TYPE OF EXHIBIT:	INSTRUCTION BOOK (PRELIMINARY)
FCC PART:	2.983 (d) (8)
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODEL:	DTX-154
TYPE OF UNIT:	UHF-FM Transceiver
FCC ID:	AIERIT12-150
DATE:	September 15, 1999

Preliminary Instruction Book follows.

RITRON, INC.

PRELIMINARY 08-99

RITRON MODELS DTX-154 & DTX-454

PROGRAMMABLE

FM TRANSCEIVER MODULES

MAINTENANCE & OPERATING

MANUAL

FOR USE ONLY BY AUTHORIZED SERVICE/MAINTENANCE PERSONNEL

IMPORTANT MAINTENANCE/REPAIR INFORMATION

Surface Mount Repair: RITRON surface mount products require special equipment and servicing techniques. Improper servicing techniques can cause permanent damage to the printed circuit board and/or components, which is not covered by RITRON's warranty. If you are not completely familiar with surface mount component repair techniques, RITRON recommends that you defer maintenance to qualified service personnel.

Precautions For Handling CMOS Devices: The DTX transceiver module contains complementary metal-oxide semiconductor (CMOS) devices, which require special handling techniques. CMOS circuits are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, with no failure appearing until weeks or months later. For this reason, take special precautions any time you disassemble the module. Follow the precautions below, which are even more critical in low humidity environments.

1) Storage/transport-CMOS devices that will be stored or transported must be placed in conductive material so that all exposed leads are shorted together. CMOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type that are being used for other semiconductors. Conductive containers are typically gray or pink in color.

2) Grounding-All CMOS devices must be placed on a grounded bench surface. The technician that will work on the radio/CMOS circuit must be grounded before handling the radio. Normally, the technician wears a conductive wrist strap in series with a 100 kΩ resistor to ground.

3) Clothing-Do not wear nylon clothing while handling CMOS circuits.

4) Power Off-Remove power before connecting, removing, or soldering on a PC board that contains CMOS devices.

5) Power/Voltage Transients-Do not insert or remove CMOS devices with power applied. Check all power supplies to be used for testing CMOS devices, making sure that no voltage transients are present.

6) Soldering-Use a soldering iron with a grounded tip for soldering CMOS circuitry.

7) Lead-Straightening Tools-When straightening CMOS leads, provide ground straps for the tool used.

VCO Shield: The VCO shield is virtually impossible to remove without damaging either the PC board or nearby components. The parts within the shield are low failure items; repair or replacement should not be required unless the RF board is mishandled. If failure of a part within the shield is deemed to have occurred, the RF board should be returned to RITRON for service or replacement.

Unit Disassembly and Re-assembly:

1) Case Removal

   a) Remove the two screws at the rear of the unit. These screws secure the rear bracket to the case.

   b) Remove the two screws (one per side) on the side of the unit. These screws secure the front bracket to the case.

   c) Slide the case off the two-board assembly.

2) Board Separation

Remove the two screws that secure the Loader Board to the rear bracket. Remove the two screws that secure the RF board to the front bracket. The two boards are held together by their interconnecting header/socket. Gently pry the two boards apart at the header/socket. The RF board is then rotated and tilted so to allow the right angle BNC connector to pass through the hole in the front bracket.

3) Re-assembly is the reverse of assembly with the rear screws installed before the side screws.

1. MODELS DTX-154 AND DTX-454 SPECIFICATIONS

	DTX-154	DTX-454
1.1 GENERAL		
FCC Identifier	AIERIT12-150 (Pending)	AIERIT11-450
FCC Rule Parts	22, 74, 90	22, 74, 90, 95
Frequency Range	136-162 MHz* 148-174 MHz*	400-420 MHz * 420-440 MHz * 430-450 MHz * 450-470 MHz 470-490 MHz * 490-512 MHz *
Number of Channels	8	
Transmit/Receive Spacing	26 MHz max.	20 MHz max.
Mode of Operation	Simplex or Half Duplex	
Frequency Control	PLL Synthesizer	
Channel Increment (Synthesizer step size)	2.5 kHz	5/6.25 kHz
Emissions Bandwidth		
Narrow Mode	11 kHz	
Wide Mode	16 kHz	
Frequency Stability (-30 to +65 °C)	1.5 ppm	
Supply Voltage		
3 and 6 watt versions		
w/o internal regulator	7.5 VDC	
w internal regulator	11-16 VDC	
10 watt version	N/A	11.5 to 15 VDC
RF Input/Output Connector	BNC standard	
Power/Data Interface	15 pin subminiature D type	
Operating Temperature	-30 to +65 °C	

Maximum Dimensions (L x W x H)	3.6” x 2.3” x 1.0” including connectors	
Weight	6 oz.	

* Not Available Yet

1.2 TRANSMITTER

Operating Bandwidth	26 MHz	20 MHz
RF Output Power (internally adjustable)		
3 watt version	N/A	1 to 3 watts
6 watt version	1 to 6 watts	
10 watt version	N/A	1 to 10 watts
Duty Cycle	5 to 100 % depending upon voltage and power level	
RF Load Impedance	50 ohms	
Modulation Distortion (per TIA/EIA 603)	5 % max.	
Modulation Frequency Response (+1/-3 dB ref 1 kHz)		
At MIC IN (ref pre-emphasis curve)	50 Hz to 2500 Hz	
At AUX IN w/o pre-emphasis	50 Hz to 2700 Hz	
Transmitter Attack Time:	15 ms max	
Spurious and Harmonics	-20 dBm max.	
FM Hum and Noise (per TIA/EIA 603)		
12.5 kHz channel operation	40 dB min.	
25 kHz channel operation	45 dB min.	
Group Delay Variation (Within Frequency Response)	5 us max.	
Current Drain		
1 watt	1.0 A max.	1.0 A max.
3 watts	1.6 A max.	1.6 A max.
6 watts	2.4 A max.	
10 watts @ 13.5 V	N/A	2.4 A max.

1.3 RECEIVER

Operating Bandwidth	26 MHz	20 MHz
Sensitivity (12 SINAD w de-emphasis)	0.30 uV (-117.5 dBm)	
RF Input Impedance	50 ohms	
Adjacent Channel Selectivity		
+/- 12.5 kHz w narrow IF	60 dB min.	
+/- 25 kHz w wide IF	70 dB min.	
Spurious and Image Rejection	70 dB min.	
Intermodulation Rejection	70 dB min.	
FM Hum and Noise (per TIA/EIA 603)		
12.5 kHz channel operation	40 dB min.	
25 kHz channel operation	45 dB min.	
Conducted Spurious	-57 dBm max.	
Receive Attack Time (transmit to receive)	15 ms max.	
Noise Squelch Attack Time	13 ms max.	
RSSI Squelch Attack Time	5 ms max.	
Audio Distortion (per TIA/EIA 603)	5 % max.	
Audio Response at AUX OUT (+1/-3 dB, ref 1 kHz)		
12.5 kHz channel operation	100 Hz to 3.5 kHz	
25 kHz channel operation	100 Hz to 5 kHz	
Group Delay Variation (Within Frequency Response)	20 us max.	
Receive Current Drain	75 mA max.	

1.4 DTX-154/454 INPUT/OUTPUT CONNECTOR

Connector Pinout

Pin Number	Name	Description	Comments
1	CS0	Channel Select low bit	
2	CS1	Channel Select mid bit	
3	CS2	Channel Select high bit	
4	MIC IN	Microphone Input	Input for microphone type signals to be transmitted. Signals at this input are pre-emphasized, limited, and filtered.
5	CSN	High/Low Power or Channel 1/2	
6	RAW SUPPLY	Power Supply Input	Positive Supply voltage input.
7	AUX IN	Auxiliary Input	Wideband input for data.
8	AUX OUT	Auxiliary Output	Wideband output for data.
9	PGN IN/OUT	Programming I/O	External programmer connects here.
10.	CTS	Clear to Send	Active high when transmitter can accept modulation.
11.	RX MON	Monitor	Breaks squelch in receive.
12.	AUDIO OUT	Audio PA Output	Output of audio PA.
13.	DCD	Carrier Detect	Carrier detect output.
14.	PTT/RTS	Push to Talk	Activates transmitter.
15.	GND	Ground	Negative supply point and reference for all inputs.

Pinout Description

Pin Number	Description
1	CS0-Least significant bit of the channel select lines. Active high 5 volt TTL/CMOS level. Internal 10 kΩ pull-up to +5 volts.
2	CS1-Mid bit of the channel select lines. Active high 5 volt TTL/CMOS level. Internal 10 kΩ pull-up to +5 volts.

3 CS2-Most significant bit of the channel select lines. Active high 5 volt TTL/CMOS level. Internal 10 kΩ pull-up to +5 volts.

Channel	CS2	CS1	CS0
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	0
6	1	0	1
7	1	1	0
8	1	1	1

0 = Logic low
1 = Logic high

Note: Due to the internal pull-up resistors, the unit defaults to channel 8 if the channel pins are left open (unconnected).

4 MIC IN-Microphone input. This input accepts microphone type input signals for transmit. The signal is amplified, passed through the clipper and the clipper filter and then to the RF board. This input can be programmed to be disabled (muted) if desired.

5 CSN-When enabled through programming, this input selects between channels 1 and 2. This input is TTL/CMOS level type input with a logic low required for channel 1 and a logic high required for channel 2. Internal 10 kΩ pull-up to +5 volts.

6 RAW SUPPLY- The positive supply voltage for the unit is supplied through this pin. The actual supply voltage required depends upon model type. Ensure that the correct supply voltage per the given model is used.

7 AUX IN-This is the broadband input for modulation. The gain through this input to the modulator is programmable, as is the use of pre-emphasis. This signal passes the clipper and clipper filter.

8 AUX OUT-This is the broadband output of the receiver. The gain from the receiver to the output is programmable, as is the use of de-emphasis. The choice of AC or DC coupling from the RF board discriminator is also programmable. The coupling at the output of this pin is AC coupled, however. It can be converted to DC coupling with internal hardware modifications.

9 PGN IN/OUT-Connect via RITRON RPT-PCPK PC Programming Kit to computer for programming the unit.

10 CTS-Clear-To-Send output from the unit which indicates that the unit is transmitting a carrier at the correct frequency and power level and is ready to accept an input signal to be transmitted. This output would normally become true in response to a PTT RTS (see pin 14 description below) activation. The polarity of this output can be programmed. The output is active low 5 volt logic with an internal 10 k ohm pull-up to 5 volts. It can source up to 10 mA when low.

11	RX MON-This input breaks the squelch on the receiver i.e. allows for monitoring the channel even when a signal not strong enough to break squelch is present. Input levels are TTL/CMOS; polarity may be programmed. Internal 10 kΩ pull-up to +5 volts.
12	AUDIO OUT-This is the output of the audio power amplifier. This output can drive up to ½ watt in to an 8 ohm load. This output can be enabled and its gain controlled by programming.
13	DCD-Carrier detect output. This output becomes true when a signal strong enough to exceed the programmed squelch threshold is present. This output is not affected by the RX MON input. The polarity can be programmed. The output is active low 5 volt logic with an internal 10 kΩ pull-up to +5 volts. It can source up to 10 mA when low.
14	PTT/RTS-Push to Talk/Request to Send. This input commands the unit to transmit. Input levels are TTL/CMOS; polarity may be programmed. Internal 10 kΩ pull-up to +5 volts.
15	GND-System ground. All signals and voltages are referenced to this input. The negative side of the power supply should connect here.

1.5 RF BOARD J301 INPUT/OUTPUT

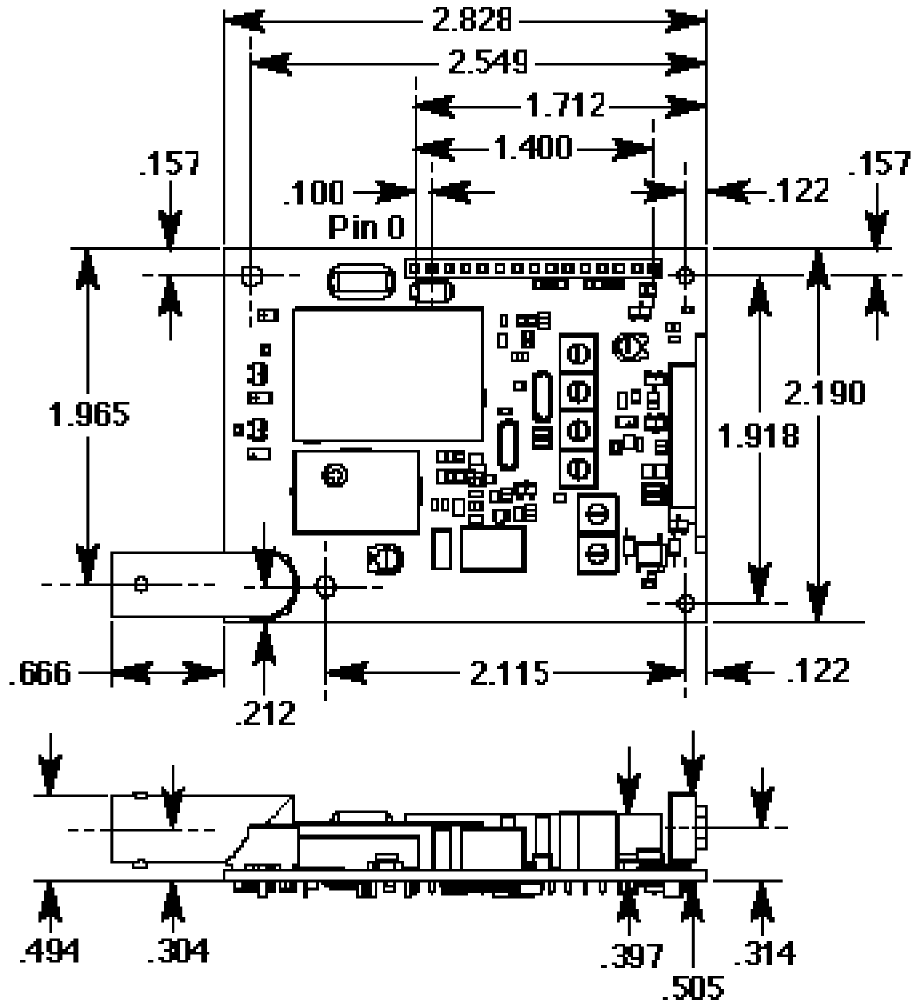
Pin Number	Name	Description
J102-0	PWR_SET	When PC board jumper R185 is installed (R186 omitted), the voltage on this pin controls the RF output power. When R186 is installed (R185 omitted), the RF output power is controlled by R187 on the RF board and this pin has no function. When this pin is used, the voltage should range between about 1 and 4.5 VDC to vary the output power from 1 to 5 watts. The relationship between output power and voltage is non-linear and may vary as a function of operating frequency. The input resistance at this pin is approximately 15 k-ohm.
J101-1	GND	System ground. All voltages are referenced to this point.
J101-2	FB+	Power supply input for the RF PA module. Voltage at this pin is filtered. Current drain can be as high as 2.5 amperes at 5 watts RF output.
J102-3	TX_EN	Active high, 5 volt CMOS logic level input used to enable the transmitter driver stage and PA pin diodes. Timing circuitry exists on the RF board to ramp the PA power up or down to control keying spurious outputs.
J102-4	RX_EN	Active high, 5 volt CMOS logic level input used to enable the receiver stages and to set the VCO to the receive frequency range.
J102-5	XCVR_EN	Active high, 5 volt logic level input used to enable all stages of the board except the PA and PA driver stages. This pin can

		be used to conserve current consumption in a battery save configuration.
J102-6	MOD_IN	Modulation input for the transmitter. The modulating signal must be superimposed upon a very stable and low noise 2.5 VDC level. Modulation sensitivity is approximately 14 kHz/V. The input resistance is approximately 17 k-ohm. Note: The DC voltage at this pin directly controls the frequency of the unit. Therefore, the DC voltage must be well regulated and controlled over environmental conditions.
J102-7	LOCK_DETECT	Lock detect output of the frequency synthesizer. Output is at 5 volt logic level with a low level indicating lock.
J102-8	SYN_EN	Enable line for loading the synthesizer. Signal is at 5 volt CMOS logic levels.
J102-9	SYN_DATA	Data line for loading the synthesizer. Signal is at 5 volt CMOS logic levels.
J102-10	SYN_CK	Clock line for loading the synthesizer. Signal is at 5 volt CMOS logic levels.
J102-11	+7.2V	+7.2 VDC +/- 10 % input for powering all stages of the radio except the RF PA module. Current drain is approximately 45 mA in receive and 100 mA in transmit.
J102-12	RSSI	Receive signal strength indicator output. This is a high impedance output, which is used to indicate the presence of a carrier. When R124 is installed (R125 omitted), the output will vary between approximately 0.5 VDC and 3.0 VDC as the input signal level varies between –130 dBm and –70 dBm. When R125 is installed (R124 omitted), the output will vary between approximately 2.5 VDC at 0 dB SINAD to 0.5 VDC at 20 dB SINAD. The loading on this output must be kept above 100 k-ohm.
J102-13	DISC_OUT	DC coupled discriminator output. The polarity of this output is controlled by R131 and R132. For positive polarity i.e. an increase in carrier frequency causes the DC level to increase, R131 should be installed and R132 omitted. For negative polarity, R132 should be installed and R1431 omitted. The output is low impedance with a modulation sensitivity of approximately 0.5 V/kHz for narrow band units and 0.25 V/kHz for wide band units. The DC level at this pin is typically between 2 and 4 volts.
J102-14	VCO_MOD	When R179 is installed (R178 omitted), a signal at this pin will modulate the VCO. When R178 is installed (R179 omitted), the VCO receives its modulation from the MOD_IN pin and this pin has no function. This pin is provided to allow the modulation balance to be controlled through an external board rather than R180 on the RF board. If this pin is to be used, the DC level should be approximately 5 VDC and from a low noise source. The DC voltage at this pin does not affect

the transmit frequency. The modulation sensitivity is approximately 20 kHz/V.

Note: An RF board purchased as a stand-alone board has components installed to support easy interface to external circuitry. This includes, but is not limited to, potentiometers for setting deviation and balance, and various zero ohm jumpers. If the zero ohm jumpers are placed in the correct position, operation with the RITRON loader board is possible. An RF board which is part of a DTX module cannot as easily be integrated in a system as a stand-alone board since the parts not required when used with the RITRON loader board are not installed.

1.6 DTX RF BOARD DIMENSIONS



1.7 DTX SYNTHESIZER PROGRAMMING

The following information describes the DTX-154/454 synthesizer programming format. This information can be used for designing programming software for the DTX-154/454 RF board synthesizer when the DTX-154/454 Loader board is not used.

> Note: The user must obtain FCC Type Acceptance when the RITRON RF board is not used with the RITRON Loader board in the DTX-154/454 enclosure.

The DTX-154/454 RF board uses a PLL (Phase Locked Loop) frequency synthesizer which compares the phase of the outputs of two digital frequency dividers. One divider divides the VCO (Voltage Controlled Oscillator) frequency and the other divides the reference frequency. If the two divided outputs differ in frequency, an error signal is generated which, after filtering, is used to control the frequency of the VCO. The net result is that the VCO is locked in frequency to an integer multiple of the reference. To set the desired frequency, the divider values must be determined. These values are converted to binary and become part of four control words, which must be loaded into the synthesizer IC for proper operation. The steps for determining the frequency control part of the words is as follows:

1. The RF R register counter value is first determined. This integer is the reference oscillator frequency (14.4 MHz in this product) divided by desired reference frequency. The reference frequency is 16 times the desired synthesizer step size. Typical step sizes are 2.5 kHz for VHF and either 5 kHz or 6.25 kHz for UHF. For a 6.25 kHz step size and a 14.4 MHz reference oscillator, the R register counter value would be 144 decimal. When converted to binary, this value is substituted for the R in the State column in the RF_R_Register table.

2. The RF N register counter values are then determined. This is accomplished by taking the desired VCO frequency and dividing it by the desired synthesizer step size value used above. The resulting integer is converted to binary. The least significant 4 bits become the value for the FRAC_CNTR. For frequencies below 500 MHz, bit 21 (PRESC_SEL) must be set to 0 with the next 3 significant bits of the integer used to fill in the 3 least significant bits of RF_NA_CNTR (bits 6,7,and 8). The two most significant bits of RF_NA_CNTR (bits 9 and 10) are loaded with 0. The remaining bits of the integer are loaded into RF_NB_CNTR (bits 11 through 20). For frequencies above 500 MHz, bit 21 (PRESC_SEL) must be set to 1 and the 4 bits following the 3 loaded into FRAC_CNTR are used for RF_NA_CNTR with the most significant bit of RF_NA_CNTR (bit 10) set to 0. The remaining bits of the integer are loaded into RF_NB_CNTR.

3. In transmit, the VCO frequency is equal to the operating frequency. In receive, the VHF units have a VCO frequency which is 43.650 MHz above the receive frequency. The VCO in the UHF units operate 43.650 MHz below the desired receive frequency. When calculating receive values, ensure that 43.650 MHz is either added or subtracted (depending upon whether the unit is VHF or UHF) from the desired frequency before beginning the above calculations.

4. Example:

   For a frequency of 461.750 MHz in transmit with a 6.25 kHz step size, the RF_R value is 144 decimal or 0000 0000 1001 0000 binary. The RF_R register would therefore become 1000 0110 0000 0010 0100 0010 (MSB first). The VCO frequency divided by the step size is 73,880 decimal or 0001 0010 0000 1001 1000 binary. The RF_N register would therefore become 0001 0010 0000 1000 0110 0011 binary. For 461.750 MHz receive, the VCO frequency would be 418.100 MHz (461.750 – 43.650) which yields a divider of 66,896 decimal or 0001 0000 0101 0101 0000 binary. The RF_N register would become 0001 0000 0101 0001 0100 0011 binary.

The four registers of the synthesizer, their bit definitions, and required states are shown below:

IF-R Register

Bit	Name	State	Comments
23	OSC	0	External reference oscillator
22	FRAC 16	1	Fraction = 16
21	FoLD	0	RF digital lock detect
20	FoLD	1	RF digital lock detect
19	FoLD	0	RF digital lock detect
18	CP_GAIN_8	X	Don’t care (1=IF charge pump current=8X)
17	IF_PD_POL	X	Don’t care (1=positive polarity on IF charge pump)
16	IF_R_CNTR	X	Don’t care (IF reference divider MSB)
15	IF_R_CNTR	X	Don’t care
14	IF_R_CNTR	X	Don’t care
13	IF_R_CNTR	X	Don’t care
12	IF_R_CNTR	X	Don’t care
11	IF_R_CNTR	X	Don’t care
10	IF_R_CNTR	X	Don’t care
9	IF_R_CNTR	X	Don’t care
8	IF_R_CNTR	X	Don’t care
7	IF_R_CNTR	X	Don’t care
6	IF_R_CNTR	X	Don’t care
5	IF_R_CNTR	X	Don’t care
4	IF_R_CNTR	X	Don’t care
3	IF_R_CNTR	X	Don’t care
2	IF_R_CNTR	X	Don’t care (IF reference divider LSB)
1		0	Identifies register
0		0	Identifies register

Notes:

1. The IF part of the dual synthesizer is not used. Only those bits which affect the RF part of the synthesizer have importance.

IF_N Register

Bit	Name	State	Comments
23	IF_CNT_RS	0	Normal operation
22	PWDN_IF	1	IF powered down
21	PWDN_MODE	0	Asynchronous power down
20	Fastlock	1	Fastlock enabled
19	Test	0	Test bit-should be set to 0
18	OUT_1	X	Don’t care in fastlock mode
17	OUT-0	X	Don’t care in fastlock mode

16	IF_NB_CNTR	X	Don’t care (IF N register B counter MSB)
15	IF_NB_CNTR	X	Don’t care
14	IF_NB_CNTR	X	Don’t care
13	IF_NB_CNTR	X	Don’t care
12	IF_NB_CNTR	X	Don’t care
11	IF_NB_CNTR	X	Don’t care
10	IF_NB_CNTR	X	Don’t care
9	IF_NB_CNTR	X	Don’t care
8	IF_NB_CNTR	X	Don’t care
7	IF_NB_CNTR	X	Don’t care
6	IF_NB_CNTR	X	Don’t care
5	IF_NB_CNTR	X	Don’t care (IF N register B counter LSB)
4	IF_NA_CNTR	X	Don’t care (IF N register A counter MSB)
3	IF_NA_CNTR	X	Don’t care
2	IF_NA_CNTR	X	Don’t care (IF N register A counter LSB)
1		0	Identifies register
0		1	Identifies register

Note:

1. The IF part of the dual synthesizer is not used. Only those bits which affect the RF portion of the synthesizer and the bits to shut down the IF portion are used.

RF_R Register

Bit	Name	State	Comments
23	DLL_MODE	1	Delay line loop calibration enabled
22	V2_EN	0	Charge pump voltage doubler not enabled
21	CP_8X	0	Charge pump current MSB
20	CP_4X	0	Charge pump current MSB-1
19	CP_2X	0	Charge pump current LSB+1
18	CP_1X	1	Charge pump current LSB
17	PF_PD_PO	1	Charge pump polarity is positive
16	RF_R_CNTR	R	RF R register counter MSB
15	RF_R_CNTR	R	RF R register counter
14	RF_R_CNTR	R	RF R register counter
13	RF_R_CNTR	R	RF R register counter
12	RF_R_CNTR	R	RF R register counter
11	RF_R_CNTR	R	RF R register counter
10	RF_R_CNTR	R	RF R register counter
9	RF_R_CNTR	R	RF R register counter
8	RF_R_CNTR	R	RF R register counter
7	RF_R_CNTR	R	RF R register counter
6	RF_R_CNTR	R	RF R register counter
5	RF_R_CNTR	R	RF R register counter
4	RF_R_CNTR	R	RF R register counter
3	RF_R_CNTR	R	RF R register counter
2	RF_R_CNTR	R	RF R register counter LSB
1		1	Identifies register
0		0	Identifies register

Notes:

1. CP_1X through CP_8X bits determine the magnitude of the charge pump current. The values range from 100 uA for 000b to 1.6 mA for 111b in 100 uA steps. The values shown are for 200 uA. For fast loading algorithms, this current may have to be changed dynamically.

2. The RF_R_CNTR bits are determined by the desired reference frequency which is determined by the synthesizer step size.

RF_N Register

Bit	Name	State	Comments
23	RF_CNT_RST	0	Normal operation
22	PWDN_RF	0	Powered up
21	PRESC_SEL	0	Prescaler modulus set for 8/9 for 250-500 MHz operation
20	RF_NB_CNTR	B	RF N register B counter MSB
19	RF_NB_CNTR	B	RF N register B counter
18	RF_NB_CNTR	B	RF N register B counter
17	RF_NB_CNTR	B	RF N register B counter
16	RF_NB_CNTR	B	RF N register B counter
15	RF_NB_CNTR	B	RF N register B counter
14	RF_NB_CNTR	B	RF N register B counter
13	RF_NB_CNTR	B	RF N register B counter
12	RF_NB_CNTR	B	RF N register B counter
11	RF_NB_CNTR	B	RF N register B counter LSB
10	RF_NA_CNTR	A	RF N register A counter MSB
9	RF_NA_CNTR	A	RF N register A counter
8	RF_NA_CNTR	A	RF N register A counter
7	RF_NA_CNTR	A	RF N register A counter
6	RF_NA_CNTR	A	RF N register A counter LSB
5	FRAC_CNTR	F	RF fraction counter MSB
4	FRAC_CNTR	F	RF fraction counter
3	FRAC_CNTR	F	RF fraction counter
2	FRAC_CNTR	F	RF fraction counter LSB
1		1	Identifies register
0		1	Identifies register

Note:

1. The bits for the RF_NB_CNTR, RF_NA_CNTR, and FRAC_CNTR are determined by operating frequency and reference frequency.

2. To conserve power, the synthesizer can be powered down with the PWDN_RF bit.

The four registers are loaded using pins 8, 9, and 10 of J102. Pin 8, SYN_EN, is the synthesizer enable line. Pin 9, SYN_DATA, is the data line and pin 10, and SYN_CK, is the clock line. Data is clocked into the synthesizer most significant bit first and must be valid and stable on the rising edge of the clock. The clock must be high a minimum of 10 ns and must be low a minimum of 50 ns before the next pulse. During loading, the synthesizer enable line must be held low. At the conclusion of loading a register, the enable line must be taken high for a minimum of 50 ns. The user should wait a minimum of 5 ms after board power up before loading the synthesizer. This gives the power supply regulators time to reach stable voltages. More complete information regarding the synthesizer IC may be obtained by referring to the National LMX2352 data sheet.

2.0 INTRODUCTION

2.1 GENERAL

The RITRON DTX-154/454 modules are programmable 2-way radios, which operates either in the VHF or UHF professional FM communications bands. Each of eight channels can be programmed to contain a unique set of operating frequencies. The DTX-154/454 module is made up of two PC boards, an RF board and a Loader/Control board. These two boards are enclosed in a metal case with two connectors on one end; a 50 ohm BNC connector for connection to an antenna and a DB-15 sub-miniature connector for power and control input/output.

In addition, the RF board is available as a stand-alone unit for system integrators. The RF board as sold as a stand-alone item has a few more hardware options than when installed and sold as part of a module. See section 7 for details on the hardware options.

3. MODEL IDENTIFICATION

The part number system for the DTX-154/454 module is as follows:

The module has a part number in the form of "DTX-A54-BCDEF"

Where:

A is the major frequency band designator:

1=VHF
4=UHF

B is the sub-band designator:

G=136-162 for VHF and 400-420 for UHF
A=420-440
B=430-450
O=148-174 for VHF and 450-470 for UHF
C=470-490
T=490-512

C is the connector designator:

B=BNC connector

D designates the IF bandwidth:

N=narrow
W=wide

E designates the maximum power level:

3=3 watts
6=6 watts
9=10 watts

F designates whether the loader board has a regulator and if so, at what current level:

D=no regulator; the unit must operate at +7.5 VDC and is limited to either 3 or 6 watts max.
L=low current regulator; the power module is not regulated. Used for 10 watt version only.
I=high current regulator; the unit operates from 10-15 volts at either 3 or 6 watts max.

Example: A DTX-454-OBN6I would be a UHF module for operation between 450 and 470 MHz with a BNC RF connector, narrow (12.5 kHz channel spacing) IF bandwidth, 6 watts maximum output power, and an internal regulator to allow operation from 10 to 15 volts.

The part number system for a stand-alone RF board is the same as that for a module except that "F" designator (regulator option) does not exist and a "-DD" is appended at the end.

Note that the RF board inside a module is not exactly the same as the corresponding stand-alone RF board. There are a number of components and jumper options on the stand-alone board that are not necessary when mated to the RITRON DTX loader/control board.

2.3 FCC REGULATIONS

2.3.1 LICENSING

The FCC requires that the radio owner obtain a station license for his radio before using the equipment to transmit, but does not require an operating license or permit. The station licensee is responsible for proper operation and maintenance of his radio equipment, and for ensuring that transmitter power, frequency and deviation are within the limits specified by the station license. This includes checking the transmitter frequency and deviation periodically using appropriate methods.

2.3.2 TYPE ACCEPTANCE

The unit is type accepted for transmission of either voice or data signals when aligned according to the alignment procedure for the proper bandwidth and when operated as a complete unit in the metal case. Operation of the RF board as a stand-alone unit or in combination with any other equipment, in any mode outside the alignment procedure, or with the clipper filter electronically disabled will require the filing of a new type acceptance application with the FCC by the user.

2.3.3 SAFETY STANDARDS

The FCC, with its action in General Docket 79-144, March 13, 1985, adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment. RITRON follows these safety standards and recommends that you observe them also:

DO NOT operate radio equipment near electrical blasting caps or in an explosive atmosphere.

DO NOT operate any radio transmitter unless all RF connectors are secure and any open connectors are properly terminated.

DO NOT operate the transmitter of a fixed radio (base station, microwave, rural telephone RF equipment) or marine radio when someone is within two feet of the antenna.

Repair of RITRON products should be performed only by RITRON authorized personnel.

3.0 ACCESSORIES

Note: Programming kits are for use by authorized service/maintenance personnel only.

The Programming Kit for DTX-154/454 radios (via compatible computer) is model RPT-PCKT. It includes:

1) software installation instructions

2) programming software diskettes, 3.5” and 5.25” (1 each)

3) 1 PC/radio adapter cable (DB25F connector to 6 pin modular connector and to DB-15 connector)

Factory programming of channels and features is also optional. Contact the factory for details.

4.0 OPERATION

4.1 CHANNEL SELECTION

The DTX module supports eight channels. The desired channel is chosen via pins 1,2, and 3 of the 15 pin connector as shown:

Channel	Pin 3	Pin 2	Pin 1
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	0
6	1	0	1
7	1	1	0
8	1	1	1

0 = Logic low
1 = Logic high

A logic low is a voltage level below 1 volt while a logic high is a voltage level above 3.5 volts. These three pins have an internal 10 kΩ pull-up resistor to + 5 volts. Therefore, any pin left unconnected will assume a logic high state. Do NOT apply voltages outside the range of 0 to +5 volts to these pins.

A change in the channel selection in receive will cause the receiver to operate on the new channel. In transmit, however, the channel selection is only checked upon a push-to-talk activation. Changes in channel during transmit will not change the transmit operating channel of the unit until the unit is cycled from transmit to receive and back to transmit.

4.2 POWER SUPPLY VOLTAGE

Pin 6 is the positive supply input to the unit. The type of module determines the actual voltage that should be applied to this pin. One should be absolutely sure of the proper voltage and current requirements before applying power.

Three voltages are used within the unit; +5 volts for the processor and logic circuits along with most of the receiver, +7.5 volts for the transmitter driver stages, and the supply voltage for the RF power module which depends upon which module is used.

The VHF unit and the 3 and 6-watt UHF units use 7.5 volt RF power modules. Two supply voltage options are available for these units depending upon whether the loader/control board has a regulator installed. If a regulator is not installed, the voltage should be 7.5 volts +/-10 %. This voltage should be “clean” and preferably regulated since the RF power module is powered directly from this source. Variations in voltage will cause variations in transmitted output power. Conversely, if the loader/control board has a regulator installed, the supply voltage can be at any voltage between 10 and about 15 volts. Although the use of the regulator allows flexibility in terms of supply voltage, because of the amount of heat generated by the regulator, significant duty cycle/key down limitations may apply (see below).

The RF power module in the 10 watt UHF unit requires at least 12 volts to achieve 10 watts, although voltages as high as 15 may be used. Since the module is powered directly from this voltage, the supply should be "clean" and, preferably, regulated. The output power will vary with supply voltage. The 7.5 volts required for the transmitter driver stages is developed by a regulator, but since the current requirements are limited, the regulator is not a factor in determining the duty cycle/key down limits.

4.3 DUTY CYCLE/KEY-DOWN LIMITATIONS

4.3.1 DTX MODULE

The major heat generating components within the module such as the RF power amplifier and voltage regulator (if used) have maximum temperature limits that should not be exceeded. In addition, the temperature within the module itself must be kept below the maximum temperature of the reference oscillator. As a result, depending upon power, supply voltage, and temperature, limits upon the average transmit duty cycle and the maximum continuous transmitter on time exist. These limits are summarized below for operation in still air:

	Temperature (°C)	Duty Cycle (%)	Key-Down Time (s)
w/o internal regulator:			
3 watt RF output	25	100	30
	60	15	5
6 watt RF output	25	80	30
	60	10	5
10 watt RF output @ 13.5 V	25	30	15
	60	5	5
w internal regulator			
3 watt RF output	25	50	20
	60	5	5
6 watt RF output	25	30	15
	60	5	5

Blowing air across the unit and/or adding heat sinks can significantly improve the duty cycle/key-down times, especially in units without the internal regulator.

4.3.2 RF BOARD

It is not possible to establish duty cycle/key-down limits for the stand-alone RF board since each system in which the board is integrated is unique. For those wishing to integrate the RF board into a system, the RF PA module at the rear of the board is the only major source of heat generation. The rear-mounting bracket which holds the module should be bolted to a heat sink of some type with a layer of thermal compound between them for good heat conduction.

4.4 OPERATING MODES

4.4.1 RECEIVE

Carrier Detect and Squelch Operation

The DTX is a transceiver; i.e. it can receive and transmit, although not at the same time. A carrier detect system exists within the unit to detect the presence of a carrier which controls the logic state of the DCD (data carrier detect) output. The RF levels at which this output changes state are programmable. In addition, the unit may be programmed such that the audio outputs, AUDIO OUT and AUX OUT, are muted (squelched) in conjunction with DCD operation. In units where squelch operation has been enabled, the RX MON input can be used to override a squelched condition. The DCD output is not affected by the RX MON operation.

Receiver Audio Outputs

Two receiver audio outputs are present on the DTX module. The AUX OUT is general purpose output which can have pre-emphasis enabled or bypassed. Its gain can be controlled and its output is designed to drive 600 loads. The coupling from the discriminator on the RF board may be set to AC or DC by the programmer. The output stage is AC coupled, but can be modified for DC coupling. See the maintenance section of the manual for details on this modification. The AUDIO OUT is always de-emphasized, but its gain can be programmed. In addition, transmit sidetone can be programmed as an option, if desired. This output can drive 8 ohm speaker-type loads.

4.4.2 TRANSMIT

PTT Operation

The transmitter is activated by placing the PTT/RTS (Push-To-Talk/Request-To-Send) input in its true state. This state is programmable. If the unit is to operate in simplex (transmitter and receiver on the same frequency), one should check for activity on the channel before transmitting. This can be done by checking the state of the DCD output. In addition, the unit can be programmed so that transmit operation is inhibited if the DCD threshold has been exceeded.

CTS Output

The CTS (Clear To Send) output goes to its true state when the unit has powered up the transmitter, is locked on the correct transmit frequency, and is ready to accept modulation. This output may be used to signal a modem to start transmitting data. If this output is not used, to avoid loosing data, a delay of at least 15 ms is required between PTT/RTS activation and the application of data.

Transmitter Audio Inputs

Two audio inputs are available on the DTX module. The AUX IN is a general-purpose input that can have pre-emphasis enabled or bypassed and its gain can be controlled through programming. The input impedance is greater than 50 kΩ and is capacitive coupled with a lower roll-off frequency of about 25 Hz. The MIC IN input is fixed gain input designed for connection to a standard electret or dynamic microphone. About 25 mV rms of input signal at 1 kHz will produce 60 % of maximum deviation. The signal at this input is pre-emphasized. The signals at both inputs pass through the modulation limiter and post-limiter filter.

High/Low Power

If RNet compatibility mode is not programmed into the unit, high and low power levels can be programmed into the unit on a channel by channel basis. High power is selected by placing the CSN input at a logic high state. Placing the CSN input at a logic low state chooses low power. The CSN input has an internal pull-up resistor; it will assume the high state i.e. high power when left unconnected.

Specialized Modem Operation

Modems designed to achieve the highest data rates possible in a radio channel may require a direct DC connection to the modulation path and the removal of the limiter-filter. In order to receive FCC Type Acceptance, the DTX module must either be tested and approved with a specific modem connected to the transmitter, or a modulation limiter and limiter-filter must always be present in the transmit modulator audio path with the modulation inputs AC coupled. To allow for the most flexibility for the end user, the unit was type accepted as a stand-alone unit. It is possible, with hardware modifications and special programming software (not supplied with the unit), to DC couple the AUX IN input and/or defeat the limiter-filter. The modulation limiter would still be in place, but the deviation of the DTX module could be set such that the modulation limit within the DTX module is never reached. The deviation would be set by the modem level and the AUX IN gain setting. The end user/system integrator would then bear the responsibility of obtaining type acceptance or operating in a frequency band where type acceptance is not required. Contact RITRON for details. **Note: Most modems will connect directly to the DTX without requiring any special modifications or programming.**

Antenna Placement

The DTX module is enclosed in a metal housing for RF shielding. However, RF emitting sources located very close (less than 12 inches) to the unit can at times affect its operation. It is not recommended that an antenna be connected directly to the module’s BNC connector unless the RF output power is set for less than 1 watt or the module is placed within another RF tight enclosure.

4.5 RNET COMPATIBILITY MODE

The DTX module can be programmed to mimic some of the behavior of the RNet 450 radio. In the RNet compatibility mode, the CSN input is used as a channel selector line. A logic low selects channel 1 while a logic high selects channel 2. The channel select lines, CS0, CS1, and CS2 have no effect. Also, the DCD output is held in its true state during transmit. It would normally be false in transmit.

5.0 PROGRAMMING

To program the DTX Module, the RITRON PC Programming Kit must be used.

5.1 PC PROGRAMMING KIT

The RITRON adapter cable connects the radio to a computer's serial communications port. Once the cable is hooked up, the user inserts the diskette provided into the computer's floppy disk drive and loads the programmer software. This program transfers data between radio and computer memory and includes on-screen instruction.

5.1.1 PROGRAMMING KIT CONTENTS AND REQUIREMENTS

The RITRON Programming Kit includes the following:

1. Programming software that is contained on one diskette.

2. Installation Instructions and a Registration Form.

3. PC to radio adapter cable, which is terminated at one end with a DB-25F connector and at the other end with a modular plug. The DB-25 connector plugs into the computer's serial port, the modular plug into an adapter.

4. The adapter for use with the DTX Plus series of radios. This adapter mates the modular plug to a DB-15M plug for connection to the radio.

The Programmer Kit requires a PC compatible computer with Windows 95 or later operating system installed. The computer must have an RS-232 serial port available. A hard disk drive is recommended.

5.2 COMPUTER SOFTWARE COPYRIGHTS

The RITRON, Inc. products described in this manual include copyrighted RITRON, Inc. computer programs. Laws in the United States and other countries grant to RITRON, Inc. certain exclusive rights in its copyrighted computer programs, including the exclusive right to distribute copies of the programs, make reproductions of the programs, and prepare derivative works based on the programs. Accordingly, any computer programs contained in RITRON, Inc. products may not be copied or reproduced in any manner without the express written permission of RITRON, Inc. The purchase of RITRON, Inc. products does not grant any license or rights under the copyrights or other intellectual property of RITRON, Inc. except for the non-exclusive, royalty fee license to use that arises in the sale of a product, or as addressed in a written agreement between RITRON, Inc. and the purchaser of RITRON, Inc. products.

5.3 PROGRAMMER MENUS

The DTX Programmer has four menus or pages, selectable via tabs at the top of each page, which are always visible. These pages are:

1. Frequency Selection-Used to program the channel frequencies of the radio.

2. Settings-Used to set programmable features/functions of the radio.

3. Alignment-Used to align and set the internal digital potentiometers in the radio. Information on the use of this page is found in the Maintenance Manual.

4. Summary-Used to summarize on one page the model, settings, and alignment information.

5.3.1 FREQUENCY SELECTION

The Frequency page has fields for each channel, transmit and receive for frequency information. Channel information can be entered by clicking on the appropriate box and entering the desired frequency. The frequency chosen must be within the operating range of the radio and on a frequency that the synthesizer is capable of channeling i.e. for VHF, divisible by 2.5 kHz and for UHF, divisible by 5 or 6.25 kHz. When the RNET compatibility mode is chosen, only channel one and two are available for programming.

5.3.2 SETTINGS

The Settings page allows for programming various parameters of the radio. These are detailed below:

Microphone Mute-Allows the signal path from the MIC IN (microphone input) to be muted. If the microphone input is not to be used, the “mute” function should be selected.

TX Pre-emphasis-Allows for the signal path from AUX IN to be either pre-emphasized or flat. Most applications where the AUX IN input is used prefer a flat response.

RX De-emphasis-Allows for the signal path from the discriminator to the AUX OUT to be either de-emphasized or flat. Most applications where the AUX OUT output is used prefer a flat response.

Busy Channel Lockout-Prevents the transmitter from activating when the carrier detect output is true. Used to prevent interference on a channel where activity already exists. Not normally enabled in half duplex operation since the transmit and receive channels are not on the same frequency.

Squelch Enable-Allows the receive audio paths to be muted when the carrier detect output is false. Used to prevent the output of noise from the audio outputs when no signal is present. Due to the finite squelch attack time, some high-speed modems prefer to work with unsquelched audio.

DCD Output Logic Level-Allows the setting of the polarity of the DCD (Data Carrier Detect) output. Active high means that the true state is a logic high while active low means that the true state is logic low. Normal setting is active high.

Carrier Mode-Allows the programmer to set the radio to match the type of carrier detection used by the RF board. The carrier detect mode may be either RSSI (Receive Signal Strength Indicator), based upon carrier level or Noise, which is based upon the receive signal to noise level. RSSI based is significantly faster than noise based systems and is usually preferred for data applications where fast turn-around times are important. **This selection must match that of the radio hardware. It is preset at the factory to match the RF board and must not be changed unless the RF board is modified.** See the Maintenance Manual for details.

Audio PA TX Sidetone-When enabled, the signal to be transmitted is made available at the AUDIO OUT output as a sidetone.

CSN Input-Selects whether RNET Compatibility mode is to be used. See section 4.5 for an explanation of this function. Normal operation is to set this for high/low Power.

PTT/RTS Input Logic Level-Sets the polarity of the PTT/RTS input. Normally set for active low i.e. transmitter is activated when this input is at the logic low state. **Due to the internal pull-up resistor, setting this to active high will cause activation of the transmitter when the PTT/RTS input is left unconnected.**

CTS Output Logic Level-Sets the polarity of the CTS (Clear-To-Send) output. Setting for active high caused the true logic state to be high. Active high is the normal setting.

TX Timeout Timer-Allows for limits on the maximum time the transmitter may be keyed continuously. When set, the maximum limit is set in the box. To prevent overheating and possible damage to the unit, this is normally set on with a time of 30 seconds. See section 4.3.1 for limits on maximum key-down times.

5.3.3 SUMMARY

The summary page summarizes the information shown on the other three pages and, in addition, includes the model and serial number of the unit.

6.0 THEORY OF OPERATION

6.1 DTX-154 RF BOARD

6.1.1 RECEIVER

RF amplifier and Bandpass Filters

The incoming RF signal from the input connector J101 passes backwards through the transmitter lowpass filter and the electronic T/R switch to a three pole bandpass filter formed around L102, L103, and L104. This filter is of Cohn type with 1.5 dB insertion loss and a bandwidth of 30 MHz. This filter is followed by a low noise amplifier stage formed around Q101. This amplifier has a gain of about 17 dB with a noise figure of 2 dB and serves to amplify the incoming RF signal above the noise of the following stages. Following this stage is a three pole Cohn filter formed around L107 through L109. The characteristics of this filter are identical to that of the first. The two filter sections are narrow enough to filter out the spurious responses of the first mixer while wide enough to support a performance bandwidth of 26 MHz.

1^{st} Mixer, 1^{st} IF filters, and 1^{st} IF Amplifier

IC101 is an active double balanced mixer which converts the incoming RF signal to the first intermediate frequency (IF) of 43.65 MHz. This mixer has a gain of 0 dB and a noise figure of 10 dB. Its differential output is matched to the first IF filter, YF101, by L107, L108, C128, and C137. An IF amplifier based around Q102 is used to provide gain. Its output drives another IF filter section, YF102, which is identical to YF101. These two filters serve the double function filtering out the spurious responses of the second mixer and, with the second IF filter, of removing signals at the adjacent and further removed channels.

2^{nd} IF IC

The output of YF102 drives the mixer internal to IC102. IC102 is an integrated FM IF IC which contains a mixer, high gain limiting IF amplifier, FM discriminator (detector), and other support circuitry. The mixer in IC102 converts the RF signal at the first IF to the second IF of 450 kHz. The output of the mixer exits the IC and is filtered by the second IF filter, YF103. The output of the filter re-enters the IC and drives the high gain limiting amplifier. Because the discriminator inside IC102 is sensitive to both amplitude and frequency modulation components, a limiter must precede it to remove any amplitude modulation. In addition, the noise based carrier detection system available with this product requires that the RF signal at the discriminator stay constant in amplitude as the RF input signal level varies. The output of the limiter amplifier drives the discriminator. The resonator for the discriminator is YF104.

Receiver Audio and Carrier Detection

The recovered audio from pin 9 of IC102 is filtered and DC shifted by IC103A and associated components. IC103B is a simple inverter and is used to provide inverted audio for those applications which may require it.

Two methods of carrier detection are available on this radio. One is based upon the absolute RF signal level at IC102's input and the other is based upon the magnitude of the ultrasonic noise on the recovered audio. IC102 has circuitry which develops a DC current which is proportional to the input RF signal level. Passing this current through a resistor (R115) creates a voltage which varies from about 0.5 volts at no signal input to about 3 volts with –70 dBm at the antenna connector. In addition, a voltage can be developed which is proportional to the amount of noise present on the recovered audio signal. This is effected by filtering the recovered audio such that only frequencies above the normal modulation range remain. This prevents modulation components from being detected as noise. The filter is formed around an op-amp internal to IC102 between pins 10 and 11 and the components connected to these two pins. The filtered output at pin 11 is rectified by Q103B and then filtered. The output varies from about 3 volts for a 0 dB SINAD signal to about 0.5 volts for a 20 dB SINAD signal.

2nd Local Oscillator

The two mixers in this radio act to produce an output signal whose frequency is equal to the difference between the frequency present at the RF input port and the frequency at the local oscillator port. To convert signals at the first IF frequency of 43.65 MHz to that of the second IF at a frequency of 450 kHz, a local oscillator signal at a frequency of 43.2 MHz (43.65 – 0.45) is used. This signal is created by tripling the output of the radio's 14.4 MHz master reference oscillator, Y101. Transistor Q111 acts as a frequency tripler. Its associated components are used to bias the transistor at an harmonic rich bias point and to filter the output such that only the third harmonic remains for use as the 2nd local oscillator.

6.1.2 VCO AND SYNTHESIZER

The synthesizer is responsible for generating the carrier in transmit and the first local oscillator in receive. A voltage-controlled oscillator (VCO) is an oscillator whose frequency can be controlled by an external signal. The synthesizer, almost wholly contained within IC108, divides the VCO frequency by digital dividers and compares the result with an accurate reference. An error signal, proportional to the frequency error is created which is routed to the frequency control input of the VCO. This action locks the VCO to a frequency which is equal to the reference frequency multiplied by the divider number. To set the VCO frequency, different divider numbers can be programmed into the synthesizer. In most synthesizer designs, the divider must be an integer, which forces the reference frequency to be equal to the synthesizer step size. The synthesizer IC used in this radio, however, allows the use of non-integer values for the divider which in turn allows the reference frequency to be much higher than normal. This creates a synthesizer whose output has lower noise, lower spurious levels, and higher switching speeds. The reference frequency is derived by digitally dividing the frequency of the 14.4 MHz master oscillator. When locked, the VCO attains the same relative frequency stability as that of the master oscillator.

The VCO itself is a voltage follower Hartley oscillator formed around Q107. One of the elements in the resonant circuit is a varactor diode, CR105, whose capacitance, when reverse biased, varies as a function of the applied voltage. Since the oscillator frequency is controlled by the resonant circuit, varying the voltage on the varactor diode effects a change in frequency. To serve as a local oscillator for the first mixer, the VCO operates at a frequency 43.65 MHz above that of the desired receive frequency. In receive, the VCO's oscillating frequency range is shifted upward by about 44 MHz by switching C191, C192, and L115 into the resonant circuit. The VCO has a tuning range of about 40 MHz when its tuning voltage is varied between 1 and 5 volts. To frequency modulate the VCO for transmit, another varactor diode, CR106, is lightly coupled into the resonant circuit.

The output of the VCO is amplified to a level of about 0 dBm by Q106. Q110 with R171 and C196 act as a very low noise power supply filter for the VCO.

6.1.3 TRANSMITTER

PA Driver Stages

The output of the VCO buffer drives Q105 through R152. The signal level at this point is about –10 dBm. Q105 amplifies this signal to about +5 dBm. Q104 further amplifies the signal to +13 dBm, the level required by the PA module. The supply voltage to these two stages is switched on in transmit by Q113.

PA Module, Lowpass Filter, and T/R Switch

When driven by +13 dBm, the PA module is capable of producing 6 watts or more of power at the antenna connector. Pin 2 of the module is used for power control. The output power level can be varied from less than 0.5 watts to full power by changing the voltage at this pin.

To reduce carrier frequency harmonics of the PA module output to acceptable levels, a lowpass filter is inserted between the module and the antenna connector. This filter is of elliptic design and formed around L115 and L116 and C169 through C173.

To isolate the PA module from the receiver, an electronic T/R switch is used. The switch is formed around PIN diodes CR103 and CR104 which are turned on in transmit and are off in receive. CR104 switches the PA module into and out of the circuit while CR103 protects and isolates the receiver input when the radio is in transmit.

6.1.4 MISCELLANEOUS FUNCTIONS

Two on-board regulators are used to provide the 5 volts DC used by most of the circuitry in the radio. IC107 is a low noise, low dropout regulator which provides 5 volts to all the portions of the radio which do not get switched on or off as the radio changes from transmit to receive. This regulator is enabled by the XCVR-EN (J102, pin 5) input. When this regulator is not enabled, the radio is essentially powered down. IC108 is an identical regulator which supplies power to those circuits which are to be powered-up only in receive and to the switches in the VCO which shift the VCO frequency range to that needed in transmit. The regulator is enabled through IC106E and IC106F by the RX-EN (J102, pin 4) input.

The transmitter PA module driver stages and the T/R switch are powered by +7.2 volts through Q113. Q113 is enabled by the TX-EN (J102, pin3) input through delay and sequencing circuitry formed around IC106 and Q112 and Q114. The sequencing circuitry delays PA turn-on until the driver stages and T/R switches are on and delays driver stage and T/R switch shutdown until the PA module has ramped down in power. This prevents “keyclicks” from abrupt transmitter turn-on and turn-off.

6.2 DTX-454 RF BOARD

6.2.1 RECEIVER

RF Amplifier and Bandpass Filters

The incoming RF signal from the input connector J101 passes backwards through the transmitter lowpass filter and the electronic T/R switch to a two pole bandpass filter formed around L101 and L102. This filter is of Cohn type with 1.5 dB insertion loss and a bandwidth of 25 MHz. This filter is followed by a low noise amplifier stage formed around Q101. This amplifier has a gain of about 17 dB with a noise figure of 2 dB and serves to amplify the incoming RF signal above the noise of the following stages. Following this stage is a four pole Cohn filter formed around L103 through L106. This filter has an insertion loss of 4 dB and a bandwidth of 25 MHz. The two filter sections are narrow enough to filter out the spurious responses of the first mixer while wide enough to support a performance bandwidth of 20 MHz.

1st mixer, 1st IF Filters, and 1st IF Amplifier

IC101 is an active double balanced mixer which converts the incoming RF signal to the first intermediate frequency (IF) of 43.65 MHz. This mixer has a gain of 0 dB and a noise figure of 10 dB. Its differential output is matched to the first IF filter, YF101, by L107, L108, C128, and C137. An IF amplifier based around Q102 is used to provide gain. Its output drives another IF filter section, YF102, which is identical to YF101. These two filters serve the double function filtering out the spurious responses of the second mixer and, with the second IF filter, of removing signals at the adjacent and further removed channels.

2nd IF IC

The output of YF102 drives the mixer internal to IC102. IC102 is an integrated FM IF IC which contains a mixer, high gain limiting IF amplifier, FM discriminator (detector), and other support circuitry. The mixer in IC102 converts the RF signal at the first IF to the second IF of 450 kHz. The output of the mixer exits the IC and is filtered by the second IF filter, YF103. The output of the filter re-enters the IC and drives the high gain limiting amplifier. Because the discriminator inside IC102 is sensitive to both amplitude and frequency modulation components, a limiter must precede it to remove any amplitude modulation. In addition, the noise based carrier detection system available with this product requires that the RF signal at the discriminator stay constant in amplitude as the RF input signal level varies. The output of the limiter amplifier drives the discriminator. The resonator for the discriminator is YF104.

Receiver Audio and Carrier Detection

The recovered audio from pin 9 of IC102 is filtered and DC shifted by IC103A and associated components. IC103B is a simple inverter and is used to provide inverted audio for those applications which may require it.

Two methods of carrier detection are available on this radio. One is based upon the absolute RF signal level at IC102’s input and the other is based upon the magnitude of the ultrasonic noise on the recovered audio. IC102 has circuitry which develops a DC current which is proportional to the input RF signal level. Passing this current through a resistor (R115) creates a voltage which varies from about 0.5 volts at no signal input to about 3 volts with –70 dBm at the antenna connector. In addition, a voltage can be developed which is proportional to the amount of noise present on the recovered audio signal. This is effected by filtering the recovered audio such that only frequencies above the normal modulation range remain. This prevents modulation components from being detected as noise. The filter is formed around an op-amp internal to IC102 between pins 10 and 11 and the components connected to these two pins. The filtered output at pin 11 is rectified by

Q103B and then filtered. The output varies from about 3 volts for a 0 dB SINAD signal to about 0.5 volts for a 20 dB SINAD signal.

2nd Local Oscillator

The two mixers in this radio act to produce an output signal whose frequency is equal to the difference between the frequency present at the RF input port and the frequency at the local oscillator port. To convert signals at the first IF frequency of 43.65 MHz to that of the second IF at a frequency of 450 kHz, a local oscillator signal at a frequency of 43.2 MHz (43.65 – 0.45) is used. This signal is created by tripling the output of the radio's 14.4 MHz master reference oscillator, Y101. Transistor Q112 acts as a frequency tripler. Its associated components are used to bias the transistor at an harmonic rich bias point and to filter the output such that only the third harmonic remains for use as the 2nd local oscillator.

6.2.2 VCO AND SYNTHESIZER

The synthesizer is responsible for generating the carrier in transmit and the first local oscillator in receive. A voltage-controlled oscillator (VCO) is an oscillator whose frequency can be controlled by an external signal. The synthesizer, almost wholly contained within IC108, divides the VCO frequency by digital dividers and compares the result with an accurate reference. An error signal, proportional to the frequency error is created which is routed to the frequency control input of the VCO. This action locks the VCO to a frequency which is equal to the reference frequency multiplied by the divider number. To set the VCO frequency, different divider numbers can be programmed into the synthesizer. In most synthesizer designs, the divider must be an integer, which forces the reference frequency to be equal to the synthesizer step size. The synthesizer IC used in this radio, however, allows the use of non-integer values for the divider which in turn allows the reference frequency to be much higher than normal. This creates a synthesizer whose output has lower noise, lower spurious levels, and higher switching speeds. The reference frequency is derived by digitally dividing the frequency of the 14.4 MHz master oscillator. When locked, the VCO attains the same relative frequency stability as that of the master oscillator.

The VCO itself is a voltage follower Colpitts oscillator formed around Q108. One of the elements in the resonant circuit is a varactor diode, CR106, whose capacitance, when reverse biased, varies as a function of the applied voltage. Since the oscillator frequency is controlled by the resonant circuit, varying the voltage on the varactor diode effects a change in frequency. To serve as a local oscillator for the first mixer, the VCO operates at a frequency 43.65 MHz below that of the desired receive frequency. In transmit, the VCO's oscillating frequency range is shifted upward by about 44 MHz by switching C190 and L115 into the resonant circuit. The VCO has a tuning range of about 30 MHz when its tuning voltage is varied between 1 and 5 volts. To frequency modulate the VCO for transmit, another varactor diode, CR105, is lightly coupled into the resonant circuit.

The output of the VCO is amplified to a level of about 0 dBm by Q107 and Q106. Q111 with R172 and C196 act as a very low noise power supply filter for the VCO.

6.2.3 TRANSMITTER

PA Driver Stages

The output of the last VCO buffer drives Q105 through R151. The signal level at this point is about –10 dBm. Q105 amplifies this signal to about +5 dBm. Q104 further amplifies the signal to +17 dBm, the level required by the PA module. The supply voltage to these two stages is switched on in transmit by Q113.

PA Module, Lowpass Filter, and T/R Switch

When driven by +17 dBm, the PA module is capable of producing 6 watts (10 watts in the 10 watt version) or more of power at the antenna connector. Pin 2 of the module is used for power control. The output power level can be varied from less than 0.5 watts to full power by changing the voltage at this pin.

To reduce carrier frequency harmonics of the PA module output to acceptable levels, a lowpass filter is inserted between the module and the antenna connector. This filter is of elliptic design and formed around a buried stripline transmission line and C164, C165, and C166.

To isolate the PA module from the receiver, an electronic T/R switch is used. The switch is formed around PIN diodes CR101 and CR104 which are turned on in transmit and are off in receive. CR104 switches the PA module into and out of the circuit while CR101 protects and isolates the receiver input when the radio is in transmit.

6.2.4 MISCELLANEOUS FUNCTIONS

Two on-board regulators are used to provide the 5 volts DC used by most of the circuitry in the radio. IC106 is a low noise, low dropout regulator which provides 5 volts to all the portions of the radio which do not get switched on or off as the radio changes from transmit to receive. This regulator is enabled by the XCVR-EN (J102, pin 5) input. When this regulator is not enabled, the radio is essentially powered down. IC107 is an identical regulator which supplies power to those circuits which are to be powered-up only in receive and to the switches in the VCO which shift the VCO frequency range to that needed as the 1st local oscillator. The regulator is enabled through IC105E and IC105F by the RX-EN (J102, pin 4) input.

The transmitter PA module driver stages and the T/R switch are powered by +7.2 volts through Q113. Q113 is enabled by the TX-EN (J102, pin3) input through delay and sequencing circuitry formed around IC105 and Q115 and Q114. The sequencing circuitry delays PA turn-on until the driver stages and T/R switches are on and delays driver stage and T/R switch shutdown until the PA module has ramped down in power. This prevents “keyclicks” from abrupt transmitter turn-on and turn-off.

7.0 HARDWARE OPTIONS

The DTX is setup at the factory in a configuration that should be acceptable for most users. The most common changes required are effected through the programmer without removing the cover from the unit. There are, however, a number of component jumper changes which can be made which may result in more satisfactory integration in a data system. These changes require the soldering and unsoldering of SMD components and should be undertaken only by qualified service personnel. Refer to the PCB component locator and schematic diagrams as needed.

7.1 UNIT DISASSEMBLY AND RE-ASSEMBLY:

1) Case Removal

   a) Remove the two screws at the rear of the unit. These screws secure the rear bracket to the case.

   b) Remove the two screws (one per side) on the side of the unit. These screws secure the front bracket to the case.

   c) Slide the case off the two-board assembly.

2) Board Separation

   Remove the two screws that secure the Loader Board to the rear bracket. Remove the two screws that secure the RF board to the front bracket. The two boards are held together by their interconnecting header/socket. Gently pry the two boards apart at the header/socket. The RF board is then rotated and tilted so to allow the right angle BNC connector to pass through the hole in the front bracket.

3) Re-assembly is the reverse of assembly with the rear screws installed before the side screws.

7.2 LOADER/CONTROL BOARD OPTIONS

AUX OUT Coupling

The AUX OUT output is normally AC coupled through C380. If DC coupling is desired, an 0805 size SMD zero ohm jumper resistor (RITRON P/N 47100000) must be soldered in the location of R383. (In lieu of a zero ohm jumper, a small piece of wire may be carefully soldered between the pads.) The R383 pad pair would normally be open. The AUX OUT DC level then becomes nominally 2.5 volts.

AUX IN Coupling

The AUX IN input is normally AC coupled through C359. DC coupling is possible, however, the carrier frequency of the unit would then become directly affected by the DC voltage present. If DC coupling is desired, R355 must be removed and installed in the open location of R354**.** The DC voltage should be 2.5 volts nominal and very well regulated. **Note: The FCC Type Acceptance obtained by RITRON is invalid once this modification is made. The user is responsible for obtaining type acceptance in a configuration which includes the device which is connected to the AUX IN input.**

7.3 RF BOARD OPTIONS

7.3.1 STAND-ALONE AND PART OF DTX MODULE

Discriminator Polarity

The polarity of the discriminator output at pin 13 of J102 is configured at the factory such that an increase in RF frequency causes an increase in DC voltage. This is considered “normal” mode. An inverted mode is available where an increase in frequency causes a decrease in voltage. This is effected by removing R131 and placing it in the open pad pair for R132.

Carrier Detect Method

Two methods of carrier detection are available on the DTX, carrier level based referred to as RSSI (Receive Signal Strength Indicator) and signal to noise ratio based, referred to as Noise. The factory configuration is for RSSI based carrier detection. If Noise based carrier detection is desired, R124 should be removed and placed in the open pad pair for R125. **Note that the software programmed selection for carrier detect type on the selection page must match the hardware.**

7.3.2 STAND-ALONE ONLY

Some of the functions provided by the Control/Loader board may not be available in all of the applications which use the RF board in its stand-alone form. To provide maximum flexibility, additional options exist on a stand-alone RF board verses one which is part of a DTX module. These additional options are as follows:

VCO Modulation Source

When used with the RITRON Control/Loader board, the VCO receives its modulation signal from pin 14 of J102. The stand-alone version of the RF board is configured such that the VCO modulation is derived from the signal at pin 6 of J102, MOD_IN and the balance adjustment is done through R180. If the user wishes to provide a separate VCO modulation signal, R178 should be removed and placed in the open pad pair for R179.

Transmitter Output Power Adjustment

When used with the RITRON Control/Loader board, the RF output power is controlled through pin 0 of J102. The stand-alone version of the RF board is configured such that the output power is controlled by R187, pin 0 is not connected. If the user wishes to supply the voltage to set output power, R186 should be removed and placed in the open pad pair for R185.

8.0 ALIGNMENT

Warning: Alignment must only be performed by qualified and trained service personnel.

The DTX module is aligned at the factory before shipment and should need no further adjustment. It is possible that the gain settings for the audio input and output signal paths may need optimized. The frequency trim, deviation, and balance should not need adjustment. The procedure for performing all of the alignment steps is detailed below. The unit should not be opened for alignment; all adjustments are electronic and effected through the programmer software.

8.1 REQUIRED TEST EQUIPMENT

Depending upon which alignment steps are to be performed, some or all of the following pieces of test equipment may be required:

DC Power Supply -capable of operating at the correct voltage for the module and capable of 2.5 Ampere minimum current.

RF Signal Generator-capable of operating at the carrier frequency of the module with an output level adjustment and able to be frequency modulated.

FM Demodulator/Deviation Meter-capable of operating at the carrier frequency of the module.

RF Frequency Counter-must operate at the RF frequency of the unit with a resolution of 10 Hz or better and an accuracy of 1 ppm or better.

Audio Oscillator-must have sinewave output allow for output frequency and amplitude adjustment.

Oscilloscope

RF Power Attenuator or Dummy Load with coupled output-must be 50 ohms impedance at the operating frequency and rated for the output power of the module and have an output which can drive the FM demodulator at the correct level and the frequency counter.

RF Power Meter-capable of accurately indicating the RF output power of the module.

Note: A two-way radio test set may include most, if not all, of the required equipment, except for the power supply.

8.2 ALIGNMENT PROCEDURE

It is not absolutely necessary to perform all of the alignment steps detailed below. However, some adjustments interact somewhat with others e.g. balance affects deviation, deviation affects AUX IN gain, and the output power has a slight affect on TX frequency trim. It may be prudent to spot check all of the adjustments which interact. These will be indicated in the particular alignment step.

The programmer must be connected to the unit via the programming interface cable and the alignment screen selected. During alignment, the channel may be selected via the channeling control lines on the module or through the programmer. A channel pull-down menu allows for the selection. Also, the unit can be keyed through the programmer, if desired.

8.2.1 RX FREQUENCY TRIM

The RX Frequency Trim trims the unit on frequency during receive. This setting, if incorrect, may degrade receive sensitivity, distortion, and possible recovered audio level, which in turn affects AUX OUT (RX) Gain and Audio PA Gain.

To determine if the receiver is correctly trimmed to frequency, the 1st local oscillator frequency must be measured. When the RX frequency trim box on the alignment screen is highlighted, certain stages in the transmit chain are enabled which cause the local oscillator leakage at the antenna connector to stronger than normal. Even so, the level may be less than 0 dBm. The frequency counter must be connected directly to the antenna connector and be able to operate at this level**. DO NOT KEY THE UNIT DURING THIS PROCEDURE AS SERIOUS DAMAGE TO THE COUNTER MAY RESULT!**

A channel with a receive frequency programmed into it should be selected. The correct local oscillator will be displayed on the programmer channel box. The frequency on the counter should be observed and the RX Frequency Trim value adjusted for least error.

8.2.2 AUX OUT GAIN

To set the AUX OUT gain, an RF signal generator must be connected to the DTX module. Its frequency should be set to that of a programmed channel. The generator should be modulated at the desired deviation, typically 60 % of maximum, with a 1 kHz tone. The RF output level is not critical, but should be above any squelch threshold which may have been set. –70 dBm should be sufficient. If not, squelch can be disabled via the settings menu of the programmer for this procedure.

With an oscilloscope connected to the AUX OUT output, the AUX OUT Gain setting should be set to value which produces the desired output level. Note that the output impedance of the AUX OUT is about 600 ohms. If the load impedance of the load that will be connected to this output is less than 10 kΩ of so, a resistor of a value equal to the load impedance should be connected when making the adjustment.

8.2.3 AUDIO PA GAIN

To set the Audio PA gain, an RF signal generator must be connected to the DTX module. Its frequency should be set to that of a programmed channel. The generator should be modulated at the desired deviation, typically 60 % of maximum, with a 1 kHz tone. The RF output level is not critical, but should be above any squelch threshold which may have been set. A –70 dBm level should be sufficient. If not, squelch operation can be disabled via the settings menu of the programmer.

With an oscilloscope connected to the AUX OUT output, the AUX OUT Gain setting should be set to value which produces the desired output level.

8.2.4 CARRIER DETECT ON and CARRIER DETECT OFF

The Carrier Detect On and Carrier Detect Off settings control the RF level (or Signal-to-noise ratio) at which the DCD output goes true and what level at which it goes false. To prevent chattering on noise, these two settings are not normally the same. A few dB of hysteresis is usually provided i.e. if the RF signal level is increased from zero, at some point, the DCD output will go from false to true. The RF level may then have to be decreased by several dB before the DCD output goes false again. If squelch is enable, the receive audio muting will follow the DCD output.

To determine the state of the DCD output, connect a DC coupled oscilloscope or DVM to the DCD output. It may help to disable the squelch via the Monitor input or Monitor button on the programmer so that the receive audio signal can be continuously observed i.e. not squelched when DCD is false.

Set the RF signal generator output to the level at which the Carrier Detect On should go true. Set the Carrier Detect On value to maximum. If the DCD output is true, increase the Carrier Detect Off value until the DCD output goes false.

Set the Carrier Detect Off value to minimum. Slowly adjust the Carrier Detect On value downward until the DCD output just goes true. Re-adjust the signal generator level to the desired level for the DCD output to go false. Normally, this would be about 3 dB or so lower than the level for DCD to go true. Slowly increase the Carrier Detect Off value until the DCD output goes false.

Confirm the operation of the DCD output by decreasing the signal generator level to that substantially below the Carrier Detect Off point and increasing it beyond the Carrier Detect On point and back while observing the DCD output. If the settings are not satisfactory, they can be modified or the procedure can be repeated.

8.2.5 TX LOW POWER AND HIGH POWER

The transmitter output power level can be programmed on a per channel basis via the alignment page of the programmer. If RNet Compatibility has not been programmed on the settings page, both the low and high power levels can be set. If RNet Compatibility has been programmed, only high power can be set. The TX High Power and TX Low Power settings in the TX Power box act to select a common value for all channels. Individual values for each channel can be entered in the per channel boxes at the bottom of the screen. Note that the transmitter does not recognize a change in power setting while transmitting, only while receiving. If the PTT is activated and a change in setting is made, the PTT would have to be released and then re-activated to see the new power setting. The relationship between power and setting is not linear and may vary as a function of channel frequency.

8.2.6 TX FREQUENCY TRIM

This setting is used to trim the transmitter to frequency. This value should not normally need adjustment. However, as the unit ages and if the transmitter power is changed significantly, corrections may be required. Note: Any adjustments must be made at a unit temperature of 25 +/- 2 °C (77 +/- 1.8 °F).

The unit should be set to a channel which is at an output power which is close to what will be used the majority of the time. The frequency of the unit may be slightly affected by the output power level. The RF output of the unit should be coupled to a frequency counter through a suitable attenuator or coupler. The PTT should be activated and the TX Frequency Trim value adjusted for the correct frequency. The value can be changed while the unit is transmitting.

8.2.7 DEVIATION AND BALANCE

The deviation adjustments are used to set the maximum limiting deviation of the transmitter. This must be set properly to ensure that the unit will meet the regulatory spurious emissions requirements, in particular, occupied bandwidth. The balance adjustment is used to ensure a proper relationship between the modulating signal to the reference and to the VCO. If the ratio i.e. balance is not correct, the transmit audio frequency response will not be correct which will result in a distorted data waveform.

The optimum values for deviation and balance vary in a predictable manner as a function of carrier frequency. In order to relieve the user of having to adjust deviation and balance each time a transmit frequency is entered or changed, the programmer calculates the required values based upon the correct values for two special alignment frequencies. These required values have already been determined at the factory and are stored in the unit. As transmit frequencies are entered or changed, new calculated values will appear in the per channel boxes at the bottom of the screen. These values can be changed on a channel by channel basis, if desired.

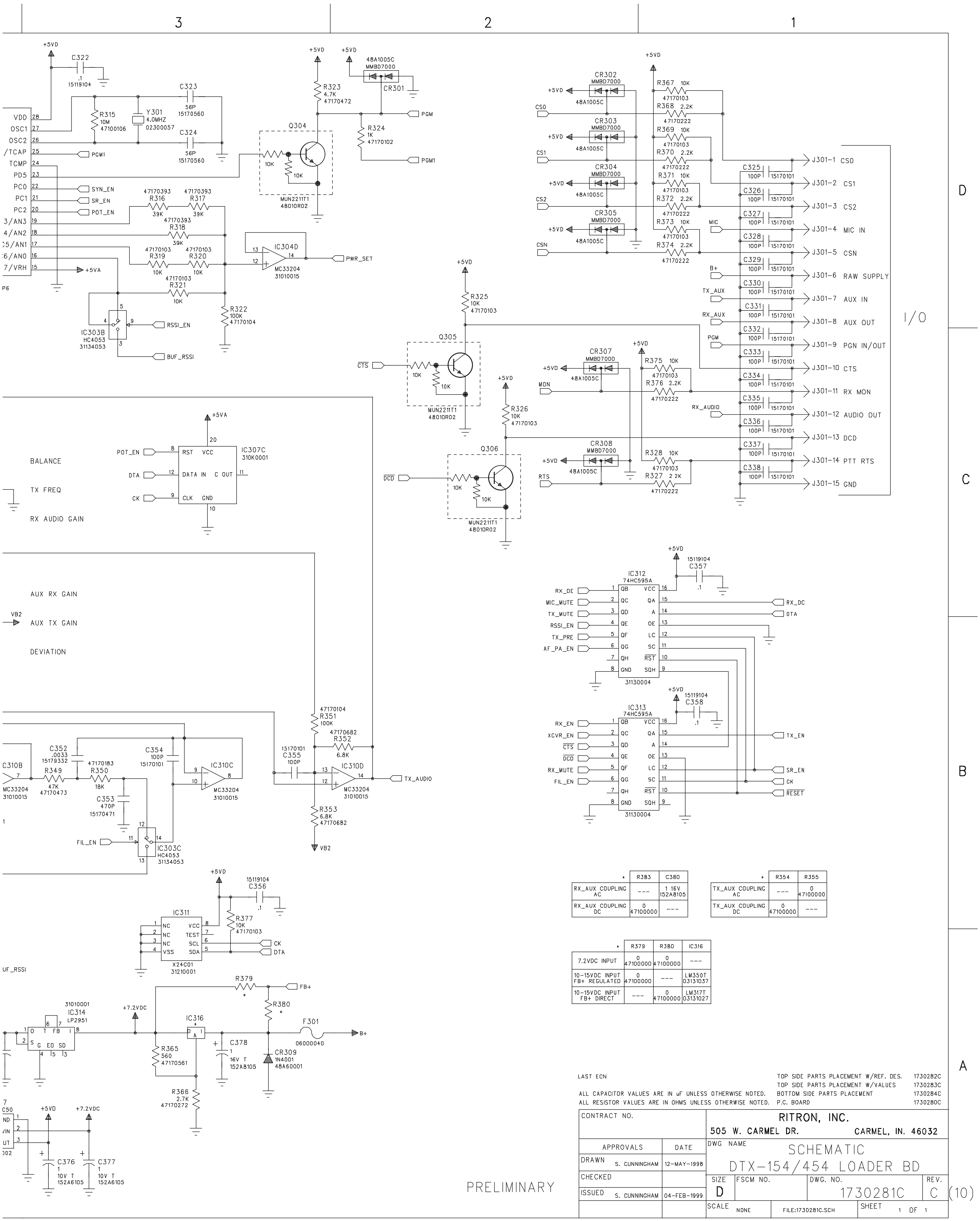
The procedure detailed here is for setting the deviation and balance at the special alignment frequencies so that the deviation and balance will be correct at any programmed frequency. This same procedure can be used to set any given channel values in the per channel boxes.

An FM demodulator should be connected to the RF output of the module through a suitable power attenuator. The demodulator filters should be set for no de-emphasis, as low a highpass cutoff as possible (<50 Hz, preferably down to DC), lowpass cutoff approximately 15 kHz. The demodulator output should be connected to an oscilloscope so that it can be observed.

An audio oscillator should be connected to the AUX IN input. The output waveform should be sine, the level at zero, and at a frequency of 500 Hz. Confirm that the Aux In Gain value is at least 10.

On the channel drop-down menu, select lower band edge. Activate the PTT, and while observing the demodulated waveform on the oscilloscope, begin increasing the oscillator output level. The waveform should begin as a sinewave and at some point show clipping. The clipped portion may not necessarily be flat. The audio oscillator level should be set so that a substantial portion of the waveform is clipped, at least 50 %. Adjust the balance value so that the clipped portion is flat i.e. horizontal rather than tilted. Although the programmer can change values while transmitting, it is better to unkey between value entries. The process of loading values causes some disturbance of the waveform. After the balance is set, the deviation should be set to a value of 2.4 kHz for a 12.5 kHz channel or 4.8 kHz for a 25/30 kHz channel. Select the upper band edge on the channel menu and repeat. As a result of this procedure, the per channel balance and deviation values may have changed.

9.0 TROUBLESHOOTING



*	R383	C380
RX_AUX COUPLING AC	---	1 16V 152A8105
RX_AUX COUPLING DC	0 47100000	---

*	R354	R355
TX_AUX COUPLING AC	---	0 47100000
TX_AUX COUPLING DC	0 47100000	---

*	R379	R380	IC316
7.2VDC INPUT	0 47100000	0 47100000	---
10-15VDC INPUT FB+ REGULATED	0 47100000	---	LM350T 03131037
10-15VDC INPUT FB+ DIRECT	---	0 47100000	LM317T 03131027

LAST ECN

ALL CAPACITOR VALUES ARE IN uF UNLESS OTHERWISE NOTED.
ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.

TOP SIDE PARTS PLACEMENT W/REF. DES.	1730282C
TOP SIDE PARTS PLACEMENT W/VALUES	1730283C
BOTTOM SIDE PARTS PLACEMENT	1730284C
P.C. BOARD	1730280C

PRELIMINARY

CONTRACT NO.

RITRON, INC.
505 W. CARMEL DR. CARMEL, IN. 46032

APPROVALS		DATE
DRAWN	S. CUNNINGHAM	12-MAY-1998
CHECKED		
ISSUED	S. CUNNINGHAM	04-FEB-1999

DWG NAME SCHEMATIC
DTX-154/454 LOADER BD

SIZE D | FSCM NO. | DWG. NO. 1730281C | REV. C (10)

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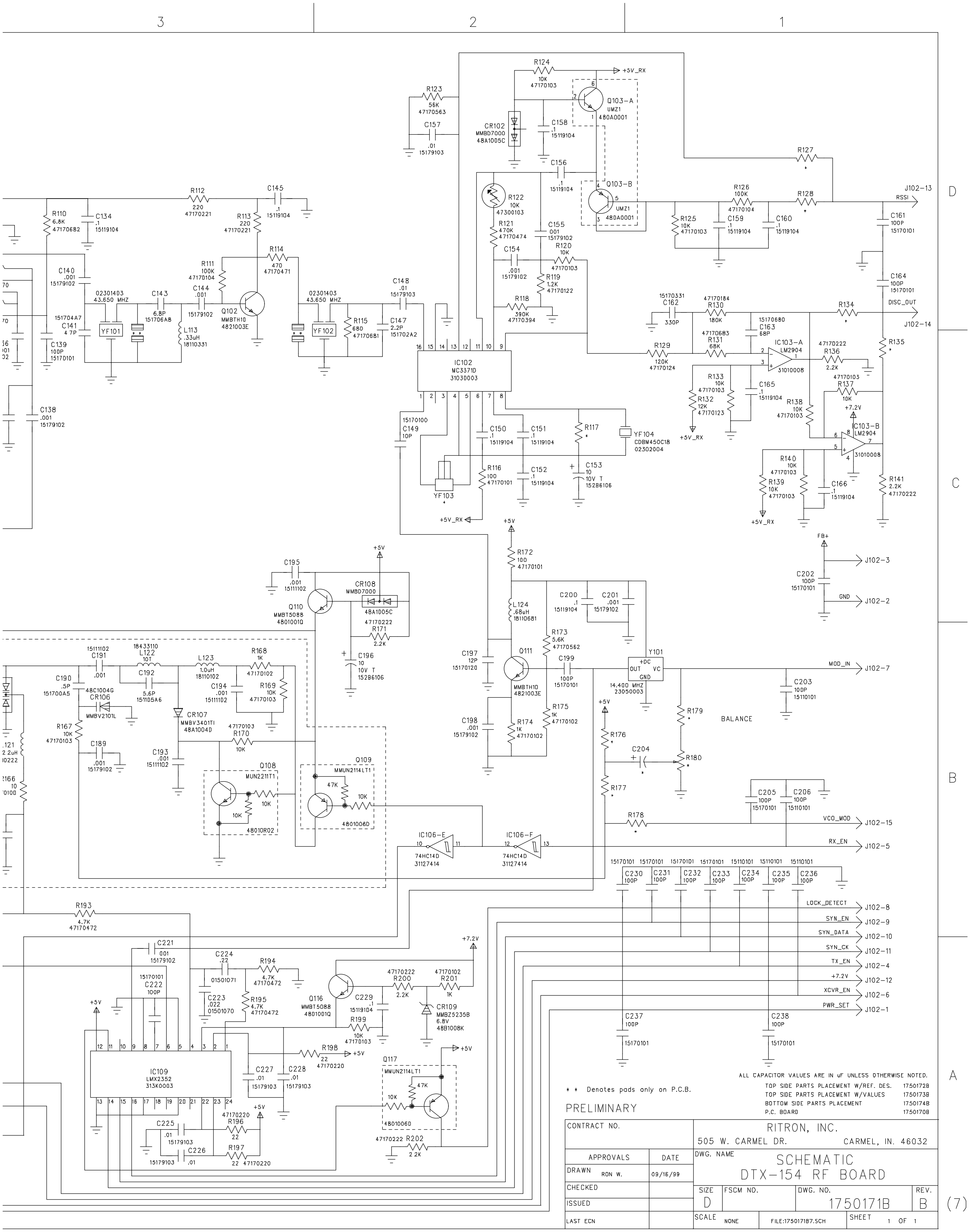

ALL CAPACITOR VALUES ARE IN uF UNLESS OTHERWISE NOTED.

TOP SIDE PARTS PLACEMENT W/REF. DES.	1750172B
TOP SIDE PARTS PLACEMENT W/VALUES	1750173B
BOTTOM SIDE PARTS PLACEMENT	1750174B
P.C. BOARD	1750170B

* * Denotes pads only on P.C.B.

PRELIMINARY

CONTRACT NO.

RITRON, INC.
505 W. CARMEL DR. CARMEL, IN. 46032

APPROVALS		DATE
DRAWN	RON W.	09/16/99
CHECKED		
ISSUED		
LAST ECN		

DWG. NAME
SCHEMATIC
DTX-154 RF BOARD

SIZE	FSCM NO.	DWG. NO.	REV.
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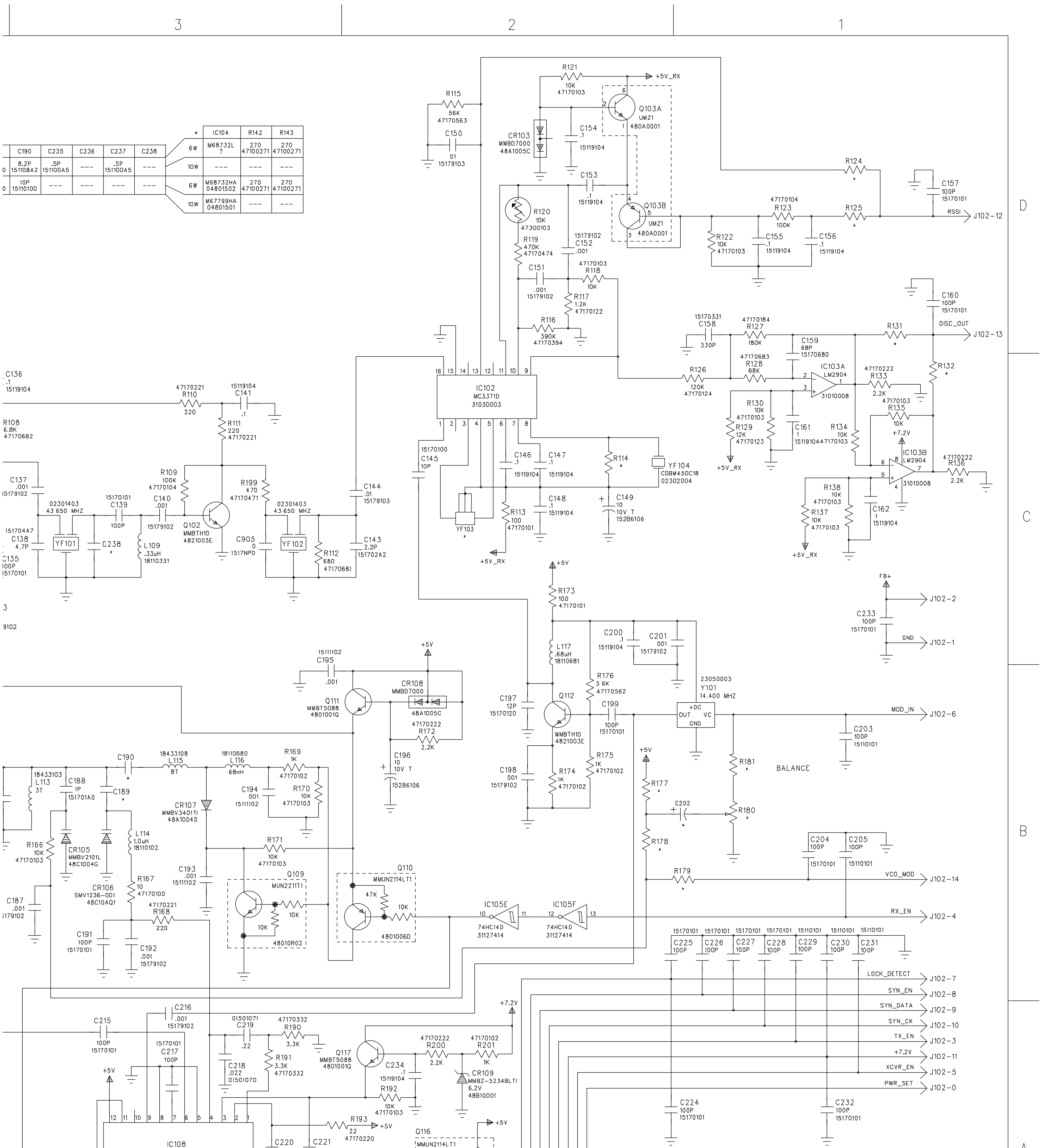
(7)



C190	C235	C236	C237	C238
8.2P 151108A2	.5P 151100A5	---	.5P 151100A5	---
10P 15110100	---	---	---	---

*	IC104	R142	R143
6W	M68732L ?	270 47100271	270 47100271
10W	---	---	---
6W	M6B732HA 04801502	270 47100271	270 47100271
10W	M67799HA 04801501	---	---

LAST ECN PRELIMINARY

ALL CAPACITOR VALUES ARE IN uF UNLESS OTHERWISE NOTED.
ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.

TOP SIDE PARTS PLACEMENT W/REF. DES.	1750162A
TOP SIDE PARTS PLACEMENT W/VALUES	1750163A
BOTTOM SIDE PARTS PLACEMENT	1750164A
P C BOARD	1750160A

CONTRACT NO.

RITRON, INC.
505 W. CARMEL DR. CARMEL, IN. 46032

APPROVALS		DATE
DRAWN	S. CUNNINGHAM	19-MAR-1998
CHECKED		
ISSUED	S CUNNINGHAM	29-JAN-1999

DWG. NAME
SCHEMATIC DTX-454 RF BOARD

SIZE	FSCM NO.	DWG. NO.	REV.
D		1750161A	A

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