



**Computer Controlled Data Interface
Software Requirements Specification**

Orca Development Project

Issue 1.03
21 December 1998

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Tait Electronics Ltd
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Now the CCDI is specific to only Tait Orca Conventional radios. Since the Trunking radios use MAP27, the commands for Trunked radio is not implemented. However to be compatible with T2000 CCI, the commands for Trunked radio are reserved for future features.

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1. INTRODUCTION

1.1 PURPOSE

This document specifies the Software Requirements for the Computer Controlled Data Interface (CCDI) for the Tait Orca Conventional Radios. This document describes how the CCDI works while under the control of the radio software and its protocol commands. This document is intended primarily for the Product Manager, the Project Leader, the Software Engineers, and the Test Engineers, involved in the Tait Orca Software Development project.

1.2 SCOPE

This document covers:

- C Description of the Computer Controlled Data Interface
- C Details of the command protocol used between the Tait Orca Conventional Radio and the computer equipment.

1.3 GLOSSARY

CCDI	Computer Controlled Data Interface - the command protocol which allows communication between a CE and a RU.
CE	Computer Equipment - the intelligent device which controls the RU and/or receives data over the interface.
RU	A Tait Orca Conventional Radio Unit.
SDM	Short Data Message.
GPS	Global Positioning System.

1.4 REFERENCES

T2000 Computer Control Interface Design Specification
Issue 1.7, Phil Holliday, Tait Electronics Ltd.

NMEA 0183 STANDARD FOR INTERFACING MARINE ELECTRONICS DEVICES
Issue 2.01, NATIONAL MARINE ELECTRONICS ASSOCIATION.

GARMIN GPS 35/36 TracPak GPS SMART ANTENNA TECHNICAL SPECIFICATION
Issue Rev. C, GARMIN

1.5 GUIDE TO DOCUMENT

The structure of this document is based upon the standard SRS template.

1.5.1 Document Organisation

1.5.1.1 Section 1

This section provides an introduction to the document including its purpose, scope, a glossary of terms, and a list of referenced documents.

1.5.1.2 Section 2

This section provides an overview of the product.

1.5.1.3 Section 3

This section describes the command protocol.

1.5.1.4 Section 4

This section describes the details of the commands.

1.5.2 Document Conventions

1.5.2.1 Supporting Information

Throughout this document additional background information is provided. This information does not form part of the requirements per se, but is provided to assist the reader in understanding the intent of the requirements. This information is represented as follows:

(INFO: Applies to full off air call systems. A characteristic of these type of systems ...)

1.5.2.2 Measurement Tolerance

The general tolerance on any measurement specification is " 5% unless otherwise indicated.

1.5.2.3 Number Bases

All numeric values are decimal unless otherwise indicated.

Hexadecimal numbers are represented by the suffix **Ah** and represent a whole number of bytes (i.e. 2Ah is a single byte having the decimal value 42).

2. PRODUCT OVERVIEW

2.1 Product

The Computer Controlled Data Interface is intended to provide a means of controlling a Tait Orca Conventional radio from some form of CE. Such control would allow the implementation of either a semi or fully automatic communications system.

Potential applications include:

- * Computerised despatcher terminals
- * Remote outstations (data logging, security monitor etc.)
- * Data radio terminals

The CCDI is a command protocol which is embedded in the radio software. It requires an appropriate serial cable, such as the Tait Programming Lead, to establish a RS-232 link between a CE and a RU.

The features offered by the CCDI are determined by its command protocol. These will apply to the Conventional radio but not to the Trunked radio. The command protocol determines how and what the user can control on the radio. Section 4. COMMAND DESCRIPTION is devoted to describing the command protocol.

Note that the Tait Orca Trunked radios use MAP27 protocol. The CCI commands that the Trunked radios used in the T2000's, are not implemented yet. However the function numbers and command parameters used in the T2000 Trunked radios are reserved for future compatibility.

2.2 Serial Communication Parameters

The RS232 communication between the CE and the RU requires the following parameters:

- * Baud rate = 9600
- * Number of data bits = 8
- * Parity = none
- * Number of stop bits = 1

(INFO : Unlike the T2000 CCI, the CCDI communication parameters are not programmable.)

2.3 Programmable DATA parameters

The following parameters must be programmed properly for a RU before CCDI can operate:

- | | |
|-----------------|--|
| * Data Option | This is for enabling or disabling CCDI operation in the RU.
- If enabled, RU processes all valid CCDI commands including SEND_SDM command.
- If disabled, RU ignores any CCDI commands including SEND_SDM command.
- Note that receiving SDM data and sending SDM data on Tait Orca Eclipse Handportable radios depend upon the SDM Option. |
| * Data Identity | This inputs the data message ID for SDM calls and DATA calls. A maximum |

-
- of 8 alphanumeric characters including the wildcard character >*= can be entered.
- * SDM Option This enables/disables sending and receiving SDM data.
 - * SDM Auto Acknowledge This enables/disables the checking and sending of SDM auto acknowledgements.
 - * Wait For Acknowledgement When >SDM Auto Acknowledgement= is enabled, after sending SDM data, if SDM acknowledgement is received within this time, RU indicates >SDM_ACK_RECEIVED_INDICATOR=. Otherwise RU indicates >SDM_NO_ACK_RECEIVED_INDICATOR=.
 - * Auto Acknowledge Delay When >SDM Auto Acknowledgement= is enabled, after RU receives SDM data, RU sends SDM acknowledgement after the auto acknowledge delay.
 - * Lead In Delay This lead-in-delay is applied when transmitting data in Transparent mode or sending SDM data on Tait Orca Eclipse Handportable radios.
 - * Handshaking:
XON/XOFF characters These are character definitions which are used for Software Handshaking to prevent losing data between CE and RU.
 - * Ignore Subaudible Signalling This is for enabling or disabling checking subaudible signalling when receiving data in Transparent mode or SDM data.
 - When enabled, RU ignores any received FFSK data if subaudible signalling is not valid.
 - When disabled, RU processes any valid FFSK data whether subaudible signalling is valid or not.

Note that these parameters are in the AData Parameters@page of the programming software for the Tait Orca Conventional radio.

3. COMMAND PROTOCOL

The CE is connected to the RU via RS232 serial link. Commands are generated by the CE and responses/status messages returned by the RU. By means of a special command message the CCDI can be transparent to the CE and a connection can be made between the CE and the RU modem. Also by receiving a special message from the modem, CCDI lets the RU go into a mode where any messages from the CE are ignored and only the messages received by the modem are executed and responses are returned thru the modem. Thus following modes of operation are 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 can communicate directly to a modem in the RU through the CCDI.
Repair mode	The mode in which the CE cannot control the CCDI operation but only the command messages which are received from modem are performed.

In Command mode, there is a set format for messages and mechanisms for detecting communication errors. In Transparent mode, however, the communication is free-format, any protocol being determined entirely by the CE and the modem and it is transparent to the CCDI.

Note : In order to process CCDI commands, the Data Option must be enabled by using the programming software.

Note : In Repair mode, the communication protocol is yet to be defined.

3.1 Command mode

The CCDI normally operates in Command mode. This is the default mode 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 that 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 A.@(full stop, ASCII code = 2Eh).

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).

In Command mode, if the RU receives any data from the modem, then RU sends a message to the CE indicating that data has been received from the modem.

3.2 Transparent mode

Transparent mode allows for direct communications between the CE and the modem. The Transparent link allows the CE to send and receive data without having to pass messages via the CCDI.

The transparent link is administered by the RU in that it reads data arriving from the modem and sends them to the serial port. The communication format is largely free, 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.

Data passing between the CE and the modem is buffered in both directions, and the XON/XOFF software handshaking is

automatically utilised as long as the RU is in the Transparent mode.

Whilst in Command Mode, if any data has arrived from the modem, then the data will be buffered and a status message is generated from the RU to the CE to indicate that data has been received, and the buffered data 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 but will be preceded by three consecutive Aescape@characters in order to alert the CE. This Aescape@character is the same one determined by the CE to exit Transparent mode.

3.3 Repair mode

Repair mode allows for direct communications between the RU and the modem. In Repair mode, the RU ignores any messages coming from the CE, but executes the messages coming from the modem. This mode enables programming data in the database area or codes in code area in the RU so that an error can be fixed or codes can be upgraded to a later version remotely thru the modem.

Note : Further details of this requirement have yet to be defined.

3.4 Switching Modes

Mode switching is always initiated by the CE.

Upon powerup, the CCDI 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 modem.

In order to return to Command mode, the CE must send the Aescape@sequence of characters to the RU. The Aescape@sequence is determined by the CE at the time it commands the CCDI to enter Transparent mode. As part of the mode switching command the CE must identify a character which, when repeated three times in succession, will force the CCDI to Command mode.

Because the RU Aeavesdrops@on Transparent mode communications from the CE, it can identify the Aescape@sequence, which cannot occur naturally in its communications with the modem.

The use of the Aescape@sequence can be summarized as follows:

- * Three consecutive Aescape@characters to the RU will force the CCDI out of Transparent mode only if already in that mode.
- * Three consecutive Aescape@characters to the CE will alert the CE that the following data is a message from the RU only if the CCDI is in Transparent mode.

Note that since the three consecutive Aescape@characters works as above, they cannot be used for data communication purpose.

Note : Entering into and exiting from the Repair mode has yet to be defined.

3.5 Connecting GPS

The GPS data feature is intended primarily for the Tait Orca Mobile radios, but may be used on the Handportable radios if so desired.

To use the GPS function two radios are needed. One RU is connected to the CE located in a control centre system, (ACENTRE RU®). This radio is used to process commands from the CE and communicates with the second radio. The

second radio (AGPS RU) usually located in an automobile and is serially connected to a GPS unit.

When the control centre wants to interrogate a specific GPS unit, the CE sets the channel of the CENTRE RU to the channel of the GPS RU using the CCDI GO_TO_CHANNEL command. The CE then sends the CCDI GPS command (along with a parameter of the required NMEA sentence header) to the CENTRE RU. The CENTRE RU transmits this command to the GPS RU using FFSK data transmission. The GPS RU receives the FFSK data, decodes the GPS command, and sends GARMIN GPS commands to the GARMIN GPS to request NMEA sentence. The GPS unit sends the requested NMEA sentence only once to the GPS RU. The GPS RU then transmits the NMEA sentence using FFSK data transmission to the CENTRE RU. Upon receiving the FFSK data, the CENTRE RU decodes the data as a NMEA sentence, and sends it to the CE over the serial port.

There are two Tait proprietary NMEA sentences which indicate an error status. One is APTGNK and is sent from the CENTRE RU to the CE when a GPS RU is not responding after the CENTRE RU's command transmission. The other is APTGNO and is sent from the GPS RU to the CENTRE RU onto the CE, when the GPS RU cannot get any NMEA GPS sentences after it sends a NMEA sentence to the GARMIN GPS to interrogate it.

Note Since NMEA specifies the baud rate as 4800 bps, at the first time the GPS RU decodes a GPS command it sets the bps of the serial port to 4800 from 9600 which is set at power-up. Once the GPS RU sets at 4800 bps then it keeps that baud rate until either power-off, or it receives a command of GPS mode off, which is APTGOF.

Note The GPS normally keeps on sending the enabled NMEA sentences every 1 second or every specified time. However for the Tait Orca radios, that continuous NMEA sentences output causes either the RX_OVERRUN_ERROR (SYSTEM ERROR 24) if the GPS RU is at 9600 bps or the HEAP_EXHAUSTED_ERROR (SYSTEM ERROR 02) if the GPS RU is at 4800 bps. To avoid these system errors, the GARMIN proprietary NMEA sentences must be used so that the GPS data output NMEA sentence is only enabled ONCE whenever it is requested. Hence when the GARMIN GPS is used with the Tait Orca radios, the GPS is not outputting the NMEA sentences constantly, and the control centre should interrogate the GPS data by polling. Also therefore if some other brand's GPS receiver is used, then the radio software also should be modified to cope with the above problem.

Note By using the GARMIN proprietary sentence it is possible to set the GARMIN GPS baud rate to 9600, but there is no immediate benefits from doing this.

4. COMMAND DESCRIPTION

This section details the standard commands and responses.

4.1 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 (0Dh).

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. when [SIZE] = 00. For example, c003D is the CANCEL command which is 5 characters.
- * The maximum length of the [PARAMETERS] field is 32 characters. The maximum length of the command packet is therefore 37([SIZE]=@20") characters.
- * An example of a message line is as follows:

d0601234507

Ad@ is the message [IDENT], in this case describing that this message is a **ADIAL@** command.

A06" is the message [SIZE], describing that there are 6 characters of data to follow in the [PARAMETERS] field.

A012345" are the data bytes in the [PARAMETERS] field.

A07" 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

4.1.1 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 : 64h + 30h + 36h + 30h + 31h + 32h + 33h + 34h + 35h = F9h

Take the two's complement of F9h = 07h

4.2 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
SEND_SDM	Send a Short Data Message (SDM).
GET_GPS	Interrogating GPS data from a GPS RU.

(INFO : In T2000 there is a RESET command in Command mode, but the Tait Orca doesn't have a RESET command. Instead it has a reset character ^@ (ASCII code = 5Eh). However if the reset character is received as part of the parameter of the above commands, then RU will process it as a data in the parameter and it will not reset the RU. Also in Transparent mode, the reset character ^@ will be regarded as data. Thus, in Transparent mode, in order to reset the radio, either exiting the Transparent mode and sending ^@, or powering off and on will reset the Tait Orca radio.)

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.

Note that DIAL, GO_TO_CHANNEL, CANCEL, QUERY, TRANSPARENT command messages are compatible with T2000 CCI. Some function types of FUNCTION command message are newly added. The SEND_SDM command message is newly added.

4.2.1 DIAL

The DIAL command allows access to the full dialling capability of the RU. Selcall and/or DTMF sequences may be dialled (on the current channel).

[IDENT] Ad@
 [PARAMETERS] [DTYPE][NUMBER_STR]

[DTYPE] A single character representing the type of dialling required:

 0 = SELCALL (Conventional radio only)
 1 = DTMF (Conventional radio only)
 2 = Reserved for Trunked radio dialling.

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

 [DTYPE] = 0, range = 0...9, A...F, -, V (maximum of 32 digits)
 [DTYPE] = 1, range = 0...9, A...D, *, #,- (maximum 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, 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 the digits 0...9. Some of the tones A...F have special meaning, i.e. A = Group; C = Reset; E = Repeat.
2. The maximum number of digits in a Selcall string is 32.
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, etc.
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: key-up delay, tone period and inter-tone gap, etc.
7. Examples of DIAL command 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.

4.2.2 GO_TO_CHANNEL

The GO_TO_CHANNEL command forces the RU to change to another channel.

[IDENT] Ag@
 [PARAMETERS] [CHANNEL_NO]
 [CHANNEL_NO] 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. The maximum number of digits in the [CHANNEL_NUMBER] string is 3.
3. Examples of GO_TO_CHANNEL command would be:

g0245CE This message specifies a channel change to channel 45.
g03100A5 This message specifies a channel change to channel 100.

4.2.3 CANCEL

The CANCEL command allows the CE to abort the current action the RU is performing.

[IDENT] A@

[PARAMETERS] [CANCEL_TYPE]

[CANCEL_TYPE] A single character representing the cancelling type.
0 = cancel call.
1 = delete SDM data.

Notes

1. When [CANCEL_TYPE] = 0,
the CANCEL command will force the RU to do the following:
 - clear down a Selcall call if the radio is alerting;
 - cancel deferred calling if it is in progress;
 - take the RU out of emergency mode if the radio is currently in the AEmergency Tx Rx cycles@;
 - cancel any Selcall call retries.
2. When [CANCEL_TYPE] = 1,
the CANCEL command will delete last received SDM data. If there is no valid SDM data, it will do nothing.
3. Note that in order to keep the compatibility with T2000 CCI, the CANCEL command with no parameter will execute the same as the cancelling call ([CANCEL_TYPE] = 0).
4. Examples of a CANCEL command would be:

c0100C This message specifies a cancel call command.
c003D This message also specifies a cancel call command.
c0110B This message specifies a delete SDM command.

4.2.4 FUNCTION

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

[IDENT] Af@

[PARAMETERS] [FUNCTION][QUALIFIER]

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

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

The following describes each [FUNCTION] category and its [QUALIFIER] values.

[FUNCTION] = 0	currently not supported. [QUALIFIER] = none
[FUNCTION] = 1	Set signalling status (Orca Eclipse radio only) [QUALIFIER] = two BCD digit new status
[FUNCTION] = 2	AUX control (Mobile radio only) [QUALIFIER] = 0 : deactivate AUX signal [QUALIFIER] = 1 : activate AUX signal
[FUNCTION] = 3	Hook control (Mobile radio only) [QUALIFIER] = 0 : force mic. Aon-hook@ [QUALIFIER] = 1 : force mic. Aoff-hook@
[FUNCTION] = 4	User controls [QUALIFIER] = 0 : disable all user controls [QUALIFIER] = 1 : disable user input only [QUALIFIER] = 2 : enable all user controls
[FUNCTION] = 5	Receiver audio mute control [QUALIFIER] = 0 : cancel request CCDI mute rx audio [QUALIFIER] = 1 : request CCDI mute rx audio
[FUNCTION] = 6	TMODE Filter control [QUALIFIER] = 0 : deactivate TMODE Filter [QUALIFIER] = 1 : activate TMODE Filter
[FUNCTION] = 7	Subsignalling validity control [QUALIFIER] = 0 : deactivate validation of sub signalling [QUALIFIER] = 1 : activate validation of sub signalling
[FUNCTION] = 8	Monitor control [QUALIFIER] = 0 : deactivate monitor [QUALIFIER] = 1 : activate monitor
[FUNCTION] = 9	Tx/Rx control [QUALIFIER] = 0 : change to Rx state [QUALIFIER] = 1 : change to Tx state

Notes

1. The FUNCTION 0 is reserved for later use.
2. The ASet signalling status@loads a new value into the 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. The range of allowed characters is 0...9 only and the number of digits must be 2.
3. Mobile radio only.
The AAUX 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.

The RU will only support this function if it has been programmed with the AUX key controlling the auxiliary line. This may be a **AMomentary@** or **ALatching@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. **Mobile radio only.**
The **AHook control@**function operates in parallel with the microphone hookswitch. The CE may use this function to enable and disable signalling mutes, and also continue and suspend scanning.
5. The **AUser controls@**function allows the CE to selectively disable the front panel controls of the RU. Three states are defined:
 - **Disable All User Controls**
This disables all user inputs and all indicators including the display. The RU will indicate **ACCDI BUSY@** indication.
 - **Disable 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.
 - **Enable All User Controls**
This enables the RU to be used normally except when the CCDI is processing a message. When the CCDI is processing a message, the RU will indicate **ACCDI BUSY@**. When processing is complete, the RU will be returned to its normal state.
Note that after power on, this parameter value is defaulted to **AEnable All User Controls@**.
6. The **AReceiver audio mute control@**function will request or cancel its request for a **ACCDI mute@**of the RU. This mute request will affect the mute state of the RU and can only be overwritten by the **ASquelch Override@**of the RU.
7. The **ATMODE Filter control@**function will activate or deactivate filtering out two progress messages of **ARECEIVER BUSY@**and **ARECEIVER NOT BUSY@**, in the Transparent mode.
Note that after power on, this parameter value is defaulted to **Aactivate TMODE Filter@**.
8. The **ASubsignalling validity control@**function will activate or deactivate validation of subsignalling, i.e. CTCSS or DCS when CCDI is receiving FFSK data. If the current channel is not programmed with any subsignalling, then FFSK data is always received regardless of the validation state.
Note that after power on, this parameter value is depending on **Ignore Subaudible Signalling=**option value.
9. Conventional radio and Trunked radio in conventional mode.
The **AMonitor control@**function will activate or deactivate monitoring of the RU. If this message is received in traffic channel in Trunked radio, then a parameter error message will be sent to CE.
10. The **ATx/Rx control@**function will change the RU into Tx or Rx state.
11. The [FUNCTION] numbers 1 to 6 are compatible to T2000, but numbers 7, 8, and 9 are newly added.
12. Examples of FUNCTION command would be:

f03100A6	This message specifies a set status command requesting an update of the current status digit to status digit 00.
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 TMODE Filter command.
f0271D0	This message specifies a validation of sub signalling.
f0281CF	This message specifies an activate MONITOR command.
f0291CE	This message specifies a set to Tx state command.

4.2.5 QUERY

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

[IDENT]	Aq@
[PARAMETERS]	[QUERY_TYPE]
[QUERY_TYPE]	A single character representing the query type. 0 = query model message. 1 = query SDM message.

Notes

1. When [QUERY_TYPE] = 0, the ID. data is returned to the CE as a MODEL message. However the [PARAMETERS] of MODEL message is now modified. (See 4.3.3)
2. When [QUERY_TYPE] = 1, the SDM message is returned to the CE as a GET_SDM message.(See 4.3.6)
3. Note that in order to keep the compatibility with T2000 CCI, the QUERY command with no parameter will execute the same as query model message ([QUERY_TYPE] = 0).
4. Examples of the QUERY command would be:

q010FE	This messages specifies a QUERY command, requesting the MODEL message.
q002F	This messages also specifies a QUERY command, requesting the MODEL message.
q011FD	This message specifies a QUERY command, requesting the GET_SDM message.

4.2.6 TRANSPARENT

The TRANSPARENT command requests the RU to put the CCDI into transparent mode. The Aescape@character to exit from Transparent mode is specified in this message itself:

[IDENT]	At@
[PARAMETERS]	[ESC_CHAR]

[ESC_CHAR] A single character which will be the Aescape@ character.

Notes

1. It must be ensured that three consecutive Aescape@ characters do not appear embedded in any data to or from the CE and the modem.
2. When data is transmitted in Transparent mode, it has lead-in-delay which has the programmed value in XLead In Delay= option in data base.
3. When three consecutive Aescape@ characters are sent to the modem from the CE, the RU will force the CCDI back to the Command mode.
4. When three consecutive Aescape@ characters are received by the CE, this is an indication to the CE that the following data is a message from the RU.
5. Examples of switching mode commands would be:

t01zB1 This message specifies a TRANSPARENT command, requesting that the CCDI be put into Transparent mode. The Aescape@ character specified here is Az@ (ASCII code = \$7A).

zzz In Transparent mode, when this data is detected in the data stream from the CE to the modem, the RU will force the CCDI back to Command mode.

...zzzp0202CC... In Transparent mode, when this data is detected in the data stream to the CE, the CE will know that Ap0202CC= is a message from the RU.

4.2.7 SEND_SDM

The SEND_SDM command requests the RU to send a Short Data Message (SDM):

[IDENT] As@

[PARAMETERS] [LEAD_IN_DELAY][DATA_MESSAGE_ID][MESSAGE]

[LEAD_IN_DELAY] 2 byte characters representing the key-up lead in delay (range = 00 to FF).

[DATA_MESSAGE_ID] 8 byte characters representing the data message ID.

[MESSAGE] Maximum 32 characters of SDM data. (Optional)

Notes

1. The SEND_SDM command can send maximum of 32 characters ONLY in command mode. However a RU can receive SDM either in Command mode or Transparent mode.
2. The [LEAD_IN_DELAY] parameter representing the key-up lead in delay which can be 00 to FF. The actual lead in delay is calculated by multiplying this number by 20 msec. However a minimum 100 msec of lead in delay is required, hence when 00 to 04 is inputted the actual lead in delay will be 100 msec. Thus the actual lead in delay shall be minimum 100 msec to maximum 5.12 sec by step of 20 msec.
3. [DATA_MESSAGE_ID] is a 8 character string representing the data message ID of the radio which the SDM is sent to. It can be any alphanumeric characters. *= is the wildcard character. When a radio receives a SDM message, the data message ID is checked against the database of the radio. If the data message ID sent matches, then the received SDM data will be preserved and the radio will indicate

this. Otherwise the SDM data will be ignored.

3. [MESSAGE] is optional and can be maximum of any 32 data. However when a RU is received SDM, it shall display only the ASCII code of 20h to 7Fh. If a code is outside of this ASCII code range then it will be displayed either as a blank character or a random font. If the received SDM data is valid and includes [MESSAGE], then the RU will generate SDM call RING message to the CE. If the received SDM data is valid and does not include [MESSAGE], then the RU will generate DATA call RING message to the CE.
4. When >SDM Auto Acknowledgement= is enabled, after sending SDM data, if SDM acknowledge data is received within the time of >Wait For Acknowledgement=, RU indicates >SDM_ACK_RECEIVED_INDICATOR=. Otherwise RU indicates >SDM_NO_ACK_RECEIVED_INDICATOR=.
5. In Command mode, if a SDM data is received whether it is valid or not, it will be buffered and the RU will generate a FFSK_DATA_RECEIVED progress message. If the received SDM data is valid, i.e the data message ID is matched, then the RU will also update the SDM data buffer and will generate a sound beep to indicate that RU has received a valid SDM data.
6. In Transparent mode, if a SDM data is received whether it is valid or not, it will be sent to the CE but no progress message is generated. If the received SDM data is valid, i.e the data message ID is matched, then the RU will also update the SDM data buffer and will generate a sound beep to indicate that RU has received a valid SDM data.
7. Note that if a SDM call is sent to a Tait Orca Elan Conventional radio, the RU will not do any indication. But the received message can be retrieved by the GET_SDM message. Tait Orca Excel and Eclipse Conventional radios will indicate both by beeping and displaying ASDM@ on LCD. For Tait Orca Trunked radios, the indication has yet to be defined.
8. An example of SEND_SDM command would be:

s0A051234567813 This message transmits data message ID A1234567890@ with 100 msec lead in delay thru current channel.
s0CFF12345678Hi39 This message transmits data message ID A1234567890@ and SDM data AHi@ with 5.1 sec lead in delay thru current channel.

4.2.8 GET_GPS

The GET_GPS command requests the RU to interrogate a GPS unit on the current selected channel;

[IDENT] An@

[PARAMETERS] [NMEA_SENTENCE_HEADER],[ENABLE]

[NMEA_SENTENCE_HEADER] 5 characters representing a NMEA sentence header requested.

[ENABLE] 1 to enable the above requested NMEA sentence.
0 to disable the above requested NMEA sentence.

Notes

1. Since the radio software is designed specifically for using GARMIN GPS, the available NMEA sentence headers which can be requested are limited to the GARMIN GPS specification.
2. To turn off GPS mode and set the baud rate back to 9600 bps on the GPS RU, [NMEA_SENTENCE_HEADER] is APTGOF@ and [ENABLE] parameter is DON-T-CARE. Note it is Tait proprietary NMEA sentence.
3. The resulting GPS data is just the NMEA sentence which is requested by the CE.

4. If the GPS RU does not respond to the CENTRE GPS within 5 seconds, a Tait proprietary NMEA sentence IPTGNK@ shall be generated to the CE from the CENTRE GPS.
5. If the GARMIN GPS does not respond to the GPS RU within 2 seconds, a Tait proprietary NMEA sentence IPTGNO@ shall be transmitted to the CENTRE RU and to the CE.
6. An example of GET_GPS command would be:

n07GPRMC,155 It requests a GPRMC NMEA sentence from the GPS RU.
n07PTGOF,04F It requests the GPS RU to turn off GPS mode and set the baud rate back to 9600 bps.

4.3 RESPONSES FROM RU

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

Transaction OK	Transaction processed OK
ERROR	Transaction processing error
MODEL	Identify RU type
RING	Incoming call alert
PROGRESS	Call progress report
GET_SDM	Get SDM data

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

Note that in response to the GET_GPS command, an NMEA sentence is sent to the CE in addition to the above commands.

4.3.1 Transaction OK

Solicited.

This message 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.

4.3.2 ERROR

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] Ae@

[PARAMETERS] [ETYPE][ERRNUM]

[ETYPE] Error type. A single character representing the error category.

[ERRNUM] Error number. A character string representing a decimal number in the range of 00 to 99, which can identify the specific error condition.

The following describes each [ETYPE] and its [ERRNUM] values.

[ETYPE] = 0, Transaction error
 [ERRNUM] = 01, unsupported command
 [ERRNUM] = 02, checksum error
 [ERRNUM] = 03, parameter error
 [ERRNUM] = 04, invalid terminating character
 [ERRNUM] = 05, RU not ready error
 [ERRNUM] = 10, communication failure

[ETYPE] = 1, System error
 [ERRNUM] = Existing Ru system 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 CCDI 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. RU not ready error (05) occurs when another new message is receiving from CE even before a prompt character A.@is sent from RU. This error is newly added.
8. Communication failure errors (10) encompass all low level mechanisms, i.e. framing error, overrun error, parity error etc.
9. An example of the ERROR response message would be:

e03003A5 This message indicates that the parameter of current received message is incorrect.

4.3.3 MODEL

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 CCDI software operating in the RU.

[IDENT] Am@

[PARAMETERS] [RUTYPE][RUMODEL][RUTIER][VERSION]

[RUTYPE]	A single character representing the type of the RU. [RUTYPE] = 1, Conventional radio [RUTYPE] = 2, Reserved for Trunked radio
[RUMODEL]	A single character representing the model of the RU. [RUMODEL] = 1, Handportable radio [RUMODEL] = 2, Mobile radio
[RUTIER]	A single character representing the tier of the RU. [RUTIER] = 0, Tait Orca Elan radio [RUTIER] = 1, Tait Orca Excel radio [RUTIER] = 2, Tait Orca Eclipse radio
[VERSION]	CCDI software version. A character string, in the format of XX.XX, identifying the capabilities of the RU operating in CCDI mode.

Notes

1. The value of [VERSION] = 1.01 is reserved for the first release of CCDI firmware implementing the command protocol described in this document. Subsequent enhancements and major upgrades will increment this number accordingly.
2. Note that [PARAMETERS] is modified compared to T2000 CCI.
3. An example of the MODEL response message would be:

m0811100.01A9 This message indicates that the RU is a Conventional Handportable Tait Orca Elan radio and the CCDI software version is 00.01.

4.3.4 RING

Unsolicited.

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

[IDENT] Ar@

[PARAMETERS] [RCATEGORY][TYPE][STATUS][CALLER_ID]

[RCATEGORY] A single character representing the category of the incoming call arrived.

[RCATEGORY] = 0, Selcall
[RCATEGORY] = 1, Undefined
[RCATEGORY] = 2, Reserved for Trunked system call

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

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

[TYPE1] = 0, speech call
[TYPE1] = 1, Reserved for Trunked non prescribed data call
[TYPE1] = 2, status call
[TYPE1] = 3, interrogation call
[TYPE1] = 4, SDM call
[TYPE1] = 5, DATA call
[TYPE1] = 6, remote Monitor call

[TYPE2] = 0, normal priority

[TYPE2] = 1, emergency / priority

[TYPE3] = 0, individual call

[TYPE3] = 1, group call

[TYPE4] = 0, Reserved for not an include call (Trunked radio only)

[TYPE4] = 1, Reserved for include call (Trunked radio only)

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

[CALLER_ID] It is caller's ID which has a variable length.

Notes

1. The Trunked system call (when [RCATEGORY] = 2) includes all types of Trunked system call such as MPT1343, ZVEI, NOKIA, GONGAN, etc.
2. [TYPE4] is always A0", but value A1" is reserved for Trunked radio.
3. If [STATUS] value is not received when RU receives a call, then [STATUS] will be AFF@.
4. [CALLER_ID] field is optional. The length of received [CALLER_ID] can be variable.
5. By checking [SIZE] in RING message, CE will be able to know if the whole [CALLER_ID] part is missed or not.
6. An example of a RING response message would be:

r071400FFA6 This message indicates that the received call is a normal SDM call.

Note that [PARAMETERS] of RING message is modified compared to T2000 CCI.

4.3.5 PROGRESS

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] Ap@

[PARAMETERS] [PTYPE][PARA1][PARA2]

[PTYPE] A two digit 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, Reserved for CALL SET UP IN PROGRESS of Trunked radio
[PTYPE] = 10, Reserved for STRING NOT ACCEPTED of Trunked radio
[PTYPE] = 11, Reserved for CALL FAILED of Trunked radio
[PTYPE] = 12, Reserved for ALERT of Trunked radio
[PTYPE] = 13, Reserved for GO TO CHANNEL of Trunked radio
[PTYPE] = 14, Reserved for TRANSACTION CONFIRMED of Trunked radio
[PTYPE] = 15, Reserved for CALL CLEAR of Trunked radio
[PTYPE] = 16, Reserved for SERVICE of Trunked radio
[PTYPE] = 17, Reserved for CALL QUEUED of Trunked radio
[PTYPE] = 18, Reserved for CALLED PARTY RINGING of Trunked radio
[PTYPE] = 19, Reserved for MANUAL CALL DIVERSION of Trunked radio
[PTYPE] = 20, Reserved for INVALID REQUEST of Trunked radio
[PTYPE] = 21, Reserved for DATA ERROR of Trunked radio

[PTYPE] = 22, SELCALL RETRY
[PTYPE] = 23, RADIO STUNNED
[PTYPE] = 24, RADIO REVIVED
[PTYPE] = 25, FFSK DATA RECEIVED
[PTYPE] = 26, REPAIR MODE INITIATED
[PTYPE] = 27, REPAIR MODE DONE

Note that messages marked with A*@ will be filtered out by the Transparent mode message filter when the filter is activated and the CCDI is in Transparent mode.

Notes

1. Conventional radio 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. Conventional radio 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. Conventional radio and Trunked radio in conventional mode.
The TX INHIBITED (02) progress message indicates that transmission has been inhibited. This message will be sent whenever transmission is requested but is inhibited.
4. Conventional radio 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. Conventional radio 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 Areset@ to take it out of emergency mode.
6. Conventional radio 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. Conventional radio 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. Conventional radio and Trunked radio 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. Conventional radio and Trunked radio 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. Trunked radio only.
The progress type numbers 09 to 21 are reserved for Trunked radio.
 11. Conventional radio only.
The SELCALL RETRY (22) progress message indicates that a standard Selcall call has been retried.
 12. Conventional radio only.
The RADIO STUNNED (23) progress message indicates that RU has been stunned.
 13. Conventional radio only.
The RADIO REVIVED (24) progress message indicates that RU has been revived.
 14. Conventional radio only.
The FFSK DATA RECEIVED (25) progress message indicates to CE that the RU has received a valid FFSK data in Command mode. The buffered FFSK data will be sent to the CE when Transparent mode is next invoked. Note that if FFSK data has received in Transparent mode, it will be sent directly to the CE without sending this progress message.
 15. Conventional radio only.
The REPAIR MODE INITIATED (26) progress message indicates the RU has become the Repair mode.
 16. Conventional radio only.
The REPAIR MODE DONE (27) progress message indicates that all transaction for modifying code or data has been finished.
 17. The progress type numbers 00 to 08 are compatible to T2000 CCI, but the numbers 22 to 27 are newly added.
 18. An example of a PROGRESS response message would be:

p0202CC This message indicates the progress message of TX INHIBITED.

4.3.6 GET_SDM

Solicited.

The GET_SDM message is sent to the CE in response to a QUERY command. It sends the buffered SDM data the RU.

[IDENT] As@

[PARAMETERS] [SDM_DATA]

[SDM_DATA] It can be maximum 32 character string but optional.

Notes

1. If there is any buffered SDM data in the RU, the SDM data will be sent to the CE. If there is no data

available then the command is sent with no [PARAMETERS].

2. Examples of the GET_SDM response message would be:

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

s02Hi7A This message indicates that the RU has a valid SDM data AHi@