

RA1001 Narrow Band Radio, Type III PC Card

USER MANUAL

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Issue Date: December 2004

REVISION HISTORY & DESCRIPTION OF CHANGES

Revision	Date	Approval	Description of Change
Prelim.	June 2003		Initial Document
Prel.2	23 June, 2003		Update to comply with NGNB MRD Rev0.3.doc

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1. INTRODUCTION

1.1 General Description

This document specifies a complete data radio module that will support the company's next generation of PCMCIA based handheld and vehicle mount terminal, base station, access point and ruggedized computer products. The radio specified herein shall provide full support for, and be backwards compatible with the company's proprietary narrowband radio protocols which include 4800 and 9600 baud two level FM, and 4800, 9600 and 19,200 baud four level FM. Specific host products that this radio is required to support are listed below under *Host Support*. Included as part of this support are the appropriate software drivers that will reside on the host. Connection to the host computer system shall be restricted to the standards governing a PCMCIA type III PC card. **The traditional radio deck, interface card and flex cable will be integrated into a single type III PC card and connected via a cable to the host antenna.**

This document represents the prime revision-controlled description of the project, the product and its requirements and will be updated throughout the life of the project. A list of all relevant documents and drawings is included as the main reference for the project.

2. REFERENCES

2.1 Applicable Documents and Drawings - Teklogix

<u>Doc./Dwg No.</u>	<u>Description & Notes</u>
	EFJ Spec./Manual
	Business Case
TBD	Manufacturing Plan
TBD	Hardware design specification
TBD	R/F test fixture specification
TBD	Driver software design specification
TBD	Software requirements
TBD	Software design plan

2.2 Invoked Specifications

PC Card Standard Feb. 1995

Card and Socket Services V2.1

Advanced Power Management (APM) BIOS Interface Specification V1.2

IEEE 1149.1 Standard - Test Access Port & Boundary Scan Architecture

2.3 Abbreviations & Acronyms

API	Application Programmer's Interface
BIST	Built-in Self Test
BER	Bit Error Rate
E-NB	Enhanced Narrowband
FCS	First Customer Ship
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
POST	Power On Self Test
SINAD	Signal to Noise and Distortion ratio
WLAN	Wireless LAN Proprietary Protocol

Section A - Product Level Specifications

3. DETAILED FEATURE AND FUNCTIONAL REQUIREMENTS

3.1 General

The RA1001 shall provide narrowband data communications using all Teklogix proprietary narrowband FM protocols and modulation schemes, which include 2 level FM running at 4800 and 9600 baud, and 4 level FM running at 4800, 9600 and 19,200 bps. It shall be functionally backward compatible with existing Teklogix narrowband radios including the TRX7340, TRX7345, TRX7355 and TRX7370.

The implementation shall be modular and consist of a PCMCIA form factor interface card, incorporating the radio deck, an external antenna system and an antenna connecting cable. The latter, along with appropriate mounting hardware shall be custom designed for each target host as required and will not be covered under this specification.

The interface card shall provide the stack protocol, control the radio, acquire and provide transmitted and received data streams via the PCMCIA interface, carry out all appropriate signal processing, encoding, decoding and control functions required to properly transmit and receive data via the radio. The PC Card interface shall conform as closely as possible to the PC-Card 95 Type III standard. Deviations from the standard must not affect in any way the compatibility of the RA1001 with any Teklogix host products.

3.2 Host Support

The RA1001 shall function per specification when installed in the following Teklogix PCMCIA based host products:

- Teklogix 7530 NG Handheld Terminal (WinCE.net operating system)
- Teklogix 8525 NG Vehicle Mount Terminal (WinCE.net operating system)
- Teklogix 8560/70 Vehicle Mounted Terminal (Win2K/XP operating system)

Use of the RA1001 in the following Teklogix PCMCIA based products is considered to be beyond the scope of this project.

- Teklogix 7035 Compact Handheld Terminal (DOS operating system)
- Teklogix 9150 Access Point (VxWorks operating system)
- Teklogix 8255/60 Vehicle Mounted Terminal (DOS operating system)

Software drivers for the indicated terminals / operating systems will be provided. The RA1001 shall also be designed to accommodate where possible other portable and mobile computers that support a PCMCIA type III slot.

3.3 Host Based Software Drivers

Drivers supporting the following operating systems and platforms shall be delivered, in priority order:

- Windows CE (7530, 8525)
- Windows 2K, XP (8560/70)

Support for the following operating systems may be added as required:

- DOS (7035).
- VXWORKS (9150 Access Point) NOTE: 9150 Base Station compatibility is required and so may necessitate VXWORKS software support.

3.4 Software Driver Compatibility

The client terminals interface to the NB radio will be Teklogix proprietary RMAN API for mobile host computers -- full qualification for Teklogix TekTerm application

- WinCE.Net (4.1 and subsequent)
- Windows 2K & XP.

Support for the features following, if subsequently required, are outside the scope of this project.

- Card & Socket Services V2.1 compliant (DOS) (include compliance with Advanced Power

Management V1.2)

- Teklogix proprietary Cell Base module for 9150 access point.

3.5 RF Connectivity

Network access:	Teklogix 9150 Access Point & Base Station, or 9130/9140 base station, combined with Teklogix 93xx/94xx/95xx Series of Network Controllers
RF protocol:	Teklogix NB Polling Protocol (Cellular mode). <i>[Compatible with all current 32-bit 4800/9600/19.2 Teklogix systems.]</i>
Roaming:	transparent via 9130, 9140 and 9150 Access Point Cell Base modes
Frequency range:	403 - 512 MHz
Data Rate & Mode:	2 level FM (proprietary FSK) 4800 bps, 9600 bps
(effective peak rate)	4 level FM: (proprietary FSK) 4800, 9600 bps, 19.2 Kbps
RF Power:	Factory set, 0.5 to 1 Watt (1.5 Watt growth objective)
Channel Spacing:	12.5, 20, 25 KHz (6.25KHz required from FCC, 1 Jan.'05).
Sensitivity:	-112 dBm nominal @ 10^{-2} BER <i>- Dependent upon the host computer EMC characteristics, qualified in various Teklogix terminals (& Teklogix 9150 Access Point if required).</i>

3.6 PC Card Accessible Control, Configuration and Diagnostics

The following control and diagnostic features can be accessed by the host system through the PC Card interface:

3.6.1 Radio Alignment

- transmit frequency channel centering
- transmit power level (fine adjustment only)
- transmit deviation
- receiver squelch level or equivalent

Access to these settings shall be restricted through the use of a password or other secure feature to avoid unauthorized adjustment. This security feature will be implemented by the driver software.

3.6.2 Radio Control and Support Functions for FI&T, Approvals and EMC Testing (i.e. RTEST features)

- channel(frequency) selection
- transmit long
- transmit with no modulation
- transmit test
- receive test
- carrier detect disable
- transmit time-out (adjustable timer)
- site survey mode

See the section describing radio modes for a more complete description.

3.7 Modes of Operation

The RA1001 shall support the following power saving modes of operation:

- Off
- Suspend: (radio deck powered down, DSP processor idle, control and interface circuitry active only)
- APM enabled (Standby, Receive, Transmit as appropriate)

3.8 Features Not Supported

The following features are *not* offered in this product.

TekTalk. Not supported. Voice support at the system level is not defined.

Intrinsically Safe Not supported. No possibility of future support.

Formal MTBF **Formal** calculations to MIL-HDBK-217F will *not* be supplied.

While the PC card itself is not intended for excessive shock & vibration environments, it is required to survive product specific shock & vibration testing and drop testing (ref. Temperature conditions), i.e. when installed in, and protected by, the corresponding product enclosure.

4. APPROVAL REQUIREMENTS

- Radio, EMC and all other mandatory approvals for all Teklogix major markets
- Approvals in new markets where they are technically feasible will remain a design goal (e.g. Argentina requires access to analogue signals for approvals which may not be viable)
- Specific approvals test jigs will be required as part of the completed package to allow access to signals that would not normally be available through the host interface.
- Safety not required as this is a low voltage device.

Approvals And Safety Summary

This equipment complies with Class B Part 15 of the FCC rules.

Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Psion Teklogix, the party responsible for compliance, may void the user's authority to operate the equipment.

1. FCC Information to Users

For Class B Unintentional Radiators:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

2. Warning to Users

Warning: Changes or modifications not expressly approved by Psion Teklogix Inc. could void the user's authority to operate the equipment.

FCC & IC RF Exposure Warning

- A separation Distance of at least 20 cm is required be maintained between the user and the antenna when the antenna with the gain of less than or equal to 2 dBi is used for Mobile Application.
- A separation Distance of at least 50 cm is required to be maintained between the user and the antenna when the antenna with the gain of less than or equal to 12 dBi is used for Fixed Base Application.

Labeling Requirement for OEM Product

OEM Manufacturer to make their own FCC & IC Label with the following wording:

Contains Psion Teklogix Inc UHF Radio, Model RA1001

FCC ID: GM3RA1001

IC: 2739D-RA1001

5. MANUFACTURING SUPPORT

- The RA1001 radio card will arrive fully assembled and tested from the subcontractor. **Note that PC cards cannot be opened without causing permanent damage to the device enclosure, etc.**
- JTAG will be supported for partial board test and firmware upgrade
- Test jigs for PA&T will be created to simplify the radio tuning operation as available, and required by Manufacturing.

Section B - Detailed Specifications

6. GENERAL

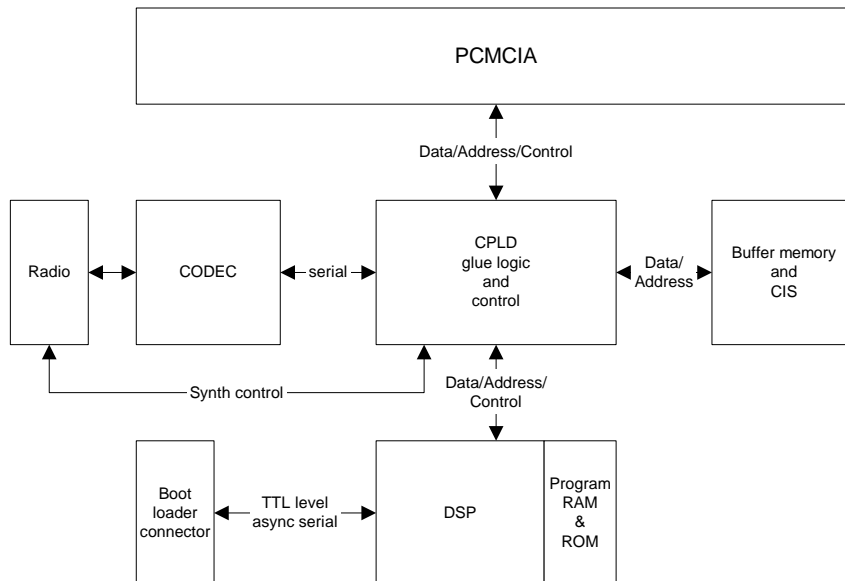
6.1 Design Approach and General Description:

The interface includes a DSP, CPLD (or FPGA), CODEC, minimal baseband filters and auxiliary circuitry. The interface will control the radio, acquire and generate analog signals, process these signals in digital form, encode and decode information in the format supported by Teklogix narrowband radio protocols, which include 4800 and 9600 baud two level FM, and 4800, 9600 and 19,200 bps four level FM.

The interface shall follow as close as possible the PC-Card 95 Type III standard. Deviations from standard must not affect in any way the compatibility with Teklogix host products.

Block Diagram (TBC) - PC Card

SYSTEM BLOCK DIAGRAM



6.2 PC Card Signal Processor

Central Processing Unit

CPU: TI TMS320VCS410A 16 bit fixed point DSP
CPU Performance: 120 MIPS (@ 120MHz)
Data Bus: 16 ext., 16 int.

6.3 Memory

Flash ROM: 1 Mbytes (external)
RAM: 128 Kbytes (internal, 64k x 16), 32Kbytes (external)
Attribute Memory: 4 Kbytes (4K x 8)
Common Memory: 4Kbytes (2K x 16, byte addressable)

Peripherals

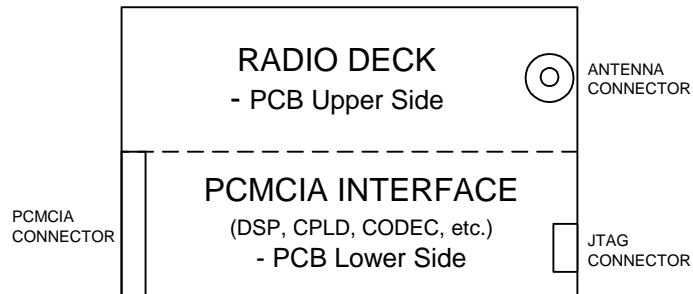
Serial Port: Asynchronous (up to 19,200 bps)

6.4 Radio Deck

7. INTERFACES

Figure below describes the connection and interface scheme for the RA1001.

Interface and Connection Scheme



7.1 P1 - PCMCIA Connection to Host

Type: PC Card Standard February 1995- Type III, 16-bit Multi-Function

Pinout: 68 pin as per PC Card Standard

7.2 Diagnostic and Test Signals Access Point - Requirement TBD

Type: 15 pin - Amp InfoPort III

Pinout - The following is referenced to the PC Card.

<u>Pin</u>	<u>I/O</u>	<u>Signal Name</u>	<u>Description and Requirements</u>
1		DVDD_SENSE	Digital 5V voltage sense required for the TI JTAG programmer
2	input	DSP_TMS	DSP Test Mode Select (JTAG 1149.1) <ul style="list-style-type: none"> • 5V TTL compatible
3	input	TDI	Test Data Input (JTAG 1149.1) <ul style="list-style-type: none"> • 5V TTL compatible
4	output	TDO	Test Data Output (JTAG 1149.1) <ul style="list-style-type: none"> • DSP driven @ 5V TTL Levels • FPGA driven @ 3V3 CMOS Levels w/ 5V pull-up
5	input	TCK	Test Clock (JTAG 1149.1) <ul style="list-style-type: none"> • 5V TTL compatible
6	input	TRST	Test Reset (JTAG 1149.1) <ul style="list-style-type: none"> • 5V TTL compatible
7	in/out	EMU0	Emulator test pins <ul style="list-style-type: none"> • 5V TTL
8	in/out	EMU1/OFF	Emulator test pins <ul style="list-style-type: none"> • 5V TTL
9	input	A_TEST_IN	Input to the DSP (will be digitized and filtered before passing to the radio deck) <ul style="list-style-type: none"> • 0-5V analog

10	output	A_TEST_OUT	<ul style="list-style-type: none"> 0-5V analog
11	output	TRIG_OUT	Programmable trigger output <ul style="list-style-type: none"> 5V TTL
12	input	FPGA_TMS	FPGA Test Mode Select (JTAG 1149.1) <ul style="list-style-type: none"> 5V TTL compatible
13	output	TTL_rs232_Tx	<ul style="list-style-type: none"> 5V TTL
14	input	TTL_rs232_Rx	<ul style="list-style-type: none"> 5V TTL
15		GND	

7.3 Antenna connection

Antenna: 50 Ω nominal impedance; external only , via interconnecting RF cable

8. ELECTRICAL CHARACTERISTICS

8.1 Power Supply Requirements

8.1.1 PC Card

Power Requirements:

+5.0V \pm 5%: 1A max. transmit (lower for other modes)

Limitations: Hot-swap supported by card; host may not support

8.1.2 Power Consumption - Nominal

<u>Mode</u>	<u>+5 volts</u>
Off	TBD mA
Standby	TBD mA
Receive	TBD mA
Transmit	TBD mA

8.2 Modes of Operation

The RA1001 shall support the following modes of operation:

- Off (radio powered down, power removed from PCMCIA socket)
- Standby (radio powered down, DSP idle)
- Receive
- Transmit

9. SOFTWARE, FEATURES AND FUNCTIONS

9.1 PC Card Firmware

9.1.1 DSP Firmware

Implements PHY layer of NB Polling Protocol. The DSP has complete control of the radio deck. It communicates with the host system through buffers allocated in common memory. There will be a limited POST executed after reset, to test major function blocks (RAM, FLASH checksum, PCMCIA I/F, etc).

9.1.2 Manufacturing

There will be a separate, comprehensive manufacturing test program which, combined with special “loop-back” cables and JTAG test interface will fully test the card . SINAD will be a built-in test, while the SINAD test is running the radio link will not be functional (it will be the only task executed by the interface card). A SINAD measurement will be available to the host system in digitized format

9.2 Host Software (Ref.: RTEST features)

9.2.1 Radio Protocol

Drivers shall be developed supporting the following features:

- compatible with Teklogix NB Polling Protocol in both Cellular and non-Cellular modes
- transparent roaming and power saving modes (terminals only)
- RMAN API interface supported by the TekTerm application (terminals only)
- radio protocol diagnostic information (viewable via TekTerm for terminals and via BCM command line for the 9150)

9.2.2 Radio Tests

Software shall be developed that will allow the user to perform the following radio tests:

- channel (frequency) selection
- transmit long
- transmit without modulation
- transmit test
- receive test
- carrier detect disable

The radio test software will display appropriate statistics for each test (eq.BER for receive test).

9.2.3 Configuration and Tuning

Software shall be developed that will allow the user to configure all necessary radio settings such as data rate, modulation type and operating frequency. The software will also allow the user to perform the following radio tuning operations:

- fine adjustment of transmit power
- transmit center frequency adjust
- transmit modulation adjust
- transmit modulation balance adjust

Access to restricted radio configuration settings will be password protected.

9.2.4 Site Survey (terminals only)

A site survey application shall be developed for the RA1001 that will perform in a similar manner to the site survey application available on the 7030 terminal.

9.2.5 Power Management (terminals only)

The RA1001 radio drivers will set the operating mode of the RA1001 radio to properly correspond with the terminal modes of operation which include *Full On*, *APM Enabled*, *APM Standby*, *APM Suspend*, and *Off*. There will be no support for the APM mode "Full-On", the radio interface card will always enter the lowest power possible.

9.2.6 RA1001 FLASH Upgrade

Software shall be developed to support upgrading the RA1001 FLASH through the PCMCIA host connection, for in-system upgrade. For depot upgrade, a JTAG programming interface will be supported. Only firmware which is Regulatory Agency approved can be loaded on customer terminals.

9.3 Supplied Drivers Support Services

Socket Services: TBD

Radio Parameters: **TBD** [Note parameters affecting regulatory approvals must be permanently configured at the factory with no facility for a user application to modify them.]

FLASH Upgrade: Programmable through PCMCIA host connector for field upgrade, or through JTAG test connector for manufacture **or in the event that flash**

memory has been corrupted and PCMCIA interface is subsequently no longer operational. A host resident program is required for upgrades through the PCMCIA connector.

Limitations: Not compatible with PCMCIA 1.0 / JEIDA 4.0

10. MAINTENANCE, DIAGNOSTICS & SERVICE

User Maintenance: none
User Troubleshooting: none
Hardware Reset: through host socket services
Service Strategy: Equipment shall be returned to a service depot for repair or replacement.
Repair Strategy: There will be no repair of PCMCIA cards, defective cards will be scrapped!
Diagnostics: Basic diagnostic facilities will be made available to service personnel to permit troubleshooting & fault isolation to the replaceable assembly level.
Special Tools/Fixtures: RA1001 Radio Test Jig (P/N TBD)

11. MECHANICAL & ERGONOMIC SPECIFICATIONS

11.1 General

format: Single piece design includes Type III PC Card internal only.
interface: PCMCIA Type III slot.
weight: TBD g (TBD oz)
dimensions: PC Card - Type III
drop: Dependent upon host mounting system; will not reduce the host specifications when mounted correctly in the host system.
(Ref.: Section 3.8 & host specific requirements, e.g. for 7530, drop test is cold-soaked, 26 times from 2m to concrete).
vibration: Dependent upon host mounting system; will not reduce the host specifications when mounted correctly in the host system.

11.2 Antenna

The RA1001 will interface with an external, 1/4 wave loaded helical whip (similar to 7030) via a sealed SMA connector (Antenna will have Female external thread).
Coverage & performance shall be comparable to existing Teklogix Narrow Band products.
Limitations: *No internal antenna option.*

11.3 Environmental conditions

temperature - storage -35°C to +65°C
temperature - operating -30° C to +60°C not sealed
temperature - shock +/- 50°C over 20 second time frames (5°C/sec)
humidity 10 to 95% (non-condensing)

There will be **NO** environmental protection on the RA1001, as it is designed to be fully enclosed within the host unit.

11.4 Enclosure

PC Card: Standard 'off-the-shelf' PCMCIA card kit

11.5 Labeling Requirements:

Regulatory label: Must be visible on exterior of product enclosure. Includes all notices as per regulatory requirements of section 13, adhering to minimum text sizes defined therein. Identifies Psion Teklogix radio model number

(RA1001) and part number specific to the radio configuration.

12. APPROVAL REQUIREMENTS

12.1 Radio

ETSI	ETS 300-113 EN 300-220-1
FCC	FCC Part 90 Intentional Radiator (card and radio)
DOC	ICAN RSS-210 Intentional Radiators. ICAN RSS-119 Intentional Radiators EC
EC	Each model requires separate approvals in each target country.
ROW	As required on a per country basis.

12.2 EMC

USA	FCC Part 15, Subpart B, Class B – Unintentional Radiator, Canada ICES-003 / CSA C108.8-M1983 Unintentional Radiators - Class B (Note: not required if FCC part 15, subpart B is tested)
EC	ETS 300 683 ETS 300 279 These standards will provide compliance with EMC Directive 89/336/EEC, Class B (CE Mark Compliance)
Rest of World	As required on per country basis.

12.3 SAFETY

EC	Low Voltage Directive 73/23/EEC, but no voltage limit applying.
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13. MANUFACTURING SPECIFICATIONS

13.1 General

The design of this product and all accessories will be compliant with Manufacturing strategies, requirements and processes as defined in the Manufacturing Plan.

The final product and sub-assemblies are designed to be tested using current methods and equipment (whether at Teklogix or a vendor), wherever feasible [custom test fixtures & test software is of course required.].

All components which may be subject to significant supply risks will have alternates sourced where feasible.

13.2 Production Assembly

13.2.1 Assembly Processes

The RA1001 PC Card will be fully assembled, tested and sealed by the subcontractor prior to shipment to Teklogix.

13.2.2 Production Test Specifications

TBD

14. FUTURE OPTIONS & UPGRADES

14.1 Operating Systems & User Interfaces

As required (supported by Change of Scope).

14.2 Voice Mode

Two voice modes could be supported in future releases, the first would support digitized

voice; and the second digital to analog transmission. Because analog signals cannot be passed through the PCMCIA interface voice digitization will occur in the host system in order to support base-station beacon requirement (as for TRX7370).

14.3 Increased Baud rates

Through improved algorithms it should be possible to improve throughput of the Teklogix RF network. New firmware for the DSP can be downloaded from the host system through the PCMCIA interface for an in-the-field upgrade. However, re-approval of the radio module may be required.

Appendices

15. APPENDIX B - RADIO PERFORMANCE SPECIFICATIONS

(EFJ coupled to I/F Card)

15.1 GENERAL

Frequency Range	435-470 MHz
Frequency Control	Synthesized
Channel Spacing	12.5/20/25
Mode of Operation	Simplex or Half Duplex
Regulated Supply Voltage	+5 VDC +/- 5%
Operating Temperature	-30 to +60 Celsius Degree, -22 to +140 Farenheit Degrees
Maximum Dimensions:	LxWxT = 7.19cm X 5.56cm X 1.70cm, 2.83" x 2.19" x 0.64"
Weight:	2.3 oz. (65 g)
FCC Compliance:	Yes

15.2 RECEIVER

Bandwidth	16 Mhz (20 MHz)
Frequency Stability	+/- 1.5 ppm
Sensitivity - 12 dB SINAD	0.45 uV
RF Input Impedance	50 ohms
Selectivity	-70 dB
Spurious and Image Rejection	-60 dB (12.5 kHz), -70 dB (20/25 kHz)
Intermodulation	-70 dB
FM Hum and Noise	-40 dB (12.5 kHz), -45 dB (20/25 kHz)
Conducted Spurious	-57 dBm
Receive Current Drain	<70 mA nominal
Receive Attack Time	< 7 ms (depending on synthesizer loading implementation)
Audio Distortion	< 3 %
Output Level DM3474	600-1200 mVp-p or 200-400 mV RMS (1 kHz at +/- 3 kHz)
Response DM3474	+/- 2 dB from DC to % kHz (reference to 1 kHz)
Minimum Load Impedance	1 Kohm

15.3 TRANSMITTER

Bandwidth	16 Mhz (20 MHz)
Frequency Stability	+/- 1.5 ppm
TCXO Coupling	DC
RF Power Output	1 W nominal adjustable to 500 mW (1.5 Watt growth objective)

	500 mW nominal adjustable to 75 mW (with Low Power Kit)
RF Output Impedance	50 ohms
Modulation Distortion	< 3 %
Duty Cycle	50 %, 60 seconds maximum transmit time
Transmitter Attack Time	< 7 ms (dependent on synthesizer implementation)
Spurious & Harmonic FM	-37 dB
FM Hum and Noise	-40 dB (12.5 KHz) , -45 dB (25 kHz)
Audio Response	+/- 1.5 dB from DC to 5 kHz (reference to 1 kHz) programmable to +/- 1 dB at the RF band edges via J201, pin 14
Data Input Impedance	100 Kohms
Modulation Response	+/- 1 dB from DC to 5 kHz (reference to 1 kHz)
Current Drain	< 800 mA at 2 W, +7.5 VDC