

T2000-60

**COMPUTER CONTROLLED
INTERFACE**

OPERATOR'S MANUAL

CONTENTS

	Page
1 Introduction	1
2 Common Abbreviations	2
3 UART Interface Module	3
4 Command Protocol	4
4.1 Command Mode	4
4.2 Transparent Mode	5
4.3 Switching Modes	6
5 Programmable Parameters	7
6 Handshaking	8
7 Differences Between T2020 And T2040	11
7.1 PTT Input	11
7.2 Option Board Connectors	12
7.2.1 T2020	12
7.2.2 T2040	12
8 Command Description	13
8.1 Message Format	13
8.1.1 Calculating [CHECKSUM]	14
8.2 Commands To RU	15
8.2.1 Dial	16
8.2.2 Go_To_Channel	18
8.2.3 Cancel	19
8.2.4 Function	20
8.2.5 Query	23
8.2.6 Transparent	24
8.2.7 Reset	25
8.3 Responses From RU	26
8.3.1 Transaction OK	26
8.3.2 Error	26
8.3.3 Model	28
8.3.4 Progress	29
8.3.5 Ring	34
Appendix A	37

1 INTRODUCTION

The T2000-60 Computer Controlled Interface (CCI) allows a T2020 or T2040 radio to be controlled via a computer. Full remote control of the radio allows either semi or fully automatic communication systems to be developed.

The CCI is a sophisticated device and is mounted inside a T2020 or T2040 radio onto the options interface. It allows an RS-232 link between the computer equipment and either the radio or an auxiliary device attached to the radio. In most applications only a single serial port is required by the computer.

The features offered by the CCI are determined by its command protocol which is embedded in the radio software (this will vary between the T2020 and T2040). The command protocol determines how and what the user can control on the radio and how auxiliary devices can be controlled. The bulk of this document is devoted to describing the command protocol, as the user must have a good understanding of its functionality to write application software. Section 8 of the T2000 service manual describes how the CCI is fitted and the set up procedures.

The following topics are covered in this manual:

- terminology used in this manual
- CCI hardware and operating modes
- signal descriptions and connector pin out information
- radio programming required prior to using the CCI
- handshaking between computer and CCI
- CCI operational differences when used with a T2020 or T2040.

The remainder of this document details the command protocol used between the CCI and the computer equipment to control the radio's functionality (some typical applications are outlined).

Note: At release of this specification the enhanced Selcall facilities will not be fully utilised via the CCI.

2 COMMON ABBREVIATIONS

AE	Auxiliary Equipment - the general term for any supplementary device connected to the interface. AE may be a modem, printer, display unit etc.
CCI	Computer Control Interface - the combination of command protocol and interface hardware which allows communication between CE and the RU.
CE	Computer Equipment - the "intelligent" device which controls the RU and/or receives data over the interface.
PGM2000	The PC based radio programming equipment.
PortA	Refers to the primary serial port provided on the UIM. The CE connects to this port.
PortB	Refers to the secondary serial port provided on the UIM. The AE connects to this port.
RU	Radio unit.
UART	Universal Asynchronous Receiver/Transmitter. The integrated circuit which provides the serial port logic.
UIM	UART Interface Module - the hardware portion of the interface. This module is physically located inside the RU.

3 UART INTERFACE MODULE

The UIM is a printed circuit board which mounts in the option space inside the radio. Refer to section 8 of the T2000 service manual for instructions on fitting the UIM.

A dual UART (SCN2681T) connects to the microprocessor's bus and provides two independent, asynchronous serial ports. The serial interface signals pass in and out through level converting buffers which provide compatibility with the electrical provisions of RS-232. Buffering of data in both the transmit and receive paths is handled by the radio's microprocessor.

Transmit and receive audio connections are provided with buffering and gain control to suit most signalling devices (e.g. modems etc.).

A switched +13.8V supply is also provided from the radio to the D-range connector at the rear of the radio. Provided the current stated in the "Signal Specifications" is not exceeded, the AE (i.e. a modem) can be powered from here.

4 COMMAND PROTOCOL

The CE is connected to the RU via port A on the UIM. Commands are generated by the CE and responses/status messages returned by the RU. By means of a special command sequence a "connection" can be made between port A and port B, enabling the CE to communicate with a device attached to the second port. Two modes of operation are thus defined:

Command Mode: the mode in which the CE communicates directly to the RU via a set of defined messages.

Transparent Mode: the mode in which the CE communicates directly to a device attached to port B.

In Command Mode there is a set format for messages and mechanisms for detecting transmission errors. In Transparent Mode, however, the communication is free-format, any protocol being determined entirely by the CE and equipment connected to port B.

4.1 COMMAND MODE

The CCI normally operates in Command Mode which is the default upon power-up of the RU. Control of the RU is accomplished by the CE sending a command sequence (packet) and receiving a response (a transaction). Unsolicited messages may originate from the RU if there is a significant change of state inside the RU which the CE should be aware of.

The RU will issue a prompt character to indicate to the CE that it is ready to accept a new command. After issuing a command, the CE must wait for another prompt before beginning the next transaction. The prompt character is "." (full stop, ASCII code = \$2E).

Messages directed to the RU will always be responded to, either explicitly by means of a return message, or implicitly by just the prompt being issued. The RU will not originate a message to which a reply is expected (unsolicited messages from the RU are for information purposes only).

4.2 TRANSPARENT MODE

Transparent Mode allows for direct communications between the CE (on port A) and any AE connected to port B of the UIM. In most applications the AE would be a modem. The transparent link allows the CE to send set-up commands etc. to the AE and send and receive data without having to pass messages via the RU. Thus, the RU does not require any knowledge about the AE or its command set.

Note: The transparent link is administered by the RU in that it reads characters arriving at one port and sends them to the second. The communication format is largely free, and the only precaution which needs to be taken is that the command to switch back to Command Mode should not appear embedded in any data the CE sends to the AE.

Data passing between CE and AE is buffered in both directions. If the data "packets" are small enough and communication is semi-duplex only, handshaking on the serial link is not necessary. However, if full duplex communications are required, large blocks of data are being transferred, or the port A and port B baud rates are different, then handshaking must be utilised. Both hardware (DTR/CTS) and software (XON/XOFF) handshaking options are available.

Whilst in Command Mode, any data arriving from the AE will be buffered and output to the CE when Transparent Mode is next invoked. In Transparent Mode, status messages from the RU may be inserted in the data stream to the CE. Status messages will have the standard packet format described in the section above, but will be preceded by three consecutive "escape" characters in order to alert the CE. This "escape" character is the same one determined by the CE to exit the Transparent Mode. (Refer to paragraph three of the "Switching Modes" section.)

4.3 SWITCHING MODES

Mode switching is always initiated by the CE.

Upon power-up, the CCI always comes up in Command Mode. In order to enter Transparent Mode, the CE must send a special message to the RU. Once acknowledged, any further communication is via the transparent link to the AE. In order to return to Command Mode, the CE must send the "escape" sequence of characters to the RU. The "escape" sequence is determined by the CE at the time it commands the CCI to enter Transparent Mode. As part of the mode switch command the CE must identify a character which, when repeated three times in succession, will force the CCI to Command Mode.

Because the RU "eavesdrops" on Transparent Mode communications, it can identify the "escape" sequence in any stream of data coming from the CE. The CE must take care to identify an "escape" sequence which cannot occur naturally in its communications with the AE.

The use of the "escape" sequence can be summarised as follows:

- three consecutive "escape" characters *to the RU* will force the CCI out of Transparent Mode only if already in that mode;
- three consecutive "escape" characters *to the CE* will alert the CE that the following data is a message from the RU only if the CCI is in Transparent Mode.

5 PROGRAMMABLE PARAMETERS

The serial ports on the UIM may be configured to suit a wide range of computer equipment and/or modems. The following parameters may be adjusted when programming the T2000 (default settings highlighted):

PORT A

Baud rate	.. 600, 1200 , 2400, 4800, 9600
Number of data bits	.. 7, 8
Parity	.. even, odd, none
Number of stop bits	.. 1 , 2
Handshaking	.. hardware, software, none

PORT B

Baud rate	.. 600, 1200 , 2400, 4800, 9600
Number of data bits	.. 7, 8
Parity	.. even, odd, none
Number of stop bits	.. 1 , 2
Handshaking	.. hardware, software, none

Note: The maximum baud rate for the T2040 is 2400.

GENERAL

XON character	.. default = \$11 [^Q]
XOFF character	.. default = \$13 [^S]

6 HANDSHAKING

The provision of the handshaking modes enables the control of data flow, and thus reduces the possibility of losing data when transferring large amounts of data. The following points must be taken into consideration.

- * If the baud rates of ports A and B are not the same, then handshaking must be active.
- * If Software Handshaking or No Handshaking has been selected, then the DTR outputs **MUST** be connected to their corresponding CTS inputs:

```
DTRA  ┌──┐ Link6
CTSA  └──┘
```

```
DTRB  ┌──┐ Link7
CTSB  └──┘
```

- * When using handshaking, once the XOFF character has been transmitted **OR** the DTR output has been deactivated, up to 20 more bytes will be accepted before data is lost. This should provide sufficient time for the transmitting device to react to the XOFF character or the DTR change of state.
- * For Software Handshaking mode:
 - To help ensure that the XOFF character is not missed by the external device, an XOFF character will be sent again if data is still being received after an XOFF character has already been sent.
 - Any XOFF/XON characters will only originate from the RU. The XOFF/XON characters sent by an external device in transparent mode will be filtered by the RU, thus not appearing at the other port.
- * The lines provided for Hardware Handshaking mode are as follows.

DTRA Data Terminal Ready for port A. This is an output on the radio used to indicate to the connected equipment if the radio is ready to receive data through port A. DTRA is activated whenever the radio is ready to receive data through port A. This is regardless of whether the connected equipment wants to send data or not. DTRA is deactivated whenever the radio is not ready to receive data through port A. If using hardware handshaking, the connected equipment should always check this line before transmitting data to port A. When not using hardware handshaking, this output will always be active.

DTRB Data Terminal Ready for port B. This is an output on the radio used to indicate to the connected equipment if the radio is ready to receive data through port B. DTRB is activated whenever the radio is ready to receive data through port B. This is regardless of whether the connected equipment wants to send data or not. DTRB is deactivated whenever the radio is not ready to receive data through port B. If using hardware handshaking, the connected equipment should always check this line before transmitting data to port B. When not using hardware handshaking, this output will always be active.

CTSA Clear To Send for port A. This is an input on the radio used by the connected equipment to indicate to the radio if it is ready to receive data from port A. CTSA is to be activated by the connected equipment whenever it is ready to receive data from port A. This is regardless of whether the radio wants to send data or not. CTSA is to be deactivated by the connected equipment whenever it is not ready to receive data from port A. The radio will always check this line before attempting to transmit data through port A.

CTSB Clear To Send for port B. This is an input on the radio used by the connected equipment to indicate to the radio if it is ready to receive data from port B. CTSB is to be activated by the connected equipment whenever it is ready to receive data from port B. This is regardless of whether the radio wants to send data or not. CTSB is to be deactivated by the connected equipment whenever it is not

ready to receive data from port B. The radio will always check this line before attempting to transmit data through port B.

7 DIFFERENCES BETWEEN T2020 AND T2040

There are some differences in the operation of computer control mode between the T2020 and T2040. This is entirely due to the fundamental differences between trunked and non-trunked radios.

7.1 PTT INPUT

Asserting this input on a T2020 will always cause the radio to transmit unless signalling inhibits are active.

On a T2040, exact operation will depend upon programming and whether the radio is active on a traffic channel or not. The truth table is:

- * Radio programmed for "PTT initiates a call":
 - if on a control channel, asserting this input will make a call to the last called number;
 - if on a traffic channel, asserting this input will cause the radio to transmit.

- * Radio not programmed for "PTT initiates a call":
 - if on a control channel, asserting this input will have no effect.
 - if on a traffic channel, asserting this input will cause the radio to transmit.

7.2 OPTION BOARD CONNECTIONS

Note: Any one of the following options can be linked to the EXTERNAL line to make the option available at the T2020/2040 power connector.

7.2.1 T2020

- * The EMERGENCY option (input) can be used to set up an emergency Selcall to a pre-programmed address.
- * The HUSH option (output) reflects the status of the receiver's mute.
- * The AUX option (output), if programmed accordingly, reflects the status of the "AUX" key on the T2020 keypad.
- * The HORN option (output), if programmed accordingly, can be used as an external alert if a Selcall is received.
- * EXTERNAL is a line to pin 1 of the T2020 power connector (P3).

7.2.2 T2040

- * With the CCI fitted, the EMERGENCY option (input) can be used to set up a preset data call to the address specified in the ECR preset call string.
- * The HUSH option (output) is not used.
- * The AUX option (output) is normally set active, but remains low while call set-up is in progress.
- * The HORN option (output) can be set up for an external alert for incoming calls.

8 COMMAND DESCRIPTION

This section details the standard commands and responses which apply in Command Mode.

8.1 MESSAGE FORMAT

All 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 - there is no explicit type definition.

[CHECKSUM] An 8-bit checksum of fields [IDENT], [SIZE] and [PARAMETERS]. It is expressed in ASCII-hex notation (two characters).

<CR> The packet terminator. It is the ASCII "carriage return" character (\$0D).

General characteristics of the message format worth noting are:

- * 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. this is when [SIZE] = 00).
- * The maximum length of the [PARAMETERS] field is 32 characters for the T2020 and 64 characters for the T2040. The maximum length of the command packet is therefore 37 characters ([SIZE]=20) for the T2020 and 69 characters ([SIZE]=40) for the T2040.
- * An example of a message line is as follows:

d0601234507

"d" is the message [IDENT], in this case describing that this message is a "DIAL" command.

"06" is the message [SIZE], describing that there are 6 characters of data to follow in the [PARAMETERS] field.

"0-5" are the data bytes in the [PARAMETERS] field.

"07" is the calculated checksum of the message line.

The actual data that will be sent out the port in hexadecimal form is:

64 30 36 30 31 32 33 34 35 30 37

8.1.1 Calculating [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..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.
5. Taking the same example used above, d0601234507, the checksum of the above message is calculated as follows.

Take the sum of all message bytes and retain only bits 0 = 7.

Hex addition: $64+30+36+30+31+32+33+34+35 = F9$

Take the 2's Complement of Hex F9 = Hex 07

8.2 COMMANDS TO RU

The following commands are available to the CE to control operation of the RU:

DIAL	Make a call
GO_TO_CHANNEL	Go to channel
CANCEL	Abort current activities
FUNCTION	Implement RU function
QUERY	Identify RU type
TRANSPARENT	Switch to Transparent Mode
RESET	Perform RU warm reset

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

8.2.1 Dial

Applies to T2020 and T2040.

The DIAL command allows access to the full dialling capability of the RU. In the case of the T2020, this means Selcall and/or DTMF sequences may be dialled (on the current channel). In the T2040, any MPT1343 string or other dial-access function may be entered.

[IDENT] d

[PARAMETERS] [DTYPE][NUMBER_STRING]

[DTYPE] A single character representing the type of dialling required:
 0 = SELCALL (T2020 only)
 1 = DTMF (T2020 only)
 2 = Trunked radio dialling string(T2040 only)

[NUMBER_STRING] A string of characters representing the dialled sequence. The range of allowed characters depends upon the value of [DTYPE]:

[DTYPE] = 0, range = 0..9,A..F (must be 5 digits)

[DTYPE] = 1, range = 0..9,A..D,*,# (max. of 32 digits)

[DTYPE] = 2, range = 0..9,*,# (max. of 32 digits)

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 RU will return a "Transaction OK" message as soon as the DIAL command is accepted and calling starts, but the CE may have to wait for a PROGRESS message advising of successful call set-up before proceeding.

Notes

1. Selcall strings usually utilise only the digits 0..9. Some of the tones A..F have special meaning, i.e. A = Group; C = Reset; E = Repeat.

2. The Selcall string length **MUST** always be 5.
3. Selcall calls are made within the bounds of the following parameters, as programmed into the RU: tone period, tone set and lead-in delay.
4. DTMF digits A..D are not normally accessible from the keypad of the RU but are included here for completeness.
5. The maximum number of digits in a DTMF string is (nominally) 32.
6. DTMF calls are made within the bounds of the following parameters, as programmed into the RU: lead-in delay, tone period and inter-tone gap.
7. All trunked radio dialling strings and call modifiers are accessible, as are other functions available via dialling entry. It is recommended, however, that the `GO_TO_CHANNEL` command be used to access non-trunked channels in order to maintain consistency with the T2020.
8. If a T2040 is operating in non-trunked mode and receives a valid `DIAL` command which requires a trunked call to be set up, the RU will automatically resume trunking operation and process the call. If the call set-up fails, **THE RU WILL REMAIN IN TRUNKED MODE.**
9. The maximum number of digits in an MPT1343 string is (nominally) 32.
10. Examples of `DIAL` command lines would be:

d0601234507 This message specifies a Selcall dialling of the number *1 2 3 4 5*.

d0611234506 This message specifies a DTMF dialling of the number *1 2 3 4 5*.

8.2.2 Go_To_Channel

Applies to T2020 and T2040.

The GO_TO_CHANNEL command forces the RU to change to another (conventional) channel.

[IDENT] g

[PARAMETERS] [CHANNEL_NUMBER]

[CHANNEL_NUMBER] A string of characters representing the new channel number. The range of allowed characters is 0..9 only and the maximum number of digits is 3.

Notes

1. The value of the new channel number must be valid for the RU being controlled (range of allowed values depends upon the RU's programming).
2. If the RU is a T2040 currently active in trunking mode, a valid GO_TO_CHANNEL will put the RU into conventional mode.
3. The maximum number of digits in the [CHANNEL_NUMBER] string is 3.
4. Examples of GO_TO_CHANNEL command lines would be:

g0245CE This message specifies a channel change to Channel 45.

g03100A5 This message specifies a channel change to Channel 100.

8.2.4 Function

Applies to T2020 and T2040.

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

[IDENT] f

[PARAMETERS] [FUNCTION][QUALIFIER]

[FUNCTION] A single character representing the required function category:

0 = Query RU state (currently not supported)

1 = Set signalling status level

2 = AUX control

3 = Hook control

4 = User controls

5 = Receiver audio mute control

6 = Transparent mode message filter control

[QUALIFIER] A character string representing the action to be taken. The meaning of [QUALIFIER] is dependent upon the value of [FUNCTION]:

[FUNCTION] = 0

[QUALIFIER] = none

[FUNCTION] = 1

[QUALIFIER] = new status level

[FUNCTION] = 2

[QUALIFIER] = 0 : deactivate AUX signal

[QUALIFIER] = 1 : activate AUX signal

[FUNCTION] = 3

[QUALIFIER] = 0 : force mic. "on-hook"

[QUALIFIER] = 1 : force mic. "off-hook"

[FUNCTION] = 4

[QUALIFIER] = 0 : disable all user controls

[QUALIFIER] = 1 : disable user input only

[QUALIFIER] = 2 : enable all user controls

[FUNCTION] = 5
[QUALIFIER] = 0 : cancel request cci mute rx
audio

[QUALIFIER] = 1 : request cci mute rx audio

[FUNCTION] = 6
[QUALIFIER] = 0 : deactivate message filter
[QUALIFIER] = 1 : activate message filter

Notes

1. The "query RU state" is currently not supported.
2. The "set signalling status function" loads a new value into the user status variable in the RU. This value is transmitted whenever a status call is made from the front panel of the RU or the RU transponds to signalling received from some other party.

Note: The range of allowed status values depends upon the RU under consideration and how it has been programmed. In general, the following apply:

* T2020 - range = 0..9, A..F (single digit).

* T2040 - range = 01..30 (two digits).

NB: Special meanings may be attached to one or more of these status levels, restricting the range able to be set by this command.

3. The "AUX control" function sets the state of the AUX control signal on the options connector inside the RU. This signal may be used for any switching purpose.

Note: The RU will only support this function if it has been programmed with the AUX key controlling the auxiliary line. This may be a "Momentary" or "Latching" AUX key. In these cases, this function command will operate in parallel with the operation of the RU AUX key.

The state of the AUX signal line is preserved after a reset of the RU. Care must be taken to ensure it is always in the correct state for the application after power-up.

4. The "hook control" function operates in parallel with the microphone hookswitch. On a T2020, the CE may use this function to enable and disable signalling mutes, and also continue and suspend scanning. On a T2040, this function is used to answer incoming (full off-air set-up) calls and terminate an active call.
5. The "user controls" function allows the CE to selectively disable the front panel controls of the RU. Three states are defined:

Enable All User Controls

This enables the RU to be used normally except when the CCI is processing a message. When the CCI is processing a message, the top row LEDs will light up and "CCI BUSY" will be displayed; when processing has completed, the RU will be returned to its normal state.

Display User Input Only

This disables all user inputs, but the display and other indicators will be enabled for user information. Any attempt on user input will result in the invalid keypress tone being sounded.

Disable All User Controls

This disables all user inputs and all indicators including the display. The top row LEDs will light up and "CCI BUSY" will be displayed on the display.

6. The "Receiver audio mute control" function will request or cancel its request for a "CCI mute" of the RU. This mute request will affect the mute state of the RU and can only be overwritten by the "Squelch Override" of the RU.
7. The "Transparent mode message filter control" function will activate or deactivate the message filter for transparent mode. This is a filter for stopping selected progress messages from being transmitted when in transparent mode. The messages that currently will be filtered by this function are indicated in the section on PROGRESS messages.

8. Examples of FUNCTION command lines would be:

f0210D7 This message specifies a set status command requesting an update of the current status digit to *status digit 0*.

f0221D5 This message specifies an *activate AUX signal* command.

f0230D5 This message specifies an *on hook* command.

f0241D3 This message specifies a *disable user input* command.

f0250D3 This message specifies a *receiver audio mute control* command.

f0261D1 This message specifies an *activate message filter* command.

8.2.5 Query

Applies to T2020 and T2040.

The QUERY command requests the RU to respond with a block of data identifying the type of RU attached and the version of its CCI firmware.

[IDENT] q

[PARAMETERS] None.

Notes

1. The I.D. data is returned to the CE as a MODEL message.
2. An example of the QUERY command line would be:

q002F This message specifies a *QUERY command*, requesting the model message.

8.2.6 Transparent

Applies to T2020 and T2040.

The TRANSPARENT command requests the RU to put the CCI into Transparent Mode. The "escape" character to exit from Transparent Mode is specified in this message itself.

[IDENT]	t
[PARAMETERS]	[ESC_CHAR]
[ESC_CHAR]	A single character which will be the "escape" character.

Notes

1. Ensure that three consecutive "escape" characters do not appear embedded in any data to or from the CE and AE.
2. When three consecutive "escape" characters are sent to the AE from the CE, the RU will force the CCI back to Command Mode.
3. When three consecutive "escape" characters are received by the CE, this is an indication to the CE that the following data is a message from the RU.
4. An example of the SMODE command line would be:

t01zB1 This message specifies a *TRANSPARENT* command, requesting that the CCI be put into Transparent Mode. The "escape" character specified here is "z" (ASCII code = \$7A).

5. An example of the data line to force the CCI back to Command Mode, using "z" as the "escape" character, would be:

zzz When this data is detected in the data stream from the CE to the AE, the RU will force the CCI back into Command Mode.

8.3 RESPONSES FROM RU

The following messages may be returned to the CE as part of a CCI transaction or as an unsolicited message indicating a significant change of state inside the RU:

Transaction OK

ERROR	Transaction processing error
MODEL	Identify RU type
RING	Incoming call alert
PROGRESS	Call progress report

Note: In all cases, the prompt character will be issued after the RU response to terminate the transaction and signify that another may begin.

8.3.1 Transaction OK

Applies to T2020 and T2040.

Solicited.

Confirms that the command has been received, is valid, and has been executed.

No response will be issued to a command which meets the above criteria.

8.3.2 Error

Applies to T2020 and T2040.

Solicited and Unsolicited.

The **ERROR** message advises the CE that the RU has detected an error condition and cannot proceed with the current transaction (= a transaction error, solicited response). In some cases, an exception condition in the RU may cause an **ERROR** message to be sent to the CE independently of any control transactions (system error, unsolicited message).

[IDENT]	e
[PARAMETERS]	[ETYPE][ERRNUM]
[ETYPE]	Error type. A single character representing the error category. [ETYPE] = 0, transaction error [ETYPE] = 1, system error
[ERRNUM]	Error number. A character string representing a decimal number in the range of 00 to 99, which can identify the specific error condition. For [ETYPE] = 0 [ERRNUM] = 01, unsupported command [ERRNUM] = 02, checksum error [ERRNUM] = 03, parameter error [ERRNUM] = 04, invalid terminating character [ERRNUM] = 10, communication failure For [ETYPE] = 1 [ERRNUM] = Existing RU error numbers

Notes

1. All system errors ([ETYPE] = 1) are defined by the RU. In general, they will be a two character string representing some fatal condition which prevents the RU from operating correctly. Recovery procedures are defined by the RU.
2. Transaction errors ([ETYPE] = 0) indicate some problem with communications over the CCI link. All such errors result in the transaction being terminated without the current command being executed.
3. Unsupported command errors (01) may arise when the CE expects a later version of RU than is attached and attempts to use a command which is not recognised by the RU.

4. A checksum error (02) indicates that the checksum calculated by the RU did not match the one received in the command packet.
5. Parameter errors (03) encompass values out of range or missing fields.
6. A character terminating error (04) may occur on a packet sent to the RU.
7. Communication failure errors (010) encompass all low level mechanisms, i.e. framing error, overrun error, parity error etc.

8.3.3 Model

Applies to T2020 and T2040.

Solicited.

The MODEL message is sent to the CE in response to a QUERY command. It identifies the type of RU and the version of CCI firmware operating in the RU.

[IDENT]	m
[PARAMETERS]	[RUTYPE][VERSION]
[RUTYPE]	A single character representing the model category of the RU. [RUTYPE] = 1, T2020 [RUTYPE] = 2, T2040
[VERSION]	CCI firmware version. A character string, in the format of X.XX, identifying the capabilities of the RU operating in CCI mode. [VERSION] = 1.01, for first release.

Notes

1. The value of [VERSION] = 1.01 is reserved for the first release of CCI firmware implementing the command protocol described in this document. Subsequent enhancements and major upgrades will increment this number accordingly.
2. Additional fields may be added to this message in future releases to provide more information about the RU environment. In particular, it may be necessary to pass the CE some information as to how the RU has been programmed (call type restrictions etc.), or what optional hardware is fitted (DTMF, Selcall etc).
3. An example of the MODEL response message line would be:

m0511.013D

This message indicates the following:

- m** Identifies the message as a MODEL message.
- 05** Indicates that there are 5 data bytes in the parameter field.
- 1** Identifies the RU as a T2020.
- 1.01** Indicates the CCI firmware version as VERSION 1.01.
- 3D** Is the calculated checksum for the message.

8.3.4 Progress

Applies to T2020 and T2040.

Unsolicited.

The PROGRESS message advises the CE of RU status when some significant change of state in the radio occurs (typically during call processing).

IDENT] p
[PARAMETERS] [PTYPE][PARAM1][PARAM2]

[PTYPE] A character string representing a decimal number in the range of 00 to 99 which can identify the progress message category from the defined list.

- [PTYPE] = 00, SELCALL ANSWERED
- [PTYPE] = 01, DEFERRED CALLING
- [PTYPE] = 02, TX INHIBITED
- [PTYPE] = 03, EMERGENCY MODE INITIATED
- [PTYPE] = 04, EMERGENCY MODE TERMINATED
- [PTYPE] = 05, RECEIVER BUSY *
- [PTYPE] = 06, RECEIVER NOT BUSY *
- [PTYPE] = 07, PTT MIC ACTIVATED
- [PTYPE] = 08, PTT MIC DEACTIVATED
- [PTYPE] = 09, CALL SET UP IN PROGRESS
- [PARAM1] = 0, CALLING PARTY
- [PARAM1] = 1, CALLED PARTY
- [PTYPE] = 10, STRING NOT ACCEPTED
- [PARAM1] = 0, FUNCTION NOT AVAILABLE
- [PARAM1] = 1, NUMBER NOT OBTAINABLE
- [PTYPE] = 11, CALL FAIL
- [PARAM1] = 0, CALL UNAVAILABLE
- [PARAM1] = 1, CALLED PARTY BUSY
- [PARAM1] = 2, NUMBER UNOBTAINABLE
- [PARAM1] = 3, SYSTEM BUSY
- [PTYPE] = 12, ALERT
- [PTYPE] = 13, GO TO CHANNEL
- [PARAM1] = 0, SPEECH CHANNEL
- [PARAM1] = 1, DATA CHANNEL
- [PARAM1] = 2, CALL TIME in seconds range 0-999
- [PTYPE] = 14, TRANSACTION CONFIRMED
- [PTYPE] = 15, CALL CLEAR
- [PTYPE] = 16, SERVICE
- [PARAM1] = 0, NO SERVICE
- [PARAM1] = 1, IN SERVICE
- [PTYPE] = 17, CALL QUEUED
- [PTYPE] = 18, CALLED PARTY RINGING
- [PTYPE] = 19, MANUAL CALL DIVERSION
- [PTYPE] = 20, INVALID REQUEST
- [PTYPE] = 21, DATA ERROR

Note: Messages marked with an "*" will be filtered out by the transparent mode message filter when the filter is activated and the CCI is in transparent mode.

Notes

A description of the progress messages follows, but where you require more information on the trunked progress messages, please refer to MPT1343.

1. T2020 only.

The Selcall ANSWERED (00) progress message indicates that a standard Selcall has been answered. This message will be sent when the call has been answered either by the CE or manually by the user.

2. T2020 only.

The DEFERRED CALLING (01) progress message indicates that deferred calling is in progress. This message will be sent every three seconds while the RU is still waiting to make the deferred call.

3. T2020 and T2040 in conventional mode.

The TX INHIBITED (02) progress message indicates that transmission has been inhibited. This message will be sent whenever transmission is requested for but is inhibited.

4. T2020 only.

The EMERGENCY MODE INITIATED (03) progress message indicates that the RU has been put into emergency mode. This message will be sent when the RU emergency mode switch is activated.

5. T2020 only.

The EMERGENCY MODE TERMINATED (04) progress message indicates that the RU is no longer in emergency mode. This message will be sent when the RU receives a "reset" to take it out of emergency mode.

6. T2020 only.

The RECEIVER BUSY (05) progress message indicates that the receiver has detected RF signal on the current channel. This message will be sent when the current channel becomes busy. This message can be controlled by the transparent mode message filter.

7. T2020 only.

The RECEIVER NOT BUSY (06) progress message indicates that the receiver no longer detects RF signal on the current channel. This message will be sent when the current channel becomes not busy. This message can be controlled by the transparent mode message filter.

8. T2020 and T2040 on traffic channel or in conventional mode.

The PTT MIC ACTIVATED (07) progress message indicates that the PTT has been pressed. This message will be sent whenever the PTT is pressed in an attempt to transmit.

9. T2020 and T2040 on traffic channel or in conventional mode.

The PTT MIC DEACTIVATED (08) progress message indicates that the PTT has been released. This message will be sent whenever the PTT is released after attempting to transmit.

10. T2040 only.

The CALL SET UP IN PROGRESS (09) progress message indicates a call is in progress with both the calling party and called party identities displayed.

11. T2040 only.

The STRING NOT ACCEPTED (10) trunking progress message indicates the MPT1343 function you require is not available or that the number you have dialled is unobtainable.

12. T2040 only.

The CALLED FAIL (11) trunking progress message indicates a call attempt has failed and also why it has failed.

13. T2040 only.

The ALERT (12) trunking progress message indicates the RU is ringing (eg in response to an incoming call).

14. T2040 only.

The GO TO CHANNEL (13) trunking progress message indicates a call has been processed by the system and the radio has been allocated a traffic channel this call.

15. T2040 only.

The TRANSACTION CONFIRMED (14) trunking progress message indicates that certain requests by the radio have been confirmed by the system.

16. T2040 only.

The CALL CLEAR (15) trunking progress message indicates that the radio has received a call clear down message from the system.

17. T2040 only.

The SERVICE (16) trunking progress message indicates whether the RU is in range of the system or not.

18. T2040 only.

The CALLED QUEUED (17) trunking progress message indicates the radio's current call in progress is in the queue for the system to process.

19. T2040 only.

The CALLED PARTY RINGING (18) trunking progress message indicates the called unit is ringing but as yet unanswered. This will only be used on full off air call set up (i.e. refer MPT1343).

20. T2040 only.

The MANUAL CALL DIVERSION (19) trunking progress message indicates the called party has call diversion active.

21. T2040 only.

The INVALID REQUEST (20) trunking progress message indicates the request to the RU was invalid (i.e. the RU may not support the function).

22. T2040 only.

The DATA ERROR (21) trunking progress message indicates an error in the data sent in the Short Data Message (SDM). Currently not supported.

23. An example of a PROGRESS response message line would be:

p0202CC

This message indicates the following:

- p** Identifies the message as a PROGRESS message.
- 02** Indicates that there are 2 data bytes in the parameter field.
- 02** Indicates the progress message of TX INHIBITED.
- CC** Is the calculated checksum for the message.

8.3.5 Ring

Applies to T2020 and T2040.

Unsolicited.

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

[IDENT] r

[PARAMETERS] [RCATEGORY][TYPE][INCLUDE][STATUS]
[CALLERID]

[RCATEGORY] A single character representing the signalling medium by which the incoming call arrived.

[RCATEGORY] = 0, Selcall

[RCATEGORY] = 1, Undefined

[RCATEGORY] = 2, MPT1343 (T2040 only)

[TYPE] A single character qualifying the type of call received.

[TYPE] = [TYPE1][TYPE2][TYPE3][TYPE4]

[TYPE1] = 0, speech call

[TYPE1] = 1, non prescribed data call

[TYPE1] = 2, status call

[TYPE2] = 0, normal priority

[TYPE2] = 1, emergency

[TYPE3] = 0, individual call

[TYPE3] = 1, group call

[TYPE4] = 0, not an include call

[TYPE4] = 1, include call

[STATUS] A 2 digit string representing the received status for status calls.

[CALLERID] An eleven digit string representing the identity of the calling party.

[CALLERID] = [IDENT_TYPE][PREFIX][IDENT]
[NUMBER]

[IDENT_TYPE] = 0, calling party is a normal ident

[IDENT_TYPE] = 1, calling party is a PABX ident

[IDENT_TYPE] = 2, calling party is a PABX number

[IDENT_TYPE] = 3, calling party is a PSTN number

[PREFIX] is a 3 digit calling prefix, range 000 - 127

[IDENT] is a 3 digit calling ident, range 0001 - 8191

[NUMBER] is a 3 digit string representing the caller's number, if known (i.e. range 020 to 099 or 200 to 998), or else if not known, 000.

Notes

1. The [CALLERID] field is optional. If it is not included, the CE should assume that the identity of the caller is unknown, or cannot be determined.

2. All incoming Selcalls are generally either [TYPE] = 0 or 1, and have a null [CALLERID] field. Where a non-predictive decoder is fitted, [CALLERID] may be supplied.

3. An example of a RING response message line would be:

r010FD

This message indicates the following:

- r** Identifies the message as a RING message.

- 01** Indicates that there is only 1 data byte in the parameter field.

- 0** Indicates that a standard speech Selcall has been received.

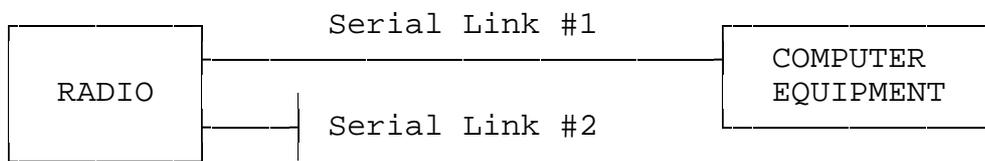
- FD** Is the calculated checksum for the message.

APPENDIX A

1. This configuration is typical for remote control operation (only port A of the CCI is used).

Applications:

- message display/SDM (T2040)
- despatcher terminal (T2020 or T2040)
- remote monitor (T2020 or T2040)



2. This configuration is to be used when an AE is connected to port B of the CCI. The CE is able to communicate with the AE (in this case a modem) by placing the CCI, within the radio, into transparent mode.

Applications:

- data radio (T2020 or T2040)
- radio LAN

