Type Acceptance Test Report

Broad Band PCS Transceiver

FCC ID: DNY0A5DATA1900

FCC Rule Part: 24E

ACS Report Number: 03-0096-24TA

Manufacturer: EMS Wireless
Model: DataNex

Installation and Operators Guide

EMS Wireless
DataNex™
Data-20 Digital Radio

User Reference Manual

EMS Wireless
A Division of EMS Technologies, Inc.

2850 Colonnades Court NW
Norcross, GA 30071
Phone: 770-582-0555
Fax: 770-729-0075

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Section	Drawing No:	REV	Revised / Released	Reason
Data-20		A	SN	NEW

WARNINGS, CAUTIONS, AND GENERAL NOTES

This product conforms to FCC Part 15. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 instructions, 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 or 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."

In accordance with FCC regulations regarding human exposure to radiofrequency energy, this device shall be installed such that a minimum separation distance of 20cm is maintained between it and general population.

The antennas used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. 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.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant des règlements d'équipement. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

Table of Contents

1 System Description

1.1 Introduction

The DATA-20 is a spectrum-scalable point-to-point digital radio that can deliver 8Mbps of data. Advanced modulation and digital processing techniques allow one radio to deliver user-defined rates from 512 kbps to 8Mbps

The product is an all-digital, open-architecture, modular system (see Figure 1-1 below). The versatility and power of the product comes from a complete range of “plug and play” personality modules.

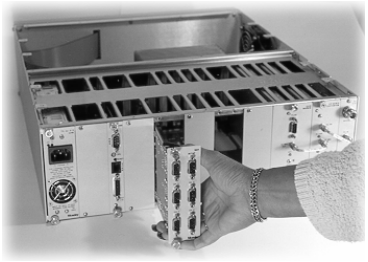

Figure 1-1. DATA-20 Modular Open Architecture

The high spectral efficiency of the DATA-20 is achieved by user-selectable QPSK, or 16 QAM. Powerful Reed-Solomon error correction, coupled with a 20-tap adaptive equalizer, provides unsurpassed signal robustness in hostile RF environments.

1.2 System Features

- Selectable Rates: 512 kbps to 8.448 Mbps
- Selectable Spectral Efficiency of 1.6 or 3.2 bps/Hz
- QPSK & QAM Modulation
- Powerful Reed-Solomon Error Correction with up to 12 level interleaver
- Built-in Adaptive Equalizer
- Internal Duplexer or external for hot standby system
- Independent Synthesized Tx & Rx units

- Auto / Manual Power Control of up to 20 dB
- Built-in Auto Pin Diode Attenuator for powerful signals
- Accurate Digital Filtering for adjacent channel rejection
- 386 Processor-based controller
- Extensive LCD screen status monitoring
- Built-in BER Meter
- Built-in NMS
- Monitoring & Time Stamping
- Monitor up to 4 external Analog & Digital I/O
- Readout of RSL in dBm
- Completely modular

1.3 Typical Configurations

1.3.1 Data Rate and Interface

Table 1-1 provides basic data channel capabilities for the DATA-20. See Section 2 (Installation) for more detailed information.

Table 1-1.DATA-20 Data Channel Configurations

Data Rate	MUX Hardware	Channels	Interface(s)
1.5 Mbps-8 Mbps	2 or 4 x E1/T1	2 or 4	G.703, E1/T1
512 kbps-2 Mbps	QAM Modem	1	Fractional E1/T1
512 kbps-2 Mbps	QAM Modem	1	V35, RS449

1.3.2 Standalone Operation

The DATA-20 may be used as a standalone digital radio with an interface in the modem or with a Multiplexer with 2 or 4 E1/T1 interfaces. The Multiplexer has an overhead channel which can be utilized by the customer

1.3.3 Hot Standby (Protected) Operation

The product in a hot standby configuration as depicted in Fig.1-2, using two DATA-20 radios and a TP64 transfer panel.

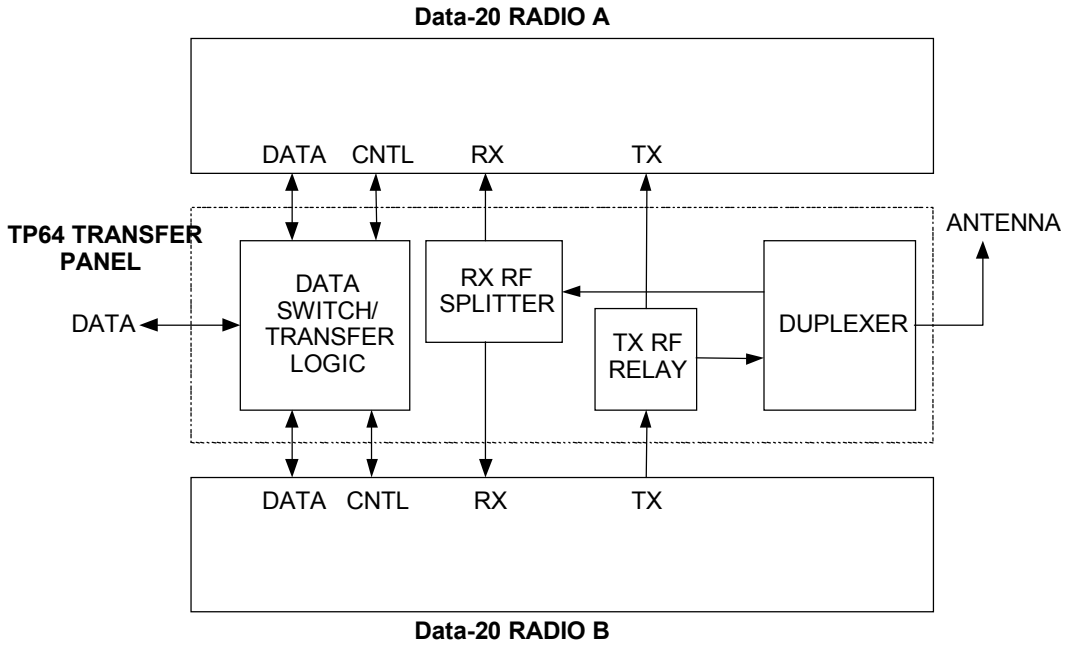

Figure 1-2. DATA-20 Hot Standby – Two Discrete Radios with Transfer Panel

1.4 Regulatory Notices

FCC Part 15 Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. 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. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his expense. Any external data or audio connection to this equipment must use shielded cables.

1.5 System Description (QAM)

1.5.1 Introduction

The product is a full-duplex digital radio. The following sections describe the TX system, RX system, followed by sub-system components. Please reference the accompanying block diagrams for clarification.

We will follow the typical end-to-end progression of a radio system starting with the TX baseband inputs, to the QAM modulator, followed by the upconversion process and the power amplifier. We then proceed to the RX preamplifier input, the downconversion process, followed by the QAM demodulator and baseband outputs.

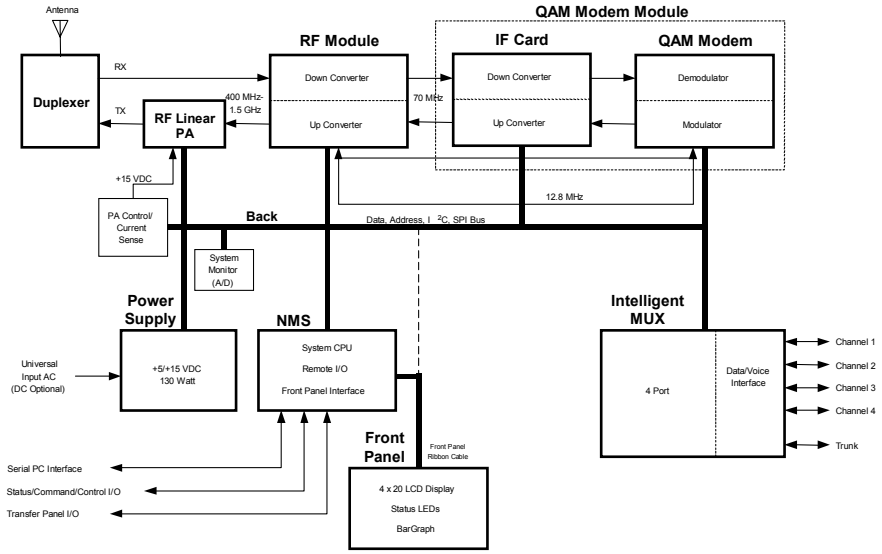

Figure 1-3. DATA-20 System Block Diagram

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All modules (excluding the Front Panel and Power Amplifier) are interconnected via the backplane that traverses the entire width of the unit. The backplane contains the various communication buses as well as the PA (Power Amplifier) control and redundant transfer circuitry. The power supply levels and status are monitored on the backplane and the NMS/CPU card processes the data.

Figure 1-4. Location of theDATA-20Backplane and Power Amplifier

The NMS/CPU card incorporates microprocessor and FPGA logic to configure and monitor the overall operation of the system via front panel controls, LCD screen menus, status LEDs and the bar graph display. Module settings are loaded into the installed cards and power-up default settings are stored in non-volatile memory. LCD screen menu software is uploaded into memory, providing field upgrade capability. A Windows-based PC interface is available for connection at the rear panel DATA port.

1.5.2 QAM Modulator/IF Upconverter

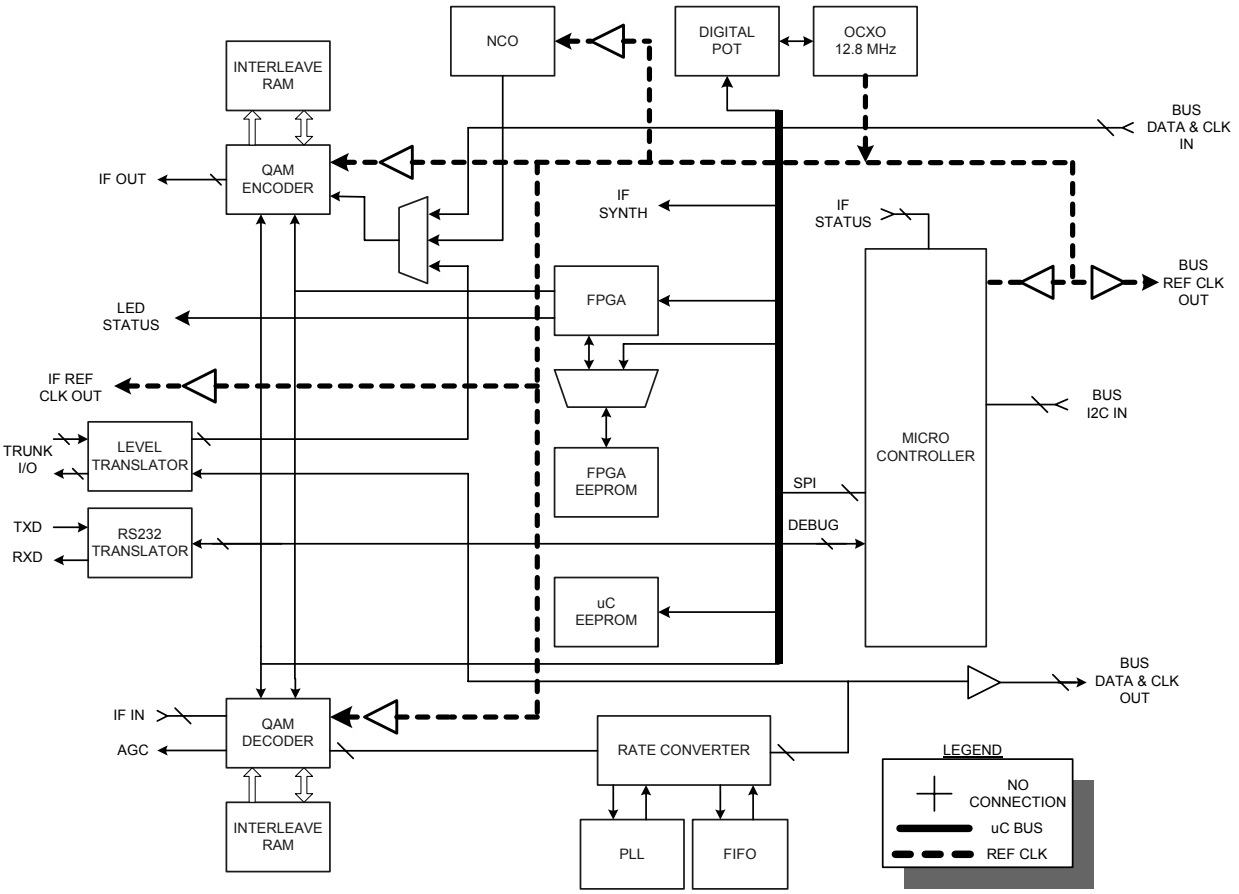


Figure 1-5. QAM Modem Block Diagram

The QAM (Quadrature Amplitude Modulation) Modulator is the transmit portion of the QAM Modem card. The QAM Modem also houses the IF Up/Down Converter. The QAM Modulator utilizes the upconverter portion of the IF daughter card.

The QAM Modulator accepts the aggregate data stream via the backplane (see Figure 1-5 above). The module performs modulation at a carrier frequency of 6.4 MHz, adding FEC (Forward Error Correction) bits while interleaving the blocks of data. The result is a very spectrally efficient, yet robust linear modulation scheme. This process requires an ultra-stable

master clock provided by an OCXO (oven controlled crystal oscillator) that is accurate to within 0.1 ppm.

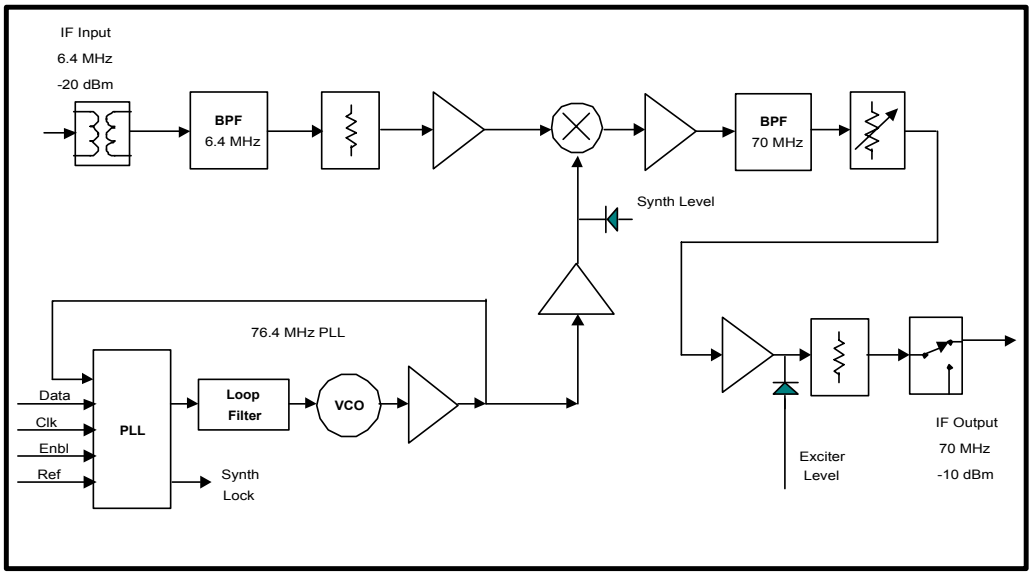


Figure 1-6. IF Upconverter Block Diagram

The resultant carrier is translated up to 70 MHz by the IF Upconverter (see Figure 1-6). This is accomplished by a standard mixing of the carrier with a phase-locked LO. A 70 MHz SAW filter provides an exceptional, spectrally-clean output signal.

1.5.3 RF Upconverter

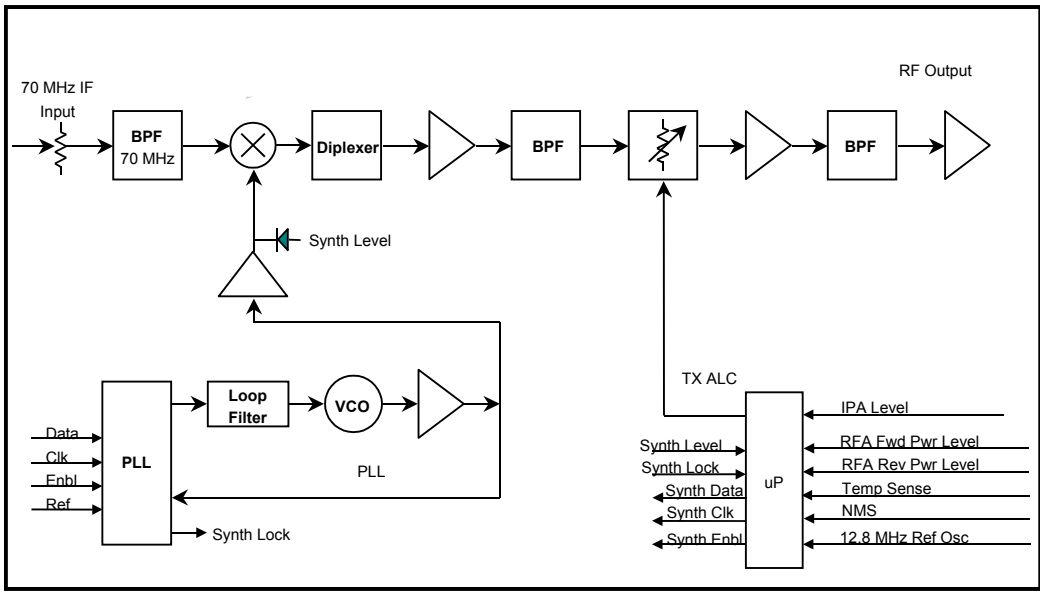


Figure 1-7. RF Upconverter Block Diagram

The IF output carrier of the IF Upconverter daughter card is fed to the transmit portion of the RF Module via an external (rear panel) semi-rigid SMA cable. This module performs the necessary upconversion to the RF carrier (see Figure 1-7). There is an on-board CPU for independent control of the critical RF parameters of the system.

Since this is a linear RF processing chain, an automatic leveling control loop (ALC) is implemented here to maintain maximum available power output (and therefore maximum system gain). The ALC monitors the PA forward power (FWD) output sample, and controls the upconverter gain per an algorithm programmed in the CPU. The ALC also controls the power-up RF conditions of the transmitter output.

1.5.4 Power Amplifier (PA)

The Power Amplifier (PA) is a separate module that is mounted to a heat sink and is fan-cooled for reliable operation. The PA is a design for maximum linearity in an amplitude modulation-based system.

1.5.5 RF Downconverter

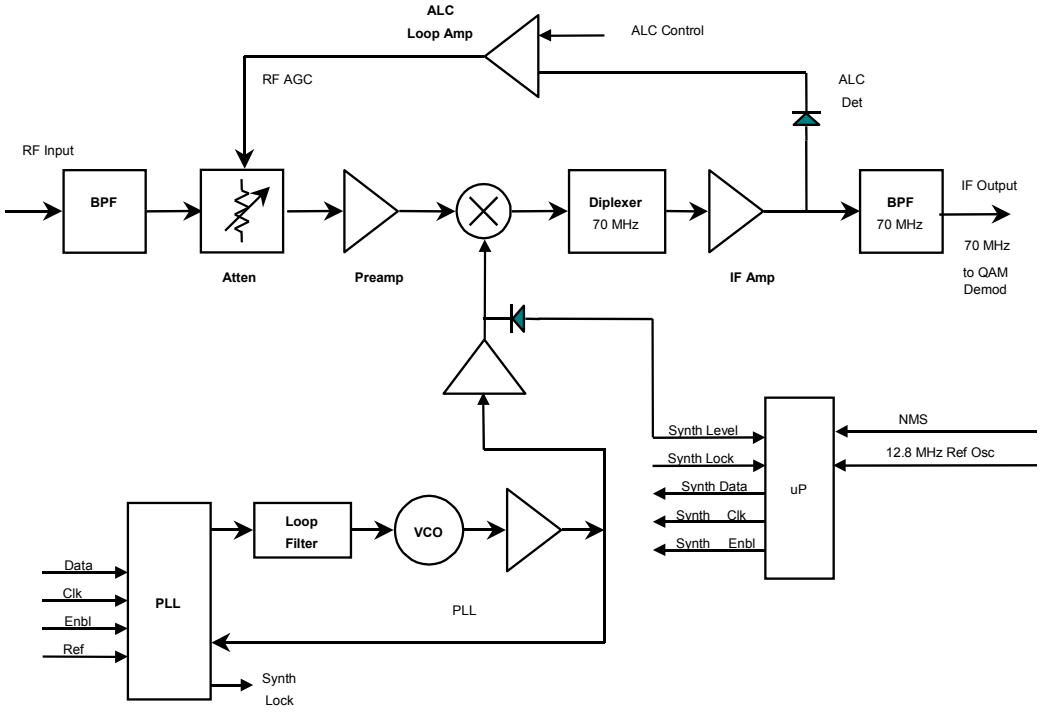


Figure 1-8. RF Downconverter Block Diagram

The receiver handles the traditional RF to IF conversion from the carrier to 70 MHz (see Figure 1-8). Considerations are given to image rejection, intermodulation performance, dynamic range, agility, and survivability. A separate AGC loop was assigned to the RF front end to prevent intermodulation and saturation problems associated with reception of high level undesirable

interfering RF signals resulting from RF bandwidth that is much wider than the IF bandwidth. The linear QAM scheme is fairly intolerant of amplifier overload.

1.5.6 QAM Demodulator/IF Downconverter

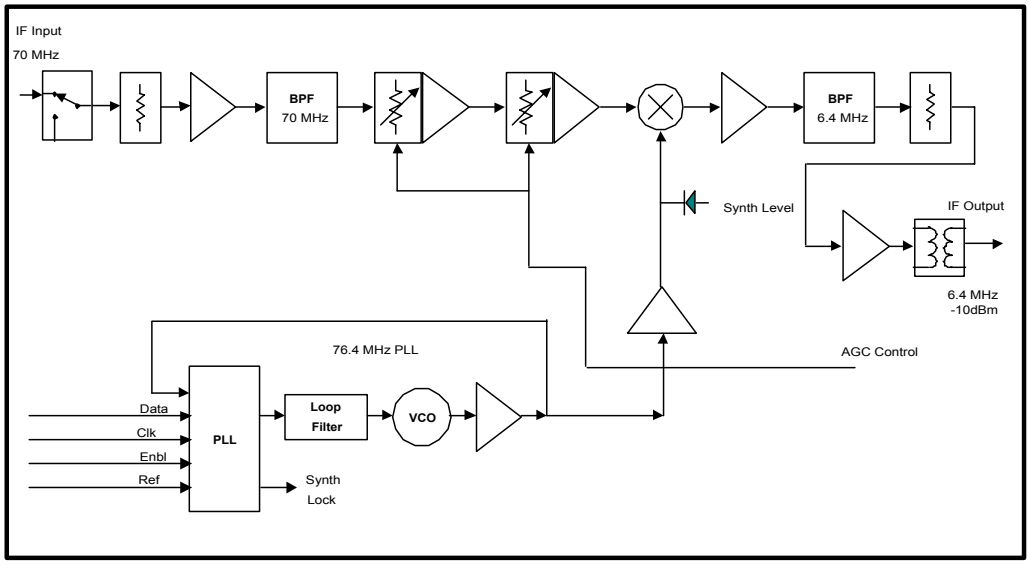


Figure 1-9. IF Downconverter Block Diagram

The QAM (Quadrature Amplitude Modulation) Demodulator is the receive portion of the QAM Modem card. The QAM Modem also houses the IF Up/Down Converter. The QAM Demod utilizes the downconverter portion of the IF daughter card.

The IF Downconverter receives the 70 MHz carrier from the receiver portion of the RF Module via an external semi-rigid cable and directly converts the carrier to 6.4 MHz by mixing with a low-noise phase-locked LO (see Figure 1-9). System selectivity is achieved through the use of a 70 MHz SAW filter.

The QAM Demod receives and demodulates the 6.4 MHz carrier (see Figure 1-7). The demodulation process includes the FEC implementation and de-interleaving that matches the QAM modulator in the transmitter, and the critical “data assisted recovery” of the clock. This process requires an ultra-stable master clock provided by an OCXO (oven controlled crystal oscillator).

The output is an aggregate data stream that is distributed to the trunk port for if the data input/output is out of the Modem, or to the backplane for connection to the multiplexer connected on the backplane.

2 Installation

2.1 Unpacking

The following is a list of all included items.

Description	Quantity
Digital Radio (3RU chassis)	1
Rack Ears (with hardware)	4
Extender Card (Universal QAM) — optional	1
Power Cord (IEC 3 conductor for AC, 2-wire for DC)	2
Manual (or Soft copy on a CD)	1
Test Data Sheet (customer documentation)	1

Be sure to retain the original boxes and packing material in case of return shipping. Inspect all items for damage and/or loose parts. Contact the shipping company immediately if anything appears damaged. If any of the listed parts are missing, call the distributor or the factory immediately to resolve the problem.

2.2 Notices

CAUTION

DO NOT OPERATE UNITS WITHOUT AN ANTENNA, ATTENUATOR, OR LOAD CONNECTED TO THE ANTENNA PORT. DAMAGE MAY OCCUR TO THE TRANSMITTER DUE TO EXCESSIVE REFLECTED RF ENERGY.

ALWAYS ATTENUATE THE SIGNAL INTO THE RECEIVER ANTENNA PORT TO LESS THAN 3000 MICROVOLTS. THIS WILL PREVENT OVERLOAD AND POSSIBLE DAMAGE TO THE RECEIVER MODULE

WARNING

HIGH VOLTAGE IS PRESENT INSIDE THE POWER SUPPLY MODULE WHEN THE UNIT IS PLUGGED IN. REMOVAL OF THE POWER SUPPLY CAGE WILL EXPOSE THIS POTENTIAL TO SERVICE PERSONNEL. TO PREVENT ELECTRICAL SHOCK, UNPLUG THE POWER CABLE BEFORE SERVICING. UNIT SHOULD BE SERVICED BY QUALIFIED PERSONNEL ONLY.

PRE-INSTALLATION NOTES

Always pre-test the system on the bench in its intended configuration prior to installation at a remote site. Avoid cable interconnection length in excess of 1 meter in strong RF environments. We highly recommend installation of lightning protectors to prevent line surges from damaging expensive components.

2.3 Rack Mount

The product is normally rack-mounted in a standard 19” cabinet. Leave space clear above (or below) the unit for proper air ventilation of the card cage. The rack ears are typically mounted as shown in Figure 2-1. Other mounting methods are possible by changing the orientation of the rack ears.

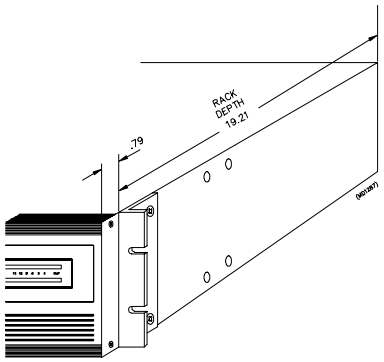


Figure 2-1.DATA-20 Typical Rack Mount Bracket Installation

2.4 Duplexer: Internal/External

Various duplexers, both internal and external, can be utilized. For current duplexers utilized with the radios, please see the Appendix.

2.5 Rear Panel Connections & Indicators

Please refer to the Figure 2-2 for a pictorial of a typical product rear panel (internal duplexer). Following is a descriptive text of the connections and LED indicators.

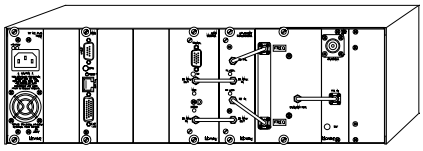


Figure 2-2.DATA-20 Rear Panel Connections

Power Supply:

Inputs:	AC:	Universal Input, 100-240V, 50/60 Hz; IEC 3 conductor
	DC:	24v/48v (Isolated Input); 2 pin socket (custom)
Status LED:	+12V:	Green LED indicates +12 volt supply OK
	+5V:	Green LED indicates +5 volt supply OK

NMS Card

I/O Port:	RS232 PC access; 9 pin D-sub (female)
Reset Switch:	Activates hard system reset
Status LED:	Green LED Indicates CPU OK

QAM Modem

I/O Ports:	TRUNK:	Data I/O 15pin D-sub (female) HD
RF Connectors:	70 MHz OUT:	SMA (female); Modulator output
	70 MHz IN:	SMA (female); Demod input
Status LED:	MOD:	GREEN indicates Modulator Lock
	DEMOD:	GREEN indicates Demod Lock

Up/Down Converter Module

RF Connectors:	TO PA:	SMA (female), Upconverter output to be applied to linear Power Amplifier module (internal to radio).
	70 MHz IN:	SMA (female), Modulated IF input from QAM Modulator.
	RF IN:	SMA (female), Receiver input.
	70 MHz OUT:	SMA (female); Downconverter output to Modulator input
Status LED:	TX LOCK:	GREEN indicates TX AFC LOCK Flashing RED indicates LOSS OF TX LOCK
	RX LOCK:	GREEN indicates RX AFC LOCK and strong RX signal YELLOW indicates RX AFC LOCK and nominal RX signal RED (continuous) indicates RX AFC LOCK and weak RX signal RED (flashing) indicates LOSS OF RX LOCK

RF I/O Panel

RF Connectors:	ANTENNA:	Type N (female), RF cabling from internal PA module.
	PA IN:	SMA (female), RF cabling to internal PA module.
	RX OUT:	SMA (female), RF cabling from internal duplexer.

SEMI-RIGID CABLE

Ensure that the cables are secure and tightly attached.

Check for any damage (kinks or breaks in the copper sheath).

2.6 Power Requirements

2.6.1 Power Supply Card Slot Details

The leftmost slot in the DATA-20 card cage (as viewed from the rear of the unit) is designated as the “PRIMARY A” power supply. The main bus voltages (+5 and +/-12) are summed in the backplane and provide the supply the plug-in modules.

NOTE: The front panel LCD screen displays the system supply voltages and the nomenclature follows the physical location of the power supply modules.

2.6.2 AC Line Voltage

The DATA-20 uses a high reliability, universal input switching power supply capable of operating within an input range of:

100 - 240 VAC; 50/60 Hz

The power supply module is removable from the unit and a perforated cage protects service personnel from high voltage. The power supply is fan cooled due to high power consumption by the PA.

CAUTION

High voltage is present when the unit is plugged in. To prevent electrical shock, unplug the power cable before servicing. Power supply module should be serviced by qualified personnel only.

2.6.3 DC Input Option

An optional DC input power supply is available for the DATA-20; using high reliability, DC-DC converter(s) capable of operation within the following input ranges (dependent upon nominal input rating):

Nominal DC Input	Operating Input Range
24 Volt:	20 – 28 VDC
48 Volt:	32 – 64 VDC

The DC input is isolated from chassis ground and can be operated in a positive or negative ground configuration. The power supply module is removable from the unit and no high voltages are accessible.

2.6.4 Fusing

For AC modules, the main input fuse is located on the switching power supply mounted to the carrier PC board and the protective cage may be removed for access to the fuse.

For DC modules, all fusing is located on the carrier PC board.

Always replace any fuse with same type and rating. Other fuses are present on the board, and are designed for output fail-safe protection of the system. All output fuse values are printed on the backside of the PC board to aid in replacement.

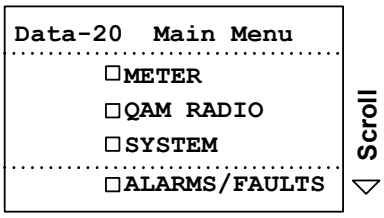
NOTE: If a fuse does blow in operation, investigate the possible cause of the failure prior to replacing the fuse, as there is adequate built-in protection margin.

2.7 Power-Up Setting

As shipped, the DATA-20 will radiate into the antenna upon power-up, THIS ASSUMES THAT THE ANTENNA LOAD IS GOOD (LOW VSWR). If the VSWR of the load causes a high reverse power indication at the PA, the red VSWR LED will light and the transmitter will cease radiating. This is called the “AUTO” setting in the QAM RADIO CONTROL screen (see below).

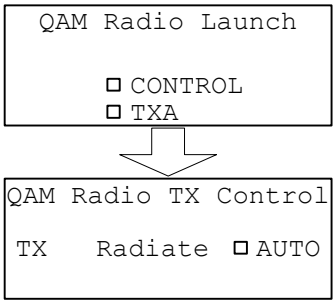
The LCD screen (“QAM RADIO TX CONTROL”) selects the power-up state and controls the radiate function of the TX unit.

Go to the MAIN MENU:



Scroll to QAM Radio, press ENTER.

Select Launch Screen for CONTROL TX, press ENTER:



Verify the AUTO setting.

AUTO: Transmitter will protect its PA by “folding back” the ALC under bad load VSWR condition *(default setting)*

ON: Transmitter will remain in radiate at full power under all antenna port conditions *(not recommended).*

OFF: Transmitter in standby mode.

2.8 Data Interface

2.8.1 4xE1/T1 MUX Channel Configurations

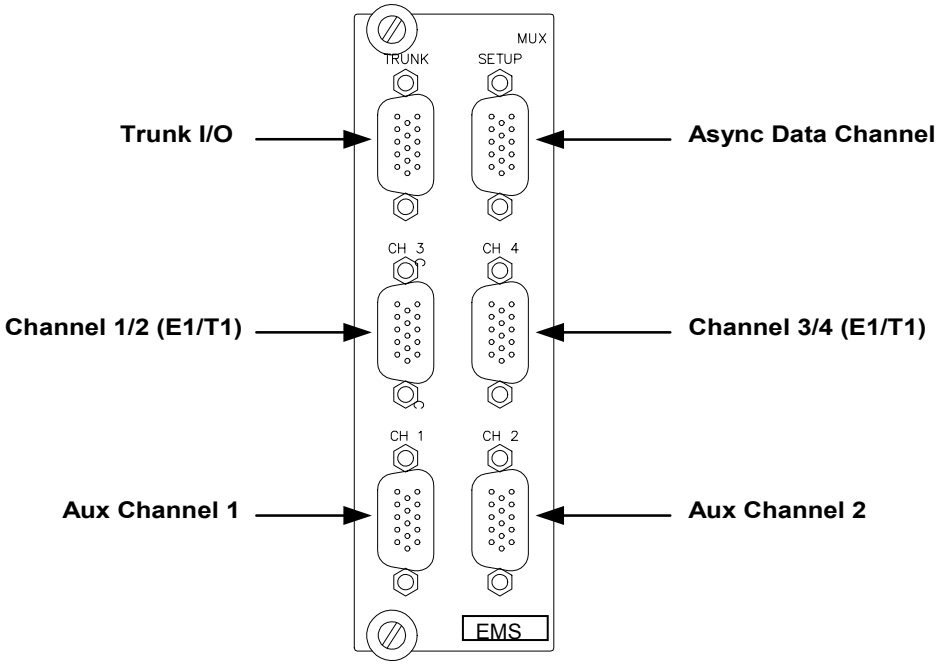


Figure 2-3. 4XE1/T1 MUX Panel

The 4xE1/T1 MUX is a high speed card (up to 8 MBPS) that has a total of 7 ports. Table 2-1 summarizes the capabilities.

Table 2-1.DATA-20 4xE1/T1 MUX Data Channel Configurations

Chnl	Data Rate 4xE1 (BPS)	Data Rate 4xT1 (BPS)	Data Rate 2xE1 (BPS)	Data Rate 2xT1 (BPS)	Data Rate 1xE1 (BPS)	Data Rate 1xT1 (BPS)	Inter-face
1	2.048 K	1.544 K	2.048 K	1.544 K	2.048 K	1.544 K	G.703, DSX-1
2	2.048 K	1.544 K	2.048 K	1.544 K	---	---	G.703, DSX-1
3	2.048 K	1.544 K	---	---	---	---	G.703, DSX-1
4	2.048 K	1.544 K	---	---	---	---	G.703, DSX-1
* Aux1	128 K	96 K	64 K	48 K	32 K	24 K	V.35, RS449
* Aux2	128 K	96 K	64 K	48 K	32 K	24 K	V.35, RS449
ASYNC Data	9600	7200	4800	3600	2400	1800	RS232

* AUX Channels 1-2 can be combined to form 2xCh.1 or 2xCh.2 (i.e., in 4xE1 mode, AUX could be a single channel of 256 KBPS)

2.9 Hot Standby (Protected) Configuration

The DATA-20 may be installed in a hot standby (protected) configuration. This consists of twoDATA-20 chassis with a TP64 transfer panel (Figure 2-5)

Transfer Panel Connection

The usual hot standby configuration uses an external duplexer. This minimizes RF losses and provides independent TX and RX module switching. A duplexer should already be mounted on the TP64 chassis. Alternatively, rack mounted duplexers (typical for tighter channel spacings) may be provided. The connections are the same, although the physical location is different.

A power divider (used to split the signal equally to two receivers) is required in this mode. The input to the power divider connects directly to the duplexer with an N-N (male) adapter.

See Figure 2-4 for installation details.

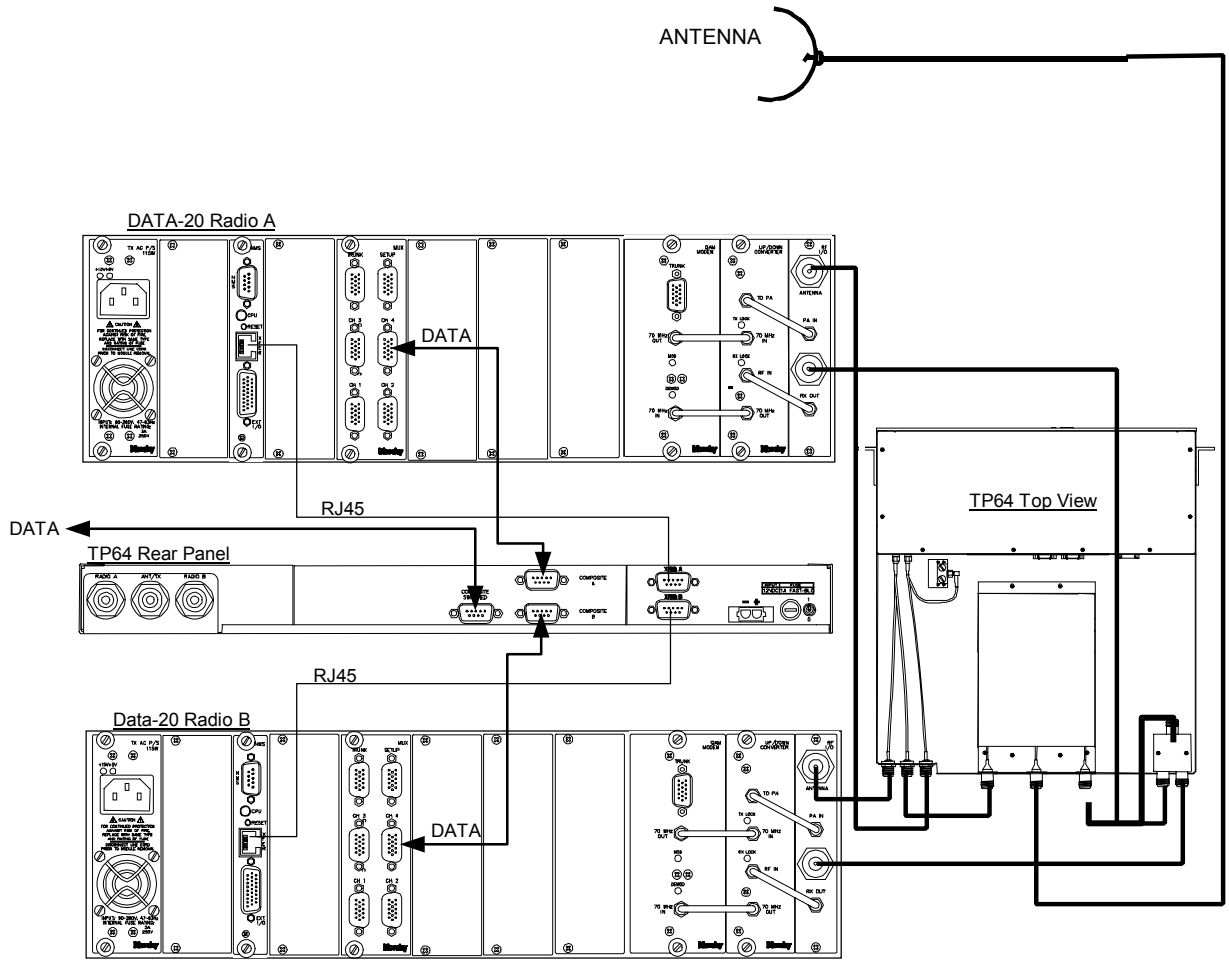


Figure 2-4.DATA-20 Hot Standby – with Transfer Panel

2.9.1 Hot/Cold Standby Modes

Hot Standby (*preferred)

Hot standby leaves both transmitters in the RADIATE ON condition, and the transfer logic controls the RF relay to select the active transmitter, thereby decreasing switchover time. This is the preferred operating mode.

Cold Standby

Cold standby can be used in situations where lower power consumption is a priority. In this mode, the transfer logic will control the RADIATE function of each transmitter, turning the RF

output ON (in tandem with the RF relay) as required for switching. This will increase switching time and a corresponding increase in data loss during the switchover.

2.9.2 Hot Standby Control using the TP64

2.9.2.1 TP64 Front Panel Controls and Indicators

Note: See the following section for a detailed description of the Master/Slave logic implemented in the TP64.

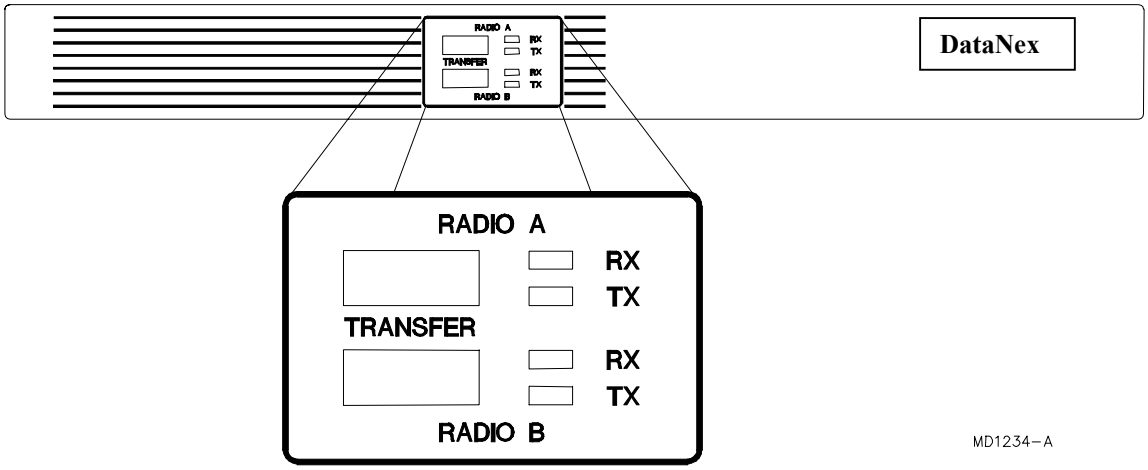


Figure 2-5. TP64 Front Panel

LED Indicators

Green:	The indicated module is active, and that the module is performing within its specified limits.
Yellow:	The indicated module is in standby mode, ready and able for back-up transfer.
Red:	There is a fault with the corresponding module. It is not ready for backup, and the TP64 will not transfer to that module.

TRANSFER Switches

The RADIO A and RADIO B transfer switches cause the selected radio to become *active*, and the *Master*. See Section 3.4 (following) for further details.

2.9.2.2 Master/Slave Operation & LED Status

The TP64 operates in a Master/Slave logic mode. In the power up condition, the Master is RADIO A. This means that RADIO A is the default active unit. The following logic applies to hot or cold standby, external or internal duplexer configurations.

Table 2-3. TP64 Transmitter Master/Slave Logic

	Selected Master	TXA Status	TXB Status	TXA LED	TXB LED	Active TX	TX Relay Position
A-Master Logic	A	OK	OK	GRN	YEL	A	A
	A	OK	FAIL	GRN	RED	A	A
	A	FAIL	OK	RED	GRN	B	B
	A	FAIL	FAIL	RED	RED	N/A	A
B-Master Logic	B	OK	OK	YEL	GRN	B	B
	B	OK	FAIL	GRN	RED	A	A
	B	FAIL	OK	RED	GRN	B	B
	B	FAIL	FAIL	RED	RED	N/A	B

Table 2-4. TP64 Receiver Master/Slave Logic

	Selected Master	RXA Status	RXB Status	RXA LED	RXB LED	Active RX	RX Data & Clk
A-Master Logic	A	OK	OK	GRN	YEL	A	A
	A	OK	FAIL	GRN	RED	A	A
	A	FAIL	OK	RED	GRN	B	B
	A	FAIL	FAIL	RED	RED	N/A	None
B-Master Logic	B	OK	OK	YEL	GRN	B	B
	B	OK	FAIL	GRN	RED	A	A
	B	FAIL	OK	RED	GRN	B	B
	B	FAIL	FAIL	RED	RED	N/A	None

A-Master Logic (default power-up):

If RADIO A is “good”, the TP64 will remain in RADIO A position, regardless of RADIO B’s status.

If RADIO A fails, the TP64 will switch to RADIO B (assuming that RADIO B is “good”)

If RADIO A then returns to a “good” condition, the TP64 will switch back to RADIO A (the default Master)

Manual Switchover to B-Master Logic

The front panel switch on the TP64 can be used to manually force the system to a new Master.

By pressing the RADIO B button, RADIO B now becomes the Master, and the TP64 will switchover to RADIO B (assuming that RADIO B is “good”).

The default A-Master Logic will then switch to B-Master Logic, as outlined in Tables 2-3 and 2-4.

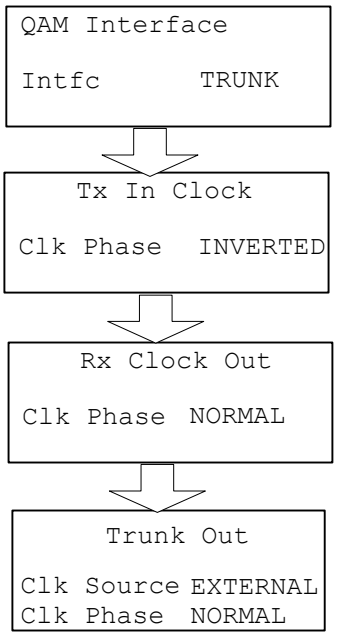
Note: Manual switching of the Master is often used to force the system over to the standby unit. The user may want to put more “time” on the standby unit after an extended period of service. In Hot Standby configurations, this will not buy the user anything in terms of reliability. In Cold Standby, the “burn time“ is more significant, since the RF power amplifier device operating life becomes a factor.

2.9.2.3 DATA-20 Software Settings

The full array of available settings for the Control and Configuration menus are located in Section 3—Operation of the Front Panel. Shown here are the applicable settings for redundant standby systems.

Clock Settings

For proper operation, the clock settings (located in the QAM Radio/Config/Modem Menu) must be set as follows:

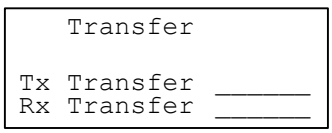


Control Settings

These settings configure the transmitter for hot (or cold) standby.

It is important that each DATA-20 radio in the redundant pair is configured identically for proper operation.

In the SYSTEM TRANSFER menu:



Tx Transfer:

OFF: Turns Transmitter Transfer Mode OFF.

Rx Transfer:

OFF: Indicates the receivers are not switched.

In the QAM Radio TX Control menu:

```
QAM Radio Tx Control

TX   Radiate_______
```

Tx Radiate:

ON: Configures the Transmitter to always RADIATE.

2.9.2.4 TP64 Settings

The TP64 software settings are contained in the internal firmware. Aside from the front panel RADIO A/B Master Select (as described above), there are no user-configurable settings in the TP64 unit.

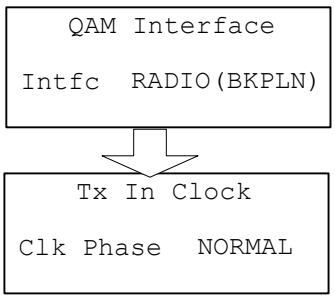
2.9.3 Hot Standby Control with Single Unit

2.9.3.1 DATA-20 Software Settings

The full array of available settings for the Control and Configuration menus are located in Section 3—Operations. Shown here are the applicable settings for single systems.

Clock Settings

All controls and indications can be found on the DATA-20 front panel LCD display (located in the QAM Radio/Config/ModA or ModB Menu).



Control Settings

These settings configure the transmitter for hot (or cold) standby.

It is important that each DATA-20 radio in the redundant pair is configured identically for proper operation.

In the SYSTEM TRANSFER menu:

```
   Transfer

Tx Transfer  ______
Rx Transfer  ______
```

Tx Transfer:

HOT: Configures the Transmitter for HOT STANDBY operation.**(preferred)*

COLD: Configures the Transmitter for COLD STANDBY operation.

Rx Transfer:

ON: Places the receivers in both active and transfer mode.

In the QAM Radio TX Control menu:

```
QAM Radio Tx Control

TX   Radiate______
```

Tx Radiate:

AUTO: Software controls the RADIATE function.

2.10 Site Installation

The installation of the DATA-20 involves several considerations. A proper installation is usually preceded by a pre-installation site survey of the facilities. The purpose of this survey is to familiarize the customer with the basic requirements needed for the installation to go smoothly. The following are some considerations to be addressed (refer to Figure 2-8 for Site Installation Details).

Before taking the product to the installation site verify that the interface connections are compatible with the equipment to be connected. Also, locate the information provided by the path analysis that should have been performed before ordering the equipment. At the installation site, particular care should be taken in locating the product in an area where it is protected from the weather and as close to the antenna as possible. Locate the power source and verify that it is suitable for proper installation.

The installations should only be performed by qualified technical personnel only.

2.11 Antenna/Feed System

2.11.1 Antenna Installation

For compliance with FCC RF Exposure requirements the following has to be adhered to:-

1. All antenna installation and servicing is to be performed by qualified technical personnel only. When servicing the antenna, or working at distances closer than those noted below, ensure the transmitter has be disabled.

2. Typically, the antenna connected to the transmitter is a directional (high gain) antenna, fixed-mounted on the side or top of a building, or on a tower. Depending upon the application and the gain of the antenna, the total composite power could exceed 20 to 61watts EIRP. The antenna location should be such that only qualified technical personnel can access it, and that under normal operating conditions the antenna separation from the user is required to be located at the distance of 3.5meters or more.

   EIRP at the antenna is calculated as follows:-

   Transmit power – Cable loss + Antenna Gain = EIRP

   Eg.

   +31.1dBm – 6dB(for 100m LDF5-50A) +36dBi = 61.1Bmi

3 Front Panel Operation

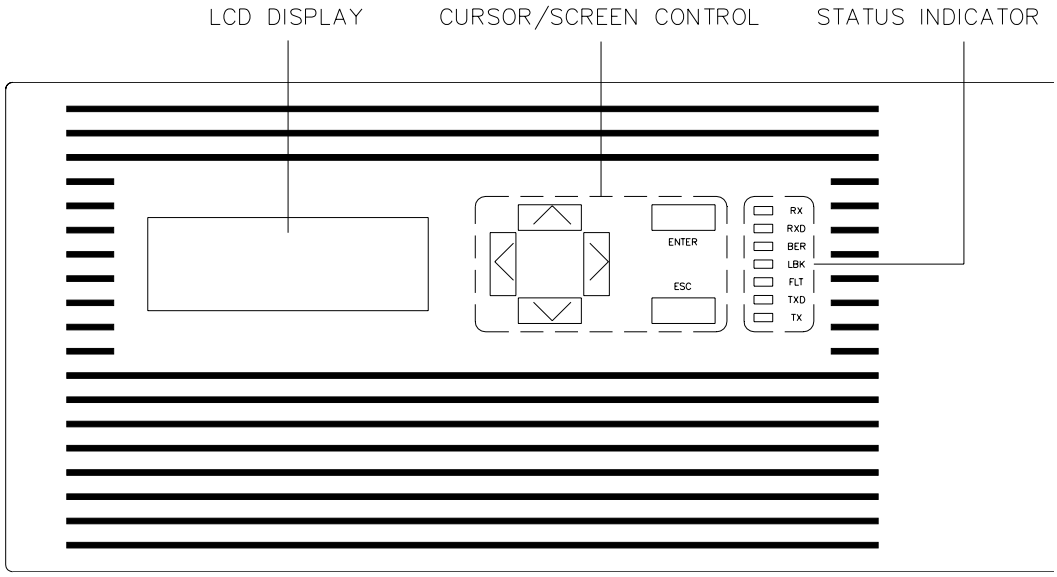
3.1 Introduction

This section describes the front panel operation of the DATA-20 digital radio/modem. This includes:

- LCD display (including all screen menus)
- Cursor and screen control buttons
- LED status indicators

3.2 Front Panel Operation

A picture of the DATA-20 front panel is depicted in Figure 3-1 below.



(MD1152-A)

Figure 3-1.DATA-20 Front Panel

3.2.1 LCD Display

The Liquid Crystal Display (LCD) on the DATA-20 front panel is the primary user interface and provides status, control, configuration, and calibration functionality. The menu navigation and various screens are explained in detail later in this section.

Backlight:

An automatic backlight is built-in to the LCD for better clarity under low-light conditions. This backlight is enabled on power-up and will automatically turn off if there is no button activity by the user. The backlight will automatically turn on as soon as any button is pressed.

Contrast Adjustment:

Internal adjustment on board (in back of front panel button PCB).

3.2.2 Cursor and Screen Control Buttons

The buttons on theDATA-20 front panel are used for LCD screen interface and control functions:

ENT	<ENTER>	Used to accept an entry (such as a value, a condition, or a menu choice).
ESC	<ESC>	Used to “back up” a level in the menu structure without saving any current changes.
▲ ▼	<UP>,<DOWN>	Used in most cases to move between the menu items. If there is another menu in the sequence when the bottom of a menu is reached, the display will automatically scroll to that menu.
◀ ▶	<LEFT>,<RIGHT>	Used to select between conditions (such as ON/OFF, ENABLED/DISABLED, LOW/HIGH, etc.) as well as to increase or decrease numerical values.

3.2.3 LED Status Indicators

Table 3-1. LED Status Indicator Functions

LED	Name	Function
RX	Receiver	Green indicates that the receiver is enabled, the synthesizer is phase-locked, and a signal is being received.
RXD	Receive Data	Green indicates that valid data is being received.
BER	Bit Error Rate	Flashes red for each data error detected.
FLT	Fault	General fault light (red). Consult the STATUS menus for out of tolerance conditions.
LBK	Loopback	Red indicates analog or digital loopback is enabled.
TXD	Transmit Data	Green indicates the modem clock is phase-locked and data is being sent.
TX	Transmitter	Green indicates the transmitter is radiating, and the RF output (forward power) is above the factory-set threshold.

3.2.4 Screen Menu Tree Structure

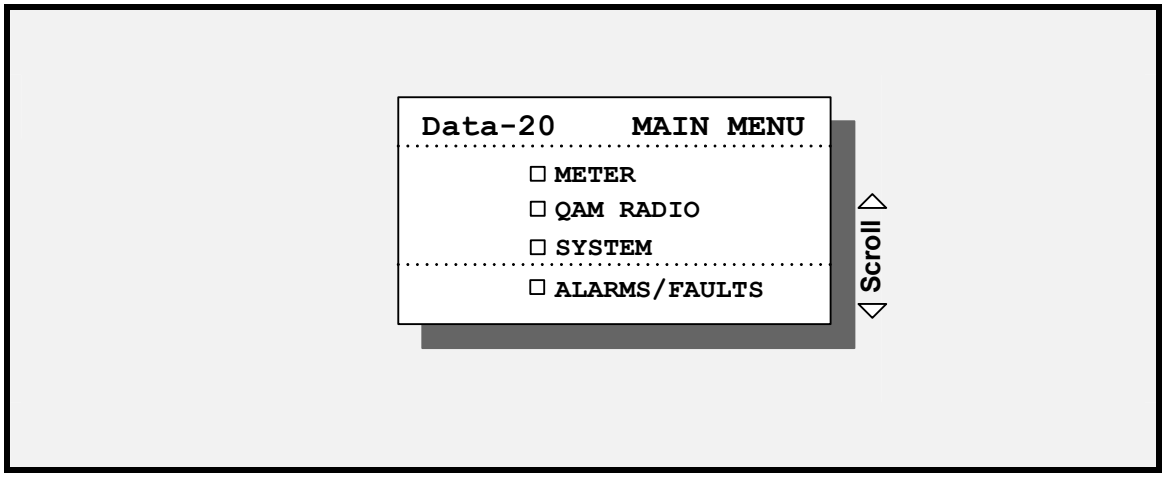
Figures 3-2a, b and c, located on pages 3-7, 3-8, 3-9 and 3-10, show the tree structure of the screen menu system. The figures group the screens into functional sets. There may be minor differences in the purchased unit, due to software enhancements and revisions. The current software revision may be noted in the **SYSTEM** sub-menu (under **INFO**).

In general, <**ENTER**> will take you to the next screen from a menu choice, <**UP**> or <**DOWN**> will scroll through screens within a menu choice, and <**ESC**> will take you back up one menu level. Certain configuration screens have exceptions to this rule, and are noted later in this section.

CAUTION

DO NOT change any settings in the CONFIGURE or CALIBRATE screens. The security lock-out features of the software may not be fully implemented, and changing a setting will most likely render the system non-operational!

3.3 Main Menu



The main menu appears on system boot-up, and is the starting point for all screen navigation. Unlike most other screens in the software, the main menu scrolls up or down, one line item at a time.

3.3.1 Launch Screens

The **LAUNCH** screen allows the user to quickly get to a particular screen within a functional grouping in the unit. The logic is slightly different than other screens. Figure 3-2 below contains a "Launch Screen Navigation Guide" to assist the user in locating the desired Radio screen.

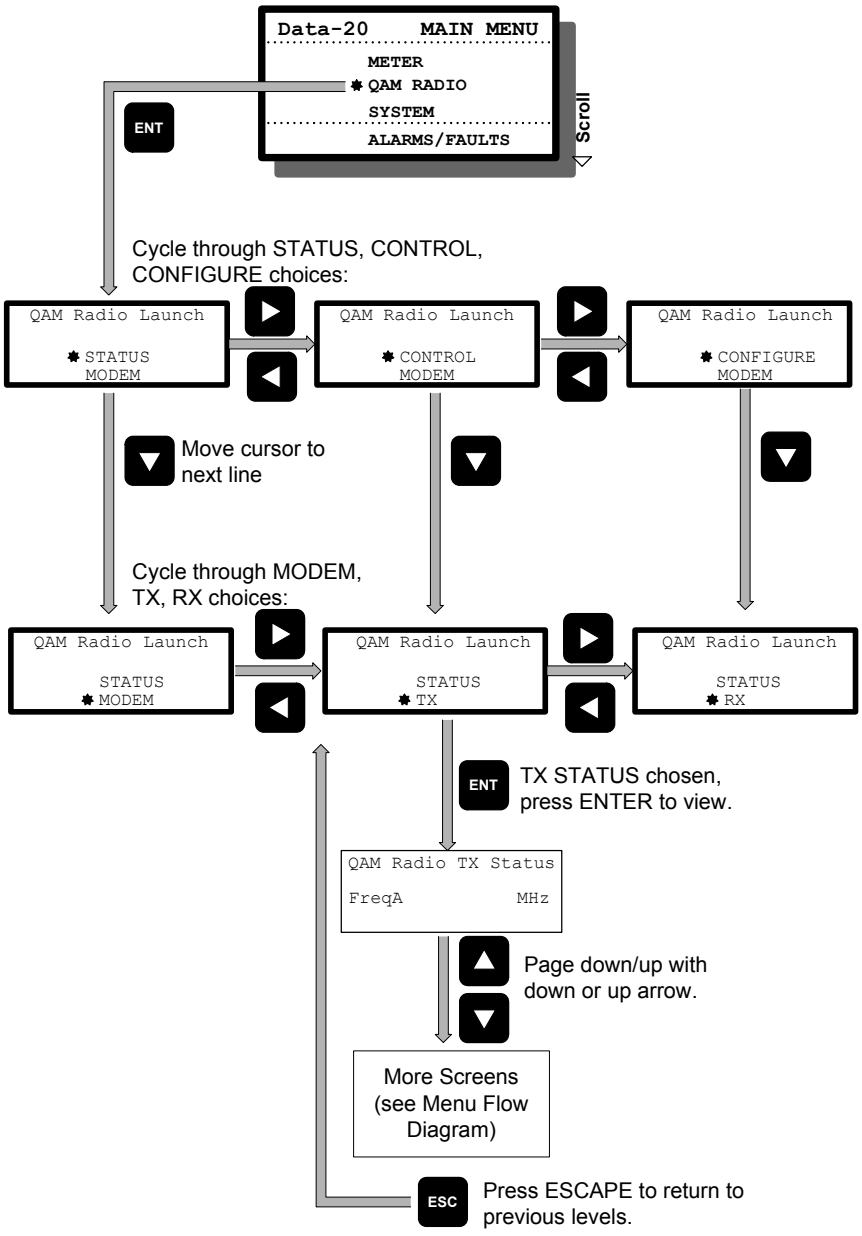
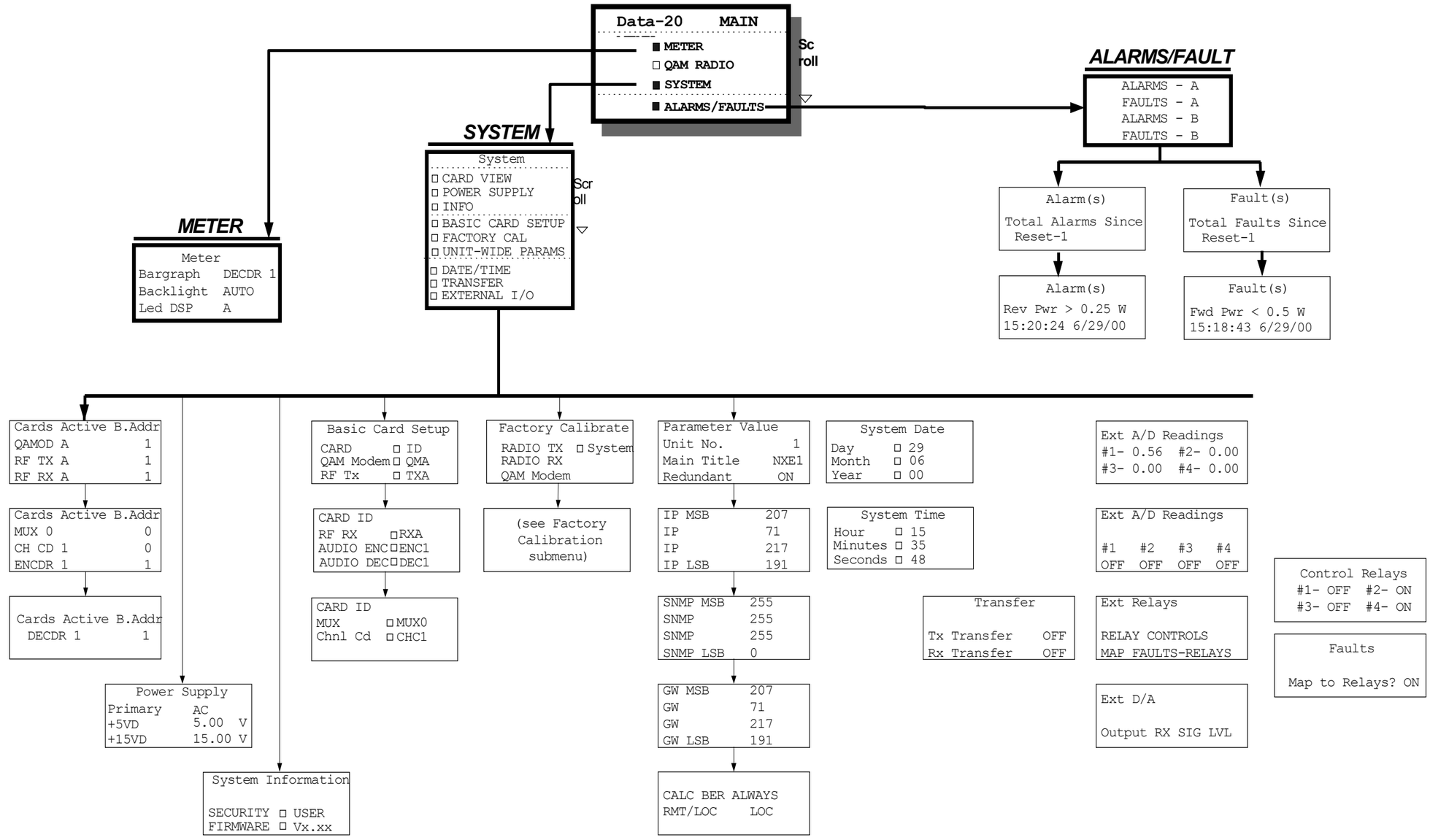


Figure 3-2. Launch Screen Navigation Guide

This page is intentionally blank.



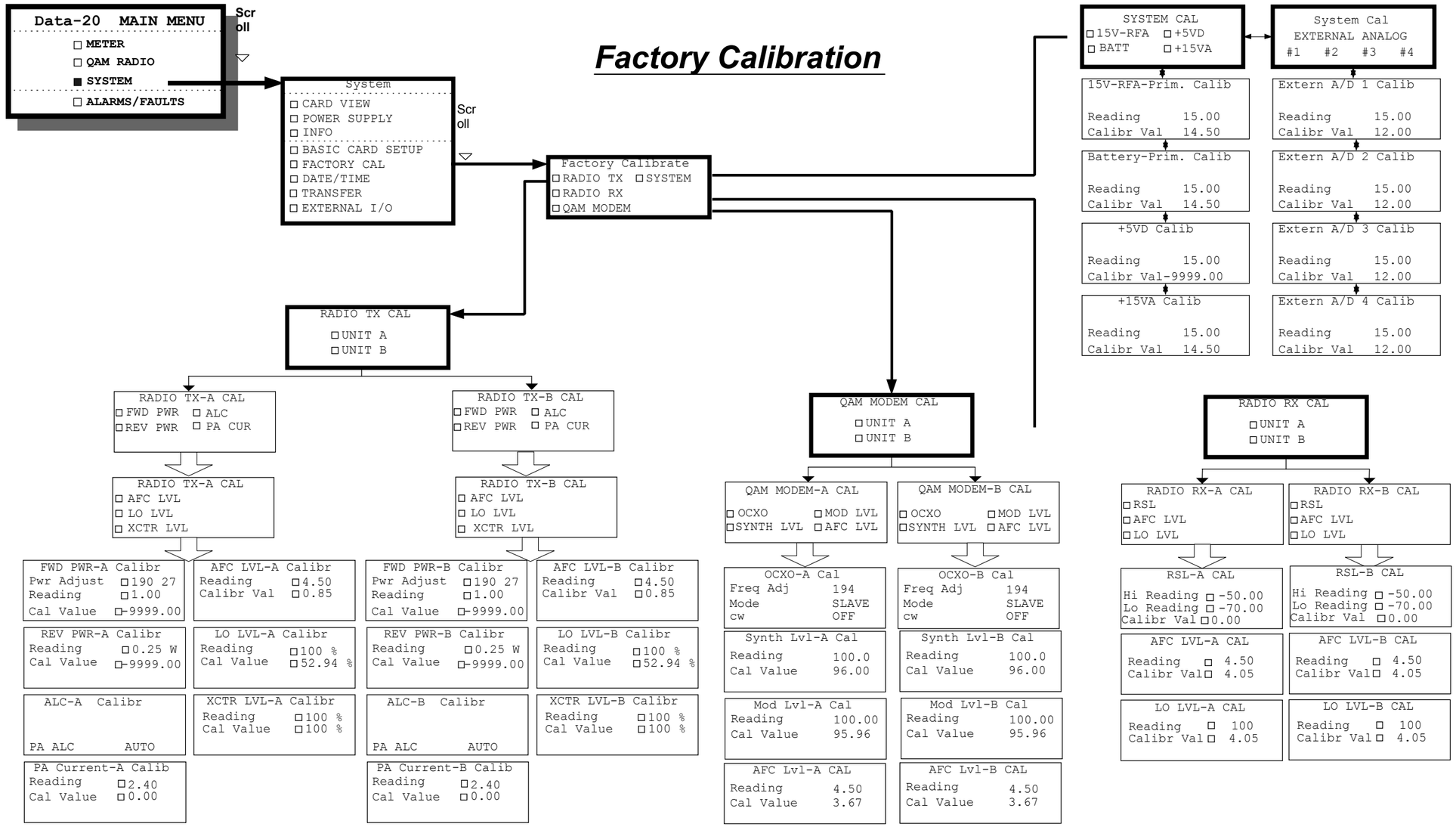
****Note:** "A" module and "Primary" screens are the default.

"B" module and "Secondary" calibrations are available only when redundant systems are configured.

Meter, System,

Figure 3-2a
LCD SCREEN MENU

Factory Calibration



Note: "B" Module and "Secondary" calibrations are available only when redundant systems are configured.

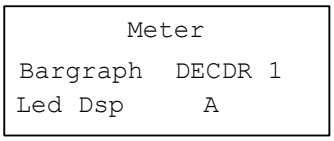
"A" module and "Primary" screens are the default.

Figure 3-2d
LCD SCREEN MENU TREE

3.4 Screen Menu Summaries

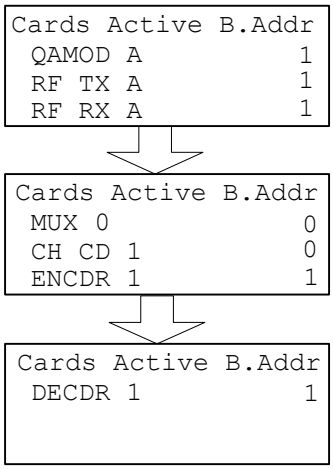
The following tables and text provide a screen view for that topic as well as the functions and settings of that screen. The order follows the Screen Menu Tree (Figures 3-2a and 4-2d) with the exception of the QAM Radio screens, which are grouped in the STATUS, CONTROL and CONFIGURE categories.

3.4.1 Meter



Function	Settings	Summary
Bargraph	ENCDR1, 2, etc…	Selects the desired audio source for display on the audio level bargraph
	DECDR1, 2, etc…	
	NONE	Turns off the bargraph
Led Dsp	A	The status of Radio A or Radio B is displayed on the LEDs on the front panel.
	B	

3.4.2 System: Card View



Function	Settings	Summary
Cards Active	RF RX A	QAM Receiver RF Module installed in QAM Radio “A” slots (base address 0)
	DECDR 1	Audio Decoder #1 installed (base address 1)
	ENCDR 1	Audio Encoder #1 installed (base address 2)
	QAMOD A	QAM Modem Module installed in QAM Radio “A” slots (base address 3)
	RF TX A	QAM Transmitter RF Module installed in QAM “A” slots (base address 4)
	MUX 0 CH CD 1	Intelligent Multiplexer #0 installed (base address 5)

Note: The card view screen gives the user a list of all installed cards in the unit. The base address (B. Addr) is listed for diagnostic purposes only.

3.4.3 System: Power Supply

```
Power Supply Status
Primary      AC
+5VD         5.00  V
+15VD        15.00 V
```

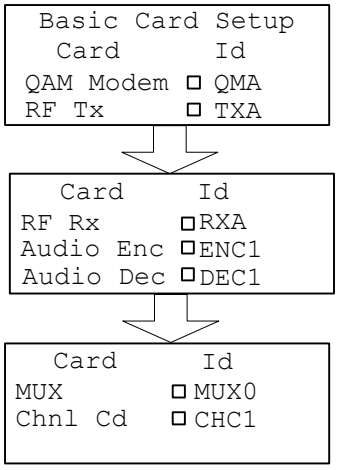
Function	Settings	Summary
Primary		Indicates type of supply in primary slot A:
	AC	Universal AC input
	DC	DC Option
+5 VD	0-9.99 V 5.20 V nominal	Voltage level of the main +5 volt supply
+15 VD	0-99.9 V 15.2 V nominal	Voltage level of the main +15 volt supply

3.4.4 System: Info

```
 System Information
Unit No.     1
Security     USER
Firmware     V.2.04
```

Function	Settings	Summary
Unit No.	1,2,3,…	Identification for NMS system
SECURITY		Indicates access level of security:
	Lockout	No control available
	User *(default)*	Limited control of parameters
	Factory	Full configure and calibration
FIRMWARE	V x.xx	Revision of front panel screen menu software

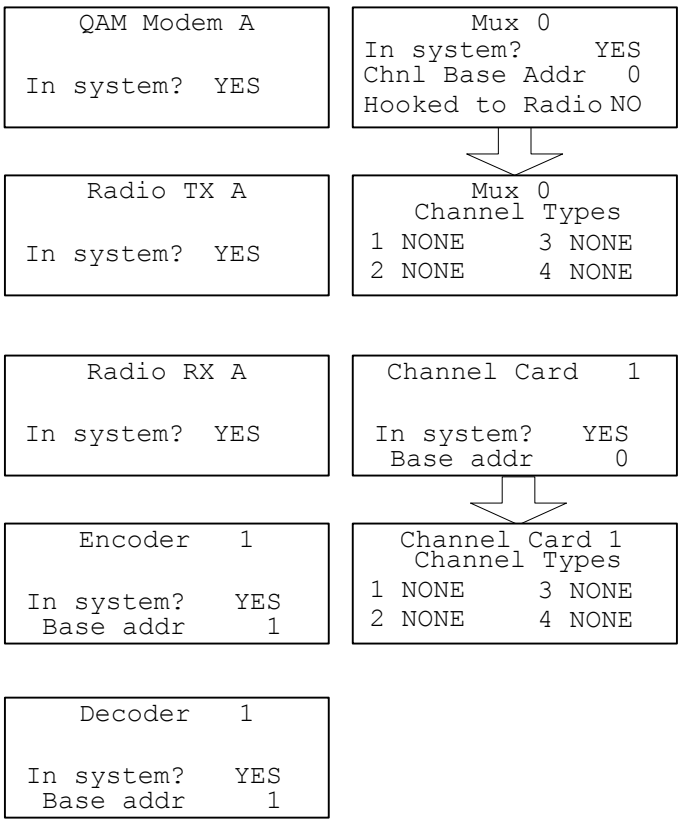
3.4.5 System: Basic Card Setup



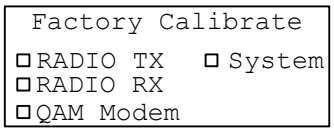
Function	Settings	Summary
QAM Modem	QMA, QMB	QAM Modem installed in QAM Radio slots A or B
RF Tx	TXA, TXB	QAM Transmitter installed in QAM Radio slots A or B
RF Rx	RXA, RXB	QAM Receiver installed in QAM Radio slots A or B
Audio Enc	ENC1,2,…	Audio Encoder installed and identified (affects meter selection of bargraph)
Audio Dec	DEC1,2,…	Audio Decoder installed and identified (affects meter selection of bargraph)
MUX	MUX 0,1,…	Mux Module installed and identified
Chnl Cd	CHC 1,2,…	Channel Card installed and identified

Note: *These are factory settings of installed cards, used to control appropriate displays in the CARD VIEW screens.*

Note: Pressing **enter** at each ID type brings up another screen with the Card Function shown and the question: **In System?** Is displayed. Depending upon the card type, this screen also indicates the base address. These windows are shown below:

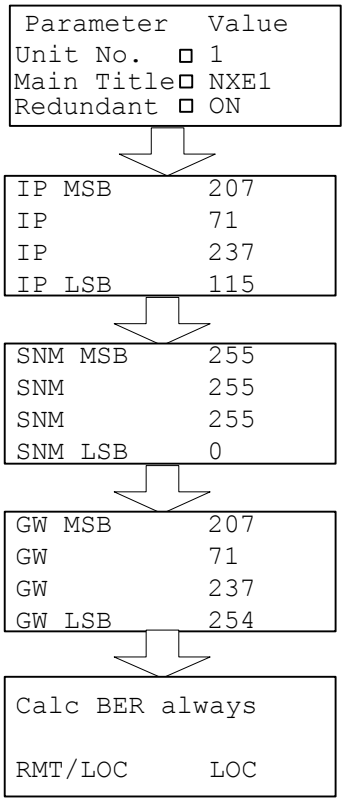


3.4.6 System: Factory Calibration



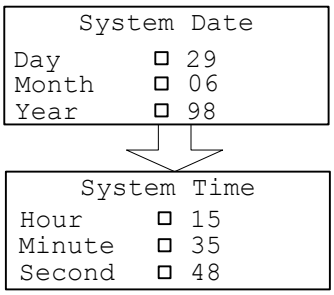
The Factory Calibration Screens are documented in Figure 3-2 (Screen Menu Tree). The user may refer to this diagram when instructed to do so by customer service technicians.

3.4.7 System: Unit-Wide Parameters



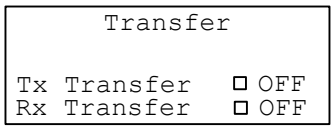
Function	Settings	Summary
Unit No.	1,2,3,…	Identification for NMS system
Main Title	TRANSMITTER, RECEIVER, TRANSCEIVER T1 DTV Link NXE1	Determines main menu display and affects screen menu selection of modules
Redundant	ON	Hot Standby Dual Radio operation.
	OFF	Single Radio operation.
IP	Integer (0-255)	Internet Protocol (IP) address of the device. These values must be set for the device to possess network capabilities.
SNM	Integer	Subnet Mask of the device. Only needs to be set if the device is to use its network capabilities. Subnetting allows network administrators additional flexibility in defining relationships among network hosts.
GW	Integer	The default Gateway of the device. The Gateway address is configured by the network administrator. This address informs each device where to send data if the target station does not reside on the same subnet as the source.
Calc BER always	RMT	(Remote) Use RMT only in SNMP mode.
	LOC	(Local) Put in local.

3.4.8 System: Date/Time



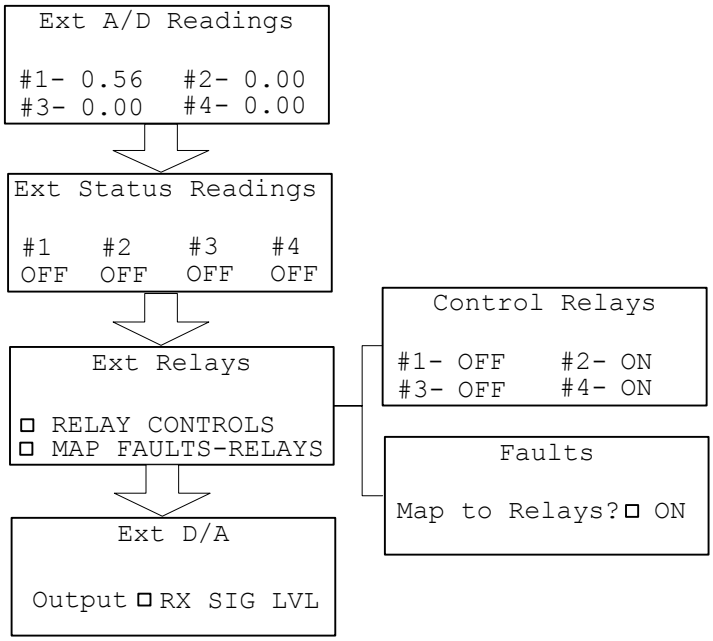
Function	Settings	Summary
Day	01-31	Sets the system date used for NMS and Fault/Alarm logging
Month	01-12	
Year	00-99	After selection, press ENTER to save
Hour	00-23	Sets the system time used for NMS and Fault/Alarm logging
Minute	00-59	
Second	00-59	After selection, press ENTER to save

3.4.9 System: Transfer



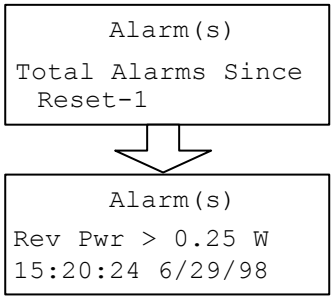
Function	Settings	Summary
TX Transfer	OFF HOT COLD	Configures the internal logic for transfer panel (TP64) TX control
RX Transfer	OFF ON	Configures the internal logic for transfer panel (TP64) RX control

3.4.10 External I/O



Function	Settings	Summary
Ext A/D Readings	#1, #2, #3, #4	Voltage readings via the NMS I/O card
Ext Status Readings	#1, #2, #3, #4	Logic Level readings via the NMS I/O card
Ext Relays	#1, #2, #3, #4	Control of relays at the NMS I/O card
Map Faults-Relays	ON OFF	Maps pre-determined fault conditions to trigger relays at the NMS I/O card
Ext D/A Output	RX SIG LVL NOTHING TX FWD PWR	External output follows Receive Signal Level. External output follows nothing. External output follows Transmit Forward Power.

3.4.11 Alarms



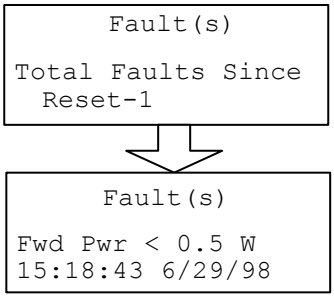
Module	Parameter	Nominal	Trip Value
QAM RF TX	Reverse Power	0.05 Watt	> 0.25 Watt
	PA Current	2.5 Amp	> 3.0 Amp
	LO Level	100%	< 50%
	Exciter Level	100%	< 50%
QAM RF RX	RSL	-30 to –90 dBm	
	LO Level	100%	< 50%
QAM MODEM	BER	-	>1.00E-04
	Synth Level	100%	< 50%
Modulator only	Modem Level	100%	< 50%

Alarm definition: *A specific parameter is out of tolerance, but is NOT crucial for proper system operation. ALARMS are cautionary only, and indicates a degradation in a system parameter.*

Logging: *All fault and alarm events are logged with the date and time.*

Alarm screen reset: *After viewing the screen, press ENTER to clear all logs entries. If the alarm has been corrected, no new logs will be generated.*

3.4.12 Faults



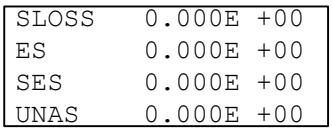
Module	Parameter	Nominal	Trip Value
QAM RF TX	Forward Power	1.0 Watt	< 0.5 Watt
	AFC Lock	Lock	Unlock
	PA Temp	40 deg C	>80 deg C
QAM RF RX	AFC Lock	Lock	Unlock
QAM MODEM	AFC Lock	Lock	Unlock
	Mbaud	Lock	Unlock
	Dbaud	Lock	Unlock
	Dfec	Lock	Unlock

Fault definition: *A specific parameter is out of tolerance and is crucial for proper system operation.*

Logging: *All fault and alarm events are logged with the date and time.*

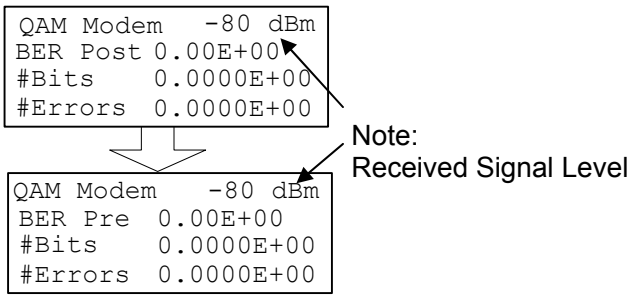
Fault screen reset: *After viewing the screen, press ENTER to clear all logs entries. If the fault has been corrected, no new logs will be generated.*

3.4.13 G821 Parameters



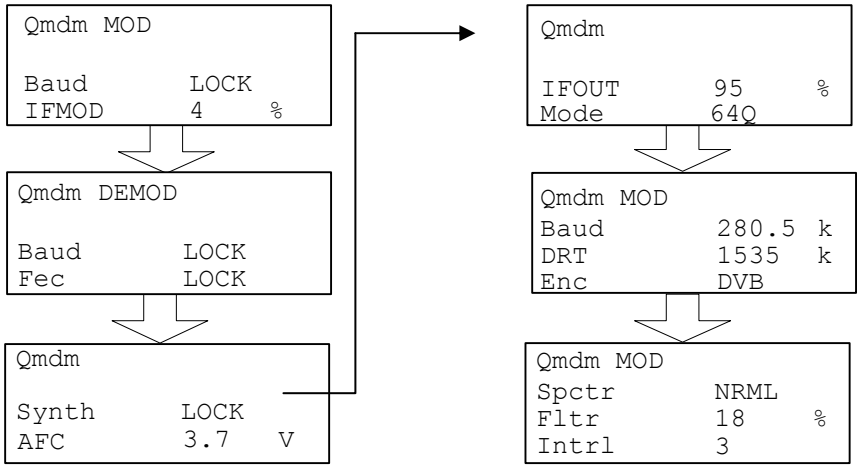
Function	Settings	Summary
SLOSS	0.000E +00	Number of times the signal has been lost for more than 10 seconds
ES	0.000E +00	Errored seconds
SES	0.000E +00	Severely errored seconds
UNAS	0.000E +00	Unavailable seconds

3.4.14 QAM Modem Status



Function	Settings	Summary
BER Post	0.00E-00	Post-FEC (Forward Error Correction) Bit Error Rate since last “ENTER” reset
BER Pre	0.00E-00	Pre-FEC (Forward Error Correction) Bit Error Rate since last “ENTER” reset
# Bits	0.0000E+00	# of Bits counted since last “ENTER” reset
# Errors	0.0000E+00	# of Errors counted since last “ENTER” reset

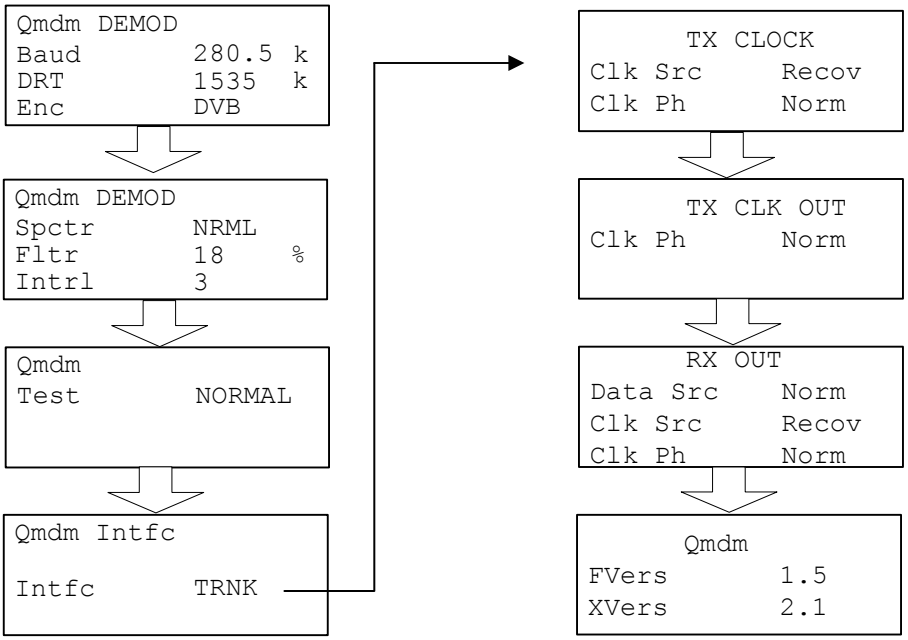
QAM Modem Status (continued)



Function	Settings	Summary
BAUD	LOCK *(default)* UNLOCK	Indicates modulator PLL is locked to incoming data clock
IFMOD	0 – 100% 100% NOM	
BAUD	LOCK *(default)* UNLOCK	Indicates demodulator PLL is locked to incoming data clock
FEC	LOCK *(default)* UNLOCK	Indicates FEC decoder is synchronized
SYNTH	LOCK *(default)* UNLOCK	Confirms 70 MHz IF synthesizer is phase locked
AFC	0 – 9.9 VDC 3.7 VDC *(nominal)*	70 MHz IF synthesizer AFC voltage
IFOUT	0 – 100% 100% *(nominal)*	Modulator level
Mode	16-64Q	Modulation mode:16QAM, 32QAM, 64QAM
BAUD	280.5 K	Symbol rate
DRT	1535 K	Data rate
ENC	DVB	Encoding mode
SPCTR	NRML	Spectrum Normal or Invert
FLTR	18 %	Nyquist filter
INTRL	3	Interleave Depth

Continued on next page.

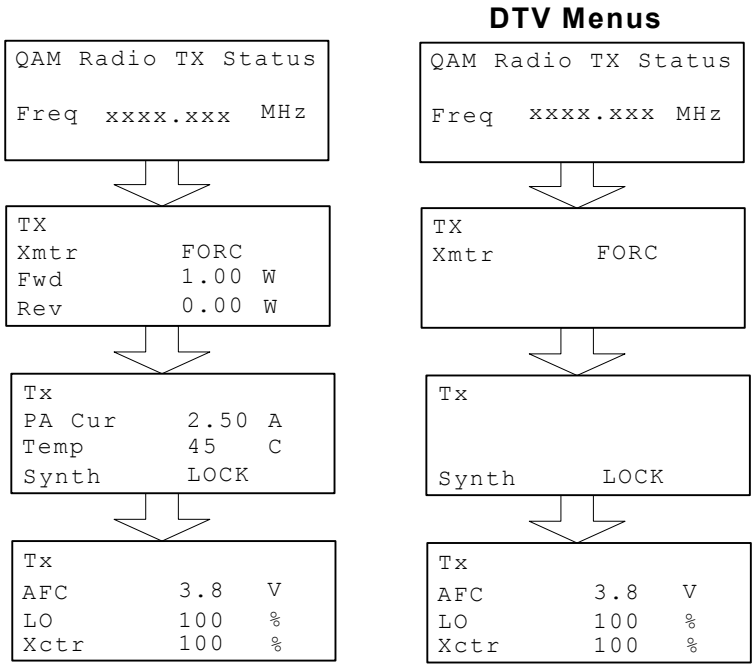
QAM Modem Status (continued)



Function	Settings	Summary
BAUD	280.5 K	Symbol rate
DRT0	1535 K	Data rate
ENC	DVB	Encoding mode
SPCTR	NRML	Spectrum Normal or Invert
FLTR	18 %	Nyquist filter
INTRL	3	Interleave Depth
TEST	NORMAL	Internal Test Pattern Generator
Interface	Trunk	Active Interface
Clk Src (Tx Clock)	Internal, EXT TXC, EXT RXC, Recovered	Clock source of the Transmitter.
Clk Ph (Tx Clock)	Inverted, Normal	Clock Phase of the Transmitter.
Clk Ph (Tx Clock Out)	Inverted, Normal	Clock Phase of the Transmitter Clock Out.
Data Src (Rx Out)	Norm, RPT, Loop	Data Source of the Receiver Out. Normal means the source is either BKPLN or TRNK; RPT sets the radio to Repeater; Loop sets the radio to loopback mode.
Clk Src (Rx Out)	Internal, EXT TXC, EXT RXC, Recov	Clock Source of the Receiver Out.
Clk Ph (Rx Out)	Norm, Inverted	Clock Phase of the Receiver Out.
Fvers		
Xvers		

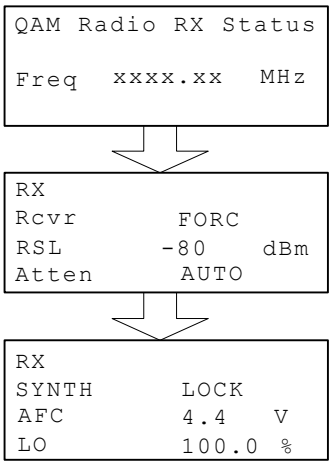
Internal is the internal clock of the NXE1; EXT TXC is the External Transmit Clock; EXT RXC is the External Receive Clock; Recovered is the recovered clock from the receiving RF.

3.4.15 QAM Radio TX Status



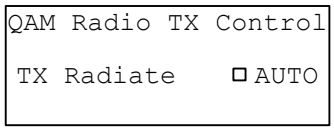
Function	Settings	Summary
Freq A	2300.00MHz	Displays the transmitter output carrier frequency
XMTR		Status of transmitter:
	TRAFFIC	ON in a hot standby mode
	FORCED *(default)*	Forced ON
FWD	0 – 9.99 Watt 1.00 Watt *(nominal)*	Output Power of TX. This menu item does not appear when the unit is configured for DTV.
REV	0 – 9.99 Watt 0.07 Watt *(nominal)*	Reverse (or reflected) power at antenna port. This menu item does not appear when the unit is configured for DTV.
PA CUR	0.00– 9.99 Amp 2.40 Amp *(nominal)*	Power amplifier current consumption. This menu item does not appear when the unit is configured for DTV.
TEMP	0– 99.9 deg C 45.0 deg C *(nominal)*	Power amplifier temperature. This menu item does not appear when the unit is configured for DTV.
SYNTH	LOCK *(default)* UNLOCK	Indicates phase lock of the 1st LO
AFC	0 – 9.9 VDC 3.8 VDC *(nominal)*	1st LO PLL AFC Voltage
LO	0 – 99.9% 100% *(nominal)*	1st LO relative power level
XCTR	0 – 99.9% 100% *(nominal)*	Transmit module's relative output power level

3.4.16 QAM Radio RX Status



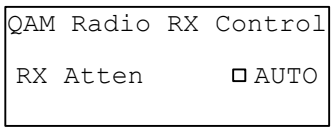
Function	Settings	Summary
Freq A	2300.00 MHz	Displays the receiver operating frequency
XMTR		Transfer status of receiver:
	TRAFFIC	Is operating, ready for transfer
	FORCED *(default)*	Is operating, will not transfer (forced ON)
RSL	-30.0 to -90.0 dBm	Received signal level (signal strength) Nominal level dependent upon customer path/system gain
ATTEN		Receiver PIN attenuator setting:
	AUTO *(default)*	Controlled by internal software
	ON	Forced ON
	OFF	Forced Off
SYNTH	LOCK *(default)* UNLOCK	Indicates phase lock of the 1st LO
AFC	0 – 9.9 VDC 3.5 VDC *(nominal)*	1st LO PLL AFC Voltage
LO	0 – 99.9% 100% *(nominal)*	1st LO relative power level

3.4.17 QAM Radio TX Control



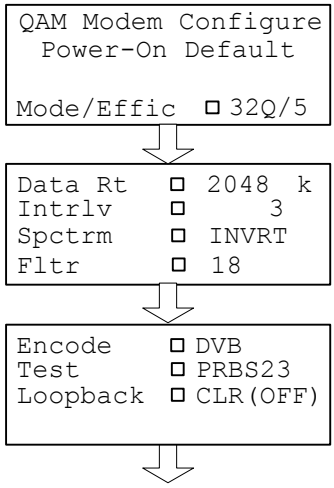
Function	Settings	Summary
TX-A Radiate	AUTO *(default)*	Transmitter radiating, but folds back output power on high antenna VSWR (REV PWR)
	ON	Transmitter radiating
	OFF	Transmitter not radiating

3.4.18 QAM Radio RX Control



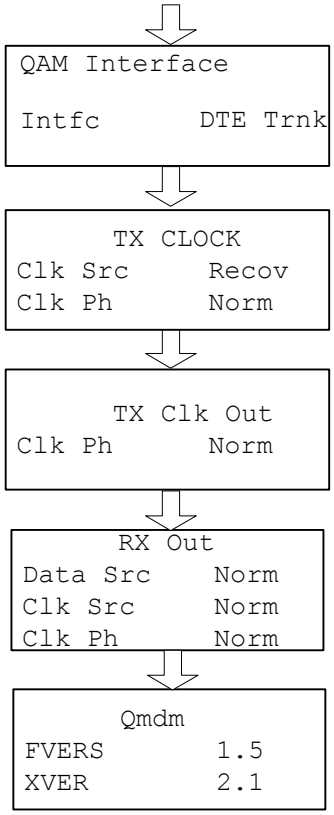
Function	Settings	Summary
RX-A ATTEN	AUTO *(default)*	ON, and is activated on high signal level
	ON	ON *always*
	OFF	OFF

3.4.19 QAM Modem Configure



Function	Settings	Summary
Interface	QPSK/2, 16Q/4, 32Q/5, 64Q/6, 128Q/7, 256Q/8	Default is 64QAM
DATA RATE	N x 64 kbps,	Valid range depends upon configuration.
INTERLEAVE	1 2 3 *(default)* 4 6 12 2,17 2,34 2,51 2,68 2,102 2,204	Interleave depth. 1 to 204
SPECTRUM	INVERT *(default)*	
FILTER	18 15 *(default)* 12	Nyquist roll-off factor
ENCODING	DVB *(default)*	Raw data format
TEST	NORMAL *(default)* PRBS15, PRBS23	Test pattern length
Loopback	CLR (Off) RMT+LOC RPTR	Loopback mode

QAM Modem Configure (continued)



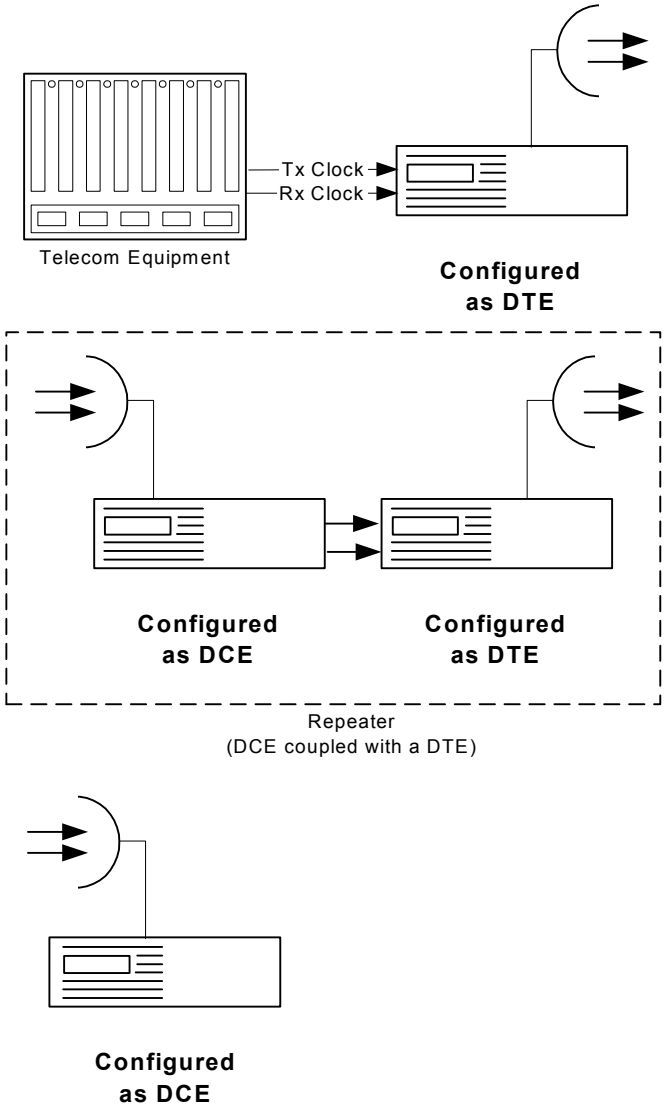
Function	Settings	Summarys
Interface	Trunk	Uses Trunk for I/O.
	Radio (bkpln)	Uses Backplane for I/O.
Clk Src (Tx Clock)	Internal, EXT TXC, EXT RXC, Recovered	Clock source of the Transmitter.
Clk Ph (Tx Clock)	Inverted, Normal	Clock Phase of the Transmitter.
Clk Ph (Tx Clock Out)	Inverted, Normal	Clock Phase of the Transmitter Clock Out.
Data Src (Rx Out)	Norm, RPT, Loop	Data Source of the Receiver Out. Normal means the source is either BKPLN or TRNK; RPT sets the radio to Repeater; Loop sets the radio to loopback mode.
Clk Src (Rx Out)	Internal, EXT TXC, EXT RXC, Recov	Clock Source of the Receiver Out.
Clk Ph (Rx Out)	Norm, Inverted	Clock Phase of the Receiver Out.
Fvers		
Xvers		

Internal is the internal clock of the DATA-20; EXT TXC is the External Transmit Clock; EXT RXC is the External Receive Clock; Recovered is the recovered clock from the receiving RF.

NOTE: See the User Clock Options Conceptual Diagram in Figure 3-4 below for clarification.

3.4.19.1 Typical Configuration

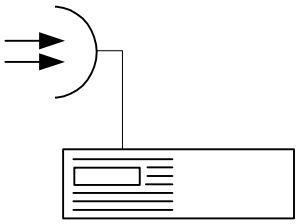
A typical installation of DATA-20 Digital Radios involves configuring each DATA-20 as either Data Communications Equipment (DCE) or as Data Terminal Equipment (DCE), as illustrated below:



A DCE coupled together with a DTE enables the signal to be relayed to another DCE. This configuration is called a Repeater. A network can consist of as many Repeaters as necessary. The following sub-sections describe how to configure the DATA-20 a DCE or as a DTE.

3.4.19.2 DATA-20 as Data Communications Equipment (DCE)

By default, the DATA-20 is configured as Data Communications Equipment (DCE). In the mode, the device recovers the transmitted clocks and effectively performs as a modem.



Configured as DCE

To configure the DATA-20 as a DCE, select the following clock settings in the System menu:

```
      QAM Inerface

Intfc    DCE Trunk
```

```
      TX CLOCK
Clk Src     Recov
Clk Ph      Norm
```

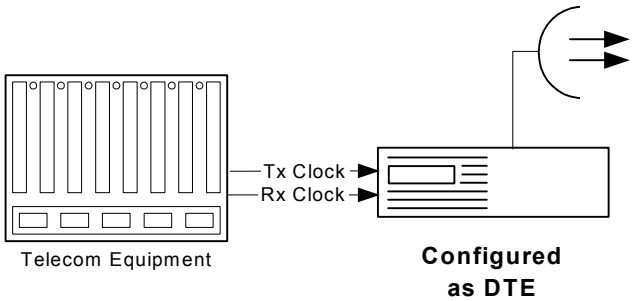
```
      TX CLK OUT

Clk Ph      Norm
```

```
      RX CLOCK
Clk Src     Recov
Clk Ph      Norm
```

3.4.19.3 DATA-20 as Data Terminal Equipment (DTE)

When configured as Data Terminal Equipment (DTE), the DATA-20 gets its clock from an external source, such as a telecommunications device.



Configured as DTE

To configure the DATA-20 as a DTE, make the following clock selections in the System menu:

```
    QAM Interface

Intfc    DTE Trunk
```

```
      TX CLOCK
Clk Src   EXT TXC
Clk Ph    Norm
```

```
      TX CLK OUT

Clk Ph      Norm
```

```
      RX CLOCK
Clk Src    EXT TXC
Clk Ph     Norm
```

3.4.19.4 User Clock Options Conceptual Diagram

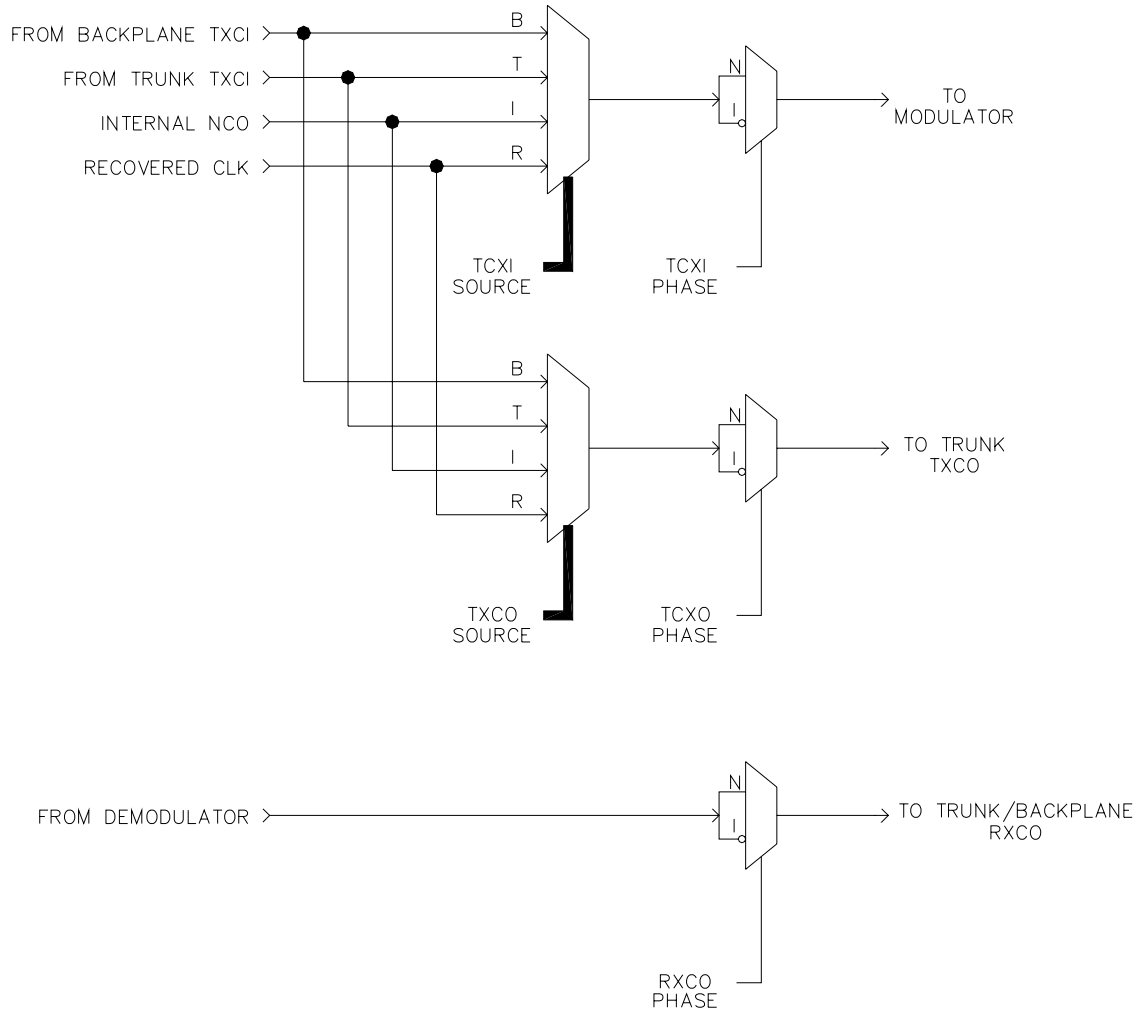
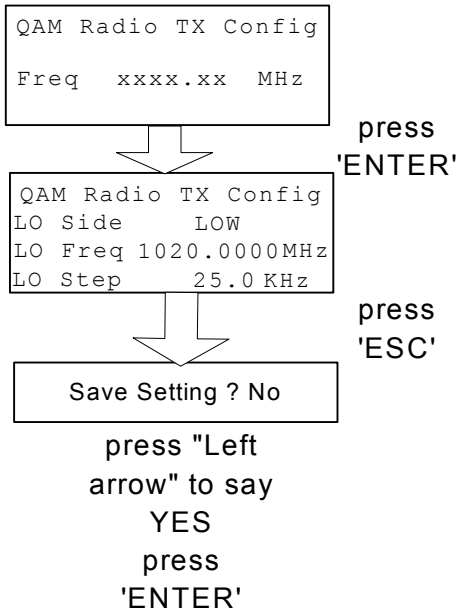


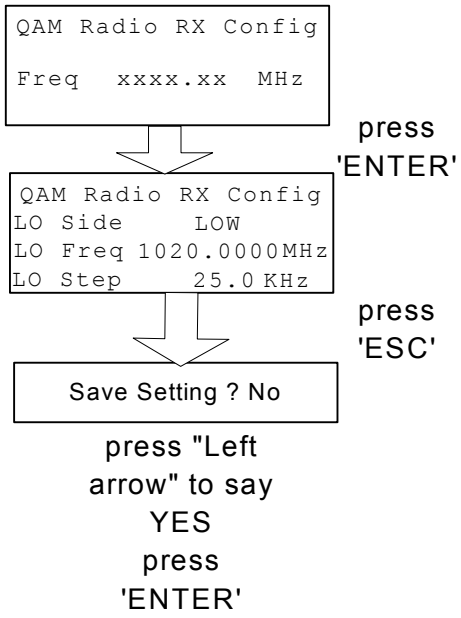
Figure 3-4. User Clock Options Conceptual Diagram

3.4.20 QAM Radio TX Configure



Function	Settings	Summary
FREQ	2300.00 MHz	Displays the frequency of the transmitter and allows the user to make frequency changes.
LO Side	LOW	LOW: LO freq is less than carrier freq.
	HIGH	High: LO freq is greater than carrier freq.
LO Freq	2370 MHz	
LO Step	25.0 KHz	Programming frequency step size

3.4.21 QAM Radio RX Configure



Function	Settings	Summary
FREQ	2300.00MHz	Displays the frequency of the receiver and allows the user to make frequency changes.
LO Side	LOW	LOW: LO freq is less than carrier freq.
	HIGH	High: LO freq is greater than carrier freq.
LO Freq	2370.00 MHz	
LO Step	25.0 KHz	Programming frequency step size

3.5 NMS/CPU PC Configuration Software

The NMS/CPU card is configured with a Windows-based PC software package. The hardware is accessed through the serial port on the NMS card back panel. See the manual for EMS Wireless DATA-20 *Configuration Software* for more information.

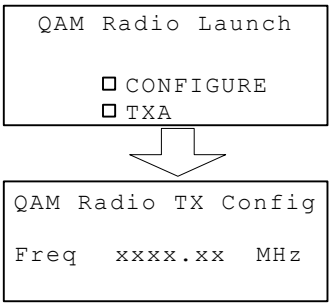
3.6 Up/Down Converter: Frequency Adjust

3.6.1 TX Frequency Adjust

It is possible to change the carrier frequency of the transmitter via the front panel.

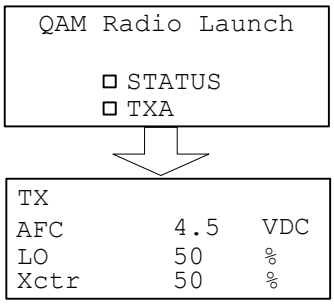
Before changing frequency ensure that this is carried out in a controlled environment with test equipment to ensure that you are transmitting the defined frequency:

1. Power-up the unit and navigate the LCD screens as follows:



1. Using the cursors, change to the desired frequency. Press ENTER and the TX will most likely lose AFC LOCK.

2. Navigate the LCD screens to monitor the AFC voltage as follows



1. Ensure that the voltage reads 0.5 to 9.5 +/- .25 VDC.

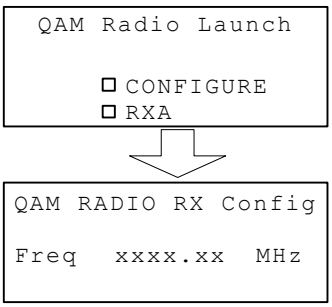
2. The TX should achieve AFC LOCK and the operation is successful.

3.6.2 AFC Level—RX

It is possible to change the operating frequency of the receiver via the front panel.

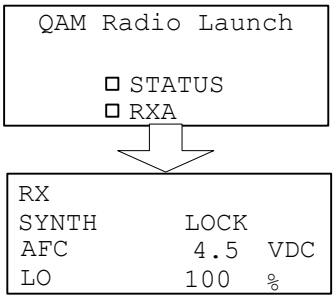
Before changing frequency ensure that this is carried out in a controlled environment with test equipment to ensure that you are transmitting the defined frequency:

1. Power-up the unit and navigate the LCD screens as follows:



1. Using the cursors, change to the desired frequency. Press ENTER and the RX will most likely lose AFC LOCK.

2. Navigate the LCD screens to monitor the AFC voltage as follows



3. Ensure that the voltage reads 0.5 to 9.5 +/- .25 VDC.

4. The RX should achieve AFC LOCK and the operation is successful.

4 Data Interface Cables

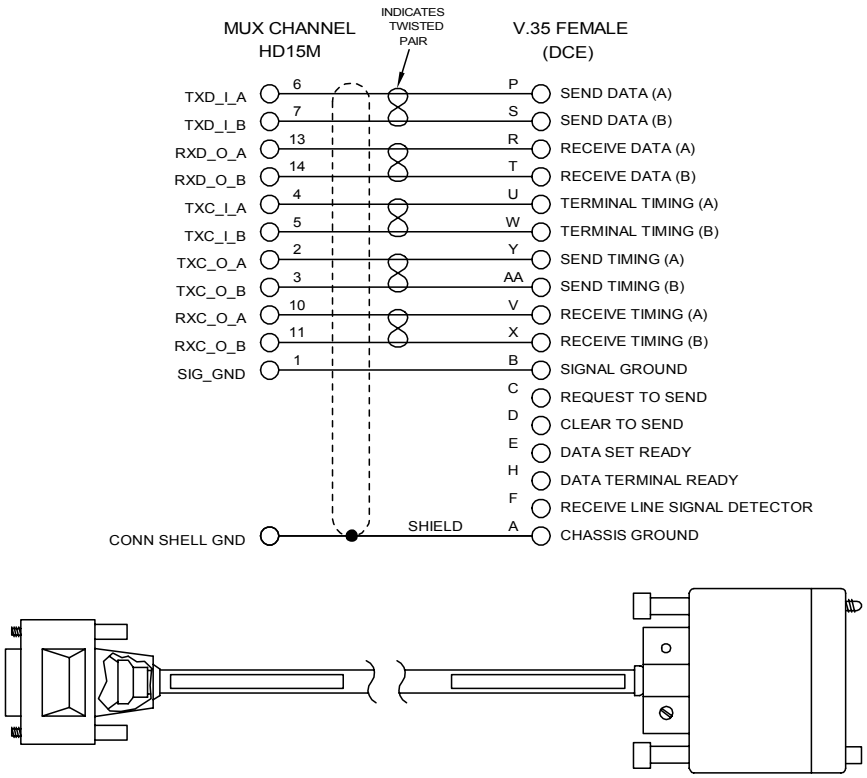


Figure 4-1. Mux Channel – V.35 (DCE)

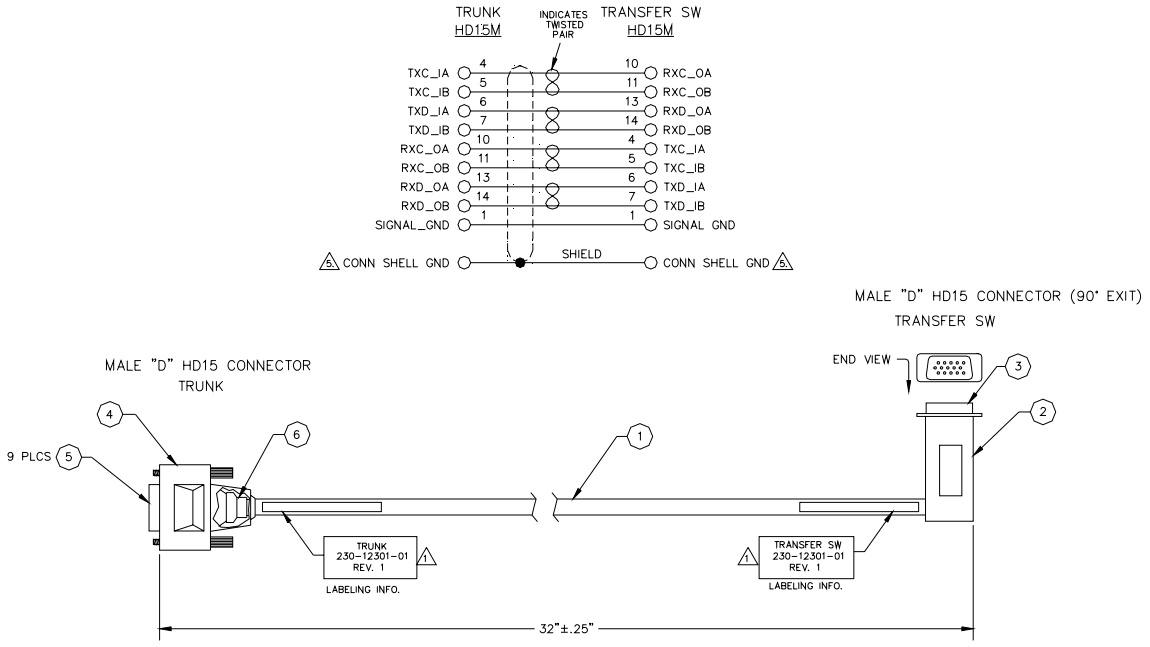


Figure 4-2. Trunk to Trunk Cable (Mux-Trunk Null)

5 Appendix

5.1 Abbreviations & Acronyms

A/D, ADC	Analog-to-Digital, Analog-to-Digital Converter
ADPCM	Adaptive Differential Pulse Code Modulation
AES/EBU	Audio Engineering Society/European Broadcast Union
AGC	Auto Gain Control
ATM	Automatic Teller Machine
BER	Bit Error Rate
CMRR	Common Mode Rejection Ratio
Codec	Coder-Decoder
CPFSK	Continuous-Phase Frequency Shift Keying
CSU	Channel Service Unit
D/A, DAC	Digital-to-Analog, Digital-to-Analog Converter
DB	Decibel
DBc	Decibel relative to carrier
DBm	Decibel relative to 1 mW
DBu	Decibel relative to .775 Vrms
DCE	Data Circuit-Terminating Equipment
DSP	Digital Signal Processing
DSTL	Digital Studio-Transmitter Link
DTE	Data Terminal Equipment
DVM	Digital Voltmeter
EIRP	Effective Isotropic Radiated Power
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge/Electrostatic Damage
FEC	Forward Error Correction
FET	Field effect transistor
FMO	Frequency Modulation Oscillator
FPGA	Field Programmable Gate Array

FSK	Frequency Shift Keying
FT1	Fractional T1
IC	Integrated circuit
IEC	International Electrotechnical Commission
IF	Intermediate frequency
IMD	Intermodulation Distortion
ISDN	Integrated-Services Digital Network
Kbps	Kilobits per second
KHz	Kilohertz
LED	Light-emitting diode
LO, LO1	Local oscillator, first local oscillator
LSB	Least significant bit
Mbps	Megabits per second
Modem	Modulator-demodulator
Ms	Millisecond
MSB	Most significant bit
MUX	Multiplex, Multiplexer
μs	Microsecond
μV	Microvolts
NC	Normally closed
NMS	Network Management System
NO	Normally open
PCB	Printed circuit board
PCM	Pulse Code Modulation
PGM	Program
PLL	Phase-Locked Loop
QAM	Quadrature Amplitude Modulation
R	Transmission Rate
RF	Radio Frequency
RPTR	Repeater
RSL	Received Signal Level (in dBm)
RSSI	Received Signal Strength Indicator/Indication
RX	Receiver
SCA	Subsidiary Communications Authorization
SCADA	Security Control and Data Acquisition
SNR	Signal-to-Noise Ratio

SRD	Step Recovery Diode
STL	Studio-Transmitter Link
TDM	Time Division Multiplexing
THD	Total harmonic distortion
TP	Test Point
TTL	Transistor-transistor logic
TX	Transmitter
Vrms	Volts root-mean-square
Vp	Volts peak
Vp-p	Volts peak-to-peak
VRMS	Volts, root-mean-square
VSWR	Voltage standing-wave ratio
ZIN	Input Impedance
ZOUT	Output Impedance

5.2 Conversion Chart

microvolts to dBm (impedance = 50 ohms)

microvolts	**dBm**	**microvolts**	**dBm**
0.10	-127.0	180	-61.9
0.25	-119.0	200	-61.0
0.50	-113.0	250	-59.0
0.70	-110.1	300	-57.4
1.0	-107.0	350	-56.1
1.4	-104.1	400	-54.9
2.0	-101.0	450	-53.9
2.5	-99.0	500	-53.0
3.0	-97.4	600	-51.4
3.5	-96.1	700	-50.1
4.0	-94.9	800	-48.9
4.5	-93.9	900	-47.9
5.0	-93.0	1,000	-47.0
6.0	-91.4	1,200	-45.4
7.0	-90.1	1,400	-44.1
8.0	-88.9	1,600	-42.9

microvolts	**dBm**	**microvolts**	**dBm**
9.0	-87.9	1,800	-41.9
10	-87.0	2,000	-41.0
11	-86.2	2,500	-39.0
12	-85.4	3,000	-37.4
14	-84.1	3,500	-36.1
16	-82.9	4,000	-34.9
18	-81.9	4,500	-33.9
20	-81.0	5,000	-33.0
25	-79.0	6,000	-31.4
30	-77.4	7,000	-30.1
35	-76.1	8,000	-28.9
40	-74.9	9,000	-27.9
45	-73.9	10,000	-27.0
50	-73.0	22.36 mV	-20 (10 mW)
60	-71.4	70.7 mV	-10(100 mW)
70	-70.1	223.6 mV	0 (1 mW)
80	-68.9	707.1 mV	+10 (10mW)
90	-67.9	2.23 V	+20(100 mW)
100	-67.0	7.07 V	+30 (1 W)
120	-65.4	15.83 V	+37 (5 W)
140	-64.1	22.36 V	+40 (10 W)
160	-62.9		