SIEMENS

SERVICE MANUAL

HOT/EOT REPEATERS, Q3440/R AND Q3443

NOVEMBER 2018

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VERSION A

Siemens Mobility, Inc.
700 East Waterfront Drive
Munhall, Pennsylvania 15120
1-800-793-SAFE

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2400 NELSON MILLER PARKWAY		939 S. MAIN STREET	
LOUISVILLE, KENTUCKY 40223		MARION, KENTUCKY 42064	
TELEPHONE:	(502) 618-8800	TELEPHONE:	(270) 918-7800
FAX:	(502) 618-8810	CUSTOMER SERVICE:	(800) 626-2710
SALES & SERVICE:	(800) 626-2710	TECHNICAL SUPPORT:	(800) 793-7233
WEB SITE:	USA Rail Automation Site	FAX:	(270) 918-7830

FCC RULES COMPLIANCE

The equipment covered in this manual 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/her own expense.

DOCUMENT HISTORY

Version	Release Date	Sections Changed	Details of Change
A	11/27/2018	N/A	Initial Release

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NOTES, CAUTIONS, AND WARNINGS

Throughout this manual, notes, cautions, and warnings are frequently used to direct the reader's attention to specific information. Use of the three terms is defined as follows:

WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY. WARNINGS ALWAYS TAKE PRECEDENCE OVER NOTES, CAUTIONS, AND ALL OTHER INFORMATION.

CAUTION

REFERS TO PROPER PROCEDURES OR PRACTICES WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN A POTENTIALLY HAZARDOUS SITUATION AND/OR POSSIBLE DAMAGE TO EQUIPMENT. CAUTIONS TAKE PRECEDENCE OVER NOTES AND ALL OTHER INFORMATION, EXCEPT WARNINGS.

NOTE

Generally used to highlight certain information relating to the topic under discussion.

If there are any questions, contact Siemens Mobility, Inc. Application Engineering

ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS

Static electricity can damage electronic circuitry, particularly low voltage components such as the integrated circuits commonly used throughout the electronics industry. Therefore, procedures have been adopted industry-wide which make it possible to avoid the sometimes invisible damage caused by electrostatic discharge (ESD) during the handling, shipping, and storage of electronic modules and components. Siemens Mobility, Inc. has instituted these practices at its manufacturing facility and encourages its customers to adopt them as well to lessen the likelihood of equipment damage in the field due to ESD. Some of the basic protective practices include the following:

- Ground yourself before touching card cages, assemblies, modules, or components.
- Remove power from card cages and assemblies before removing or installing modules.
- Remove circuit boards (modules) from card cages by the ejector lever only. If an ejector lever is not provided, grasp the edge of the circuit board but avoid touching circuit traces or components.
- Handle circuit boards by the edges only.
- Never physically touch circuit board or connector contact fingers or allow these fingers to come in contact with an insulator (e.g., plastic, rubber, etc.).
- When not in use, place circuit boards in approved static-shielding bags, contact fingers first. Remove circuit boards from static-shielding bags by grasping the ejector lever or the edge of the board only. Each bag should include a caution label on the outside indicating static-sensitive contents.
- Cover workbench surfaces used for repair of electronic equipment with static dissipative workbench matting.
- Use integrated circuit extractor/inserter tools designed to remove and install electrostatic-sensitive integrated circuit devices such as PROM's (OK Industries, Inc., Model EX-2 Extractor and Model MOS-40 Inserter (or equivalent) are highly recommended).
- Utilize only anti-static cushioning material in equipment shipping and storage containers.

For information concerning ESD material applications, please contact the Technical Support Staff at 1-800-793-7233. ESD Awareness Classes and additional ESD product information are also available through the Technical Support Staff.

SECTION 1 **INTRODUCTION**

1.0 INTRODUCTION

This manual will provide information for the integration, installation, and configuration of the Q3440/R and Q3443 HOT repeaters.

The Q3440/R and Q3443 repeaters have identical functionality. The main difference between them is the Q3443 contains an internal antenna signal combiner, presenting a single antenna connector on the front panel, instead of the two antenna connectors present on the Q3440/R front panel (see Figure 1-1). The Q3443 also has test points on the front panel (each aligned under the respective frequency label) for receiver sensitivity measurements (see Figure 4-1).

1.1 PRODUCT FEATURES

Siemens Q3440/R and Q3443 HOT/EOT Repeaters are designed to assist communication between Head-of-Train (HOT) and End-of-Train (EOT) transceivers where communication between these devices may be impeded by obstructions or other forms of radio interference.

The Siemens Q3440/R and Q3443 supports the AAR S-9152 standard protocol on the frequency pairs of 457.9375 MHz and 452.9375 MHz. Siemens Repeaters are designed to operate without any user input. Once initialized (powered up), operational status LED indicators, located on the front panel, provide visual indications of the operating status of the Repeaters.

Q3440/R **Q3443**

Figure 1-1 End of Train Repeater

1.2 PARTS LIST

The following lists all components available from Siemens for the installation, interconnection, and servicing of the Siemens Q3440/R and Q3443 HOT/EOT Repeaters.

Table 1-1 Parts List

Siemens Part Number	Quantity	Description
Q3440/R	1	AAR Protocol HOT/EOT Repeater
Q3443	1	AAR Protocol HOT/EOT Repeater
QP-06954	1	Repeater Configuration Cable
QP-16385	1	Repeater Configuration Software
OBE-00-17-01	1	Service Manual (this manual)

SECTION 2 **INSTALLATION**

2.0 INSTALLATION

The Siemens Q3440/R and Q3443 Repeater operates without any user intervention. They are generally installed in areas where radio communication is lost between the HOT and EOT due to terrain or other obstructions.

Please refer to the installation drawings, found in the Drawings Section of this manual, for installation details. The Q3440/R uses two 450 MHz antennas with PL-259 connectors. The Q3443 uses one 450 MHz antenna with PL-259 connector.

2.1 INSTALLATION REQUIREMENTS

The Repeater requires a regulated power supply (12 VDC +/- 2.5 VDC @ 3A) and is fully operational within 5 seconds of power-up. Connect the power to the terminals as marked on the units and as shown on the installation drawings located in the Drawings Section of this manual.

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SECTION 3 **CONFIGURATION**

3.0 CONFIGURATION

Configuration of the Repeaters are limited to: adding additional EOT ID numbers to the "NO REPEAT LIST" that is stored in the memory of each Repeater, setting the Repeat Delay, executing a Transmit Test, and checking the error list for any error codes. As shipped from the factory, each repeater is programmed NOT to repeat any EOT or HOT messages for EOT ID numbers listed in Table 3-1. Additional numbers can be added to the "NO REPEAT LIST" by using the Siemens Repeater Configuration Software, QP-16385 HETRComm.

3.1 USING THE EOT REPEATER CONFIGURATION SOFTWARE

Connect a serial cable between a Windows PC and the DB9 connector on the front panel of the repeater. Configure the serial communication parameters for 19,200 baud, no flow-control, 8 data-bits, 1 stop-bit, and no parity (19200, N, 8, 1, N).

After installing the software tool, select the HETRComm icon from the desktop.

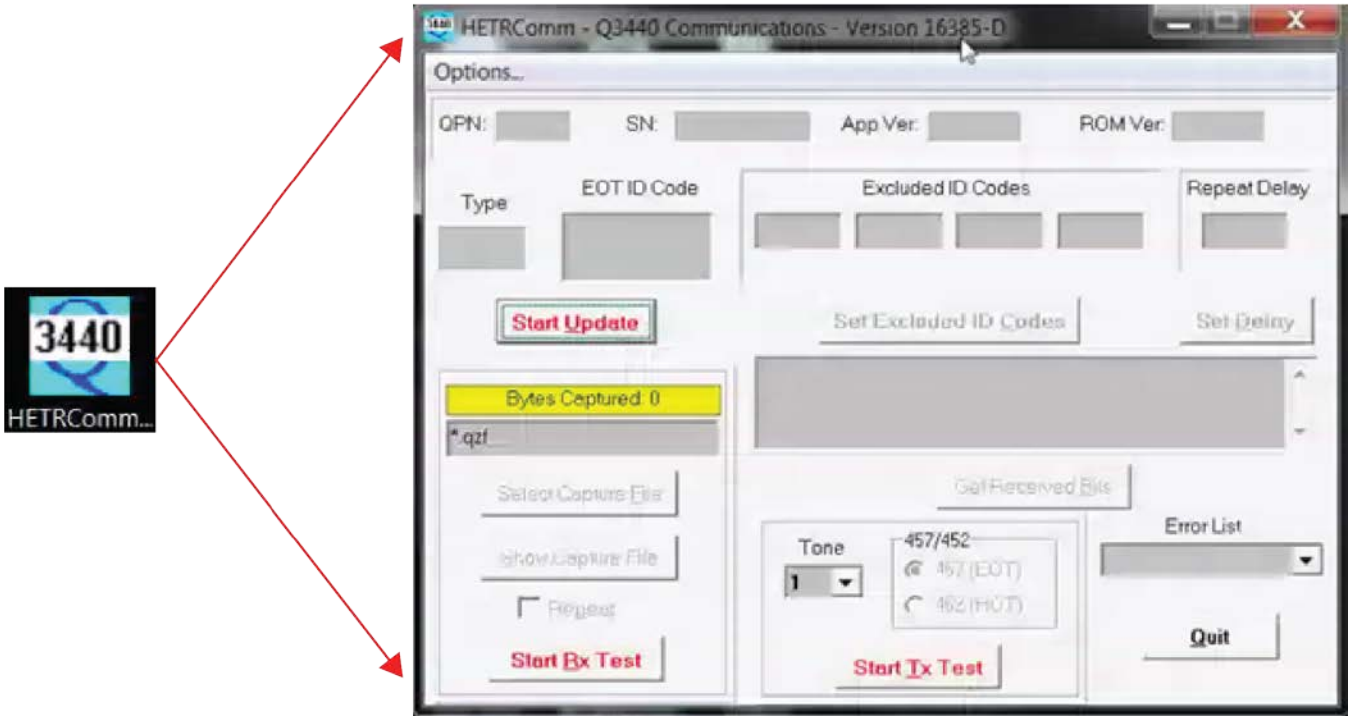


Figure 3-1 Open Program

The tool will open with all fields greyed out.

Use the drop-down menu under **Options** to select which Com Port is connected to the EOT Repeater.

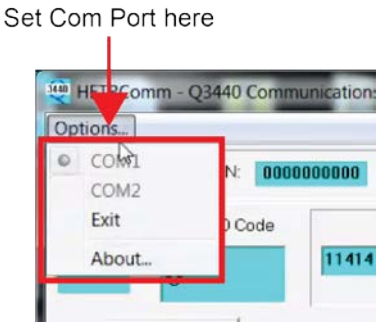


Figure 3-2 Com Port Selection

To connect to the repeater, click **Start Update**. The fields will then turn blue and the configuration information for the connected repeater will be displayed.

3.1.1 EOT Repeater Configuration and Identification

Once the correct Com Port has been selected, the program will display the serial number and the application software and boot loader versions of the EOT Repeater.

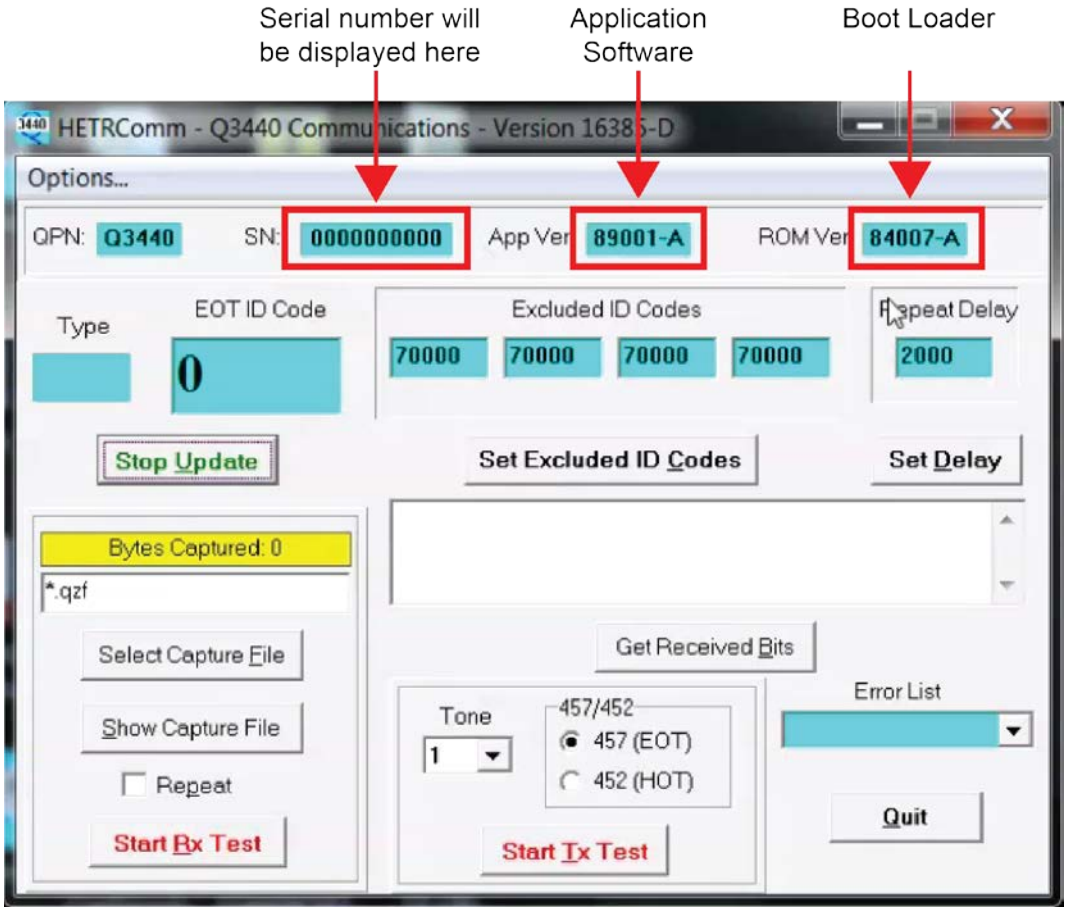


Figure 3-3 EOT Identification Fields

The program will also flash in the EOT ID Code box any IDs found in received messages.

3.1.2 Setting Excluded ID Codes

To set excluded ID codes (No Repeat Codes) not covered in the factory defaults (see Table 3-1), click into one of the **Excluded ID Codes** fields. Type the desired number, then select **Set Excluded ID Codes**. The number will then be added to the No Repeat List.

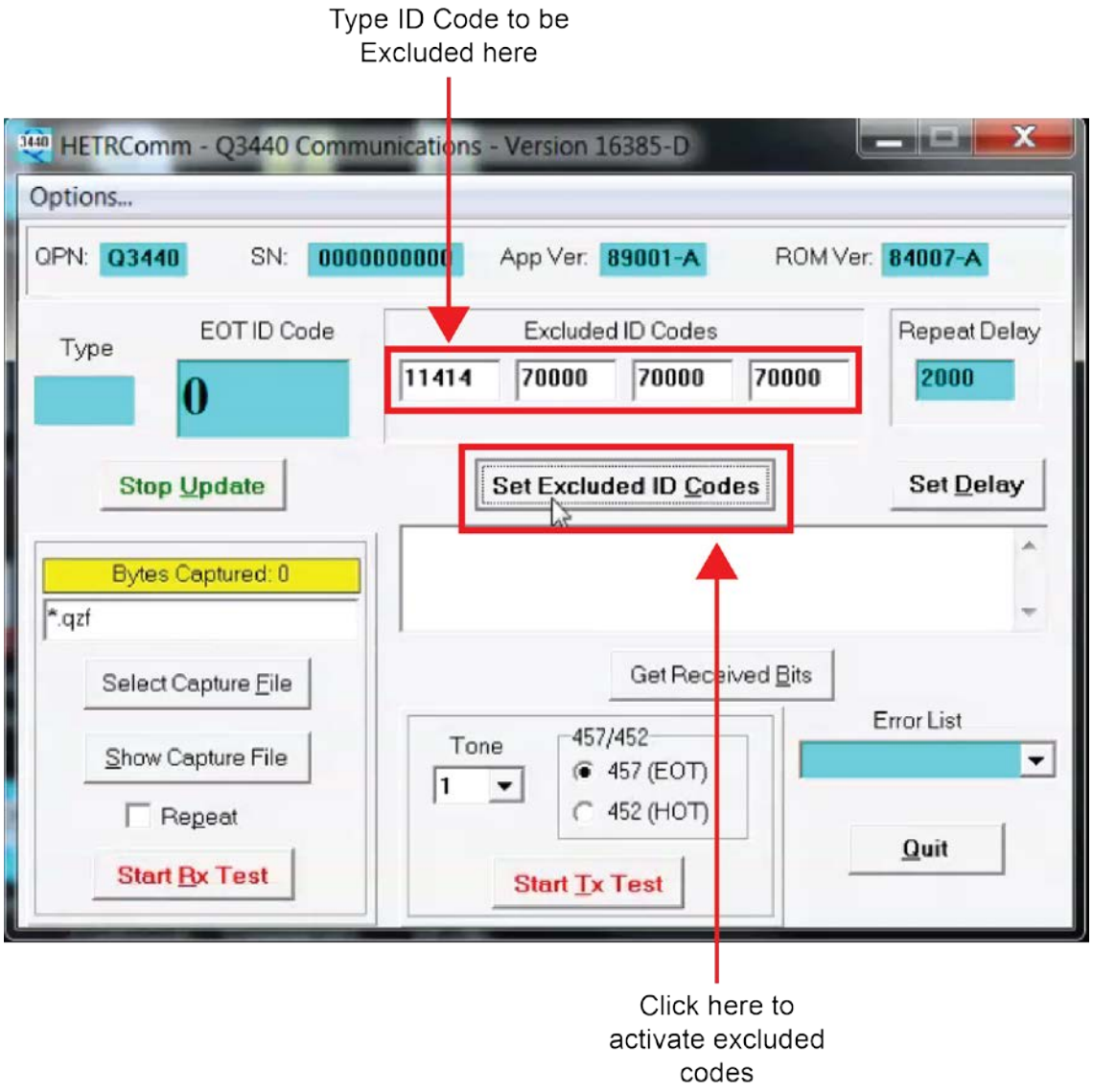


Figure 3-4 Setting Excluded ID Codes

Table 3-1 Factory Default EOT No Repeat

Status	EOT ID Numbers
Pre-programmed NO REPEAT	71000
Pre-programmed NO REPEAT	71001
Pre-programmed NO REPEAT	71002

3.1.3 HETRComm Display

The fields highlighted in Figure 3-5 are also used to configure the EOT Repeater. The **Repeat Delay** field allows the user to adjust the delay time for message repeat. The **Error List** allows the user to see any error codes the EOT Repeater may have active. The Tone and Frequency can also be selected to execute transmitter tests when aligning the radio.

NOTE

It's recommended that the Repeater Delay be kept at the default value of 2000 milliseconds.

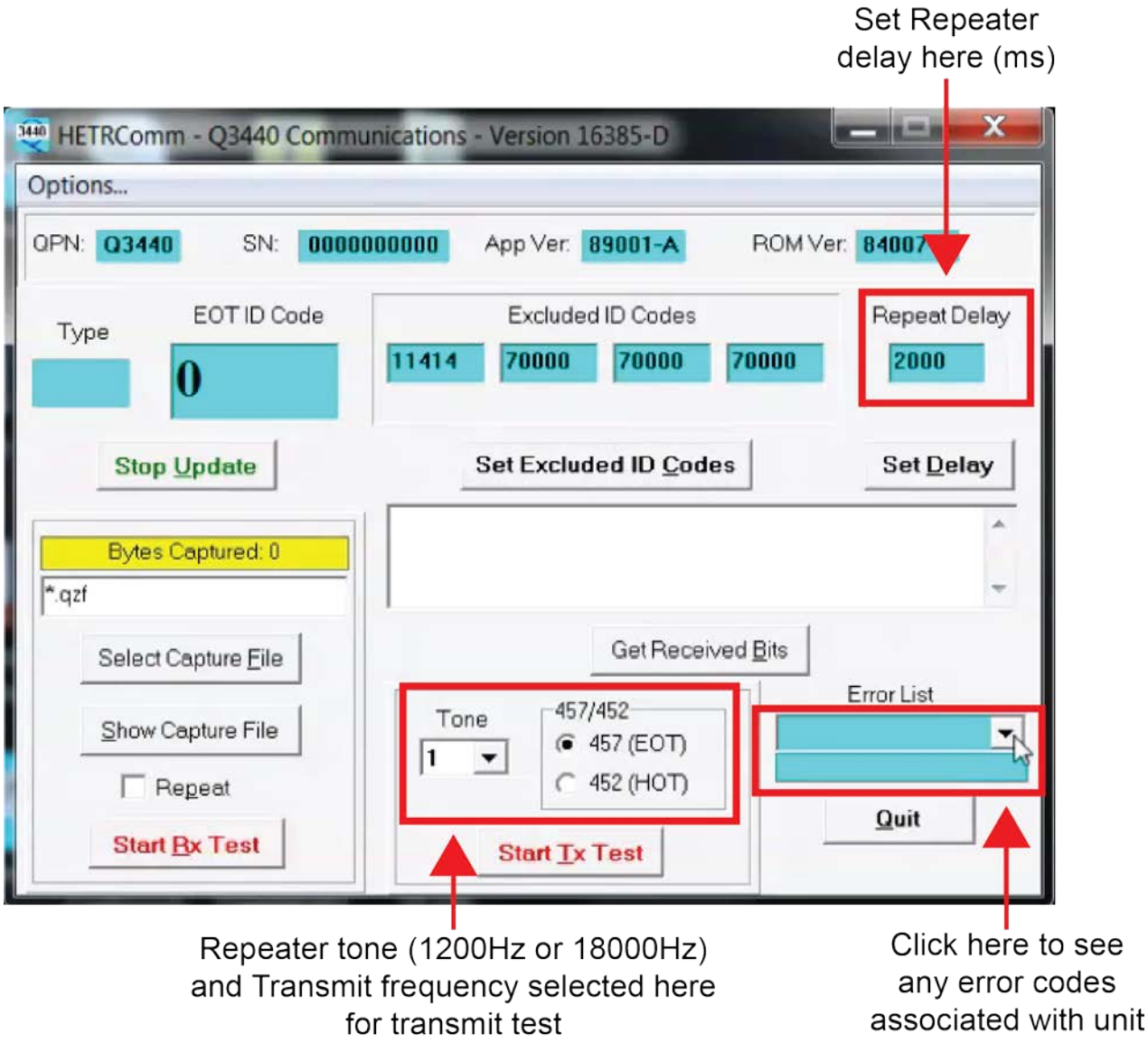


Figure 3-5 HETRComm Additional Configuration Options

SECTION 4 **OPERATION**

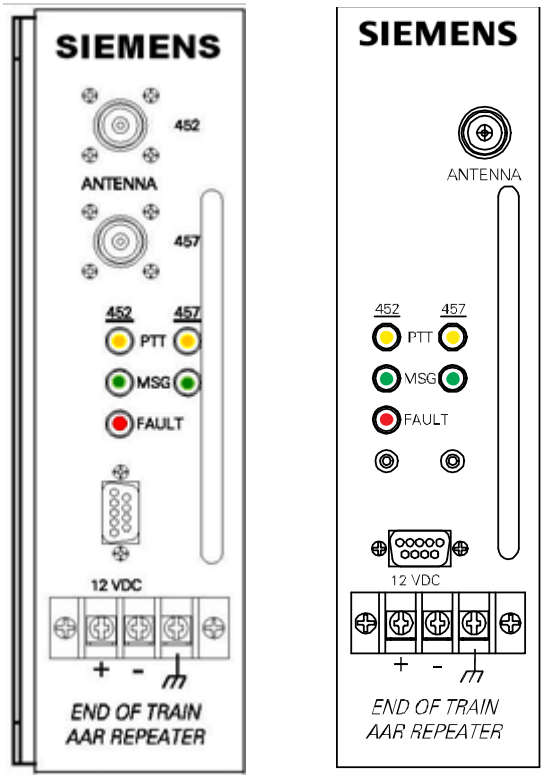
4.0 OPERATION

The Q3440/R and Q3443 operate without any user intervention. They are equipped with LED indicator lights that show the unit's status after power is applied and the Repeater is operational.

4.1 LED OPERATIONAL INDICATORS

The LED indicators are located on the front panel of the Repeater. Three colored indicators are provided and will be illuminated when the following operations or conditions occur:

OPERATION/CONDITION	INDICATOR	INDICATION
Transmitter is keyed	Yellow PTT LED	Solid Yellow
Unit is powered	Green MSG LED	Solid Green
Unit received a valid message	Green MSG LED	Blinking Green
Internal Failure	Red Fault LED	Blinking Red



Q3440 **Q3443**

Figure 4-1 LED Operational

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SECTION 5 **MAINTENANCE AND TESTING**

5.0 MAINTENANCE

There are no components in the Q3440/R and Q3443 Repeaters that require annual calibration. The radio modules are subject to FCC requirements but do not explicitly require annual inspection. Additionally, the Ritron radio transceiver inside this product was granted an FRA waiver (FRA-2009-0015) and is therefore exempt from the requirements of 49CFR232.409 (d).

In case of failure or degraded performance, return the Q3440/R and Q3443 Repeaters to the factory for repairs. Reference the Warranty and Repair Section of this manual regarding the return of equipment to Siemens for service.

5.1 TESTING

This section is used to test the repeater chassis sub-assembly P/N 62143/R.

Test Equipment

- 12V power supply (3A)
- Multimeter
- Computer Running Windows®
- Repeater Configuration Program 16385 (HETRComm)
- RF Cables
- Radio Service Monitor (RSM)
- BNC-to-clip-lead cable or adapter

5.1.1 Electrical Inspection

5.1.1.1 PCB Power Supplies

1. Connect a 12V power supply to appropriate terminals (POS to +, NEG to –) of terminal strip on the unit.
2. Apply **+12V** power.

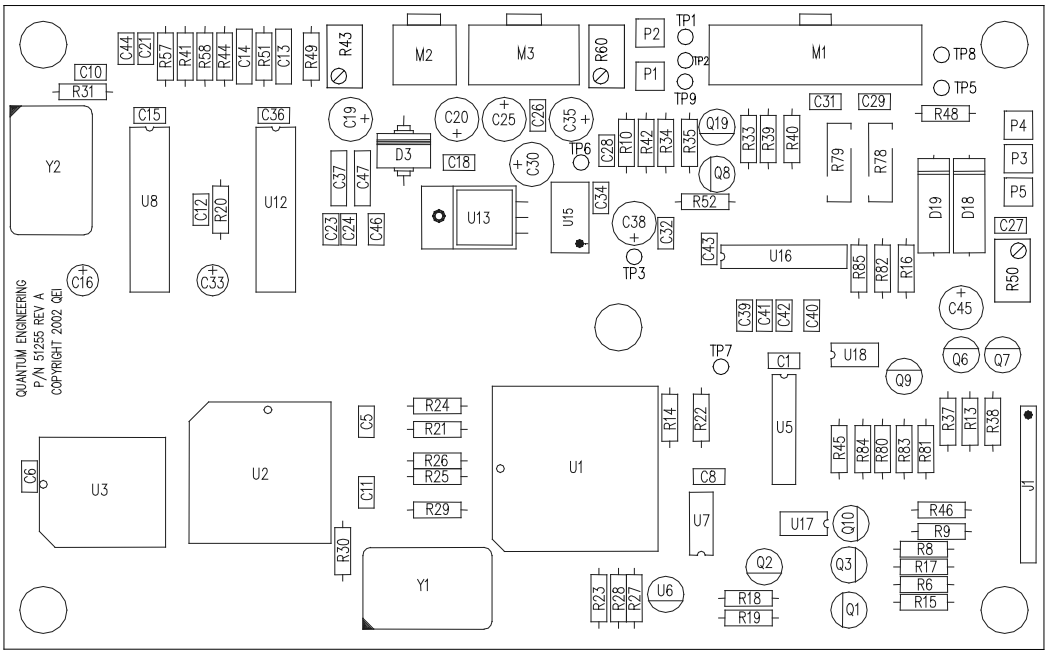

Figure 5-1 60255 Rev A PCB

3. Measure 5.00 (± 0.25) volts DC between TP3 (POS) and GND jumper P1-P2 (NEG).
4. Measure 12.0 (± 0.6) volts DC between TP5 (POS) and GND jumper P1-P2 (NEG).
5. Measure 5.00 (-0.38 / +0.5) volts DC between TP6 (POS) and TP7 (NEG).

5.1.2 Radio Tests

5.1.2.1 457 (EOT) Transmitter Power & Frequency Error Check

1. Connect an RF cable between the **457 –ANTENNA–** connector on the unit and the input of the Radio Service Monitor (RSM).
    a. For the Q3443 connect the cable to the single antenna connector on the unit.
2. Set the RSM to measure transmitter properties in narrow band on the appropriate transmitter frequency (457.9375 MHz).
3. On a Windows® computer, run 16385.EXE program (HETRComm).
4. Press the Start Update button.

NOTE

If any EOT units are in operation, add the active ID codes to the Excluded ID Codes listings by using 16385.EXE program.

5. On the computer running 16385.EXE (HETRComm) program, click on the 457 button to select the 457 frequency radio.
6. Verify Tone 1 is selected.
7. Press Start Tx Test button to activate the transmitter.

NOTE

Allow no more than 20 sec transmit duration and allow the transmitter to cool for 2 min between transmit cycles during power measurements.

8. Verify **2.0 to 2.5 Watts** measured transmit power on the RSM display.
9. Verify the unit is transmitting on 457.9375 MHz +/- 100 Hz.
10. Verify the **457** YELLOW PTT LED is lit.
11. Press Stop Tx Test button to deactivate transmitter.
12. Select Tone 2 on HETRComm and repeat steps 7 through 11 above.

5.1.2.2 457 (EOT) Transmit Modulation Deviation

1. Select Tone 1 on HETRComm.
2. Press Start Tx Test button to activate the transmitter.
3. Adjust R50 on the 60255 PCB to read **2.3 to 2.45 kHz** on the IFR digital display.
4. Press Stop Tx Test to deactivate transmitter.
5. Select Tone 2 on HETRComm and repeat steps 2 through 4 above.

5.1.2.3 457 (EOT) Receiver Sensitivity

1. Set the RSM to measure receiver properties in narrow band on the appropriate frequency (457.9375 MHz) as follows:
   Set Deviation to 2.5 kHz.
   Set Modulating Signal to 1 kHz.
   Set RF level to –117.4dBm (0.3µV)
2. Connect a BNC-to-clip-lead cable from TP9 (POS) and GND jumper P1-P2 (NEG) to the RSM SINAD connector.
   a. For the Q3443, this measurement can also be made by connecting the positive clip-lead to the 457 (right-side) test jack on the front panel.
3. Verify the SINAD reads > 12dB on the RSM display.
4. Set RF level to 97.4 dBm (3µV)
5. Verify the RX audio level is 354 mV RMS +/- 5%
6. Disconnect the BNC -to- clip-lead cable from unit's PCB.
7. Disconnect the RF cable from the antenna connector on the unit.

5.1.2.4 452 (HOT) Receiver Sensitivity

NOTE

NOTE

This radio is used in receive mode only.

1. Move the RF cable to the **452 ANTENNA**-connector.
    a. For the Q3443, the cable remains connected to the single antenna connector on the unit.
2. Set the RSM to measure receiver properties in narrow band on the appropriate frequency (452.9375 MHz) as follows:
   Set Deviation to 2.5 kHz.
   Set Modulating Signal to 1 kHz.
   Set RF level to –117.4dBm (0.3µV)
3. Connect a BNC -to-clip-lead cable from TP1 (POS) and GND jumper P1-P2 (NEG) to the RSM SINAD connector.
    a. For the Q3443, this measurement can also be made by connecting the positive clip-leads to the 452 (left-side) test jack on the front panel.
4. Verify the SINAD reads > 12dB on the RSM display.
5. Set RF level to -97.4 dBm (3µV)
6. Verify the RX audio level is 354 mV RMS +/- 5%
7. Disconnect the BNC-to-clip-lead cable from the PCB.
8. Disconnect the RF cable from antenna connector on the unit.

If any parameters do not pass, perform radio alignment (see Appendix A)

SECTION 6 WARRANTY AND REPAIR

6.0 WARRANTY POLICY

All Siemens equipment, excluding credit card memory or other similar devices that already carry a manufacturer's warranty, is warranted against failure, due to materials or workmanship, for a period of two (2) years commencing on the month of manufacture. Siemens will repair or replace, at our discretion, all defective material returned to our factory in Marion, Kentucky, prepaid. The equipment will be fully repaired and tested to the original equipment specifications. Equipment will be returned at the equipment owners' expense with the existing warranty in effect.

The date (month/year) of manufacture will be listed on the serial number label.

6.1 REPAIR POLICY

Equipment must be shipped to the address listed below. Equipment which has exceeded the warranty period, must be shipped freight pre-paid to our factory, unless other arrangements have been previously negotiated. Repair charges will be estimated and charged upon determination of the extent of damage, current costs of parts and labor. Return shipping is the responsibility of the equipment owner and will be charged accordingly.

NOTE

NOTE

Before returning any equipment for warranty or repair, a Return Material Authorization (RMA) number must be obtained from Siemens Customer Service prior to shipping the equipment.

Return all equipment to:

Siemens Mobility, Inc.
939 S. Main Street
Marion, Kentucky 42064

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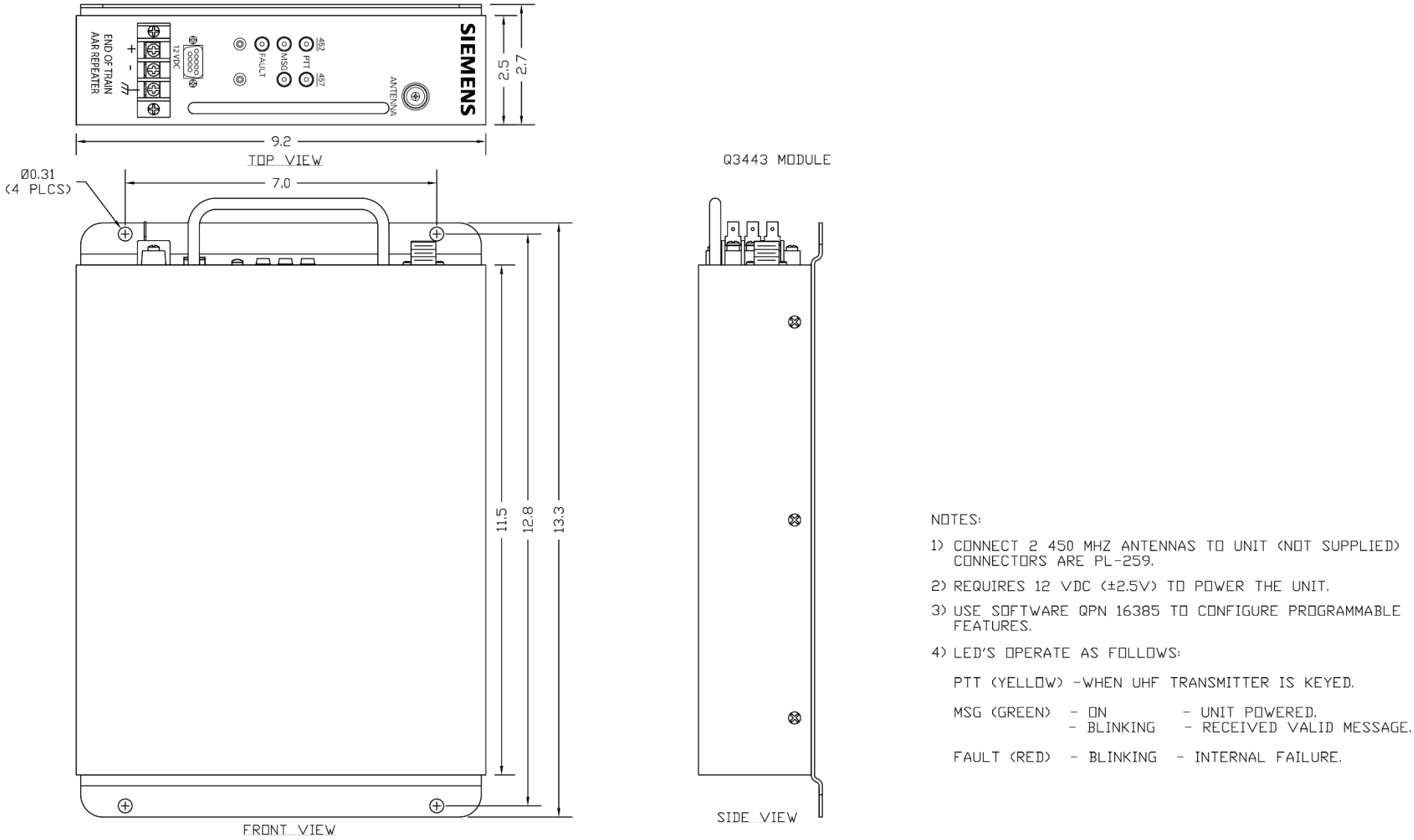
SECTION 7 **DRAWINGS**

7.0 DRAWINGS INCLUDED

The following table lists all applicable Siemens drawings and their corresponding revision levels for the Siemens Q3440/R and Q3443 HOT/EOT Repeaters.

Table 7-1 HOT/EOT Repeater Drawings

Drawing	Description	Revision
Q3443	Dimensions	A
Q3440	Dimensions	B
1255 Pages 1-2	AAR Repeater 60255 Board SCH	D



NOTES:

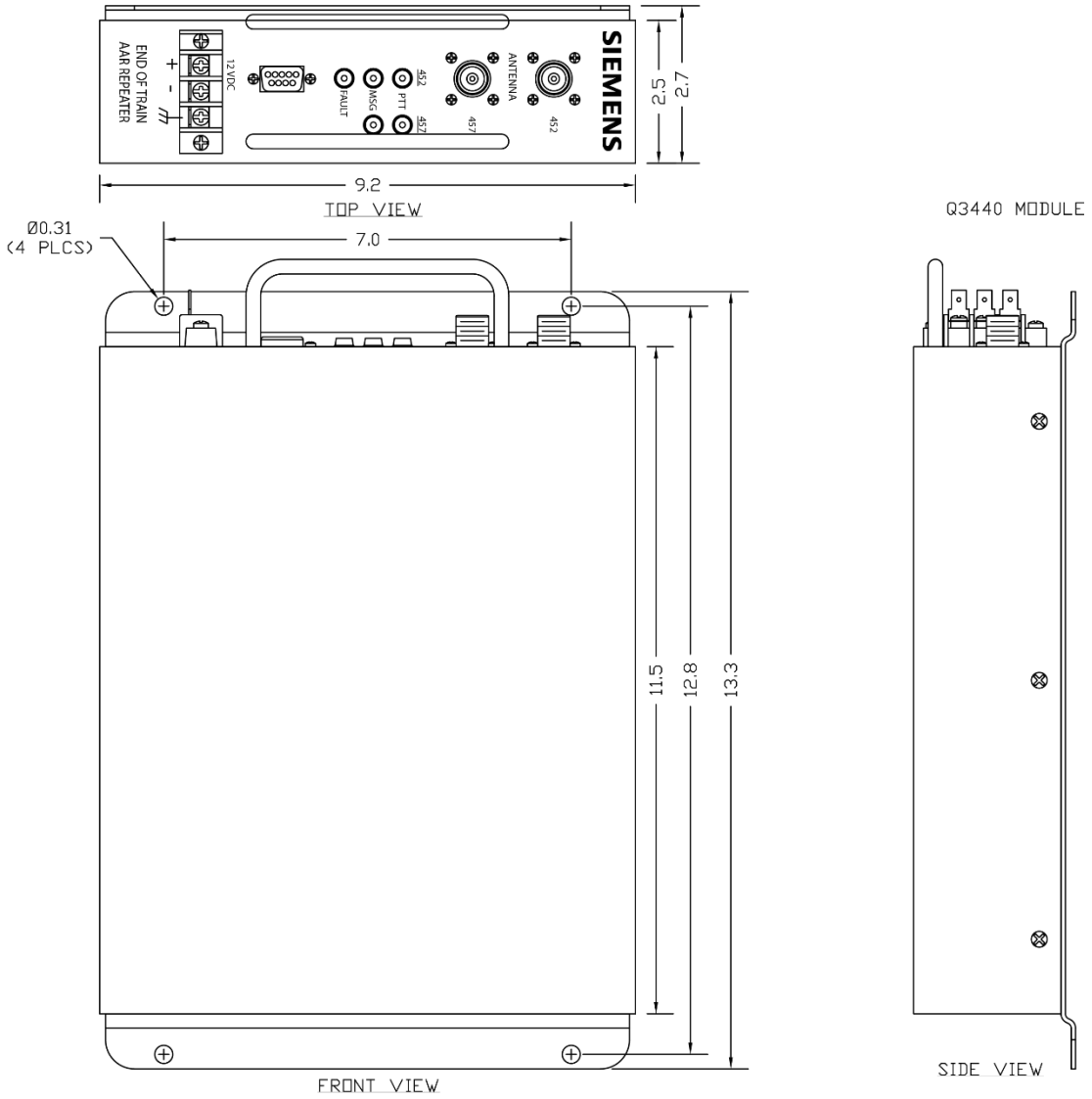
1) CONNECT 2 450 MHZ ANTENNAS TO UNIT (NOT SUPPLIED) CONNECTORS ARE PL-259.
2) REQUIRES 12 VDC (±2.5V) TO POWER THE UNIT.
3) USE SOFTWARE QPN 16385 TO CONFIGURE PROGRAMMABLE FEATURES.
4) LED'S OPERATE AS FOLLOWS:

   PTT (YELLOW) -WHEN UHF TRANSMITTER IS KEYED.

   MSG (GREEN) - ON - UNIT POWERED.
   - BLINKING - RECEIVED VALID MESSAGE.

   FAULT (RED) - BLINKING - INTERNAL FAILURE.

Figure 7-1 Q3443 Dimensions



NOTES:

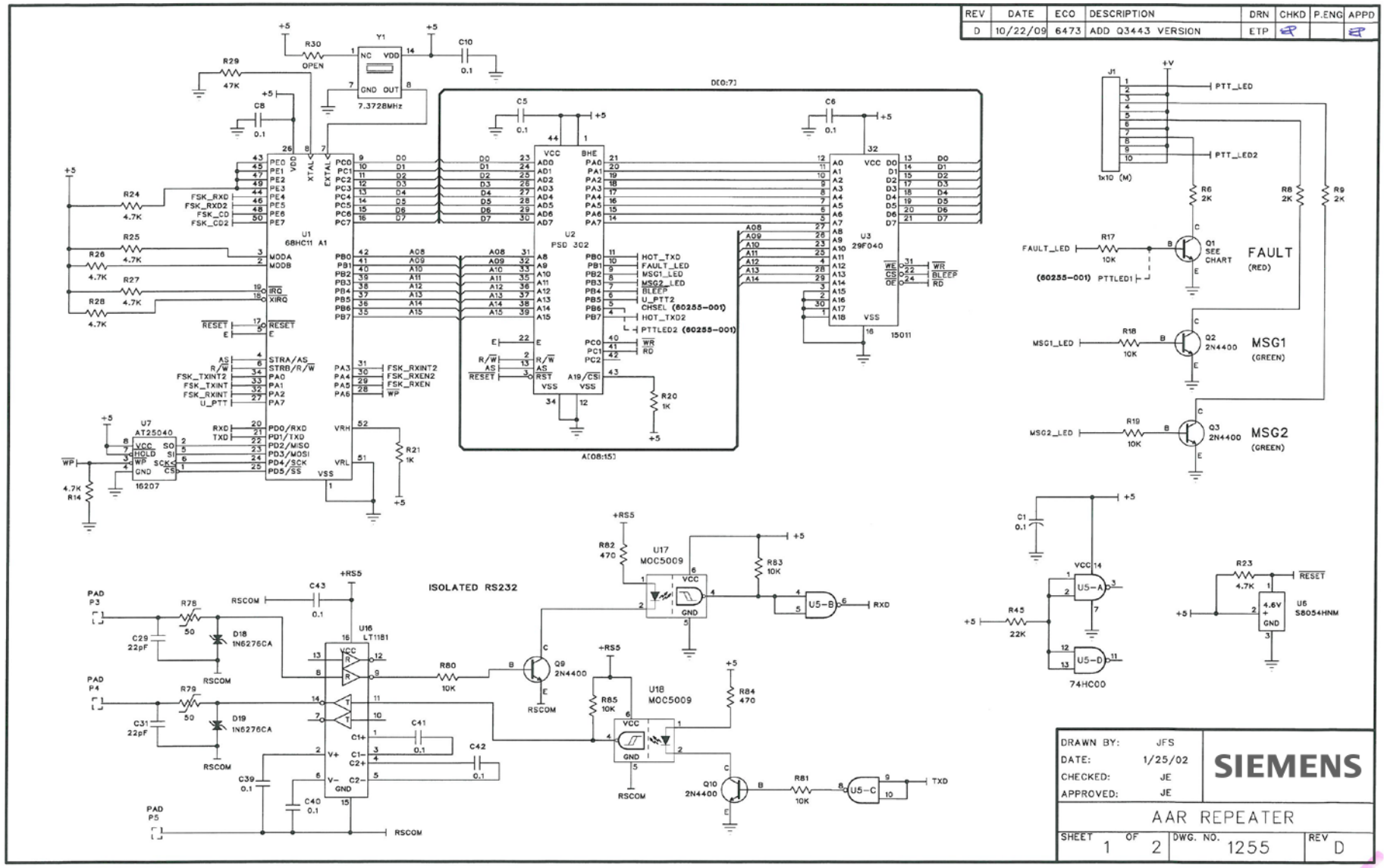
1) CONNECT 2 450 MHZ ANTENNAS TO UNIT (NOT SUPPLIED) CONNECTORS ARE PL-259.
2) REQUIRES 12 VDC (±2.5V) TO POWER THE UNIT.
3) USE SOFTWARE QPN 16385 TO CONFIGURE PROGRAMMABLE FEATURES.
4) LED'S OPERATE AS FOLLOWS:

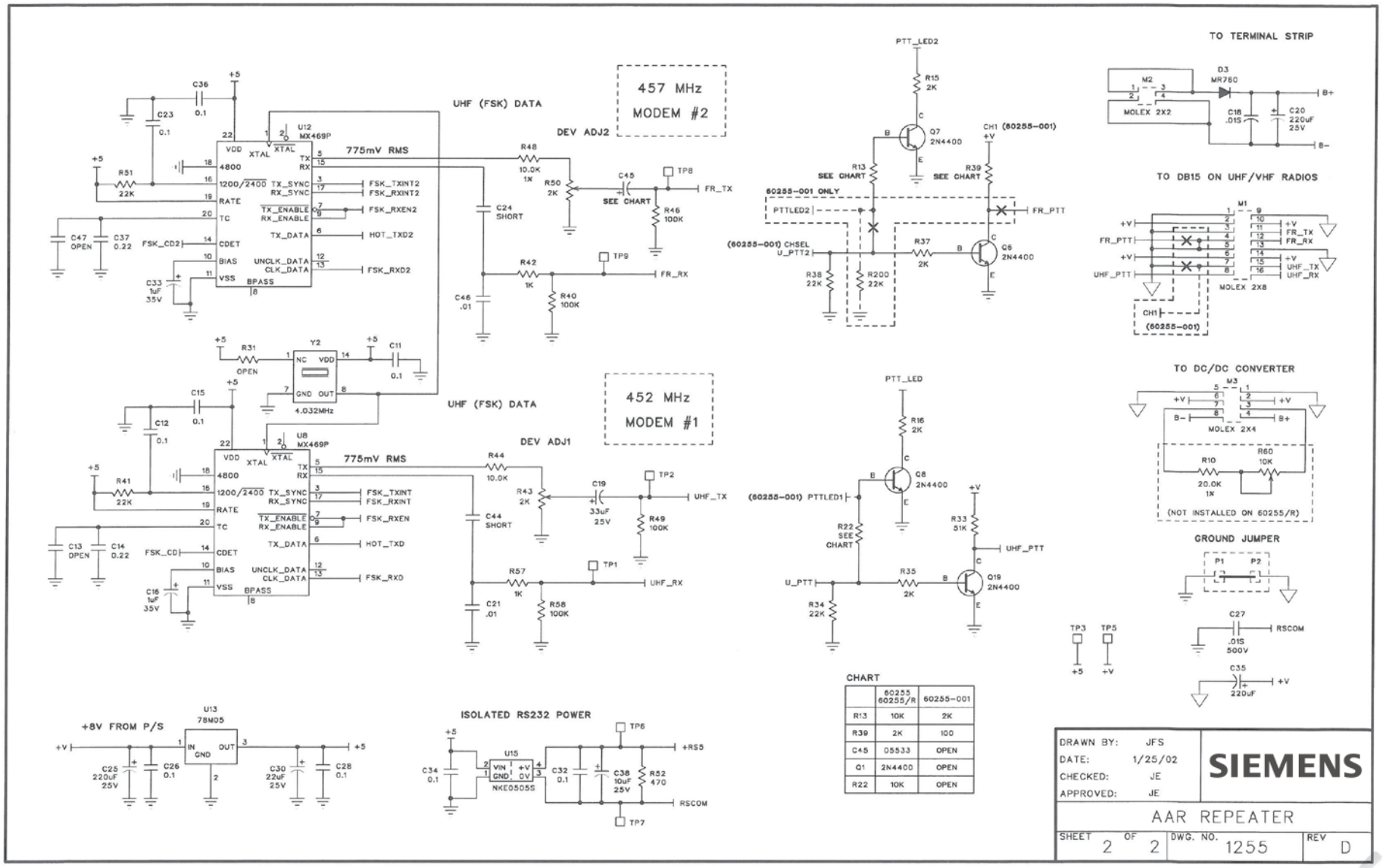
   PTT (YELLOW) -WHEN UHF TRANSMITTER IS KEYED.

   MSG (GREEN) - ON - UNIT POWERED.
   - BLINKING - RECEIVED VALID MESSAGE.

   FAULT (RED) - BLINKING - INTERNAL FAILURE.

Figure 7-2 Q3440 Dimensions


REV | DATE | ECO | DESCRIPTION | DRN | CHKD | P.ENG | APPD
D | 10/22/09 | 6473 | ADD Q3443 VERSION | ETP
ISOLATED RS232
PTT_LED
PTT_LED2
FAULT
(RED)
MSG1
(GREEN)
MSG2
(GREEN)
74HC00
DRAWN BY: JFS
DATE: 1/25/02
CHECKED: JE
APPROVED: JE
SIEMENS
AAR REPEATER
SHEET 1 OF 2
DWG. NO. 1255
REV D



	60255 60255/R	60255-001
R13	10K	2K
R39	2K	10O
C45	05533	OPEN
Q1	2N4400	OPEN
R22	10K	OPEN

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APPENDIX A RADIO ALIGNMENT

WARNING

ALIGNMENT MUST ONLY BE PERFORMED BY QUALIFIED AND TRAINED SERVICE PERSONNEL.

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

A.1 REQUIRED TEST EQUIPMENT

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

- DC Power Supply -capable of operating at the correct voltage for the module and capable of 2.5 Ampere minimum current.
- RF Signal Generator-capable of operating at the carrier frequency of the module with an output level adjustment and able to be frequency modulated.
- FM Demodulator/Deviation Meter-capable of operating at the carrier frequency of the module.
- RF Frequency Counter-must operate at the RF frequency of the unit with a resolution of 10 Hz or better and an accuracy of +/-1 ppm (+/-150 Hz at VHF, +/-450 Hz at UHF) or better.
- Audio Oscillator-must have sine wave output allow for output frequency and amplitude adjustment.

A.2 OSCILLOSCOPE

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

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

NOTE

Except for the power supply, a two-way radio test set may include most, if not all, of the required equipment.

A.3 ALIGNMENT PROCEDURE

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

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

NOTE

NOTE

Interrupting the power supply to the unit while the programmer software is open will require exiting the software and re-opening it.

A.4 RX FREQUENCY TRIM

The RX Frequency Trim trims the unit frequency during receive. This setting, if incorrect, may degrade receive sensitivity, distortion, and possible recovered audio level, which in turn affects AUX OUT (RX) Gain and Audio PA Gain. The receive frequency trim is not affected by any other alignment step.

To determine if the receiver is correctly trimmed to frequency, the 1st local oscillator frequency must be measured.

⚠ WARNING

WARNING

DO NOT KEY THE UNIT DURING THIS PROCEDURE AS SERIOUS DAMAGE TO THE COUNTER MAY RESULT!

A channel with a receive frequency programmed into it should be selected. The correct local oscillator will be displayed on the programmer channel box. The frequency on the counter should be observed and the RX Frequency Trim value adjusted for least error. Because of the very low local oscillator level at the antenna terminals, the frequency counter may not be able to read the frequency. If so, perform the TX Frequency Trim adjustment detailed later and set the RX Frequency Trim value to match that of the proper TX Frequency Trim value.

A.5 AUX OUT GAIN

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

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

NOTE

NOTE

The output impedance of the AUX OUT is about 600 ohms. If the load impedance of the load that will be connected to this output is less than 10 kΩ or so, a resistor of a value equal to the load impedance should be connected to the AUX OUT output when making the adjustment.

A.6 AUDIO PA GAIN

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

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

A.7 CARRIER DETECT ON AND CARRIER DETECT OFF

The Carrier Detect On and Carrier Detect Off settings control the RF level (or Signal-to-noise ratio) at which the DCD output goes true and what level at which it goes false. To prevent chattering on noise, these two settings are not normally the same. 3 to 5 dB of hysteresis is usually provided i.e. if the RF signal level is increased from zero, at some point, the DCD output will go from false to true. The RF level may then have to be decreased by several dB before the DCD output goes false again. This prevents chattering with signal levels near the carrier detect level. If squelch is enabled, the receive audio muting will follow the DCD output. The desired carrier detect levels can be directly entered via the alignment screen in dBm and then fine-tuned with a high-quality signal generator, if necessary.

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

A.8 TX LOW POWER AND HIGH POWER

The transmitter output power level can be programmed on a per channel basis via the alignment page of the programmer. If RNet Compatibility has not been programmed on the settings page, both the low and high-power levels can be set. If RNet Compatibility has been programmed, only high power can be set. The TX High Power and TX Low Power settings in the TX Power box act to select a common value for all channels. Individual values for each channel can be entered in the per channel boxes at the bottom of the screen. Power is set in watts with a resolution of 0.1 watt. The power level can be confirmed and fine-tuned, if desired, by connecting the radio to an accurate wattmeter.

A.9 AUX IN GAIN

To set the Aux In gain, an audio oscillator or appropriate signal source (e.g. modem) should be connected to the Aux In input at the desired input level. An FM deviation meter should be connected to the antenna connector through a suitable attenuator or coupler. The unit should be keyed for transmit and the Aux In gain should be adjusted for the desired deviation, typically 60% of rated deviation.

A.10 TX FREQUENCY TRIM

This setting is used to trim the transmitter to frequency. This value should not normally need adjustment. However, as the unit ages and/or if the transmitter power or the Aux In gain is changed significantly, slight corrections may be prudent.

NOTE

Any adjustments must be made at a unit temperature of 25 ±2 °C (77 ±1.8 °F). Due to internal heating, this adjustment must not be made after the unit has been transmitting unless it has been allowed to cool to the correct temperature. Likewise, the adjustment itself should be made as quickly as possible.

The unit should be set to a channel which is at an output power which is close to what will be used the majority of the time. The RF output of the unit should be coupled to a frequency counter through a suitable attenuator or coupler. Ensure that no modulation source is connected to the MIC IN or AUX IN. The PTT should be activated and the TX Frequency Trim value adjusted for the correct frequency. The value can be changed while the unit is transmitting.

A.11 DEVIATION AND BALANCE

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

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

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

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

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

On the channel drop-down menu, select lower band edge. Activate the PTT, and while observing the demodulated waveform on the oscilloscope, begin increasing the audio oscillator's output level or the Aux In setting. The waveform should begin as a sine wave and at some point show clipping. The clipped portion may not necessarily be flat. The audio oscillator level should be set so that a substantial portion of the waveform is clipped, at least 50 %. Adjust the balance value so that the clipped portion is flat i.e. horizontal rather than tilted. Although the programmer can change values while transmitting, it is better to unkey between value entries. After the balance is set, the deviation should be set to a value of 1.2 kHz for a very narrow channel, 2.3 kHz for a 12.5 kHz channel or 4.6 kHz for a 25/30 kHz channel. Select the upper band edge on the channel menu and repeat. As a result of this procedure, the per channel balance and deviation values may have changed.

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