TaitNet

MPT 1327
Trunked Radio Networks

T1511 Channel Control Module

Installation Manual

Scope of Manual

This manual provides installation and service information for the T1511 Channel Control Module when operating with the software identified as "Q1711MIN version 7.05". This manual may apply to newer versions of software.

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PREFACE

Scope of manual

This support manual is part of the documentation set for TaitNet™ trunked radio systems. This manual provides installation and service information for the T1511 Channel Control Module.

Enquiries and comments

Any enquiries regarding this manual as well as any comments, suggestions and notifications of errors, should be addressed to Technical Support, Tait Electronics Ltd, PO Box 1645, Christchurch, New Zealand. Orders for this manual can be placed with your Tait Dealer.

Updates of manual and equipment

In the interests of improving the performance, reliability or servicing of the equipment, Tait Electronics Limited reserves the right to update the equipment or this manual or both without prior notice.

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LIST OF ACRONYMS

RF   Radio frequency
RU   Radio unit
TN   Technical note

CCM   Channel control module
DAS   Digital audio switch
LBU   Line barrier unit
NMT   Network management terminal
SCD   System configuration dossier
SMM   Site management module

PABX   Private automatic branch exchange
PSTN   Public switched telephone network

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1.00	April 1998	First release
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MNA-00005-01	June 2005	Re-released and updated for Q1711MIN version 7.05 software

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CHAPTER 1

INTRODUCTION

1.1 TaitNet Systems and the CCM

Site sub-system

The channel control module (CCM) is used in TaitNet trunked radio systems. It is one of the assemblies that makes up the site subsystem. The site subsystem consists of the following:

- site management module (SMM)
- between 1 and 24 radio channels
- transmit and receive antenna equipment
- digital audio switch (DAS) - in networks where telephone connections are required at site

The CCM is one of the assemblies that make up each channel. The antenna equipment includes receive multi-coupler equipment and transmit combiner equipment as well as the antennas themselves. The SMM, channels, and combiner and multi-coupler equipment are mounted in standard 19 inch (483 mm) cabinets. The node-site links for audio signals proceed via Krone terminal blocks mounted at the back of the cabinets. These links are called intersite audio links.

Channel equipment

Each channel consists of the following assemblies:

- CCM
- receiver
- transmitter
- PSU (power supply unit)
- pre-wired rack

The CCM, receiver, transmitter and PSU modules fit into slots in the pre-wired rack. The transmitter may consist of a single module (when low power is sufficient) or separate exciter and power amplifier modules (when high power is needed). Data communications between the SMM and the CCMs of the different channels proceed via a bus called the site bus. At the site the node-site link used for control purposes is connected to the SMM.

Types of channels

A channel can operate in one of three ways:

- control channel
- local traffic channel
- intersite traffic channel

The control and traffic channels are discussed separately below:

Control channel

There is always only one control channel at a site. The control channel handles the communications over the air involved in setting up calls involving radios at the site. It will inform the SMM of any call setups. The SMM will then assign the handling of a given call to one of the traffic channels. If no dedicated traffic channels are available, the control channel may operate temporarily as a traffic channel.

Traffic channels

Local traffic channels handle local calls that involve only radios registered at the site in question. Intersite traffic channels handle intersite calls as well as local calls. Intersite calls are calls that proceed from a radio at one site, via the node, to a radio at another site. The node can also be connected to a telephone system to allow intersite calls between telephones and radios. The intersite audio links are used by the intersite channels for implementing intersite calls.
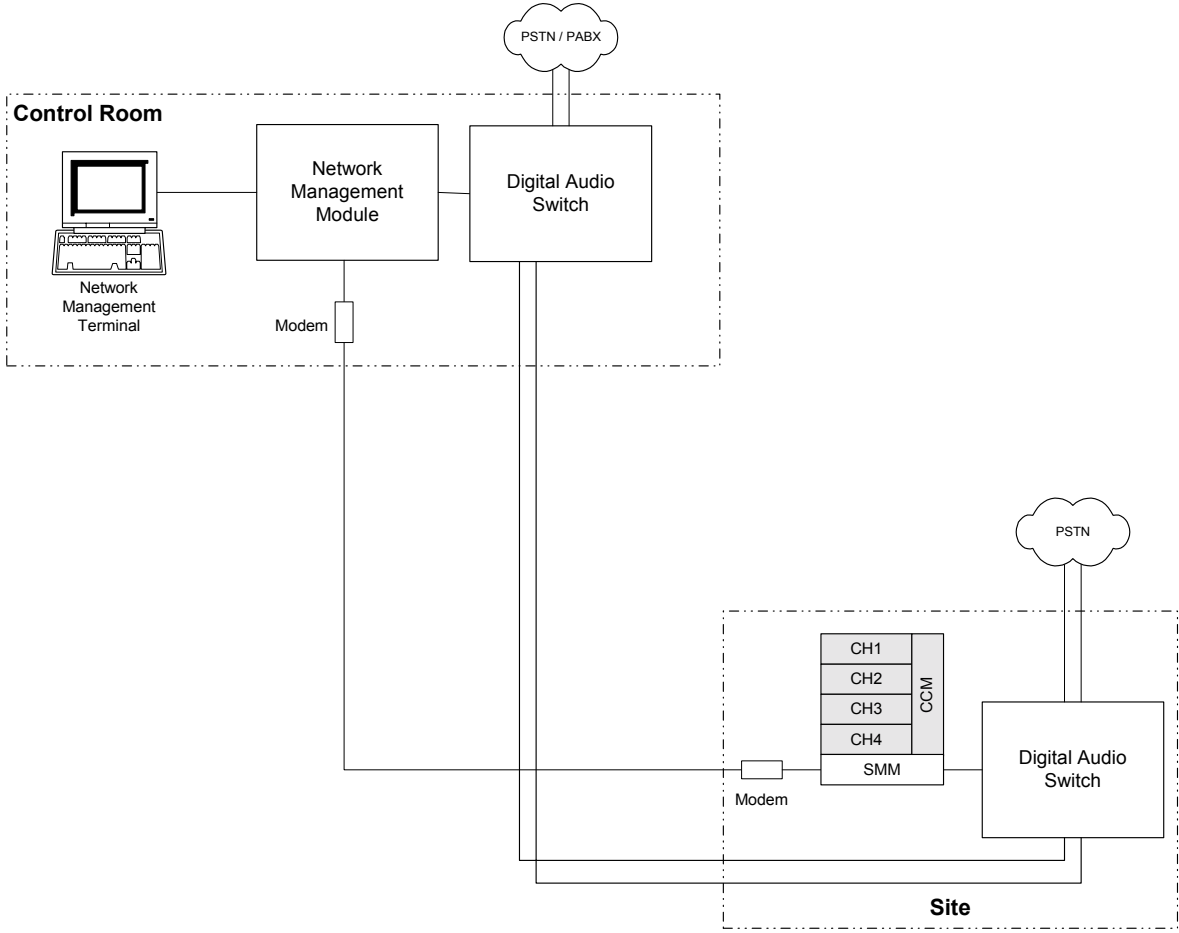
Figure 1: Where the CCM fits in a TaitNet system

1.2 Specifications

The performance figures given are minimum figures, unless otherwise indicated, for equipment operating at standard room temperature (+22°C to +28°C).

Details of test methods and the conditions which apply for Type Approval testing in all countries can be obtained from Tait Electronics Ltd.

Table 1: Specifications for the channel control functions of the T1511 CCM

General Information	
Maximum number of channels	24
Signalling protocol	MPT 1327
Supply Voltage	
Operating voltage	10.8 to 16 V DC
Standard test voltage	13.8V DC
Polarity	negative earth only
Polarity protection	series diode
Supply current (operating)	200mA
Operating temperature range	-10 to +60°C
Dimensions	
Height	191mm (1U)
Width	60mm
Length	320mm
Weight	1kg
External Connections	
Data bus	site bus to SMM and other CCMs
Data speed	63,000 baud
External Connections (continued)	
Logic inputs	diode-protected CMOS
Logic input levels	12V active low
Logic outputs	open collector
Logic output levels	12V active low

Table 1: Specifications for the channel control functions of the T1511 CCM

General Information	
CCM Logic Connections	
CCM status	Active low open-connector output to CCM
Local call out and Intersite call out	Active low input from CCM (to match open-collector output drive) 10k pull-up resistor to +8V

Table 2: Specifications for the switching and termination functions of the T1511 CCM

Cross-talk	
Local calls	>50dB (intersite-local)
Intersite calls	>50dB (transmit-receive audio paths)
Signal-to-noise ratio	
Intersite audio paths	>50dB
Local audio path	>50dB
Local Audio Interface	
Input type	2 wire, 600 Ω, balanced
Output type	2 wire, 600 Ω, balanced
Line levels	-10dBm fixed, ±2dB
Intersite Audio Interface	
Input type	2 wire, 600 Ω, balanced
Output type	2 wire, 600 Ω, balanced
Maximum output level	0dBm
Maximum input level	0dBm
Minimum intersite input level	-30dBm
Frequency response	300Hz to 3kHz (±1dB into 600 Ω)
Return loss	better than 15dB
Distortion	less than 0.3%

CHAPTER 2

DESCRIPTION

2.1 Control Functions of the CCM

The CCMs in both control and traffic configuration have several functions. They:

- handle site bus communications
- handle input and output of Fast Frequency Shift Keying (FFSK) messages
- ensure the transmitter transmits audio signals when required
- ensure the transmitter transmits FFSK messages when required
- ensure correct switching of audio signals
- monitor the status of the receiver
- monitor alarm inputs from the transmitter

FFSK messages are data messages composed of binary digits, with the digits 0 and 1 represented by two different audio frequencies. The CCM functions are discussed below, the inputs and outputs involved are listed in Table 3.

Table 3: Sources of inputs to, and destinations of outputs from, the CCM

Inputs and Outputs	Source or Destination
Data Comms Site Bus	SMM and other CCMs
FFSK Messages Rx FFSK Tx FFSK	From RX To Tx
Logic Inputs (active low) Fwd Power Alarm Rev Power Alarm Rx Gate	From Tx From Tx From Rx
Logic Outputs (active low) Tx Key	To Tx
CCM status	From rack frame DIP switch

The CMM has two audio inputs and two outputs. The inputs are the RX LINE signal from the receiver and, if connected, the INTERSITE AUDIO IN signal from the node. The outputs are the TX LINE signal to the transmitter and, if connected, the INTERSITE AUDIO OUT signal to the node.

The intersite audio port is presented as a 600Ω/4-wire, complying with the requirements of CTR 17 and FCC Part 68 for direct connection to third party leased-line circuits.

Site bus communications

Each CCM communicates with the SMM and the other CCMs at the site by means of the site bus. The site bus is used for two purposes:

*   polling
*   data transmission.

The SMM continually polls all the CCMs to determine their status, but will poll the control channel CCM more often in order to see if there are any call requests that need to be processed. When polled, a CCM outputs an appropriate message to the bus. The site bus is also used for the transmission of the necessary messages involved in the establishment, handling and conclusion of calls. The messaging takes place between the control channel CCM, the SMM and the CCM of the traffic channel handling the call.

Reception of FFSK messages

The RX FFSK signal contains either FFSK messages or audio signals. The CCM ignores the audio signals but decodes any FFSK message and responds accordingly. Typically, the control channel CCM receives FFSK messages from radio units during the establishment of calls, and traffic channel CCMs receive FFSK messages during calls and at the conclusion of calls.

The control channel CCM continually outputs FFSK messages to be broadcast to all radios by the transmitter. The CCM uses these messages to control the radios at the site. The control channel CCM also outputs the FFSK messages that are needed when calls are established. Traffic channel CCMs output the FFSK messages that are needed when calls are concluded.

Transmission of FFSK messages

To output an FFSK message, the CCM sets the TX KEY output low and outputs the message on the TX FFSK signal. The TX KEY output keys on the transmitter and transmits the signal. At the conclusion of the message the CCM sets the TX KEY output high, which keys off the transmitter. Note that the CCM also mutes the TX LINE output during this time.

Transmission of audio signals

When the audio signal of a call is to be transmitted by the transmitter, the CCM sets the TX KEY logic output low. This keys on the transmitter and transmits the signal presented at the TX LINE. At the conclusion of the call the CCM sets the TX KEY output high, which disables the transmitter. Note that the CCM also mutes the TX FFSK output during this time.

Monitoring of receiver status

The CCM in a traffic channel monitors the RX GATE logic input from the receiver while a call is in progress. This input is set low when the received signal exceeds the receiver's mute threshold; when set high, the implication is that there is no RF (radio frequency) carrier present. The CCM makes use of the RX GATE input in setting the following timeouts

- inactivity timeout
- stuck mute timeout

Inactivity timeout

During a call the RX GATE input is set low so long as the RF carrier is present. If the input changes to high, the CCM anticipates the end of the call and applies the inactivity timeout.

If the input changes back to low before the timeout expires, the CCM assumes that the call is continuing.

However, if the input is still high when the timeout expires, the CCM assumes that the call has ended, and seeks to clear down the call.

Stuck mute timeout

Sometimes the RX GATE input remains low even after the maximum time allowed for a call has expired. In such cases the CCM assumes that the receiver mute has remained open. If the mute is still open when the timeout expires, the CCM will cancel the call and attempt to clear the channel.

Monitoring of transmitter status

The CCM determines the status of the transmitter from two logic inputs from the transmitter

• FWD PWR ALARM

• REV PWR ALARM

These inputs are set low when the transmitter is functioning normally. If at any time either the forward (transmitted) power to the transmitter is too low, or the reverse (reflected) power is too high, the relevant input is set high. If such an alarm occurs, the CCM removes the channel from the service.

Both alarms may be set active low regardless of the input by turning on rack frame DIP switch SW2: 1, 2.

Termination of audio signals

The CCM circuitry provides a four-wire 600Ω termination for the audio signals. The levels of these signals can be adjusted to the values required for transmission via the intersite audio links.

Switching of audio signals

The switching of audio signals by the CCM depends on the nature of the call:

• no call or Rx line mute

• local call

• intersite call

• intersite group call.

Intersite group calls are calls that involve several radios registered at two or more sites. The switching functions of the CCM in each type of call are described below.

No call/Rx line mute

When there is no call the intersite audio input is looped back to the intersite audio output and to the TX line. The intersite audio loop is attenuated by 20db.

Local calls

For a local call the CCM switches to audio signal from the receiver so that it is output directly to the transmitter.

Intersite calls

For an intersite call, the CCM switches the receiver audio signal so that it is output to the node; it also switches the audio signal from the node so that it is output to the transmitter.

Intersite group calls   For an intersite group call, the CCM switches the receiver audio signal so that it is output to the node; it also adds the audio signal from the node via the intersite audio input together with the receiver audio signal and outputs them to the transmitter.

**Audio loop back
level selection**   For the situation where the CCM is not processing any call type, the audio level for the I/S loop back can be selected by LNK304. The two possible settings are:

1. 0dB loop back loss, ie no loss (LNK304 = 1,2)

2. Approximately 30dB loop back loss (LNK304 = 2,3)

(Note that **2** is the default position.)

There are six released variants of T1511 CCM hardware. The original five (PCPB 220–01431–01 to 220–01431–05) incorporate changes to address compliance and manufacturing issues. The sixth variant is modified in accordance with TN–769 to add support for the "pressel gates receiver audio" feature.

Table 4: Switching matrix for unmodified hardware (PCBs 220-01431-01 to 220-01431-05)

Call type	Input audio signal		Output audio signal
Idle	RX LINE I/S LINE	TO TO	TX LINE I/S OUT (-30dB)
Local call	RX LINE RX LINE	TO TO	I/S OUT TX LINE
Intersite call	I/S IN RX LINE	TO TO	TX LINE I/S OUT
Intersite group call	I/S IN RX LINE RX LINE	TO TO TO	TX LINE I/S OUT TX LINE

Table 5: Switching matrix for TN-769 modified hardware

Call type	Input audio signal		Output audio signal
Idle/ Rx line mute	I/S IN	TO	TX LINE
	I/S IN	TO	I/S OUT (-30dB)
Local call	RX LINE	TO	I/S OUT
	RX LINE	TO	TX LINE
Intersite call	I/S IN	TO	TX LINE
	RX LINE	TO	I/S OUT
Intersite group call	I/S IN	TO	TX LINE
	RX LINE	TO	I/SOUT
	RX LINE	TO	TX LINE

2.2 Monitoring CCM Operation with the Front Panel LEDs

LED labels

The six LEDs on the front panel of the CCM have the following colours and labels:

- "Signalling": red
- "Talk Through": red
- "Sync": yellow
- "In Service": green
- "Local Call": red
- "I/S Call": red

The indications provided by each LED are discussed below:

"Signalling" LED

The "Signalling" LED illuminates when the CCM sets the TX KEY logic output low for FFSK transmissions. The control channel transmits FFSK messages continually; the traffic channels do so only when calls are cleared down. Hence, on the control channel CCM the "Signalling" LED is permanently illuminated. On a traffic channel CCM the LED flashes briefly when a call is cleared down from the channel.

"Talk Through" LED

The "Talk Through" LED illuminates when the CCM sets the TX KEY logic output low for speech transmissions. Hence, on a traffic channel CCM the "Talk Through" LED illuminates while a call is in progress. On a control channel CCM the LED is normally off; it will only illuminate if the channel reverts temporarily to traffic channel use.

"Signalling" versus
"Talk Through"

The transmitter can transmit either FFSK messages or audio signals, but not both simultaneously. Hence, when the "Talk Through" LED is illuminated, the "Signalling" LED is off, and vice versa.

"Sync" LED

The "Sync" LED flashes at varying speeds dependant of the CCM's operating mode, as listed in Table 6.

Table 6: Sync LED functions

Operating Mode	On Rate	Off Rate	Description
Not turned on	0 ms	13515 ms	LED permanently off
No service	13515 ms	0 ms	LED permanently on
Control channel	53 ms	53 ms	Flashes very quickly
Traffic channel idle	795 ms	795 ms	Flashes slowly
Active call on channel	795 ms	53 ms	On, with a small flicker off
Traffic channel reserved	265 ms	265 ms	Flashes at a medium rate
Fallback control channel	106 ms	106 ms	Flashes quickly
Interference or stuck mute	106 ms	954 ms	Off, with a small flicker on

"In Service" LED

The "In Service" LED of a particular CCM remains illuminated so long as the channel is in service. The channel is in service so long as the SMM continues to poll the control channel and traffic channel CCMs. A traffic channel is in service so long as the CCM does not detect a fault with the receiver, transmitter or CCM, and so long as the CCM itself has not failed.

Switching and
termination
indications

The two LEDs are labelled "Local Call" and "I/S Call"; both are red. The "Local Call" LED illuminates for a local call, and the "I/S Call" LED for an intersite call; both LEDs illuminate for an intersite group call. The "I/S Rx Adjust" and "I/S Tx Adjust" potentio–meters are used to adjust the levels of the intersite audio input and output signals respectively.

2.3   Front Panel Status Display

Purpose of status
display

The status display on the front panel of the CCM is used to display the following:

• diagnostic messages during tests

• error messages when faults occur

• status messages in normal operation

Table 7: Error message displays provided by the four-digit status display

Display	Error message
UU01	Low forward transmitter power
UU02	High reverse transmitter power
UU03	Low forward and high reverse transmitter power

Error messages

If the CCM detects a fault with the receiver, transmitter or CCM, the status display provides an appropriate error message. As described earlier, the CCM monitors the following logic inputs to detect when a fault occurs:

- FWD PWR ALARM
- REV PWR ALARM

Status messages

During normal operation the status display provides four different status messages. These messages depend on whether the CCM is operating in a control channel or a traffic channel. The four messages are, in sequential order:

- CCM number
- RF channel number
- alarm error number (if an error has occurred)
- dynamic call timer (control); call time remaining (traffic)

CCM number

Each CCM at a site is identified by a CCM number. For data communications via the site bus, each CCM connected to the bus needs to have a different site-bus address. This address is called the CCM number. The CCM number is a two-digit number and is set by means of two switches inside the CCM module.

RF channel number

Each channel in a trunked radio system is identified according to its receiver and transmitter frequencies by an RF channel number. The RF channel number is a four-digit number (from 1 to 1024) and is set by means of three switches inside the CCM module.

Note: If you require an RF channel number greater than 999, you must set the channel number thousands digit to '1' (see).

| Cycling of status display | In normal operation the display cycles through the four status messages; the display is updated every second. The nature of the display depends on the version of the software installed. The features of the display are described below; example displays are given in Table 8. |

Table 8: Example displays of status messages provided by the four-digit status display

Software version	Example display	Message
Control Channel		
	. 00 01.02 (blank) 0100.	CCM number is 0 RF channel number is 102 No alarm has been detected Dynamic call time is 1 minute

| First status message | The two right most digits of the status display are used to indicate the CCM number of the first message. If necessary, a leading zero is added. |

| Second status message | With the earlier software the three right most digits indicate the RF channel number of the second message. With the later soft-ware all four digits are used. In both cases leading zeroes are added if necessary. |

| Third status message | The third status message indicates the error (alarm) condition of the channel.

A blank display means no alarm has occurred. An alarm is indicated by a "UU0x" display in the third status message. See Table 7 for possible alarm displays. |

| Fourth status message | All four digits are used for time indications in the fourth message; the first two digits indicate minutes, and the last two digits indicate seconds. In the case of an idle traffic channel a row of dashes is displayed – four dashes with the later soft-ware, but three dashes in place of the right most digits with the earlier software. |

| Indication of message number | The message number is indicated by the position of the decimal point of the display – whether with the first, second, third or fourth digit. In addition, with the earlier software the left most digit is also used to indicate the message number; however, in the case of the fourth message the message-number digit is overwritten when times are displayed. |

2.4   CCM Construction

D–range plugs   The pin connections for the D–range plugs at the back of the CCM are listed in Table 9. The two plugs mate with corresponding sockets on the pre–wired rack when the CCM is installed in the rack.

D–range plugs and RJ11 socket   The two D–range plugs at the back of the CCM mate with corresponding sockets on the pre–wired rack when the CCM is installed in the rack. The RJ11 socket is used when the channel is connected as an intersite channel. In this case a loom is connected at one end to the RJ11 socket and at the other to the relevant Krone terminal block; the loom carries the required intersite audio input and output signals.

Table 9: Pin connections for the D-range plugs of the CCM. As viewed from the outside.

Pin	Left D-range	Right D-range
1	Site bus screen	RSSI
2	Site bus true	
3	Site bus comp	REV PWR alarm
4		T800 data
5		FWD PWR alarm
6		RX FSSK
7		Negative
8		TX FSSK
9	Audio in +	+13×8 V
10	Audio in -	+13×8 V
11	Audio out +	RX gate
12	Audio out -	
13	Local call in	TX key audio
14	Intersite call in	Negative
15	CCM status in	Negative

2.5   Rack Frame Construction

This section describes the T1500-56 rack frame and the features available on it.

1. PCB based rack frame wiring solution.
2. Standard speaker/Programming port available.
3. Radio audio port provided for alignment.
4. Multiple site bus connections available.
5. Site bus fitted with self-resettable fuse
6. DIP switch based channel selection
7. DIP switch based test mode, setup selection

Site Bus Connections

Site bus connections are made via the two site bus connectors. These two connectors are in parallel with the site bus connection on the T1511-20 CCM so either or both can be used as required.

Re-settable Fuse Operation

A self resetting fuse provides power to the site bus connection. This connection is used to power the SCU. The total current draw from the site bus should not exceed 900 mA maximum. Should a fault condition occur, the fuse will go open circuit and isolate the rack frame from the fault condition. Only once the fault condition has been removed will the fuse re-set for normal operation.

Rack Power Source

Power to the T1500-56 PCB is supplied via the rack frame loom cable. This cable provides the PA and power connection.

Fan Connection

This connection point provides power for the rack mount fan. No protection is provided.

Test/setup Switches

The test/setup DIP switch has the following functions:

1. DISABLE FORWARD POWER ALARM (ON to disable alarm)
2. DISABLE REVERSE POWER ALARM (ON to disable alarm)
3. LOCAL: Puts the audio section of the CCM into local call mode. Audio is switched as if a local call has been set up. (ON to enable local audio.)
4. INTERSITE: Puts the audio section of the CCM into intersite call mode. Audio is switched as if an intersite call has been set up. (ON to enable intersite audio.)
5. TX KEY: Enables the exciter/transmitter (ON to transmit).
6. INTERSITE/-LOCAL: Sets the CCM capability to be either local or intersite capable (ON for Intersite capable).

The local, intersite and Tx Key switches should normally be OFF while the Intersite/-local I/S switch should be set according to system requirements.

Channel select switches

The channel select switch allows the operational channel of both the receiver and exciter/transmitter to be selected. This means modules can be plugged into the rack frame and operate on the channel assigned to that rack frame.

In order for the channel switch information to be passed to the micro-controller inside the radio, the T800-03-0000 Auxiliary D-range kit must be fitted to the radio.

When all switches are OFF the operational channel is controlled by the default channel setting of the T800 programming software.

PCB Release Information

Due to design updates the layout of the backplane PCB has changed over several PCB releases. The IPN (Internal Part Number) identifies the release of the PCB. The information below details the pin-outs and release information.
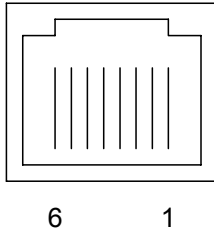
Table 10: Pin-out information

Function	Pin numbers	
	IPN 220-01433-00	IPN 220-01433-02
Tx audio	4, 5	1, 2
Rx audio	1, 2	4, 5
N/C	3, 6	3, 6

Table 11: Function settings

Part	Function	IPN 220-01433-00	IPN 220-01433-02
DIP switch 1	Channel select	SW1	SW1
DIP switch 2	Test/setup select	SW4	SW2
Site bus connector	(CN1, CN2)	CN1, CN2	CN1, CN2
FAN connector	Fan power	CN3	CN3
Audio test port	Audio interface	-	SK9
Speaker/programming port	Program interface	-	SK8

CHAPTER 3

CONFIGURATION

3.1 Setting the Software Parameters

Installation of CCM

A preliminary step to installing the CCM is the setting of various software parameters. These parameters are discussed in the following pages.

Software parameters

Before installation of the CCM, the main–processor needs to be programmed and fitted to the main PCB of the CCM. Depending on the system configuration, a certain number of these parameters might have to be changed.

Types of parameters

The values of the system parameters are stored in the main–processor FLASH.

Configuring the firmware file

There are two ways of configuring a firmware file:

1. Manually edit the firmware file by using a hex editor. The address of each parameter is contained later in this document.

Warning: If using a hex editor to modify these parameters, please note that there is no internal error checking. If an invalid value is used the system may behave unpredictably or fail in an undefined manner. Even within the allowed value range of a parameter, some values may be totally inappropriate for any system. For most parameters, the default values are adequate and need not be altered.

2. Use the CFG tool.

With each release of the MIN firmware, a configuration utility is provided that allows you to edit and view configurable parameters in the file.

The CFG tool is a simple DOS utility (can be run from windows), which allows you to select the firmware file to be edited. It then provides a simple menu of all the parameters you can configure in the software. The CFG tool will make sure the parameters you edit are in valid ranges.

To use the CFG tool you require:

a) CFG software: The DOS utility that you run to edit files. (CFG.exe)

b) Configuration file: The configuration file contains all the information required (Q1711MIN7_04.cfg) by the CFG tool to edit a particular version of firmware.

For each version of firmware, a new configuration file will be released.

Configuration files have a .cfg extension, and must be placed in the same directory as the CFG tool.

c) Firmware file: This is the firmware file you wish to edit (eg: Q1711MIN7.05). You may name this file anything you like, as the CFG tool will check the internal values of the file to see if it can be edited. It does not have to be the release name, eg: site_chch_1_min.bin (instead of Q1711MIN7.05).

3.2   System Parameters

Introduction   The system parameters are applicable to the main processor. There are two types of system parameter; general parameters and fallback parameters. They are defined in turn in the sections below.

The address and default value of each parameter are given in Table 12 and Table 13.

Table 12: CCM General Parameters

Parameter	Address	Default
Codeword synchronisation sequences		
SYNC	$8089	$C4D7
SYNT	$808B	$3B28
Channel number thousands digit	$808E	$00
Number of disable transmission messages to send	$808F	$02
Number of CLEAR messages to send	$8090	$02

Table 13: CCM Fallback Parameters

Parameter	Address	Default
Fallback mode	$8091	$02
System Identity Code	$80C4	$0000
Numbering mode	$8092	$00
CPSx L parameter	$8093	$0A
CPSx M parameter	$8094	$0A
CPSx S parameter	$8095	$0A
ANN default MEP	$8096	
ANN default FPP	$8097	
ANN alternative table	$8098	
SIL3 Enabled	$80C6	$00
SIL Length	$80C7	$00
CWID String	$80AF	$53

Table 13: CCM Fallback Parameters

Parameter	Address	Default
CWID Interval	$80C3	$00
Static Frame Length	$80C8	$0A
Call Mode	$80C9	$00

3.3   General Parameters

Codeword synchronisation sequences

Definition

For messages transmitted on control and traffic channels, codeword synchronisation sequences called respectively SYNC and SYNT are transmitted. These sequences enable decoders to establish codeword framing. Also, the SYNC parameter indicates to radios that the channel is a control channel, and the SYNT parameter indicates a traffic channel. The parameter values are determined as defined in the MPT1327 document.

Parameter values

Two control bytes are reserved for each of the control channel and traffic channel codeword synchronisation sequences. The default values are:

- SYNC: $C4D7
- SYNT: $3B28

Note: For systems in use in France the values must be altered as follows:
SYNC: $B433
SYNT: $4BCC

In the SYNC parameter, $C4 is the value of the first byte, and $D7 the value of the second. In the SYNT parameter, $3B is the value of the first byte, and $28 the value of the second. Certain networks may require these defaults to be changed. In such a case, refer to the definitions in the MPT1327 document.

Parameter addresses

SYNC: $8089

SYNT: $808B

Channel number thousands digits

Definition	The decade rotary switches on the hardware can set only the hundreds, tens and unit digits of the channel number. The thousands digit cannot be set. This is a way of allowing this value to be set.
Parameter value	By default this is set to $00. Valid values are in the range $00 to $01.
Parameter address	Channel number thousands digit: $808E

Number of Disable Transmission Messages to Send

Definition	For broadcast group calls, a traffic channel must send a disable transmit MAINT message at the start of a call to stop called parties from transmitting.
Parameter value	Any value between $00 (0) and $FF (255) can be specified. The default is $02.
Parameter address	Number of disable transmission messages to send: $808F

Number of CLEAR Messages to Send

Definition	At the end of a call, the system transmits call clear messages to all receiving radios involved in the call. The effect is to move the radios from the traffic channel back to the control channel. The value of this parameter determines the number of clear messages transmitted. (Multiple CLEAR messages are sent to increase the likelihood that the radios will hear them.)
Parameter values	Any value between $00 (0) and $FF (255) can be specified. The default is $02.
Parameter address	Number of CLEAR messages to send: $8090

3.4   Fallback Parameters

The fallback parameters are only used during fallback mode. During normal operation they are downloaded from the SMM.

Fallback Mode

Definition

In version 7 Site software, the SMM performs all the control processing of call setups and traffic allocation. In the unlikely event where the SMM has a failure where it can no longer control the site, a CCM can be configured to take over this call control, by entering one of three different fallback modes.

The CCM will enter fallback mode if it loses contact with the SMM for over 10 seconds.

The fallback modes are:

- Off line

  The channel will become off line, and will not be used for calls.

- Conventional (default)

  The channel will become a conventional repeater. Anything received by the channel will be transmitted. The transmitter will only be turned on when it detects a signal.

- MPT Controller

  The channel will attempt to take over control of the site and start setting up calls. Unlike the other fallback modes, the site will still basically be running as a working MPT trunking system, although with some limitations.

In both conventional and MPT controller mode, a short 3 beep tone will be emitted every 30 seconds to indicate that the site is running in fallback mode.

Off line and conventional modes are fairly self–explanatory. If more information on these is required, please contact Tait.

MPT Controller Mode

When running as the MPT fallback controller, the site will work as follows:

- If several CCMs are configured for fallback mode, then the lowest channel will take control.
- Temporary registration mode is entered, which allows any radio at all to register on the site.
- It will have a default framelength of 10 slots.

- It will allocate speech calls to all traffic channels. Speech calls will have a maximum call time of 60 seconds, with 10 second inactivity and call answer timeouts, and 30 seconds stuck mute timeout.

- Traffic channels with fault conditions will be disabled from being used.

- If the control channel has a fault, it will pass control to another CCM.

Note: The default system identity code must be set in the eprom, otherwise radios will not be able to use the site.

Call types supported:

- Speech and NPD calls
- Group calls – includes broadcast calls, but not repeat GTC group calls
- Status, SST and MST messages
- Interprefix calls
- ALLI calls
- CPSx numbering is available, but requires the default eprom parameters to be set

The following features are not supported cause, in fallback mode, node communications are lost:

- No call queuing, ie:
    - If the called radio is busy in a call, then the status will be 'engaged'
    - If there are no free channels, then the status will be 'system busy'
- No radio validations – any radio registered on the site is allowed to make any call type available (ie, speech, SST, MST, status, group calls)
- No phone calls
- No intersite calls
- No network operator calls
- No emergency pre-emption of calls or channels – all emergency calls, and high priority calls, are treated as normal speech calls
- No full off air call setup (FOACSU)
- No billing records will be recorded for calls while in fallback mode.

Parameter values

For off line mode, set to $00.

For MPT controller mode, set to $01.

For conventional mode, set to $02.

By default, this feature is set to $02, conventional mode. Values from $03 to $FF are invalid.

Parameter address   Fallback mode: $8091

System Identity Code

Definition   The system identity code is transmitted by the control channel at a site principally in order to identify the site to radios registered on the system.

This parameter is normally overridden by the system identity code set in the Site Management Module. Change this parameter only if the fallback mode parameter is enabled. If the module enters fallback mode, it will use this parameter rather than the one set in the Site Management Module.

Please refer to Technical Note TN-599 if more information is required about system identity codes.

Parameter address   System identity code: $80C4

Numbering Mode

Definition   There are three numbering modes available:

- MPT 1327/MPT 1343
- CPSx
- ANN

Note: The numbering parameters are downloaded from the SMM under normal system operation. The numbering parameters entered here are only used when the CCM is in fallback mode.

Parameter values   The default numbering mode parameter value is $00 (MPT 1327/MPT 1343). Valid values are $00, $01(CPSx), or $03 (ANN).

CPSx   CPSx is a special version of the MPT 1343 numbering system that allows the group and individual numbers to be different from a standard system. CPSx numbering has three additional parameters to set:

- CPSx L parameter
- CPSx M parameter

• CPSx S parameter

You can select CPSx addressing with the numbering mode parameter. The other three parameters allow you to set up the size and number of fleets in each prefix range.

The L M S parameters determine how many large, medium. small. and tiny fleets there are in the system. These are set according to the CPSx MPT 1343 specifications. Valid values are between $00 and $0A, with $L \leq M \leq S$.

For example, if L = $02, M = $05, and S = $08 there will be:

(L – 0) x 1 = 2 Large fleets (810 idents each)

(M – L) x 2 = 6 Medium fleets (405 idents each)

(S – M) x 3 = 9 Small fleets (270 idents each)

(10 – S) x 6 = 12 Tiny fleets (135 idents each)

The default for all three values is $0A (ie, 10 large fleets, no smaller fleets).

ANN

ANN is a new type of numbering mode, and requires settings for FPP and MEP (in the same way that CPSx mode requires CPSx L, M, S).

FPP (Fleet Partition Parameter) and MEP (Miniaturisation Extent Parameter) divide the network into large, medium and small fleets, having up to 700, 70 and 22 subscribers each, respectively.

Up to 7 prefixes can be entered in the Alternative FPP/MEP table as non–default values. A prefix value of 255 indicates that the entry is not used. The default values of FPP and MEP (usually 10 and 0 respectively) are used whenever there is no matching entry in the Alternative FPP/MEP Table for that prefix.

Table 14 shows a typical ANN Alternative FPP/MEP table.

Table 14: ANN Alternative FPP/MEP Table

Entry	Prefix	MEP	FPP
1	1	1	5
2	36	0	0
3	37	0	0
4	38	10	0
5	39	10	0
6	80	1	5
7	255	0	0

Parameter addresses   Numbering mode: $8092

CPSx L parameter: $8093

CPSx M parameter: $8094

CPSx S parameter: $8095

ANN default MEP: $8096

ANN default FPP: $8097

ANN alternative FPP/MEP table: $8098

SIL3 Enabled

Definition   When enabled, the 3 least significant bits of the SIL subfield are used in MAINT and CLEAR messages sent to radios on a traffic channel. Radios use these 3 bits to determine whether the message they have received is from 'their' traffic channel and not a traffic channel from a nearby site that is using the same frequency. Enabling this parameter therefore allows greater re-use of traffic channels between adjacent sites.

To determine which bits of the SIL to use when SIL3 is enabled, the SIL Length parameter must also be set.

Parameter values   To enable this parameter it should be set to $FF. To disable this parameter it should be set to $00. The default setting is $00. Values from $01 to $FE are invalid.

Parameter address   SIL3 enabled: $80C6

SIL Length

Definition   The SIL subfield is related to the NDD field in the system identity code (see Technical Note TN-599). It is almost always the same length as the NDD field (ie. 4 for a regional network or 9 for a national network), but it can be shorter. If you need to change this parameter for a particular site, then the value you require will be supplied to you by a senior Tait engineer.

Note: The SIL length must also be programmed into the radios.

Parameter values   This is the length of the SIL field.

Minimum value = $03

Maximum value = $04 for a regional network

Maximum value = $09 for a national network

Default = $00 which means use maximum values

$01, $02 and values greater than $09 must not be used.

Parameter addresses   SIL length: $80C7

CWID String

Definition   While in fallback mode, the channels will periodically send out a short sequence of beeps indicating that the site is running in fallback mode. This sequence is actually a CWID morse code message, and it can be configured to send a different message.

The interval between the messages being sent are set with the CWID Interval parameter.

Parameter values   A maximum of 19 characters (numbers, letters and spaces) can be entered. The last character entered **must** be a full stop. If the character string is blank, no beeps will be sent. The default value is $53, which means that a single "dot–dot–dot" will be sent.

Parameter address   CWID String: $80AF

CWID Interval

Definition   This is the interval, in seconds, between each CWID String message being sent.

Parameter value   Any value between $00 and $FF may be specified. The default value is $14 (20), which means that CWID messages will be sent every 20 seconds.

Parameter address   CWID Interval: $80C3

Static Frame Length

Definition   During fallback mode, a static frame length is always used. This parameter defines the number of slots (106 ms) that will be in each frame.

Parameter value   The values used to enter the static frame length parameters are "aloha numbers", which are interpreted as follows:

$01 to $0A – represents the number of slots in each frame (1 to 10)

$0B to $0F – represents increasingly larger numbers of slots per frame: $0B = 12 slots, $0C = 15 slots, $0D = 19 slots, $0E = 25 slots and $0F = 32 slots

Values greater than $0F must not be used. The default value is
$0A.

Parameter address Static Frame Length: $80C8

Call Mode

Definition During fallback mode, using pressel messages to detect activity
and inactivity can still be enabled.

- Pressel resets inactivity

  A call will normally timeout and clear down if no activity is
  detected on the channel audio line for a specified period. The
  pressel message resets inactivity timer can be used if a channel
  is often subject to interference that would otherwise prevent a
  channel from timing out due to inactivity. With this feature
  enabled, PTT on/off messages and MAINT messages are used
  to detect activity. (**Note:** some Non–MPT compliant radios
  may not send periodic MAINT messages while transmitting,
  causing a call to timeout prematurely.)

- Pressel gates receiver

  With this feature enabled the base station talk-through path is
  controlled by PTT on/off messages from the radio. This means
  that the system audio path is muted between 'overs'. Enabling
  this feature prevents channel interference from being heard
  between 'overs'. This can be useful on channels with heavy
  interference.

Parameter values The call mode byte is a bit field parameter, where setting a bit to
1 means enabling the parameter. Call mode has the following bits:

Field	Least significant bit number
Pressel resets inactivity	1
Pressel gates receiver	3

The default value is $00.

Parameter address Call Mode: $80C9

CHAPTER 4

INSTALLATION AND TESTING

4.1 Introduction

This chapter describes the procedures for installing and adjusting CCM parameters that could require changes depending on the service requirements of your TaitNet system.

Test equipment

An RF communications test set (HP8920A) is required for these procedures. The HP8920A test set is used to:

* measure the RF transmitter's frequency deviation
* apply an RF standard test signal to the RF receiver and measure the FM receiver's audio output
* apply an audio standard test tone to a CCM's intersite input port and measure the audio output at the intersite output port

Caution: Adjustment procedures must be carried out by properly trained personnel. Failure to make the adjustments correctly using the correct test equipment will result in less than optimum system performance. The correct termination techniques for applying and measuring both audio and RF frequencies are particularly important.

4.2 Setting the intersite line interface (ILI)

The CCM determines the local/intersite capabilities of the channel from the CCM STATUS logic input. If the channel is installed as a local traffic channel, the input is set permanently off. If the channel is installed as an intersite channel, the STATUS input is set on. In other words, in normal operation, traffic channel CCMs assume the following:

* CCM STATUS is set off: channel is local traffic channel
* CCM STATUS is set on: channel is intersite traffic channel

When polled by the SMM, a traffic channel CCM will indicate whether the channel is a local or an intersite channel.

This is set with the rack frame DIP switch SW2: 8.

4.3 Installation Checks

Setting the CCM number

Procedure

1 Remove the cover of the T1511 CCM to expose each PCB unit (each CCM can have up to four PCB's).

2 Use the BCD switches SW101 and SW102 to set the CCM number on each PCB unit. Valid settings for the switches are in the range 00 to 90. The numbers from 00 to 23 are reserved for CCM numbers, whilst the other numbers (24 to 99) are used for special testing functions.

3 The PCB unit set to the lowest number will automatically become the control channel. The number for each subsequent traffic channel should be incremented by 1.

Note: CCM's at different sites can have the same numbers, but the CCM's at the same site must have different numbers.

Setting the RF channel number

For each channel, the RF receiver and transmitter are tuned to a pair of receive–transmit frequencies which can vary depending on the RF band plan of the TaitNet system. Each frequency pair constitutes an RF channel and is assigned a unique RF channel number.

Procedure

1 Use the BCD switches SW103, SW104 and SW105 to set the RF channel number for the CCM on each PCB unit. All settings from 001 to 999 are valid.

2 If you are replacing a CCM, you must set the switches to the same setting as the previously removed CCM.

Note: If you require an RF channel number greater than 999, you must set the channel number thousands digit to '1' (see page 25).

Checking the Jumper and DIP switch settings on the PCB's

The settings in Table 15 are the default settings for the Jumper and DIP switches that each PCB should be set to after factory testing.

Table 15: Default Jumper and DIP switch settings on CCM PCB's

Jumper / DIP switch	Setting	Description
PRE-EMP jumper	Pins 2-3	Pre-Emphasis for FFSK RX ON
DE-EMP jumper	Pins 1-2	De-Emphasis for FFSK TX OFF
FWDPWR jumper	Pins 1-2	
REVPWR jumper	Pins 1-2	
C-B IN jumper	Pins 1-2	
DIP SW300	OFF	All set to OFF

Rack wiring

CCM to T800 base station

A cable with two 15-pin D-range plugs is used to connect the CCM to the either the SK6 or SK7 15-pin D-range female connector on the T800-56-0000 PCB, which is fitted in theT800-56-7000 rack.

CCM to SMM

A cable with two RJ11 plugs is used to connect the CCM site bus to the SMM.

Intersite traffic channels to DAS

If a CCM is set for an intersite traffic channel, the cable with one RJ45 is used to link to a port card in the DAS.

BCD Switch settings for test modes

Table 16 shows the BCD switch settings for SW101 and SW102 for the various test modes available.

Table 16: BCD Switches SW101 and SW102 - settings for test modes

Test mode	SW101 and SW102 setting
Local audio tests	90
Intersite audio tests	91
Local and intersite audio tests	92

Table 16: BCD Switches SW101 and SW102 - settings for test modes

Test mode	SW101 and SW102 setting
Continuous preamble tests	96

Alarm status

There are three types of system error that can result in an alarm status error. They are:

- Low forward power
- High reverse power
- Forward power and reverse power

All of these errors can be simulated in the following way:

1 Connect the CCM to the SMM and power up the equipment.

2 Low forward power – switch on pin 1 of DIP SW2 on the T800–56 rack PCB

3 High reverse power – switch on pin 2 of DIP SW2 on the T800–56 rack PCB

4 Forward power and reverse power – switch on pin 3 of DIP SW2 on the T800-56 rack PCB.

5 If the low forward power alarm occurs, the CMM will not be withdrawn from service. This is because the low forward power alarm is considered to be a minor alarm. The alarm will still be reported to the SMM, and displayed on the NMT.

6 The high reverse power and forward power/reverse power alarms will cause the CMM to be withdrawn from service. The Sync LED will stay on permanently, and an alarm will be displayed on the NMT, should these alarms occur.

7 After performing the above tests, power down the CMM, replace all related DIP switches to their original settings, and power up again.

4.4 Check and set the FFSK output levels

Set the FFSK output level by means of the adjustable resistor FFSK OUT on each PCB.

Procedure

1 Turn off the CCM power supply.

2 Disconnect the antenna cable from the RF output of the transmitter at the rear of the prewired rack.

3   To measure the RF output signal of the transmitter, connect the RF output of the transmitter to the HP8920A test set "RF IN/OUT" connector.

4   Disconnect the antenna cable from the RF input of the receiver at the rear of the prewired rack.

5   The standard RF input test signal is generated from the HP8920A test set. Connect the HP8920A test set "DUPLEX OUT" connector to the RF input of the receiver.

6   Turn on the power supply and set the BCD switches SW101 and SW102 to 96.

7   Press the TX key on the HP8920A test set to display the TX TEST screen for testing the transmitter

8   The FM deviation and modulating frequency is measured and monitored by the HP8920A test set, which is set to Tx frequency. Adjust the FFSK OUT potentiometer until the correct transmitter output deviation is reached. This will be a peak of 1.5kHz for a narrow-band and 3kHz for a wide-band system.

9   Disconnect the HP8920A test set, and reconnect the antenna cable to the RF output of the transmitter.

4.5   Check and set the local audio levels

Adjusting the RF receiver audio level

A standard RF input test signal is produced from the HP8920A test set. This signal must be:

• the same frequency as the working frequency of the receiver

• at a level of –70dBm

• modulated by 1kHz tone

• the FM deviation should be 1.5kHz for a narrow–band and 3kHz for a wide-band system

On the T800-56-0000 rack PCB, there are two 15-pin D-range female connectors SK6 and SK7. One of them is used to connect to the CCM. The other one is spare and can be used for the test lead connection to the test point.

Procedure

1   Using a test lead, connect it to pin 1 (RX LINE +) and pin 2 (RX LINE –) of SK6 or SK7, and connect the receiver output to the HP8920A test set "AUDIO IN" connector.

2   Press the RX key on the HP8920A test set to display the RX TEST screen for testing the receiver

3   Set the HP8920A test set to produce the RF standard test tone signal to the RF receiver.

4 Set the HP8920A test set "Ext load impedance" as 600 Ohm.

Note: In this test case, where the CCM audio input port with 600 Ohm is connected to the receiver output port, the HP8920A test set simply needs to be plugged in at high impedance. It does not need be terminated by another extra 600 Ohm impedance load on the HP8920A test set "AUDIO IN" connector.

5 Measure the receiver output line level and adjust the receiver's "Line Level". Set the output level as –10 dBm (at 1 kHz). This corresponds to the system deviation level found on the factory test sheet (the default level used by Tait Electronics Ltd).

Checking the RF transmitter audio input level

To check the RF transmitter audio input level, the FM deviation of the RF transmitter is measured.

Test mode setting

Set BCD switches SW101 & SW102 to 90 (local audio level check mode).

Procedure

1 Turn off CCM power, and then turn on again.

2 Press the DUPLEX key on the HP8920A test set to display the DUPLEX TEST screen for simultaneous testing of both the transmitter and the receiver.

3 Using a test lead, connect pin 1 and pin 2 of the SK6 or SK7, and connect the CCM local line input port (the RF receiver output) to the HP8920A test set "AUDIO OUT" connector.

4 Set the HP8920A test set to produce the standard audio test tone (–10 dBm at 1 kHz) at its "AUDIO OUT" connector.

5 Set the HP8920A test set to measure the FM deviation and modulating frequency by selecting the "AF ANL IN" field as "FM Demod" (ie for FM demodulated audio from input signals connected to the HP8920A test set "RF IN/OUT" connectors), and selecting the "Detector" field as "Pk+-/2".

6 Measure and check the transmitter output deviation. Adjust the transmitter's "Line Sensitivity" until the correct deviation is reached. This will be 1.5kHz for a narrow-band and 3kHz for a wide-band system.

Note: The T1511 CCM local line output level cannot be adjusted.

4.6   Check and set intersite audio levels

Test mode setting   Set BCD switches SW101 & SW102 to 91 (intersite audio level check mode).

Checking and setting the intersite audio levels is done in two parts:

- Apply a test tone on the intersite line input port, and check and set the correct audio level at the local line output port by means of measuring the RF transmitter output deviation

- Apply a test tone on the local line input port, and check and set the correct audio level at the intersite line output port.

For more details, see the following procedures.

Apply a test tone on the intersite line input port, adjust ISIN, and ensure that the correct transmitter output deviation is reached

Procedure   1   Press the DUPLEX key on the HP8920A test set to display the DUPLEX TEST screen for simultaneous testing of both the transmitter and the receiver.

2   Set the HP8920A test set to produce the standard audio test tone (–10 dBm at 1 kHz) at its "AUDIO OUT" connector.

3   Using a test lead, connect line 4 (RX+) and line 5 (RX–) of the RJ45 cable, and connect the CCM intersite line input to the HP8920A test set "AUDIO OUT" connector.

4   Set the HP8920A test set to measure FM deviation and modulating frequency by selecting the "AF ANL IN" field as "FM Demod" (ie for FM demodulated audio from input signals connected to the HP8920A test set "RF IN/OUT" connectors), and selecting the "Detector" field as "Pk+-/2".

5   Adjust the ISIN potentiometer, and measure and check if the correct transmitter output deviation is reached. This will be 1.5kHz for a narrow–band and 3kHz for a wide–band system.

Apply a test tone on the local line input port, adjust ISOUT, and check the intersite line output

Procedure

1 Apply the standard test tone generated from the HP8920A test set "AUDIO OUT" connector to the CCM local line input. In other words, using a test lead, connect the HP8920A test set "AUDIO OUT" connector to the CCM local line input port (actually the same as the RF receiver output) at pin 1 (RX LINE+) and pin 2 (RX LINE–) of the SK6 or SK7.

2 Using a test lead, connect line 7 (TX+) and line 8 (TX–) of the RJ45 intersite link cable, and connect the CCM intersite line output to the HP8920A test set "AUDIO IN" connector.

Note: Ensure there is no real DAS link connection, ie, that there is no load on the intersite output port. The HP8920A test set has to plug in with the correct load (terminated with 600 Ohm).

3 Set the HP8920A test set by selecting the "AF ANL IN" field as "Audio In" (ie, to measure the audio signal to the HP8920A test set "AUDIO IN" connector), and selecting the "Detector" field as "RMS".

4 Measure the CCM intersite line output. Adjust the ISOUT potentiometer, and check that the intersite line output signal range is adjustable over the ranges –20 to 0 dBm, and then set the output level as –10 dBm (at 1 kHz).

CHAPTER 5

REGULATORY INFORMATION

5.1 Canada

This product meets:

- Industry Canada Digital Apparatus requirement ICES-003 (radiated and conducted emissions, and electromagnetic susceptibility specifications) for a Class A digital apparatus.
- Industry Canada Terminal Equipment requirement CS-03, Certification number 737 9543 A.

5.2 United States of America

This product complies with the following standards:

- Part 15 Class A of 47CFR: Federal Communications Commission (FCC) rules for the United States relating to radiated and conducted emissions, and electromagnetic susceptibility.

  Operation is subject to the following two conditions:

  1 This device may not cause harmful interference, and

  2 This device must not accept any interference received, including interference that may cause undesired operation.

- Part 68 of 47CFR: Federal Communications Commission (FCC) rules for the United States relating to the connection of terminal equipment to the telephone network.

5.3 Europe

This product complies with the following standards:

- CTR/TBR 17: Requirements for terminal equipment interface, 4-wire.
- EN 55022: Limits and methods of measurement of radio interference characteristics of information technology equipment.

- EN 50082-1: Electromagnetic compatibility – Generic emission standard Part 1: Residential, commercial and light industry.
- EN 60950 & A1–A4: Electrical Safety of Information Technology equipment.

5.4   New Zealand

This product complies with the following standards:

- EN 60950 & A1–A4: Electrical Safety of Information Technology equipment.
- PTC 200: Requirements for devices intended for connection to the Telecom analogue Public Switched Telephone Network (PSTN).

General Warning

"The grant of a Telepermit for any item of terminal equipment indicates only that Telecom has accepted that the item complies with minimum conditions for connection to its network. It indicates no endorsement of the product by Telecom, nor does it provide any sort of warranty. Above all, it provides no assurance that any item will work correctly in all respects with another item of Telepermitted equipment of a different make or model, nor does it imply that any product is compatible with all of Telecom's network services."

5.5   Australia

This product complies with the following standards:

- ACA TS 006: General Requirements for Customer Equipment Connected to the Non-switched Telephone Network.
- EN 60950 & A1–A4: Electrical Safety of Information Technology equipment.

5.6   Hong Kong

This product complies with the following standards:

- EN 60950 & A1–A4: Electrical Safety of Information Technology equipment.
- HKTA 2011: Connection of customer premises equipment to the Public Switched Telephone Network.

5.7   Singapore

This product complies with:

- EN 60950 & A1–A4: Electrical Safety of Information Technology equipment.
- TAS TS PSTN 1: Type Approval Specification for connection of Terminal Equipment to the Public Switched Telephone Network.

5.8   Other

Use of LBUs

In certain installations the intersite links for each intersite channel must be connected via an LBU (line barrier unit) to the Krone terminal block. This applies in countries where the CCM is not type approved for connection to the leased direct circuits of the telecommunications network. The LBUs must conform to the requirements of the provider of the leased direct circuits.