	872	.36000	947	.73500	1022	.11000
573	.86500	648	.24000	723	.61500	798	.99000	873	.36500	948	.74000	1023	.11500
574	.87000	649	.24500	724	.62000	799	.99500	874	.37000	949	.74500	1024	.12000
575	.87500	650	153.25000	725	.62500	800	154.00000	875	.37500	950	154.75000	1025	.12500
576	.88000	651	.25500	726	.63000	801	.00500	876	.38000	951	.75500	1026	.13000
577	.88500	652	.26000	727	.63500	802	.01000	877	.38500	952	.76000	1027	.13500
578	.89000	653	.26500	728	.64000	803	.01500	878	.39000	953	.76500	1028	.14000
579	.89500	654	.27000	729	.64500	804	.02000	879	.39500	954	.77000	1029	.14500
580	.90000	655	.27500	730	.65000	805	.02500	880	.40000	955	.77500	1030	.15000
581	.90500	656	.28000	731	.65500	806	.03000	881	.40500	956	.78000	1031	.15500
582	.91000	657	.28500	732	.66000	807	.03500	882	.41000	957	.78500	1032	.16000
583	.91500	658	.29000	733	.66500	808	.04000	883	.41500	958	.79000	1033	.16500
584	.92000	659	.29500	734	.67000	809	.04500	884	.42000	959	.79500	1034	.17000
585	.92500	660	.30000	735	.67500	810	.05000	885	.42500	960	.80000	1035	.17500
586	.93000	661	.30500	736	.68000	811	.05500	886	.43000	961	.80500	1036	.18000
587	.93500	662	.31000	737	.68500	812	.06000	887	.43500	962	.81000	1037	.18500
588	.94000	663	.31500	738	.69000	813	.06500	888	.44000	963	.81500	1038	.19000
589	.94500	664	.32000	739	.69500	814	.07000	889	.44500	964	.82000	1039	.19500
590	.95000	665	.32500	740	.70000	815	.07500	890	.45000	965	.82500	1040	.20000
591	.95500	666	.33000	741	.70500	816	.08000	891	.45500	966	.83000	1041	.20500
592	.96000	667	.33500	742	.71000	817	.08500	892	.46000	967	.83500	1042	.21000
593	.96500	668	.34000	743	.71500	818	.09000	893	.46500	968	.84000	1043	.21500
594	.97000	669	.34500	744	.72000	819	.09500	894	.47000	969	.84500	1044	.22000
595	.97500	670	.35000	745	.72500	820	.10000	895	.47500	970	.85000	1045	.22500
596	.98000	671	.35500	746	.73000	821	.10500	896	.48000	971	.85500	1046	.23000
597	.98500	672	.36000	747	.73500	822	.11000	897	.48500	972	.86000	1047	.23500
598	.99000	673	.36500	748	.74000	823	.11500	898	.49000	973	.86500	1048	.24000
599	.99500	674	.37000	749	.74500	824	.12000	899	.49500	974	.87000	1049	.24500

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
1050	155.25000	1125	155.62500	1200	156.00000	1275	156.37500	1350	156.75000	1425	157.12500	1500	157.50000
1051	.25500	1126	.63000	1201	.00500	1276	.38000	1351	.75500	1426	.13000	1501	.50500
1052	.26000	1127	.63500	1202	.01000	1277	.38500	1352	.76000	1427	.13500	1502	.51000
1053	.26500	1128	.64000	1203	.01500	1278	.39000	1353	.76500	1428	.14000	1503	.51500
1054	.27000	1129	.64500	1204	.02000	1279	.39500	1354	.77000	1429	.14500	1504	.52000
1055	.27500	1130	.65000	1205	.02500	1280	.40000	1355	.77500	1430	.15000	1505	.52500
1056	.28000	1131	.65500	1206	.03000	1281	.40500	1356	.78000	1431	.15500	1506	.53000
1057	.28500	1132	.66000	1207	.03500	1282	.41000	1357	.78500	1432	.16000	1507	.53500
1058	.29000	1133	.66500	1208	.04000	1283	.41500	1358	.79000	1433	.16500	1508	.54000
1059	.29500	1134	.67000	1209	.04500	1284	.42000	1359	.79500	1434	.17000	1509	.54500
1060	.30000	1135	.67500	1210	.05000	1285	.42500	1360	.80000	1435	.17500	1510	.55000
1061	.30500	1136	.68000	1211	.05500	1286	.43000	1361	.80500	1436	.18000	1511	.55500
1062	.31000	1137	.68500	1212	.06000	1287	.43500	1362	.81000	1437	.18500	1512	.56000
1063	.31500	1138	.69000	1213	.06500	1288	.44000	1363	.81500	1438	.19000	1513	.56500
1064	.32000	1139	.69500	1214	.07000	1289	.44500	1364	.82000	1439	.19500	1514	.57000
1065	.32500	1140	.70000	1215	.07500	1290	.45000	1365	.82500	1440	.20000	1515	.57500
1066	.33000	1141	.70500	1216	.08000	1291	.45500	1366	.83000	1441	.20500	1516	.58000
1067	.33500	1142	.71000	1217	.08500	1292	.46000	1367	.83500	1442	.21000	1517	.58500
1068	.34000	1143	.71500	1218	.09000	1293	.46500	1368	.84000	1443	.21500	1518	.59000
1069	.34500	1144	.72000	1219	.09500	1294	.47000	1369	.84500	1444	.22000	1519	.59500
1070	.35000	1145	.72500	1220	.10000	1295	.47500	1370	.85000	1445	.22500	1520	.60000
1071	.35500	1146	.73000	1221	.10500	1296	.48000	1371	.85500	1446	.23000	1521	.60500
1072	.36000	1147	.73500	1222	.11000	1297	.48500	1372	.86000	1447	.23500	1522	.61000
1073	.36500	1148	.74000	1223	.11500	1298	.49000	1373	.86500	1448	.24000	1523	.61500
1074	.37000	1149	.74500	1224	.12000	1299	.49500	1374	.87000	1449	.24500	1524	.62000
1075	.37500	1150	155.75000	1225	.12500	1300	156.50000	1375	.87500	1450	157.25000	1525	.62500
1076	.38000	1151	.75500	1226	.13000	1301	.50500	1376	.88000	1451	.25500	1526	.63000
1077	.38500	1152	.76000	1227	.13500	1302	.51000	1377	.88500	1452	.26000	1527	.63500
1078	.39000	1153	.76500	1228	.14000	1303	.51500	1378	.89000	1453	.26500	1528	.64000
1079	.39500	1154	.77000	1229	.14500	1304	.52000	1379	.89500	1454	.27000	1529	.64500
1080	.40000	1155	.77500	1230	.15000	1305	.52500	1380	.90000	1455	.27500	1530	.65000
1081	.40500	1156	.78000	1231	.15500	1306	.53000	1381	.90500	1456	.28000	1531	.65500
1082	.41000	1157	.78500	1232	.16000	1307	.53500	1382	.91000	1457	.28500	1532	.66000
1083	.41500	1158	.79000	1233	.16500	1308	.54000	1383	.91500	1458	.29000	1533	.66500
1084	.42000	1159	.79500	1234	.17000	1309	.54500	1384	.92000	1459	.29500	1534	.67000
1085	.42500	1160	.80000	1235	.17500	1310	.55000	1385	.92500	1460	.30000	1535	.67500
1086	.43000	1161	.80500	1236	.18000	1311	.55500	1386	.93000	1461	.30500	1536	.68000
1087	.43500	1162	.81000	1237	.18500	1312	.56000	1387	.93500	1462	.31000	1537	.68500
1088	.44000	1163	.81500	1238	.19000	1313	.56500	1388	.94000	1463	.31500	1538	.69000
1089	.44500	1164	.82000	1239	.19500	1314	.57000	1389	.94500	1464	.32000	1539	.69500
1090	.45000	1165	.82500	1240	.20000	1315	.57500	1390	.95000	1465	.32500	1540	.70000
1091	.45500	1166	.83000	1241	.20500	1316	.58000	1391	.95500	1466	.33000	1541	.70500
1092	.46000	1167	.83500	1242	.21000	1317	.58500	1392	.96000	1467	.33500	1542	.71000
1093	.46500	1168	.84000	1243	.21500	1318	.59000	1393	.96500	1468	.34000	1543	.71500
1094	.47000	1169	.84500	1244	.22000	1319	.59500	1394	.97000	1469	.34500	1544	.72000
1095	.47500	1170	.85000	1245	.22500	1320	.60000	1395	.97500	1470	.35000	1545	.72500
1096	.48000	1171	.85500	1246	.23000	1321	.60500	1396	.98000	1471	.35500	1546	.73000
1097	.48500	1172	.86000	1247	.23500	1322	.61000	1397	.98500	1472	.36000	1547	.73500
1098	.49000	1173	.86500	1248	.24000	1323	.61500	1398	.99000	1473	.36500	1548	.74000
1099	.49500	1174	.87000	1249	.24500	1324	.62000	1399	.99500	1474	.37000	1549	.74500
1100	155.50000	1175	.87500	1250	156.25000	1325	.62500	1400	157.00000	1475	.37500	1550	157.75000
1101	.50500	1176	.88000	1251	.25500	1326	.63000	1401	.00500	1476	.38000	1551	.75500
1102	.51000	1177	.88500	1252	.26000	1327	.63500	1402	.01000	1477	.38500	1552	.76000
1103	.51500	1178	.89000	1253	.26500	1328	.64000	1403	.01500	1478	.39000	1553	.76500
1104	.52000	1179	.89500	1254	.27000	1329	.64500	1404	.02000	1479	.39500	1554	.77000
1105	.52500	1180	.90000	1255	.27500	1330	.65000	1405	.02500	1480	.40000	1555	.77500
1106	.53000	1181	.90500	1256	.28000	1331	.65500	1406	.03000	1481	.40500	1556	.78000
1107	.53500	1182	.91000	1257	.28500	1332	.66000	1407	.03500	1482	.41000	1557	.78500
1108	.54000	1183	.91500	1258	.29000	1333	.66500	1408	.04000	1483	.41500	1558	.79000
1109	.54500	1184	.92000	1259	.29500	1334	.67000	1409	.04500	1484	.42000	1559	.79500
1110	.55000	1185	.92500	1260	.30000	1335	.67500	1410	.05000	1485	.42500	1560	.80000
1111	.55500	1186	.93000	1261	.30500	1336	.68000	1411	.05500	1486	.43000	1561	.80500
1112	.56000	1187	.93500	1262	.31000	1337	.68500	1412	.06000	1487	.43500	1562	.81000
1113	.56500	1188	.94000	1263	.31500	1338	.69000	1413	.06500	1488	.44000	1563	.81500
1114	.57000	1189	.94500	1264	.32000	1339	.69500	1414	.07000	1489	.44500	1564	.82000
1115	.57500	1190	.95000	1265	.32500	1340	.70000	1415	.07500	1490	.45000	1565	.82500
1116	.58000	1191	.95500	1266	.33000	1341	.70500	1416	.08000	1491	.45500	1566	.83000
1117	.58500	1192	.96000	1267	.33500	1342	.71000	1417	.08500	1492	.46000	1567	.83500
1118	.59000	1193	.96500	1268	.34000	1343	.71500	1418	.09000	1493	.46500	1568	.84000
1119	.59500	1194	.97000	1269	.34500	1344	.72000	1419	.09500	1494	.47000	1569	.84500
1120	.60000	1195	.97500	1270	.35000	1345	.72500	1420	.10000	1495	.47500	1570	.85000
1121	.60500	1196	.98000	1271	.35500	1346	.73000	1421	.10500	1496	.48000	1571	.85500
1122	.61000	1197	.98500	1272	.36000	1347	.73500	1422	.11000	1497	.48500	1572	.86000
1123	.61500	1198	.99000	1273	.36500	1348	.74000	1423	.11500	1498	.49000	1573	.86500
1124	.62000	1199	.99500	1274	.37000	1349	.74500	1424	.12000	1499	.49500	1574	.87000

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
1575	157.87500	1650	158.25000	1725	158.62500	1800	159.00000	1875	159.37500	1950	159.75000	2025	160.12500
1576	.88000	1651	.25500	1726	.63000	1801	.00500	1876	.38000	1951	.75500	2026	.13000
1577	.88500	1652	.26000	1727	.63500	1802	.01000	1877	.38500	1952	.76000	2027	.13500
1578	.89000	1653	.26500	1728	.64000	1803	.01500	1878	.39000	1953	.76500	2028	.14000
1579	.89500	1654	.27000	1729	.64500	1804	.02000	1879	.39500	1954	.77000	2029	.14500
1580	.90000	1655	.27500	1730	.65000	1805	.02500	1880	.40000	1955	.77500	2030	.15000
1581	.90500	1656	.28000	1731	.65500	1806	.03000	1881	.40500	1956	.78000	2031	.15500
1582	.91000	1657	.28500	1732	.66000	1807	.03500	1882	.41000	1957	.78500	2032	.16000
1583	.91500	1658	.29000	1733	.66500	1808	.04000	1883	.41500	1958	.79000	2033	.16500
1584	.92000	1659	.29500	1734	.67000	1809	.04500	1884	.42000	1959	.79500	2034	.17000
1585	.92500	1660	.30000	1735	.67500	1810	.05000	1885	.42500	1960	.80000	2035	.17500
1586	.93000	1661	.30500	1736	.68000	1811	.05500	1886	.43000	1961	.80500	2036	.18000
1587	.93500	1662	.31000	1737	.68500	1812	.06000	1887	.43500	1962	.81000	2037	.18500
1588	.94000	1663	.31500	1738	.69000	1813	.06500	1888	.44000	1963	.81500	2038	.19000
1589	.94500	1664	.32000	1739	.69500	1814	.07000	1889	.44500	1964	.82000	2039	.19500
1590	.95000	1665	.32500	1740	.70000	1815	.07500	1890	.45000	1965	.82500	2040	.20000
1591	.95500	1666	.33000	1741	.70500	1816	.08000	1891	.45500	1966	.83000	2041	.20500
1592	.96000	1667	.33500	1742	.71000	1817	.08500	1892	.46000	1967	.83500	2042	.21000
1593	.96500	1668	.34000	1743	.71500	1818	.09000	1893	.46500	1968	.84000	2043	.21500
1594	.97000	1669	.34500	1744	.72000	1819	.09500	1894	.47000	1969	.84500	2044	.22000
1595	.97500	1670	.35000	1745	.72500	1820	.10000	1895	.47500	1970	.85000	2045	.22500
1596	.98000	1671	.35500	1746	.73000	1821	.10500	1896	.48000	1971	.85500	2046	.23000
1597	.98500	1672	.36000	1747	.73500	1822	.11000	1897	.48500	1972	.86000	2047	.23500
1598	.99000	1673	.36500	1748	.74000	1823	.11500	1898	.49000	1973	.86500	2048	.24000
1599	.99500	1674	.37000	1749	.74500	1824	.12000	1899	.49500	1974	.87000	2049	.24500
1600	158.00000	1675	.37500	1750	158.75000	1825	.12500	1900	159.50000	1975	.87500	2050	160.25000
1601	.00500	1676	.38000	1751	.75500	1826	.13000	1901	.50500	1976	.88000	2051	.25500
1602	.01000	1677	.38500	1752	.76000	1827	.13500	1902	.51000	1977	.88500	2052	.26000
1603	.01500	1678	.39000	1753	.76500	1828	.14000	1903	.51500	1978	.89000	2053	.26500
1604	.02000	1679	.39500	1754	.77000	1829	.14500	1904	.52000	1979	.89500	2054	.27000
1605	.02500	1680	.40000	1755	.77500	1830	.15000	1905	.52500	1980	.90000	2055	.27500
1606	.03000	1681	.40500	1756	.78000	1831	.15500	1906	.53000	1981	.90500	2056	.28000
1607	.03500	1682	.41000	1757	.78500	1832	.16000	1907	.53500	1982	.91000	2057	.28500
1608	.04000	1683	.41500	1758	.79000	1833	.16500	1908	.54000	1983	.91500	2058	.29000
1609	.04500	1684	.42000	1759	.79500	1834	.17000	1909	.54500	1984	.92000	2059	.29500
1610	.05000	1685	.42500	1760	.80000	1835	.17500	1910	.55000	1985	.92500	2060	.30000
1611	.05500	1686	.43000	1761	.80500	1836	.18000	1911	.55500	1986	.93000	2061	.30500
1612	.06000	1687	.43500	1762	.81000	1837	.18500	1912	.56000	1987	.93500	2062	.31000
1613	.06500	1688	.44000	1763	.81500	1838	.19000	1913	.56500	1988	.94000	2063	.31500
1614	.07000	1689	.44500	1764	.82000	1839	.19500	1914	.57000	1989	.94500	2064	.32000
1615	.07500	1690	.45000	1765	.82500	1840	.20000	1915	.57500	1990	.95000	2065	.32500
1616	.08000	1691	.45500	1766	.83000	1841	.20500	1916	.58000	1991	.95500	2066	.33000
1617	.08500	1692	.46000	1767	.83500	1842	.21000	1917	.58500	1992	.96000	2067	.33500
1618	.09000	1693	.46500	1768	.84000	1843	.21500	1918	.59000	1993	.96500	2068	.34000
1619	.09500	1694	.47000	1769	.84500	1844	.22000	1919	.59500	1994	.97000	2069	.34500
1620	.10000	1695	.47500	1770	.85000	1845	.22500	1920	.60000	1995	.97500	2070	.35000
1621	.10500	1696	.48000	1771	.85500	1846	.23000	1921	.60500	1996	.98000	2071	.35500
1622	.11000	1697	.48500	1772	.86000	1847	.23500	1922	.61000	1997	.98500	2072	.36000
1623	.11500	1698	.49000	1773	.86500	1848	.24000	1923	.61500	1998	.99000	2073	.36500
1624	.12000	1699	.49500	1774	.87000	1849	.24500	1924	.62000	1999	.99500	2074	.37000
1625	.12500	1700	158.50000	1775	.87500	1850	159.25000	1925	.62500	2000	160.00000	2075	.37500
1626	.13000	1701	.50500	1776	.88000	1851	.25500	1926	.63000	2001	.00500	2076	.38000
1627	.13500	1702	.51000	1777	.88500	1852	.26000	1927	.63500	2002	.01000	2077	.38500
1628	.14000	1703	.51500	1778	.89000	1853	.26500	1928	.64000	2003	.01500	2078	.39000
1629	.14500	1704	.52000	1779	.89500	1854	.27000	1929	.64500	2004	.02000	2079	.39500
1630	.15000	1705	.52500	1780	.90000	1855	.27500	1930	.65000	2005	.02500	2080	.40000
1631	.15500	1706	.53000	1781	.90500	1856	.28000	1931	.65500	2006	.03000	2081	.40500
1632	.16000	1707	.53500	1782	.91000	1857	.28500	1932	.66000	2007	.03500	2082	.41000
1633	.16500	1708	.54000	1783	.91500	1858	.29000	1933	.66500	2008	.04000	2083	.41500
1634	.17000	1709	.54500	1784	.92000	1859	.29500	1934	.67000	2009	.04500	2084	.42000
1635	.17500	1710	.55000	1785	.92500	1860	.30000	1935	.67500	2010	.05000	2085	.42500
1636	.18000	1711	.55500	1786	.93000	1861	.30500	1936	.68000	2011	.05500	2086	.43000
1637	.18500	1712	.56000	1787	.93500	1862	.31000	1937	.68500	2012	.06000	2087	.43500
1638	.19000	1713	.56500	1788	.94000	1863	.31500	1938	.69000	2013	.06500	2088	.44000
1639	.19500	1714	.57000	1789	.94500	1864	.32000	1939	.69500	2014	.07000	2089	.44500
1640	.20000	1715	.57500	1790	.95000	1865	.32500	1940	.70000	2015	.07500	2090	.45000
1641	.20500	1716	.58000	1791	.95500	1866	.33000	1941	.70500	2016	.08000	2091	.45500
1642	.21000	1717	.58500	1792	.96000	1867	.33500	1942	.71000	2017	.08500	2092	.46000
1643	.21500	1718	.59000	1793	.96500	1868	.34000	1943	.71500	2018	.09000	2093	.46500
1644	.22000	1719	.59500	1794	.97000	1869	.34500	1944	.72000	2019	.09500	2094	.47000
1645	.22500	1720	.60000	1795	.97500	1870	.35000	1945	.72500	2020	.10000	2095	.47500
1646	.23000	1721	.60500	1796	.98000	1871	.35500	1946	.73000	2021	.10500	2096	.48000
1647	.23500	1722	.61000	1797	.98500	1872	.36000	1947	.73500	2022	.11000	2097	.48500
1648	.24000	1723	.61500	1798	.99000	1873	.36500	1948	.74000	2023	.11500	2098	.49000
1649	.24500	1724	.62000	1799	.99500	1874	.37000	1949	.74500	2024	.12000	2099	.49500

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
2100	160.50000	2175	160.87500	2250	161.25000	2325	161.62500	2400	162.00000	2475	162.37500	2550	162.75000
2101	.50500	2176	.88000	2251	.25500	2326	.63000	2401	.00500	2476	.38000	2551	.75500
2102	.51000	2177	.88500	2252	.26000	2327	.63500	2402	.01000	2477	.38500	2552	.76000
2103	.51500	2178	.89000	2253	.26500	2328	.64000	2403	.01500	2478	.39000	2553	.76500
2104	.52000	2179	.89500	2254	.27000	2329	.64500	2404	.02000	2479	.39500	2554	.77000
2105	.52500	2180	.90000	2255	.27500	2330	.65000	2405	.02500	2480	.40000	2555	.77500
2106	.53000	2181	.90500	2256	.28000	2331	.65500	2406	.03000	2481	.40500	2556	.78000
2107	.53500	2182	.91000	2257	.28500	2332	.66000	2407	.03500	2482	.41000	2557	.78500
2108	.54000	2183	.91500	2258	.29000	2333	.66500	2408	.04000	2483	.41500	2558	.79000
2109	.54500	2184	.92000	2259	.29500	2334	.67000	2409	.04500	2484	.42000	2559	.79500
2110	.55000	2185	.92500	2260	.30000	2335	.67500	2410	.05000	2485	.42500	2560	.80000
2111	.55500	2186	.93000	2261	.30500	2336	.68000	2411	.05500	2486	.43000	2561	.80500
2112	.56000	2187	.93500	2262	.31000	2337	.68500	2412	.06000	2487	.43500	2562	.81000
2113	.56500	2188	.94000	2263	.31500	2338	.69000	2413	.06500	2488	.44000	2563	.81500
2114	.57000	2189	.94500	2264	.32000	2339	.69500	2414	.07000	2489	.44500	2564	.82000
2115	.57500	2190	.95000	2265	.32500	2340	.70000	2415	.07500	2490	.45000	2565	.82500
2116	.58000	2191	.95500	2266	.33000	2341	.70500	2416	.08000	2491	.45500	2566	.83000
2117	.58500	2192	.96000	2267	.33500	2342	.71000	2417	.08500	2492	.46000	2567	.83500
2118	.59000	2193	.96500	2268	.34000	2343	.71500	2418	.09000	2493	.46500	2568	.84000
2119	.59500	2194	.97000	2269	.34500	2344	.72000	2419	.09500	2494	.47000	2569	.84500
2120	.60000	2195	.97500	2270	.35000	2345	.72500	2420	.10000	2495	.47500	2570	.85000
2121	.60500	2196	.98000	2271	.35500	2346	.73000	2421	.10500	2496	.48000	2571	.85500
2122	.61000	2197	.98500	2272	.36000	2347	.73500	2422	.11000	2497	.48500	2572	.86000
2123	.61500	2198	.99000	2273	.36500	2348	.74000	2423	.11500	2498	.49000	2573	.86500
2124	.62000	2199	.99500	2274	.37000	2349	.74500	2424	.12000	2499	.49500	2574	.87000
2125	.62500	2200	161.00000	2275	.37500	2350	161.75000	2425	.12500	2500	162.50000	2575	.87500
2126	.63000	2201	.00500	2276	.38000	2351	.75500	2426	.13000	2501	.50500	2576	.88000
2127	.63500	2202	.01000	2277	.38500	2352	.76000	2427	.13500	2502	.51000	2577	.88500
2128	.64000	2203	.01500	2278	.39000	2353	.76500	2428	.14000	2503	.51500	2578	.89000
2129	.64500	2204	.02000	2279	.39500	2354	.77000	2429	.14500	2504	.52000	2579	.89500
2130	.65000	2205	.02500	2280	.40000	2355	.77500	2430	.15000	2505	.52500	2580	.90000
2131	.65500	2206	.03000	2281	.40500	2356	.78000	2431	.15500	2506	.53000	2581	.90500
2132	.66000	2207	.03500	2282	.41000	2357	.78500	2432	.16000	2507	.53500	2582	.91000
2133	.66500	2208	.04000	2283	.41500	2358	.79000	2433	.16500	2508	.54000	2583	.91500
2134	.67000	2209	.04500	2284	.42000	2359	.79500	2434	.17000	2509	.54500	2584	.92000
2135	.67500	2210	.05000	2285	.42500	2360	.80000	2435	.17500	2510	.55000	2585	.92500
2136	.68000	2211	.05500	2286	.43000	2361	.80500	2436	.18000	2511	.55500	2586	.93000
2137	.68500	2212	.06000	2287	.43500	2362	.81000	2437	.18500	2512	.56000	2587	.93500
2138	.69000	2213	.06500	2288	.44000	2363	.81500	2438	.19000	2513	.56500	2588	.94000
2139	.69500	2214	.07000	2289	.44500	2364	.82000	2439	.19500	2514	.57000	2589	.94500
2140	.70000	2215	.07500	2290	.45000	2365	.82500	2440	.20000	2515	.57500	2590	.95000
2141	.70500	2216	.08000	2291	.45500	2366	.83000	2441	.20500	2516	.58000	2591	.95500
2142	.71000	2217	.08500	2292	.46000	2367	.83500	2442	.21000	2517	.58500	2592	.96000
2143	.71500	2218	.09000	2293	.46500	2368	.84000	2443	.21500	2518	.59000	2593	.96500
2144	.72000	2219	.09500	2294	.47000	2369	.84500	2444	.22000	2519	.59500	2594	.97000
2145	.72500	2220	.10000	2295	.47500	2370	.85000	2445	.22500	2520	.60000	2595	.97500
2146	.73000	2221	.10500	2296	.48000	2371	.85500	2446	.23000	2521	.60500	2596	.98000
2147	.73500	2222	.11000	2297	.48500	2372	.86000	2447	.23500	2522	.61000	2597	.98500
2148	.74000	2223	.11500	2298	.49000	2373	.86500	2448	.24000	2523	.61500	2598	.99000
2149	.74500	2224	.12000	2299	.49500	2374	.87000	2449	.24500	2524	.62000	2599	.99500
2150	160.75000	2225	.12500	2300	161.50000	2375	.87500	2450	162.25000	2525	.62500	2600	163.00000
2151	.75500	2226	.13000	2301	.50500	2376	.88000	2451	.25500	2526	.63000	2601	.00500
2152	.76000	2227	.13500	2302	.51000	2377	.88500	2452	.26000	2527	.63500	2602	.01000
2153	.76500	2228	.14000	2303	.51500	2378	.89000	2453	.26500	2528	.64000	2603	.01500
2154	.77000	2229	.14500	2304	.52000	2379	.89500	2454	.27000	2529	.64500	2604	.02000
2155	.77500	2230	.15000	2305	.52500	2380	.90000	2455	.27500	2530	.65000	2605	.02500
2156	.78000	2231	.15500	2306	.53000	2381	.90500	2456	.28000	2531	.65500	2606	.03000
2157	.78500	2232	.16000	2307	.53500	2382	.91000	2457	.28500	2532	.66000	2607	.03500
2158	.79000	2233	.16500	2308	.54000	2383	.91500	2458	.29000	2533	.66500	2608	.04000
2159	.79500	2234	.17000	2309	.54500	2384	.92000	2459	.29500	2534	.67000	2609	.04500
2160	.80000	2235	.17500	2310	.55000	2385	.92500	2460	.30000	2535	.67500	2610	.05000
2161	.80500	2236	.18000	2311	.55500	2386	.93000	2461	.30500	2536	.68000	2611	.05500
2162	.81000	2237	.18500	2312	.56000	2387	.93500	2462	.31000	2537	.68500	2612	.06000
2163	.81500	2238	.19000	2313	.56500	2388	.94000	2463	.31500	2538	.69000	2613	.06500
2164	.82000	2239	.19500	2314	.57000	2389	.94500	2464	.32000	2539	.69500	2614	.07000
2165	.82500	2240	.20000	2315	.57500	2390	.95000	2465	.32500	2540	.70000	2615	.07500
2166	.83000	2241	.20500	2316	.58000	2391	.95500	2466	.33000	2541	.70500	2616	.08000
2167	.83500	2242	.21000	2317	.58500	2392	.96000	2467	.33500	2542	.71000	2617	.08500
2168	.84000	2243	.21500	2318	.59000	2393	.96500	2468	.34000	2543	.71500	2618	.09000
2169	.84500	2244	.22000	2319	.59500	2394	.97000	2469	.34500	2544	.72000	2619	.09500
2170	.85000	2245	.22500	2320	.60000	2395	.97500	2470	.35000	2545	.72500	2620	.10000
2171	.85500	2246	.23000	2321	.60500	2396	.98000	2471	.35500	2546	.73000	2621	.10500
2172	.86000	2247	.23500	2322	.61000	2397	.98500	2472	.36000	2547	.73500	2622	.11000
2173	.86500	2248	.24000	2323	.61500	2398	.99000	2473	.36500	2548	.74000	2623	.11500
2174	.87000	2249	.24500	2324	.62000	2399	.99500	2474	.37000	2549	.74500	2624	.12000

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
2625	163.12500	2700	163.50000	2775	163.87500	2850	164.25000	2925	164.62500	3000	165.00000	3075	165.37500
2626	.13000	2701	.50500	2776	.88000	2851	.25500	2926	.63000	3001	.00500	3076	.38000
2627	.13500	2702	.51000	2777	.88500	2852	.26000	2927	.63500	3002	.01000	3077	.38500
2628	.14000	2703	.51500	2778	.89000	2853	.26500	2928	.64000	3003	.01500	3078	.39000
2629	.14500	2704	.52000	2779	.89500	2854	.27000	2929	.64500	3004	.02000	3079	.39500
2630	.15000	2705	.52500	2780	.90000	2855	.27500	2930	.65000	3005	.02500	3080	.40000
2631	.15500	2706	.53000	2781	.90500	2856	.28000	2931	.65500	3006	.03000	3081	.40500
2632	.16000	2707	.53500	2782	.91000	2857	.28500	2932	.66000	3007	.03500	3082	.41000
2633	.16500	2708	.54000	2783	.91500	2858	.29000	2933	.66500	3008	.04000	3083	.41500
2634	.17000	2709	.54500	2784	.92000	2859	.29500	2934	.67000	3009	.04500	3084	.42000
2635	.17500	2710	.55000	2785	.92500	2860	.30000	2935	.67500	3010	.05000	3085	.42500
2636	.18000	2711	.55500	2786	.93000	2861	.30500	2936	.68000	3011	.05500	3086	.43000
2637	.18500	2712	.56000	2787	.93500	2862	.31000	2937	.68500	3012	.06000	3087	.43500
2638	.19000	2713	.56500	2788	.94000	2863	.31500	2938	.69000	3013	.06500	3088	.44000
2639	.19500	2714	.57000	2789	.94500	2864	.32000	2939	.69500	3014	.07000	3089	.44500
2640	.20000	2715	.57500	2790	.95000	2865	.32500	2940	.70000	3015	.07500	3090	.45000
2641	.20500	2716	.58000	2791	.95500	2866	.33000	2941	.70500	3016	.08000	3091	.45500
2642	.21000	2717	.58500	2792	.96000	2867	.33500	2942	.71000	3017	.08500	3092	.46000
2643	.21500	2718	.59000	2793	.96500	2868	.34000	2943	.71500	3018	.09000	3093	.46500
2644	.22000	2719	.59500	2794	.97000	2869	.34500	2944	.72000	3019	.09500	3094	.47000
2645	.22500	2720	.60000	2795	.97500	2870	.35000	2945	.72500	3020	.10000	3095	.47500
2646	.23000	2721	.60500	2796	.98000	2871	.35500	2946	.73000	3021	.10500	3096	.48000
2647	.23500	2722	.61000	2797	.98500	2872	.36000	2947	.73500	3022	.11000	3097	.48500
2648	.24000	2723	.61500	2798	.99000	2873	.36500	2948	.74000	3023	.11500	3098	.49000
2649	.24500	2724	.62000	2799	.99500	2874	.37000	2949	.74500	3024	.12000	3099	.49500
2650	163.25000	2725	.62500	2800	164.00000	2875	.37500	2950	164.75000	3025	.12500	3100	165.50000
2651	.25500	2726	.63000	2801	.00500	2876	.38000	2951	.75500	3026	.13000	3101	.50500
2652	.26000	2727	.63500	2802	.01000	2877	.38500	2952	.76000	3027	.13500	3102	.51000
2653	.26500	2728	.64000	2803	.01500	2878	.39000	2953	.76500	3028	.14000	3103	.51500
2654	.27000	2729	.64500	2804	.02000	2879	.39500	2954	.77000	3029	.14500	3104	.52000
2655	.27500	2730	.65000	2805	.02500	2880	.40000	2955	.77500	3030	.15000	3105	.52500
2656	.28000	2731	.65500	2806	.03000	2881	.40500	2956	.78000	3031	.15500	3106	.53000
2657	.28500	2732	.66000	2807	.03500	2882	.41000	2957	.78500	3032	.16000	3107	.53500
2658	.29000	2733	.66500	2808	.04000	2883	.41500	2958	.79000	3033	.16500	3108	.54000
2659	.29500	2734	.67000	2809	.04500	2884	.42000	2959	.79500	3034	.17000	3109	.54500
2660	.30000	2735	.67500	2810	.05000	2885	.42500	2960	.80000	3035	.17500	3110	.55000
2661	.30500	2736	.68000	2811	.05500	2886	.43000	2961	.80500	3036	.18000	3111	.55500
2662	.31000	2737	.68500	2812	.06000	2887	.43500	2962	.81000	3037	.18500	3112	.56000
2663	.31500	2738	.69000	2813	.06500	2888	.44000	2963	.81500	3038	.19000	3113	.56500
2664	.32000	2739	.69500	2814	.07000	2889	.44500	2964	.82000	3039	.19500	3114	.57000
2665	.32500	2740	.70000	2815	.07500	2890	.45000	2965	.82500	3040	.20000	3115	.57500
2666	.33000	2741	.70500	2816	.08000	2891	.45500	2966	.83000	3041	.20500	3116	.58000
2667	.33500	2742	.71000	2817	.08500	2892	.46000	2967	.83500	3042	.21000	3117	.58500
2668	.34000	2743	.71500	2818	.09000	2893	.46500	2968	.84000	3043	.21500	3118	.59000
2669	.34500	2744	.72000	2819	.09500	2894	.47000	2969	.84500	3044	.22000	3119	.59500
2670	.35000	2745	.72500	2820	.10000	2895	.47500	2970	.85000	3045	.22500	3120	.60000
2671	.35500	2746	.73000	2821	.10500	2896	.48000	2971	.85500	3046	.23000	3121	.60500
2672	.36000	2747	.73500	2822	.11000	2897	.48500	2972	.86000	3047	.23500	3122	.61000
2673	.36500	2748	.74000	2823	.11500	2898	.49000	2973	.86500	3048	.24000	3123	.61500
2674	.37000	2749	.74500	2824	.12000	2899	.49500	2974	.87000	3049	.24500	3124	.62000
2675	.37500	2750	163.75000	2825	.12500	2900	164.50000	2975	.87500	3050	165.25000	3125	.62500
2676	.38000	2751	.75500	2826	.13000	2901	.50500	2976	.88000	3051	.25500	3126	.63000
2677	.38500	2752	.76000	2827	.13500	2902	.51000	2977	.88500	3052	.26000	3127	.63500
2678	.39000	2753	.76500	2828	.14000	2903	.51500	2978	.89000	3053	.26500	3128	.64000
2679	.39500	2754	.77000	2829	.14500	2904	.52000	2979	.89500	3054	.27000	3129	.64500
2680	.40000	2755	.77500	2830	.15000	2905	.52500	2980	.90000	3055	.27500	3130	.65000
2681	.40500	2756	.78000	2831	.15500	2906	.53000	2981	.90500	3056	.28000	3131	.65500
2682	.41000	2757	.78500	2832	.16000	2907	.53500	2982	.91000	3057	.28500	3132	.66000
2683	.41500	2758	.79000	2833	.16500	2908	.54000	2983	.91500	3058	.29000	3133	.66500
2684	.42000	2759	.79500	2834	.17000	2909	.54500	2984	.92000	3059	.29500	3134	.67000
2685	.42500	2760	.80000	2835	.17500	2910	.55000	2985	.92500	3060	.30000	3135	.67500
2686	.43000	2761	.80500	2836	.18000	2911	.55500	2986	.93000	3061	.30500	3136	.68000
2687	.43500	2762	.81000	2837	.18500	2912	.56000	2987	.93500	3062	.31000	3137	.68500
2688	.44000	2763	.81500	2838	.19000	2913	.56500	2988	.94000	3063	.31500	3138	.69000
2689	.44500	2764	.82000	2839	.19500	2914	.57000	2989	.94500	3064	.32000	3139	.69500
2690	.45000	2765	.82500	2840	.20000	2915	.57500	2990	.95000	3065	.32500	3140	.70000
2691	.45500	2766	.83000	2841	.20500	2916	.58000	2991	.95500	3066	.33000	3141	.70500
2692	.46000	2767	.83500	2842	.21000	2917	.58500	2992	.96000	3067	.33500	3142	.71000
2693	.46500	2768	.84000	2843	.21500	2918	.59000	2993	.96500	3068	.34000	3143	.71500
2694	.47000	2769	.84500	2844	.22000	2919	.59500	2994	.97000	3069	.34500	3144	.72000
2695	.47500	2770	.85000	2845	.22500	2920	.60000	2995	.97500	3070	.35000	3145	.72500
2696	.48000	2771	.85500	2846	.23000	2921	.60500	2996	.98000	3071	.35500	3146	.73000
2697	.48500	2772	.86000	2847	.23500	2922	.61000	2997	.98500	3072	.36000	3147	.73500
2698	.49000	2773	.86500	2848	.24000	2923	.61500	2998	.99000	3073	.36500	3148	.74000
2699	.49500	2774	.87000	2849	.24500	2924	.62000	2999	.99500	3074	.37000	3149	.74500

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
3150	165.75000	3225	166.12500	3300	166.50000	3375	166.87500	3450	167.25000	3525	167.62500	3600	168.00000
3151	.75500	3226	.13000	3301	.50500	3376	.88000	3451	.25500	3526	.63000	3601	.00500
3152	.76000	3227	.13500	3302	.51000	3377	.88500	3452	.26000	3527	.63500	3602	.01000
3153	.76500	3228	.14000	3303	.51500	3378	.89000	3453	.26500	3528	.64000	3603	.01500
3154	.77000	3229	.14500	3304	.52000	3379	.89500	3454	.27000	3529	.64500	3604	.02000
3155	.77500	3230	.15000	3305	.52500	3380	.90000	3455	.27500	3530	.65000	3605	.02500
3156	.78000	3231	.15500	3306	.53000	3381	.90500	3456	.28000	3531	.65500	3606	.03000
3157	.78500	3232	.16000	3307	.53500	3382	.91000	3457	.28500	3532	.66000	3607	.03500
3158	.79000	3233	.16500	3308	.54000	3383	.91500	3458	.29000	3533	.66500	3608	.04000
3159	.79500	3234	.17000	3309	.54500	3384	.92000	3459	.29500	3534	.67000	3609	.04500
3160	.80000	3235	.17500	3310	.55000	3385	.92500	3460	.30000	3535	.67500	3610	.05000
3161	.80500	3236	.18000	3311	.55500	3386	.93000	3461	.30500	3536	.68000	3611	.05500
3162	.81000	3237	.18500	3312	.56000	3387	.93500	3462	.31000	3537	.68500	3612	.06000
3163	.81500	3238	.19000	3313	.56500	3388	.94000	3463	.31500	3538	.69000	3613	.06500
3164	.82000	3239	.19500	3314	.57000	3389	.94500	3464	.32000	3539	.69500	3614	.07000
3165	.82500	3240	.20000	3315	.57500	3390	.95000	3465	.32500	3540	.70000	3615	.07500
3166	.83000	3241	.20500	3316	.58000	3391	.95500	3466	.33000	3541	.70500	3616	.08000
3167	.83500	3242	.21000	3317	.58500	3392	.96000	3467	.33500	3542	.71000	3617	.08500
3168	.84000	3243	.21500	3318	.59000	3393	.96500	3468	.34000	3543	.71500	3618	.09000
3169	.84500	3244	.22000	3319	.59500	3394	.97000	3469	.34500	3544	.72000	3619	.09500
3170	.85000	3245	.22500	3320	.60000	3395	.97500	3470	.35000	3545	.72500	3620	.10000
3171	.85500	3246	.23000	3321	.60500	3396	.98000	3471	.35500	3546	.73000	3621	.10500
3172	.86000	3247	.23500	3322	.61000	3397	.98500	3472	.36000	3547	.73500	3622	.11000
3173	.86500	3248	.24000	3323	.61500	3398	.99000	3473	.36500	3548	.74000	3623	.11500
3174	.87000	3249	.24500	3324	.62000	3399	.99500	3474	.37000	3549	.74500	3624	.12000
3175	.87500	3250	166.25000	3325	.62500	3400	167.00000	3475	.37500	3550	167.75000	3625	.12500
3176	.88000	3251	.25500	3326	.63000	3401	.00500	3476	.38000	3551	.75500	3626	.13000
3177	.88500	3252	.26000	3327	.63500	3402	.01000	3477	.38500	3552	.76000	3627	.13500
3178	.89000	3253	.26500	3328	.64000	3403	.01500	3478	.39000	3553	.76500	3628	.14000
3179	.89500	3254	.27000	3329	.64500	3404	.02000	3479	.39500	3554	.77000	3629	.14500
3180	.90000	3255	.27500	3330	.65000	3405	.02500	3480	.40000	3555	.77500	3630	.15000
3181	.90500	3256	.28000	3331	.65500	3406	.03000	3481	.40500	3556	.78000	3631	.15500
3182	.91000	3257	.28500	3332	.66000	3407	.03500	3482	.41000	3557	.78500	3632	.16000
3183	.91500	3258	.29000	3333	.66500	3408	.04000	3483	.41500	3558	.79000	3633	.16500
3184	.92000	3259	.29500	3334	.67000	3409	.04500	3484	.42000	3559	.79500	3634	.17000
3185	.92500	3260	.30000	3335	.67500	3410	.05000	3485	.42500	3560	.80000	3635	.17500
3186	.93000	3261	.30500	3336	.68000	3411	.05500	3486	.43000	3561	.80500	3636	.18000
3187	.93500	3262	.31000	3337	.68500	3412	.06000	3487	.43500	3562	.81000	3637	.18500
3188	.94000	3263	.31500	3338	.69000	3413	.06500	3488	.44000	3563	.81500	3638	.19000
3189	.94500	3264	.32000	3339	.69500	3414	.07000	3489	.44500	3564	.82000	3639	.19500
3190	.95000	3265	.32500	3340	.70000	3415	.07500	3490	.45000	3565	.82500	3640	.20000
3191	.95500	3266	.33000	3341	.70500	3416	.08000	3491	.45500	3566	.83000	3641	.20500
3192	.96000	3267	.33500	3342	.71000	3417	.08500	3492	.46000	3567	.83500	3642	.21000
3193	.96500	3268	.34000	3343	.71500	3418	.09000	3493	.46500	3568	.84000	3643	.21500
3194	.97000	3269	.34500	3344	.72000	3419	.09500	3494	.47000	3569	.84500	3644	.22000
3195	.97500	3270	.35000	3345	.72500	3420	.10000	3495	.47500	3570	.85000	3645	.22500
3196	.98000	3271	.35500	3346	.73000	3421	.10500	3496	.48000	3571	.85500	3646	.23000
3197	.98500	3272	.36000	3347	.73500	3422	.11000	3497	.48500	3572	.86000	3647	.23500
3198	.99000	3273	.36500	3348	.74000	3423	.11500	3498	.49000	3573	.86500	3648	.24000
3199	.99500	3274	.37000	3349	.74500	3424	.12000	3499	.49500	3574	.87000	3649	.24500
3200	166.00000	3275	.37500	3350	166.75000	3425	.12500	3500	167.50000	3575	.87500	3650	168.25000
3201	.00500	3276	.38000	3351	.75500	3426	.13000	3501	.50500	3576	.88000	3651	.25500
3202	.01000	3277	.38500	3352	.76000	3427	.13500	3502	.51000	3577	.88500	3652	.26000
3203	.01500	3278	.39000	3353	.76500	3428	.14000	3503	.51500	3578	.89000	3653	.26500
3204	.02000	3279	.39500	3354	.77000	3429	.14500	3504	.52000	3579	.89500	3654	.27000
3205	.02500	3280	.40000	3355	.77500	3430	.15000	3505	.52500	3580	.90000	3655	.27500
3206	.03000	3281	.40500	3356	.78000	3431	.15500	3506	.53000	3581	.90500	3656	.28000
3207	.03500	3282	.41000	3357	.78500	3432	.16000	3507	.53500	3582	.91000	3657	.28500
3208	.04000	3283	.41500	3358	.79000	3433	.16500	3508	.54000	3583	.91500	3658	.29000
3209	.04500	3284	.42000	3359	.79500	3434	.17000	3509	.54500	3584	.92000	3659	.29500
3210	.05000	3285	.42500	3360	.80000	3435	.17500	3510	.55000	3585	.92500	3660	.30000
3211	.05500	3286	.43000	3361	.80500	3436	.18000	3511	.55500	3586	.93000	3661	.30500
3212	.06000	3287	.43500	3362	.81000	3437	.18500	3512	.56000	3587	.93500	3662	.31000
3213	.06500	3288	.44000	3363	.81500	3438	.19000	3513	.56500	3588	.94000	3663	.31500
3214	.07000	3289	.44500	3364	.82000	3439	.19500	3514	.57000	3589	.94500	3664	.32000
3215	.07500	3290	.45000	3365	.82500	3440	.20000	3515	.57500	3590	.95000	3665	.32500
3216	.08000	3291	.45500	3366	.83000	3441	.20500	3516	.58000	3591	.95500	3666	.33000
3217	.08500	3292	.46000	3367	.83500	3442	.21000	3517	.58500	3592	.96000	3667	.33500
3218	.09000	3293	.46500	3368	.84000	3443	.21500	3518	.59000	3593	.96500	3668	.34000
3219	.09500	3294	.47000	3369	.84500	3444	.22000	3519	.59500	3594	.97000	3669	.34500
3220	.10000	3295	.47500	3370	.85000	3445	.22500	3520	.60000	3595	.97500	3670	.35000
3221	.10500	3296	.48000	3371	.85500	3446	.23000	3521	.60500	3596	.98000	3671	.35500
3222	.11000	3297	.48500	3372	.86000	3447	.23500	3522	.61000	3597	.98500	3672	.36000
3223	.11500	3298	.49000	3373	.86500	3448	.24000	3523	.61500	3598	.99000	3673	.36500
3224	.12000	3299	.49500	3374	.87000	3449	.24500	3524	.62000	3599	.99500	3674	.37000

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
3675	168.37500	3750	168.75000	3825	169.12500	3900	169.50000	3975	169.87500	4050	170.25000	4125	170.62500
3676	.38000	3751	.75500	3826	.13000	3901	.50500	3976	.88000	4051	.25500	4126	.63000
3677	.38500	3752	.76000	3827	.13500	3902	.51000	3977	.88500	4052	.26000	4127	.63500
3678	.39000	3753	.76500	3828	.14000	3903	.51500	3978	.89000	4053	.26500	4128	.64000
3679	.39500	3754	.77000	3829	.14500	3904	.52000	3979	.89500	4054	.27000	4129	.64500
3680	.40000	3755	.77500	3830	.15000	3905	.52500	3980	.90000	4055	.27500	4130	.65000
3681	.40500	3756	.78000	3831	.15500	3906	.53000	3981	.90500	4056	.28000	4131	.65500
3682	.41000	3757	.78500	3832	.16000	3907	.53500	3982	.91000	4057	.28500	4132	.66000
3683	.41500	3758	.79000	3833	.16500	3908	.54000	3983	.91500	4058	.29000	4133	.66500
3684	.42000	3759	.79500	3834	.17000	3909	.54500	3984	.92000	4059	.29500	4134	.67000
3685	.42500	3760	.80000	3835	.17500	3910	.55000	3985	.92500	4060	.30000	4135	.67500
3686	.43000	3761	.80500	3836	.18000	3911	.55500	3986	.93000	4061	.30500	4136	.68000
3687	.43500	3762	.81000	3837	.18500	3912	.56000	3987	.93500	4062	.31000	4137	.68500
3688	.44000	3763	.81500	3838	.19000	3913	.56500	3988	.94000	4063	.31500	4138	.69000
3689	.44500	3764	.82000	3839	.19500	3914	.57000	3989	.94500	4064	.32000	4139	.69500
3690	.45000	3765	.82500	3840	.20000	3915	.57500	3990	.95000	4065	.32500	4140	.70000
3691	.45500	3766	.83000	3841	.20500	3916	.58000	3991	.95500	4066	.33000	4141	.70500
3692	.46000	3767	.83500	3842	.21000	3917	.58500	3992	.96000	4067	.33500	4142	.71000
3693	.46500	3768	.84000	3843	.21500	3918	.59000	3993	.96500	4068	.34000	4143	.71500
3694	.47000	3769	.84500	3844	.22000	3919	.59500	3994	.97000	4069	.34500	4144	.72000
3695	.47500	3770	.85000	3845	.22500	3920	.60000	3995	.97500	4070	.35000	4145	.72500
3696	.48000	3771	.85500	3846	.23000	3921	.60500	3996	.98000	4071	.35500	4146	.73000
3697	.48500	3772	.86000	3847	.23500	3922	.61000	3997	.98500	4072	.36000	4147	.73500
3698	.49000	3773	.86500	3848	.24000	3923	.61500	3998	.99000	4073	.36500	4148	.74000
3699	.49500	3774	.87000	3849	.24500	3924	.62000	3999	.99500	4074	.37000	4149	.74500
3700	168.50000	3775	.87500	3850	169.25000	3925	.62500	4000	170.00000	4075	.37500	4150	170.75000
3701	.50500	3776	.88000	3851	.25500	3926	.63000	4001	.00500	4076	.38000	4151	.75500
3702	.51000	3777	.88500	3852	.26000	3927	.63500	4002	.01000	4077	.38500	4152	.76000
3703	.51500	3778	.89000	3853	.26500	3928	.64000	4003	.01500	4078	.39000	4153	.76500
3704	.52000	3779	.89500	3854	.27000	3929	.64500	4004	.02000	4079	.39500	4154	.77000
3705	.52500	3780	.90000	3855	.27500	3930	.65000	4005	.02500	4080	.40000	4155	.77500
3706	.53000	3781	.90500	3856	.28000	3931	.65500	4006	.03000	4081	.40500	4156	.78000
3707	.53500	3782	.91000	3857	.28500	3932	.66000	4007	.03500	4082	.41000	4157	.78500
3708	.54000	3783	.91500	3858	.29000	3933	.66500	4008	.04000	4083	.41500	4158	.79000
3709	.54500	3784	.92000	3859	.29500	3934	.67000	4009	.04500	4084	.42000	4159	.79500
3710	.55000	3785	.92500	3860	.30000	3935	.67500	4010	.05000	4085	.42500	4160	.80000
3711	.55500	3786	.93000	3861	.30500	3936	.68000	4011	.05500	4086	.43000	4161	.80500
3712	.56000	3787	.93500	3862	.31000	3937	.68500	4012	.06000	4087	.43500	4162	.81000
3713	.56500	3788	.94000	3863	.31500	3938	.69000	4013	.06500	4088	.44000	4163	.81500
3714	.57000	3789	.94500	3864	.32000	3939	.69500	4014	.07000	4089	.44500	4164	.82000
3715	.57500	3790	.95000	3865	.32500	3940	.70000	4015	.07500	4090	.45000	4165	.82500
3716	.58000	3791	.95500	3866	.33000	3941	.70500	4016	.08000	4091	.45500	4166	.83000
3717	.58500	3792	.96000	3867	.33500	3942	.71000	4017	.08500	4092	.46000	4167	.83500
3718	.59000	3793	.96500	3868	.34000	3943	.71500	4018	.09000	4093	.46500	4168	.84000
3719	.59500	3794	.97000	3869	.34500	3944	.72000	4019	.09500	4094	.47000	4169	.84500
3720	.60000	3795	.97500	3870	.35000	3945	.72500	4020	.10000	4095	.47500	4170	.85000
3721	.60500	3796	.98000	3871	.35500	3946	.73000	4021	.10500	4096	.48000	4171	.85500
3722	.61000	3797	.98500	3872	.36000	3947	.73500	4022	.11000	4097	.48500	4172	.86000
3723	.61500	3798	.99000	3873	.36500	3948	.74000	4023	.11500	4098	.49000	4173	.86500
3724	.62000	3799	.99500	3874	.37000	3949	.74500	4024	.12000	4099	.49500	4174	.87000
3725	.62500	3800	169.00000	3875	.37500	3950	169.75000	4025	.12500	4100	170.50000	4175	.87500
3726	.63000	3801	.00500	3876	.38000	3951	.75500	4026	.13000	4101	.50500	4176	.88000
3727	.63500	3802	.01000	3877	.38500	3952	.76000	4027	.13500	4102	.51000	4177	.88500
3728	.64000	3803	.01500	3878	.39000	3953	.76500	4028	.14000	4103	.51500	4178	.89000
3729	.64500	3804	.02000	3879	.39500	3954	.77000	4029	.14500	4104	.52000	4179	.89500
3730	.65000	3805	.02500	3880	.40000	3955	.77500	4030	.15000	4105	.52500	4180	.90000
3731	.65500	3806	.03000	3881	.40500	3956	.78000	4031	.15500	4106	.53000	4181	.90500
3732	.66000	3807	.03500	3882	.41000	3957	.78500	4032	.16000	4107	.53500	4182	.91000
3733	.66500	3808	.04000	3883	.41500	3958	.79000	4033	.16500	4108	.54000	4183	.91500
3734	.67000	3809	.04500	3884	.42000	3959	.79500	4034	.17000	4109	.54500	4184	.92000
3735	.67500	3810	.05000	3885	.42500	3960	.80000	4035	.17500	4110	.55000	4185	.92500
3736	.68000	3811	.05500	3886	.43000	3961	.80500	4036	.18000	4111	.55500	4186	.93000
3737	.68500	3812	.06000	3887	.43500	3962	.81000	4037	.18500	4112	.56000	4187	.93500
3738	.69000	3813	.06500	3888	.44000	3963	.81500	4038	.19000	4113	.56500	4188	.94000
3739	.69500	3814	.07000	3889	.44500	3964	.82000	4039	.19500	4114	.57000	4189	.94500
3740	.70000	3815	.07500	3890	.45000	3965	.82500	4040	.20000	4115	.57500	4190	.95000
3741	.70500	3816	.08000	3891	.45500	3966	.83000	4041	.20500	4116	.58000	4191	.95500
3742	.71000	3817	.08500	3892	.46000	3967	.83500	4042	.21000	4117	.58500	4192	.96000
3743	.71500	3818	.09000	3893	.46500	3968	.84000	4043	.21500	4118	.59000	4193	.96500
3744	.72000	3819	.09500	3894	.47000	3969	.84500	4044	.22000	4119	.59500	4194	.97000
3745	.72500	3820	.10000	3895	.47500	3970	.85000	4045	.22500	4120	.60000	4195	.97500
3746	.73000	3821	.10500	3896	.48000	3971	.85500	4046	.23000	4121	.60500	4196	.98000
3747	.73500	3822	.11000	3897	.48500	3972	.86000	4047	.23500	4122	.61000	4197	.98500
3748	.74000	3823	.11500	3898	.49000	3973	.86500	4048	.24000	4123	.61500	4198	.99000
3749	.74500	3824	.12000	3899	.49500	3974	.87000	4049	.24500	4124	.62000	4199	.99500

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
4200	171.00000	4275	171.37500	4350	171.75000	4425	172.12500	4500	172.50000	4575	172.87500	4650	173.25000
4201	.00500	4276	.38000	4351	.75500	4426	.13000	4501	.50500	4576	.88000	4651	.25500
4202	.01000	4277	.38500	4352	.76000	4427	.13500	4502	.51000	4577	.88500	4652	.26000
4203	.01500	4278	.39000	4353	.76500	4428	.14000	4503	.51500	4578	.89000	4653	.26500
4204	.02000	4279	.39500	4354	.77000	4429	.14500	4504	.52000	4579	.89500	4654	.27000
4205	.02500	4280	.40000	4355	.77500	4430	.15000	4505	.52500	4580	.90000	4655	.27500
4206	.03000	4281	.40500	4356	.78000	4431	.15500	4506	.53000	4581	.90500	4656	.28000
4207	.03500	4282	.41000	4357	.78500	4432	.16000	4507	.53500	4582	.91000	4657	.28500
4208	.04000	4283	.41500	4358	.79000	4433	.16500	4508	.54000	4583	.91500	4658	.29000
4209	.04500	4284	.42000	4359	.79500	4434	.17000	4509	.54500	4584	.92000	4659	.29500
4210	.05000	4285	.42500	4360	.80000	4435	.17500	4510	.55000	4585	.92500	4660	.30000
4211	.05500	4286	.43000	4361	.80500	4436	.18000	4511	.55500	4586	.93000	4661	.30500
4212	.06000	4287	.43500	4362	.81000	4437	.18500	4512	.56000	4587	.93500	4662	.31000
4213	.06500	4288	.44000	4363	.81500	4438	.19000	4513	.56500	4588	.94000	4663	.31500
4214	.07000	4289	.44500	4364	.82000	4439	.19500	4514	.57000	4589	.94500	4664	.32000
4215	.07500	4290	.45000	4365	.82500	4440	.20000	4515	.57500	4590	.95000	4665	.32500
4216	.08000	4291	.45500	4366	.83000	4441	.20500	4516	.58000	4591	.95500	4666	.33000
4217	.08500	4292	.46000	4367	.83500	4442	.21000	4517	.58500	4592	.96000	4667	.33500
4218	.09000	4293	.46500	4368	.84000	4443	.21500	4518	.59000	4593	.96500	4668	.34000
4219	.09500	4294	.47000	4369	.84500	4444	.22000	4519	.59500	4594	.97000	4669	.34500
4220	.10000	4295	.47500	4370	.85000	4445	.22500	4520	.60000	4595	.97500	4670	.35000
4221	.10500	4296	.48000	4371	.85500	4446	.23000	4521	.60500	4596	.98000	4671	.35500
4222	.11000	4297	.48500	4372	.86000	4447	.23500	4522	.61000	4597	.98500	4672	.36000
4223	.11500	4298	.49000	4373	.86500	4448	.24000	4523	.61500	4598	.99000	4673	.36500
4224	.12000	4299	.49500	4374	.87000	4449	.24500	4524	.62000	4599	.99500	4674	.37000
4225	.12500	4300	171.50000	4375	.87500	4450	172.25000	4525	.62500	4600	173.00000	4675	.37500
4226	.13000	4301	.50500	4376	.88000	4451	.25500	4526	.63000	4601	.00500	4676	.38000
4227	.13500	4302	.51000	4377	.88500	4452	.26000	4527	.63500	4602	.01000	4677	.38500
4228	.14000	4303	.51500	4378	.89000	4453	.26500	4528	.64000	4603	.01500	4678	.39000
4229	.14500	4304	.52000	4379	.89500	4454	.27000	4529	.64500	4604	.02000	4679	.39500
4230	.15000	4305	.52500	4380	.90000	4455	.27500	4530	.65000	4605	.02500	4680	.40000
4231	.15500	4306	.53000	4381	.90500	4456	.28000	4531	.65500	4606	.03000	4681	.40500
4232	.16000	4307	.53500	4382	.91000	4457	.28500	4532	.66000	4607	.03500	4682	.41000
4233	.16500	4308	.54000	4383	.91500	4458	.29000	4533	.66500	4608	.04000	4683	.41500
4234	.17000	4309	.54500	4384	.92000	4459	.29500	4534	.67000	4609	.04500	4684	.42000
4235	.17500	4310	.55000	4385	.92500	4460	.30000	4535	.67500	4610	.05000	4685	.42500
4236	.18000	4311	.55500	4386	.93000	4461	.30500	4536	.68000	4611	.05500	4686	.43000
4237	.18500	4312	.56000	4387	.93500	4462	.31000	4537	.68500	4612	.06000	4687	.43500
4238	.19000	4313	.56500	4388	.94000	4463	.31500	4538	.69000	4613	.06500	4688	.44000
4239	.19500	4314	.57000	4389	.94500	4464	.32000	4539	.69500	4614	.07000	4689	.44500
4240	.20000	4315	.57500	4390	.95000	4465	.32500	4540	.70000	4615	.07500	4690	.45000
4241	.20500	4316	.58000	4391	.95500	4466	.33000	4541	.70500	4616	.08000	4691	.45500
4242	.21000	4317	.58500	4392	.96000	4467	.33500	4542	.71000	4617	.08500	4692	.46000
4243	.21500	4318	.59000	4393	.96500	4468	.34000	4543	.71500	4618	.09000	4693	.46500
4244	.22000	4319	.59500	4394	.97000	4469	.34500	4544	.72000	4619	.09500	4694	.47000
4245	.22500	4320	.60000	4395	.97500	4470	.35000	4545	.72500	4620	.10000	4695	.47500
4246	.23000	4321	.60500	4396	.98000	4471	.35500	4546	.73000	4621	.10500	4696	.48000
4247	.23500	4322	.61000	4397	.98500	4472	.36000	4547	.73500	4622	.11000	4697	.48500
4248	.24000	4323	.61500	4398	.99000	4473	.36500	4548	.74000	4623	.11500	4698	.49000
4249	.24500	4324	.62000	4399	.99500	4474	.37000	4549	.74500	4624	.12000	4699	.49500
4250	171.25000	4325	.62500	4400	172.00000	4475	.37500	4550	172.75000	4625	.12500	4700	173.50000
4251	.25500	4326	.63000	4401	.00500	4476	.38000	4551	.75500	4626	.13000	4701	.50500
4252	.26000	4327	.63500	4402	.01000	4477	.38500	4552	.76000	4627	.13500	4702	.51000
4253	.26500	4328	.64000	4403	.01500	4478	.39000	4553	.76500	4628	.14000	4703	.51500
4254	.27000	4329	.64500	4404	.02000	4479	.39500	4554	.77000	4629	.14500	4704	.52000
4255	.27500	4330	.65000	4405	.02500	4480	.40000	4555	.77500	4630	.15000	4705	.52500
4256	.28000	4331	.65500	4406	.03000	4481	.40500	4556	.78000	4631	.15500	4706	.53000
4257	.28500	4332	.66000	4407	.03500	4482	.41000	4557	.78500	4632	.16000	4707	.53500
4258	.29000	4333	.66500	4408	.04000	4483	.41500	4558	.79000	4633	.16500	4708	.54000
4259	.29500	4334	.67000	4409	.04500	4484	.42000	4559	.79500	4634	.17000	4709	.54500
4260	.30000	4335	.67500	4410	.05000	4485	.42500	4560	.80000	4635	.17500	4710	.55000
4261	.30500	4336	.68000	4411	.05500	4486	.43000	4561	.80500	4636	.18000	4711	.55500
4262	.31000	4337	.68500	4412	.06000	4487	.43500	4562	.81000	4637	.18500	4712	.56000
4263	.31500	4338	.69000	4413	.06500	4488	.44000	4563	.81500	4638	.19000	4713	.56500
4264	.32000	4339	.69500	4414	.07000	4489	.44500	4564	.82000	4639	.19500	4714	.57000
4265	.32500	4340	.70000	4415	.07500	4490	.45000	4565	.82500	4640	.20000	4715	.57500
4266	.33000	4341	.70500	4416	.08000	4491	.45500	4566	.83000	4641	.20500	4716	.58000
4267	.33500	4342	.71000	4417	.08500	4492	.46000	4567	.83500	4642	.21000	4717	.58500
4268	.34000	4343	.71500	4418	.09000	4493	.46500	4568	.84000	4643	.21500	4718	.59000
4269	.34500	4344	.72000	4419	.09500	4494	.47000	4569	.84500	4644	.22000	4719	.59500
4270	.35000	4345	.72500	4420	.10000	4495	.47500	4570	.85000	4645	.22500	4720	.60000
4271	.35500	4346	.73000	4421	.10500	4496	.48000	4571	.85500	4646	.23000	4721	.60500
4272	.36000	4347	.73500	4422	.11000	4497	.48500	4572	.86000	4647	.23500	4722	.61000
4273	.36500	4348	.74000	4423	.11500	4498	.49000	4573	.86500	4648	.24000	4723	.61500
4274	.37000	4349	.74500	4424	.12000	4499	.49500	4574	.87000	4649	.24500	4724	.62000

VT-3/160 Channel Designation Table: 150 to 174 MHz, 5 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
4725	173.62500	4800	174.00000										
4726	.63000												
4727	.63500												
4728	.64000												
4729	.64500												
4730	.65000												
4731	.65500												
4732	.66000												
4733	.66500												
4734	.67000												
4735	.67500												
4736	.68000												
4737	.68500												
4738	.69000												
4739	.69500												
4740	.70000												
4741	.70500												
4742	.71000												
4743	.71500												
4744	.72000												
4745	.72500												
4746	.73000												
4747	.73500												
4748	.74000												
4749	.74500												
4750	173.75000												
4751	.75500												
4752	.76000												
4753	.76500												
4754	.77000												
4755	.77500												
4756	.78000												
4757	.78500												
4758	.79000												
4759	.79500												
4760	.80000												
4761	.80500												
4762	.81000												
4763	.81500												
4764	.82000												
4765	.82500												
4766	.83000												
4767	.83500												
4768	.84000												
4769	.84500												
4770	.85000												
4771	.85500												
4772	.86000												
4773	.86500												
4774	.87000												
4775	.87500												
4776	.88000												
4777	.88500												
4778	.89000												
4779	.89500												
4780	.90000												
4781	.90500												
4782	.91000												
4783	.91500												
4784	.92000												
4785	.92500												
4786	.93000												
4787	.93500												
4788	.94000												
4789	.94500												
4790	.95000												
4791	.95500												
4792	.96000												
4793	.96500												
4794	.97000												
4795	.97500												
4796	.98000												
4797	.98500												
4798	.99000												
4799	.99500												

4 VT-3/160 Channel Designation Table: 150-174MHz, 6.25kHz Increments

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
5000	150.00000	5075	150.46875	5150	150.93750	5225	151.40625	5300	151.87500	5375	152.34375	5450	152.81250
5001	.00625	5076	.47500	5151	.94375	5226	.41250	5301	.88125	5376	.35000	5451	.81875
5002	.01250	5077	.48125	5152	.95000	5227	.41875	5302	.88750	5377	.35625	5452	.82500
5003	.01875	5078	.48750	5153	.95625	5228	.42500	5303	.89375	5378	.36250	5453	.83125
5004	.02500	5079	.49375	5154	.96250	5229	.43125	5304	.90000	5379	.36875	5454	.83750
5005	.03125	5080	150.50000	5155	.96875	5230	.43750	5305	.90625	5380	.37500	5455	.84375
5006	.03750	5081	.50625	5156	.97500	5231	.44375	5306	.91250	5381	.38125	5456	.85000
5007	.04375	5082	.51250	5157	.98125	5232	.45000	5307	.91875	5382	.38750	5457	.85625
5008	.05000	5083	.51875	5158	.98750	5233	.45625	5308	.92500	5383	.39375	5458	.86250
5009	.05625	5084	.52500	5159	.99375	5234	.46250	5309	.93125	5384	.40000	5459	.86875
5010	.06250	5085	.53125	5160	151.00000	5235	.46875	5310	.93750	5385	.40625	5460	.87500
5011	.06875	5086	.53750	5161	.00625	5236	.47500	5311	.94375	5386	.41250	5461	.88125
5012	.07500	5087	.54375	5162	.01250	5237	.48125	5312	.95000	5387	.41875	5462	.88750
5013	.08125	5088	.55000	5163	.01875	5238	.48750	5313	.95625	5388	.42500	5463	.89375
5014	.08750	5089	.55625	5164	.02500	5239	.49375	5314	.96250	5389	.43125	5464	.90000
5015	.09375	5090	.56250	5165	.03125	5240	151.50000	5315	.96875	5390	.43750	5465	.90625
5016	.10000	5091	.56875	5166	.03750	5241	.50625	5316	.97500	5391	.44375	5466	.91250
5017	.10625	5092	.57500	5167	.04375	5242	.51250	5317	.98125	5392	.45000	5467	.91875
5018	.11250	5093	.58125	5168	.05000	5243	.51875	5318	.98750	5393	.45625	5468	.92500
5019	.11875	5094	.58750	5169	.05625	5244	.52500	5319	.99375	5394	.46250	5469	.93125
5020	.12500	5095	.59375	5170	.06250	5245	.53125	5320	152.00000	5395	.46875	5470	.93750
5021	.13125	5096	.60000	5171	.06875	5246	.53750	5321	.00625	5396	.47500	5471	.94375
5022	.13750	5097	.60625	5172	.07500	5247	.54375	5322	.01250	5397	.48125	5472	.95000
5023	.14375	5098	.61250	5173	.08125	5248	.55000	5323	.01875	5398	.48750	5473	.95625
5024	.15000	5099	.61875	5174	.08750	5249	.55625	5324	.02500	5399	.49375	5474	.96250
5025	.15625	5100	.62500	5175	.09375	5250	.56250	5325	.03125	5400	152.50000	5475	.96875
5026	.16250	5101	.63125	5176	.10000	5251	.56875	5326	.03750	5401	.50625	5476	.97500
5027	.16875	5102	.63750	5177	.10625	5252	.57500	5327	.04375	5402	.51250	5477	.98125
5028	.17500	5103	.64375	5178	.11250	5253	.58125	5328	.05000	5403	.51875	5478	.98750
5029	.18125	5104	.65000	5179	.11875	5254	.58750	5329	.05625	5404	.52500	5479	.99375
5030	.18750	5105	.65625	5180	.12500	5255	.59375	5330	.06250	5405	.53125	5480	153.00000
5031	.19375	5106	.66250	5181	.13125	5256	.60000	5331	.06875	5406	.53750	5481	.00625
5032	.20000	5107	.66875	5182	.13750	5257	.60625	5332	.07500	5407	.54375	5482	.01250
5033	.20625	5108	.67500	5183	.14375	5258	.61250	5333	.08125	5408	.55000	5483	.01875
5034	.21250	5109	.68125	5184	.15000	5259	.61875	5334	.08750	5409	.55625	5484	.02500
5035	.21875	5110	.68750	5185	.15625	5260	.62500	5335	.09375	5410	.56250	5485	.03125
5036	.22500	5111	.69375	5186	.16250	5261	.63125	5336	.10000	5411	.56875	5486	.03750
5037	.23125	5112	.70000	5187	.16875	5262	.63750	5337	.10625	5412	.57500	5487	.04375
5038	.23750	5113	.70625	5188	.17500	5263	.64375	5338	.11250	5413	.58125	5488	.05000
5039	.24375	5114	.71250	5189	.18125	5264	.65000	5339	.11875	5414	.58750	5489	.05625
5040	150.25000	5115	.71875	5190	.18750	5265	.65625	5340	.12500	5415	.59375	5490	.06250
5041	.25625	5116	.72500	5191	.19375	5266	.66250	5341	.13125	5416	.60000	5491	.06875
5042	.26250	5117	.73125	5192	.20000	5267	.66875	5342	.13750	5417	.60625	5492	.07500
5043	.26875	5118	.73750	5193	.20625	5268	.67500	5343	.14375	5418	.61250	5493	.08125
5044	.27500	5119	.74375	5194	.21250	5269	.68125	5344	.15000	5419	.61875	5494	.08750
5045	.28125	5120	150.75000	5195	.21875	5270	.68750	5345	.15625	5420	.62500	5495	.09375
5046	.28750	5121	.75625	5196	.22500	5271	.69375	5346	.16250	5421	.63125	5496	.10000
5047	.29375	5122	.76250	5197	.23125	5272	.70000	5347	.16875	5422	.63750	5497	.10625
5048	.30000	5123	.76875	5198	.23750	5273	.70625	5348	.17500	5423	.64375	5498	.11250
5049	.30625	5124	.77500	5199	.24375	5274	.71250	5349	.18125	5424	.65000	5499	.11875
5050	.31250	5125	.78125	5200	151.25000	5275	.71875	5350	.18750	5425	.65625	5500	.12500
5051	.31875	5126	.78750	5201	.25625	5276	.72500	5351	.19375	5426	.66250	5501	.13125
5052	.32500	5127	.79375	5202	.26250	5277	.73125	5352	.20000	5427	.66875	5502	.13750
5053	.33125	5128	.80000	5203	.26875	5278	.73750	5353	.20625	5428	.67500	5503	.14375
5054	.33750	5129	.80625	5204	.27500	5279	.74375	5354	.21250	5429	.68125	5504	.15000
5055	.34375	5130	.81250	5205	.28125	5280	151.75000	5355	.21875	5430	.68750	5505	.15625
5056	.35000	5131	.81875	5206	.28750	5281	.75625	5356	.22500	5431	.69375	5506	.16250
5057	.35625	5132	.82500	5207	.29375	5282	.76250	5357	.23125	5432	.70000	5507	.16875
5058	.36250	5133	.83125	5208	.30000	5283	.76875	5358	.23750	5433	.70625	5508	.17500
5059	.36875	5134	.83750	5209	.30625	5284	.77500	5359	.24375	5434	.71250	5509	.18125
5060	.37500	5135	.84375	5210	.31250	5285	.78125	5360	152.25000	5435	.71875	5510	.18750
5061	.38125	5136	.85000	5211	.31875	5286	.78750	5361	.25625	5436	.72500	5511	.19375
5062	.38750	5137	.85625	5212	.32500	5287	.79375	5362	.26250	5437	.73125	5512	.20000
5063	.39375	5138	.86250	5213	.33125	5288	.80000	5363	.26875	5438	.73750	5513	.20625
5064	.40000	5139	.86875	5214	.33750	5289	.80625	5364	.27500	5439	.74375	5514	.21250
5065	.40625	5140	.87500	5215	.34375	5290	.81250	5365	.28125	5440	152.75000	5515	.21875
5066	.41250	5141	.88125	5216	.35000	5291	.81875	5366	.28750	5441	.75625	5516	.22500
5067	.41875	5142	.88750	5217	.35625	5292	.82500	5367	.29375	5442	.76250	5517	.23125
5068	.42500	5143	.89375	5218	.36250	5293	.83125	5368	.30000	5443	.76875	5518	.23750
5069	.43125	5144	.90000	5219	.36875	5294	.83750	5369	.30625	5444	.77500	5519	.24375
5070	.43750	5145	.90625	5220	.37500	5295	.84375	5370	.31250	5445	.78125	5520	153.25000
5071	.44375	5146	.91250	5221	.38125	5296	.85000	5371	.31875	5446	.78750	5521	.25625
5072	.45000	5147	.91875	5222	.38750	5297	.85625	5372	.32500	5447	.79375	5522	.26250
5073	.45625	5148	.92500	5223	.39375	5298	.86250	5373	.33125	5448	.80000	5523	.26875
5074	.46250	5149	.93125	5224	.40000	5299	.86875	5374	.33750	5449	.80625	5524	.27500

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
5525	153.28125	5600	153.75000	5675	154.21875	5750	154.68750	5825	155.15625	5900	155.62500	5975	156.09375
5526	.28750	5601	.75625	5676	.22500	5751	.69375	5826	.16250	5901	.63125	5976	.10000
5527	.29375	5602	.76250	5677	.23125	5752	.70000	5827	.16875	5902	.63750	5977	.10625
5528	.30000	5603	.76875	5678	.23750	5753	.70625	5828	.17500	5903	.64375	5978	.11250
5529	.30625	5604	.77500	5679	.24375	5754	.71250	5829	.18125	5904	.65000	5979	.11875
5530	.31250	5605	.78125	5680	154.25000	5755	.71875	5830	.18750	5905	.65625	5980	.12500
5531	.31875	5606	.78750	5681	.25625	5756	.72500	5831	.19375	5906	.66250	5981	.13125
5532	.32500	5607	.79375	5682	.26250	5757	.73125	5832	.20000	5907	.66875	5982	.13750
5533	.33125	5608	.80000	5683	.26875	5758	.73750	5833	.20625	5908	.67500	5983	.14375
5534	.33750	5609	.80625	5684	.27500	5759	.74375	5834	.21250	5909	.68125	5984	.15000
5535	.34375	5610	.81250	5685	.28125	5760	154.75000	5835	.21875	5910	.68750	5985	.15625
5536	.35000	5611	.81875	5686	.28750	5761	.75625	5836	.22500	5911	.69375	5986	.16250
5537	.35625	5612	.82500	5687	.29375	5762	.76250	5837	.23125	5912	.70000	5987	.16875
5538	.36250	5613	.83125	5688	.30000	5763	.76875	5838	.23750	5913	.70625	5988	.17500
5539	.36875	5614	.83750	5689	.30625	5764	.77500	5839	.24375	5914	.71250	5989	.18125
5540	.37500	5615	.84375	5690	.31250	5765	.78125	5840	155.25000	5915	.71875	5990	.18750
5541	.38125	5616	.85000	5691	.31875	5766	.78750	5841	.25625	5916	.72500	5991	.19375
5542	.38750	5617	.85625	5692	.32500	5767	.79375	5842	.26250	5917	.73125	5992	.20000
5543	.39375	5618	.86250	5693	.33125	5768	.80000	5843	.26875	5918	.73750	5993	.20625
5544	.40000	5619	.86875	5694	.33750	5769	.80625	5844	.27500	5919	.74375	5994	.21250
5545	.40625	5620	.87500	5695	.34375	5770	.81250	5845	.28125	5920	155.75000	5995	.21875
5546	.41250	5621	.88125	5696	.35000	5771	.81875	5846	.28750	5921	.75625	5996	.22500
5547	.41875	5622	.88750	5697	.35625	5772	.82500	5847	.29375	5922	.76250	5997	.23125
5548	.42500	5623	.89375	5698	.36250	5773	.83125	5848	.30000	5923	.76875	5998	.23750
5549	.43125	5624	.90000	5699	.36875	5774	.83750	5849	.30625	5924	.77500	5999	.24375
5550	.43750	5625	.90625	5700	.37500	5775	.84375	5850	.31250	5925	.78125	6000	156.25000
5551	.44375	5626	.91250	5701	.38125	5776	.85000	5851	.31875	5926	.78750	6001	.25625
5552	.45000	5627	.91875	5702	.38750	5777	.85625	5852	.32500	5927	.79375	6002	.26250
5553	.45625	5628	.92500	5703	.39375	5778	.86250	5853	.33125	5928	.80000	6003	.26875
5554	.46250	5629	.93125	5704	.40000	5779	.86875	5854	.33750	5929	.80625	6004	.27500
5555	.46875	5630	.93750	5705	.40625	5780	.87500	5855	.34375	5930	.81250	6005	.28125
5556	.47500	5631	.94375	5706	.41250	5781	.88125	5856	.35000	5931	.81875	6006	.28750
5557	.48125	5632	.95000	5707	.41875	5782	.88750	5857	.35625	5932	.82500	6007	.29375
5558	.48750	5633	.95625	5708	.42500	5783	.89375	5858	.36250	5933	.83125	6008	.30000
5559	.49375	5634	.96250	5709	.43125	5784	.90000	5859	.36875	5934	.83750	6009	.30625
5560	153.50000	5635	.96875	5710	.43750	5785	.90625	5860	.37500	5935	.84375	6010	.31250
5561	.50625	5636	.97500	5711	.44375	5786	.91250	5861	.38125	5936	.85000	6011	.31875
5562	.51250	5637	.98125	5712	.45000	5787	.91875	5862	.38750	5937	.85625	6012	.32500
5563	.51875	5638	.98750	5713	.45625	5788	.92500	5863	.39375	5938	.86250	6013	.33125
5564	.52500	5639	.99375	5714	.46250	5789	.93125	5864	.40000	5939	.86875	6014	.33750
5565	.53125	5640	154.00000	5715	.46875	5790	.93750	5865	.40625	5940	.87500	6015	.34375
5566	.53750	5641	.00625	5716	.47500	5791	.94375	5866	.41250	5941	.88125	6016	.35000
5567	.54375	5642	.01250	5717	.48125	5792	.95000	5867	.41875	5942	.88750	6017	.35625
5568	.55000	5643	.01875	5718	.48750	5793	.95625	5868	.42500	5943	.89375	6018	.36250
5569	.55625	5644	.02500	5719	.49375	5794	.96250	5869	.43125	5944	.90000	6019	.36875
5570	.56250	5645	.03125	5720	154.50000	5795	.96875	5870	.43750	5945	.90625	6020	.37500
5571	.56875	5646	.03750	5721	.50625	5796	.97500	5871	.44375	5946	.91250	6021	.38125
5572	.57500	5647	.04375	5722	.51250	5797	.98125	5872	.45000	5947	.91875	6022	.38750
5573	.58125	5648	.05000	5723	.51875	5798	.98750	5873	.45625	5948	.92500	6023	.39375
5574	.58750	5649	.05625	5724	.52500	5799	.99375	5874	.46250	5949	.93125	6024	.40000
5575	.59375	5650	.06250	5725	.53125	5800	155.00000	5875	.46875	5950	.93750	6025	.40625
5576	.60000	5651	.06875	5726	.53750	5801	.00625	5876	.47500	5951	.94375	6026	.41250
5577	.60625	5652	.07500	5727	.54375	5802	.01250	5877	.48125	5952	.95000	6027	.41875
5578	.61250	5653	.08125	5728	.55000	5803	.01875	5878	.48750	5953	.95625	6028	.42500
5579	.61875	5654	.08750	5729	.55625	5804	.02500	5879	.49375	5954	.96250	6029	.43125
5580	.62500	5655	.09375	5730	.56250	5805	.03125	5880	155.50000	5955	.96875	6030	.43750
5581	.63125	5656	.10000	5731	.56875	5806	.03750	5881	.50625	5956	.97500	6031	.44375
5582	.63750	5657	.10625	5732	.57500	5807	.04375	5882	.51250	5957	.98125	6032	.45000
5583	.64375	5658	.11250	5733	.58125	5808	.05000	5883	.51875	5958	.98750	6033	.45625
5584	.65000	5659	.11875	5734	.58750	5809	.05625	5884	.52500	5959	.99375	6034	.46250
5585	.65625	5660	.12500	5735	.59375	5810	.06250	5885	.53125	5960	156.00000	6035	.46875
5586	.66250	5661	.13125	5736	.60000	5811	.06875	5886	.53750	5961	.00625	6036	.47500
5587	.66875	5662	.13750	5737	.60625	5812	.07500	5887	.54375	5962	.01250	6037	.48125
5588	.67500	5663	.14375	5738	.61250	5813	.08125	5888	.55000	5963	.01875	6038	.48750
5589	.68125	5664	.15000	5739	.61875	5814	.08750	5889	.55625	5964	.02500	6039	.49375
5590	.68750	5665	.15625	5740	.62500	5815	.09375	5890	.56250	5965	.03125	6040	156.50000
5591	.69375	5666	.16250	5741	.63125	5816	.10000	5891	.56875	5966	.03750	6041	.50625
5592	.70000	5667	.16875	5742	.63750	5817	.10625	5892	.57500	5967	.04375	6042	.51250
5593	.70625	5668	.17500	5743	.64375	5818	.11250	5893	.58125	5968	.05000	6043	.51875
5594	.71250	5669	.18125	5744	.65000	5819	.11875	5894	.58750	5969	.05625	6044	.52500
5595	.71875	5670	.18750	5745	.65625	5820	.12500	5895	.59375	5970	.06250	6045	.53125
5596	.72500	5671	.19375	5746	.66250	5821	.13125	5896	.60000	5971	.06875	6046	.53750
5597	.73125	5672	.20000	5747	.66875	5822	.13750	5897	.60625	5972	.07500	6047	.54375
5598	.73750	5673	.20625	5748	.67500	5823	.14375	5898	.61250	5973	.08125	6048	.55000
5599	.74375	5674	.21250	5749	.68125	5824	.15000	5899	.61875	5974	.08750	6049	.55625

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
6050	156.56250	6125	157.03125	6200	157.50000	6275	157.96875	6350	158.43750	6425	158.90625	6500	159.37500
6051	.56875	6126	.03750	6201	.50625	6276	.97500	6351	.44375	6426	.91250	6501	.38125
6052	.57500	6127	.04375	6202	.51250	6277	.98125	6352	.45000	6427	.91875	6502	.38750
6053	.58125	6128	.05000	6203	.51875	6278	.98750	6353	.45625	6428	.92500	6503	.39375
6054	.58750	6129	.05625	6204	.52500	6279	.99375	6354	.46250	6429	.93125	6504	.40000
6055	.59375	6130	.06250	6205	.53125	6280	158.00000	6355	.46875	6430	.93750	6505	.40625
6056	.60000	6131	.06875	6206	.53750	6281	.00625	6356	.47500	6431	.94375	6506	.41250
6057	.60625	6132	.07500	6207	.54375	6282	.01250	6357	.48125	6432	.95000	6507	.41875
6058	.61250	6133	.08125	6208	.55000	6283	.01875	6358	.48750	6433	.95625	6508	.42500
6059	.61875	6134	.08750	6209	.55625	6284	.02500	6359	.49375	6434	.96250	6509	.43125
6060	.62500	6135	.09375	6210	.56250	6285	.03125	6360	158.50000	6435	.96875	6510	.43750
6061	.63125	6136	.10000	6211	.56875	6286	.03750	6361	.50625	6436	.97500	6511	.44375
6062	.63750	6137	.10625	6212	.57500	6287	.04375	6362	.51250	6437	.98125	6512	.45000
6063	.64375	6138	.11250	6213	.58125	6288	.05000	6363	.51875	6438	.98750	6513	.45625
6064	.65000	6139	.11875	6214	.58750	6289	.05625	6364	.52500	6439	.99375	6514	.46250
6065	.65625	6140	.12500	6215	.59375	6290	.06250	6365	.53125	6440	159.00000	6515	.46875
6066	.66250	6141	.13125	6216	.60000	6291	.06875	6366	.53750	6441	.00625	6516	.47500
6067	.66875	6142	.13750	6217	.60625	6292	.07500	6367	.54375	6442	.01250	6517	.48125
6068	.67500	6143	.14375	6218	.61250	6293	.08125	6368	.55000	6443	.01875	6518	.48750
6069	.68125	6144	.15000	6219	.61875	6294	.08750	6369	.55625	6444	.02500	6519	.49375
6070	.68750	6145	.15625	6220	.62500	6295	.09375	6370	.56250	6445	.03125	6520	159.50000
6071	.69375	6146	.16250	6221	.63125	6296	.10000	6371	.56875	6446	.03750	6521	.50625
6072	.70000	6147	.16875	6222	.63750	6297	.10625	6372	.57500	6447	.04375	6522	.51250
6073	.70625	6148	.17500	6223	.64375	6298	.11250	6373	.58125	6448	.05000	6523	.51875
6074	.71250	6149	.18125	6224	.65000	6299	.11875	6374	.58750	6449	.05625	6524	.52500
6075	.71875	6150	.18750	6225	.65625	6300	.12500	6375	.59375	6450	.06250	6525	.53125
6076	.72500	6151	.19375	6226	.66250	6301	.13125	6376	.60000	6451	.06875	6526	.53750
6077	.73125	6152	.20000	6227	.66875	6302	.13750	6377	.60625	6452	.07500	6527	.54375
6078	.73750	6153	.20625	6228	.67500	6303	.14375	6378	.61250	6453	.08125	6528	.55000
6079	.74375	6154	.21250	6229	.68125	6304	.15000	6379	.61875	6454	.08750	6529	.55625
6080	156.75000	6155	.21875	6230	.68750	6305	.15625	6380	.62500	6455	.09375	6530	.56250
6081	.75625	6156	.22500	6231	.69375	6306	.16250	6381	.63125	6456	.10000	6531	.56875
6082	.76250	6157	.23125	6232	.70000	6307	.16875	6382	.63750	6457	.10625	6532	.57500
6083	.76875	6158	.23750	6233	.70625	6308	.17500	6383	.64375	6458	.11250	6533	.58125
6084	.77500	6159	.24375	6234	.71250	6309	.18125	6384	.65000	6459	.11875	6534	.58750
6085	.78125	6160	157.25000	6235	.71875	6310	.18750	6385	.65625	6460	.12500	6535	.59375
6086	.78750	6161	.25625	6236	.72500	6311	.19375	6386	.66250	6461	.13125	6536	.60000
6087	.79375	6162	.26250	6237	.73125	6312	.20000	6387	.66875	6462	.13750	6537	.60625
6088	.80000	6163	.26875	6238	.73750	6313	.20625	6388	.67500	6463	.14375	6538	.61250
6089	.80625	6164	.27500	6239	.74375	6314	.21250	6389	.68125	6464	.15000	6539	.61875
6090	.81250	6165	.28125	6240	157.75000	6315	.21875	6390	.68750	6465	.15625	6540	.62500
6091	.81875	6166	.28750	6241	.75625	6316	.22500	6391	.69375	6466	.16250	6541	.63125
6092	.82500	6167	.29375	6242	.76250	6317	.23125	6392	.70000	6467	.16875	6542	.63750
6093	.83125	6168	.30000	6243	.76875	6318	.23750	6393	.70625	6468	.17500	6543	.64375
6094	.83750	6169	.30625	6244	.77500	6319	.24375	6394	.71250	6469	.18125	6544	.65000
6095	.84375	6170	.31250	6245	.78125	6320	158.25000	6395	.71875	6470	.18750	6545	.65625
6096	.85000	6171	.31875	6246	.78750	6321	.25625	6396	.72500	6471	.19375	6546	.66250
6097	.85625	6172	.32500	6247	.79375	6322	.26250	6397	.73125	6472	.20000	6547	.66875
6098	.86250	6173	.33125	6248	.80000	6323	.26875	6398	.73750	6473	.20625	6548	.67500
6099	.86875	6174	.33750	6249	.80625	6324	.27500	6399	.74375	6474	.21250	6549	.68125
6100	.87500	6175	.34375	6250	.81250	6325	.28125	6400	158.75000	6475	.21875	6550	.68750
6101	.88125	6176	.35000	6251	.81875	6326	.28750	6401	.75625	6476	.22500	6551	.69375
6102	.88750	6177	.35625	6252	.82500	6327	.29375	6402	.76250	6477	.23125	6552	.70000
6103	.89375	6178	.36250	6253	.83125	6328	.30000	6403	.76875	6478	.23750	6553	.70625
6104	.90000	6179	.36875	6254	.83750	6329	.30625	6404	.77500	6479	.24375	6554	.71250
6105	.90625	6180	.37500	6255	.84375	6330	.31250	6405	.78125	6480	159.25000	6555	.71875
6106	.91250	6181	.38125	6256	.85000	6331	.31875	6406	.78750	6481	.25625	6556	.72500
6107	.91875	6182	.38750	6257	.85625	6332	.32500	6407	.79375	6482	.26250	6557	.73125
6108	.92500	6183	.39375	6258	.86250	6333	.33125	6408	.80000	6483	.26875	6558	.73750
6109	.93125	6184	.40000	6259	.86875	6334	.33750	6409	.80625	6484	.27500	6559	.74375
6110	.93750	6185	.40625	6260	.87500	6335	.34375	6410	.81250	6485	.28125	6560	159.75000
6111	.94375	6186	.41250	6261	.88125	6336	.35000	6411	.81875	6486	.28750	6561	.75625
6112	.95000	6187	.41875	6262	.88750	6337	.35625	6412	.82500	6487	.29375	6562	.76250
6113	.95625	6188	.42500	6263	.89375	6338	.36250	6413	.83125	6488	.30000	6563	.76875
6114	.96250	6189	.43125	6264	.90000	6339	.36875	6414	.83750	6489	.30625	6564	.77500
6115	.96875	6190	.43750	6265	.90625	6340	.37500	6415	.84375	6490	.31250	6565	.78125
6116	.97500	6191	.44375	6266	.91250	6341	.38125	6416	.85000	6491	.31875	6566	.78750
6117	.98125	6192	.45000	6267	.91875	6342	.38750	6417	.85625	6492	.32500	6567	.79375
6118	.98750	6193	.45625	6268	.92500	6343	.39375	6418	.86250	6493	.33125	6568	.80000
6119	.99375	6194	.46250	6269	.93125	6344	.40000	6419	.86875	6494	.33750	6569	.80625
6120	157.00000	6195	.46875	6270	.93750	6345	.40625	6420	.87500	6495	.34375	6570	.81250
6121	.00625	6196	.47500	6271	.94375	6346	.41250	6421	.88125	6496	.35000	6571	.81875
6122	.01250	6197	.48125	6272	.95000	6347	.41875	6422	.88750	6497	.35625	6572	.82500
6123	.01875	6198	.48750	6273	.95625	6348	.42500	6423	.89375	6498	.36250	6573	.83125
6124	.02500	6199	.49375	6274	.96250	6349	.43125	6424	.90000	6499	.36875	6574	.83750

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
6575	159.84375	6650	160.31250	6725	160.78125	6800	161.25000	6875	161.71875	6950	162.18750	7025	162.65625
6576	.85000	6651	.31875	6726	.78750	6801	.25625	6876	.72500	6951	.19375	7026	.66250
6577	.85625	6652	.32500	6727	.79375	6802	.26250	6877	.73125	6952	.20000	7027	.66875
6578	.86250	6653	.33125	6728	.80000	6803	.26875	6878	.73750	6953	.20625	7028	.67500
6579	.86875	6654	.33750	6729	.80625	6804	.27500	6879	.74375	6954	.21250	7029	.68125
6580	.87500	6655	.34375	6730	.81250	6805	.28125	6880	161.75000	6955	.21875	7030	.68750
6581	.88125	6656	.35000	6731	.81875	6806	.28750	6881	.75625	6956	.22500	7031	.69375
6582	.88750	6657	.35625	6732	.82500	6807	.29375	6882	.76250	6957	.23125	7032	.70000
6583	.89375	6658	.36250	6733	.83125	6808	.30000	6883	.76875	6958	.23750	7033	.70625
6584	.90000	6659	.36875	6734	.83750	6809	.30625	6884	.77500	6959	.24375	7034	.71250
6585	.90625	6660	.37500	6735	.84375	6810	.31250	6885	.78125	6960	162.25000	7035	.71875
6586	.91250	6661	.38125	6736	.85000	6811	.31875	6886	.78750	6961	.25625	7036	.72500
6587	.91875	6662	.38750	6737	.85625	6812	.32500	6887	.79375	6962	.26250	7037	.73125
6588	.92500	6663	.39375	6738	.86250	6813	.33125	6888	.80000	6963	.26875	7038	.73750
6589	.93125	6664	.40000	6739	.86875	6814	.33750	6889	.80625	6964	.27500	7039	.74375
6590	.93750	6665	.40625	6740	.87500	6815	.34375	6890	.81250	6965	.28125	7040	162.75000
6591	.94375	6666	.41250	6741	.88125	6816	.35000	6891	.81875	6966	.28750	7041	.75625
6592	.95000	6667	.41875	6742	.88750	6817	.35625	6892	.82500	6967	.29375	7042	.76250
6593	.95625	6668	.42500	6743	.89375	6818	.36250	6893	.83125	6968	.30000	7043	.76875
6594	.96250	6669	.43125	6744	.90000	6819	.36875	6894	.83750	6969	.30625	7044	.77500
6595	.96875	6670	.43750	6745	.90625	6820	.37500	6895	.84375	6970	.31250	7045	.78125
6596	.97500	6671	.44375	6746	.91250	6821	.38125	6896	.85000	6971	.31875	7046	.78750
6597	.98125	6672	.45000	6747	.91875	6822	.38750	6897	.85625	6972	.32500	7047	.79375
6598	.98750	6673	.45625	6748	.92500	6823	.39375	6898	.86250	6973	.33125	7048	.80000
6599	.99375	6674	.46250	6749	.93125	6824	.40000	6899	.86875	6974	.33750	7049	.80625
6600	160.00000	6675	.46875	6750	.93750	6825	.40625	6900	.87500	6975	.34375	7050	.81250
6601	.00625	6676	.47500	6751	.94375	6826	.41250	6901	.88125	6976	.35000	7051	.81875
6602	.01250	6677	.48125	6752	.95000	6827	.41875	6902	.88750	6977	.35625	7052	.82500
6603	.01875	6678	.48750	6753	.95625	6828	.42500	6903	.89375	6978	.36250	7053	.83125
6604	.02500	6679	.49375	6754	.96250	6829	.43125	6904	.90000	6979	.36875	7054	.83750
6605	.03125	6680	160.50000	6755	.96875	6830	.43750	6905	.90625	6980	.37500	7055	.84375
6606	.03750	6681	.50625	6756	.97500	6831	.44375	6906	.91250	6981	.38125	7056	.85000
6607	.04375	6682	.51250	6757	.98125	6832	.45000	6907	.91875	6982	.38750	7057	.85625
6608	.05000	6683	.51875	6758	.98750	6833	.45625	6908	.92500	6983	.39375	7058	.86250
6609	.05625	6684	.52500	6759	.99375	6834	.46250	6909	.93125	6984	.40000	7059	.86875
6610	.06250	6685	.53125	6760	161.00000	6835	.46875	6910	.93750	6985	.40625	7060	.87500
6611	.06875	6686	.53750	6761	.00625	6836	.47500	6911	.94375	6986	.41250	7061	.88125
6612	.07500	6687	.54375	6762	.01250	6837	.48125	6912	.95000	6987	.41875	7062	.88750
6613	.08125	6688	.55000	6763	.01875	6838	.48750	6913	.95625	6988	.42500	7063	.89375
6614	.08750	6689	.55625	6764	.02500	6839	.49375	6914	.96250	6989	.43125	7064	.90000
6615	.09375	6690	.56250	6765	.03125	6840	161.50000	6915	.96875	6990	.43750	7065	.90625
6616	.10000	6691	.56875	6766	.03750	6841	.50625	6916	.97500	6991	.44375	7066	.91250
6617	.10625	6692	.57500	6767	.04375	6842	.51250	6917	.98125	6992	.45000	7067	.91875
6618	.11250	6693	.58125	6768	.05000	6843	.51875	6918	.98750	6993	.45625	7068	.92500
6619	.11875	6694	.58750	6769	.05625	6844	.52500	6919	.99375	6994	.46250	7069	.93125
6620	.12500	6695	.59375	6770	.06250	6845	.53125	6920	162.00000	6995	.46875	7070	.93750
6621	.13125	6696	.60000	6771	.06875	6846	.53750	6921	.00625	6996	.47500	7071	.94375
6622	.13750	6697	.60625	6772	.07500	6847	.54375	6922	.01250	6997	.48125	7072	.95000
6623	.14375	6698	.61250	6773	.08125	6848	.55000	6923	.01875	6998	.48750	7073	.95625
6624	.15000	6699	.61875	6774	.08750	6849	.55625	6924	.02500	6999	.49375	7074	.96250
6625	.15625	6700	.62500	6775	.09375	6850	.56250	6925	.03125	7000	162.50000	7075	.96875
6626	.16250	6701	.63125	6776	.10000	6851	.56875	6926	.03750	7001	.50625	7076	.97500
6627	.16875	6702	.63750	6777	.10625	6852	.57500	6927	.04375	7002	.51250	7077	.98125
6628	.17500	6703	.64375	6778	.11250	6853	.58125	6928	.05000	7003	.51875	7078	.98750
6629	.18125	6704	.65000	6779	.11875	6854	.58750	6929	.05625	7004	.52500	7079	.99375
6630	.18750	6705	.65625	6780	.12500	6855	.59375	6930	.06250	7005	.53125	7080	163.00000
6631	.19375	6706	.66250	6781	.13125	6856	.60000	6931	.06875	7006	.53750	7081	.00625
6632	.20000	6707	.66875	6782	.13750	6857	.60625	6932	.07500	7007	.54375	7082	.01250
6633	.20625	6708	.67500	6783	.14375	6858	.61250	6933	.08125	7008	.55000	7083	.01875
6634	.21250	6709	.68125	6784	.15000	6859	.61875	6934	.08750	7009	.55625	7084	.02500
6635	.21875	6710	.68750	6785	.15625	6860	.62500	6935	.09375	7010	.56250	7085	.03125
6636	.22500	6711	.69375	6786	.16250	6861	.63125	6936	.10000	7011	.56875	7086	.03750
6637	.23125	6712	.70000	6787	.16875	6862	.63750	6937	.10625	7012	.57500	7087	.04375
6638	.23750	6713	.70625	6788	.17500	6863	.64375	6938	.11250	7013	.58125	7088	.05000
6639	.24375	6714	.71250	6789	.18125	6864	.65000	6939	.11875	7014	.58750	7089	.05625
6640	160.25000	6715	.71875	6790	.18750	6865	.65625	6940	.12500	7015	.59375	7090	.06250
6641	.25625	6716	.72500	6791	.19375	6866	.66250	6941	.13125	7016	.60000	7091	.06875
6642	.26250	6717	.73125	6792	.20000	6867	.66875	6942	.13750	7017	.60625	7092	.07500
6643	.26875	6718	.73750	6793	.20625	6868	.67500	6943	.14375	7018	.61250	7093	.08125
6644	.27500	6719	.74375	6794	.21250	6869	.68125	6944	.15000	7019	.61875	7094	.08750
6645	.28125	6720	160.75000	6795	.21875	6870	.68750	6945	.15625	7020	.62500	7095	.09375
6646	.28750	6721	.75625	6796	.22500	6871	.69375	6946	.16250	7021	.63125	7096	.10000
6647	.29375	6722	.76250	6797	.23125	6872	.70000	6947	.16875	7022	.63750	7097	.10625
6648	.30000	6723	.76875	6798	.23750	6873	.70625	6948	.17500	7023	.64375	7098	.11250
6649	.30625	6724	.77500	6799	.24375	6874	.71250	6949	.18125	7024	.65000	7099	.11875

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
7100	163.12500	7175	163.59375	7250	164.06250	7325	164.53125	7400	165.00000	7475	165.46875	7550	165.93750
7101	.13125	7176	.60000	7251	.06875	7326	.53750	7401	.00625	7476	.47500	7551	.94375
7102	.13750	7177	.60625	7252	.07500	7327	.54375	7402	.01250	7477	.48125	7552	.95000
7103	.14375	7178	.61250	7253	.08125	7328	.55000	7403	.01875	7478	.48750	7553	.95625
7104	.15000	7179	.61875	7254	.08750	7329	.55625	7404	.02500	7479	.49375	7554	.96250
7105	.15625	7180	.62500	7255	.09375	7330	.56250	7405	.03125	7480	165.50000	7555	.96875
7106	.16250	7181	.63125	7256	.10000	7331	.56875	7406	.03750	7481	.50625	7556	.97500
7107	.16875	7182	.63750	7257	.10625	7332	.57500	7407	.04375	7482	.51250	7557	.98125
7108	.17500	7183	.64375	7258	.11250	7333	.58125	7408	.05000	7483	.51875	7558	.98750
7109	.18125	7184	.65000	7259	.11875	7334	.58750	7409	.05625	7484	.52500	7559	.99375
7110	.18750	7185	.65625	7260	.12500	7335	.59375	7410	.06250	7485	.53125	7560	166.00000
7111	.19375	7186	.66250	7261	.13125	7336	.60000	7411	.06875	7486	.53750	7561	.00625
7112	.20000	7187	.66875	7262	.13750	7337	.60625	7412	.07500	7487	.54375	7562	.01250
7113	.20625	7188	.67500	7263	.14375	7338	.61250	7413	.08125	7488	.55000	7563	.01875
7114	.21250	7189	.68125	7264	.15000	7339	.61875	7414	.08750	7489	.55625	7564	.02500
7115	.21875	7190	.68750	7265	.15625	7340	.62500	7415	.09375	7490	.56250	7565	.03125
7116	.22500	7191	.69375	7266	.16250	7341	.63125	7416	.10000	7491	.56875	7566	.03750
7117	.23125	7192	.70000	7267	.16875	7342	.63750	7417	.10625	7492	.57500	7567	.04375
7118	.23750	7193	.70625	7268	.17500	7343	.64375	7418	.11250	7493	.58125	7568	.05000
7119	.24375	7194	.71250	7269	.18125	7344	.65000	7419	.11875	7494	.58750	7569	.05625
7120	163.25000	7195	.71875	7270	.18750	7345	.65625	7420	.12500	7495	.59375	7570	.06250
7121	.25625	7196	.72500	7271	.19375	7346	.66250	7421	.13125	7496	.60000	7571	.06875
7122	.26250	7197	.73125	7272	.20000	7347	.66875	7422	.13750	7497	.60625	7572	.07500
7123	.26875	7198	.73750	7273	.20625	7348	.67500	7423	.14375	7498	.61250	7573	.08125
7124	.27500	7199	.74375	7274	.21250	7349	.68125	7424	.15000	7499	.61875	7574	.08750
7125	.28125	7200	163.75000	7275	.21875	7350	.68750	7425	.15625	7500	.62500	7575	.09375
7126	.28750	7201	.75625	7276	.22500	7351	.69375	7426	.16250	7501	.63125	7576	.10000
7127	.29375	7202	.76250	7277	.23125	7352	.70000	7427	.16875	7502	.63750	7577	.10625
7128	.30000	7203	.76875	7278	.23750	7353	.70625	7428	.17500	7503	.64375	7578	.11250
7129	.30625	7204	.77500	7279	.24375	7354	.71250	7429	.18125	7504	.65000	7579	.11875
7130	.31250	7205	.78125	7280	164.25000	7355	.71875	7430	.18750	7505	.65625	7580	.12500
7131	.31875	7206	.78750	7281	.25625	7356	.72500	7431	.19375	7506	.66250	7581	.13125
7132	.32500	7207	.79375	7282	.26250	7357	.73125	7432	.20000	7507	.66875	7582	.13750
7133	.33125	7208	.80000	7283	.26875	7358	.73750	7433	.20625	7508	.67500	7583	.14375
7134	.33750	7209	.80625	7284	.27500	7359	.74375	7434	.21250	7509	.68125	7584	.15000
7135	.34375	7210	.81250	7285	.28125	7360	164.75000	7435	.21875	7510	.68750	7585	.15625
7136	.35000	7211	.81875	7286	.28750	7361	.75625	7436	.22500	7511	.69375	7586	.16250
7137	.35625	7212	.82500	7287	.29375	7362	.76250	7437	.23125	7512	.70000	7587	.16875
7138	.36250	7213	.83125	7288	.30000	7363	.76875	7438	.23750	7513	.70625	7588	.17500
7139	.36875	7214	.83750	7289	.30625	7364	.77500	7439	.24375	7514	.71250	7589	.18125
7140	.37500	7215	.84375	7290	.31250	7365	.78125	7440	165.25000	7515	.71875	7590	.18750
7141	.38125	7216	.85000	7291	.31875	7366	.78750	7441	.25625	7516	.72500	7591	.19375
7142	.38750	7217	.85625	7292	.32500	7367	.79375	7442	.26250	7517	.73125	7592	.20000
7143	.39375	7218	.86250	7293	.33125	7368	.80000	7443	.26875	7518	.73750	7593	.20625
7144	.40000	7219	.86875	7294	.33750	7369	.80625	7444	.27500	7519	.74375	7594	.21250
7145	.40625	7220	.87500	7295	.34375	7370	.81250	7445	.28125	7520	165.75000	7595	.21875
7146	.41250	7221	.88125	7296	.35000	7371	.81875	7446	.28750	7521	.75625	7596	.22500
7147	.41875	7222	.88750	7297	.35625	7372	.82500	7447	.29375	7522	.76250	7597	.23125
7148	.42500	7223	.89375	7298	.36250	7373	.83125	7448	.30000	7523	.76875	7598	.23750
7149	.43125	7224	.90000	7299	.36875	7374	.83750	7449	.30625	7524	.77500	7599	.24375
7150	.43750	7225	.90625	7300	.37500	7375	.84375	7450	.31250	7525	.78125	7600	166.25000
7151	.44375	7226	.91250	7301	.38125	7376	.85000	7451	.31875	7526	.78750	7601	.25625
7152	.45000	7227	.91875	7302	.38750	7377	.85625	7452	.32500	7527	.79375	7602	.26250
7153	.45625	7228	.92500	7303	.39375	7378	.86250	7453	.33125	7528	.80000	7603	.26875
7154	.46250	7229	.93125	7304	.40000	7379	.86875	7454	.33750	7529	.80625	7604	.27500
7155	.46875	7230	.93750	7305	.40625	7380	.87500	7455	.34375	7530	.81250	7605	.28125
7156	.47500	7231	.94375	7306	.41250	7381	.88125	7456	.35000	7531	.81875	7606	.28750
7157	.48125	7232	.95000	7307	.41875	7382	.88750	7457	.35625	7532	.82500	7607	.29375
7158	.48750	7233	.95625	7308	.42500	7383	.89375	7458	.36250	7533	.83125	7608	.30000
7159	.49375	7234	.96250	7309	.43125	7384	.90000	7459	.36875	7534	.83750	7609	.30625
7160	163.50000	7235	.96875	7310	.43750	7385	.90625	7460	.37500	7535	.84375	7610	.31250
7161	.50625	7236	.97500	7311	.44375	7386	.91250	7461	.38125	7536	.85000	7611	.31875
7162	.51250	7237	.98125	7312	.45000	7387	.91875	7462	.38750	7537	.85625	7612	.32500
7163	.51875	7238	.98750	7313	.45625	7388	.92500	7463	.39375	7538	.86250	7613	.33125
7164	.52500	7239	.99375	7314	.46250	7389	.93125	7464	.40000	7539	.86875	7614	.33750
7165	.53125	7240	164.00000	7315	.46875	7390	.93750	7465	.40625	7540	.87500	7615	.34375
7166	.53750	7241	.00625	7316	.47500	7391	.94375	7466	.41250	7541	.88125	7616	.35000
7167	.54375	7242	.01250	7317	.48125	7392	.95000	7467	.41875	7542	.88750	7617	.35625
7168	.55000	7243	.01875	7318	.48750	7393	.95625	7468	.42500	7543	.89375	7618	.36250
7169	.55625	7244	.02500	7319	.49375	7394	.96250	7469	.43125	7544	.90000	7619	.36875
7170	.56250	7245	.03125	7320	164.50000	7395	.96875	7470	.43750	7545	.90625	7620	.37500
7171	.56875	7246	.03750	7321	.50625	7396	.97500	7471	.44375	7546	.91250	7621	.38125
7172	.57500	7247	.04375	7322	.51250	7397	.98125	7472	.45000	7547	.91875	7622	.38750
7173	.58125	7248	.05000	7323	.51875	7398	.98750	7473	.45625	7548	.92500	7623	.39375
7174	.58750	7249	.05625	7324	.52500	7399	.99375	7474	.46250	7549	.93125	7624	.40000

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
7625	166.40625	7700	166.87500	7775	167.34375	7850	167.81250	7925	168.28125	8000	168.75000	8075	169.21875
7626	.41250	7701	.88125	7776	.35000	7851	.81875	7926	.28750	8001	.75625	8076	.22500
7627	.41875	7702	.88750	7777	.35625	7852	.82500	7927	.29375	8002	.76250	8077	.23125
7628	.42500	7703	.89375	7778	.36250	7853	.83125	7928	.30000	8003	.76875	8078	.23750
7629	.43125	7704	.90000	7779	.36875	7854	.83750	7929	.30625	8004	.77500	8079	.24375
7630	.43750	7705	.90625	7780	.37500	7855	.84375	7930	.31250	8005	.78125	8080	169.25000
7631	.44375	7706	.91250	7781	.38125	7856	.85000	7931	.31875	8006	.78750	8081	.25625
7632	.45000	7707	.91875	7782	.38750	7857	.85625	7932	.32500	8007	.79375	8082	.26250
7633	.45625	7708	.92500	7783	.39375	7858	.86250	7933	.33125	8008	.80000	8083	.26875
7634	.46250	7709	.93125	7784	.40000	7859	.86875	7934	.33750	8009	.80625	8084	.27500
7635	.46875	7710	.93750	7785	.40625	7860	.87500	7935	.34375	8010	.81250	8085	.28125
7636	.47500	7711	.94375	7786	.41250	7861	.88125	7936	.35000	8011	.81875	8086	.28750
7637	.48125	7712	.95000	7787	.41875	7862	.88750	7937	.35625	8012	.82500	8087	.29375
7638	.48750	7713	.95625	7788	.42500	7863	.89375	7938	.36250	8013	.83125	8088	.30000
7639	.49375	7714	.96250	7789	.43125	7864	.90000	7939	.36875	8014	.83750	8089	.30625
7640	166.50000	7715	.96875	7790	.43750	7865	.90625	7940	.37500	8015	.84375	8090	.31250
7641	.50625	7716	.97500	7791	.44375	7866	.91250	7941	.38125	8016	.85000	8091	.31875
7642	.51250	7717	.98125	7792	.45000	7867	.91875	7942	.38750	8017	.85625	8092	.32500
7643	.51875	7718	.98750	7793	.45625	7868	.92500	7943	.39375	8018	.86250	8093	.33125
7644	.52500	7719	.99375	7794	.46250	7869	.93125	7944	.40000	8019	.86875	8094	.33750
7645	.53125	7720	167.00000	7795	.46875	7870	.93750	7945	.40625	8020	.87500	8095	.34375
7646	.53750	7721	.00625	7796	.47500	7871	.94375	7946	.41250	8021	.88125	8096	.35000
7647	.54375	7722	.01250	7797	.48125	7872	.95000	7947	.41875	8022	.88750	8097	.35625
7648	.55000	7723	.01875	7798	.48750	7873	.95625	7948	.42500	8023	.89375	8098	.36250
7649	.55625	7724	.02500	7799	.49375	7874	.96250	7949	.43125	8024	.90000	8099	.36875
7650	.56250	7725	.03125	7800	167.50000	7875	.96875	7950	.43750	8025	.90625	8100	.37500
7651	.56875	7726	.03750	7801	.50625	7876	.97500	7951	.44375	8026	.91250	8101	.38125
7652	.57500	7727	.04375	7802	.51250	7877	.98125	7952	.45000	8027	.91875	8102	.38750
7653	.58125	7728	.05000	7803	.51875	7878	.98750	7953	.45625	8028	.92500	8103	.39375
7654	.58750	7729	.05625	7804	.52500	7879	.99375	7954	.46250	8029	.93125	8104	.40000
7655	.59375	7730	.06250	7805	.53125	7880	168.00000	7955	.46875	8030	.93750	8105	.40625
7656	.60000	7731	.06875	7806	.53750	7881	.00625	7956	.47500	8031	.94375	8106	.41250
7657	.60625	7732	.07500	7807	.54375	7882	.01250	7957	.48125	8032	.95000	8107	.41875
7658	.61250	7733	.08125	7808	.55000	7883	.01875	7958	.48750	8033	.95625	8108	.42500
7659	.61875	7734	.08750	7809	.55625	7884	.02500	7959	.49375	8034	.96250	8109	.43125
7660	.62500	7735	.09375	7810	.56250	7885	.03125	7960	168.50000	8035	.96875	8110	.43750
7661	.63125	7736	.10000	7811	.56875	7886	.03750	7961	.50625	8036	.97500	8111	.44375
7662	.63750	7737	.10625	7812	.57500	7887	.04375	7962	.51250	8037	.98125	8112	.45000
7663	.64375	7738	.11250	7813	.58125	7888	.05000	7963	.51875	8038	.98750	8113	.45625
7664	.65000	7739	.11875	7814	.58750	7889	.05625	7964	.52500	8039	.99375	8114	.46250
7665	.65625	7740	.12500	7815	.59375	7890	.06250	7965	.53125	8040	169.00000	8115	.46875
7666	.66250	7741	.13125	7816	.60000	7891	.06875	7966	.53750	8041	.00625	8116	.47500
7667	.66875	7742	.13750	7817	.60625	7892	.07500	7967	.54375	8042	.01250	8117	.48125
7668	.67500	7743	.14375	7818	.61250	7893	.08125	7968	.55000	8043	.01875	8118	.48750
7669	.68125	7744	.15000	7819	.61875	7894	.08750	7969	.55625	8044	.02500	8119	.49375
7670	.68750	7745	.15625	7820	.62500	7895	.09375	7970	.56250	8045	.03125	8120	169.50000
7671	.69375	7746	.16250	7821	.63125	7896	.10000	7971	.56875	8046	.03750	8121	.50625
7672	.70000	7747	.16875	7822	.63750	7897	.10625	7972	.57500	8047	.04375	8122	.51250
7673	.70625	7748	.17500	7823	.64375	7898	.11250	7973	.58125	8048	.05000	8123	.51875
7674	.71250	7749	.18125	7824	.65000	7899	.11875	7974	.58750	8049	.05625	8124	.52500
7675	.71875	7750	.18750	7825	.65625	7900	.12500	7975	.59375	8050	.06250	8125	.53125
7676	.72500	7751	.19375	7826	.66250	7901	.13125	7976	.60000	8051	.06875	8126	.53750
7677	.73125	7752	.20000	7827	.66875	7902	.13750	7977	.60625	8052	.07500	8127	.54375
7678	.73750	7753	.20625	7828	.67500	7903	.14375	7978	.61250	8053	.08125	8128	.55000
7679	.74375	7754	.21250	7829	.68125	7904	.15000	7979	.61875	8054	.08750	8129	.55625
7680	166.75000	7755	.21875	7830	.68750	7905	.15625	7980	.62500	8055	.09375	8130	.56250
7681	.75625	7756	.22500	7831	.69375	7906	.16250	7981	.63125	8056	.10000	8131	.56875
7682	.76250	7757	.23125	7832	.70000	7907	.16875	7982	.63750	8057	.10625	8132	.57500
7683	.76875	7758	.23750	7833	.70625	7908	.17500	7983	.64375	8058	.11250	8133	.58125
7684	.77500	7759	.24375	7834	.71250	7909	.18125	7984	.65000	8059	.11875	8134	.58750
7685	.78125	7760	167.25000	7835	.71875	7910	.18750	7985	.65625	8060	.12500	8135	.59375
7686	.78750	7761	.25625	7836	.72500	7911	.19375	7986	.66250	8061	.13125	8136	.60000
7687	.79375	7762	.26250	7837	.73125	7912	.20000	7987	.66875	8062	.13750	8137	.60625
7688	.80000	7763	.26875	7838	.73750	7913	.20625	7988	.67500	8063	.14375	8138	.61250
7689	.80625	7764	.27500	7839	.74375	7914	.21250	7989	.68125	8064	.15000	8139	.61875
7690	.81250	7765	.28125	7840	167.75000	7915	.21875	7990	.68750	8065	.15625	8140	.62500
7691	.81875	7766	.28750	7841	.75625	7916	.22500	7991	.69375	8066	.16250	8141	.63125
7692	.82500	7767	.29375	7842	.76250	7917	.23125	7992	.70000	8067	.16875	8142	.63750
7693	.83125	7768	.30000	7843	.76875	7918	.23750	7993	.70625	8068	.17500	8143	.64375
7694	.83750	7769	.30625	7844	.77500	7919	.24375	7994	.71250	8069	.18125	8144	.65000
7695	.84375	7770	.31250	7845	.78125	7920	168.25000	7995	.71875	8070	.18750	8145	.65625
7696	.85000	7771	.31875	7846	.78750	7921	.25625	7996	.72500	8071	.19375	8146	.66250
7697	.85625	7772	.32500	7847	.79375	7922	.26250	7997	.73125	8072	.20000	8147	.66875
7698	.86250	7773	.33125	7848	.80000	7923	.26875	7998	.73750	8073	.20625	8148	.67500
7699	.86875	7774	.33750	7849	.80625	7924	.27500	7999	.74375	8074	.21250	8149	.68125

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
8150	169.68750	8225	170.15625	8300	170.62500	8375	171.09375	8450	171.56250	8525	172.03125	8600	172.50000
8151	.69375	8226	.16250	8301	.63125	8376	.10000	8451	.56875	8526	.03750	8601	.50625
8152	.70000	8227	.16875	8302	.63750	8377	.10625	8452	.57500	8527	.04375	8602	.51250
8153	.70625	8228	.17500	8303	.64375	8378	.11250	8453	.58125	8528	.05000	8603	.51875
8154	.71250	8229	.18125	8304	.65000	8379	.11875	8454	.58750	8529	.05625	8604	.52500
8155	.71875	8230	.18750	8305	.65625	8380	.12500	8455	.59375	8530	.06250	8605	.53125
8156	.72500	8231	.19375	8306	.66250	8381	.13125	8456	.60000	8531	.06875	8606	.53750
8157	.73125	8232	.20000	8307	.66875	8382	.13750	8457	.60625	8532	.07500	8607	.54375
8158	.73750	8233	.20625	8308	.67500	8383	.14375	8458	.61250	8533	.08125	8608	.55000
8159	.74375	8234	.21250	8309	.68125	8384	.15000	8459	.61875	8534	.08750	8609	.55625
8160	169.75000	8235	.21875	8310	.68750	8385	.15625	8460	.62500	8535	.09375	8610	.56250
8161	.75625	8236	.22500	8311	.69375	8386	.16250	8461	.63125	8536	.10000	8611	.56875
8162	.76250	8237	.23125	8312	.70000	8387	.16875	8462	.63750	8537	.10625	8612	.57500
8163	.76875	8238	.23750	8313	.70625	8388	.17500	8463	.64375	8538	.11250	8613	.58125
8164	.77500	8239	.24375	8314	.71250	8389	.18125	8464	.65000	8539	.11875	8614	.58750
8165	.78125	8240	170.25000	8315	.71875	8390	.18750	8465	.65625	8540	.12500	8615	.59375
8166	.78750	8241	.25625	8316	.72500	8391	.19375	8466	.66250	8541	.13125	8616	.60000
8167	.79375	8242	.26250	8317	.73125	8392	.20000	8467	.66875	8542	.13750	8617	.60625
8168	.80000	8243	.26875	8318	.73750	8393	.20625	8468	.67500	8543	.14375	8618	.61250
8169	.80625	8244	.27500	8319	.74375	8394	.21250	8469	.68125	8544	.15000	8619	.61875
8170	.81250	8245	.28125	8320	170.75000	8395	.21875	8470	.68750	8545	.15625	8620	.62500
8171	.81875	8246	.28750	8321	.75625	8396	.22500	8471	.69375	8546	.16250	8621	.63125
8172	.82500	8247	.29375	8322	.76250	8397	.23125	8472	.70000	8547	.16875	8622	.63750
8173	.83125	8248	.30000	8323	.76875	8398	.23750	8473	.70625	8548	.17500	8623	.64375
8174	.83750	8249	.30625	8324	.77500	8399	.24375	8474	.71250	8549	.18125	8624	.65000
8175	.84375	8250	.31250	8325	.78125	8400	171.25000	8475	.71875	8550	.18750	8625	.65625
8176	.85000	8251	.31875	8326	.78750	8401	.25625	8476	.72500	8551	.19375	8626	.66250
8177	.85625	8252	.32500	8327	.79375	8402	.26250	8477	.73125	8552	.20000	8627	.66875
8178	.86250	8253	.33125	8328	.80000	8403	.26875	8478	.73750	8553	.20625	8628	.67500
8179	.86875	8254	.33750	8329	.80625	8404	.27500	8479	.74375	8554	.21250	8629	.68125
8180	.87500	8255	.34375	8330	.81250	8405	.28125	8480	171.75000	8555	.21875	8630	.68750
8181	.88125	8256	.35000	8331	.81875	8406	.28750	8481	.75625	8556	.22500	8631	.69375
8182	.88750	8257	.35625	8332	.82500	8407	.29375	8482	.76250	8557	.23125	8632	.70000
8183	.89375	8258	.36250	8333	.83125	8408	.30000	8483	.76875	8558	.23750	8633	.70625
8184	.90000	8259	.36875	8334	.83750	8409	.30625	8484	.77500	8559	.24375	8634	.71250
8185	.90625	8260	.37500	8335	.84375	8410	.31250	8485	.78125	8560	172.25000	8635	.71875
8186	.91250	8261	.38125	8336	.85000	8411	.31875	8486	.78750	8561	.25625	8636	.72500
8187	.91875	8262	.38750	8337	.85625	8412	.32500	8487	.79375	8562	.26250	8637	.73125
8188	.92500	8263	.39375	8338	.86250	8413	.33125	8488	.80000	8563	.26875	8638	.73750
8189	.93125	8264	.40000	8339	.86875	8414	.33750	8489	.80625	8564	.27500	8639	.74375
8190	.93750	8265	.40625	8340	.87500	8415	.34375	8490	.81250	8565	.28125	8640	172.75000
8191	.94375	8266	.41250	8341	.88125	8416	.35000	8491	.81875	8566	.28750	8641	.75625
8192	.95000	8267	.41875	8342	.88750	8417	.35625	8492	.82500	8567	.29375	8642	.76250
8193	.95625	8268	.42500	8343	.89375	8418	.36250	8493	.83125	8568	.30000	8643	.76875
8194	.96250	8269	.43125	8344	.90000	8419	.36875	8494	.83750	8569	.30625	8644	.77500
8195	.96875	8270	.43750	8345	.90625	8420	.37500	8495	.84375	8570	.31250	8645	.78125
8196	.97500	8271	.44375	8346	.91250	8421	.38125	8496	.85000	8571	.31875	8646	.78750
8197	.98125	8272	.45000	8347	.91875	8422	.38750	8497	.85625	8572	.32500	8647	.79375
8198	.98750	8273	.45625	8348	.92500	8423	.39375	8498	.86250	8573	.33125	8648	.80000
8199	.99375	8274	.46250	8349	.93125	8424	.40000	8499	.86875	8574	.33750	8649	.80625
8200	170.00000	8275	.46875	8350	.93750	8425	.40625	8500	.87500	8575	.34375	8650	.81250
8201	.00625	8276	.47500	8351	.94375	8426	.41250	8501	.88125	8576	.35000	8651	.81875
8202	.01250	8277	.48125	8352	.95000	8427	.41875	8502	.88750	8577	.35625	8652	.82500
8203	.01875	8278	.48750	8353	.95625	8428	.42500	8503	.89375	8578	.36250	8653	.83125
8204	.02500	8279	.49375	8354	.96250	8429	.43125	8504	.90000	8579	.36875	8654	.83750
8205	.03125	8280	170.50000	8355	.96875	8430	.43750	8505	.90625	8580	.37500	8655	.84375
8206	.03750	8281	.50625	8356	.97500	8431	.44375	8506	.91250	8581	.38125	8656	.85000
8207	.04375	8282	.51250	8357	.98125	8432	.45000	8507	.91875	8582	.38750	8657	.85625
8208	.05000	8283	.51875	8358	.98750	8433	.45625	8508	.92500	8583	.39375	8658	.86250
8209	.05625	8284	.52500	8359	.99375	8434	.46250	8509	.93125	8584	.40000	8659	.86875
8210	.06250	8285	.53125	8360	171.00000	8435	.46875	8510	.93750	8585	.40625	8660	.87500
8211	.06875	8286	.53750	8361	.00625	8436	.47500	8511	.94375	8586	.41250	8661	.88125
8212	.07500	8287	.54375	8362	.01250	8437	.48125	8512	.95000	8587	.41875	8662	.88750
8213	.08125	8288	.55000	8363	.01875	8438	.48750	8513	.95625	8588	.42500	8663	.89375
8214	.08750	8289	.55625	8364	.02500	8439	.49375	8514	.96250	8589	.43125	8664	.90000
8215	.09375	8290	.56250	8365	.03125	8440	171.50000	8515	.96875	8590	.43750	8665	.90625
8216	.10000	8291	.56875	8366	.03750	8441	.50625	8516	.97500	8591	.44375	8666	.91250
8217	.10625	8292	.57500	8367	.04375	8442	.51250	8517	.98125	8592	.45000	8667	.91875
8218	.11250	8293	.58125	8368	.05000	8443	.51875	8518	.98750	8593	.45625	8668	.92500
8219	.11875	8294	.58750	8369	.05625	8444	.52500	8519	.99375	8594	.46250	8669	.93125
8220	.12500	8295	.59375	8370	.06250	8445	.53125	8520	172.00000	8595	.46875	8670	.93750
8221	.13125	8296	.60000	8371	.06875	8446	.53750	8521	.00625	8596	.47500	8671	.94375
8222	.13750	8297	.60625	8372	.07500	8447	.54375	8522	.01250	8597	.48125	8672	.95000
8223	.14375	8298	.61250	8373	.08125	8448	.55000	8523	.01875	8598	.48750	8673	.95625
8224	.15000	8299	.61875	8374	.08750	8449	.55625	8524	.02500	8599	.49375	8674	.96250

VT-3/160 Channel Designation Table: 150 to 174 MHz, 6.25 kHz Increments (continued)

Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)	Chan. Num.	Freq. (MHz)
8675	172.96875	8750	173.43750	8825	173.90625								
8676	.97500	8751	.44375	8826	.91250								
8677	.98125	8752	.45000	8827	.91875								
8678	.98750	8753	.45625	8828	.92500								
8679	.99375	8754	.46250	8829	.93125								
8680	173.00000	8755	.46875	8830	.93750								
8681	.00625	8756	.47500	8831	.94375								
8682	.01250	8757	.48125	8832	.95000								
8683	.01875	8758	.48750	8833	.95625								
8684	.02500	8759	.49375	8834	.96250								
8685	.03125	8760	173.50000	8835	.96875								
8686	.03750	8761	.50625	8836	.97500								
8687	.04375	8762	.51250	8837	.98125								
8688	.05000	8763	.51875	8838	.98750								
8689	.05625	8764	.52500	8839	.99375								
8690	.06250	8765	.53125	8840	174.00000								
8691	.06875	8766	.53750										
8692	.07500	8767	.54375										
8693	.08125	8768	.55000										
8694	.08750	8769	.55625										
8695	.09375	8770	.56250										
8696	.10000	8771	.56875										
8697	.10625	8772	.57500										
8698	.11250	8773	.58125										
8699	.11875	8774	.58750										
8700	.12500	8775	.59375										
8701	.13125	8776	.60000										
8702	.13750	8777	.60625										
8703	.14375	8778	.61250										
8704	.15000	8779	.61875										
8705	.15625	8780	.62500										
8706	.16250	8781	.63125										
8707	.16875	8782	.63750										
8708	.17500	8783	.64375										
8709	.18125	8784	.65000										
8710	.18750	8785	.65625										
8711	.19375	8786	.66250										
8712	.20000	8787	.66875										
8713	.20625	8788	.67500										
8714	.21250	8789	.68125										
8715	.21875	8790	.68750										
8716	.22500	8791	.69375										
8717	.23125	8792	.70000										
8718	.23750	8793	.70625										
8719	.24375	8794	.71250										
8720	173.25000	8795	.71875										
8721	.25625	8796	.72500										
8722	.26250	8797	.73125										
8723	.26875	8798	.73750										
8724	.27500	8799	.74375										
8725	.28125	8800	173.75000										
8726	.28750	8801	.75625										
8727	.29375	8802	.76250										
8728	.30000	8803	.76875										
8729	.30625	8804	.77500										
8730	.31250	8805	.78125										
8731	.31875	8806	.78750										
8732	.32500	8807	.79375										
8733	.33125	8808	.80000										
8734	.33750	8809	.80625										
8735	.34375	8810	.81250										
8736	.35000	8811	.81875										
8737	.35625	8812	.82500										
8738	.36250	8813	.83125										
8739	.36875	8814	.83750										
8740	.37500	8815	.84375										
8741	.38125	8816	.85000										
8742	.38750	8817	.85625										
8743	.39375	8818	.86250										
8744	.40000	8819	.86875										
8745	.40625	8820	.87500										
8746	.41250	8821	.88125										
8747	.41875	8822	.88750										
8748	.42500	8823	.89375										
8749	.43125	8824	.90000										

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