



PTX-150
DIRECT DIGITAL PAGING TRANSMITTER

Sonik Technologies Corporation

User Manual
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1. INTRODUCTION

1.1 GENERAL

The SONIK PTX-150 Paging transmitter is a state of the art DSP/DDS (Digital Signal Processor/Direct Digital Synthesis) based device capable of generating all paging modulation formats, and is designed as a general purpose transmitter for all speed paging systems.

Construction of the transmitter is fully modular. Internally, the case is divided into compartments with PCB's arranged in modules, all interconnected by plug/sockets. All modules can be replaced without the use of a soldering iron. Replacement modules do not require alignment or tuning.

The SONIK PTX-150 transmitter incorporates a universal AC supply and can also operate from a single DC supply for battery back up operation. Software permits the option of "Hot standby" with auto changeover initiated by software selectable fault conditions.

The SONIK PTX-150 transmitter is designed for 100% duty cycle at up to 55°C ambient conditions and utilizes advanced cooling technology to maintain very low power transistor junction temperatures. This approach means assures ultra reliable power amplifier performance.

The power amplifier temperature is monitored and if the temperature rises above a preset amount (35°C), the diagnostics system is alerted and the fan and cooling system is activated. The transmitter is protected by over temperature feedback control to the PA drive input and also incorporates auto fold back for high VSWR conditions.

An external frequency reference input is designed to handle standard reference sources and will lock the transmitter to the external reference. An internal ± 1 PPM TCXO (Temperature Compensated Crystal Oscillator) is provided as standard if no external reference is available.

In POCSAG wide area systems, the carrier can be "dithered" by what is known as a "Black noise" algorithm, to minimize cancellation of equal amplitude carriers from adjacent transmitters. This technique has been used for at least 12 years and is superior to the Carrier offset method. High stability carriers are unnecessary for the carrier dithering technique. For high speed ERMES and FLEX systems, the carrier can be offset in 1Hz steps.

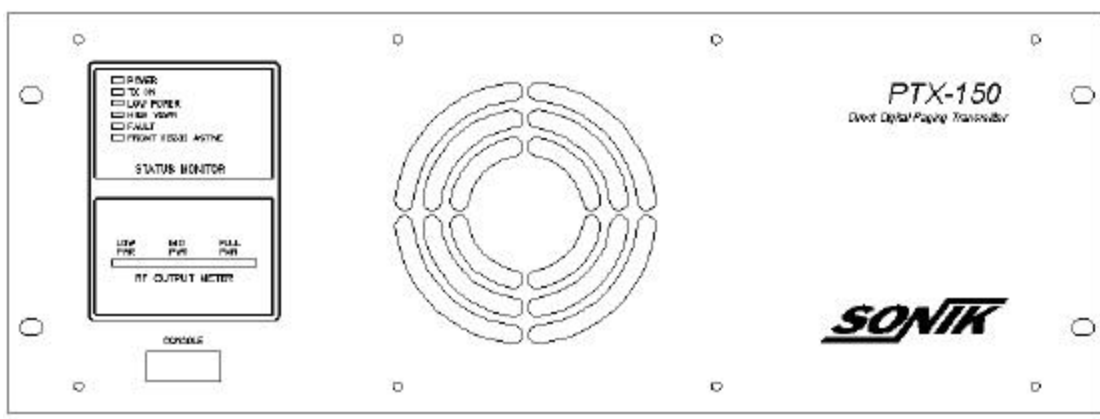
1.2 INDICATORS AND CONNECTORS

1.2.1 FRONT PANEL INDICATORS

Table 1.2.1 illustrates the front panel diagnostic LEDs.

Each LED shows the status of selected functions of the transmitter.

In the following figure, the "CONSOLE" connector acts as the standard RS232 interface for local programming.



LED	FUNCTION
POWER	Indicates that +24VDC is available from the Power supply.
TX ON	Transmitter is transmitting RF power.
LOW POWER	RF output is below alarm threshold set in software.
HIGH VSWR	Antenna port matching is out of specifications set in software.
FAULT	Global fault condition in the transmitter. Refer to 'Trouble shooting Guide' in the handbook.
FRONT RS232 ACTIVE	Indicates that the front panel RS232 port is in use.

Table1.2.1 LED indication of Transmitter status

1.2.2 REAR PANEL CONNECTORS AND SOCKETS

CONNECTOR	FUNCTION
N-TYPE	The RF output of the paging transmitter
DB9	The connection for the external dial modem interface
MAINS INPUT	115/220VAC 50/60Hz input voltage
DB37	Transmitter Controller unit connection point
BNC	External reference input (5-15MHz)
RJ11	Internal link MODEM interface

Table 1.2.2 Rear Panel functions

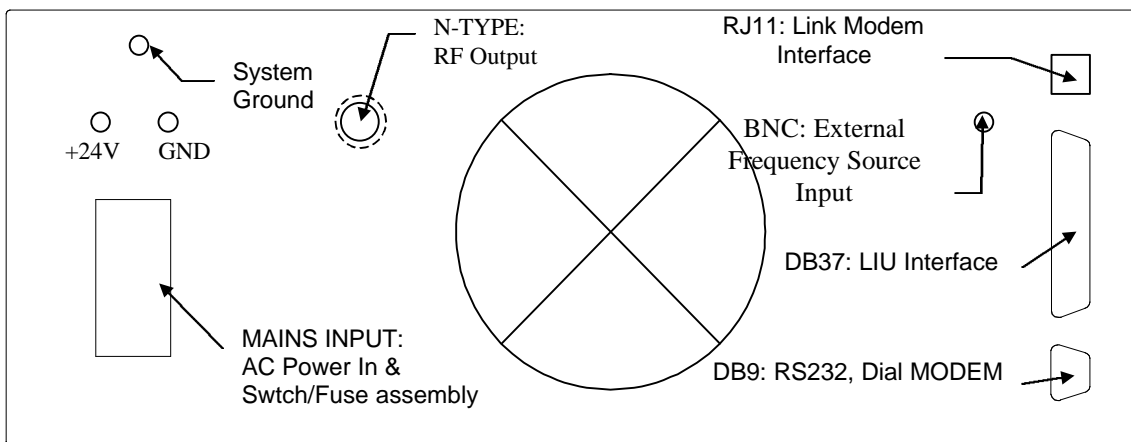


Figure 1.2.0 Rear view

1.3 DESCRIPTION OF OPERATION

INTRODUCTION

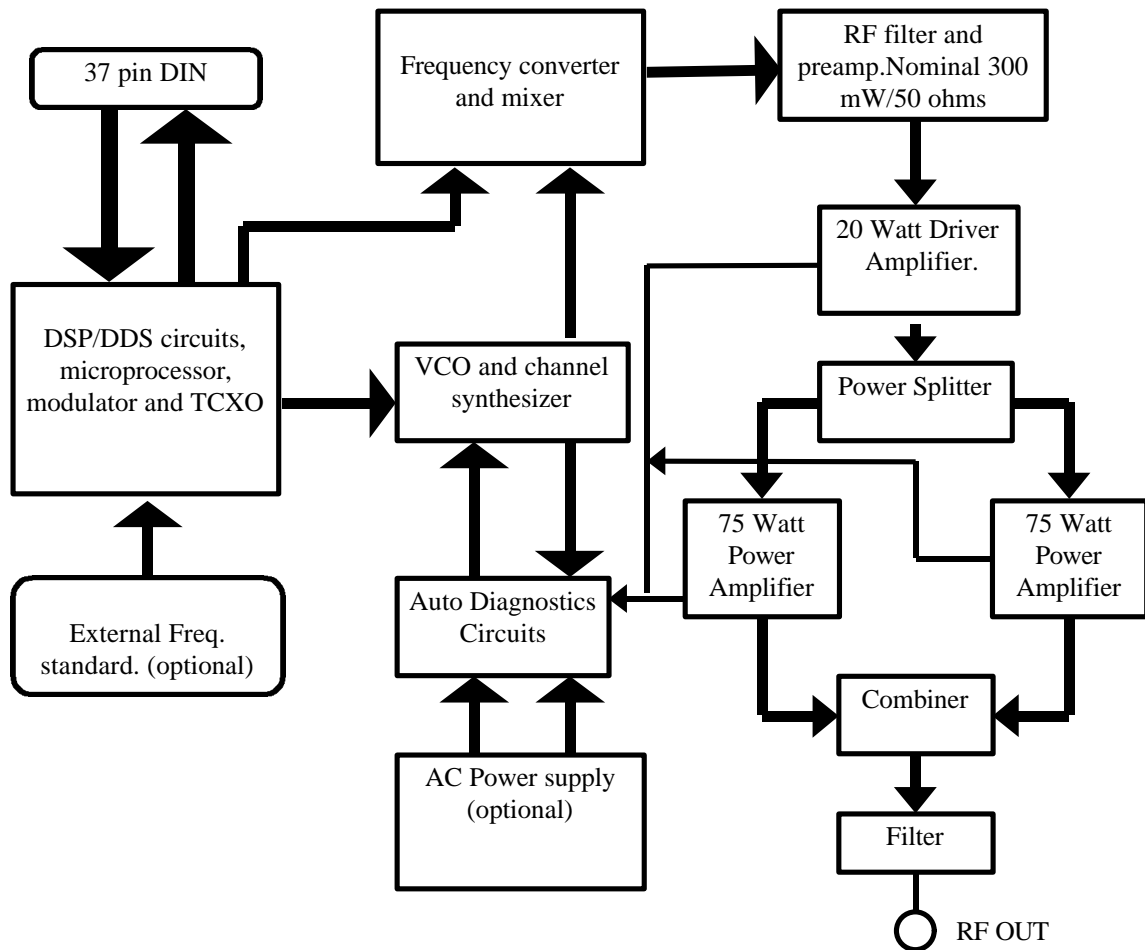


Figure 1.3.1 Block Diagram of the Paging Transmitter

A block diagram of the operation of the paging transmitter is shown in figure 1.3.1.

On the exciter printed circuit board, the DDS/DSP circuitry generates a 10.7 MHz modulated signal, referenced to the internal TCXO or an external reference frequency source. *(The reference source is selected in a software option).*

The external reference is only required when stability of the carrier better than ± 1 PPM is required. *(Parameters such as rise time, absolute deviation, mode etc are all selectable in software).*

The 10.7 MHz modulated signal is processed through a filter before being applied to the first mixer. The LO input to the first mixer is a high quality 235 MHz unmodulated signal with very low phase noise. The mixing products are filtered and buffered with two stages of SAW filtering, and the low side product of 224.3 MHz is then applied to the second mixer. The Second mixer LO frequency is equal to final frequency + 224.3 MHz. Channel change is effected by the VCO supplying the second mixer.

The final frequency output from the second mixer is filtered, buffered and amplified to 300 mW at 50 ohms, suitable for presentation to the Power amplifier modules.

Note that the TCXO of 9.6 MHz supplies the DSP, first LO and second LO to provide the accuracy required for final frequency. The DSP circuitry actually uses 38.4 MHz which is derived from a crystal at that frequency phase locked to the 9.6 MHz TCXO.

Note also that for high stability options, the 9.6 MHz TCXO is replaced when an external reference signal is applied to the BNC connector at the rear of the Transmitter. Selection of this function is via software.

Automatic level control (ALC) of the exciter is affected by the on board Microprocessor in the Exciter module.

The Exciter output is coupled via coaxial cable to the 20W driver amplifier in a separate compartment in the chassis.

The driver comprises 2 RF amplifier stages, a Harmonic filter and directional coupler for generation of forward and reverse power voltage analogs.

The output of the 20W driver amplifier goes into a power splitter, and the two 90 degree out of phase output signals from the power splitter are feed into two 75W power amplifiers.

The outputs of the two 75W power amplifiers are then combined to produce 100W continuous RF output power.

The forward and reverse power output is also monitored using a directional coupler. The exciter microprocessor computes VSWR from the directional coupler outputs. ALC is also effected in the PA to ensure stable output for all environmental and external conditions.

The transmitter is designed to operate from a single +24VDC power source with the internal AC power supply generating the required voltage.

A 37 Pin DIN female socket provides the connection for Data, Clock, mode, channel change, and PTT control from an external Line interface unit. (*Refer to 'Installation Instructions' for details regarding pin connections*).

If no external PTT control exists, provision is made for PTT control by the detection of incoming data on the TX DATA (Lbit) pin of the 37 way connector. (*Hang time for this automatic PTT control is selectable in software*).

A DB9 female socket provides access for either a PSTN dial modem or a PC.

The transmitter can be monitored by a central or local computer for automatic diagnostics or polling.

The PC and RDK software can be used on site to reprogram parameters of the transmitter.

2. SPECIFICATIONS

SPECIFICATIONS

PHYSICAL

Dimensions	19" rack mount, 7H x 18.3D in (178mm x 465mm)
Shipping weight	40 lbs (18 kg).

Table 2.0.1 - Physical Specifications

GENERAL

Operating voltage	110 / 220VAC±20%
Operating temperature	-15 to +55°C
Operating humidity	0 to 95% RH @ 50°C
Modulation generation	Discrete DSP in conjunction with DDS Chip set.
Modulation modes	POCSAG 512, 1200 or 2400 ERMES to 6400 BPS FLEX™ 2 level and 4 level at all data rates
Modulation characteristics	Rise and fall times default to standard settings as defined by ERMES/ FLEX™/POCSAG recommendations.
Modulation rates	External clock dependant if not in POCSAG mode. Any rate up to 6400 BPS.
Channel switching	Up to 16 preset channels selectable by 4 channel lines.
Interface connection	37 pin female DIN socket provided for connection to C-net, or other network support decoders. For POCSAG connection, Clock input line is not required and only TX DATA (Lbit) line is used.
Diagnostics	Auto dial up system with WINDOWS based central station monitoring software. Analogs and digital inputs are supported by the diagnostics package. Standard alarms are also made available on 37 pin DIN socket for connection to network interfaces such as C-NET.
Carrier offsets	Up to ±3000 Hz in 1 Hz steps.
Launch Time Delay	0 to 40ms in 5uS steps.

Table 2.0.2 - General Specifications

RF CHARACTERISTICS

RF output power	100 Watts ±0.5dB into 50Ω
Frequency range	138 to 174MHz
Turn on time	<25ms from TX ON signal to full power.
Frequency stability	Standard ±1PPM (optional external high stability frequency source).
External frequency reference	From 5 to 15 MHz at any level from -10 to 0 dBm/ 50Ω. External signal can be sinusoid or square wave.
Spurious performance	Conducted and radiated spuri better than 70 dBc.
Adjacent channel performance	Better than 70 dBc.

Table 2.0.3 - RF Characteristics

3. INITIAL INSTALLATION

INSTALLATION

The following equipment will be required to test the transmitter:-

1. A good quality 50Ω dummy load or 30 dB high power attenuator suitable for 150W continuous operation at 174 MHz and with a VSWR of better than 1.15:1.
2. A 486 or better PC with at least 8 Mbyte of RAM and one serial port, installed with RDK software.
3. A suitable cable to connect the serial port of the PC to the dial Modem port of the transmitter. *Details of the required cable wiring are to be found in 'CONNECTION TO THE NETWORK' section of the manual.*
4. A suitable AC lead to suit the country where the transmitter is to be tested.
5. A "ThruLine" wattmeter fitted with the appropriate insert.
6. Suitable low loss RF cables and connectors.

Remove the SONIK PTX-150 transmitter from its packing case and on a clean flat surface, carefully examine the transmitter for physical damage. Pay particular attention to the rear plugs and sockets. Verify that the rear cooling fan is free to rotate and does not have packing material in it which may prevent the blades from rotating.

Connect a good quality 50Ω dummy load rated for at least 150W continuous power at the frequency of operation of the transmitter; to the transmitter RF output "N" connector on the rear panel.

WARNING: ATTEMPTING TO OPERATE THE TRANSMITTER WITHOUT A PROPER LOAD CONNECTED TO THE RF OUTPUT PORT WILL VOID THE WARRANTY.

The SONIK PTX-150 series Transmitters have a detailed and comprehensive test sequence programmed in and this program activates immediately power is applied to the unit.

- If the beeps and light sequencing occurs as specified, then all is well.
- If a dial Modem is connected, the start up sequence differs from that which would occur if a dial Modem was not connected.
- With the transmitter located free of nearby objects which may block airflow through the unit, switch on the transmitter by connecting the AC power cord to the AC supply and operating the AC ON/OFF switch on the rear panel of the transmitter.

- Connect a PC (fitted with RDK software) to either the front panel console or rear panel modem ports of the transmitter, activate the RDK program and verify correct connection by selecting the **READ** field on the **Transmitter Configuration** window. The screen then prompts by asking "**ARE YOU SURE**". If the PC connection and the transmitter system is operational, respond "**YES**" and the transmitter parameters are read into the PC screen.

NOTE: Alarm trip points and operating parameters are preset in the factory and normally there will be no need to change these. For instructions on how to change the alarm settings and status parameters, use the PC mouse to revert to the **Transmitter Configuration** window. Select the **Alarm Settings** field and note the presets. If Auto dial out functions are required (PSTN dial modem connected), use the mouse to select which alarms will initiate a dial back (Enable).

A copy of all factory defaults can be saved onto hard disk by selecting the **SAVE** field and typing in an appropriate file name.

The power up sequence is as follows

1. A tone is heard after power is applied and all front panel lights should be **ON**.
2. After approximately 5 seconds the LEDs on the front panel will go off in sequence starting with the **FAULT** and the only remaining LED left **ON** is **POWER**.
3. The tone then stops for half a second while the SONIK PTX-150 transmitter checks for a dial modem connected to the dial modem port.
If no dial modem is detected then a brief tone is heard.
If a dial modem is detected then a series of tones will be made by the SONIK PTX-150 transmitter to indicate that a dial modem was detected.
For connections into a remote RDK network this test **must pass** if a dial modem is connected.
4. After an additional 5 seconds the SONIK PTX-150 transmitter will be ready for normal operation.

NOTES: WHEN USING EXTERNAL TELEPHONE DIAL MODEM

1. When an incoming call is detected the buzzer will ring as an indication.
2. When a SONIK PTX-150 transmitter is connected the **POWER** LED blinks to indicate that the unit is on-line to the host RDK software.

4. CONNECTION TO NETWORK

CONNECTION

Once the transmitter has been configured for the network, it is now necessary to install the unit into the station and interface to the LIU (Line Interface Unit).

- Verify that the antenna lead is connected to the station antenna. Install a Thruline Wattmeter in series with the transmitter and antenna lead.
- If a PSTN connection and dial Modem are available, install the dial modem and connect it to the dial Modem port (on the rear of the transmitter). *Use a standard DCE to DTE RS232 interface cable (usually supplied with the dial modem).*
- If an external frequency reference is used, select that option in software and connect the source via a 50Ω coaxial cable and BNC male plug to the BNC socket at the rear of the transmitter.
- Identify the appropriate data, clock and mode control connections from the LIU and connect them to the appropriate pins on the DB37 connector at the rear of the transmitter. The correct connections will vary depending upon the LIU used and the mode of operation. Refer to Table 4.0.1 of pin outs for the DB37 connector.

PIN No.	LIU Name	FUNCTION
1	PR0	Protocol select line
5	CH4	Frequency select line
6	CH3	Frequency select line
7	CH2	Frequency select line
8	CH1	Frequency select line
11	KEY	Transmitter key
15	LB	TX DATA, TTL (L-Bit)
16	HB	TX DATA, TTL (H-Bit, 4-level)
18	CLK	Clock for synchronization data
19	GND	Ground
21	ALM10	Reflected power alarm 2 (not used)
22	ALM11	Output power high alarm
23	ALM12	Output power alarm 2 (not used)
26	ALM3	TX Synthesizer alarm
29	ALM6	Output power low alarm 1
30	ALM7	Reflected power alarm 1
31	ALM8	Fan alarm

Table 4.0.1 List of the DB37 connector pins.

- Determine if PTT control is via the DB37 connector or will have to be automatic upon the detection of data.
- If desired, check the setting for the transmitter Hang Time (time that transmitter stays keyed on after the last data transition has occurred on the TX DATA TTL [Lbit] pin). *This function can be altered in software.*
- Connect AC power to the transmitter and note that the appropriate test cycle occurs.
The transmitter is now ready to operate.

5. TROUBLE SHOOTING GUIDE

The transmitter has a comprehensive test program which initiates on first application of power. It is important to understand the start up sequence to determine a likely fault scenario. Table 5.0.1 lists possible symptoms, and solutions to those symptoms.

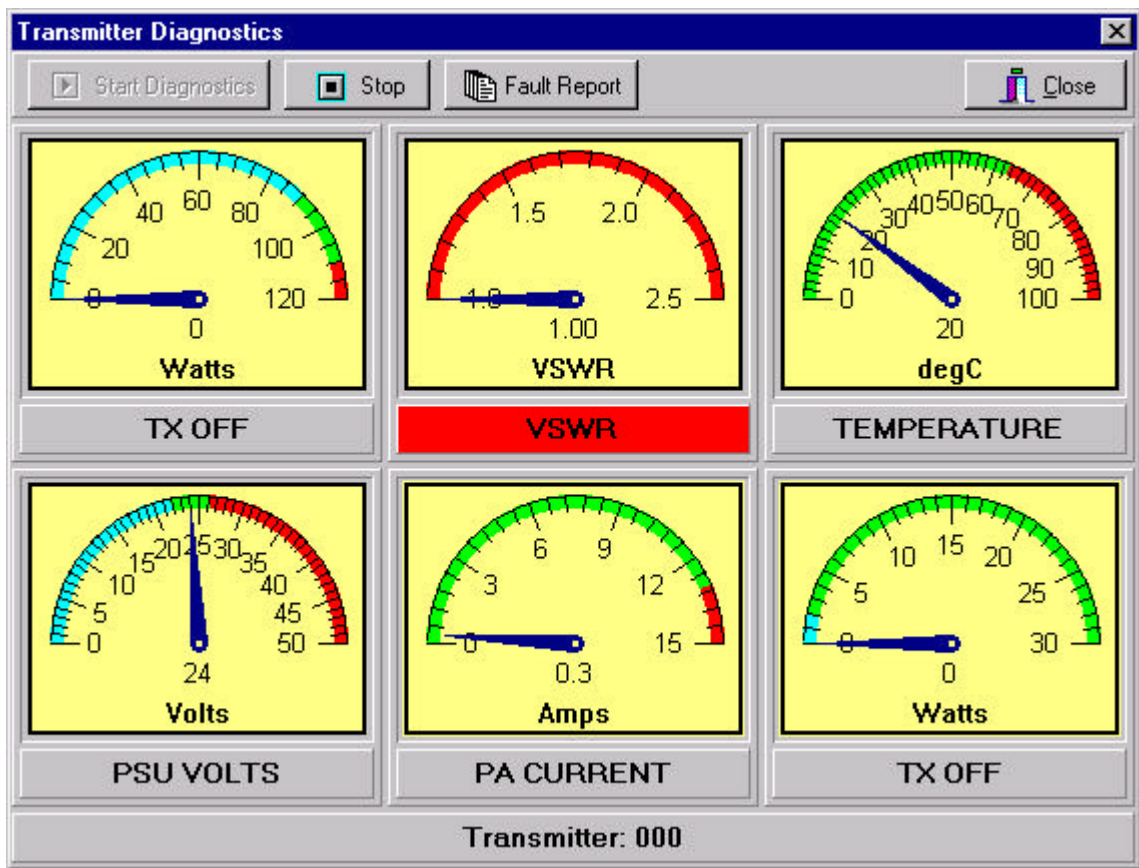
SYMPTOM	POSSIBLE PROBLEM
Dial Modem connected but the system does not indicate a connection	<ul style="list-style-type: none"> • Power to dial modem is off. • Cable is installed incorrectly • Dial Modem has not been set up as Hayes compatible 9600,8,N,1
No LEDs light up or no tone heard	<ul style="list-style-type: none"> • Mains power is off • Fuse has blown on input connector • faulty power supply
No RF output power	<ul style="list-style-type: none"> • The SONIK PTX-150 transmitter will turn off the RF output if any potentially fatal faults develop in the unit. • Fault can be caused by the LIU selecting a channel that is not configured in software. • If the fault LED is ON you must find out what fault is causing the problem through the diagnostic software and repair, or notify the Supplier

Table 5.0.1 - Trouble Shooting

6. USING THE RDK REMOTE TX DIAGNOSTIC PROGRAM

This program is used to monitor all of the transmitter functions in a real-time mode.

To initialize, have a functional transmitter working then select the **RDK Remote**



Transmitter Diagnostic icon on the PC and the program will start to run.

From the opening screen, select **Tx Diag** and the above display will result.

Each meter indicates the true state of that transmitter function and will change in real time as adjustments to that transmitter are made.

Any of the functions that has a problem (when the needle is not in the **GREEN** area) will have its label light up **RED** allowing you to immediately identify the problem area.

7. GLOSSARY OF TERMS

GLOSSARY

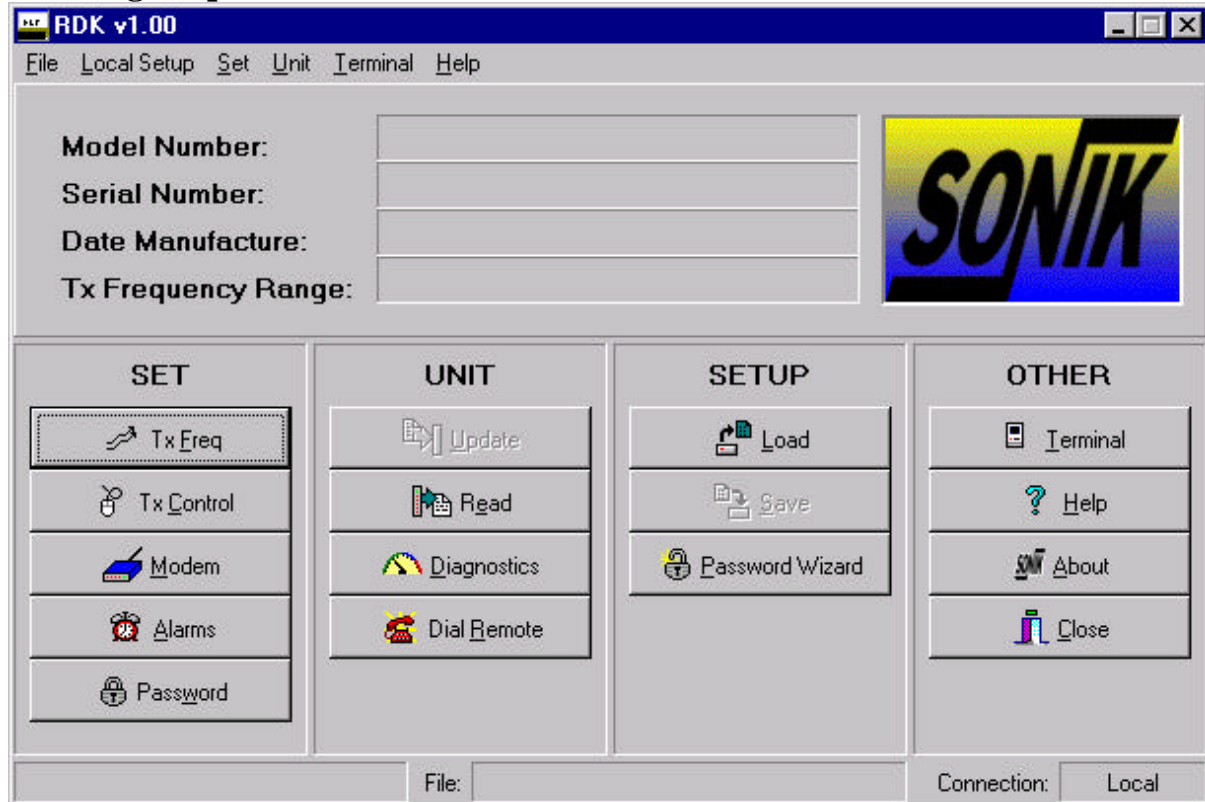
This section gives an index of how different fonts are used to represent operations between the computer and the radio and the technical terms used in this manual.

Window	This indicates the user should be in a particular window within the RDK control program to perform a particular operation.
<KEY>	The < > symbols indicate a key must be pressed on the keyboard.
DDS	Direct Digital Synthesis
DSP	Digital Signal Processor
ALC	Automatic Level Control
PC	Personal Computer
LIU	Line Interface Unit

Appendix A: RDK Software User's Guide

One set of RDK software includes 2 compressed files and one terminal application program.

Running Requirements:



- 1) PC: 486 or above, at least 8M memory, one 1.44M floppy disk drive, one RS-232 serial port, one printer port.
- 2) Cable: Serial port cable with Pin2, Pin3, Pin5 on the one side connected to Pin3, Pin2, Pin5 on the other side.
- 3) Operating System: Windows95/98, Windows NT.

- I. Select item "Comms Setup" from "Local Setup" menu to setup local serial port.
- II. Click "Tx Freq" button to set frequency values for the transmitter. The selection of different frequencies is determined by changing the input voltage level (0V or 5V) at Pin5,6,7,8 of DB37, for example, leaving Pin5,6,7,8 to be floating (5V) means the selection of the first frequency value (channel 00).
- III. Click "Tx Control" button to set parameters for the transmitter: RF power, external frequency source, data polarity, PTT signal, paging protocol, etc.
Comments: low level (0V) of Pin1 of DB37 means the selection of default protocol 1; while high level (5V) of Pin1 of DB37 means the selection of default protocol 2. The two default protocol settings should not be the same value at the same time

so that you can select different protocol (POCSAG or FLEX) just by changing the input level of Pin1 of DB37.

- IV. Click "Modem" button to configure dial-out parameters and PMD board.
- V. Click "Alarms" button to set alarm limits for RF power, High VSWR, Temperature, Voltage and High Current.
- VI. Click "Read" or "Uppdate" button to Read or Update Transmitter Parameter Settings.
- VII. Click "Diagnostics" button to Diagnose the transmitter with real-time parameters (Forward Power, VSWR, Temperature, Power Voltage, PA Current and PA driver power) monitoring.
- VIII. Click "Dial Remote" button to dial remote transmitter with an internal dialer. Before dialing, please be sure to set the dial MODEM parameters using the following AT commands: AT\$0=1, AT&D0, AT&K0, AT&W0. Then, select item "Modem Setup" or "Dialer Setup" from "Local Setup" menu to setup local dial MODEM and dialer.
- IX. Click "Load" or "Save" button to Load/Save the current transmitter settings from/to a local file.
- X. Click "Terminal" button to access the terminal program.

Appendix B: Basic Connection Between Tx and Controller

I. FLEX Mode: (Connect to MOTOROLA External NIU)

❖ Connection between SONIK PTX-150 Transmitter and External NIU:

External NIU(TB3, TB4)		Transmitter(DB37)
TB3-2: Tx Clock	Connected to	DB37-18: Data Clock
TB3-4: Tx key	Connected to	DB37-11: Tx Key
TB3-8: GND	Connected to	DB37-19: Ground
		DB37-1 to DB37-19
TB4-2: Rx FQ1	Connected to	DB37-16: Tx Data, High Bit, TTL
TB4-3: Rx FQ2	Connected to	DB37-15: Tx Data, Low Bit, TTL

❖ Connection between External NIU and GPS Receiver:

➤ GPS time signal:

GPS Receiver (serial port, 9 Pin)		External NIU (option port, 9 Pin)
Pin 1	Connected to	Pin 4
Pin 2	Connected to	Pin 3
Pin 3	Connected to	Pin 2
Pin 4	Connected to	Pin 1
Pin 5	Connected to	Pin 5
Pin 6 to Pin 1		Pin 6 to Pin 1
Pin 7	Connected to	Pin 8
Pin 8	Connected to	Pin 7

➤ GPS 1pps Signal: connected the "1pps OUT" port of GPS receiver to the "1Hz IN/OUT" port of External NIU with a RCA video cable.

- ❖ When the transmitter needs to get external frequency source from External NIU, connect the "REF IN/OUT" port of External NIU to the "External Frequency Input" port of SONIK PTX-150 transmitter with a BNC cable.

II. FLEX Mode: (Connect to Glenayre C2000 Controller)

- ❖ Connection between SONIK PTX-150 Transmitter and External NIU:

C2000 (J4)		Transmitter(DB37)
J4-10: GND	Connected to	DB37-19: Ground
		DB37-1 to DB37-19
J4-26: TXKEY+	Connected to	DB37-11: Tx Key
J4-3: TD0+, Msb	Connected to	DB37-15: Tx Data, Low Bit, TTL
J4-34: TD1+, Lsb	Connected to	DB37-16: Tx Data, High Bit, TTL
J4-18: Data Clock+	Connected to	DB37-18: Data Clock
J4-7: Freq2	Connected to	DB37-6: Freq2
J4-6: Freq1	Connected to	DB37-7: Freq1
J4-36: Freq0	Connected to	DB37-8: Freq0

- ❖ When the transmitter needs to obtain the external frequency source from C2000, connect the "10M REF OUT" port of C2000 to the "External Frequency Input" port of SONIK PTX-150 transmitter with a BNC cable.

III. POCSAG Mode: (Connect to Glenayre C2000 Controller)

Encoder		Transmitter (DB37)
Tx Data	Connected to	DB37-15: Tx Data, Low Bit
PTT	Connected to	DB37-11: Tx Key
GND	Connected to	DB37-19: Ground
		DB37-1 to DB37-19

IV. POCSAG Mode: (Connect to Zetron Model 66 Controller)

Model 66		Transmitter (DB37)
DIG DATA (pin 10)	Connected to	DB37-15: Tx Data, Low Bit
DIG PTT N/O (pin 7)	Connected to	DB37-11: Tx Key
GND (pin 3)	Connected to	DB37-19: Ground
DIG PTT COM (pin 8) to GND		DB37-1 to DB37-19

Appendix C: Satellite Link Mode Configuration for External NIU

I. Connection between External NIU and SONIK PTX-150 transmitter:

- ❖ Connect the DATA, GND and CLK output signal of satellite receiver to TB1-5(Rx Data), TB1-4(GND) and TB1-6(Rx CLK) of External NIU.

II. Jumper settings of External NIU:

- ❖ S15 Pin 1 is set to be ON. Others remain intact.

III. Software configuration for External NIU:

- ❖ The serial port settings are: COM1, 19200bps, N, 8, 1.

```
[ 0] NIU> set link ↵          ; Link settings
      link = fm2 @ 9600 from digital_in
[ 0] NIU> set align_type ↵      ; Synchronization mode
      GPS Mode: Alignment type is gps
      No GPS Mode: Alignment type is dir_sync
[ 0] NIU> config devid ↵       ; Base station device ID.
[ 0] NIU> config sysid ↵       ; System ID.
[ 0] NIU> config txd ↵         ; Paging data polarity.
[ 0] NIU> set maint_polarity ↵ ; Maintenance cycle polarity.
[ 0] NIU> show gps ↵           ; At GPS mode, display current GPS settings.
[ 0] NIU> show status ↵        ; Display current External NIU status.
[ 0] NIU> show alarm ↵         ; Display alarms for External NIU.
[ 0] NIU> show config ↵        ; Display current NIU system parameters.
[ 0] NIU> show dipsw ↵         ; Display current NIU jumper settings.
```