

TM8100 mobiles
TM8200 mobiles

Computer-Controlled Data Interface (CCDI) Protocol Manual



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Preface

Scope of Manual

This manual contains reference information about the CCDI and CCR protocols for the TM8100 and TM8200 mobiles. It applies to CCDI version 3.00 and later and CCR version 2.00.

Associated Documentation

Technical notes are published from time to time to describe applications for Tait products, to provide technical details not included in manuals, and to offer solutions for any problems that arise.¹

- Technical Note TN-855-AN: TM8000 and TB7100 Data Modem Facilities
- Technical Note TN-919-AN: Configuring the TM8100 for Data Operation
- Technical Note TN-1075-AN: MAP27 Implementation Form (Appendix A7)

Publication Record

Issue	Publication Date	Description
1	March 2006	First issue
2	April 2007	<ul style="list-style-type: none">■ Description of CCDI command prompt (TIMS 38465)■ QUERY command 7 (display) added (TIMS 59393)■ FUNCTION command 0 (functions), subfunction 4, qualifiers 2 and 3 (keypress progress message) added (TIMS 59393)■ FUNCTION command 0 (functions), subfunction 5, qualifiers 0, 1, and 2 (channel progress message) added (TIMS 59393)■ TDMA command added (TIMS 59393)■ PROGRESS message types 22 and 23 added (TIMS 59393)■ QUERY_DISPLAY_RESPONSE message added (TIMS 59393)■ TDMA_DATA message added (TIMS 59393)■ CCR section added (TIMS 57777)

1. Technical notes are available in PDF format from the Tait support website. Consult your nearest Tait Dealer or Customer Service Organization for more information.

Alert Notices

Within this manual, four types of alerts are given to the reader: warning, caution, important and note. The following paragraphs illustrate each type of alert and its associated symbol.



Warning!! This alert is used when there is a potential risk of death or serious injury.



Caution This alert is used when there is the risk of minor or moderate injury to people.



Important This alert is used to warn about the risk of equipment damage or malfunction.



Note This alert is used to highlight information that is required to ensure that procedures are performed correctly.

Abbreviations

Abbreviation	Description
ASCII	American Standard Code for Information Interchange
AVL	Automatic Vehicle Location
CCDI	Computer Controlled Data Interface
CCR	Computer Controlled Radio
CDP	Conventional Data Protocol. A Tait over-air protocol.
CRC	Cyclic Redundancy Check
CTCSS	Continuous Tone Coded Squelch System
CTS	Clear to Send
DCE	Data Circuit-Terminating Equipment
DCS	Data Carrier System
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency
FFSK	Fast Frequency Shift Keying
GFI	General Format Information for an SDM
GPIO	General Purpose Input/Output
IPN	Internal Part Number
LED	Light-Emitting Diode
MSD	Most Significant Digit
NMEA	National Marine Electronics Association standard. Combined electrical and data specification for communication between marine electronics and GPS receivers.
PC	Personal Computer
PTT	Press To Talk

Abbreviation	Description
RMC	Recommended Minimum sentence C. NMEA GPS message type for the minimum recommended transmit/GPS data.
RTS	Request to Send (ready to receive)
Rx	Receive
RXD	Receive Data
SDM	Short Data Message
SFI	Specific Format Information for an SDM
THSD	Tait High Speed Data
TIA	Telecommunications Industry Association
TOP	Tait Orca Portable
Tx	Transmit
TXD	Transmit Data
UART	Universal Asynchronous Receiver-Transmitter
XON	Transmitter On
XOFF	Transmitter Off

1 CCDI

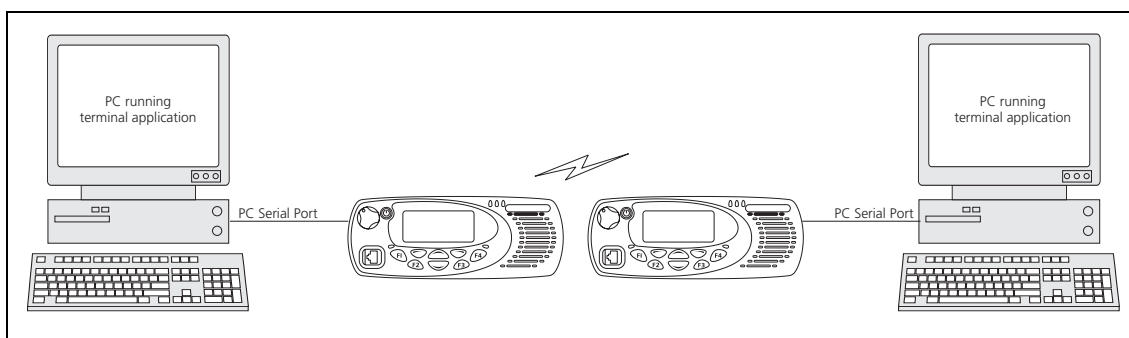
The Computer Controlled Data Interface (CCDI) protocol is a Tait proprietary command protocol embedded in the TM8100 and TM8200 radios, and used for communicating with the radio via asynchronous serial ports and over-air.

The radio is the DCE and is connected directly to the DTE, usually a PC, via the serial port.

Two modes of operation are available:

- Command mode
- Transparent mode

Figure 1.1 Modes of operation



When in Command mode, commands and response messages are passed between the PC and the radio using the CCDI protocol. CCDI commands can also be used to obtain GPS data and NMEA messages from the radio. Refer to [“QUERY”](#) and [“SEND_ADAPTABLE_SDM”](#). The baud rate is set to 1200, 2400, 4800, 9600, 14400, 19200, 28800 or 115200 (TM8200 only) baud, using the programming application.

When in Transparent mode, communication between the PC and the radio is set to 1200, 2400, 4800, 9600, 14400, 19200, 28800 or 115200 (TM8200 only) baud, using the programming application.

The over-air data rate is 1200 or 2400 bit/s for FFSK data, 12 kbit/s for Tait High Speed Data (THSD) narrow band and wide band, and can be set to 19200 bit/s for THSD wide band.

1.1 Compatibility

This manual describes CCDI version 3.00 and later.

The radio programming application used should be the latest released version for both the TM8100 and TM8200 radios. Refer to the TaitWorld website <http://www.taitworld.com> for the latest versions of programming application.

1.2 Serial Ports

Three ports are available for CCDI asynchronous serial communication with the radio. The microphone and auxiliary ports are accessed externally, and the internal options connector is internal to the radio.

Only one of these ports can be used for CCDI transmission and reception at any time. The port is selected in the Data form of the programming application, Serial Communications tab. Select “Mic”, “Aux” or “Internal Connector”.

- Mic: The radio will transmit and receive data via the MIC_TXD and MIC_RXD lines on the microphone connector.
- Aux: The radio will transmit and receive data via the AUX_TXD and AUX_RXD lines on the auxiliary connector.
- Internal Connector: The radio will transmit and receive data via the IOP_TXD and IOP_RXD lines on the internal options connector. This connector is used to fit an internal options board into the radio.

For more information on these connectors, refer to the service manual.

1.2.1 Data Characteristics

Parameter	Standard				Comments
	min.	typ.	max.	units	
Serial port					
Baud rate:	1200, 2400, 4800, 9600, 14400, 19200, 28800, 115200			bit/s	All UART parameters are fixed and common to all UARTs except for the baud rate which is configurable and different for different modes/applications
Data bits:	8				
Start bit:	1				
Stop bit:	1				
Parity:	None				
Flow control: Software Hardware	XON/XOFF RTS/CTS				Requires two GPIO lines to be programmed as flow control

1.2.2 Logic Level Compatibility

The following table show the compatibility of the radio's digital I/O used for CCDI with common industry logic standards.

Digital Input Compatibility and Tolerance

Digital Input Line	Logic standard input compatibility and tolerance			
	3.3V CMOS	5V CMOS	5V TTL	RS-232
AUX_RXD	Yes	Yes	Yes	Yes
IOP_RXD	Yes	Yes	Yes	No ^a
CH_RXD MIC_RXD PRG_RXD	Yes	Yes	Yes	Yes

a. Level compatible but not tolerant. Inputs can be made RS-232 tolerant by using 3.3k Ω series resistance inserted at the radio end.

Digital Output Compatibility

Digital Output Line	Logic standard input compatibility and tolerance			
	3.3V CMOS	5V CMOS	5V TTL	RS-232
AUX_TXD	Yes	No	Yes	No
IOP_TXD	Yes	No ^a	Yes	No
CH_TXD MIC_TXD PRG_TXD	Yes	No	Yes	No

a. These outputs can be made 5V CMOS compatible using a 3.3k Ω pull-up resistor to 5V that is provided by the device being driven.

1.2.3 GPS Port

The GPS receiver/antenna is also connected to an asynchronous serial port and must be different to the CCDI UART Port. The GPS receiver/antenna is set in the Data form of the programming application, GPS tab, and can be set to Mic, Aux or Internal Options.

If set to Aux, the GPS receiver will send NMEA messages to the radio via the AUX_RXD line on the auxiliary connector.

If set to Internal Options, the GPS receiver will send NMEA messages to the radio via the IOP_RXD line on the internal options connector.

1.2.4 MAP27 Port

MAP27 data transmission and reception also requires an asynchronous serial port and must be different to the CCDI UART Port. The MAP27 port is set in the Data form of the programming application, MAP27 tab, and can be set to Mic, Aux or Internal Options.

If set to Mic, the radio will use the MIC_TXD and MIC_RXD lines on the microphone connector.

If set to Aux, the radio will use the AUX_TXD and AUX_RXD lines on the auxiliary connector.

If set to Internal Options, the radio will use the IOP_TXD and IOP_RXD lines on the internal options connector.

For more information on MAP27 data transmission, refer to Technical Note TN-1075-AN, MAP27 Implementation Form (Appendix A7).

1.3 Before Operating

Before using CCDI, the following is useful to check.

- The radio must be correctly programmed for use with the CCDI protocol. See [“Programming” on page 14](#) for configuration information.
- At power on, the radio will select its default channel. To change the channel, select the channel using the normal radio interface or using the CCDI Go_To_Channel command. Refer to [“GO_TO_CHANNEL” on page 29](#).
- The radio will power on into the mode selected in the ‘Powerup State’ field in the Data form.
- Power, Tx and Rx LED indicators are helpful for establishing proper operation. The radio speaker can be used to listen to data coming in.
- Data flow is controlled either by the customer’s embedded computer system or by a PC running a data-sending application such as Hyperterminal.

1.4 Limitations



Important

Some data applications require extended transmission times. This may be for larger file transfers or for real-time telemetry information. This may put undue stress on the radio transmitter and care must be taken to control transmission times using flow control. Refer to [“Hardware Flow Control” on page 15](#).

1.5 Programming

For information on the parameters in the Data form of the programming application, refer to:

- the Help of the programming application
- Technical Note TN-919-AN Configuring the TM8100 for Data Operation.

1.6 CCDI Flow Control

Flow control is a method of controlling the data so that a faster DTE-DCE baud rate can be used to that of the over the air baud rate. This allows the radio (DCE) to inform the DTE that its buffer is becoming full and that the DTE needs to wait before sending more data to the radio.

Flow control should only be needed when the amount of data to send is larger than the radios buffer (512 bytes for TM8100, 600 bytes for TM8200).



Note Some older versions of the firmware have a buffer size of 128 bytes.

Available options: None, Hardware Software

1.6.1 XON/XOFF Software Flow Control

When the serial communications are set-up for software flow control, the radio will use pre-programmed bytes for XOFF and XON.



Important When using XON/XOFF software handshaking, the data stream (or the data file) must not include the programmed XON and XOFF characters. It is recommended that only ASCII text be used with software flow control.

The XOFF character is sent when there is less than 35 bytes of empty space in the buffer.

The XON character is sent when XOFF had previously been sent and there is now less than 10 bytes of data in the buffer.

1.6.2 Hardware Flow Control

When the serial communications are set-up for hardware flow control, two of the programmable I/O lines are enabled for RTS and CTS. Hardware flow control is not available for the mic port.

RTS



Important The RTS line has been implemented as a “Ready to Receive” line as per RS-232-E.

When the RTS line is inactive the radio will not output any serial data. It will buffer any data and output it when the line is activated.



Important The RTS line does not stop the radio from receiving data across the air so leaving this line inactive for any length of

time could cause the buffer to overflow and for data to be lost.

CTS The CTS line is deactivated when there is less than 35 bytes of empty space in the buffer.

The CTS line is activated when the CTS line had previously been deactivated and there is now less than 10 bytes of data in the buffer.

1.7 CCDI Transparent Mode

In Transparent mode, the radio acts as a modem, automatically transmitting in FFSK or THSD format the serial data received from the PC. In this mode, the baud rate between the PC (DTE) and the radio (DCE) can be set to either 1200, 2400, 4800, 9600, 14400, 19200, 28800 or 115200 (TM8200 only) baud using the programming application. The over-air data rate is 1200 or 2400 bps for FFSK data, 12 kbit/s for Tait High Speed Data (THSD) narrow band and 19200 bit/s for THSD wide band. The serial data input buffer is 512 bytes for the TM8100 and 600 bytes for the TM8200, to adequately cope with the data flow.

Communication in Transparent mode is free-format, with the protocol determined entirely by the PC and the modem. It is transparent to the CCDI, allowing the PC to send and receive data without passing through the CCDI. CTCSS and DCS subaudible signalling is available in FFSK Transparent mode only.

1.7.1 Entering Transparent Mode

Transparent mode can be set as the default mode at power on by selecting FFSK or THSD Transparent Mode in the 'Powerup State' field in the programming application. Refer to ["Programming" on page 14](#).

You can change to Transparent mode while operating in Command mode by sending a TRANSPARENT command to the radio or using a programmable I/O line programmed for THSD. Example: t01zB1 sends a TRANSPARENT command, requesting that the radio be put into Transparent mode. The escape character specified here is "z" (ASCII code = \$7A). Once acknowledged, any further data is linked directly to the radio in Transparent mode.

If the radio default is set to Transparent mode at power on, the default escape character is "+".

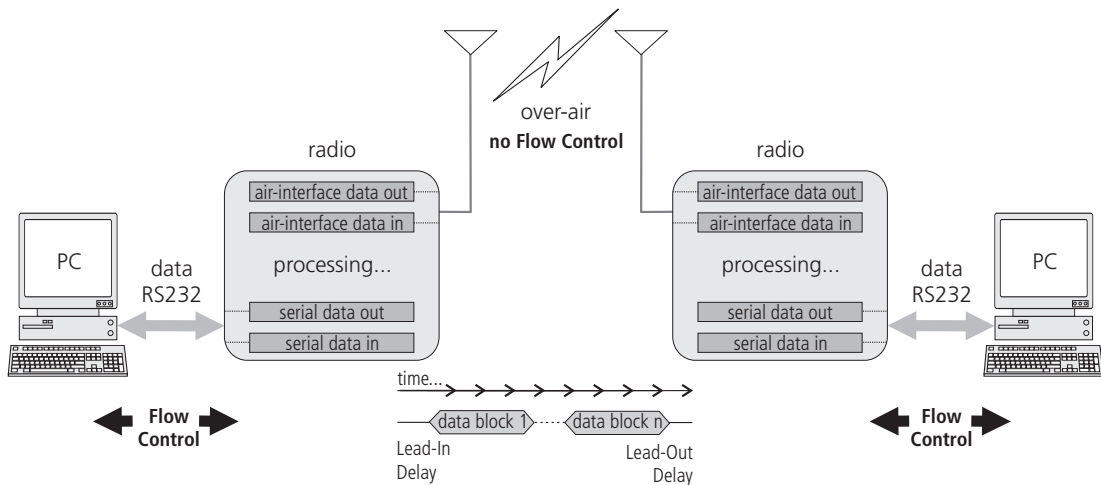
1.7.2 Exiting Transparent Mode

To change to Command mode while operating in Transparent mode, you can:

- send the escape sequence consisting of a 2 second idle time, followed by three escape characters (sent within 2 seconds), followed by a further 2 second idle time.
Example: If the escape character is “+” (default), send [2 second idle] +++ [2 second idle].
- exit via the I/O line programmed for THSD, if Transparent Mode was entered using this line.

1.7.3 Transparent Mode Format

Transparent Mode Packetisation



Transparent mode data is packetised into data blocks before it is sent over-air. The start and stop bits are removed and a header is sent at the start of each data block.

FFSK Transmission Format

The Transparent Mode transmission format is as follows:

Singe Data Block:

Lead-In Delay	preamble 2 bytes	sync 2 bytes	size 2 bytes	FFSK data block max 46 bytes	CRC 2 bytes	Lead-Out Delay
HEADER						

Multiple Data Blocks:

Lead-In Delay	HEADER 6 bytes	FFSK data block . . . max 46 bytes	CRC 2 bytes	HEADER 6 bytes	FFSK data block max 46 bytes	CRC 2 bytes	Lead-Out Delay
---------------	-------------------	---------------------------------------	----------------	-------------------	---------------------------------	----------------	----------------

THSD Transmission Format

For more information, refer to Technical Note TN-855-AN TM8000 and TB7100 Data Modem Facilities.

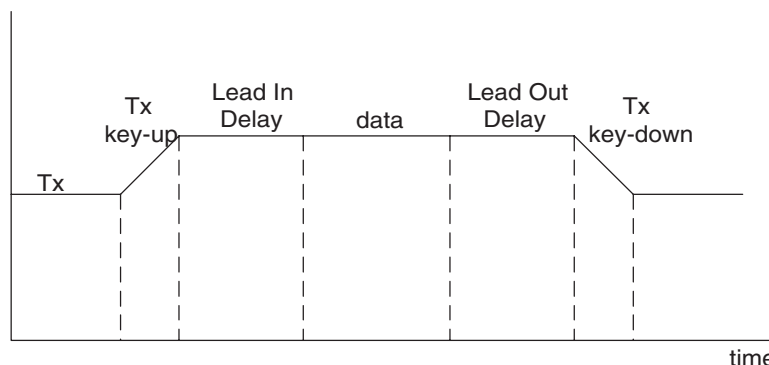
Effective Over-Air Data Rate

The effective over-the-air data rate is lower than the set data rate.

For more information, refer to Technical Note TN-855-AN TM8000 and TB7100 Data Modem Facilities.

Lead-In Delay

The lead-in delay begins after the transmitter key-up time. It gives the receiver(s) at the other end time to open before data is sent.



When data is detected at the radio's input buffer, the following occurs:

- The transmitter keys up.
- A carrier is sent from the transmitter. When the carrier reaches its full potential, the lead-in delay begins.
- If the receiving base station is set to Repeater mode, the carrier is detected and Rx Gate becomes active (opens), which in turn makes the PTT line active.
- The active PTT line keys up the transmitter.

This sequence is repeated with as many base stations as are in the chain. The optimum length of the lead-in delay should be set keeping in mind the number of base stations that need to be activated before any data is sent.

The lead-in delay must also allow for subaudible signalling decoding, if it is enabled, when used in conjunction with FFSK data.

1.8 Command Mode

Command mode uses the Tait proprietary Computer Controlled Data Interface (CCDI), a command protocol embedded in the radio firmware. It is accessed using the serial port lines from the PC. In this mode, the baud rate between the computer equipment (DTE) and the radio (DCE) can be set to either 1200, 2400, 4800, 9600, 14400, 19200, 28800 or 115200 (TM82000 only) baud using the programming application

In Command mode, the PC sends command sequences to the radio and waits for a prompt before beginning the next transaction. Some commands require the radio to send a CCDI message in response. Messages sent to the radio will always be responded to by the prompt.

Unsolicited messages such as PROGRESS or ERROR messages are sent by the radio if there is a significant change in its state that the PC should be aware of. When errors are detected, an unsolicited ERROR message is sent by the radio to the PC. The radio cannot send messages that require a reply.

The SEND_SDM, SEND_ADAPTABLE_SDM and GET_SDM commands require that SDMs are sent and received as over-the-air FFSK data by the radio while in Command mode. If an SDM is received from the over-air interface while the radio is in Command mode, the SDM data is buffered and a 'SDM Received' RING messages are generated by the radio to indicate that SDM data has been received. When using FFSK, an 'FFSK Data Received' PROGRESS message will also be generated.

1.8.1 Entering Command Mode

Command mode can be set as the default mode at power on by selecting 'Command Mode' in the 'Powerup State' field in the programming application. Refer to "[Programming](#)" on page 14.

To change to Command mode while operating in Transparent mode, you can:

- send the escape sequence consisting of a 2 second idle time, followed by three escape characters (sent within 2 seconds), followed by a further 2 second idle time.
Example: If the escape character is "+" (default), send [2 second idle] +++ [2 second idle].
- exit via the I/O line programmed for THSD, if Transparent Mode was entered using this line.

1.8.2 CCDI Command Prompt

After entering Command mode, the radio sends a "." character to the PC which is displayed as a command prompt. The command prompt indicates that the radio is ready for another command. The prompt is also sent after the radio has sent a message.



Note In early CCDI versions, the command prompt after messages was not sent for all messages.

1.8.3 CCDI Command Format

All CCDI message packets take the general form:

[IDENT] [SIZE] [PARAMETERS] [CHECKSUM] <CR>

- [IDENT] = The message identifier. Identifiers are single ASCII characters (lower-case alphabetical) which categorise the message type.
- [SIZE] = The number of characters which make up the [PARAMETERS] field. [SIZE] is an 8-bit number expressed in ASCII hex notation (two characters).
- [PARAMETERS] = An optional field, depending upon the command. Parameter values are generally character strings unless explicitly stated otherwise. Parameter type is dependent upon the command, and often has multiple parts.
- [CHECKSUM] = An 8-bit checksum of the [IDENT], [SIZE] and [PARAMETERS] fields. Expressed in two character ASCII hex notation.
- <CR> = The carriage return (0Dh) packet terminator.

1.8.4 Restrictions

- All characters in a message are printable ASCII.
- Where numeric values are represented in ASCII hex notation (two characters per byte), characters A to F are upper case.
- The minimum length of a command packet is 5 characters. For example q002F is the QUERY command where [SIZE] = 00 as there is no [PARAMETERS] field required.
- The maximum length of the [PARAMETERS] field is 255 characters. The maximum length of the command packet is therefore 260 characters.

1.8.5 Calculating the CCDI [CHECKSUM]

[CHECKSUM] is calculated by applying the following algorithm:

1. Take the modulo-2 sum of all message bytes preceding [CHECKSUM].
2. Retain bits 0 to 7, discarding any higher order bits resulting from the summation.
3. Form the two's complement of the remainder.
4. Convert the binary number into two ASCII hex digits, MSD first.

Example

s0D050800TESTHi!DA

1. Take the modulo-2 sum of all message bytes preceding [CHECKSUM].

■ $s = 73h, 0 = 30h, D = 44h$ etc. therefore the modulo-2 sum is:
 $73 + 30 + 44 + 30 + 35 + 30 + 38 + 30 + 30 + 54 + 45 + 53 +$
 $54 + 48 + 69 + 21 = 426h$

2. Retain bits 0 to 7, discarding any higher order bits resulting from the summation.
26h
3. Form the two's complement of the remainder.
 $26h = 0010\ 0110$
two's complement = 1101 1010
4. Convert the binary number into two ASCII hex digits, MSD first.
 $1101\ 1010 = DA$

Checksum Software Application

A software application is available from Tait Technical Support which will calculate the checksum for any given command and parameters.

Please contact Technical Support (refer to [“Contact Information” on page 2](#)).

1.9 Commands to the Radio

The following commands are available to send from the PC to control the radio.

Command	Character	Function	Valid in Mode	Mode radio must be in or switch to, to act upon the message (TM8200 only)
CANCEL	c	Cancel current activities	Conventional	Conventional
DIAL	d	Initiate a conventional call	Trunked Conventional	Conventional
FUNCTION	f	Implement RU function	Trunked Conventional	Dependent on function
GO_TO_CHANNEL	g	Tune to conventional channel	Trunked Conventional	Conventional
QUERY	q	Query RU Model, data parameters, software versions, etc. Query SDM.	Trunked Conventional	Either, no change required
SEND_ADAPTABLE_SDM	a	Send conventional SDM with SFI/GFI field formatting	Trunked Conventional	Conventional
SEND_SDM	s	Send conventional SDM	Trunked Conventional	Conventional
TDMA	z	Configure and open TDMA channel Queue TDMA data for sending Close TDMA channel	Conventional	Conventional
TRANSPARENT (FFSK and THSD)	t	Switch to Transparent mode (FFSK or THSD)	Conventional Trunked	Conventional

In all cases, if a command is received without error by the radio and all parameters are valid, the command is executed.

The prompt character ‘?’ is returned to the PC immediately after receiving a command, to signify that another may begin. If an error arises, the PC is notified with an appropriate ERROR response.

1.9.1 CANCEL

The CANCEL command tells the PC to abort the current action that the radio is performing.

Format **c [SIZE] [CANCEL_TYPE] [CHECKSUM]**

- 'c' is sent as a single ASCII character and represents the CANCEL command.
- [CANCEL_TYPE] is a single ASCII character representing the cancelling type.

[CANCEL_TYPE]	Function
0 (cancel call)	Cancel Call In conventional mode, Cancel can do the following: <ul style="list-style-type: none"> ■ clear down a Selcall call, including retries ■ cancel deferred calling ■ take the radio out of emergency operation if in Emergency Tx/Rx cycles by resetting the radio In trunked mode, Cancel can do the following: <ul style="list-style-type: none"> ■ act as though the front panel 'Cancel' key has been pressed.
1 (delete SDM)	Delete SDM data of the last received SDM (if any). Available in conventional mode only.



Note If no [CANCEL_TYPE] is sent, then the CANCEL command will default to CANCEL_TYPE = 0.

Examples

- c0100C a command to cancel the existing call.
- c003D also a command to cancel the existing call.
- c0110B a command to delete the currently held SDM.

1.9.2 DIAL

The DIAL command allows access to the full conventional mode dialling capability of the radio. Selcall and DTMF sequences can be dialled on the current channel. An TM8200 trunked radio must change to a conventional channel using a function key before executing this command. The function key is set to “Switch Mode” in the MPT Key Settings form of the TM8200 programming application.

Format

d [SIZE] [DTYPE] [NUMBER_STR] [CHECKSUM]

- ‘d’ is sent as a single ASCII character and represents the DIAL command.
- [DTYPE] is a single ASCII character representing the type of dialling required.
- [NUMBER_STR] represents the dialled sequence. The range of allowed characters depends upon the value of [DTYPE].

[DTYPE]	[NUMBER_STR]
0 (Selcall)	0...9, A...F, -, V (maximum of 32 digits). Selcall strings usually use the digits 0 to 9 as some of the tones A to F have special meaning, e.g. A = Group; C = Reset; E = Repeat. Selcall calls are made within the bounds of the following parameters, as programmed into the radio: tone period, tone set and Lead-In Delay, etc.
1 (DTMF conventional)	0...9, A...D, *, #,-(maximum of 32 digits) DTMF calls are made within the bounds of the following parameters, as programmed into the radio, e.g. key-up delay, tone period and inter-tone gap.



Note The DIAL command initiates the calling process only. The call may take some time to get through, especially if the channel is busy or the system heavily loaded. The receiver will return a prompt as soon as the DIAL command is accepted, but the PC may have to wait for a PROGRESS message advising successful call set-up before proceeding.

Examples

d0601234507 a command to initiate Selcall dialling of the number
1 2 3 4 5.

d0611234506 a command to initiate DTMF dialling of the number
1 2 3 4 5.

1.9.3 FUNCTION

The FUNCTION command provides access to various hardware and miscellaneous functions.

Format

f [SIZE] [FUNCTION] [SUBFUNCTION] [QUALIFIER]
[CHECKSUM]

- 'f' is sent as a single ASCII character and represents the FUNCTION command.
- [FUNCTION] is a single ASCII characters representing the required function category.
- [SUBFUNCTION] is up to two ASCII characters and is used to extend the range of the [FUNCTION] parameter.
- [QUALIFIER] is an ASCII character string representing the action to be taken, depending on the value of [FUNCTION] and [SUBFUNCTION].

[FUNCTION]	[SUBFUNCTION]	[QUALIFIER]	Action	Support
0 (functions)	0	none	Switch to CCR mode.	TM8100: Yes TM8200: No
	1	0	Disable CCDI volume control.	Yes
		1	Enable CCDI volume control (refer to SUBFUNCTION=2).	Yes
	2	0-9	Set volume level. 0=off, 1-9=loudness.	TM8100: before v2.06 TM8200: No
	2	0-25	Set volume level. 0=off, 1-25=loudness.	TM8100: from v2.06 TM8200: Yes
	3	0	Disable selcall output RING messages.	Yes
		1	Enable selcall output RING messages.	Yes
	4	0	Disable PROGRESS output messages.	Yes
		1	Enable PROGRESS output messages.	Yes
		2	Enable KEYPRESS progress messages.	TM8100: No TM8200: from v2.05
		3	Disable KEYPRESS progress messages (default).	
	5	0	Disable channel PROGRESS output messages (default).	TM8100: from v2.03 TM8200: from v2.05
		1	Enable channel PROGRESS output messages (unsolicited). Refer to "PROGRESS" on page 44, [PTYPE] = 21 User Initiated Channel Change.	
		2	Report current channel (solicited).	

[FUNCTION]	[SUBFUNCTION]	[QUALIFIER]	Action	Support
1 (SDM control)	0	0	Disable SDM output on reception.	Yes
		1	Enable SDM output on reception, QUERY command not required.	Yes
	1	0	Disable SDM caller ID encode.	Yes
		1	Enable SDM caller ID encode. The caller ID is sent as a separate SDM before sending the SDM itself.	Yes
	2	0	Disable SDM caller ID decode.	Yes
		1	Enable SDM caller ID decode. The caller ID SDM is decoded before the incoming SDM.	Yes
2 (emergency mode)	2	0	Activate non-stealth emergency mode.	Yes
		1	Activate stealth emergency mode.	Yes
3 (simulate key presses)	none	000-009	PTT keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		010-019	Hookswitch keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		020-029	'On/off' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		030-039	'Up' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		040-049	'Down' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		050-059	'FN1' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		060-069	'FN2' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		070-079	'FN3' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes
		080-089	'FN4' keypress length, 0=constantly off, 1-8=x/8 seconds on, 9=constantly on.	Yes

[FUNCTION]	[SUBFUNCTION]	[QUALIFIER]	Action	Support
4 (user controls)	none	0	Disable all user controls, display and indicators. The radio indicates "CCDI BUSY".	Yes
		1	Disable user input only. Display and indicators still operational. Any attempted user input will result in the invalid keypress tone.	Yes
		2	Enable all user controls except when CCDI commands are being processed. During this time the radio indicates "CCDI BUSY". Set as default at power on.	Yes
5 (Rx audio mute control)	none	0	Cancel CCDI request for Rx audio mute.	Yes
		1	Mute Rx audio. Can only be overridden by Squelch Override. Conventional mode only.	Yes
7 (subaudible signalling)	none	0	Deactivate validation of CTCSS and DCS subaudible signalling. Incoming data will be processed regardless of the subaudible signalling. The default radio setting at power on depends on the 'Ignore DCS/CTCSS' option set in the Data form of the programming application.	Yes
		1	Activate validation of CTCSS and DCS subaudible signalling. Incoming FFSK data will only be processed if the subaudible signalling matches. Only effective if current channel is programmed for subaudible signalling. Conventional or traffic channel mode only.	Yes
8 (monitor)	none	0	Deactivate monitor function.	Yes
		1	Activate monitor function. Conventional mode only.	Yes
9 (Rx/Tx)	none	0	Forces radio into a Rx state. Conventional or traffic channel mode only.	Yes
		1	Forces radio into a Tx state. Note that the Rx CCDI command is required to take the radio out of Tx mode when this mode is activated. The Tx will not terminate on expiry of the Tx timer. Conventional or traffic channel mode only.	Yes

Examples

- f0241D3 a command to disable user input command.
- f0250D3 a command to mute the receiver audio.
- f0271D0 a command to validate subaudible signalling.
- f0281CF a command to activate Monitor function.

f0291CE	a command to activate the transmitter.
f0290CF	a command to deactivate the transmitter following an “activate transmitter” command.
f0200D8	enter CCR Mode.
f03011A5	enable volume control.
f03010A6	disable volume control.
f03020A5	set volume level off.
f0402256D	set volume level to the maximum of ‘25’.
f03025A0	set volume level to ‘5’.
f03031A3	enable Selcall output.
f03030A4	disable Selcall output.
f03041A2	enable progress message output.
f03040A3	disable progress message output.
f03101A5	enable output SDM on reception.
f03100A6	disable output SDM on reception.
f03111A4	enable caller ID encoder.
f03110A5	disable caller ID encoder.
f03121A3	enable caller ID decoder.
f03120A4	disable caller ID decoder.
f03051A1	enable channel progress message.

1.9.4 GO_TO_CHANNEL

The GO_TO_CHANNEL command tells the radio to change to another conventional mode channel. The specified channel can be assigned to a scan/vote group in the radio. A trunked radio must change to a conventional channel before executing this command.

Format

g [SIZE] [ZONE] [CHANNEL_NO] [CHECKSUM]

- 'g' is sent as a single ASCII character and represents the GO_TO_CHANNEL command.
- [ZONE] (optional for TM8200, not applicable for TM8100) is a two-character string representing the new zone. When [ZONE] is omitted, the radio stays in the current zone.
- [CHANNEL_NO] is a maximum of four characters representing the new channel number. The range of allowed characters is 0 to 9, and must be a valid channel for the radio. If used with the [ZONE] parameter, this will always be a four-character string.



Note If the radio is using a scan/vote group when it receives this command, it will retune to the specified channel.



Note If the radio is in emergency mode then no channel change will occur, and a 'not ready' error message is returned.

Examples

g0223D2	go to channel 23.
g0414995E	go to channel 1499.
g060100120F	go to zone 1, channel 12.

1.9.5 QUERY

The QUERY command requests information from the radio.

Format

q [SIZE] [QUERY_TYPE] [DATA] [CHECKSUM]

- 'q' is sent as a single ASCII character and represents the QUERY command.
- [QUERY_TYPE] is a single ASCII character representing the query type required.
- [DATA] is a number with up to three-digits which identifies the CCTM command which is sent.

[QUERY_TYPE]	[DATA]	Function	Support
0 (model and CCDI version)	none	Query the radio model and CCDI version. Data is returned as a MODEL message.	Yes
1 (query SDM)	none	The buffered SDM data is returned to the PC as a GET_SDM message. The SDM buffer is then cleared. Available in conventional mode only.	Yes
3 (version)	none	Query the radio version information. The data is returned to the PC as a RADIO_VERSION message. Refer to "RADIO_VERSIONS".	Yes
4 (serial number)	none	Query the serial number. Refer to "RADIO_SERIAL".	Yes
5 (CCTM)	047	PA temperature. Returned to the PC as a CCTM_QUERY_RESULT message. Refer to "CCTM_QUERY_RESULTS".	TM8100: from v2.10 TM8200: No
	063	Averaged RSSI level. Returned to the PC as a CCTM_QUERY_RESULT message.	TM8100: from v2.09 TM8200: No
	064	Raw RSSI level. Returned to the PC as a CCTM_QUERY_RESULT message.	
	318	Forward power. Returned to the PC as a CCTM_QUERY_RESULT message.	
	319	Reverse power. Returned to the PC as a CCTM_QUERY_RESULT message.	
6 (GPS)	none	Query GPS. GPS data is returned packetised as though the TM8100/TM8200 is a polling radio.	TM8100: from v2.10 TM8200: No
7 (display)	0	Returns the text of the entire display. Non-ASCII text is ignored.	TM8100: No TM8200: from v3.03



Note If no [QUERY_TYPE] is sent, then the QUERY command will default to [QUERY_TYPE] = 0.

Examples	q010FE	a command requesting a MODEL message.
	q002F	also a command requesting a MODEL message.
	q011FD	a command requesting a GET_SDM message.
	q013FB	query the software version.

1.9.6 SEND_ADAPTABLE_SDM

The SEND_ADAPTABLE_SDM command requests the radio to send a fixed format ASCII Short Data Message (SDM). An SDM can be received when the radio is in Command and Transparent modes.

Format **a [SIZE] [LEAD_IN_DELAY] [GFI] [SFI] [DATA_MESSAGE_ID] [MESSAGE] [CHECKSUM]**

After an SDM is sent, if the 'SDM Auto Acknowledge' field is set in the programming application, the radio waits for an acknowledgement before it generates a PROGRESS message. The PROGRESS message is either type 1D0 'SDM auto-acknowledge not received' or 1D1 'SDM auto-acknowledge received'. Refer to "[PROGRESS](#)" on page 44.

Note that the delay before the acknowledgement is sent and how long the radio waits is also set in the programming application.

In Command mode, when any SDM is received, whether valid or not, the radio sends an 'FSK Data Received' PROGRESS message to the PC. If the SDM is valid with a [MESSAGE] component, the radio also sends an 'SDM Call' RING message to the PC. RING will be type 'Data Call'.

When in Command mode, when a valid SDM is received the radio beeps.



Note The radio can not receive any further SDMs if one is already stored in the buffer. The buffer must be cleared using a CANCEL command.

- 'a' is sent as a single ASCII character and represents the SEND_ADAPTABLE_SDM command.
- [LEAD_IN_DELAY] is two ASCII hex characters representing the delay after the radio transmitter keys-up and the start of data transmission. The range is 00 to FFh.
The actual delay is calculated by multiplying the number by 20 ms. This corresponds to a Lead-In Delay between 00 ms and 5.1 seconds, in steps of 20 ms. A minimum of at least 20 ms of Lead-In Delay is required for the radio.
- [GFI] is a single ASCII character giving the General Format Information (GFI) of the SDM.

Valid GFI values are:

GFI	Description	Comment
0	As per "s" format (i.e. Text)	Default for "s" command (ASCII SDM)
1	Binary	Binary SDM
2	Text	ASCII SDM
3 - 7	Spare	Available for future GFIs

- [SFI] is two ASCII characters giving the Specific Format Information (SFI) of the SDM.

Valid SFI values are:

SFI	Description	Comment
00	Default Value	Default Value
01	GPS_0	GPS related, CDP only.
02	Text	Text
03	CCR	SDM is directed to the CCR module. Refer to "CCR SDM (TM8100 only)" on page 33.
04	Extended SDM	Up to 128 bytes, split into multiple SDMs. Refer to "Extended SDM" on page 33.
05	Extended SDM Continuation	Continuation of an Extended SDM. Refer to "Extended SDM" on page 33.
06	NMEA Request	Request for radio to return a specified NMEA string. Refer to "NMEA Request SDM" on page 33.
07 - 31	Spare	Available for future SFIs

The following table shows valid GFI/SFI combinations. All other GFI/SFI field values which are not shown in the table are available for future formats.

GFI	SFI	Description	Comment
0	00	As per "s" command (Text)	General ASCII SDM
1	00	Binary	General binary SDM
2	00	Text	General ASCII SDM
1	01	GPS_0	GPS-related binary, non-CCDI2 compatible format
2	02	Text	General ASCII SDM
2	03	CCR	SDM for CCR control
1	04/05	Binary	Binary SDM up to 128 bytes

2	04/05	Text	ASCII SDM up to 128 bytes
2	06	NMEA Request	Requests an NMEA string to be returned as a Text SDM

- [DATA_MESSAGE_ID] is an 8-character string representing the SDM data identity of the radio to which the SDM is being sent. It can be any alphanumeric characters. “★” is the wildcard for any character. e.g. 12★★5678. The first four bytes are generally the fleet identity, the second four the radio identity.
When a radio receives a SDM message, the data identity is checked against the ‘Unit Data Identity’ set in the Data form of the programming application. Refer to “[Programming](#)” on page 14. If the data identity matches, the received SDM data is stored and the radio sends a response. If the data identity does not match then the SDM data is ignored.
- [MESSAGE] is optional and contains up to 32 characters of SDM text, or 128 characters for extended SDM. Either standard 8-bit ASCII range or binary can be sent, depending on the GFI.

Example

a0FFF20012345678Hi4A

This message transmits text data message ID “12345678” and SDM data “Hi” with 5.1 s lead-in delay through the current channel.

Extended SDM

An adaptable SDM with a SFI of 04 can have up to 128 bytes of data. This is split up into multiple SDMs where the following SDMs will have a SFI of 05. The SDM can be either Text or Binary.

CCR SDM (TM8100 only)

An adaptable SDM with a GFI of 2 and a SFI of 03 is passed to the CCR module, in radios that support CCR and are currently in CCR mode. The [MESSAGE] part of the SDM is stripped out of the SDM and passed to the CCR module as a CCR command.

The SDM can only be text as CCR commands are in ASCII.

Example

a130520312345678M01D0E36

transmits data message ID “12345678” and the CCR command “M01D0E” with 100 ms lead in delay through the current channel.

NMEA Request SDM

An adaptable SDM with a GFI of 2 and a SFI of 06 requests the receiving radio to return an Extended SDM, with the next NMEA message received of the requested type. The SDM may only be Text as NMEA messages are in ASCII.

The message of the SDM can contain a radio ID return address.

Format

[MESSAGE]=[NMEA_ADDRESS_FIELD][,][RADIO_ID]

- [NMEA_ADDRESS_FIELD] is a five character NMEA address field such as “GPRMC”.
- [,] is a delimiter to separate the address field from the radio id. This should only be added if there are more fields in the message.
- [RADIO_ID] is the radio ID that the NMEA message is to be returned to. If not in the message then the message shall be returned to the default GPS dispatcher.

Examples

a120520612345678GPRMC22

This message transmits data message to ID “12345678” and a request for the next “GPRMC” message to be returned to the default GPS dispatcher with 100 ms Lead-In Delay through the current channel.

a1B0520612345678GPGGA,8765432155

transmits data message to ID “12345678” and a request for the next “GPGGA” message to be returned to the radio “87654321” with 100 ms Lead-In Delay through the current channel.

1.9.7 SEND_SDM

The SEND_SDM command tells the radio to send a Short Data Message (SDM) but the “SEND_ADAPTABLE_SDM” is normally used instead. An SDM can be received when the radio is in Command mode.

Format

s [SIZE] [LEAD_IN_DELAY] [DATA_MESSAGE_ID]
[MESSAGE] [CHECKSUM]

After an SDM is sent, if the ‘SDM Auto Acknowledge’ field is set in the programming application, the radio waits for an acknowledgement before it generates a PROGRESS message. The PROGRESS message is either type 1D0 ‘SDM auto-acknowledge not received’ or 1D1 ‘SDM auto-acknowledge received’. Refer to “PROGRESS” on page 44.

Note that the delay before the acknowledgement is sent and how long the radio waits is also set in the programming application.

In Command mode, when any SDM is received, whether valid or not, the radio sends an ‘FSK Data Received’ PROGRESS message to the PC. If the SDM is valid with a [MESSAGE] component, the radio also sends an ‘SDM Call’ RING message to the PC. If no [MESSAGE] component is received, RING will be type ‘Data Call’.

The radio can be programmed to issue an audible indicator when a valid SDM is received while in Command mode.



Note The radio can not receive any further SDMs if one is already stored in the buffer. The buffer must be cleared using a CANCEL command.

- ‘s’ is sent as a single ASCII character and represents the SEND_SDM command.
- [LEAD_IN_DELAY] is two ASCII hex characters representing the delay after the radio transmitter keys-up and the start of data transmission, while the radio is in Command mode.
The range is 00 to FFh. The actual delay is calculated by multiplying the number by 20ms. This corresponds to a Lead-In Delay between 00ms and 5.1s, in steps of 20ms. A minimum of at least 20ms of Lead-In Delay is required for the radio.
- [DATA_MESSAGE_ID] is an 8-character string representing the SDM data identity of the radio to which the SDM is being sent. It can be any alphanumeric characters. “★” is the wildcard for any character, e.g. 12★★5678. The first four bytes are generally the fleet identity, the second four the radio identity.

When a radio receives a SDM message, the data identity is checked against the ‘Unit Data Identity’ set in the Data form of the programming application. Refer to “Programming” on page 14. If the data identity matches, the received SDM data is stored and the radio sends a response. If the data identity does not match then the SDM data is ignored.

- [MESSAGE] is optional. The field is limited to 32 hex characters in standard ASCII range 20h to 2Fh. Characters between 00 and FFh can be sent but characters above 7Fh can not be displayed.

Examples

s0A051234567813

transmits data identity “12345678” with 100ms lead-in delay through current channel.

s0CFF12345678Hi39

transmits data identity “12345678” and SDM data “Hi” with 5.1s lead-in delay through current channel.

1.9.8 TDMA

The TDMA commands consist of three sub-functions for opening a TDMA channel, sending TDMA data, and closing a TDMA channel.

Opening a TDMA Channel

Before sending or receiving TDMA data, a TDMA channel must be opened using the OPEN_TDMA_CHANNEL command.

The OPEN_TDMA_CHANNEL command instructs the RU to prepare TDMA services on a specified TDMA channel (conventional mode) and to configure the modulation scheme and packet size according to the settings in the database.



Note A TDMA channel is different to a “normal” channel with the same channel number.

Sending TDMA Data

Sending TDMA data requires a second TDMA command, QUEUE_TDMA_DATA_FOR_SENDING. This command requests the RU to queue data in a dedicated TDMA data buffer for transmission.

The QUEUE_TDMA_DATA_FOR_SENDING command passes a maximum of 128 data bytes to the TDMA module. However, the data size actually used for over-the-air transmission is a programmable parameter for each channel. The TDMA transmission module will ignore any data exceeding the programmed packet size of the current channel.

Should the data size in the CCDI command exceed 128 bytes, then an error message (Command not accepted error) will be returned.

If the specified channel is not programmed for TDMA data transfer, or if the specified channel had not been opened for TDMA using the OPEN_TDMA_CHANNEL command, then CCDI will return a TDMA status message indicating the failure of the command execution.

A second QUEUE_TDMA_DATA_FOR_SENDING command can only be accepted after the progress message “TDMA DATA QUEUED FOR

SENDING” has been sent to the DTE. Otherwise, the RU will return an error message (RU busy error).

TDMA requires an input transition from inactive to active on a TDMA input to commence the transmission over the air.

The TDMA input “GTC” (Go to Channel) has to be activated and TDMA data transmission will commence with the transition from inactive to active on the TDMA input “Send Packet”.

Closing a TDMA Channel

The CLOSE_TDAMA_DATA_CHANNEL command requests the RU to unassign a currently configured TDMA data channel. This channel will subsequently be unavailable for TDMA data transmission or reception.

Format

z [SIZE] [SUB_FUNCTION] [CHANNEL_NO] [DATA] [CHECKSUM]

- ‘z’ is a single ASCII character and represents the TDMA command.
- [SUB_FUNCTION] is a one-digit ASCII character specifying the TDMA sub-function.
 - 0 = OPEN_TDAMA_CHANNEL
 - 1 = QUEUE_TDAMA_DATA_FOR_SENDING
 - 2 = CLOSE_TDAMA_CHANNEL
- [CHANNEL_NO] is a two-digit string specifying the TDMA decimal channel number. The value of the channel number must be a valid TDMA channel for the RU being controlled (range of allowed values depends upon the RU’s programming). If the RU is in emergency mode then no channel change occurs and the radio will return an error message indicating it is busy. The RU will not give any audible indications for channel change requests. Should the channel not be a TDMA channel, then CCDI will return an error message (Command not accepted error) and the RU will not change channel.
- [DATA] is a maximum of 128 bytes of TDMA data (only used with [SUB_FUNCTION] 0 (QUEUE_TDAMA_DATA_FOR_SENDING)).

Valid in conventional mode only.

Examples

- | | |
|------------------|--|
| z030458A | specifies a channel change to TDMA channel 45. |
| z0B10412345678DB | stores “12345678” in the TDMA data buffer for TDMA channel 04. |
| z032058C | closes the TDMA services on TDMA channel 05. |

1.9.9 TRANSPARENT (FFSK and THSD)

The TRANSPARENT command changes the radio to Transparent mode and sends the escape character required to change it back to Command mode. Refer to “[CCDI Transparent Mode](#)” on page 16 for details about Transparent mode.

Format

t [SIZE] [ESC_CHAR] [MODE] [CHECKSUM]

- ‘t’ is sent as a single ASCII character and represents the TRANSPARENT command.
- [ESC_CHAR] is a single ASCII character representing the escape character. The escape sequence is three consecutive escape characters sent within two seconds, with two seconds of idle time each side. When the escape sequence is sent to the radio, it is forced into Command mode. See “[Entering Transparent Mode](#)” on page 16 for details.
- [MODE] is a single ASCII character representing the modulation scheme. If [MODE] is left blank then the modulation scheme is assumed to be FFSK.

[MODE]	Function
0 (FFSK mode)	The radio will use FFSK modulation when in transparent mode.
H (THSD mode)	The radio will use Tait High Speed Data (THSD) modulation when in transparent mode.



Note When data is transmitted in Transparent mode it has the Lead-In Delay set in the Data form of the programming application.

Examples

- t01zB1 a command requesting that the radio be put into Transparent mode. The escape character specified here is “z” (ASCII code = \$7A).
- t02z080 enter FFSK transparent mode, with the escape character set to ‘z’.
- t02yH69 enter THSD transparent mode, with the escape character set to ‘y’.

1.10 Messages from the Radio

The following messages are sent from the radio to the PC in conventional mode. Some are solicited by commands from the PC, while others are unsolicited and are sent because of changes within the radio.

Message	Character	Function
CCTM_QUERY_RESULTS	j	Results from a CCTM query command
ERROR	e	Transaction failure or other error condition
GET_SDM	s	Get original format SDM data
MODEL	m	Identify RU type
PROGRESS	p	Call progress report
QUERY_DISPLAY_RESPONSE	d	Response from query display command
RADIO_SERIAL	n	RU serial number
RADIO_VERSIONS	v	Version numbers of software components
RING	r	Incoming call alert
TDMA_DATA	z	raw TDMA data
TRANSACTION OK	.	Transaction processed OK

The prompt character '.' is returned to the PC immediately after receiving a command to signify that another may begin. If the command initiates a return message, then when the return message has been sent the radio sends another prompt.

If the radio sends an unsolicited message, it sends a prompt after the message.

1.10.1 CCTM_QUERY_RESULTS

Solicited

The CCTM_QUERY_RESULTS message is issued as a result of the QUERY CCTM command. For more information on the QUERY command, refer to “QUERY” on page 30.

Format

j [SIZE] [CCTM_COMMAND] [CCTM_RESULT] [CHECKSUM]

- ‘j’ is sent as a single ASCII character and represents the CCTM_QUERY_RESULTS command.
- [CCTM_COMMAND] is a three digit character string representing a decimal number in the range of 000 to 999, which identifies the CCTM command requested.
- [CCTM_RESULT] is a variable length character string representing the CCTM value requested.



Note If the CCTM command gives multiple results then a separate query result will be given for each one.

QUERY CCTM Command	Returns...
047 (Read PA Temperature Level)	TM8100: Temperature in °C (-1200 to 1200) [CR] ADC value in mV (0 to 1200) TM8200: ADC value in mV (0 to 1200) With: (Temperature in °C) = (ADC value)/(-1.98)+230
063 (Read averaged RSSI level)	int value of averaged RSSI in 0.1 dB
064 Read raw RSSI level)	int16 value of instantaneous RSSI in 0.1 dB
318 (Report forward Power)	uint 16 value of the forward power (0 to 1200mV)
319 (Report reverse power)	uint 16 value of the reverse power (0 to 1200mV)

Examples

q0450475B This command queries the PA temperature.

Typical responses could be:

j050472331 where temp is 23 degrees, or

j06047481F8 where the millivolt value is 481.

1.10.2 ERROR

Solicited and unsolicited.

The ERROR message advises the PC that the radio has detected an error condition and cannot proceed with the current transaction. In some cases, an exception condition in the radio may cause an ERROR message to be sent to the PC independently of any control transactions. This is a system error, which is an unsolicited message.

Format

e [SIZE] [ETYPE] [ERRNUM] [CHECKSUM]

- 'e' is sent as a single ASCII character and represents the ERROR command.
- [ETYPE] is a single character representing the error category.
- [ERRNUM] is two ASCII hex characters which identify the specific error condition.

[ETYPE]	[ERRNUM]	Error
0 (Transaction Error)	01	Unsupported Command Unsupported command errors can arise when the PC expects a later version of CCDI than is attached and attempts to use a command which is not recognised by the radio.
	02	Checksum Error A checksum error indicates that the checksum calculated by the radio did not match the one received in the command packet.
	03	Parameter Error Parameter errors encompass values out of range or missing fields.
	05	TM8000 Not Ready Error TM8000 not ready error occurs when another new message is receiving from PC even before a prompt character "." is sent from radio.
	06	Command Error The command has not been accepted as the radio is not configured to accept this command or execution of the command will interfere with current radio operation. Example: An SDM was sent but Scams are not enabled in the programming application.
1 (System Error)	Fatal system error - contact Tait Technical Support	

Examples

e03003A5 This message indicates that the parameters of the currently received message are incorrect.

1.10.3 GET_SDM

Solicited.

The GET_SDM message is sent to the PC in response to a QUERY command. It sends the SDM data buffered by the radio.

Format

s [SIZE] [SDM_DATA] [CHECKSUM]

- 's' is sent as a single ASCII character and represents the GET_SDM command.
- [SDM_DATA] is an optional string of up to 32 character, or 128 for an extended SDM.



Note If no [SDM_DATA] is sent, then the GET_SDM command will default to [SDM_DATA] = 0.
If there is buffered SDM data in the radio, the SDM data will be sent to the PC.

Examples

s002D This message indicates that the radio has no SDM data available.

s02Hi7A This message indicates that the radio has a valid SDM data "Hi".

1.10.4 MODEL

Solicited.

The MODEL message is sent to the PC in response to a QUERY 0 (model) command (q010FE). It identifies the type of radio and the version of CCDI software operating in the radio.

Format

m [SIZE] [RUTYPE] [RUMODEL] [RUTIER] [VERSION] [CHECKSUM]

- 'm' is sent as a single ASCII character and represents the MODEL command.
- [RUTYPE] is a single character representing the type of radio.

Character	Function
1	Conventional radio
2	Reserved for Trunked radio
3	North American Signalling Conventional radio
4	Dual mode radio

- [RUMODEL] is a single character representing the model of the radio.

Character	Analog radios	P25 radios
1	Tait Orca Portable (TOP) conventional unit	TM9100 mobile
2	TM8200 mobile	TP9100 portable
3	TM8100 mobile	

- [RUTIER] is a single character representing the tier of the radio.

Character	TM8100/TM8200	Tait Orca portables	TM9100/TP9100
1	TM8105, TM8115, all TM8200 models	Conventional Tait Orca Elan	all TM9100 models
2	TM8110	Tait Orca Excel	all TP9100 models
3		Tait Orca Eclipse	
4		Tait Orca 5010/5011	
5		Tait Orca 5018	
6		Tait Orca 5020/5021	
7		Tait Radio Modem (TRM)	
8		Tait Orca 5015	

- [VERSION] is the CCDI software version. A character string, in the format of XX.XX, identifying the capabilities of the radio operating in CCDI mode.

Example

m0813102.03A3

This message is sent in response to a QUERY q002F command. It indicates that the radio is a Conventional, TM8105/TM8115 radio with a small display, and the CCDI version is 02.03.

1.10.5 PROGRESS

Unsolicited.

The PROGRESS message advises the PC of the radio status when some significant change of state in the radio occurs (typically during call processing). PROGRESS messages are not sent by the radio while the radio is in Transparent mode.

Format

p [SIZE] [PTYPE] [PARA1] [PARA2] [CHECKSUM]

- 'p' is sent as a single ASCII character and represents the PROGRESS command.
- [PTYPE] is two ASCII hex characters which identify the progress message category.
- [PARA2] is appended if [PTYPE] is 21, 22, or 23.

[PTYPE]	[PARA1]	Function
00	none	Call Answered A standard Selcall or Type 99 call has been answered. This message will be sent when the call has been answered either by the PC or manually by the user.
01	none	Deferred Calling Deferred calling is in progress. This message will be sent every three seconds while the radio is still waiting to make the deferred call.
02	none	Tx Inhibited Transmission has been inhibited. This message will be sent whenever transmission is requested but is inhibited.
03	none	Emergency Mode Initiated The radio has been put into emergency mode. This message will be sent when the radio's emergency mode switch is activated.
04	none	Emergency Mode Terminated The radio is no longer in emergency mode. This message will be sent when the radio receives a "reset" to take it out of emergency mode. The reset can be a Remote Monitor Reset (enabled in programming application), a power off and on, or a CANCEL command.
05	none	Receiver Busy The receiver has detected an RF signal on the current channel. This message will be sent when the current channel becomes busy.

[PTYPE]	[PARA1]	Function
06	none	Receiver Not Busy The receiver no longer detects an RF signal on the current channel. This message will be sent when the current channel becomes not busy.
07	none	PTT Mic Activated The PTT has been pressed. This message will be sent whenever the PTT is pressed in an attempt to transmit.
08	none	PTT Mic Deactivated The PTT has been released. This message will be sent whenever the PTT is released after attempting to transmit.
16	none	Selcall Retry
17	none	Radio Stunned
18	none	Radio Revived
19	none	FFSK Data Received Indicates to that the radio has received valid FFSK data in Command mode, and will be sent to the PC when Transparent mode is next entered. Note that if FFSK data is received in Transparent mode, it will be sent directly to the PC without sending this progress message.
1C		Selcall Auto-acknowledge Indicates whether an auto-acknowledge was received from the last Selcall call. Note that this progress message will only be generated if the radio has been programmed to transmit Selcall Auto Acknowledge in the programming application.
	0	no acknowledge received.
	1	acknowledge received.
1D		SDM Auto-acknowledge Indicates whether an Auto Acknowledge was received from the last SDM call. Note that this progress message will only be generated if the radio has been programmed to transmit SDM Auto Acknowledge in the programming application.
	0	No acknowledge received.
	1	Acknowledge received.
1E		SDM GPS Data Received
	1	Data received.
1F		Radio Restarted Indicates when the radio has been restarted.
	0	Radio will restart in Command mode.
	1	Radio will restart in FFSK Transparent mode.
	2	Radio will restart in THSD Transparent mode.
	3	Radio will restart in P25 Transparent mode.
20	none	Single In-band Tone Received

[PTYPE]	[PARA1]	Function
21		User Initiated Channel Change Indicates the details of the current channel [PARA2] is a fixed length field of 6-digits which indicate zone (2 digits) and the channel or scan/vote group ID (4 digits).
	0	Single channel.
	1	Scan/vote group of channels.
	2	A channel captured within a scan/vote group.
	3	Temporary channel e.g. one used for GPS.
	9	The channel is not available or invalid.
22	2-digit decimal channel ID	TDMA channel ID [PARA2]: 2-digit hexadecimal number 00 = TDMA open accepted 01 = TDMA not available 02 = TDMA channel invalid 03 = TDMA open slot not assigned 04 = TDMA already open 05 = TDMA closed successfully 06 = TDMA service not open 07 = TDMA data buffered 08 = TDMA data buffer emptied 09 = TDMA invalid packet size 0A = TDMA data failure not open 0B = TDMA normal operation suspended 0C = TDMA normal operation not suspended 0D = TDMA normal operation unable to suspend
23		Keycode Indicates key actions [PARA2]: 0 = key down action, 1 = key up action, 2 = short keypress, 3 = long keypress
	00	PTT
	01	Hookswitch
	02	On/Off key
	03	Up key
	04	Down key
	05	Function key 1
	06	Function key 2
	07	Function key 3
08	Function key 4	

Example

p0202CC This message sends the progress message to say that Tx has been inhibited.

1.10.6 QUERY_DISPLAY_RESPONSE

Solicited.

The QUERY_DISPLAY_RESPONSE message is sent to the PC in response to a QUERY 7(display) command (q0270C6).

The QUERY_DISPLAY_RESPONSE message shows the contents of the control head display.

A QUERY_DISPLAY_RESPONSE message always consists of at least two progress messages:

- Start of the query display response
- End of the query display response.

Between those messages are multiple separate messages given for each display object (i.e. a text line or an icon).

If the QUERY 7 (display) command is applied before a previous QUERY 7 (display) has been completed (i.e. if the QUERY DISPLAY RESPONSE “End of Query Display Response” has not been sent to the CCDI port) then the error “RU not ready” will be returned.

Format

d [SIZE] [PTYPE] [PARA1] [PARA2] [CHECKSUM]

- ‘d’ is sent as a single ASCII character representing the QUERY_DISPLAY_RESPONSE command.

[PTYPE] is a single-digit character (hexadecimal value) indicating either start or end of the display response, or representing the display object type:

[PTYPE]	[PARA1]	[PARA2]	Function
0 (Start)			Start of the Query Display response.
F (End)	0		End of the Query Display response. No error.
	1		End of the Query Display response. Refresh disabled.
	2		End of the Query Display response. Query Display busy.
1 (Display string text, ASCII only)	[X_POSITION] [Y_POSITION] [FONT] (9 digits)	variable length display string	[X_POSITION], = display string x-position (3 hexadecimal digits) [Y_POSITION], = display string y-position (3 hexadecimal digits) [FONT] = display string font number (3 hexadecimal digits)
2 (Display icon)	[X_POSITION] [Y_POSITION] [FONT] [ICON_ID] (11 digits)		[X_POSITION] = displayed icon x-position (3 hexadecimal digits) [Y_POSITION] = displayed icon y-position (3 hexadecimal digits) [FONT] = display string font number (3 hexadecimal digits) [ICON_ID] = display icon ID (2 hexadecimal digits)

X- and Y-positions

The x and y positions of the display object (string or icon) are pointing to the top left pixel of the object pixel field, relative to the pixel in the upper left corner of the LCD display (max. number of x pixels = 4000, max. number of y-pixels = 4000).

Font

The following table shows the font identifiers for text strings and icons:

Font ID	Font Name
1	FontDispatch 10
2	FontDispatch 16
3	FontDispatch 24
4	FontDispatch Bold 10
5	FontDispatch Monospace Numeric 16
6	Icon Dispatch 16
7	Icon Dispatch 20
8	Icon Dispatch 48

Icon ID

The following table shows the icon IDs. IDs not listed in the table are not used.

Icon ID	Icon Dispatch			Icon ID	Icon Dispatch		
	16	20	48		16	20	48
0x31				0x65			
0x32				0x68			
0x33				0x69			
0x34				0x6a			
0x35				0x6b			
0x36				0x6c			
0x37				0x6d			
0x38				0x6e			
0x41				0x6f			
0x42				0x70			
0x43				0x71			
0x44				0x72			
0x45				0x73			
0x4a				0x74			
0x61				0x75			
0x62				0x76			
0x63				0x77			
0x64							

Control heads with 1-, 2- or 3-digit display	If the QUERY_DISPLAY command is applied on a radio with a 1-, 2- or 3-digit display control head, a response message with the current text for each line is returned including a preceding Start of display response message and a trailing End of display message response. A flashing display is treated as it was not flashing.
Control heads without display	If the QUERY_DISPLAY command is applied on a radio with a control head without display, then only two progress messages are returned: <ul style="list-style-type: none"> ■ Start of the query display response ■ End of the query display response.
Radios with multiple control heads	If the QUERY_DISPLAY command is applied on a radio with multiple control heads, then only the display content of the master control head is reported with response messages.
Limitations	<p>The QUERY_DISPLAY RESPONSE messages should represent a sequence of text and Icon data, which are used during a complete display refresh process. There is no absolute guaranty that the reported displayed items are actually visible on the screen.</p> <p>Embedded control characters in text strings on the display (i.e. ascii value less than 0x20) may interfere with the terminal attached to the CCDI port when a QUERY_DISPLAY RESPONSE message is returned. The CCDI port on the radio must not be configured for software handshake!</p>
Examples	<p>d0100B This message indicates the start of a display response message.</p> <p>d02F0C4 This message indicates the end of a display response message (no error).</p> <p>d0E107803E005Menu85 This message indicates that there is currently a string “Menu” displayed on the radio, positioned at x=078h, y=03Eh and font ID=005h (FontDispatch Monospace Numeric 16).</p> <p>d0C200800B00744BE This message indicates that there is currently an icon displayed on the radio, positioned at x=008h, y=00Bh, fontID=007h, icon ID=44h.</p>

1.10.7 RADIO_SERIAL

Solicited.

The RADIO_SERIAL message is sent to the PC in response to a QUERY 4 (serial number) command. It conveys the serial number of the radio.

Format

n [SIZE] [SERIAL_NUMBER] [CHECKSUM]

- 'n' is sent as a single ASCII character and represents the RADIO_SERIAL command.
- [SERIAL_NUMBER] is a string identifying the serial number in the radio.

Example

n08190011898D This message indicates that the RU has serial number 19001189.

1.10.8 RADIO_VERSIONS

Solicited.

The RADIO_VERSION message is sent to the PC in response to a QUERY 3 (version) command. It conveys the versions of the various software and hardware components in the radio.

Format

v [SIZE] [RECORD NUMBER] [VERSION] [CHECKSUM]

- 'v' is sent as a single ASCII character and represents the VERSION command
- [RECORD NUMBER] is two ASCII characters identifying the record number.
- [VERSION] is a variable length string identifying the version number of each hardware and software component in the radio. Multiple RADIO_VERSION messages are returned in response to a QUERY command. The messages can be distinguished using the record number.

Record Number	Radio
00	Model Name
01	Software Version
02	Database Versions
03	FPGA Version

Example

v1200TMAB12-H500_010115
This message indicates that the RU has a model name of TMAB12-H500_0101.

1.10.9 RING

Unsolicited.

The RING message advises the PC that an incoming call has been received.

Format

r [SIZE] [RCATEGORY] [TYPE1] [TYPE2] [TYPE3] [TYPE4]
[STATUS] [CALLER_ID] [CHECKSUM]

- 'r' is sent as a single ASCII character representing the RING command.
- [RCATEGORY] is a single character representing the category of the incoming call.

Character	Function
0	Selcall
1	Undefined
2	Type 99

- The RING type is a four character string qualifying the type of call received.

Type	Character	Function
[TYPE1]	0	Voice Call received
	1	reserved for Trunked non-prescribed data call
	2	Status Call received
	3	Interrogation Call received
	4	SDM received
	5	Data Call received
	6	Remote Monitor Call received
[TYPE2]	0	Normal Priority Call received
	1	Emergency Priority Call received
[TYPE3]	0	Individual Call received
	1	Group Call received
	2	Super Group call received
[TYPE4]	0	reserved
	1	Call alert
	2	Radio check
	3	Radio inhibit
	4	Radio uninhibit
	5	RUM

	6	Message
	7	Status query
	8	Status update
	9	Emergency alarm rqt [?]
	10	P25 acknowledgement

- [STATUS] is a two digit string representing the received status for status calls. If a [STATUS] value is not received, then [STATUS] will be “FF”.
- [CALLER_ID] is a caller’s ID which is optional and of variable length. If the ID is different to the radio’s ID, the destination ID is placed in front of the caller ID, separated by a “-”. This required Selcall output to be enabled using the FUNCTION command. Refer to “FUNCTION”, [FUNCTION]=0, [SUBFUNCTION]=3.



Note By checking [SIZE] in RING message, PC will be able to know if the whole [CALLER_ID] part is missed or not.

Example r0714000FFA6 This message indicates that the received call is an SDM call.

1.10.10 TDMA_DATA

Unsolicited. TM8200 only.

The TDMA_DATA message is sent to the DTE in response to a reception of a TDMA data packet.

Format z [SIZE] [TDMA_DATA] [CHECKSUM]

- ‘z’ is sent as a single ASCII character representing the TDMA_DATA message.
- [TDMA_DATA] is raw TDMA message data.

Example z15Hi_TDMA_data_receivedα
indicates that the RU has valid TDMA packet, which is “Hi_TDMA_data_received”.

α is a placeholder of the CCDI message checksum.

1.10.11 TRANSACTION OK

The Transaction OK response is a single ASCII full stop character (2Eh).

This message is sent when the radio receives a command from the PC and confirms that the command has been received.

2 CCR

2.1 Introduction

Overview

This section provides details of the Computer-Controlled Radio (CCR) protocol, version 2.00. It describes the radio to Data Terminal Equipment (DTE) protocol. This is an advanced radio control feature.



Note CCR applies to TM8100 radio terminals only.

The CCR protocol provides a means of temporarily reprogramming a channel from some form of DTE via a serial interface (PC, AVL application, Telemetry Application, MDT).

In CCR mode, the radio no longer uses a non-volatile database. A number of radio parameters are uploaded and changed during run-time from an external application. In this way, the external application provides the non-volatile data storage.

All serial ports on the radio support CCR (Microphone, Auxiliary and Internal Options).

The CCR mode is a sub-mode of CCDI. Entry into CCR is via a CCDI command ("f0200D8"). Once, in CCR mode the radio will accept serial CCR commands and will no longer process CCDI commands.

The TM8100 series of radios are able to support USER, CCDI Transparent and CCR modes of operation.

Benefits

Most of the radio functionality can be controlled by the external device operating over a serial communications link. This allows system integrators to develop their own intelligent control device. They can develop complex solutions with a low cost RF platform.

In essence, a radio which has access to all the channels in its operating range could be made. The limit is no longer in the mobile but in the external intelligence driving it. A wider range of methods can be employed to alter or modify the way the radio is controlled by the user; a step forward in control evolution.

2.1.1 Configurable Parameters

Channel information:

- Tx/Rx frequencies
- Tx & Rx CTCSS/DCS frequencies

- Tx power level
- Channel bandwidth

The unit can accept or send Selcall in:

- All the international tone formats
- Between 2 and 8 tones per sequence.
- Tone durations from 20 - 100ms
- ANI leading/trailing sequence

Other features:

- Audio volume level
- Enable/disable monitor

2.1.2 Potential Applications

- Complex conventional radio units (multi-system)
- MDT controlled radio
- Remote off-air monitoring
- System integration
- Self healing RF networks
- Rapid deployment - inter operability
- Hybrid solutions

2.2 Programmable Parameters

CCR depends on the same programmable parameters as those used to configure CCDI command mode.

2.2.1 Requirements

The following needs to be enabled as a minimum:

- Enable CCDI
- Enable a serial port for communications (**Auxiliary**, Mic or Internal Options connector) as follows:

Parameter	Value
Baud rate	1200, 2400, 4800, 9600, 14400, or 19200
Number of data bits	8
Parity	None
Number of stop bits	1



Note The recommended configuration parameters are in Bold.

The serial port is capable of driving only a limited cable length. For more information on the serial port, refer to the service manual.

Radio operation while in CCR mode also requires, as a minimum, the following to be defined:

- Enable at least one channel
- Enable at least one PTT & microphone for voice

For selcall commands it is also necessary to enable at least one network using selcall signalling, as follows:

- Enable network to be selcall

The radio will, upon entry to CCR, inherit programmable parameters from the channel that was active when CCR was entered. Modifications while in CCR mode to channel/network characteristics will be compared to this baseline. All CCR changes are temporary, nothing is saved to the database, therefore they are lost on power cycling.

2.3 Command Protocol

The DTE is connected to the RU via a serial link. Command and response messages are generated between the DTE and the RU.

2.4 Command Description

This section details the standard messages.

2.4.1 Message Format

All CCR mode message packets take the following general form:

[IDENT][SIZE][PARAMETERS][CHECKSUM]<CR>

Where:

Parameter	Value
[IDENT]	is the message identifier. Identifiers are single ASCII characters which categorise the message type
[SIZE]	is the number of characters which make up the [PARAMETERS] field. [SIZE] is an 8-bit number expressed in ASCII-hex notation (two characters)
[PARAMETERS]	is an optional field, depending upon the command. Parameter values are generally character strings unless explicitly stated otherwise. Parameter type is dependent upon the command - there is no explicit type definition.
[CHECKSUM]	is an 8-bit checksum of the [IDENT], [SIZE] and [PARAMETERS] fields. It is expressed in ASCII-hex notation (two characters)
<CR>	is the packet terminator. It is the ASCII "carriage return" character (0Dh).

General characteristics of the message format worth noting are as follows:

- All characters in a message are printable ASCII
- Where numeric values are represented in ASCII-hex notation (two characters per byte), digits A...F are upper case
- The minimum length of a command packet is 5 characters; i.e. when [SIZE] = 00. For example, c003D is the CANCEL command which is 5 characters.
- The maximum length of the [PARAMETERS] field is 32 characters, so that the maximum length of the command packet is therefore 37 ([SIZE]="20") characters

2.4.2 Calculating [CHECKSUM]

[CHECKSUM] is calculated by applying the following algorithm:

5. Take the modulo-2 sum of all message bytes preceding [CHECKSUM].
6. Retain bits 0...7, discarding any higher order bits resulting from the summation.
7. Form the two's complement of the remainder.
8. Convert the binary number into two ASCII-hex digits, MSD first.

Checksum Example s0D050800TESTHi!DA

9. Take the modulo-2 sum of all message bytes preceding [CHECKSUM].
 - s = 73h, 0 = 30h, D = 44h etc. therefore the modulo-2 sum is:
73 + 30 + 44 + 30 + 35 + 30 + 38 + 30 + 30 + 54 + 45 + 53 + 54 + 48 + 69 + 21 = 426h

10. Retain bits 0 to 7, discarding any higher order bits resulting from the summation.
26h
11. Form the two's complement of the remainder.
26h = 0010 0110
two's complement = 1101 1010
12. Convert the binary number into two ASCII hex digits, MSD first.
1101 1010 = DA

2.5 CCR Mode Commands

2.5.1 Entering CCR Mode

CCR mode is entered from CCDI with the function zero command, “f0200D8”. This command is described in the CCDI specifications.

Entry to CCR mode will be denied if the radio is busy scanning, transmitting or processing emergency mode activities. CCR mode is not, however, blocked when the radio is stunned; CCR can run in this state.

2.5.2 CCR/CCDI Mode Independence

CCDI and CCR are independent from each other in that commands and responses for either command interpreter can only be processed in its own mode. There are, for instance, no CCDI progress messages when the radio is in CCR mode.

2.5.3 CCR Mode Activated

The radio sends the string “M01R00” to the DTE when CCR mode is activated.

2.5.4 CCR Mode Busy

It is possible to program an output line for busy detect status in CCR mode.

2.5.5 Blocked Functions

CCR mode denies the following functions (that are available in user mode) and indicates them as invalid if they are attempted from a front panel or programmable input:

- Channel selection

- Scanning
- Emergency
- SDM (No GPS)
- User mode selcalling:
 - No call setups with the front panel controls, programmable I/O or PTT
 - No selcall alerting for identities defined in the database

CCR is intended for headless radio units. Third parties can, upon integration, add their own implementations for things like scanning & selcall alerts.



Note PTT initiated functionality will only be suppressed, not indicated, notably, PTT call setup.

2.5.6 CCR Persistence

When a radio is reset nothing is saved from the current CCR session to the next power up. Third party devices can check that the radio is alive with the pulse command and “reprogram” it when a power outage has been detected.

2.5.7 CCR Response Time

The receive frequency in CCR mode can be changed at least every 20ms.

2.5.8 Exiting CCR Mode

When exiting CCR mode, the radio reboots. For more information, refer to [“Exit CCR Mode” on page 70](#).

2.6 CCR Positive Acknowledgements

The radio validates the received strings since the last command on the serial port versus the CCR protocol when it sees an instance of the terminating character <CR>. It returns either a positive or negative acknowledgement. The positive acknowledgement has the following format.

Response +ssxcc

Where:

Parameter	Value
+	ASCII '+' character indicates that the command was accepted
ss	ASCII hex number ss is the size of the ack (always "01")
x	echoes back the command identity, the first letter (R, T, A, B, S, M...)
cc	ASCII hex number cc is the checksum

Effect

An ACK response is sent back when a command has been accepted, the radio does not wait until the command has been executed. The ACK may be delayed, in some cases, but usually it is sent back immediately.

2.7 CCR Negative Acknowledgements

The radio validates the received strings since the last command on the serial port versus the CCR protocol when it sees an instance of the terminating character <CR>. It returns either a positive or negative acknowledgement. The negative acknowledgements are as follows.

2.7.1 Invalid CCR Command

If a string does not conform to the protocol, or there is something else inhibiting its execution, it is rejected and a negative acknowledgement is sent to the user. The negative acknowledgement has the following format.

Response

-ssrrxcc

Where:

Parameter	Value
-	ASCII '-' character indicates that the command was rejected
ss	ASCII hex number ss is the number of characters for parameters
rr	indicates the reason for rejecting the command as follows: <ul style="list-style-type: none"> ■ '02' Checksum error ■ '01' Invalid command ■ '03' Parameter error in command ■ '05' Radio is busy ■ '06' Command is not accepted
x	echoes back the command identity, but only if the checksum in the command was correct
cc	ASCII hex number cc is the checksum



Note A command is only ever rejected with one error code.

Effect The implementation exits the validation as soon as an error has been struck – it will not check the parameters if the command does not pass the checksum test.

2.7.2 Validation Checksum Error

If the input string does not have the correct checksum, a checksum error is immediately reported and no further checks are done.

2.7.3 Invalid Validation Command

If the input string passes the checksum test but the identity contained is not a recognised CCR command, an invalid command is reported.

2.7.4 Validation Parameter Error

If the input string passes the general message format but not the command specific tests, a parameter error is sent. For details on validation rules see the specific commands.

- data length check
- range check on message data
- correct sequence of commands

2.7.5 Radio Busy Message

If the input string passes both the general and command specific validation criteria, it is processed only if the following conditions are true:

- Radio is not in transmitting state
- Radio is not busy processing the last sent command

The radio rejects the commands and returns the busy error code in these instances.

2.7.6 Command Not Accepted Message

Some commands trigger sequence errors if they are sent when the radio cannot process the command, for example:

- Radio is attempting to use a selcall command when there is no selcall configuration defined.

This error is, for instance, sent if a selcall command is received, but the CCR channel is not activated with a network using selcall signalling.

2.8 CCR Commands

2.8.1 Summary and Examples

The messages in the following table are sent from the DTE to the RU.

Message	Cmd	Function
Rssxxxxxxxxcc	R	Go to Receive Frequency
Tssxxxxxxxxcc	T	Load Transmit Frequency
Hssxcc	H	Set Bandwidth
Jssxcc	J	Set Volume Level
Assxxxxcc	A	Receive CTCSS Value
Bssxxxxcc	B	Transmit CTCSS Value
Cssxxxxcc	C	Receive DCS Value
Dssxxxxcc	D	Transmit DCS Value
Sssxxxxcc	S	Encode Selcall Sequence
Isstplcc	I	Set Selcall Parameters
Nsspxxxxcc	N	Set ANI
Pssxcc	P	Transmitter Output Power
Qssxcc	Q	Query Radio Pulse
Esscc	E	Exit CCR Mode

In all cases, if the command is received without error by the RU and all the parameters are valid, the command will be executed and the prompt will be returned to the DTE. If an error arises, the DTE will be notified with an appropriate response.

Examples

f0200D8	Enter ccr from ccdi
E005B	Exit - same effect as “^”
R0945320000087	Set Rx frequency to 453.2MHz
T0945320000085	Set Tx frequency to 453.2MHz
Q01PFE	Pulse command, returns “P” when minimum config exists
P0111E	Set power to Very Low
P0141B	Set power to High
H01324	Set bandwidth to Wide
H01126	Set bandwidth to Narrow
A0406708E	Set Rx ctcss to 67Hz
A0400009B	Set Rx ctcss to 0Hz
B0406708D	Set Tx ctcss to 67Hz
B0400009A	Set Tx ctcss to 0Hz
C03023C5	Set Rx DCS to 23
C03000CA	Set Rx DCS to 0
D03023C4	Set Tx DCS to 23
D03000C9	Set Tx DCS to 0
S051234549	Dial 12345

I03015BE	Select toneset 0, ccir, 20ms tones and 5 tones notify
N04112387	Set ani to leading and tones 123
M01D0E	Monitor “on”
M01E0D	Monitor “off”
J03000C3	Volume level 0 (range is 0-255)
J03104BE	Volume level 104 (range is 0-255)

2.8.2 Go to Receive Frequency

Description On receipt of this command, the radio checks the format and does a range check on the frequency. If it is valid, the radio sends an ACK response and then initialises the synthesizer with the new frequency. One should allow 20ms for the synthesizer to settle at the new frequency. If the command is invalid, a NAK response will be sent and the receiver will remain at the last selected frequency. If the radio is transmitting then a NAK response will also be sent.

Command Rssxxxxxxxxcc

Where:

Parameter	Value
R	ASCII letter R denotes the go to Receive frequency
ss	ASCII hex number ss is the number of characters for parameters (“08” or “09”)
xxxxxxxx	ASCII number xxxxxxxx is the receive frequency, as follows: <ul style="list-style-type: none"> ■ Minimum is a number representing the bottom of the radio model frequency band ■ Maximum is a number representing the top of the radio model frequency band
cc	ASCII hex number cc is the checksum

Effect This command has immediate effect with the receiver retuning to this channel. If the synthesizer is out of lock then a NAK response will be sent.

2.8.3 Load Transmit Frequency

Description On receipt of this command, the radio checks the format and does a range check on the frequency. If it is valid, the radio sends an ACK response. If the command is invalid, a NAK response will be sent and the transmit frequency will not change. If the radio is transmitting then a NAK response will also be sent.



Important The radio may restrict the transmitter output power depending on the programmed transmit frequency, in accordance with regulatory requirements.

Command Tssxxxxxxxxcc

Where:

Parameter	Value
T	ASCII letter T denotes the Load Transmit Frequency command
ss	ASCII hex number ss is the number of characters for parameters "08" or "09")
xxxxxxx	ASCII number xxxxxxx is the transmit frequency, as follows: <ul style="list-style-type: none">■ Minimum is a number representing the bottom of the radio model frequency band■ Maximum is a number representing the top of the radio model frequency band
cc	ASCII hex number cc is the checksum

Effect This command loads the transmit frequency into a memory location for use when the PTT or Selcall encoder is next active. The radio will not transmit if the synthesizer is out of lock.

2.8.4 Set Volume Level

Description This command sets the volume level for received audio. If the index number is out of range the radio does not act on the command and sends a NAK (range error) back.

Command J03xxxcc

Where:

Parameter	Value
J	ASCII letter J denotes the Set Volume Level command
03	ASCII hex number 03 is the number of characters for parameters
xxx	ASCII number xxx is a volume level value in the range of 0 to 255 (255 is the maximum)
cc	ASCII hex number cc is the checksum

Effect This command has immediate effect.

If there is a volume knob on the radio there is no guarantee that the value set with this command will be the volume. The radio will use the level last set with any control.

2.8.5 Receive CTCSS Value

Description This command disables (if xxxx=0), or enables (if xxxx>0), Rx CTCSS. If enabled, the audio mute is opened only when a given subaudible CTCSS tone is being received (otherwise the audio mute is closed). If disabled, muting on CTCSS is disabled. If the frequency is out of range, the radio does not act on the command and sends a NAK (range error) back.

Command A04xxxxcc

Where:

Parameter	Value
A	ASCII letter A denotes the Receive CTCSS Value load command
04	ASCII hex number 04 is the number of characters for parameters
xxxx	ASCII number xxxx is a receive subaudible frequency in 0.1Hz. The valid range is 67Hz to 254.1 Hz.
cc	ASCII hex number cc is the checksum

Effect This command has immediate effect and closes the mute to signals without a valid CTCSS tone if enabled, or opens the mute on disabling CTCSS muting.

2.8.6 Transmit CTCSS Value

Description This command disables (if xxxx=0) or enables (if xxxx>0), Tx CTCSS. If enabled, a CTCSS tone is transmitted whenever the radio is transmitting audio. If the reference number is out of range, the radio does not act on the command and sends a NAK (range error) back to the radio. If the radio is already transmitting then a NAK response will also be sent.

Command Bssxxxxcc

Where:

Parameter	Value
B	ASCII letter B denotes the transmit CTCSS value to be sent on transmit
04	ASCII hex number 04 is the number of characters for parameters
xxxx	ASCII number xxxx is a transmit CTCSS frequency in 0.1Hz. The valid range is 67Hz to 254.1 Hz.
cc	ASCII hex number cc is the checksum

Effect On receipt of the request the radio stores the CTCSS tone to generate. The radio will then generate the tone at the next PTT or Selcall encode activity.

2.8.7 Receive DCS Value

Description This command disables the DCS filter if the code is “000”. If the code is not recognized as an octal, the radio does not act on the command and sends a NAK (range error) back.

Command C03xxxcc

Where:

Parameter	Value
C	ASCII letter C denotes the Receive DCS Value load command
03	ASCII hex number 03 is the number of characters for parameters
xxx	ASCII number xxx represents a DCS code in octal
cc	ASCII hex number cc is the checksum

Effect This command has immediate effect and closes the mute to signals without a valid DCS tone.

2.8.8 Transmit DCS Value

Description This command disables the DCS encoding if the code is “000”. If the code is not recognized as an octal, the radio does not act on the command and sends a NAK (range error) back.

Command D03xxxcc

Where:

Parameter	Value
D	ASCII letter D denotes the transmit DCS value to be sent on transmit
03	ASCII hex number 03 is the number of characters for parameters
xxx	ASCII number xxx represents a DCS code in octal
cc	ASCII hex number cc is the checksum

Effect This command loads the value into memory ready for the next PTT or Selcall encode activity.

2.8.9 Encode Selcall Sequence

Description This command turns the transmitter on and sends the Selcall string following a short delay (network 1 lead-in delay). If the number of tones is incorrect the command is rejected (NAK-format error).

Command Sssx...xcc

Where:

Parameter	Value
S	ASCII letter S denotes the Transmit Selcall tone sequence
ss	ASCII hex number ss is the number of characters for parameters
x...x	ASCII number x...x is the tone sequence. Minimum is 2 tones and maximum is 33.
cc	ASCII hex number cc is the checksum

The Set Selcall Parameter command (see below) allows the user to change the Selcall parameter defaults.

Effect This command has immediate effect, provided that the receiver and transmitter frequency values have been initialised and the radio is not transmitting at the time (PTT active causes busy error)

2.8.10 Set Selcall Parameters

Description This command allows the user to modify the Selcall default parameters (tone set to use, tone period, number of tones in Tx sequence and number of tones in Rx sequence). If any of the command parameters are out of range, a NAK (range error) will be sent back to the control head.

Command I03tplcc

Where:

Parameter	Value
l	the ASCII letter l denotes the Set Selcall Parameter command
03	ASCII hex number 03 is the number of characters for parameters
t	specifies the Tone Set to use. This can be one of the following: <ul style="list-style-type: none">■ '0'cclR■ '1'EIA■ '2'EEA■ '3'ZVEI-I■ '4'ZVEI-II■ '5'ZVEI-III■ '6'PZVEI■ '7'NATEL■ '8'DZVEI
p	specifies the Tone Period to use. This can be one of the following: <ul style="list-style-type: none">■ '1'20ms■ '2'33ms■ '3'40ms■ '4'50ms■ '5'60ms■ '6'70ms■ '7'100ms
l	sets the decode buffer time and message filter as defined in "Notify Buffer Size" on page 73 and "Selcall Decode Sequence" on page 73 .
cc	ASCII hex number cc is the checksum

Effect

The Selcall modem is immediately re-initialised with the new decode parameter map. These new parameters are applied for the next Selcall decode/encode sequence.

CCR default parameters are those loaded from the network associated to the selected channel when the radio enters CCR mode. This includes selcall parameters like 'lead in delay', which it is not possible to alter in CCR mode.

2.8.11 Set ANI

Description

This command disables or enables ANI. It configures what ANI sequence is to be sent and when the ANI sequence is to be sent. If p is not '0', the tone sequence gets stored.

If the number of tones (xx...xx) does not match the currently configured length, then the command is rejected (NAK- format error). It is also rejected if p is out of range (range error).

Command Nssp x ... x cc

Where:

Parameter	Value
N	ASCII letter N denotes the Automatic Number Identification command
ss	ASCII hex number ss is the number of characters for parameters
p	denotes the ANI position with regard to PTT presses. Valid values are: <ul style="list-style-type: none">■ '0' disables ANI (in this case the tone sequence x...x is not required)■ '1' leading ANI (ANI is sent soon after PTT is pressed)■ '2' trailing ANI (ANI is sent when PTT is released)■ '3' combination of 1 and 2
x ... x	is the 5 to 8 tone sequence. It is optional if p is set to 0.
cc	ASCII hex number cc is the checksum

Effect If enabled, the ANI tones get stored and any subsequent use of the PTT button activates ANI.

2.8.12 Monitor

Description This command is the same as the monitor function available on the function keys in normal user mode. When it is active, it overrides any active subaudible signalling filters. The squelch mute is not overridden.

Command M01 x cc

Where:

Parameter	Value
M	ASCII letter M indicates it is a monitor command
01	ASCII hex number 01 is the number of characters for parameters
x	is the mute state wanted, as follows: <ul style="list-style-type: none">■ 'D' for disable mute (monitor)■ 'E' for enable mute
cc	ASCII hex number cc is the checksum

Effect Immediate.

If there is a front panel key or programmable input with monitor configured, there is no guarantee that the value set with this command will represent the monitor state. The radio will use the state last set with any control.

2.8.13 Transmitter Output Power

Description The transmitter output power is set to the value selected. If the index is incorrect the command is rejected (NAK-format error).



Important The radio may restrict the transmitter output power depending on the programmed transmit frequency, in accordance with regulatory requirements.

Command P01xcc

Where:

Parameter	Value
P	ASCII letter P indicates it is a power command
01	ASCII hex number 01 is the number of characters for parameters
x	is an index to transmit power level, as follows: <ul style="list-style-type: none">■ '1' very low power■ '2' low power■ '3' medium power■ '4' high power
cc	ASCII hex number cc is the checksum

Effect The modified power level takes effect on the next Tx activity; either PTT or Selcall.



Note If there is a front panel key or programmable input with low power configured, there is no guarantee that the value set with this command will represent the effective output power. The radio will use the state last set with any control.

2.8.14 Set Bandwidth

Description This command sets the operating transmit/receive bandwidth. If the index number is out of range, the radio does not act on the command and sends a NAK (range error) back.

Command Hssxcc

Where:

Parameter	Value
H	ASCII letter denotes the Set Bandwidth command
01	ASCII hex number 01 is the number of characters for parameters
x	is the Bandwidth Index, as follows: <ul style="list-style-type: none"> ■ '1'narrowband ■ '2'mediumband ■ '3'wideband
cc	ASCII hex number cc is the checksum

Effect This command has immediate effect.

2.8.15 Query Radio Pulse

Description The purpose of this command is to give the user a way to “ping” the radio.

The radio pulse command allows you to check that the radio is still responding. The control device may use the radio pulse command every ten seconds in the absence of other activity.

Command Q01PFE

Where:

Parameter	Value
Q	ASCII letter Q indicates it is a query command as opposed to a set-up command
01	ASCII hex number 01 is the number of characters for parameters
P	ASCII letter P indicates it is the radio pulse command
FE	ASCII hex number FE is the checksum

Response The radio will send back one of two responses:

- QssPcc - if the radio has got its minimum configuration, which typically consists of having received a ‘set receive frequency’ command.
- QssDcc - is returned if the radio has loaded its default set-up and has not yet received a ‘set receive frequency’ command.

Effect These commands invoke an immediate reply.

2.8.16 Exit CCR Mode

Description The radio initiates a software reset (same as for “^”), and exits CCR mode.

Command E005B

Where:

Parameter	Value
E	ASCII letter E indicates it is an exit command
00	ASCII hex number 00 indicates that there are no parameters
5B	ASCII hex number 5B is the checksum

Effect This command is immediate. The radio will reset.

2.9 Unsolicited Messages from the Radio

2.9.1 Summary and Examples

The following messages may be returned to the DTE without user intervention.

Message	Cmd	Function
Vssx...xcc	V	Selcall decode sequence
Msspcc	MP	Ptt exceeds max transmit limit
Mssrcc	MR	CCR initialised

Examples:	V0612345-18	Sequence 12345 detected
	V065E5E5-EE	Sequence 55555 detected (E is repeat tone in this case)
	M01P02	Transmit timeout warning (10s before inhibit)
	M01R00	CCR mode entered

2.9.2 PTT exceeds max transmit limit

Description The radio uses this response to advise the control head that PTT is about to timeout.

For control heads with user interfaces, the warning threshold is the duration timer configured for the network minus 10s.

Response Msspcc

Where:

Parameter	Value
M	ASCII letter M denotes the message
ss	ASCII hex number ss is the number of parameters (always "01")
P	ASCII letter P denotes a PTT being applied that has exceeded the default transmit timer warning threshold
cc	ASCII hex number cc is the checksum

Effect Whenever the radio reaches its maximum transmit period the radio will inform the control head. After a further short delay the radio will turn off the transmitter.

2.9.3 Selcall Decode Sequence

Description The radio sends this message every time the decoder tone buffer is emptied, in accordance with the notification criteria set by the “I” command. See “Set Selcall Parameters” on page 66 and “Notify Buffer Size” on page 73.

The sequences received are represented with the tones from the toneset. Repeat tones and gaps will be forwarded as is.

Response Vssx...xcc

Where:

Parameter	Value
V	ASCII letter V denotes the Selcall decode message
ss	ASCII hex number ss is the number of parameters
x...x	are the tones decoded within the time window specified by the notify parameters as follows: <ul style="list-style-type: none">■ ASCII digits 0 to 9■ Special tones are represented with ASCII letters A to F■ Gap. A gap in CCR is equal to the tone period set by the Selcall Parameter command
cc	ASCII hex number cc is the checksum

Effect When the radio receives the given SELCALL sequence the radio sends the decoded sequence to the DTE.

2.9.4 Notify Buffer Size

Description The number of tones to notify, set by the selcall parameter command, allow the user to define the size of the decode tone buffer. This buffer sets the maximum time period that the radio will decode and log tones before reporting to the user, when continuously receiving valid selcall tones. The timer is calculated as follows:

$$T_{max} = (N \times P) + P$$

Where:

Parameter	Value
Tmax	Notify buffer maximum time
N	Number of tones
P	Tone period

The buffer timer is started after at least one valid tone has been detected.

The buffer timer is reset if a gap is detected prior to expiry.

The notify parameter also sets a filter that allows the user to suppress decode sequences from being reported if they consist of less than the selected number of tones in a continuous sequence, as follows:

- If the decode buffer contains less than the selected number of tones when it is reset the contents shall be discarded.

If a radio in CCR receives a speech call it is very likely that the user will see this response with garbage decode sequences (1 or 2 tones) if the filter is removed.

The additional tone period added to the buffer time allows the radio to detect and report if a gap was present or not after the sequence detected.

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