System Operator's User Manual

P25net Channel Controller

Raytheon Company

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P/N 5060-600200 **Revision 1.05** **March, 2011**

PROPRIETARY STATEMENT

NOTICE

Raytheon reserves the right to make changes to the equipment and specifications without prior notice.

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REVISION HISTORY

Revision	Date	Details
1.00	03 Jan. 2008	First Release
1.01	24 Jan 2008	Minor updates & formatting; no technical changes
1.03	08 Oct 2008	Added Specifications and Radio Calibration using PCCT
1.04	22 Jan 2009	"Branding" edits to contents
1.05	28 Mar 2011	New product photos, updated interface specification

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Glossary

APCO	Association of Public-Safety Communications Officials. Note that in this document, “APCO” as used invariably refers to APCO Project 25
APCO P25	APCO Project 25 digital conventional and trunked radio standard.
BS	Base Station
BSC	Base Station Controller
CC	See P25net CC.
IP	Internet Protocol
ISSI	Inter Subsystem Interface
OTAR	Over The Air Rekeying
P25	P25 See APCO P25.
P25net	Raytheon APCO 25 network solution
P25net CC	P25 Channel Controller
PSTN	Public Switched Telephone Network
RF	RF Radio Frequency
RFSS	RFSS RF Subsystem
RSSI	RSSI Received Signal Strength Indicator
Rx or RX	Receive
Tx or TX	Transmit
WACN	Wide-Area Communications Network

1 Introduction

1.1 Scope

This instruction manual provides information necessary to install and operate the P25net Channel Controller, a component of Raytheon's P25net system. Installation requirements and calibration with the connected radio are covered. For system installation, configuration, and operation refer to the P25net Training Guide.

1.2 Description

The P25net Channel Controller (P25net CC) is a 1 RU (Rack Unit; 1.75") device designed to allow legacy analog repeaters the ability to remain in service and become digital P25 capable. By attaching a P25net CC to existing analog repeaters, all aspects of the P25 Common Air Interface (CAI) can be achieved including conventional, trunked, data, and over the air rekeying (OTAR).

The P25net CC consists of up to four channel cards per chassis, each using the P25 protocol stack. Each channel card connects to a new or existing analog repeater to provide digital P25 signaling capabilities. The P25net CC functions as a Conventional 4 Level Frequency Modulation (C4FM) modulator/demodulator for the repeater to encode and decode digital audio for transmission and reception. The channel card processor can repeat these signals locally over the connected repeater or establish a connection over an IP network to a distant repeater or network.

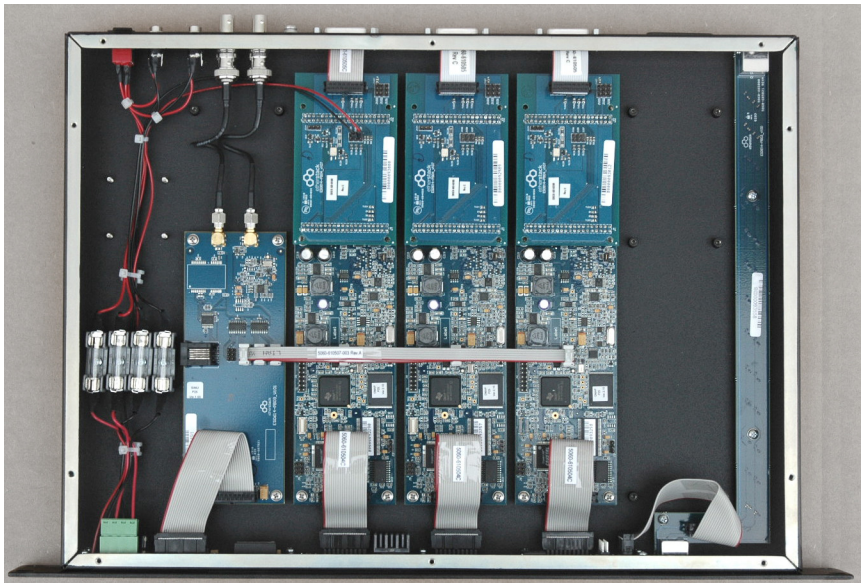

Figure 1-1 P25netCC Internal Layout (3 Channel Unit Shown)

Typically, the P25net CC is connected to multiple repeaters to provide several channels and to a Base Station Controller (BSC) which provides site control functionality (see Figure 1-2). By

combining two or more P25net sites with a Radio Network Controller (RNC) and a Network Location Register (NLR) through an IP based network, a multi site system can be created.

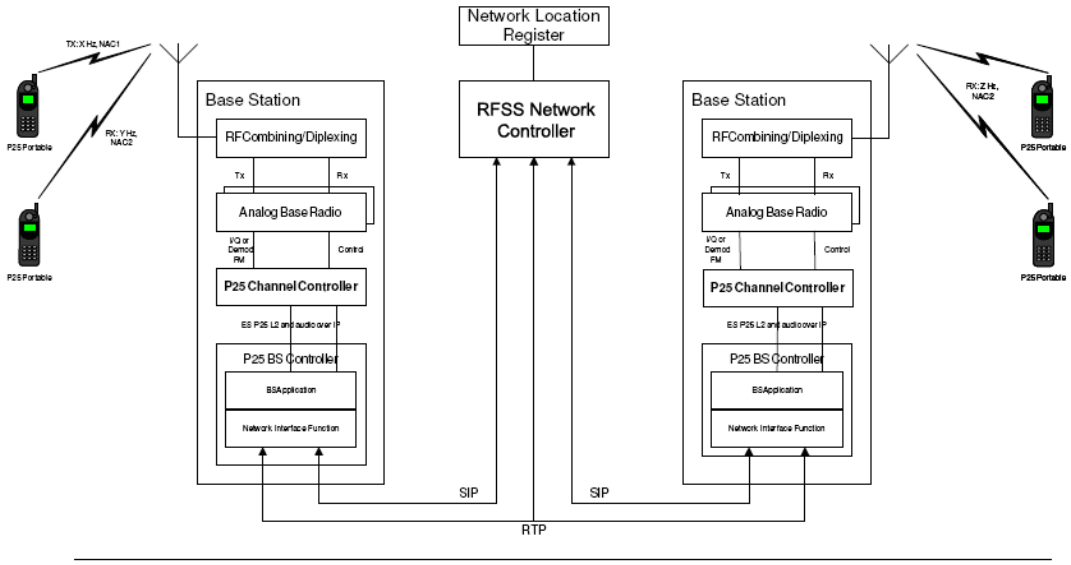

Figure 1-2 Typical P25net System

1.3 Analog Base Radio Requirements

The following are general considerations for radios suitable for P25net CC interface requirements.

1.3.1 Duplex Operation

The radio must be capable of full duplex operation as a base station rather than a repeater. This is necessary because the P25net CC must control the repeat function.

1.3.2 Unbalanced Wideband Audio

Unbalanced Tx and Rx wideband audio without pre-emphasis and de-emphasis is required to pass the 0-3000Hz baseband necessary for P25 signals. DC coupling is preferred since it provides the best low frequency response. The capability to turn off all filters is recommended. “Balanced Line Audio” means that transformers are in the signal path and will limit low frequency response.

1.3.3 PTT/Keyline

The P25net CC provides an open collector for grounding the radio PTT/Keyline to transmit.

1.3.4 RSSI

The P25net CC uses the Receive Signal Strength Indicator (RSSI) signal in determining validity of a received P25 signal.

1.3.5 Frequency Stability

The following recommendations are from the P25 standard (ANSI/TIA-102.CAAB-C):

Assigned Frequency (MHz)	Frequency Stability Parts per Million (PPM)
Below 100	2.5
138-174	1.5
406-512	0.5
764-806	0.1
806-869	0.15
896-941	0.1

1.3.6 Narrowband Channel Bandwidth

The radio should be capable of 12.5kHz channel programming.

1.4 Specifications

Table 1-1 P25net CC Specifications

Power	
AC Power Input	90-264VAC, 47-63Hz, 20VA from external AC adapters (supplied) for connection to DC Inputs A and B (J1and J2 on rear panel). J1/J2 are 5.5mm x 2.5mm locking DC Power Jacks (Switchcraft L712A; mating plug Switchcraft 761K).
DC Power Inputs A and B	+11.0-13.2VDC 1A for connection to J1and J2 on rear panel; J1/J2 are 5.5mm x 2.5mm locking DC Power Jacks (Switchcraft L712A; mating plug Switchcraft 761K).
Dual Power Source	DC inputs A and B allow connection of 2 power sources for added reliability.
Signal Inputs	
Receive Baseband Audio	Pin 7 on the D15F rear panel connector Channels 1-4; 0-3000Hz, 3vpp (1.06 vrms) maximum
RSSI	Pin 8on the D15F rear panel connector Channels 1-4; Receive Strength Signal Indicator (RSSI) signal from radio; 0-5VDC.
Signal Outputs	
Transmit Baseband Signal	Pin 6 on the D15F rear panel connector Channel 1-4 0-3000Hz, 3vpp (1.06vrms) maximum
PTT or Keyline	Pin 5 on the D15F rear panel connector Channel 1-4 Open Collector, active low
Analog Ground	Pins 14,15 on the D15F rear panel connector Channel 1-4 Ground reference for the input/output signals
Data Connections	
IP Connection	*RJ45 connectors on the front and rear panel.*

Table 1-1 P25net CC Specifications

RS-232 Receive	RS-232 Rx: Pin 1 on the D15F rear panel connector Channel 1-4
RS-232 Transmit	RS-232 Tx: Pin 2 on the D15F rear panel connector Channel 1-4
Digital Ground	Pin 9 on the D15F rear panel connector Channel 1-4 Ground reference for the RS-232 data lines.
Programmable I/O	
DIN0	Programmable Input 0 (reserved) Pin 10 on the D15F rear panel connector Channel 1-4
DIN1	Programmable Input 1 (reserved) Pin 3 on the D15F rear panel connector Channel 1-4
DIN2	Programmable Input 2 (reserved) Pin 12 on the D15F rear panel connector Channel 1-4
OUT0	Programmable Output 0 (reserved) Pin 4 on the D15F rear panel connector Channel 1-4
IN3	Programmable Input 13 (reserved) Pin 3 on the D15F rear panel connector Channel 1-4
FGND	Ground reference for IN3
LED Display	
S1	Green when 10MHz GPS Reference connected
DC Power A and B	Green when DC power is at DC Inputs A and B
Channel Status	For each supplied channel: Steady Green when controlled by BSC; flashing otherwise.
Rx	For each supplied channel: Orange when a valid P25 signal is received.
Tx	For each supplied channel: Red when a signal is being transmitted
Physical	
Size	1.75” H x 19” W x 12.4” D (4.4 x 48.3 x 31.5 cm).
Weight	5 pounds (2.3kg)
Operating Temperature	0 to +60 degrees C.
Storage Temperature	-40 to +85 degrees C.

1.5 Equipment Supplied

Table 1-2 Equipment and Accessories Supplied

P25net CC Top Level Part Number Explanation

5060-	**6**	**X**	**0**	**2**	**X**	**0**
P25net Family		# of Channels			1=Standard I/O	
		1=1 Channel			2=4 Wire AFSI	
		2=2 Channel				
		3=3 Channel				
		4=4 Channel				

All units include:

1	P25net CC Operation Manual	5060-600200
1	Accessory Kit consisting of:	5060-610150
	(2)AC Power Supply 90-264VAC	1620-264061
(2)	Line Cord	0313-037770

Table 1-3 Equipment and Accessories Supplied

P25net CC with Manual and Accessory Kit

All items below are included within P/N 5060-610000		
Items included: 1	P25NET CC One Channel Unit	5060-610500
1	Operation Manual	5060-612000
1	Accessory Kit- Consisting of:	5960-610150
	Qty Part Number Description 2 0313-037770 Line Cord 2 1620-264061 Power Supply, 90-264VAC	

Table 1-4 Equipment and Accessories Supplied

P25net CC Two Channel Unit with Manual and Accessory Kit

Quantity	**Item**	**P/N**
1	P25net CC Two Channel Unit with Manual and Accessory Kit	5060-620000
All items below are included within P/N 5060-610000		
Items included: 1	P25net CC One Channel Unit	5060-610000
1	P25net CC One Channel Expansion Kit	5060-650000
1	Operation Manual	5060-612000
1	Accessory Kit- Consisting of:	5960-610150
	Qty Part Number Description 2 0313-037770 Line Cord 2 1620-264061 Power Supply, 90-264VAC	

Table 1-5 Equipment and Accessories Supplied

P25NET CC Three Channel Unit with Manual and Accessory Kit

Quantity	**Item**	**P/N**
1	P25net CC Three Channel Unit with Manual and Accessory Kit	5060-630000
All items below are included within P/N 5060-620000		
Items included: 1	P25net CC One Channel Unit	5060-610000
2	P25net CC One Channel Expansion Kit	5060-650000
1	Operation Manual	5060-612000
1	Accessory Kit- Consisting of:	5960-610150
	Qty Part Number Description	

Table 1-5 Equipment and Accessories Supplied			
	2	0313-037770	Line Cord
	2	1620-264061	Power Supply, 90-264VAC

Table 1-6 Equipment and Accessories Supplied			
P25NET CC Four Channel Unit with Manual and Accessory Kit			
Quantity	**Item**		**P/N**
1	P25net CC Four Channel Unit with Manual and Accessory Kit		5060-640000
All items below are included within P/N 5060-620000			
	Items included: 1	P25net CC One Channel Unit	5060-610000
	3	P25net CC One Channel Expansion Kit	5060-650000
	1	Operation Manual	5060-612000
1	Accessory Kit- Consisting of:		5960-610150
	Qty	Part Number	Description
	2	0313-037770	Line Cord
	2	1620-264061	Power Supply, 90-264VAC

1.6 Optional Equipment-Not Supplied

Table 1-7 Optional Equipment - Not Supplied	
Item	**P/N**
P25net CC Single Channel Standard I/O Expansion Kit *For adding an additional channel to the P25net CC*	5060-652000
P25net CC Single Channel 4W AFSI	

End of Section 1

2 Installation

2.1 General

This section provides the instructions for unpacking, inspection, installation and set-up. Included are directions for reshipment of damaged parts or equipment.

2.2 Unpacking and Inspection

After unpacking the unit, retain the carton and packing materials until the contents have been inspected and checked against the packing list. If there is a shortage or any evidence of damage, do not attempt to use the equipment. Contact the carrier and file a shipment damage claim. A full report of the damage should be reported to the Raytheon's customer service department. The following information should be included in the report:

1. Order Number
2. Equipment Model and Serial Numbers
3. Shipping Agency
4. Date(s) of Shipment

The Raytheon customer service department can be reached by phone at (919) 790-1011, or by fax at (919) 790-1456. Upon receipt of this information, Raytheon will arrange for repair or replacement of the equipment.

2.3 Reshipment of Equipment

If it is necessary to return the equipment to the manufacturer, a Returned Material Authorization (RMA) number must first be obtained from Raytheon. This number must be noted on the outside of the packing carton and on all accompanying documents. When packing the unit for reshipment, it is best to use the original packaging for the unit; if this is not possible, special attention should be given to providing adequate packing material around connectors and other protrusions, such as front panel ears. Rigid cardboard should be placed at the corners of the unit to protect against corner damage during shipment. Failure to protect the corners of the front panel causes the most common type of shipping damage experienced on returned equipment.

Shipment should be made prepaid consigned to:

Raytheon Company

Customer Service Department

5800 Departure Drive

Raleigh, North Carolina 27616

USA

Plainly, mark with indelible ink all mailing documents as follows:

U.S. GOODS RETURNED FOR REPAIR

Mark all sides of the package:

FRAGILE - ELECTRONIC EQUIPMENT

Inspect the package prior to shipment to be sure it is properly marked and securely wrapped.

2.4 Installation Overview

Four steps are needed to properly install the P25net CC. These steps are:

1. Provide mechanical mounting for the unit. See Section 2.5 for instructions regarding air circulation requirements and other mechanical mounting considerations.
2. Provide the proper primary power for the unit; see Section 2.6 and 2.7.
3. Interconnect the unit with the communications system via the unit's rear panel connectors; see Sections 2.8 and 2.9
4. Calibrate the radio to the P25net CC using Personal Computer Calibration Tool (PCCT) as covered in Section 3.

2.5 Installation Considerations

Careful attention to the following installation suggestions should result in the best unit/system performance. Figure 2-1 provides overall unit dimensions.

The P25net CC must be installed in a structure, which provides both protection from the weather and assurance of ambient temperatures between -0 and +60 degrees C. Since the unit is neither splash proof, nor corrosion resistant, it must be protected from exposure to salt spray. When the unit is mounted in a cabinet with other heat-generating equipment, the use of a rack blower is suggested to keep the cabinet interior temperature rise to a minimum.

2.5.1 Mounting

For applications such as mobile command centers or transportable cases or any other application where some degree of shock and vibration is expected, the P25net CC must be mounted with support brackets in addition to the front mounting screws. For fixed applications such as floor mounted cabinets or racks in a fixed equipment room, rear supports are not required.

2.5.2 Cooling

The P25net CC depends on natural convection for its cooling. It must be mounted in a way that allows for sufficient air circulation to keep the ambient temperature around the unit from exceeding +60C. Use forced air-cooling in the cabinet if necessary. The P25net CC generates approximately 50 BTU/Hr heat.

2.5.3 Front Panel Indicators

INDICATOR	DESCRIPTION
Power A	Power Source A is present
Power B	Power Source B is present
S1	Green when 10MHz GPS Reference connected at rear panel input
S2	Future use
S3	Future use
Channel Status	Green when channel is under BSC control; flashing otherwise (Fallback Mode)
Tx	Red when channel is transmitting; also will indicate during a firmware update procedure and at power on or software reset.
Rx	Orange when channel receives a valid P25 signal; also will indicate during a firmware update procedure and at power on or software reset.

2.5.4 Rear Panel Connectors and Controls

2.5.4.1 D15 Radio Interface Connector

The rear panel has up to four D15 connectors for interface to radios. The pin-outs for each connector channel are listed in the following table. Units having less than 4 channels will have unused connector locations covered with a press-in type plug.

Table 2-1 D15F Connector Pin-outs (Channels 1-4)

Pin	Function
1	RS232_RX_IN
2	RS232_ TX1_OUT
3	DIN1
4	OUT0
5	TXKEY
6	AUDIO_TX_OUT
7	AUDIO_RX_IN
8	RSSI_OUT
9	DGND
10	DIN0
11	FGND
12	DIN2
13	IN3
14	AGND
15	AGND

2.5.4.2 DC Input Jack J1,J2

The supplied external AC adapters connect to DC inputs A and B (J1/J2 on rear panel; J1/J2 are 5.5mm x 2.5mm locking DC Power Jacks (Switchcraft L712A). The adapters are terminated with a mating locking plug (Switchcraft 761K).

2.5.4.3 GPS Reference Input

BNC(F) connectors for 10MHz and 1PPS signals are provided for Simulcast operation.

2.5.4.4 Power Switch S1

S1 switches both power sources.

2.5.4.5 RJ45 Ethernet port

This jack is normally used for connection to a BSC.

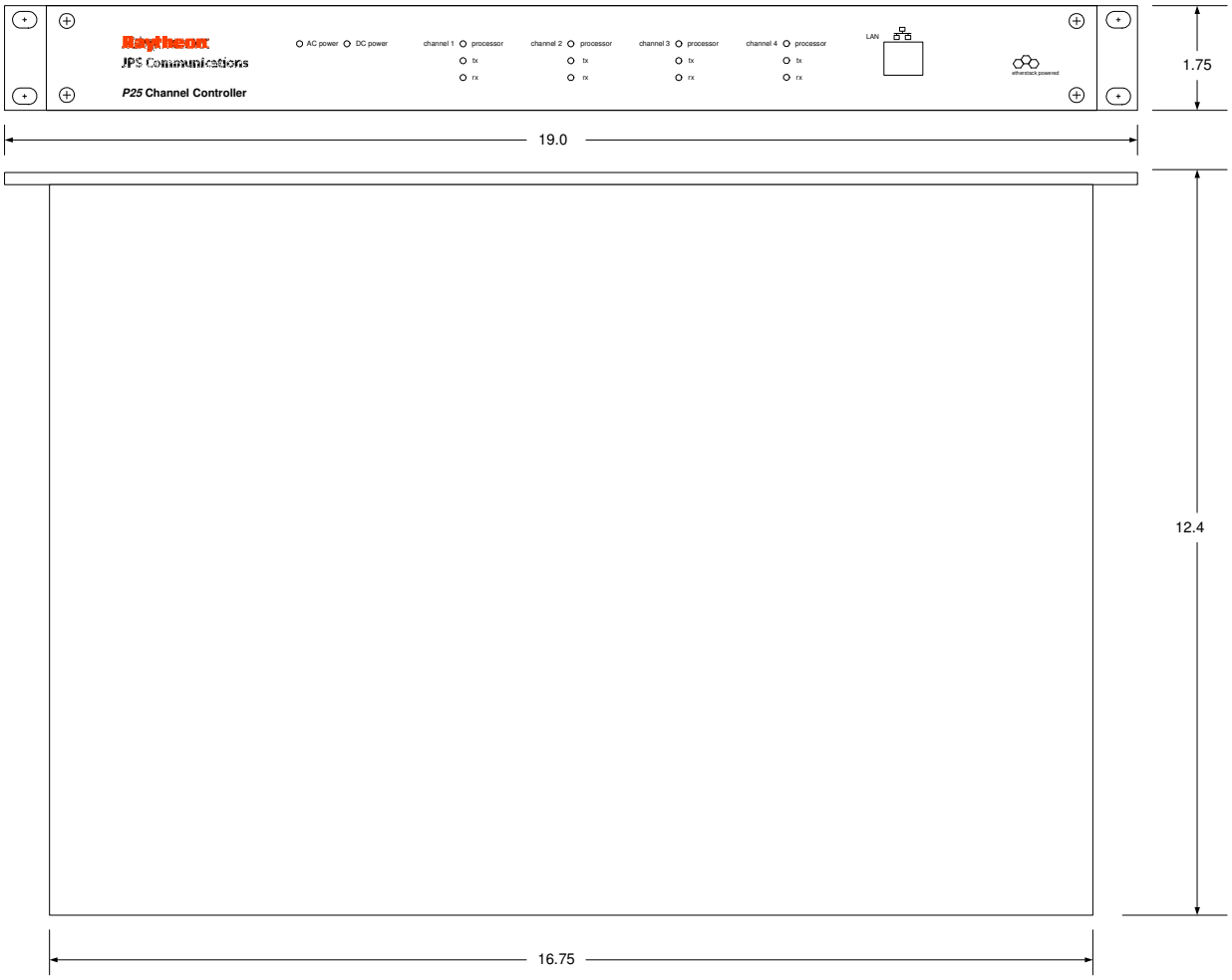

Figure 2-1 P25net CC Outline Dimensions

Figure 2-2 Front Panel

Figure 2-3 Rear Panel (3 Channel Unit shown)

2.6 AC Power Requirements

The P25net CC is supplied with two AC adapters (Figure 5) that will operate over a wide AC voltage range (90-264VAC). The supply circuit requirement is 20VA. The adapters are provided with locking DC plugs for connection to the P25net CC rear panel DC input jacks A and B. The adapters supply 12VDC @ 1A to the P25net CC. Each has an IEC 320 inlet for attaching the AC power cord (supplied).

Figure 2-4 AC Adapter

2.7 DC Power Requirements

The P25net CC will operate on +11.0 to +13.2VDC @ 1A when connected to DC Inputs A/B.

Removal of one source will have no effect on the P25net CC when running from both sources. The front panel power LED will indicate when a source is connected and the power switch is ON.

2.8 Network Connection

The P25net CC must be connected by a single Cat-5 or Cat-6 cable to either an Ethernet switch or hub, or connected directly to a Base Station Controller (BSC). Either the front or rear RJ-45 connector can be used for this purpose, but both connectors should not be cabled to the same device.
It is preferable to use the rear RJ-45 connector for connecting the P25net CC to a BSC, if they are linked directly without a local Ethernet switch or hub. This leaves the front RJ-45 connector free for connecting a PC for radio calibration or firmware updates.

2.9 Radio Interface Connection

Systems engineers at Raytheon have created interface cables and accompanying Application Notes for a number of radios. The cables are shielded and terminated with connectors for easy connection between the radio and P25net CC rear panel.

The application notes provide the cable schematic as well as programming and set-up recommendations for the specific radio.

End of Section 2

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3 Radio Calibration

3.1 Calibration Overview

The channel card in the P25net CC must be calibrated to the connected radio. This process adjusts the internal audio circuits within the P25net CC to adapt to the radio's audio levels and sets the transmit deviation for P25 narrowband requirements. In addition, the RSSI signal from the receiver is characterized by the P25 processor to enable proper synchronization to the P25 packet data streams.

Each transceiver radio has different physical components from other types of transceivers and even from other transceivers of the same make and model. Because of this, each transceiver channel in the P25net CC has to be tuned to ensure an optimal receiver and transmit signal are produced. This is a critical step and if not performed will render the channel partially or completely incapable of P25 operation.

PC Tools (PCCT) is an application that runs on a pc and provides the necessary controls to perform the calibration. PCCT also allows setting various operational parameters (such as Fallback Mode) and performing testing. See Chapter 4 for PCCT advanced features.

3.2 Equipment Required

- PCCT Running on a PC (preferably a Laptop)
- CAT 5 LAN cable
- RF Test Set (preferably with APCO 25 test capability) such as the Aeroflex 3920 as used in the following example
- A pair of conventional P25 portable radios (handsets) with programming software and cable to allow programming to the base radio channel.

3.3 Installing PCCT

The PCCT application is installed by running the Windows installer package **PCCTSetup.msi.** If this file does not run automatically from a supplied CD, find this file and execute it. The initial splash screen as shown below will then be presented to the user. As with most of these dialog boxes presented during the installation process the "Next" button moves to the next stage of the installation and the "Back" button returns to the previous dialog box.

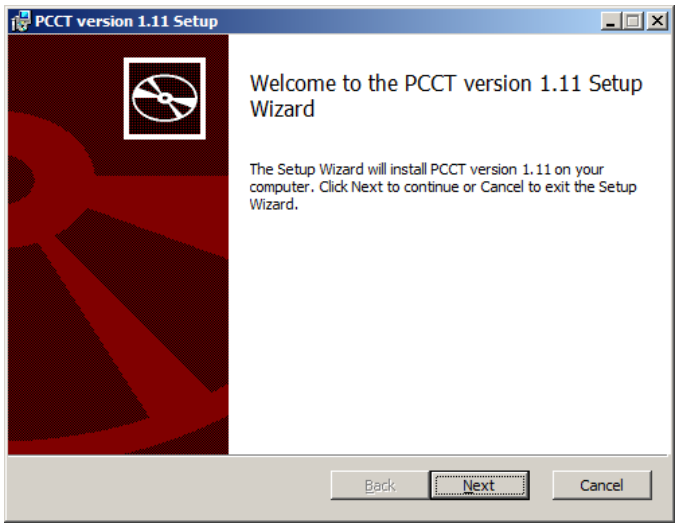

Figure 3-1: Commencing installation of the PCCT Application

During the installation process, the user will be prompted to accept the End-User License Agreement (required in order to proceed with installation), select a destination folder for the PCCT application (C:\Program Files\Etherstack\PCCT x.xx, by default), after which installation will commence.

When installation is complete, the following message will be shown:

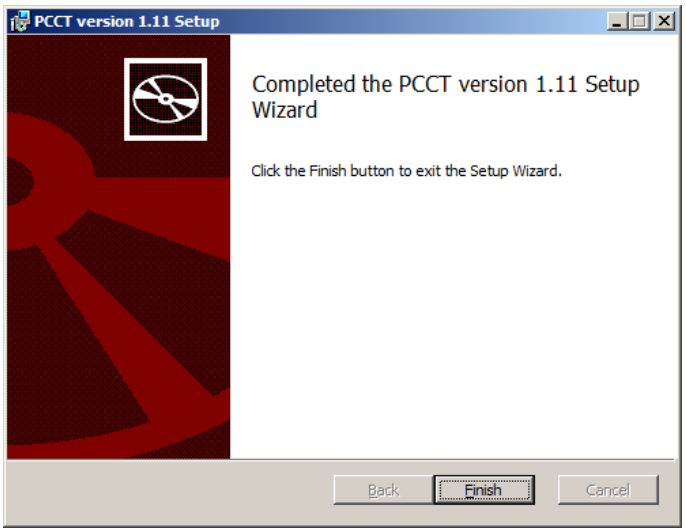

Figure 3-2: Installation of the PCCT application completed

The PCCT is then ready to use, and may be launched using the shortcut installed on the desktop:

Figure 3-3 PCCT Icon

3.4 Configuring PC Network Connection

The PC must be configured to set the Local Network connection to the same address range as the Channel Card. See Figure 3-4. Typically this is done by selecting:

Control Panel>Network Connections>Local Area Connections>Properties.

Then scroll to Internet Protocol (TCP/IP) and Click on Properties; Select “Use the Following Address” and enter the IP address and Subnet mask to correspond to the requirement of the Channel card address.

Assuming a default channel card address of 10.1.1.1 with a subnet mask of 255.255.0.0, this would require the PC to be set within the same net with a different address, for example 10.1.1.10 (the PC can’t have the same address as the Channel card).

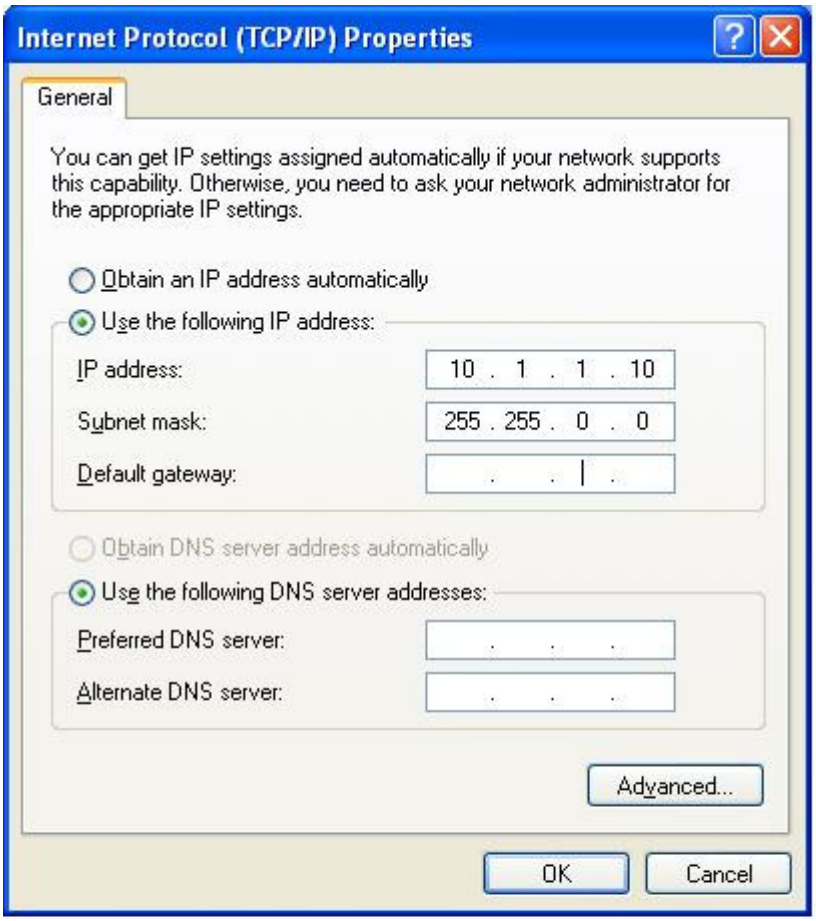

Figure 3-4 PC Local Area Network Setting

3.5 Connecting to Channel Cards

A standard Cat 5 LAN cable should be connected from the PC to the P25net CC front panel RJ45 jack.

The 'Open Connection' item in the 'File' menu allows a specific IP address to be used for connecting to a single Channel Card, and also contains a list of auto-detected Channel Cards on the local network. This list is populated by sending out a broadcast to the network, to which Channel Cards respond.

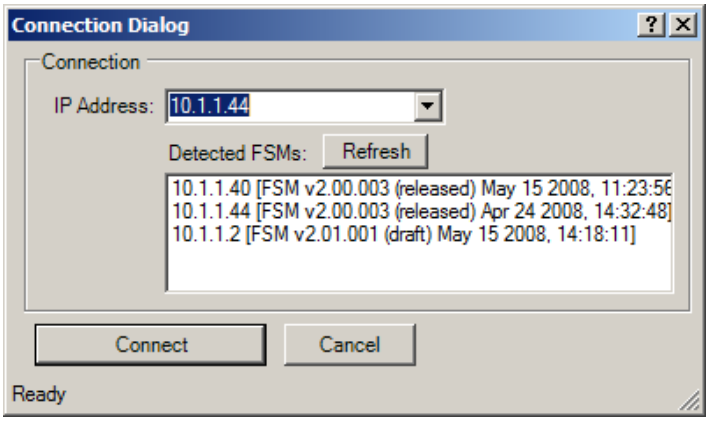

Figure 3-5 Connection Dialog Box

To connect to the Channel Card at a specific IP address, type its address in the text field, and click 'Connect'. Alternatively, double click the address in the list of auto-detected Channel Cards. Following connection, the oscilloscope window will now be visible, and the configuration interface is now ready for use.

A list of recently used IP addresses is stored, and is available by clicking the down arrow in the IP Address field.

Connection of the PCCT to the Channel Cards requires the Channel Cards to be located on the same subnet as the computer running the PCCT. If connection to a card fails, verify that this is the case.

It is possible to use the PCCT to communicate with all 4 cards, by using the Connection dialog to connect to each of them in turn. A new tab will be created for each card that the P25net CC connects to successfully.

3.6 Updating Firmware

The user can update the firmware on the Controller Card by selecting 'Write P25net CC Firmware' from the 'Options' menu. This will open the following window Figure 3-6:

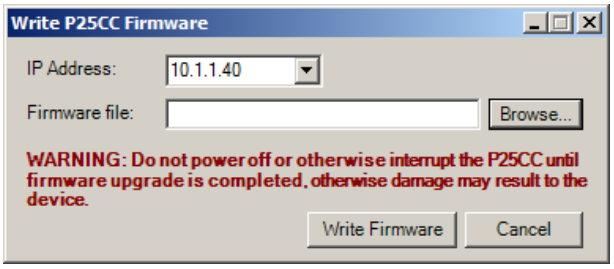

Figure 3-6 Firmware Update Window

Enter the IP address of the Controller Card whose firmware is to be updated, then select the file containing the firmware image. Click the 'Write Firmware' button'. A window will appear indicating that the firmware update is in progress, and once the update is complete (duration < 30sec) a confirmation message will indicate success of the update.

At the end of the firmware process, the front panel lights for that channel will alternate then both stay on and then only the single processor LED should remain lit.

IMPORTANT NOTE: Do not switch off the power or interrupt the connection between the PCCT and P25net CC during firmware updates. Wait until the single Processor LED remains lit before any other action.

3.7 Initialise Mode

In this mode, the user can examine and modify the current IP address of the Controller Card. The user can also examine the MAC address, license key, license status (Valid or Invalid), and board identifier of the Controller Card.

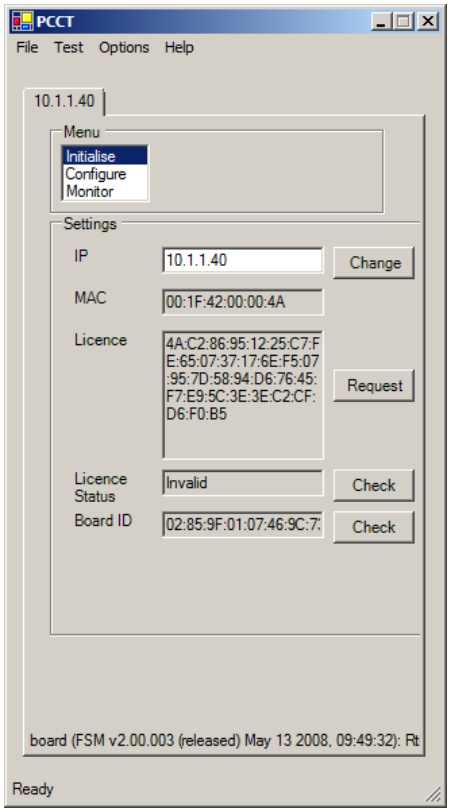

Figure 3-7 Initialise Mode Window

By default, the MAC address and license key are not user-editable. They can be edited by enabling 'Allow MAC/License Key Editing' from the Options menu. Note that each board should have a unique MAC from all other boards ever used and each IP should be distinct for all boards that will be connected to a single BSC.

IMPORTANT NOTE: Be careful when modifying the IP address. Setting an invalid address will not allow the PCCT to communicate with it. Also, make sure duplicate addresses are not used (such as two or more Channel Cards having the same address)

3.8 Radio Programming

The radio should be programmed according to the Application Note for that specific radio model.

3.9 Transmit Calibration

Transmit calibration sets the narrowband deviation for the transmitter and verifies the transmitter can be heard by a P25 receiver.

3.9.1 Equipment Set Up

Connect the equipment as shown in Figure 3-8.

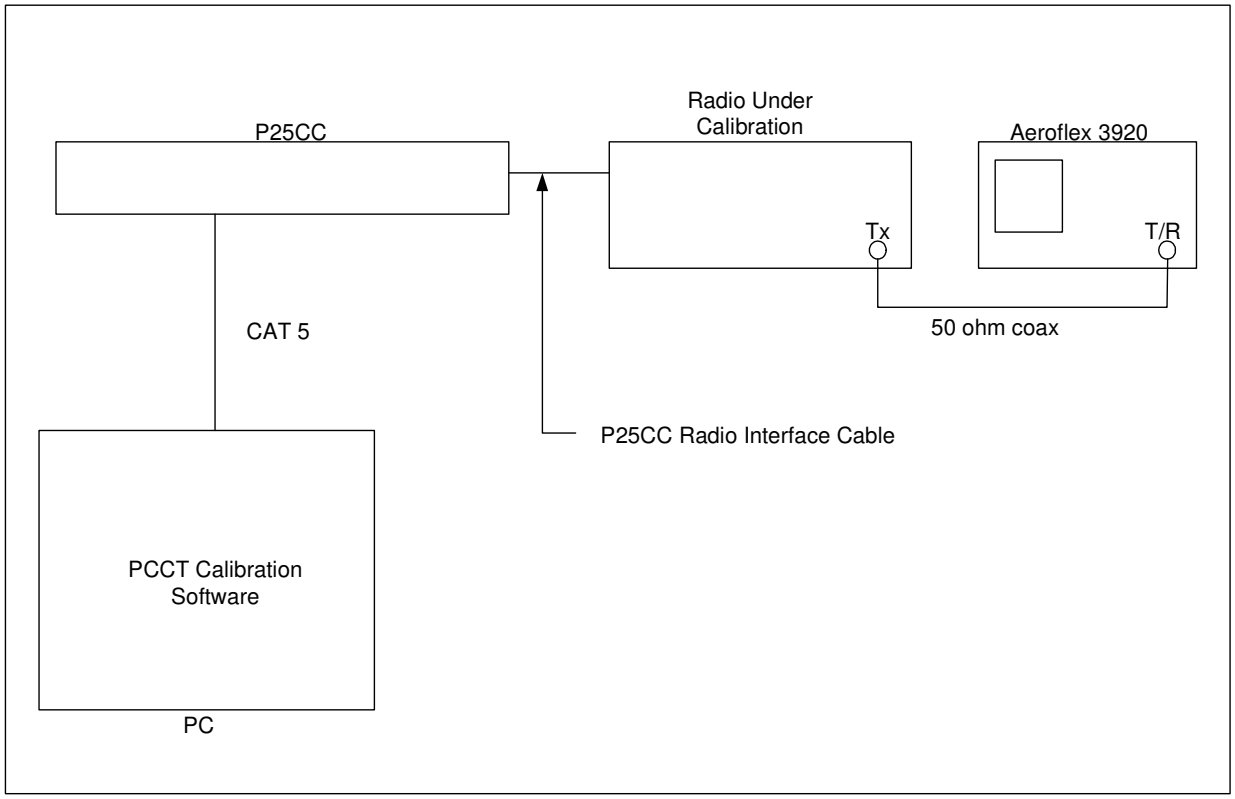

Figure 3-8 Tx Calibration Setup

IMPORTANT NOTE: Make sure the test set has an internal 50 ohm attenuator rated for the transmit power of the radio! It may be necessary to program the radio to a lower power for the Tx calibration.

3.9.2 Initial Steps

3.9.2.1 Set the Radio Test Set to analog duplex mode and program for the frequency of the transmitter.

3.9.2.2 Power up the radio and P25net CC.

3.9.2.3 Launch PCCT and connect to the P25net CC channel.

3.9.3 Radio Tx Calibration

3.9.3.1 In PCCT go to the Configure >Tx window and set default values for the Tx parameters as shown in Figure 3-9

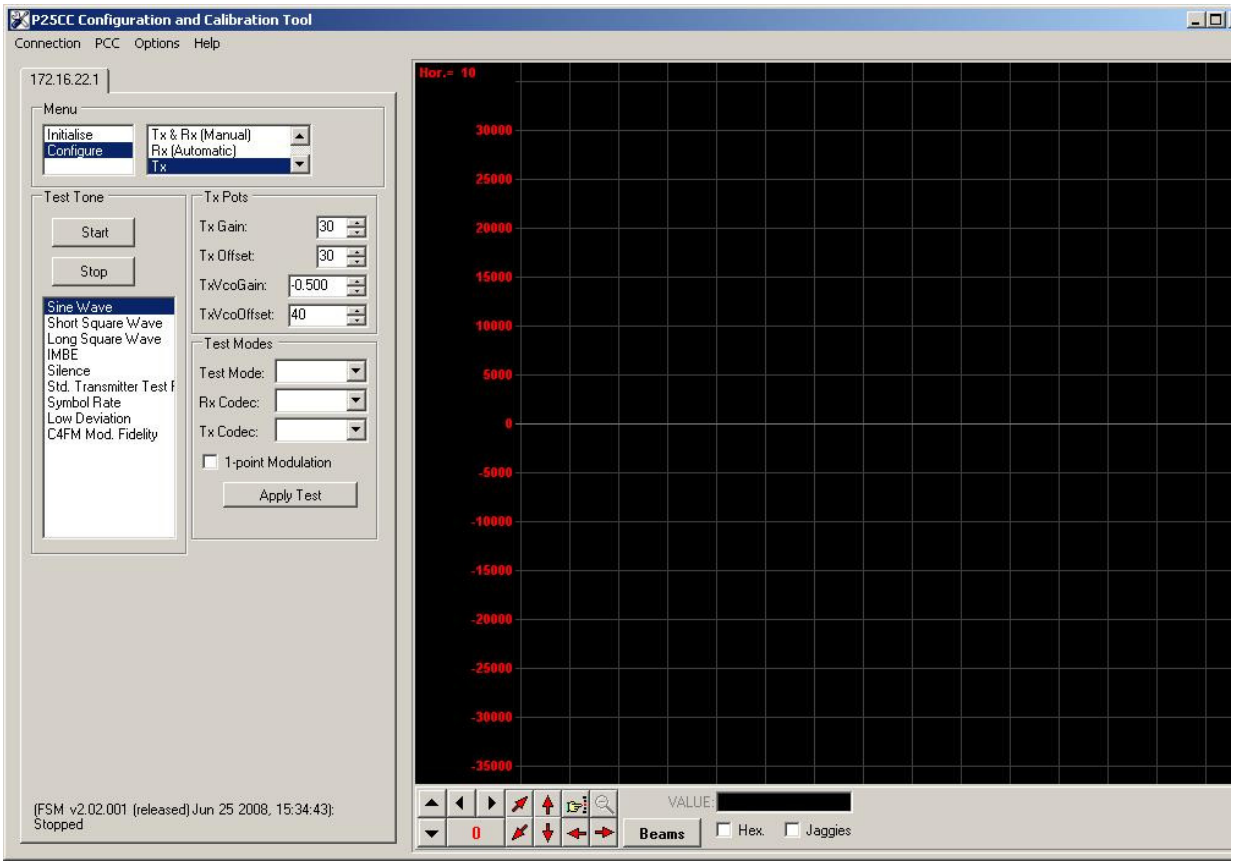

Figure 3-9 Configure Tx Window

3.9.3.2 Start a Sine Wave test tone and adjust the Tx Gain for approximately +/- 2.8kHz as read on the test set deviation meter (Figure X). Adjust the Tx Offset if necessary fort a good undistorted sine wave as displayed on the test set oscilloscope screen (Figure 3-10). Verify the Tx frequency offset error is within required range. Note: Some radios will produce a frequency offset if the Tx Offset is incorrectly adjusted.

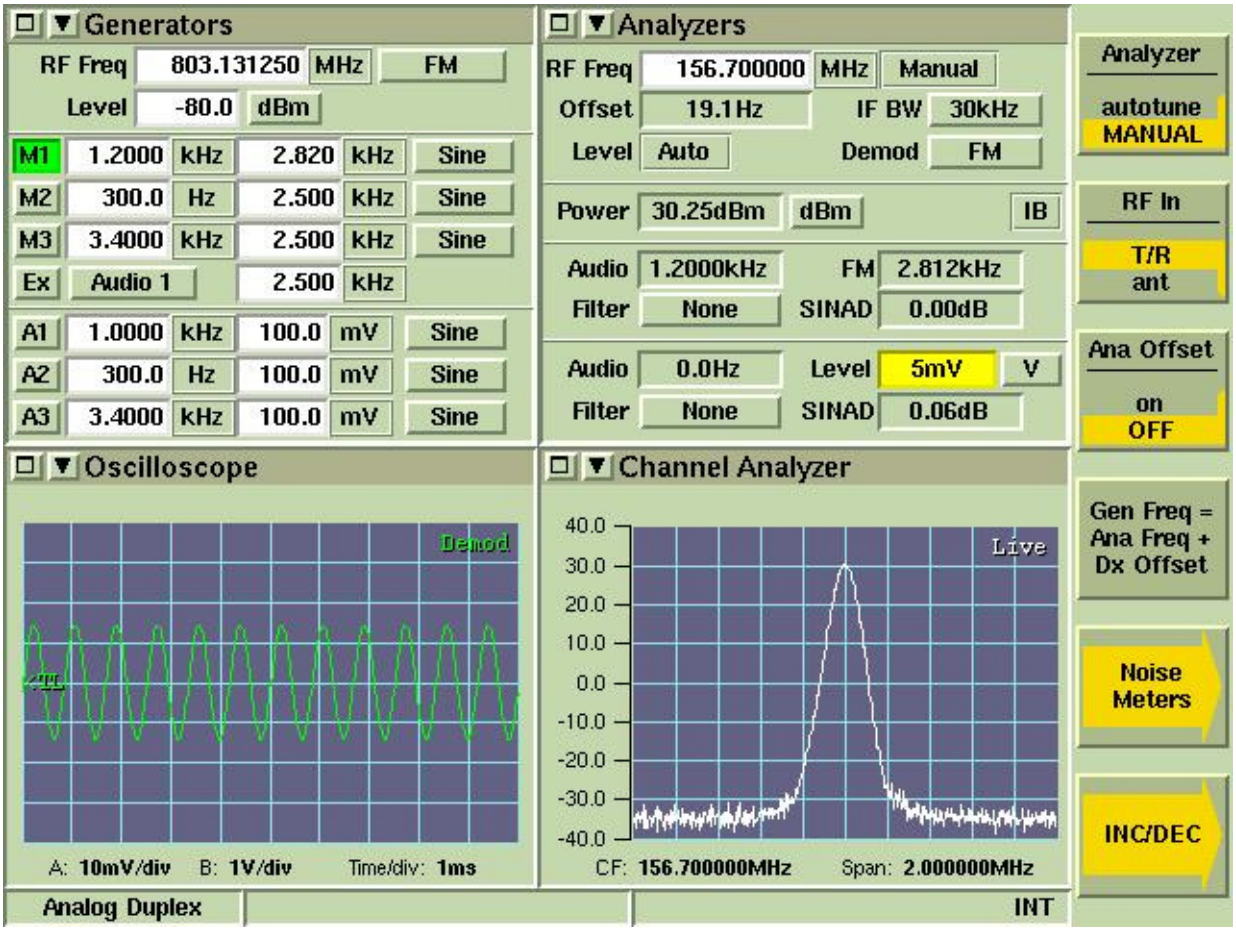

Figure 3-10 Test Set Oscilloscope: Demodulated Audio

3.9.3.3 Change the test tone selection on PCCT to Short Square Wave (100Hz) and verify the demodulated audio oscilloscope displays a good approximation of a square wave with generally flat high and low levels (Figure 3-11). A poor square wave indicated the radio needs to be aligned with the factory service software to achieve better DC Balance.

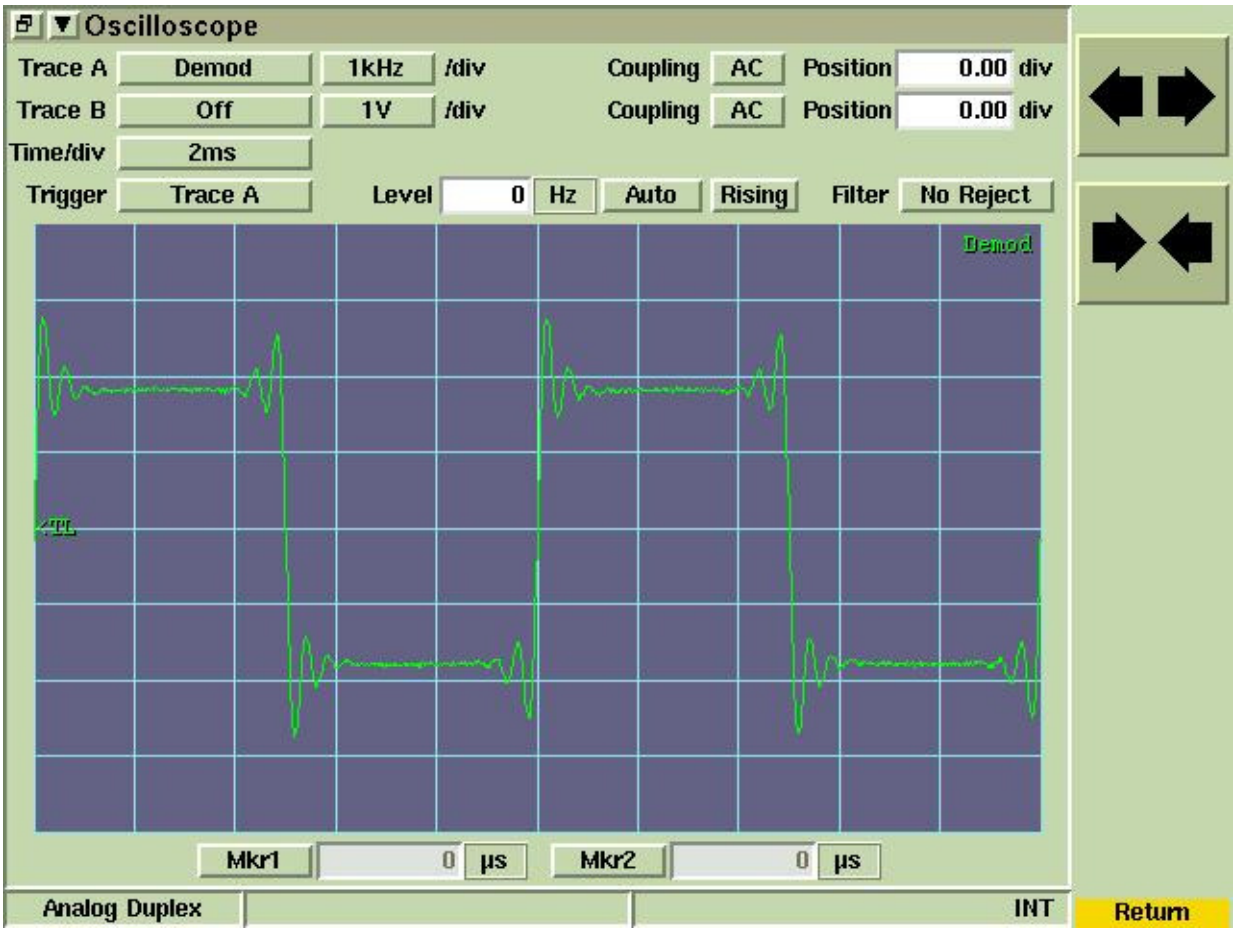

Figure 3-11 Test Set Oscilloscope: Short Square Wave

3.9.3.4 Return to the Sine Wave test tone and adjust Tx Vco Gain to get the deviation as close to +/-2.827kHz as possible and adjust the Tx Offset as necessary to correct any flattening or clipping of the sine wave. Tx Vco Gain is a finer adjustment than Tx Gain which provides coarse steps. (See Figure 3-12).

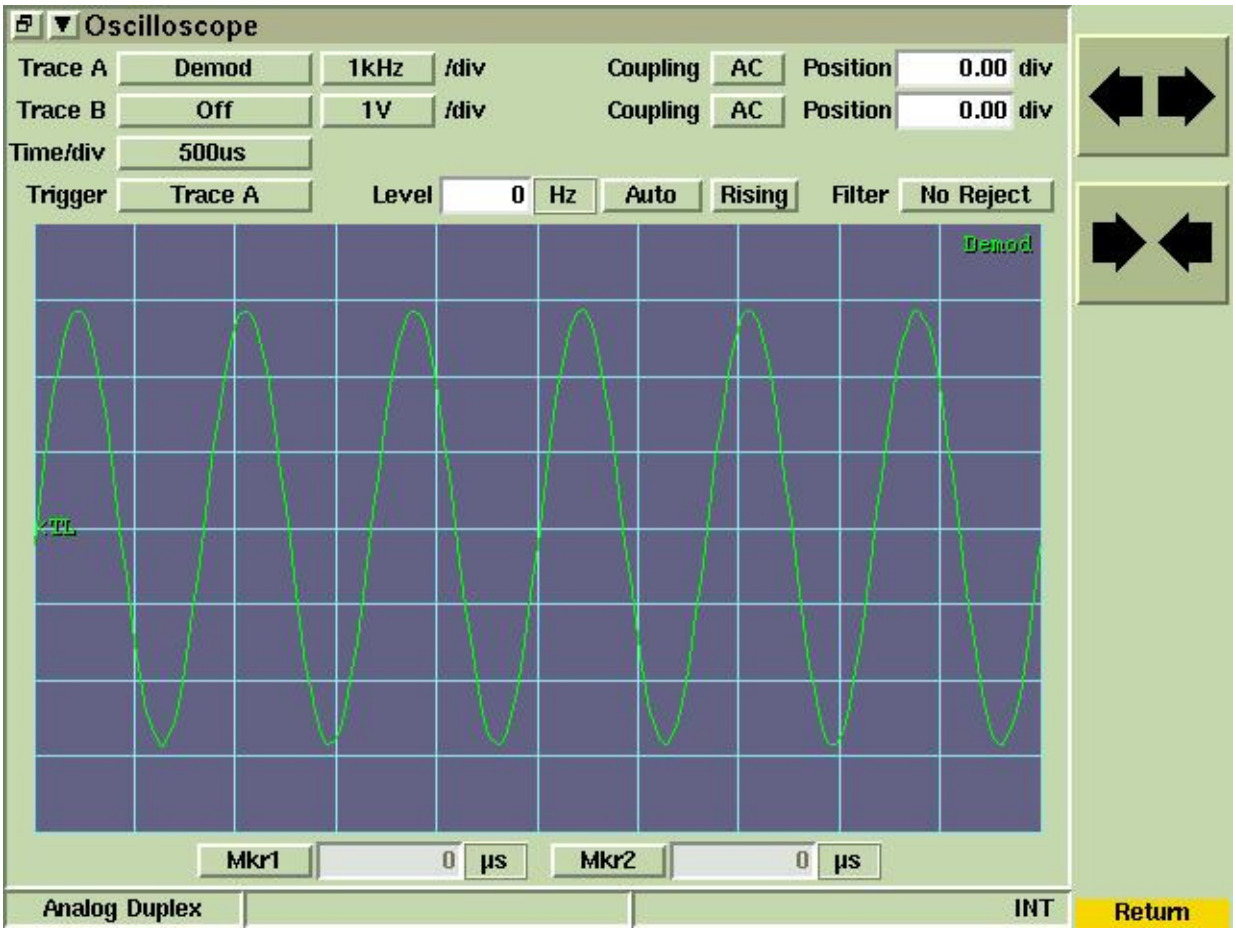

Figure 3-12 Test Set Oscilloscope: Sine Wave

3.9.3.5 Start an IMBE test tone using PCCT.

3.9.3.6 Tune the test set to P25 mode and listen for a 1200Hz sine wave in the monitor speaker set to demodulated audio. A P25 Handset may also be used for this step if tuned to the proper frequency in conventional P25 mode.

3.9.3.7 If the test tone is not heard, it may be necessary to invert the Tx audio. This is done by putting a minus (-) sign in front of the Tx Vco Gain number (see Figure 3-13). If the tone is heard then Tx calibration is complete. PCCT writes the Tx calibration settings to the Channel Card when the PCCT application is closed.

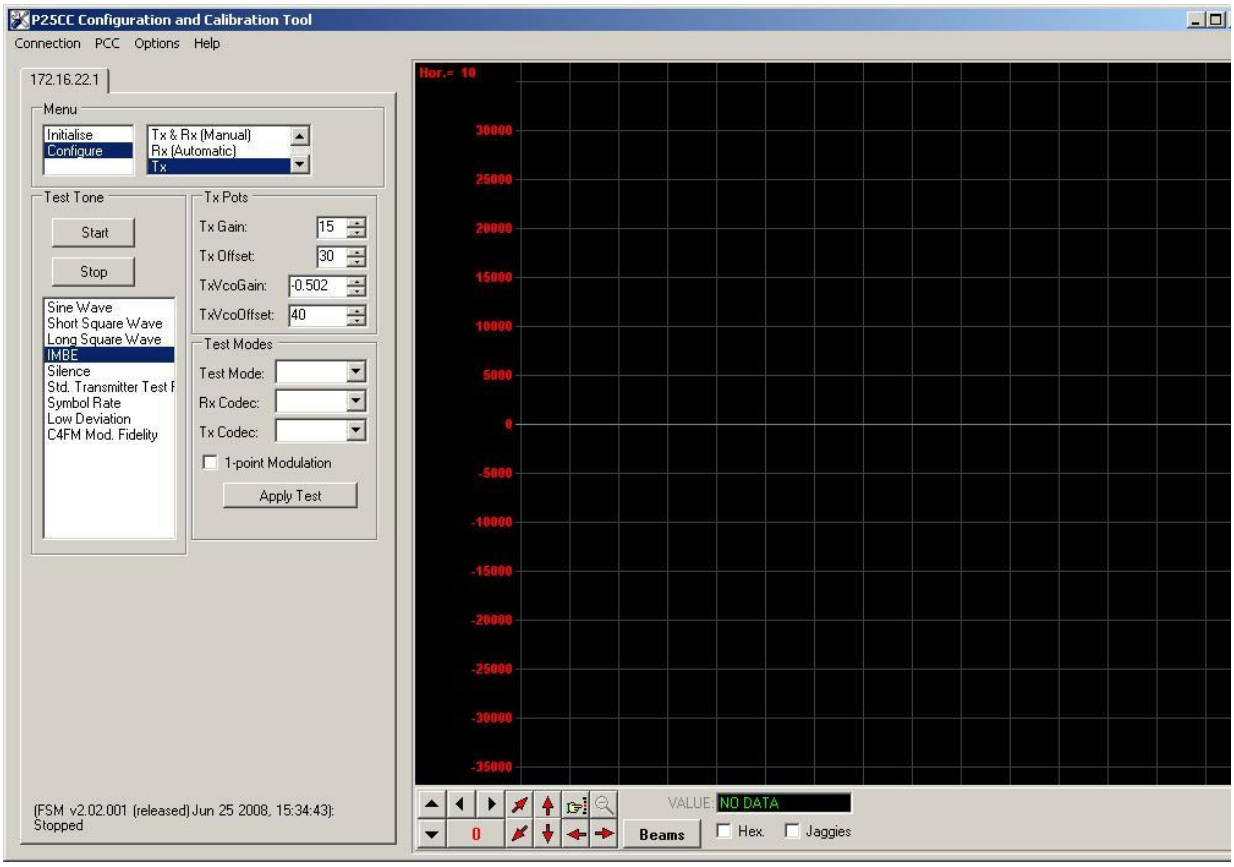

Figure 3-13 Configure Tx Window: Minus Sign for Tx Vco Gain

3.10 Rx Calibration

Receive calibration adjusts the P25net CC audio input level to match the radio line audio output level and calibrates the P25net CC for the RSSI signal from the receiver.

3.10.1 Equipment Setup

Connect the equipment as shown in Figure 3-14.

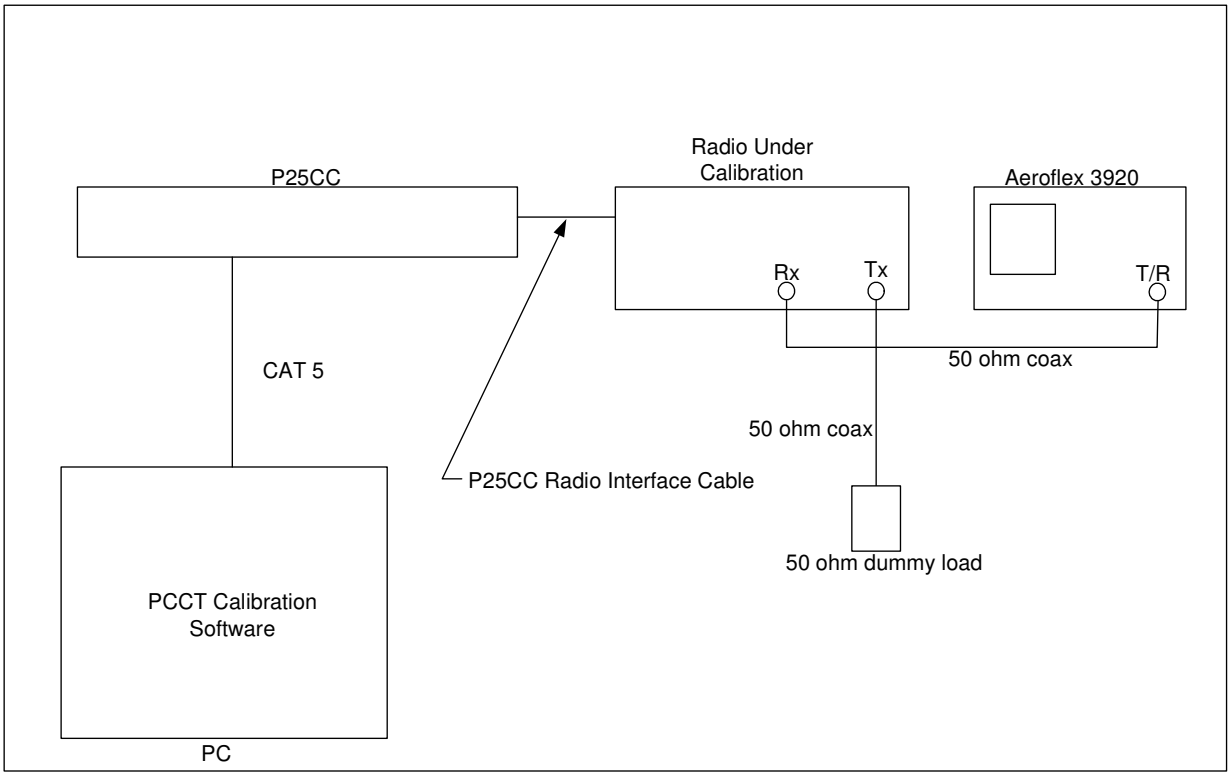

Figure 3-14 Rx Calibration Set-up

3.10.2 Initial Steps

3.10.2.1 Configure the test set for analog duplex mode and set the generator to produce a 1200Hz sine wave with a peak deviation of 2.827kHz at the receiver frequency.

3.10.2.2 In PCCT go to the Configure >Rx and Tx Manual window and set default values for the Rx parameters as shown in Figure 3-15. Check the "Enable Editing" boxes for entering parameters.

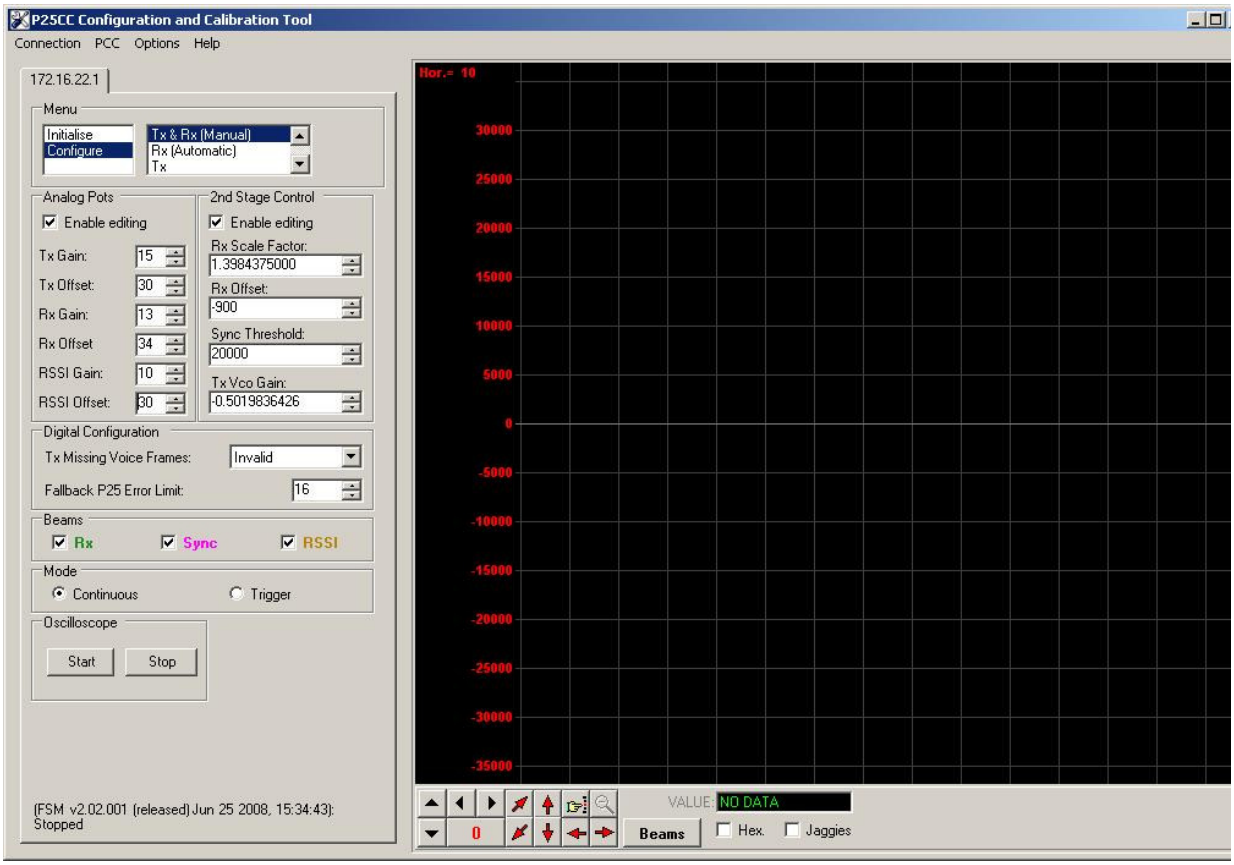

Figure 3-15 Configure Tx and Rx (Manual) Window

3.10.3 RSSI Calibration

3.10.3.1 Set the test set for -123dBm generator level and turn on the generator.

3.10.3.2 Start the PCCT oscilloscope and adjust the RSSI Offset so the trace on the oscilloscope is centered around -20000 (See Figure 3-16).

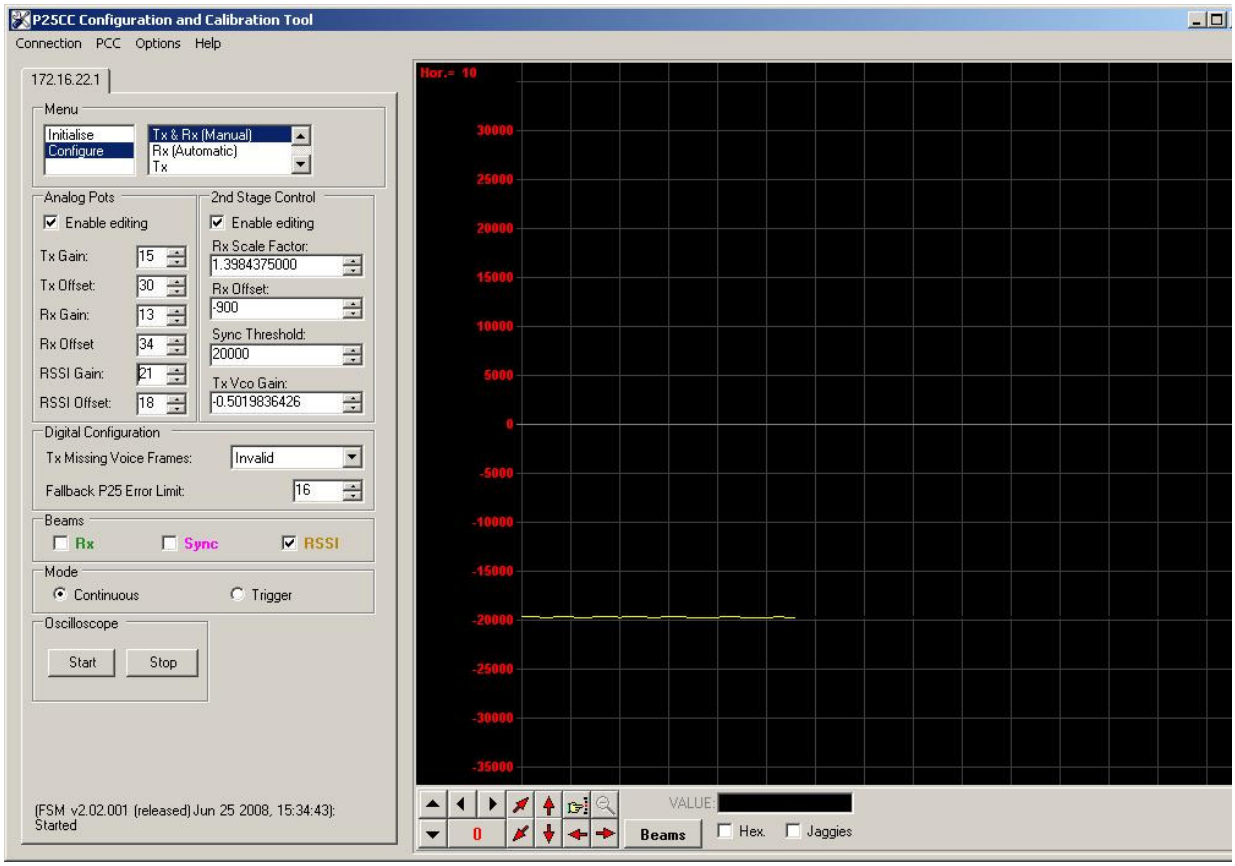

Figure 3-16 RSSI Low Level

3.10.3.3 Turn off the generator and verify the RSII level is unchanged.

3.10.3.4 Turn off the generator and change the level to -118dBm. Turn on the generator and verify RSSI goes to 30000 or above on the oscilloscope (Figure 3-17).

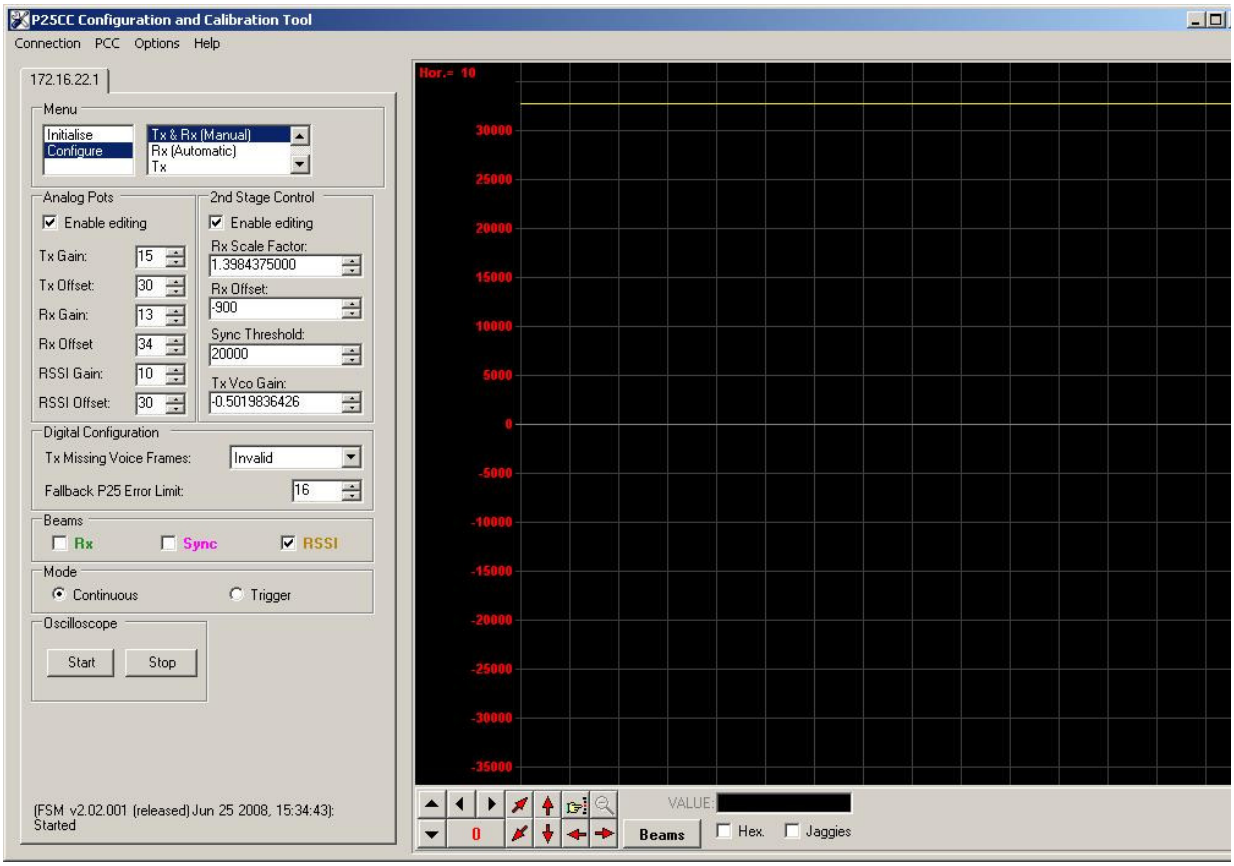

Figure 3-17 RSSI High Level

3.10.3.5 Turn off the generator; RSSI settings will be saved when exiting PCCT.

3.10.4 Rx Calibration

3.10.4.1 From the Configure>Rx and Tx Manual screen set the following to default values:

Rx Gain to 15

Rx Offset to 30

3.10.4.2 Set the generator on the test set to -60dBm.

3.10.4.3 Check the Rx beam box and start the oscilloscope on PCCT.

3.10.4.4 Adjust the Rx Offset so the mean of the observed sine wave is centered as close as possible about zero. Adjust the Rx Gain so that the signal peaks are slightly less than +20000 and -20000 (See Figure 3-18).

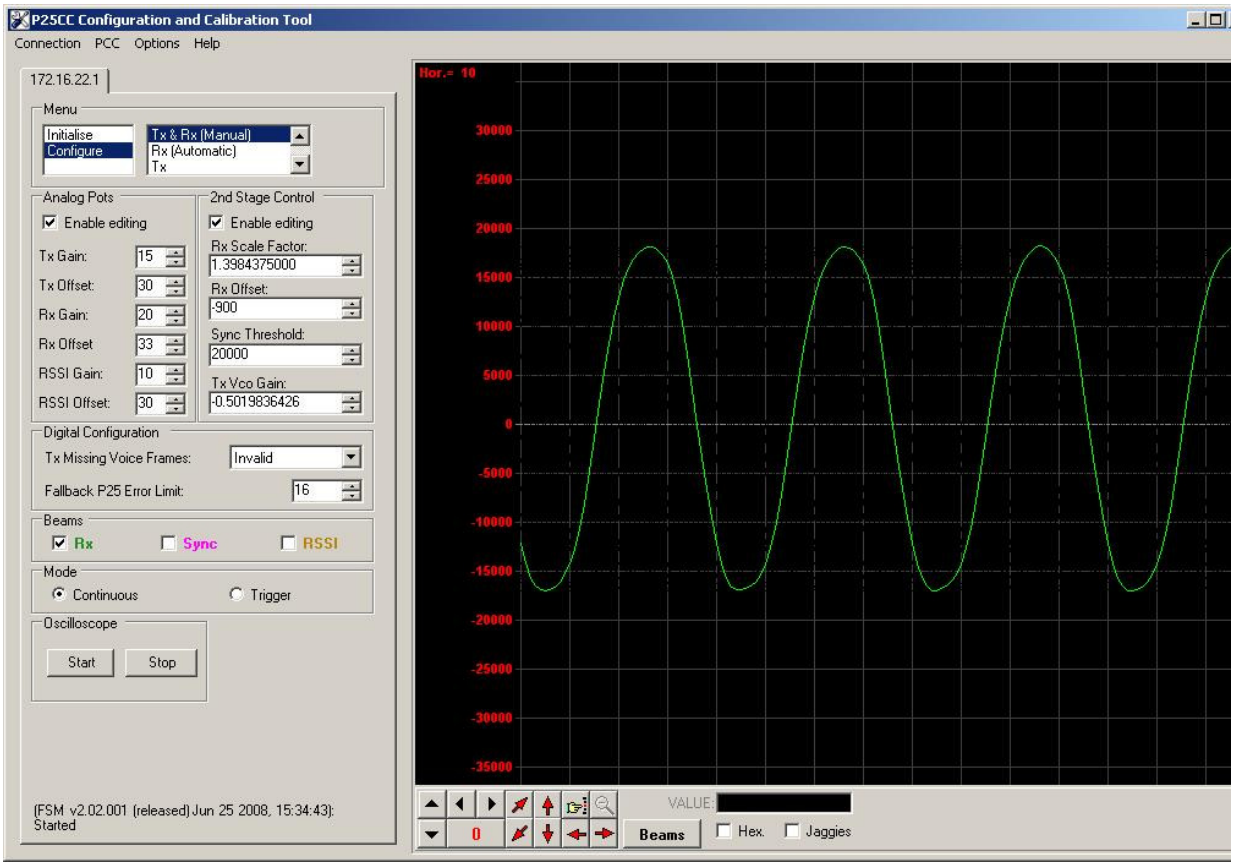

Figure 3-18 Rx Gain and Offset Adjustment

3.10.4.5 Go to the Configure>Rx (Automatic) window and select trigger on RSSI (2000).

3.10.4.6 Hit Trigger, Calculate, and Save to calculate and store the coefficients for Rx Scale Factor and Offset (Figure 3-19).

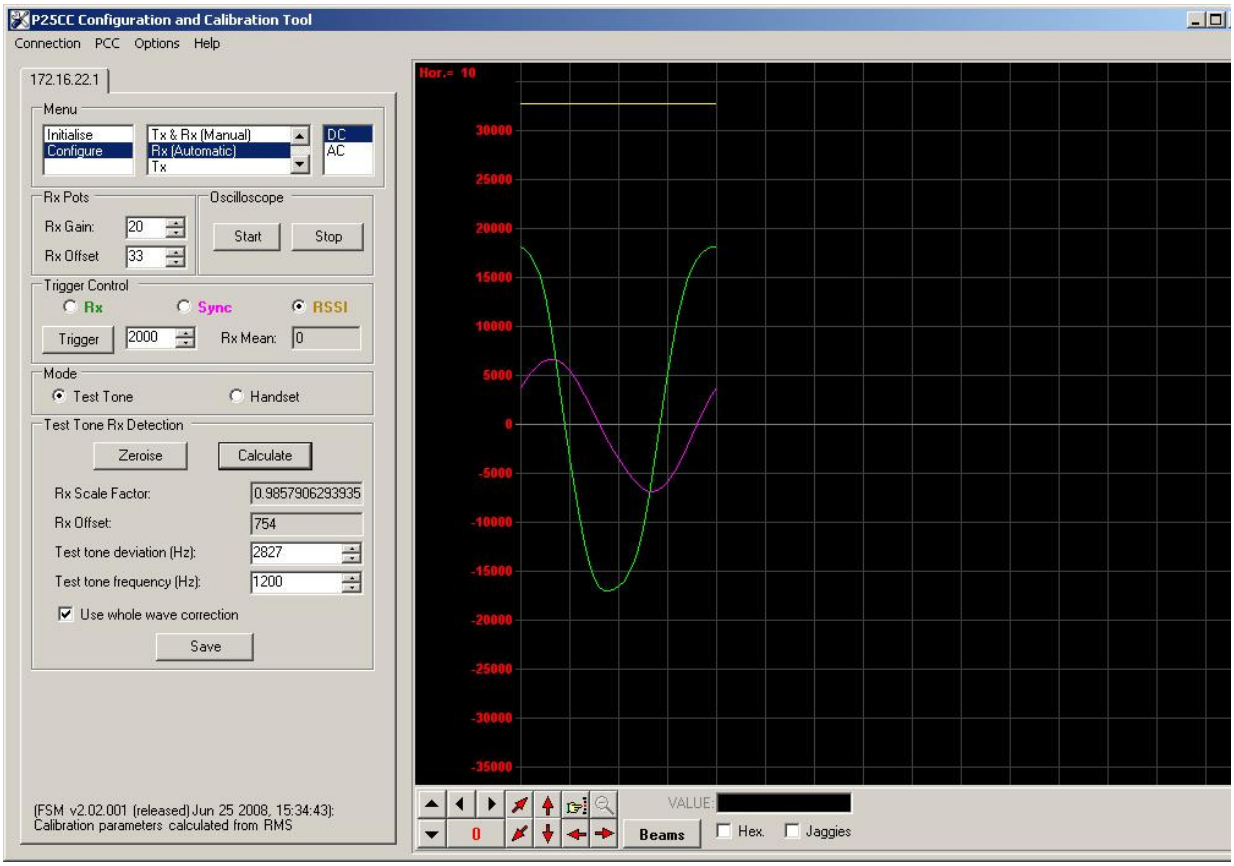

Figure 3-19 Configure Rx Automatic: RSSI Trigger

3.10.5 Sync Calibration

3.10.5.1 Turn off test set generator.

3.10.5.2 Go to the Configure>Rx and Tx (Manual) window and set the trigger controls for Handset.

3.10.5.3 Press PTT on the Handset for a short transmission.

3.10.5.4 Hit Trigger and Find Sync. You should see the sync pulse as shown in Figure 3-20.

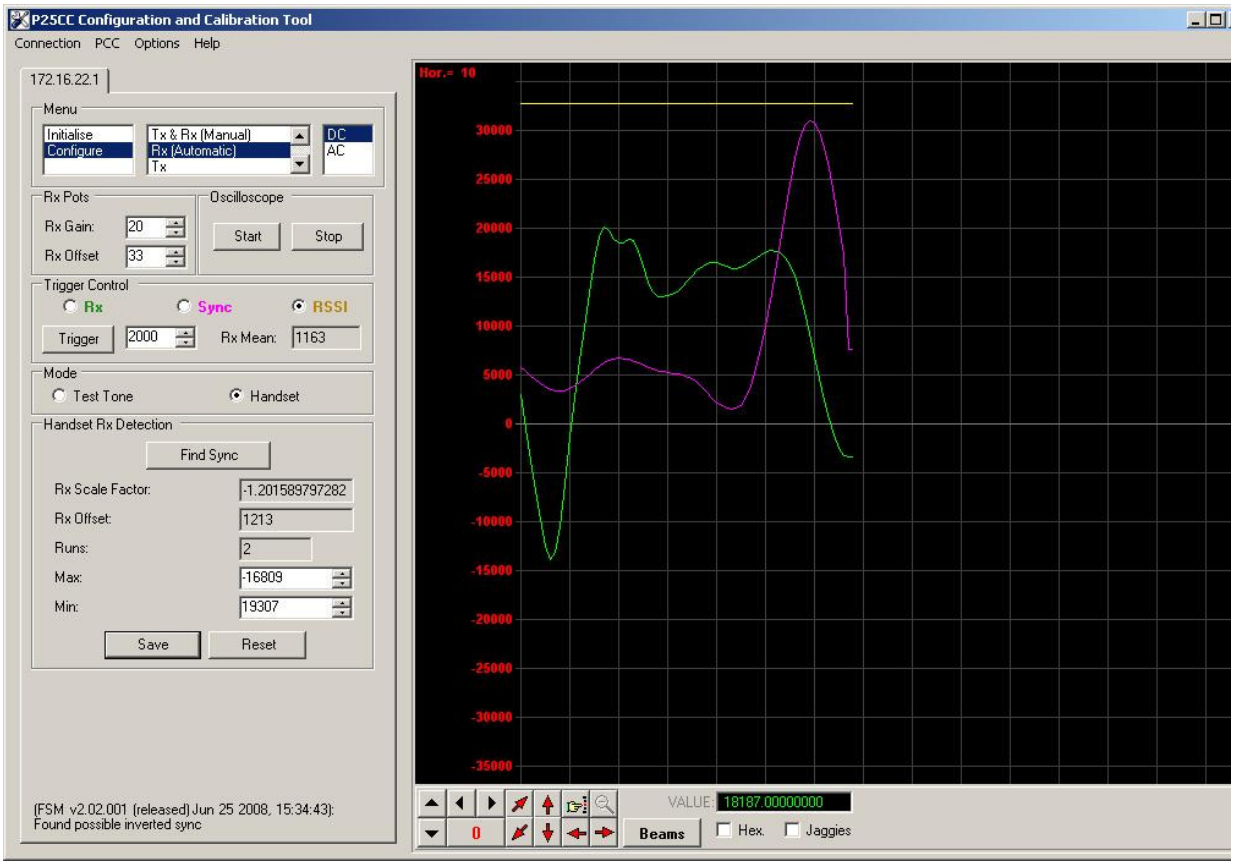

Figure 3-20 Configure Rx (Automatic): Find Sync

3.10.5.5 If the Rx LED on the P25net CC channel lights when the Handset is in PTT hit the Save button to complete the sync calibration.

3.10.5.6 If the sync is not found, go back to the Configure >Rx (manual) window and enable editing. Place a negative (-) sign in front of the Rx Scale Factor and repeat the steps.

3.11 Load/Save Transceiver Configuration

PCCT has a feature that allows saving the calibration settings for a radio as well as recalling them. This provides a short-cut around the full calibration procedure in most cases. Sometimes variation between radios and Channel Cards will require some fine adjustment of the tx/tx calibration.

3.11.1 Load/Save Config Window

Open the Configure>Load/Save Config screen and select the transceiver to be loaded (See Figure 3-21 Load/Save Config Screen).

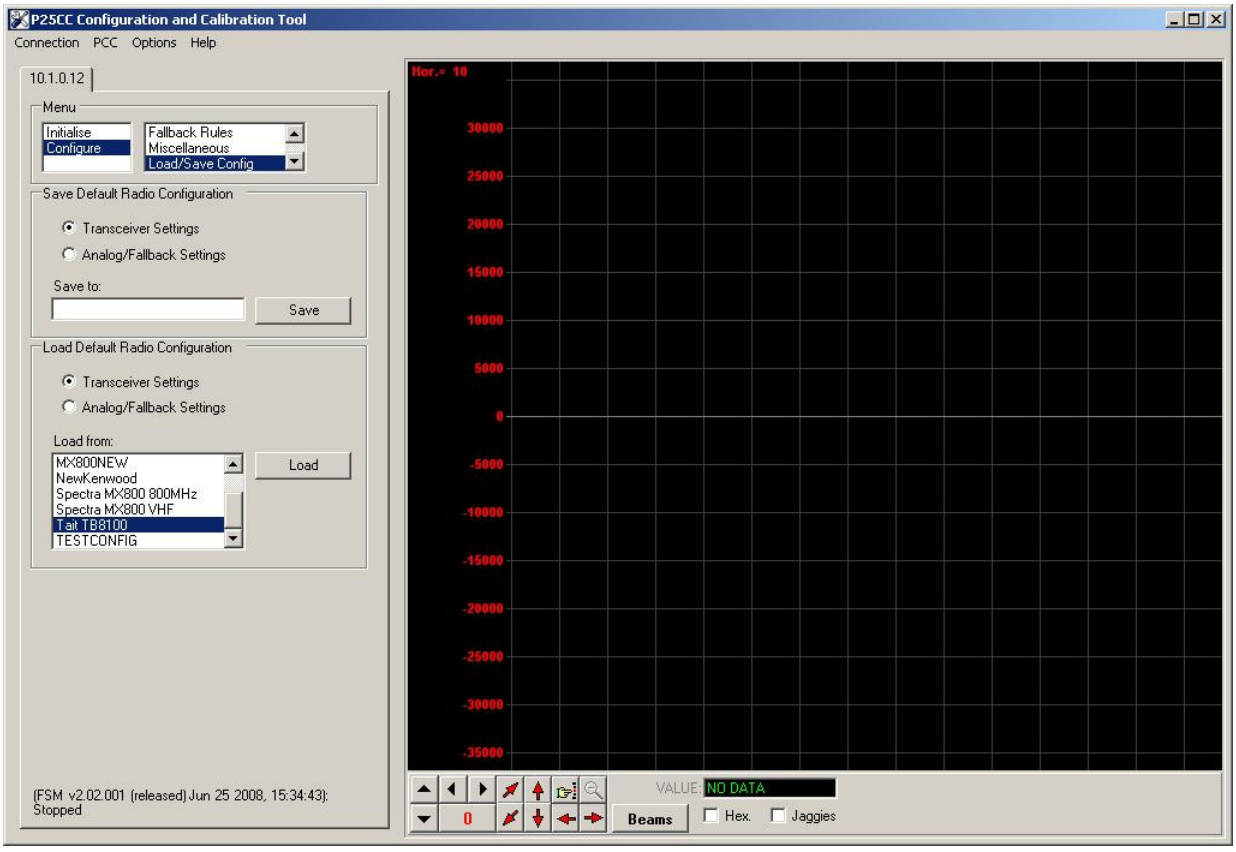

Figure 3-21 Load/Save Config Screen

3.11.2 Default Radio Settings Loaded

After loading a notification of the action will be displayed (see Figure 3-22 Default Settings Applied Screen).

Figure 3-22 Default Settings Applied Screen

3.12 Fallback Mode

The Fallback Mode can be enabled to provide conventional P25 repeater operation in the event that the BSC reboots or experiences a problem communicating with the P25net CC. Trunking will not be possible until BSC operation is restored.

In addition, it is possible to operate the P25net CC as a conventional P25 repeater (sometimes referred to as a “Dumb Repeater”) without connecting a BSC; this requires enabling the Fallback Mode.

To enable the Fallback Mode, enter PCCT and select Configure>Fallback Param (see Figure 3-23 Fallback Mode Enable Screen) and place a check in the box.

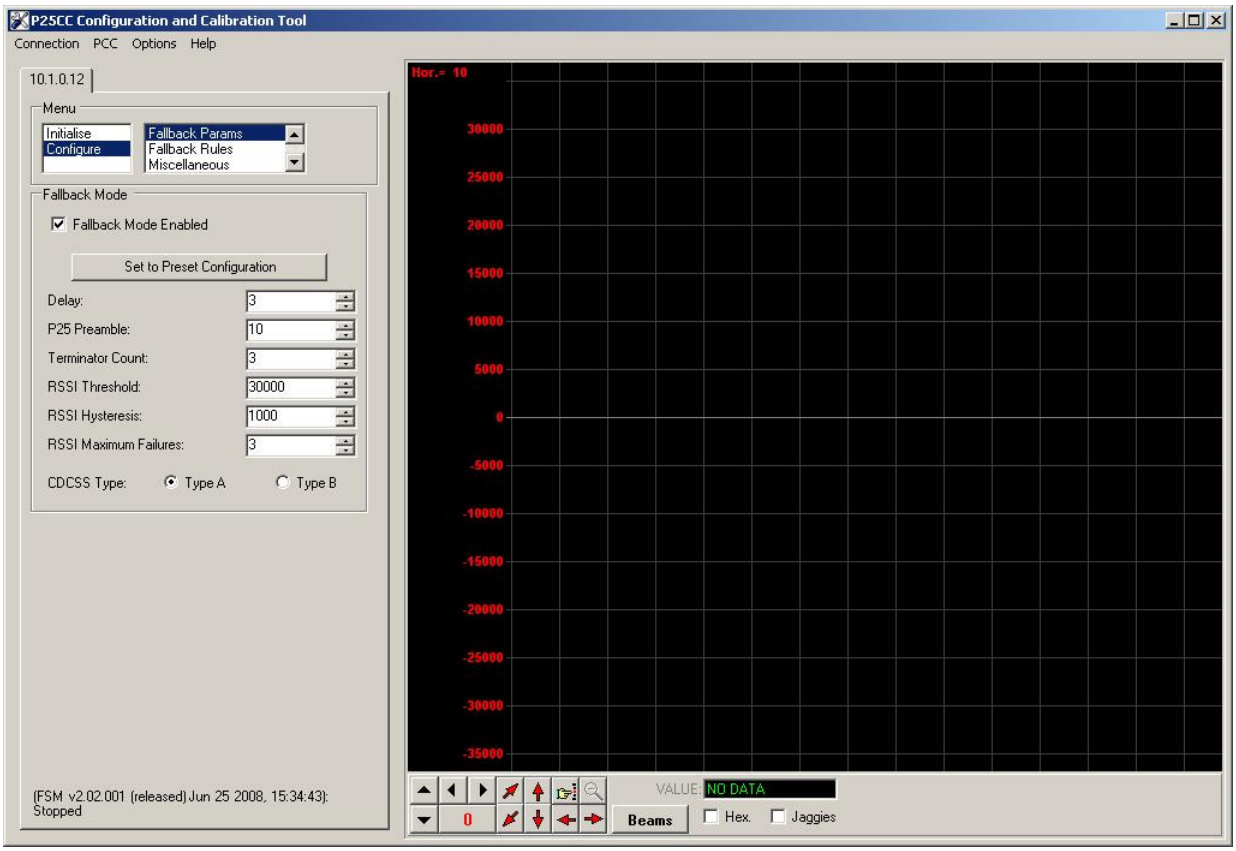

Figure 3-23 Fallback Mode Enable Screen