SUMMIT DM®
UDDI™
DESCRIPTION

APPENDIX B - UNIVERSAL DIGITAL AND DATA INTERFACE (UD^{2}I™)

LIST OF TABLES

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APPENDIX B UNIVERSAL DIGITAL AND DATA INTERFACE

B.1 GENERAL INFORMATION

B.1.1 SCOPE

This appendix describes the Universal Digital and Data Interface (UD^{2}I™) as it functions with Summit® DM Multi-Net® transceivers. This interface is also available for Viking® HT. However, operation with this transceiver is slightly different (the logic levels of some lines are inverted).

Although this interface is available for Summit DM transceivers with software Version 207 or later, this description applies specifically to operation with software Version 214 or later. Therefore, there may be slight operation differences with the earlier versions of software. Refer to Appendix A for more information on software revisions. Transceiver software can easily be updated using Flash programming. Refer to Section 4.7 for more information.

B.1.2 UNIVERSAL INTERFACE DESCRIPTION

The universal interface provides a means of conveniently connecting external equipment to the transceiver. Types of equipment that may be connected include modems and data terminals.

To utilize the Universal Interface, the optional universal interface cable (see Table 1-1) must be factory or field installed in the transceiver. This cable is approximately 1-foot long and connects to J403 and J404 on the audio/logic board. It has a standard female DB25 connector (see below) for connecting the external equipment. Also required to utilize the universal interface is transceiver software Version 207 or later as described in the preceding section.

NOTE: Validation Key, Part No. 250-9750-050, is no longer required to use this interface.

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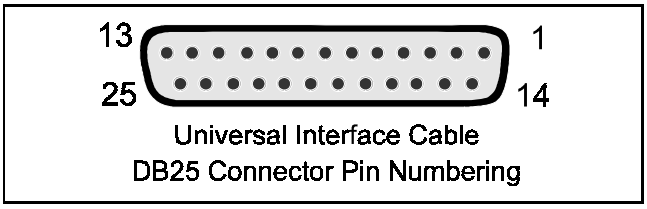

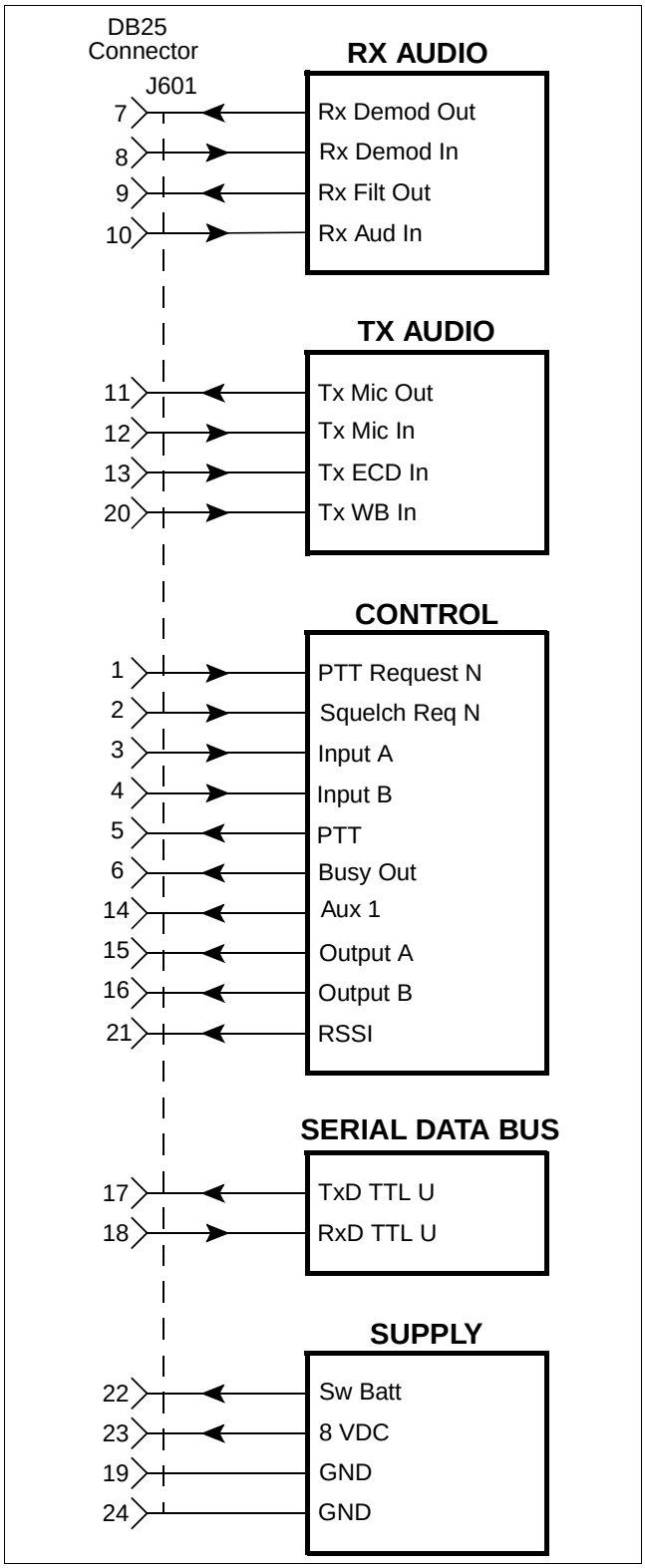

Figure B-1 Universal Interface Pin Designations

CAUTION: The DB25 universal interface connector is a non-standard port. Therefore, do not connect any equipment to this port not specially designed for this interface because equipment damage may result.

Normally, there is no need to make internal modifications to the transceiver because connection points commonly used are available at the connector and programmable internal gating circuits provide the required routing of audio signals. The programming of the universal interface functions is performed using the same software used to program the transceiver as described in Section 4. Universal interface programming is described in Section 4.8.

Gating of the receive and transmit audio signals in Figure B-1 is programmable on a system by system basis (each selectable system can be programmed for a different configuration) and are also controllable dynamically by the Serial Data Bus. The control functions are programmable only on a radio-wide basis (they are the same for all selectable systems and groups). Refer to Sections B.3, B.4, and B.5 for more information on the audio and control signals.

B.2 POWER SUPPLY

Table B-1 Power Supply Pin Description

Function	Pin	Description
Switched Battery	22	Standard battery voltage fused by 4-ampere fuse F500 on the PA board. Maximum source current is 300mA.
8 volts DC	23	Regulated 8-volt supply (±5%). Maximum source current is 300mA.
Ground	19, 24	Radio chassis ground.

A description of the power supply lines is located in Table B-1. Since the Switched Battery and 8-volt power sources used by the universal interface also provide power to other accessories, the total power consumption of all accessories must not exceed the limits stated in Table B-1. Other accessories which use the universal interface power sources are as follows:

- Equipment connected to the remote interface (J402) such as a remote control unit.
- Internal accessories installed in the option slots such as encryption or compandor modules.

B.3 RECEIVE AUDIO SIGNALS

B.3.1 PIN DESCRIPTIONS

Descriptions of the receive audio pins are located in Table B-2, and a block diagram showing how these signals are internally routed to the receive audio processing and gating circuitry is shown in Figure B-2.

B.3.2 RECEIVE AUDIO GATING

The receive audio gating circuitry has been designed to provide several choices for receive audio routing (such as injecting before or after filtering and de-emphasis). The receive audio routing for the universal interface can be programmed for the four modes shown in Table B-3. Each mode enables and disables the gates (indicated by “Mx”) so that the audio output signal from the external equipment (indicated by “Device x”) is routed to the desired filtering circuit. These modes are programmed for each selectable system as described in Section 4.8.3. The desired mode can also be selected by data on the Serial Data Bus (see Section B.8).

B.4 TRANSMIT AUDIO SIGNALS

B.4.1 PIN DESCRIPTIONS

Descriptions of the transmit audio pins are located in Table B-4, and a block diagram showing how these signals are internally routed to the transmit audio filtering and gating circuitry is shown in Figure B-3.

B.4.2 TRANSMIT AUDIO PROGRAMMING

As with the receive audio circuitry, the transmit audio circuitry has been designed to provide several choices for routing (such as injecting before or after bandpass the bandpass filter). The transmit audio routing can be programmed for the four modes shown in Table B-5. These modes are programmed for each selectable system as described in Section 4.8.3. The desired mode can also be selected by data on the Serial Data Bus (see Section B.8).

Table B-2 Receive Audio Pin Description

Function	Pin	Description
Rx Demod Out	7	Buffered discriminator output before any filtering. DC coupled with 3.8-volt DC bias. Output impedance less than 600 ohms. Output level 1V P-P at 60% system deviation. Response +1/-3 dB DC - 5 kHz. This output is shared with internal option wire-out 1.
Rx Filt Out	9	Output from 300-3000 Hz bandpass filter and de-emphasis circuits. AC coupled with 3.2-volt DC bias. Output impedance less than 600 ohms. Output level 2.0V P-P at 60% system deviation. Response 300-3000 Hz TIA. This output is shared with internal option wire-out 13.
Rx Demod In	8	Input to 300-3000 Hz bandpass filter and de-emphasis circuits. AC coupled with input impedance greater than 25k ohms. Input level 1-volt P-P nominal. Signal is subjected to 300-3000 Hz TIA filter and de-emphasis. This input is shared with internal option wire-out 2.
Rx Aud In	10	Input to final audio amplifier chain after the mute gate and filtering but before volume control. AC coupled with input impedance greater than 10k ohms. Input level 0.7-volt P-P nominal.

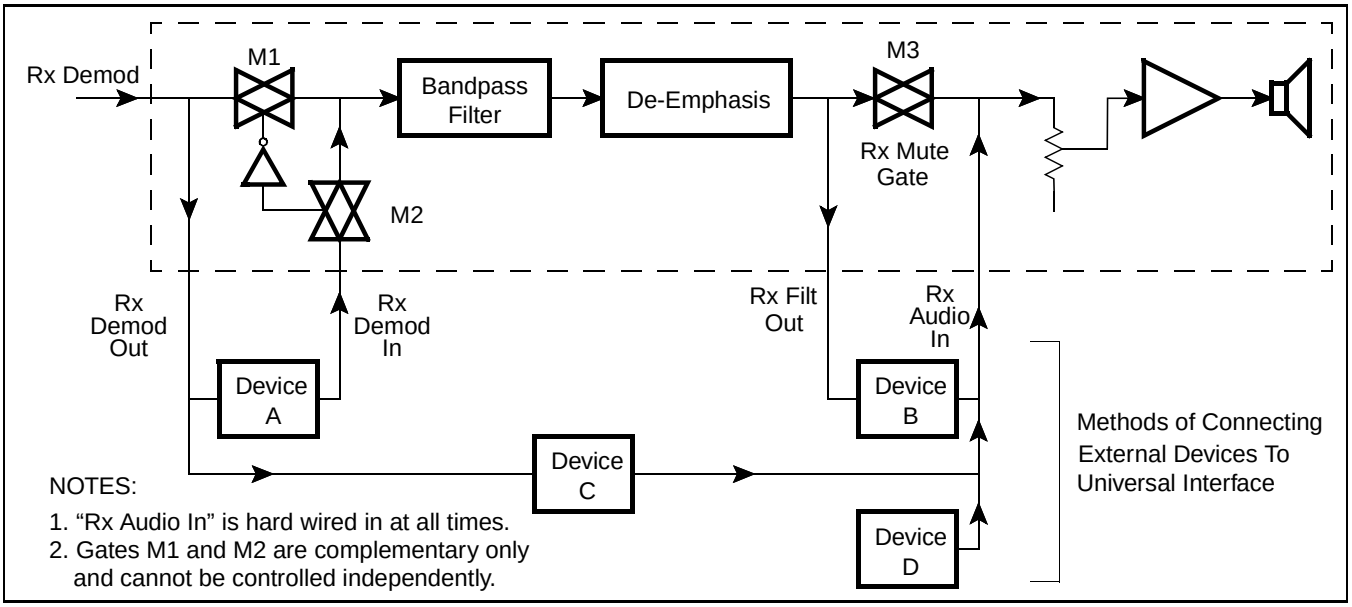

Figure B-2 Receive Audio Signal Routing

Table B-3 Receive Audio Programming

Device	Mode	M1	M2	M3
(Default)	1	Closed	Open	Squelch Ctrl
Device A	2	Open	Closed	Closed
Device B	3	Closed	Open	Open
Device C	4	Open	Closed	Open
Device D	4	Open	Closed	Open

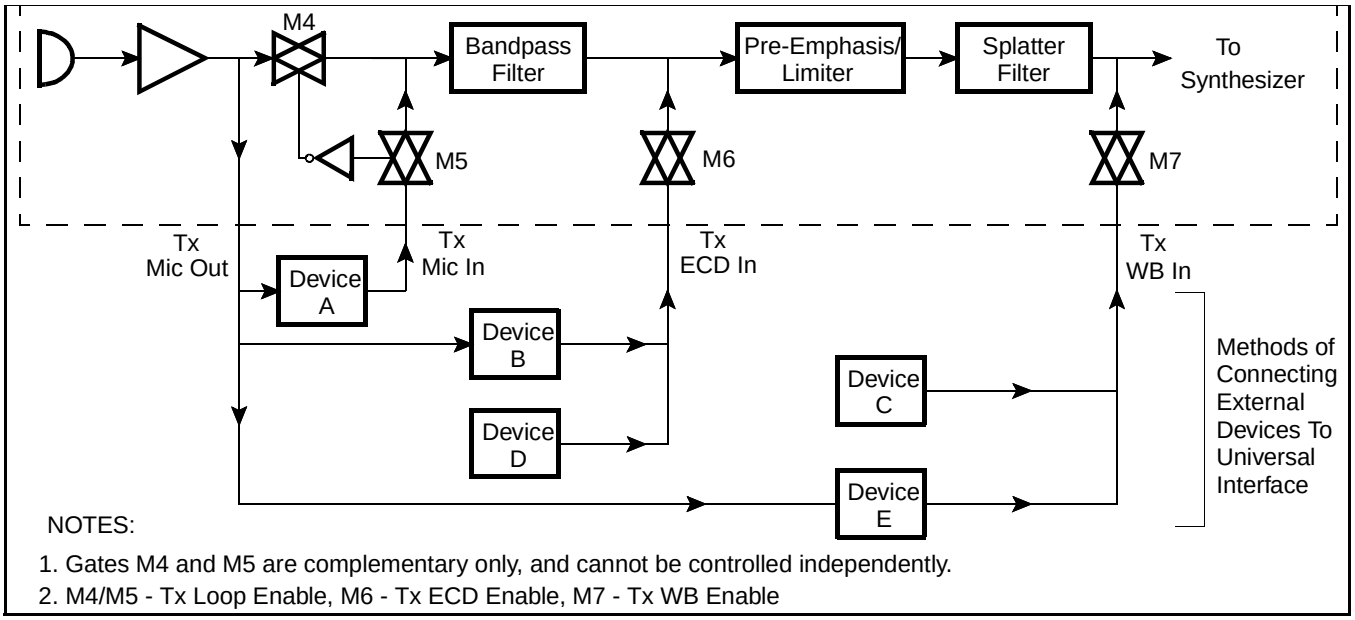

Table B-4 Transmit Audio Pin Description

Function	Pin	Description
Tx Mic Out	11	Buffered single-ended microphone signal before any filtering. DC coupled with 3.2-volt DC bias. Output impedance less than 200 ohms. Output level 1V P-P nominal. This output is shared with internal option wire-out 3.
Tx Mic In	12	Input before 300-3000 Hz TIA bandpass filtering, pre-emphasis, and limiting. Therefore, this input signal will pass through these circuits. The input impedance is greater than 24k ohms, and the nominal input level is 1-volt P-P at 60% system deviation. This input is shared with internal option wire-out 4.
Tx ECD In	13	This External Coded Data input bypasses bandpass filtering but not pre-emphasis and limiting. It could be used for modems and other equipment that produce signaling in the 4 Hz - 3000 Hz range. AC coupled with input impedance greater than 20k ohms, and nominal input level is 1-volt P-P at 60% system deviation.
Tx WB In	20	This wideband data input permits direct modulation of the transmit signal since it is after the filtering and deviation limiting circuitry. When the standard DC coupling is used, a DC bias of 2.5 volts ±2% (50 mV) must be applied to this input. This keeps the TCXO on frequency since there is then a DC path directly to the TCXO modulation input. The TCXO frequency may need to be readjusted when DC coupling is used. Nominal input level is 1-volt P-P at 60% system deviation. Optional AC coupling is available by removing jumper R707 on the audio/logic board. AC coupled input impedance is greater than 20k ohms. Frequency response is DC - 4800 Hz (DC coupled) or 4 Hz - 4800 Hz (AC coupled). ***NOTE: Since signals on this input bypass the deviation limiting circuitry, the user assumes all responsibility for FCC compliance when this port is used.***

Figure B-3 Transmit Audio Signal Routing

Table B-5 Transmit Audio Programming

Device	Mode	M4	M5	M6	M7
(Default)	1	Closed	Open	Open	Open
Device A	2	Open	Closed	Open	Open
Device B	3	Open	Closed	Closed	Open
Device C	4	Open	Closed	Open	Closed
Device D	3	Open	Closed	Closed	Open
Device E	4	Open	Closed	Open	Closed

B.5 INPUT CONTROL SIGNALS

The universal interface has four input control signals. Two of these signals are dedicated to push-to-talk and squelch functions, and the other two (Input A/B) are user programmable for various functions. All programmable control input functions are set on a radio-wide basis (they are the same for all selectable systems and groups).

All control inputs are CMOS and are internally pulled to 5-volts by 11k-ohm resistors. Also, all operate without any switch debounce. Refer to the first part of Table B-6 for a description of the input control signals. Programming of these signals is described in Section 4.8.2.

B.6 OUTPUT CONTROL SIGNALS

The universal interface has six output control signals. One of these signals is an analog output dedicated to the RSSI (Received Signal Strength Indicator) function, three are digital outputs dedicated to special functions, and two are user programmable functions. All programmable control output functions are set on a radio-wide basis.

All outputs except RSSI and AUX1 are CMOS outputs. Therefore, they have a 220-ohm output impedance and can source 20 mA maximum. Refer to the last part of Table B-6 for a description of the output control signals. Programming of these signals is described in Section 4.8.2.

Table B-6 Control Signal Description

Function	Pin	Description
INPUTS		
PTT Req N	1	Active low input which allows external control of transmitter keying. This line is shared with option wire-out 6. This input has four programmable options as follows: **Standard (default) -** Standard PTT operation like that of the microphone PTT signal. **Inhibit -** When activated, the radio ignores the microphone PTT signal. **Data -** When used in conjunction with the INPUT A "DATA ARQ" option, the radio goes to the data priority system/group and waits for activity on the DATA ARQ input. Microphone audio is muted. Upon completion of the transmission, that radio remains on the system/group on which the data transmission occurred. Refer to Section B.7.3 for more information on ARQ arbitration. **Data R (Revert) -** Same as the preceding function except that upon completion of the transmission, the radio returns to the previous system/group.
Squelch Req N	2	Active low input which mutes the receive audio. Activation of this input mutes the receive audio immediately, regardless of its current state. This input has no programmable options.
Input A	3	Active low multi-purpose input line programmable for the following functions: **Call Indicator (default) -** When activated, the call indication "CALL" is displayed. It is turned off by pressing a front panel key or taking the microphone off-hook. This function is also programmable for Input B. **Mic Mute -** When activated, the microphone audio signal is muted regardless of the current status. This function is also programmable for Input B. **Horn -** When activated, the horn alert output of the accessory interface is enabled for three cycles and then goes to the disabled state in the normal manner described in Section 3.6.4. This function is also programmable for Input B. **Data ARQ -** When used in conjunction with the preceding PTT Req N "Data" option, the radio uses this line to arbitrate data packet transmission and reception on an LTR or Multi-Net system. Refer to Section B.7.3 for more information on ARQ arbitration.
Input B	4	Active low multi-purpose input line programmable for the following functions: **Emergency (default) -** When activated, produces the same result as pressing the front panel emergency switch. **Mic Mute -** Same as the preceding Input A function. **Horn -** Same as the preceding Input A function. **Call Indicator -** Same as the preceding Input A function.

Table B-6 Control Signal Description (Continued)

Function	Pin	Description
		OUTPUTS
RSSI Out	21	Direct analog RSSI (Received Signal Strength Indicator) output. The DC voltage of this output decreases from 8 - 0 volts as signal strength increases. Output impedance is greater than 100k ohms.
AUX1	14	Active high output which is controlled by the AUX 1 option switch or menu parameter (see Section 3.5.4). This output can be used to control an external accessory. The output levels are 0 and 8 volts DC ±10%. Maximum source current is 50 mA. Therefore, a driver circuit of some type may be required. This output is shared with the option wire-out 8.
PTT	5	Active low output which provides the PTT signal to an external device. This output is shared with the option wire-out 9. Programmable options are as follows. (With the Viking HT, this signal is active high.) **Tx Sense (default) -** Indicates that the transmitter is currently activated. **Standard -** Indicates that the microphone PTT switch is pressed (the transmitter may or may not be activated, depending on the current mode).
Busy Out	6	This output which provides channel/system information to an external device. Programmable options are as follows: **Access Denied (default) -** When accessing the system/channel, this output indicates a busy or out-of-range condition. This output is active low. **RSSI -** Output from the RSSI (Receive Signal Strength Indicator) circuit. This is a logic output that reacts faster than noise squelch. Therefore, it is also subject to more falsing. Typical noise squelch response at -116 dB is 50 ms with 6 dB of hysteresis, and typical RSSI response at this level is 5 ms with 4 dB hysteresis. This output is active high.
Output A	15	Multi-purpose output programmable for the following functions. This is a CMOS output that can source up to 20 mA as described in Section B.6. It is shared with option wire-out 7. ***NOTE: When the encryption option is installed, this option is dedicated to the Clear Code function and the other options are not available.*** **Clear Code (default) -** Active high output that indicates that the transmit audio signal is to be encrypted. **Clear-to-Send -** Active low output that indicates that a trunking channel has been accessed and all overhead activities completed. This function is also programmable for Output B. **Monitor Hanger -** Active low output that indicates that the microphone is on-hook (a high indicates that it is off-hook). This function is also programmable for Output B. **Tx Audio Enable -** Active high output that indicates that the internal transmit audio signal is muted. This function is also programmable for Output B. **Auxiliary 2 -** Same as the following Output B function.
Output B	16	Multi-purpose output programmable for the following functions. This is a CMOS output that can source up to 20 mA as described in Section B.6. **Auxiliary 2 (default) -** Active high output which is controlled by the AUX2 option switch or menu parameter (see Section 3.5.4). This output can be used to control an external accessory. The preceding Output A parameter can also be programmed for this function. **Rx Data Group -** Active low output that indicates that a call is being received on a group programmed for data signaling (see Section 3.6.11). **Clear-to-Send -** Same as preceding Output A function. **Monitor Hanger -** Same as preceding Output A function. **Tx Audio Enable -** Same as preceding Output A function.

B.7 INTERFACING WITH A DATA MODEM

B.7.1 GENERAL

The following information describes how an external data modem can be connected to the universal interface. Described are the lines that are used and how they should be programmed for proper modem operation.

B.7.2 MODEM CONTROL LINES

The following control lines should be programmed as indicated in parentheses for proper modem operation. For more information on these lines, refer to Sections B.5 and B.6 and Table B-6.

PTT Request N (Data) - This input is used for transmit/receive arbitration.

Input A (Data ARQ) - This input is also used for transmit/receive arbitration.

PTT (Tx Sense) - This output indicates to the data modem the current state of the power amplifier (if it is keyed or not).

Output A (Clear-to-Send) - This output may be programmed if desired to indicate to the modem when the transmit channel is connected and available for data transmission. Note that this function is restricted to the Clear Code function when encryption is used (see description in Table B-6).

Output B (Rx Data Group) - This output indicates to the modem that a call is occurring on a "data" group.

Busy Out (Access Denied or RSSI) - This output can be programmed for either of the available options. If "Access Denied" is programmed, it indicates to the modem that an access failure has occurred because of a busy or out-of-range condition. If "RSSI" is programmed, this output can be used to indicate to the modem a busy condition on a conventional channel. This can be used to determine channel availability in the receive mode.

B.7.3 ARQ ARBITRATION

Introduction

ARQ is used on all LTR and Multi-Net data channels, but not on conventional channels. Its purpose is to provide an efficient scheme for ACK/NACK responses to each block of a multi-block message. It eliminates the normal repeater handshake interval usually required to change transmitting stations. The scheme takes advantage of a repeater time-out that terminates repeater transmission after a 1 second (minimum) interruption of the repeater received subaudible data stream.

To use this facility, the transmitting modem, on reaching end-of-block, briefly pauses the radio RF transmission (for less than 1 second) to listen for the ACK/NACK response. The receiving modem, on detecting end-of-block, inserts its RF transmitted ACK/NACK response. The transmitting modem resumes transmission with the next data block. This sequence is repeated for each data block in the multi-block message.

To implement this feature it is necessary for the modem to operate two radio input signals rather than the single "DATA PTT" signal that might be expected. This is necessary in order to define the various state changes that the radio must execute. Therefore, if LTR or Multi-Net data channels are used, both radio input signals must be operated even if the ACK/NACK feature is not used.

The DATA ARQ and DATA PTT lines must be used to set up a data transmission when operating in the LTR or Multi-Net modes (this protocol does not apply to conventional operation). Data transmissions cannot be set up using any of the other lines.

When a block of data is received, ARQ arbitration can also be used to provide a quick acknowledgment without the overhead of a repeater handshake. LTR and Multi-Net repeaters monitor for embedded data from the transmitting mobile and stop transmitting if this data is not detected for a fixed time (1 second minimum). The ARQ protocol utilizes this time-out delay to send a short acknowledgment to the trans-

mitting mobile. Normal embedded data flow then resumes before time-out occurs.

Modem Initiated Transmission

1. A data transmission is initiated by the modem by activating (grounding) the DATA PTT (PTT REQ N) line followed by activating (grounding) the DATA ARQ (INPUT A) line. The DATA PTT signal must lead the DATA ARQ signal by at least 3 ms (5 ms typical), and the DATA PTT line must remain active for the entire data transmission/acknowledge session.

2. After successfully accessing the system/channel, the modem must release the DATA ARQ line and then transmit a data block. A successful access is indicated by a high signal on the CLEAR-TO-SEND (OUTPUT A) line.

3. When ACKs or NACKs are expected, the modem must activate (ground) the DATA ARQ line. During this time the radio receives, but does not decode, subaudible data.

4. For all subsequent low-to-high transitions on the DATA ARQ line, the radio transmits modem data and encodes subaudible data.

5. For all subsequent high-to-low transitions on the DATA ARQ line, the radio receives ACKs or NACKs without decoding subaudible data.

6. The data session is completed by releasing the DATA PTT line (the DATA ARQ line must be released first if not already in that state). At this time the radio transmits the turn-off code and returns to the idle state.

Modem Initiated Reception

1. A data reception is initiated by the modem by activating (grounding) the DATA ARQ (INPUT A) line while receiving a call on a data group. A call on a data group is indicated by a low signal on the RX DATA GROUP (OUTPUT B) line. The DATA ARQ signal must lead the DATA PTT signal by at least 3 ms (5 ms typical), and the DATA ARQ signal must remain active for the entire data transmission/acknowledge session.

2. The modem must then activate (ground) the DATA PTT (PTT REQ N) line for the transmission of any ACKs or NACKs. During this time, the radio does not encode any subaudible data.

3. For the reception of any more data, the modem must release the DATA PTT line. During this time, the radio decodes subaudible data.

4. For all subsequent high-to-low transitions on the DATA PTT line, the radio transmits without decoding subaudible data.

5. For all subsequent low-to-high transitions on the DATA PTT line, the radio receives and decodes subaudible data.

6. The data session is completed by releasing the DATA ARQ line (the DATA PTT line must be released first if not already in that state).

B.8 SERIAL BUS PROTOCOL

B.8.1 INTRODUCTION

The information which follows defines the serial bus command and response protocol supported by the universal interface of the Summit® DM transceiver. (The protocol for the Viking® HT is different.)

Table B-7 Serial Bus Pin Description

Function	Pin	Description
Rx D TTL U	18	Serial receive data line (unbuffered). TTL voltage levels are used.
Tx D TTL U	17	Serial transmit data line (unbuffered). TTL voltage levels are used.

The serial bus is a component of the universal interface which also includes the discrete signals described earlier in this appendix. The serial bus provides direct control of various transceiver functions and also duplicates most of the functions provided by the discrete lines. Therefore, a very dynamic and flexible interface is provided by using only the serial bus and appropriately conditioning audio input and output signals.

This serial bus is the same bus that is used for transceiver programming and remote control. It is available on the following connectors:

Universal Interface (J601) - TxD TTL U, RxD TTL U

Remote Interface (J600) - TxD TTL R, RxD TTL R

Microphone Jack (J2) - TxD TTL, RxD TTL

Flash Programming Jack (J405) - TxD TTL, RxD TTL

B.8.2 PHYSICAL SIGNAL PATH

The electrical characteristics of the signals which implement the serial bus are described in the preceding table. These characteristics apply to the serial bus signals on all four connectors described in the preceding section. The serial interface is a full-duplex asynchronous serial port providing a standard NRZ format at standard baud rates. Timing conforms to the standard RS-232 protocol, but the levels are TTL only.

B.8.3 CHARACTER LEVEL PROTOCOL

The character level protocol for data exchange between the radio and an external device has the following characteristics:

1. The character format is one start bit, 8 data bits, one stop bit, no parity.
2. Transmission speed is 9600 baud.
3. No hardware or software flow control is used.
4. All data exchange is binary using a sync escape protocol.

B.8.4 MESSAGE LEVEL PROTOCOL

General

The message level information exchange protocol uses a variable length command and response message structure. All commands and responses share a common format. The following is a description of the message elements.

Sync	Supervision	Length	Message	Checksum
1 byte	1 byte	1 byte	0 to N bytes	1 byte

Sync - The first message character of each command or response is a unique sync character (0x7E). If the sync character or the escape character appear at any other position in the message format, it must be preceded by an inserted escape character (0x81).

Supervision - The second character of each message contains the command or response Supervision Type.

Length - The third character is the message length of the entire command/response message, not counting the initial sync or any inserted escape characters that must be sent for embedded sync/escape characters. The checksum character is, however, included in the length calculation. No message length can exceed 32 bytes.

Message - The next block of characters is the event message data which is sent to or from the radio. This character block contains the event message and always begins with an Event Type character. Each Event Type is associated with a fixed format and length for the remainder of the message data block.

Checksum - The last message character is the two's compliment of the sum of characters of the entire message. Excluded are inserted escape characters that must be sent for embedded sync characters. A message is considered complete when all the bytes have been received.

Distinguishing Embedded Sync and Escape Characters

Figure B-4 illustrates the encoding/decoding process described in the preceding information. The following example list shows how embedded sync and escape characters are distinguished from the primary use of these characters (see preceding "Sync" description).

<ESCAPE> <SYNC> - Embedded sync character in the data stream. The first escape character is absorbed and only the sync remains.

Serial Port Command Messages

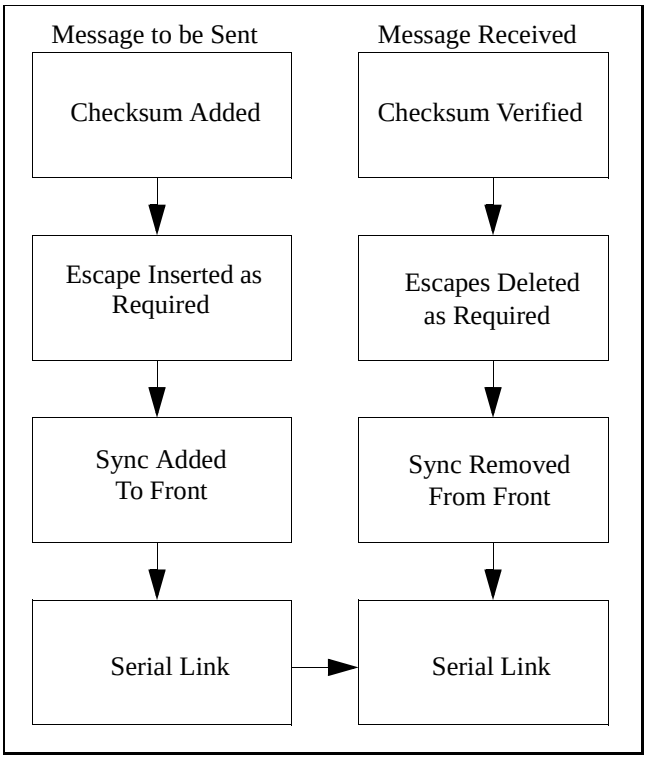

Figure B-4 Serial Bus Encode/Decode Diagram

<ESCAPE> <ESCAPE> - Embedded escape character in the data stream. The first escape character is absorbed and only the second escape remains.

<ESCAPE> <ESCAPE> <ESCAPE> <SYNC> - Embedded escape character followed by another embedded sync character. The first and third escapes are absorbed and the original data remains.

<NON ESCAPE> <SYNC> - This is the normal end of one message and the start of another.

<SYNC> <NON SYNC> - This is the normal start of a message.

<NON ESCAPE> <NON SYNC> - This is normal data.

B.8.5 MESSAGE SUPERVISION TYPES

NOTE: The last two digits of the number in parentheses are the hexadecimal code for the message. For example, 0x20 is equal to decimal 32.

The following commands have been defined for the universal interface.

ACK (0x01) - This message tells the external device that the previous message was received correctly.

NACK (0x02) - This command tells the external device that the previous message as received contained errors.

UI_CMD (0x10) - This command tells the radio that the specified event (and data, if any) has occurred and the radio should respond to it.

UI_RSP (0x0D) - This command is response to a UI_CMD or it informs an external device that an event has occurred.

B.8.6 SERIAL PORT COMMAND MESSAGES

The following events must have the Supervision of <UI_CMD> (0x10). The first byte of the data field contains the command subcode. The data field of each command subcode is shown.

AUDIO_GATE

AUDIO_GATE	Gate	State
1 byte	1 byte	1 byte

This tells the radio to open or close the specified audio gate (see Sections B.3 and B.4). Transmit gate changes are ignored if not in the transmit mode, and the gates revert to the previous state when the transmit mode is exited.

AUDIO_GATE = 0x01
Gate = Gate (M) number 0x01 - 0x07
State = New state (0 = closed, non 0 = open)

AUDIO_PA

AUDIO_PA	State
1 byte	1 byte

This tells the radio to route the receive or transmit audio to the external PA port or to mute the external PA.

AUDIO_PA = 0x03
State = New state (0 = mute, 1 = rx audio, 2 = tx audio)

Serial Port Command Messages (Cont'd)

AUDIO_PATH

AUDIO_PATH	Mode	Path
1 byte	1 byte	1 byte

This tells the radio to set the specified receive or transmit audio path mode (see Sections B.3 and B.4). Transmit audio path changes are ignored if not in the transmit mode, and the gates revert to the previous state when the transmit mode is exited.

AUDIO_PATH = 0x04
Mode = Mode being set (1 = rx path, 2 = tx path)
Path = Path being set for mode 0x01 - 0x06

BLOCK_DECODE

BLOCK_DECODE	State
1 byte	1 byte

This directs the radio to disable block decoding. If the radio is in a call, this function will not go into effect until the current call has ended. This command is global with all non-conventional systems.

BLOCK_DECODE = 0x1A
State = New state (1 = off, 0 = on)

BUTTON_PRESSED

BUTTON_PRESSED	Button
1 byte	1 byte

This tells the radio to simulate that the specified button has been pressed.

BUTTON_PRESSED = 0x05
Button = Button number 0x01-0x05 (left to right)

CALL_IND

CALL_IND	State
1 byte	1 byte

This tells the radio to turn the call indicator on or off.

CALL_IND = 0x06
State = New state (0 = off, non 0 = on)

CHANGE_SYS_GRP

CHANGE_SYS_GRP	System	Group
1 byte	1 byte	1 byte

This tells the radio to change to the specified system and group. The radio responds with the SYS_GRP response message

CHANGE_SYS_GRP = 0x07
System = New system number
Group = New group number

CLEAR_LOCKOUT_GID

CLEAR_LOCKOUT_GID	Decode ID	System No.
1 byte	1 byte	1 byte

This tells the radio to clear the lock out of a selected GID (group ID) from block decoding. This reverses the action of a SET_LOCKOUT_GID. If the ID is not locked out, no action is taken.

CLEAR_LOCKOUT_GID = 0x1E
Decode ID = Group decode ID to lock out of the block decode range
System Number = System of group ID to be cleared. This parameter is available with Version 217 and later software. System number 255 (0xFF) is a wild card and matches any system. With old format messages, the system number defaults to 255 for backwards compatibility.

DISPLAY_MESSAGE

Display_Message	String
1 byte	10 bytes

This tells the radio to display the specified message. Note that the string must be 10 bytes when included or garbage characters will appear on the radio's display. Only upper case or numeral ASCII characters should be sent. A message displayed in this manner will not be preempted until one of the following occurs:

Serial Port Command Messages (Cont'd)

- An operator action occurs
- An operator action is simulated
- A DISPLAY_MESSAGE is sent with no string (the data field contains only the sub-op code DISPLAY_MESSAGE)

DISPLAY_MESSAGE = 0x08
String = 10-character string to display

GET_DISPLAY_UPDATE

GET_DISPLAY_UPDATE
1 byte

This requests an UPDATE_DISPLAY response be sent with the current display contents.

GET_DISPLAY_UPDATE = 0x20

GET_LOCKOUT_GID

GET_LOCKOUT_GID
1 byte

This tells the radio to send a LOCKOUT_GID message containing the block decode IDs that are currently locked out from the receive mode.

GET_LOCKOUT_GID = 0x1F

GET_RADIO_STATUS

GET_RADIO_STATUS
1 byte

This tells the radio to send a RADIO_STATUS message containing the current status of several radio options.

GET_RADIO_STATUS = 0x23

MIC_HANGER

Mic Hanger	State
1 byte	1 byte

This tells the radio that the mic hanger has been placed on or off hook. This message is ignored if the microphone is actually off-hook.

MIC_HANGER = 0x09
State = New state (0 = off-hook, non 0 = on-hook)

INTERCEPT_TONE

INTERCEPT_TONE	State
1 byte	1 byte

This tells the radio to turn the intercept tone on or off. Note that the tone is generated by the radio's microprocessor and can be distorted if the radio is commanded to perform another action while the tone is turned on.

INTERCEPT_TONE = 0x0A
State = New state (0 = off, non 0 = on)

NOTIFY_ENABLE_FLAGS

NOTIFY_EVENT _FLAGS	Event Group 1	Event Group2	Event Group3	Event Group4
1 byte	1 byte	1 byte	1 byte	1 byte

This message controls which, if any, asynchronous notification messages are to be enabled. When enabled, radio events such as button pushes are reported in the <UI_RSP> RADIO_NOTIFY message. A logic 1 enables reporting and a logic 0 disables reporting. Refer to the UI_DISCONNECT message description for information on how it affects the flags.

NOTIFY_ENABLE_FLAGS = 0x0B
Event Group 1-3 = Refer to RADIO_NOTIFY message description for definitions.

PTT_EVENT

PTT Event	State
1 byte	1 byte

This tells the radio that the PTT switch has been pressed or released.

Serial Port Command Messages (Cont'd)

PTT_EVENT = 0x0C
State = New state (0 = released, non 0 = pressed)

RESET

RESET
1 byte

This tells the radio to configure event flags, I/O options, and audio path options to default states.

RESET = 0x0D

RETURN_GRP_ID

RETURN_GRP_ID
1 byte

This tells the radio to reply with the current Group ID data items using the GRP_ID response message.

RETURN_GRP_ID = 0x0E

RETURN_LAST_RX_GROUP

RETURN_LAST RX_GROUP
1 byte

This tells the radio to reply with the Group Decode ID and Home Repeater Number for the last received call using the LAST_RX_GROUP response message.

RETURN_LAST_RX_GROUP = 0x1C

RETURN_RX_UNIQUE_ID

RETURN_RX_UNIQUE_ID
1 byte

This tells the radio to reply with the Unique ID (or UID) of the current or most recent call using the RX_UNIQUE_ID response message.

RETURN_RX_UNIQUE_ID = 0x0F

RETURN_SYS_GRP

RETURN_SYS_GRP
1 byte

This tells the radio to reply with the radio's current system and group using the SYS_GRP response message.

RETURN_SYS_GRP = 0x10

RETURN_UNIQUE_ID

RETURN_UNIQUE_ID
1 byte

This tells the radio to reply with the Unique ID (or UID) of the current Multi-Net system using a UNIQUE_ID message.

RETURN_UNIQUE_ID = 0x22

SELECT_KNOB_EVENT

SELECT_KNOB_EVENT	Knob Event
1 byte	1 byte

This tells the radio that the select knob has been rotated up, rotated down, or pushed.

SELECT_KNOB_EVENT = 0x11
Knob Event = 0 = down, 1 = up, 2 = push

SEND_DTMF_DIGITS

SEND_DTMF_DIGITS	Digits
1 byte	2 to 28 bytes

This tells the radio to send the specified DTMF digits (approximately 70 ms on, 70 ms off).

SEND_DTMF_DIGITS = 0x12
Digits = 1 to 27 digits followed by a NULL byte. Digits are encoded as the ASCII characters "0" to "9", "*", and "#".

Serial Port Command Messages (Cont'd)

SET_AUTO_DISPLAY

SET_AUTO_DISPLAY	Status
1 byte	1 byte

This tells the radio to send and UPDATE_ DISPLAY message whenever the contents of the radio display change.

SET_AUTO_DISPLAY = 0x24
Status = New status (0 = off, 1 = on)

SET_LOCKOUT_GID

SET_LOCKOUT_GID	Decode ID	System No.
1 byte	1 byte	1 byte

This tells the radio to lock out a selected GID (group ID) from block decoding. A LOCKOUT_GID_ RSP message is sent in response to this message. Up to five decode IDs may be locked out at any time.

SET_LOCKOUT_GID = 0x1D
Decode ID = Group decode ID to lock out of the block decode range
System Number = System of group ID to be locked out. This parameter is available with Version 217 and later software. System number 255 (0xFF) is a wild card and matches any system. With old format messages, the system number defaults to 255 for backwards compatibility.

SET_PTT

SET_PTT	Option
1 byte	1 byte

This tells the radio to set the specified PTT_ REQUEST_N input option.

SET_PTT = 0x14
Option = PTT_REQUEST_N option:
- 0 = Standard PTT operation
- 1 = Inhibit PTT operation
- 2 = Data PTT (no revert operation)
- 3 = Data PTT (revert operation)
- 4 = Release serial override (return to programmed operation)
- 15 = Undefined (disable signal)

SET_RX_TX_GROUP_ID

SET_RX_TX_GROUP_ID	Decode ID	Encode ID
1 byte	1 byte	1 byte

This tells the radio to set the Group Decode ID (used for received calls) and Group Encode ID (used for transmit calls) to the specified values. If the radio is scanning, this command is ignored. If the radio is involved in a call, the changes take effect when the call is concluded. Priority calls are not affected. If scanning is enabled after this command has been sent, the specified values are in effect for all non-conventional systems. If either of the parameter values is zero, this command has the effect of canceling any previous SET_RX_TX_GROUP_ID commands.

SET_RX_TX_GROUP_ID = 0x1B
Decode ID = New decode ID (0 = reset to programmed value)
Encode ID = New encode ID (0 = reset to programmed value)

SET_STATUS_FIELD

SET_STATUS_FIELD	Status
1 byte	1 byte

This tells the radio to display the specified message in the two digit status field.

SET_STATUS_FIELD = 0x15
State = Displayed status value

SOUND_BEEP

SOUND_BEEP
1 byte

This tells the radio to sound a beep.

SOUND_BEEP = 0x16

SOUND_HORN

SOUND_HORN
1 byte

Serial Port Response Messages (Cont'd)

This tells the radio to enable its internal horn switch (pulse on for 0.5 second and off for 0.5 second for 3 cycles). Note that many internal actions can cancel this operation including many serial commands. Once sent, no other serial commands should be sent for three seconds to allow the sequence to complete.

SOUND_HORN = 0x17

SOUND_RING

SOUND_RING
1 byte

This tells the radio to produce a 1 second ringing tone. Several internal operations can cause this tone to be distorted since it is produced directly by the microprocessor, so no serial commands should be sent during the one second period that this tone sounds.

SOUND_RING = 0x18

TOGGLE_BACKLIGHT

TOGGLE_BACKLIGHT
1 byte

This tells the radio to toggle the backlight. Note that the current backlight status can be retrieved in the response to a GET_RADIO_STATUS message.

TOGGLE_BACKLIGHT = 0x21

UI_DISCONNECT

UI_DISCONNECT
1 byte

This tells the radio that the external device will be disconnecting itself from the radio after sending this message. This command causes all RADIO_ENABLE_NOTIFY flags to be returned to the power-on default configuration (all flags set to zero). Any pending outgoing messages are purged.

UI_DISCONNECT = 0x19

B.8.7 RESPONSE MESSAGES

The following responses must have a Supervision of <UI_RSP> (0x0D). The first byte of the data field contains the response subcode. The data field of each response subcode is shown.

DTMF_DIGITS_SENT

DTMF_DIGITS_SENT
1 byte

This is a response to a SEND_DTMF_DIGITS<digits> message, and it informs an external device that the requested DTMF digits have been sent.

DTMF_DIGITS_SENT = 0x01

GRP_ID

GRP_ID	Tx Encode ID	Rx Decode ID	Home Rptr
1 byte	1 byte	1 byte	1 byte

This is a response to a RETURN_GRP_ID message, and it provides the external device with information on the requested Group ID data items. If the radio is scanning when this message is sent, information on the revert system and group is returned.

GRP_ID = 0x03
Tx encode ID = Encode ID that was set
Rx decode ID = Decode ID that was set
Home Rptr = Home repeater that was set

LAST_RX_GROUP

LAST_RX_GROUP	Rx Encode ID	Home Rptr
1 byte	1 byte	1 byte

This is a response to a RETURN_LAST_RX_GROUP message.

LAST_RX_GROUP = 0x0A
Rx decode ID = Decode ID of last non-conventional call received
Home Rptr = Home repeater number of last non-conventional call received

Serial Port Response Messages (Cont'd)

LOCKOUT_GID

LOCKOUT_GID	Count	Decode IDs	System No.
1 byte	1 byte	Count bytes	1 byte

This is a response to a GET_LOCKOUT_GID message.

LOCKOUT_GID = 0x0D
Count = Number of decode IDs in this message
Decode ID = Decode IDs that are now locked out (0 indicates an empty lockout slot)
System Number = System of each locked out group ID. This parameter is available with Version 217 and later software. System number 255 (0xFF) is a wild card and matches any system. With old format messages, the system number defaults to 255 for backwards compatibility. Also for compatibility, this message contains all (count) decode IDs followed by all (count) system numbers in the same order.

LOCKOUT_GID_RSP

LOCKOUT_GID_RSP	Decode ID	System No.
1 byte	1 byte	1 byte

This is a response to a LOCKOUT_GID message.

LOCKOUT_GID_RSP = 0x0E
Decode ID = Decode ID that is now locked out (0 indicates failed to lockout requested ID)
System Number = System of the locked out group ID. This parameter is available with Version 217 and later software. System number 255 (0xFF) is a wild card and matches any system. With old format messages, the system number defaults to 255 for backwards compatibility.

PTT_RESULT

PTT_RESULT
1 byte

This is a response to a PTT_EVENT (pressed), informing an external device that the attempt to access the channel/system has succeeded or failed because the channel/system was busy or out of range.

PTT_RESULT = 0x04
Result = Result of PTT press (1 = success, 2 = busy, 3 = out of range)

RADIO_READY

RADIO_READY
1 byte

This is a response to a RESET<–> message informing an external device that the radio is reset and ready for universal interface operation.

RADIO_READY = 0x05

RADIO_NOTIFY

RADIO_NOTIFY	Event Group 1	Event Group2	Event Group3	Event Group4
1 byte	1 byte	1 byte	1 byte	1 byte

This is a response to a radio event. The message is transmitted only if the enable flag associated with the event has been enabled (see NOTIFY_ENABLE_FLAGS command). A "1" bit indicates the associated event occurred and a "0" bit indicates the inactive state.

RADIO_NOTIFY = 0x06

Event group 1 = Bit field (Bit 0 = LSB)

Bit 0 = Button 1 pressed (left)
Bit 1 = Button 2 pressed
Bit 2 = Button 3 pressed
Bit 3 = Button 4 pressed
Bit 4 = Button 5 pressed
Bit 5 = Button 6 pressed
Bit 6 = ZERO (reserved)
Bit 7 = ZERO (reserved)

Event group 2 = bit field (Bit 0 = LSB)

Bit 0 = Select knob rotate down
Bit 1 = Select knob rotate up
Bit 2 = Select knob push
Bit 3 = PTT pressed
Bit 4 = PTT released

Serial Port Response Messages (Cont'd)

Bit 5 = Rx valid call started
Bit 6 = Rx valid call ended
Bit 7 = ZERO (reserved)

Event group 3 = Bit field (Bit 0 = LSB)

Bit 0 = Rx on data group started
Bit 1 = Rx on data group ended
Bit 2 = Tx audio mute
Bit 3 = Tx audio unmute
Bit 4 = Mic off hook
Bit 5 = Mic on hook
Bit 6 = Clear to send asserted
Bit 7 = Clear to send released

Event group 4 = Bit field (Bit 0 = LSB)

Bit 0 = System scan started
Bit 1 = System scan stopped
Bit 2 = Group scan started
Bit 3 = Group scan stopped
Bits 4 - 7 = Zero (reserved)

RADIO_STATUS

RADIO_STATUS	Status 1	Status 2	Status 3
1 byte	1 byte	1 byte	1 byte

This is a response to a GET_RADIO_STATUS message. Note that many of these bits reflect the current status of a physical universal interface connector signal.

RADIO_STATUS = 0x0C
Status 1 = Bit field (Bit 0 = LSB)

Bit 0 = PTT_REQ_IN
Bit 1 = SQUELCH_REQ_IN
Bit 2 = INPUT_A
Bit 3 = INPUT_B
Bit 4 = BSY_OUT
Bit 5 = PTT
Bit 6 = OUTPUT_A
Bit 7 = OUTPUT_B

Status 2 = Bit field (Bit 0 = LSB)

Bit 0 = Scanning Enabled
Bit 1 = MIC On Hook
Bit 2 = Call Light
Bit 3 = Encryption
Bit 4 = System
Bit 5 = Transmitting
Bit 6 = Phone Group
Bit 7 = Backlight

Status 3 = Bit field (Bit 0 = LSB)

Bit 0 = Rx Valid Call
Bit 1 = Group scan active
Bit 2 = System scan active
Bits 3 - 7 = (Reserved)

RX_UNIQUE_ID

RX_UNIQUE_ID	UID High Byte	UID Low Byte
1 byte	1 byte	1 byte

This is a response to a RETURN_RX_UNIQUE _ID message, informing an external device of the last received Unique ID (UID).

RX_UNIQUE_ID = 0x07
UID high byte = High order byte of the UID
UID low byte = Low order byte of the UID

SYS_GRP

SYS_GRP	System	Group
1 byte	1 byte	1 byte

This is a response to RETURN_SYS_GRP and CHANGE_SYS_GRP messages, informing an external device of the currently active system and group numbers. If the radio is scanning when this message is sent, the revert system and group is returned.

SYS_GRP = 0x08
System = Currently active system number
Group = Currently active group number

SYS_GRP_INVALID

SYS_GRP_INVALID	System	Group
1 byte	1 byte	1 byte

This is a response to a CHANGE_SYS_GRP message, informing an external device that the

Serial Port Response Messages (Cont'd)

requested system/group does not exist. The parameter field includes the requested system and group numbers.

SYS_GRP_INVALID = 0x09
System = Currently active system number
Group = Currently active group number

UNIQUE_ID

UNIQUE_ID	UID High Byte	UID Low Byte
1 byte	1 byte	1 byte

This is a response to a RETURN_UNIQUE_ID message, informing an external device of the current system's Unique ID (UID). The returned ID is 0xFFFF if the current system is not a Multi-Net system.

UNIQUE_ID = 0x0F
UID high byte = High order byte of the UID
UID low byte = Low order byte of the UID

UPDATE_DISPLAY

UPDATE_DISPLAY	Compressed String
1 byte	9 bytes

This is a response to either a GET_DISPLAY_ UPDATE or SET_AUTO_DISPLAY message which is used to display the specified information in the 10-character alphanumeric and 2-character status display.

UPDATE_DISPLAY = 0x0B

The Compressed String is a series of three 3-byte message blocks as shown in Table B-8 which follows. Each block contains four display characters in a compressed ASCII format. The display characters in the message are as follows:

ADx = Alphanumeric display characters. AD0 is the left-most character and AD9 is the right-most character.

SDx = Status display characters. SD0 is the left character and SD1 the right character.

The character to be displayed is in a compressed ASCII format encoded as follows:

Compressed Code = ASCII code – (minus) 0x20

NOTE: The two digits after the "x" in 0x20 above are the hexadecimal code. For example, 0x20 is equal to decimal 32.

Table B-8 UPDATE_DISPLAY Message Coding

Message Block 0

Byte	1								2								3							
Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	AD0 Character								AD1 Character				AD2 Character				AD3 Character							

Message Block 1

Byte	4								5								6							
Bit	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	AD4 Character								AD5 Character				AD6 Character				AD7 Character							

Message Block 2

Byte	7								8								9							
Bit	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
	AD8 Character								AD9 Character				SD0 Character				SD1 Character							