CD2
Military/Government Protocol
Programmer's Guide

DC 900-1607F

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CD2 Military/Government Protocol Programmer's Guide
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Preface

Purpose of Document

This document describes Protogate's CD2 protocol for Protogate's intelligent communications processors (ICPs). This document supports and must be used in conjunction with the *Military/Government Protocols Programmer Guide* (DC 900-1602), which describes how the client writes commands to and receives responses from the ICP, as well as other non-protocol-specific aspects of Protogate's Military/Government Protocols product.

Intended Audience

This document should be read by programmers who are interfacing a client application program to Protogate's CD2 protocol. You must be familiar with the CD2 communication message formats detailed in this document.

Organization of Document

Chapter 1 describes the CD2 data formats.

Chapter 2 describes the CD2 link configuration options.

Chapter 3 lists the CD2 protocol-specific command and response details that were not covered in the *Military/Government Protocols Programmer Guide*.

Appendix A describes the CD2 electrical and physical interfaces.

Document Conventions

This document follows the most significant byte first (MSB) and most significant word first (MSW) conventions for bit-numbering and byte-ordering. In all packet transfers between the client applications and the ICPs, the ordering of the byte stream is preserved.

Physical "ports" on the ICPs are logically referred to as "links." However, since port and link numbers are identical, this document uses the term "link." The links are logically numbered from 1–n, where n is the number of physical ports on the ICP.

Program code samples are written in the "C" programming language.

Revision History

The revision history of the *CD2 Military/Government Protocol Programmer's Guide*, Protogate document DC 900-1607F, is recorded below:

Revision	Release Date	Description
DC 900-1607A	November 1998	Original release
DC 900-1607B	July 1999	Modify Section 2.5 and Section 2.6 on page 22 Add Electrical Interface option (Section 2.8 on page 22) Add Set Protocol command code and communication buffer information (Chapter 3)
DC 900-1607C	August 1999	Modify link statistics and comm buffer info (Chapter 3)
DC 900-1607D	December 2002	Update contact information for Protogate, Inc.
DC 900-1607E	March 2004	Add Protocol option (Section 2.1 on page 19) and Blocking Interval option (Section 2.15 on page 25).
DC 900-1607F	September 2011	Add mention of support for the new Link-Trace function (Chapter 3).

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Chapter

1 CD2 Data Formats

CD2 messages on the client/ICP interface consist of a header and a data area. Outgoing and incoming link data messages on this interface are described generically in the *Military/Government Protocols Programmer Guide*. The relevant information specific to CD2 protocol data is described in this chapter.

1.1 Message Transmission

For each CD2 message transmission, the client provides a series of CD2 data words. The transmit order within these words is most significant bit through least significant bit.

If the "ICP Adds/Removes Parity" option is disabled, which is the default (Section 2.12 on page 23), each word consists of a parity bit, 12 data bits, and 3 zero bits as shown in Figure 1–1. If the option is enabled, each word consists of 12 data bits and 4 zero bits as shown in Figure 1–4, and the ICP will calculate and insert the proper parity bit.

The following diagram of a message transmission is read left to right, as first transmitted bit to last transmitted bit. Spacing between bit groups is inserted for intelligibility. For purposes of illustration, seven data words (91 bits) are assumed; however, any number of data words may be provided by the client for a message, up to the configured size of the ICP's communication buffer data area. (For comparison purposes, note that this size is measured in units of 8-bit bytes, whereas each CD2 data word is held by a 16-bit unit.)

```
(start)     ddddddddddddp ddddddddddddp ddddddddddddp ddddddddddddp
(continue)  ddddddddddddp ddddddddddddp ddddddddddddp    (end)
```

Each "ddddddddddddp" is a 13-bit CD2 data word, with the parity bit in the 13th transmit position. After transmission of a message, a trio of 13-bit CD2 idle words is sent:

(start) `0001111111111 0001111111111 0001111111111` (end)

When another message is not available for immediate transmission, CD2 idle words continue to be sent as time-fill until a message becomes available.

1.2 Message Reception

For message reception, the same bit stream is received. CD2 data word reception is synchronized by the detection of a 13-bit CD2 idle word (as defined above), after which successive 13-bit units are extracted. A start of message is recognized as the first non-idle word found after a series of one or more idle words. End of message is defined as the first idle word found after the start of message. The length of a received message, in terms of data words, is constrained by the Receive Frame Size configuration option specified for the link.

If the "ICP Adds/Removes Parity" option is disabled, which is the default (Section 2.12 on page 23), each client word consists of a parity bit, 12 data bits, and 3 zero bits as shown in Figure 1–2. If the option is enabled, each client word consists of 12 data bits and 4 zero bits as shown Figure 1–3. The order of reception within a client byte is from most to least significant bit.

Two CD2 message receive errors are checked for, and reported in the Extended Error Status field of the message header. Their occurrences are accumulated in the link statistics:

- Bit 0: Parity error — Invalid parity bit in one or more 13-bit CD2 data words
- Bit 5: EOM error — The number of CD2 data words accumulated for a message exceeds the limit specified by the Receive Frame Size link configuration option value.

The failure to initially achieve receive synchronization by detecting a CD2 idle word, or to reacquire such synchronization after an EOM error, is reported to the client in Type II Link Status Report and Link Status Notification responses.

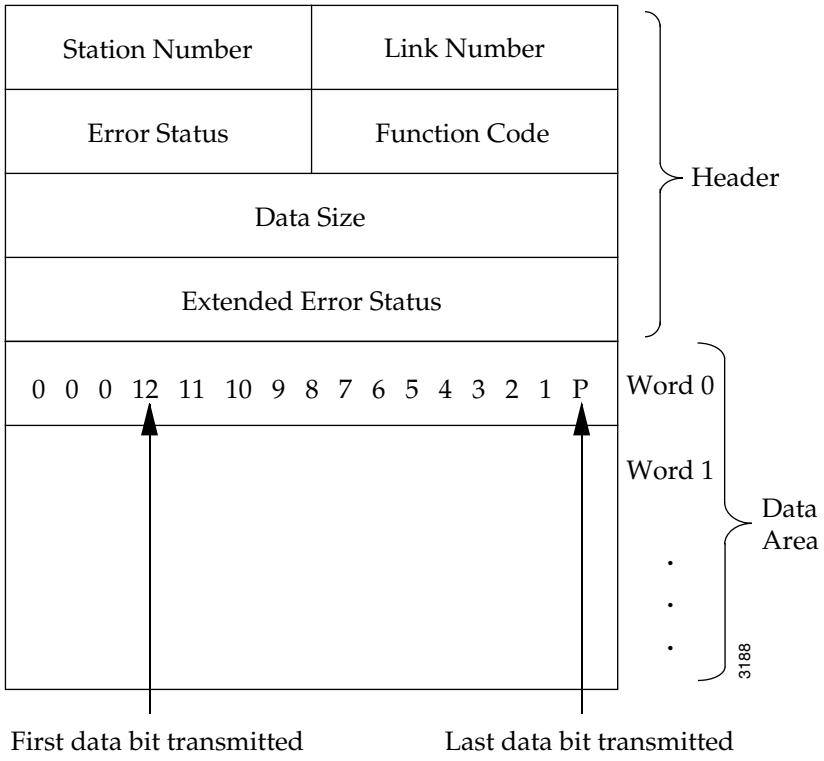


Figure 1–1: CD2 Message, Client to ICP, Client Adds Parity

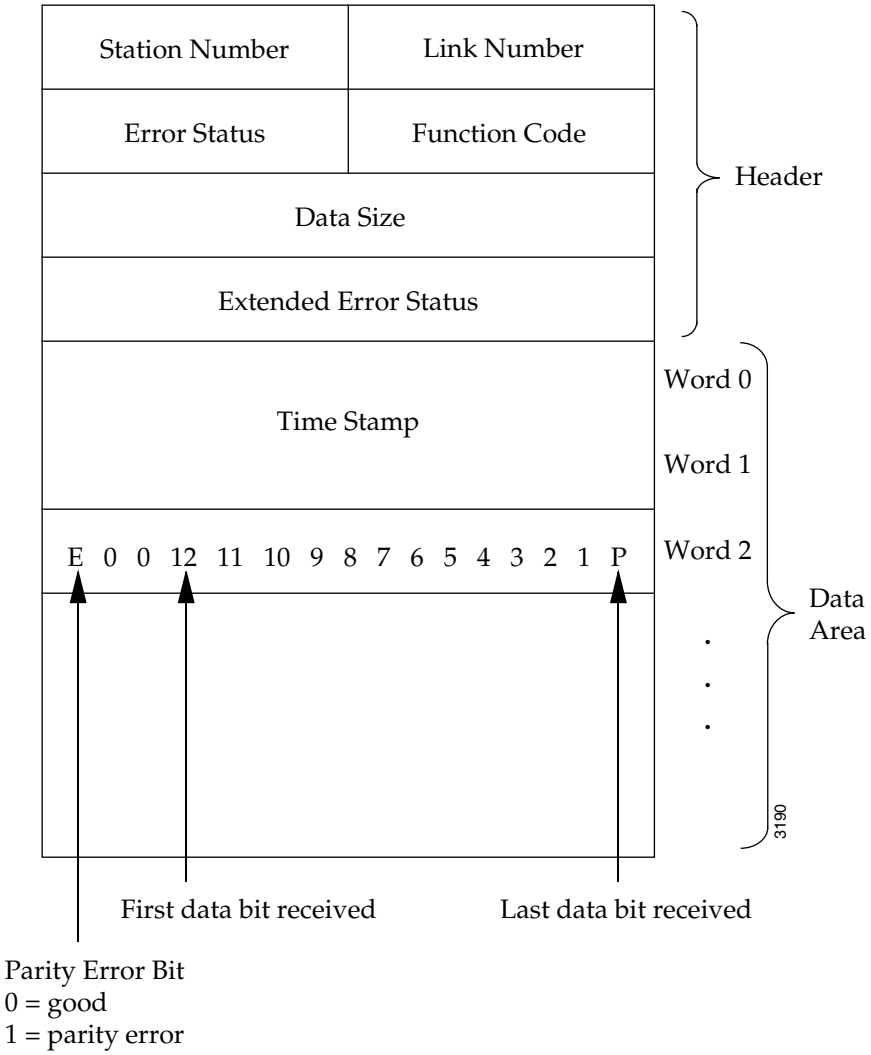


Figure 1–2: CD2 Message, ICP to Client, Client Removes Parity

Note

In Figure 1–2, the lower byte addresses are depicted on the right, and the higher byte addresses on the left.

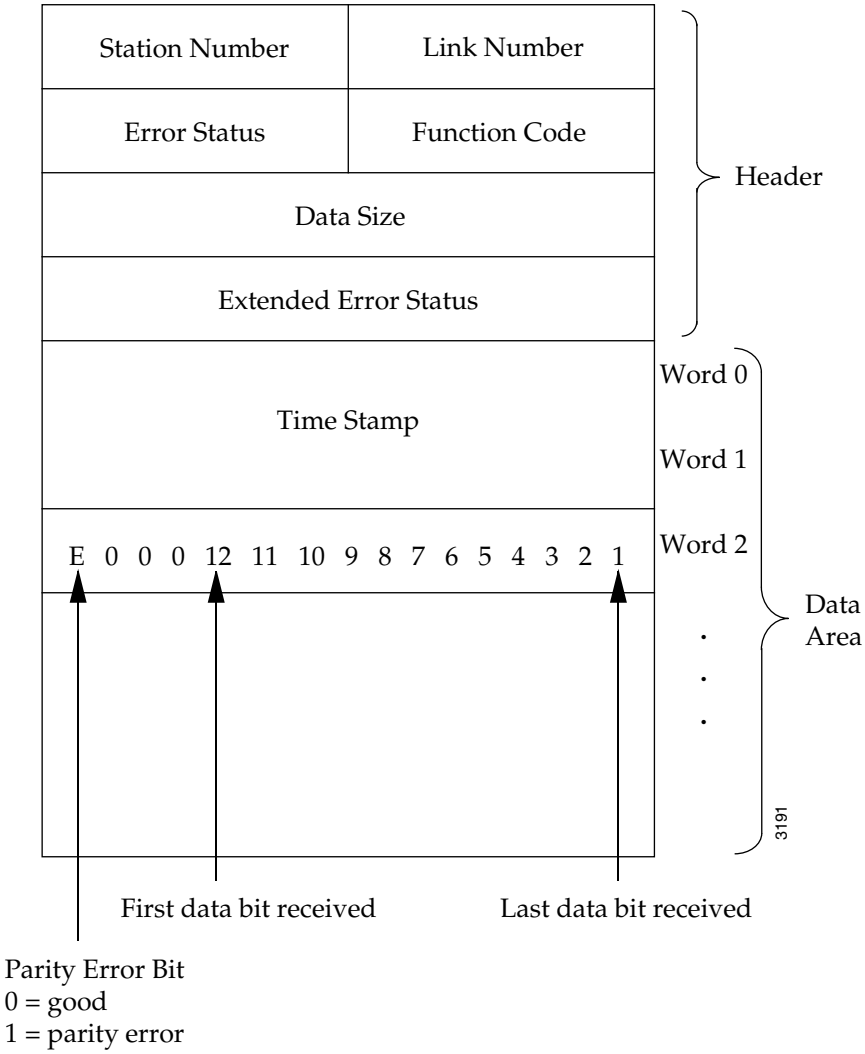


Figure 1–3: CD2 Message, ICP to Client, ICP Removes Parity

Note

In Figure 1–3, the lower byte addresses are depicted on the right, and the higher byte addresses on the left.

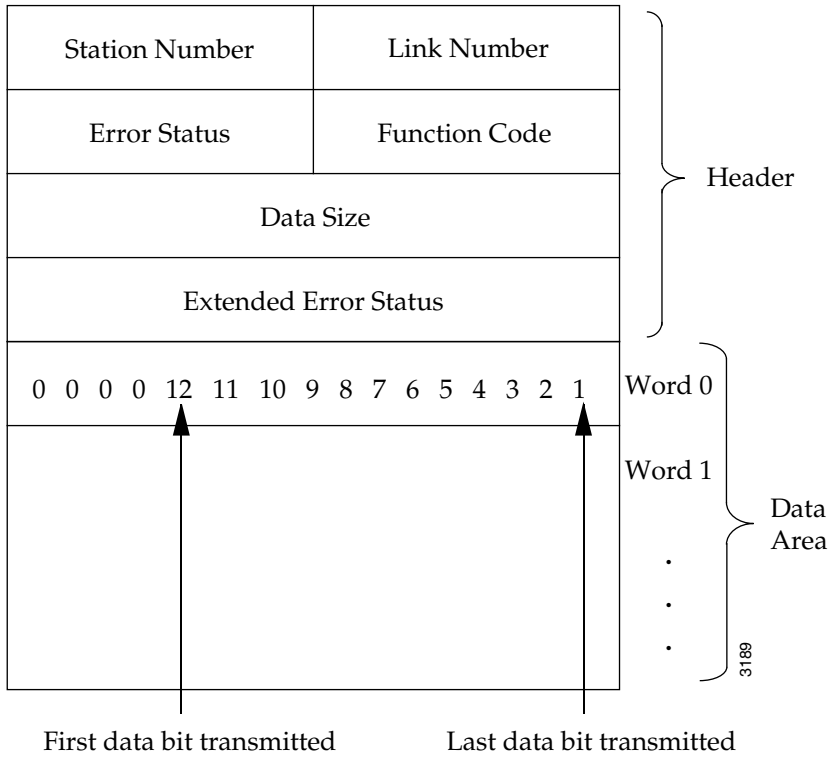


Figure 1–4: CD2 Message, Client to ICP, ICP Adds Parity

Note

In Figure 1–4, the lower byte addresses are depicted on the right, and the higher byte addresses on the left.

Chapter

2 Link Configuration Options

This chapter describes the link configuration options for the CD2 protocol. Table 2–1 lists the available configuration options in numerical order along with allowed settings and defaults. The defaults take effect immediately when the CD2 protocol has been assigned to the link. They remain in effect unless and until a Configure Link command is sent, as described in the *Military/Government Protocols Programmer Guide*.

Note

Link configuration options can be set only for a disabled link.

2.1 Protocol (-1)

The Protocol option assigns the CD2 protocol to the link. The parameter value must be 11 (as defined in Chapter 3). The protocol option, if specified, must appear *first* in the data area; any other placement causes the Configure Link command to be rejected. This enables the client to assign CD2 to the link and then set its configuration options, all in one command, making prior use of a separate Set Link Protocol command unnecessary.

2.2 Data Rate (1)

The Data Rate option defines the links data rate. The default data rate is 9600 bits per second. The full set of rates at which a link can be configured is: 300, 600, 1200, 2400, 4800, 9600, 19200, and 38400 baud. Rates above a certain point in the list might not be supportable in practice, due to message load and number of ports in use.

Table 2–1: CD2 Link Configuration Options

Option	Number	Value	Default (3)	Setting
Protocol	-1	7	n/a	11 = CD2
Data Rate	1	Section 2.2	9600	Bits/second
Clocking Source	2	1		External
		2	3	Internal
Error Screening	3	1		Enable
		2	3	Disable
Transmit Clocking	4	*n*	60	*n* = 1 to 60 seconds
Receive Clocking	5	*n*	60	*n* = 1 to 60 seconds
reserved	6–10			
Data Inversion	11	1	3	Disable (Spacing)
		2		Enable (Marking)
reserved	12–14			
Electrical Interface	15	1		Reserved
(ICP2432 only)		2	3	EIA-232
		3–11		Reserved
		12		EIA-449
		13		EIA-530
		14		V.35
		15		Reserved
Internal Loopback	16	1		Enable
		2	3	Disable
Request to Send	17	1	3	Enable
		2		Disable
reserved	18			
Transmit Acknowledgment Threshold	19	*n*	0	*n* = any 16-bit value
reserved	20–21			
Add/Remove Parity	22	1		Enable
		2	3	Disable
reserved	23–25			
Receive Frame Size	26	*n*	32	*n* = 1 to (comm buff size)/2

Table 2–1: CD2 Link Configuration Options *(Cont'd)*

Option	Number	Value	Default (3)	Setting
reserved	27-28			
Data Direction	29	1 2 3	3	Receive-only Transmit and Receive Transmit-only
reserved	30-35			
Blocking Interval	36	10-10000	1000	milliseconds

2.3 Clocking Source (2)

The Clocking Source option establishes whether the serial port transmit clocking is generated internally or supplied externally. See Appendix A. If internal clocking is selected (the default), the ICP generates transmit clocking for internal use, and supplies it on the DTE transmit clocking output (pin 24, EIA-232C). If external clocking is selected, the external agency must supply the transmit clocking signals on the DCE transmit clocking input (pin 15, EIA-232C). Receive clocking is taken from DCE receive clocking input (pin 17, EIA-232C), since receive timing is generated by the source of the receive data.

2.4 Error Screening (3)

The Error Screening option enables or disables the link for error screening. Data-word parity and proper end of message are verified for each message. If error screening is enabled, only the valid messages are sent to the client. If error screening is disabled (the default), all received messages are sent to the client, regardless of errors. Those with errors are specified by setting the receive error flag in the error status field in the communication header, and the appropriate specific error flag(s) in the extended error status field.

2.5 Transmit Clocking (4)

The Transmit Clocking option configures the interval at which the enabled link is monitored for the presence or absence of transmit clocking signals. Transmit clocking signal loss is determined by the lack of transmit data interrupts during at least a full interval. This is determinable at all times, since data (either a client message or the CD2 idle message) is always present for transmission. Signal recovery is determined by the resumption of transmit data interrupts. The interval ranges from one to 60 seconds, in units of seconds. The default is a very tolerant 60 seconds.

2.6 Receive Clocking (5)

The Receive Clocking option configures the interval at which the enabled link is monitored for the presence or absence of receive clocking signals. Receive clocking signal loss is determined by the lack of any receive data interrupts during at least a full interval. This is determinable at all times, since receive interrupts are always expected. Signal recovery is determined by the resumption of receive data interrupts. The interval ranges from one to 60 seconds, in units of seconds. The default is a very tolerant 60 seconds.

2.7 Data Inversion (11)

The Data Inversion option governs the encoding of received and transmitted bits on the link. For CD2, the standard data encoding is NRZ, for which data inversion is disabled (the default). The alternative data encoding is NRZB, for which data inversion is enabled.

2.8 Electrical Interface (15)

The Electrical Interface option configures the link's electrical interface type. This does not apply to the ICP6000 and ICP3222, which do not provide for software control of this feature. The default is EIA-232.

Note

The 8-port versions of the ICPs that provide for software control of the electrical interface type support only EIA-232.

2.9 Internal Loopback (16)

The Internal Loopback option configures the internal loopback state for the link's serial communications controller. If internal loopback is enabled, then transmit data is routed to the receiver in addition to the Transmit Data pin, the Receive Data pin is disabled, clocking is automatically internal, and modem signals are ignored.

2.10 Request to Send (17)

The Request to Send option configures the state of the Request to Send signal (RTS) when the link is enabled. The default is to turn on RTS.

2.11 Transmit Acknowledgment Threshold (19)

The Transmit Acknowledgment Threshold option enables ICP acknowledgment to the client of transmitted messages, using the Transmit Acknowledge notification. This option establishes the number of completed transmissions that will accumulate before a Transmit Acknowledge notification is sent to the client. If the value is set to zero (the default), no acknowledgments of transmitted messages are sent.

2.12 Add/Remove Parity (22)

The Add/Remove Parity option defines the ICP's responsibilities in the handling of the CD2 data word parity bits. If the Add/Remove Parity option is disabled (the default), the following procedures are followed:

- On the transmit side, the client provides the parity bit values in the data words.
- On the receive side, the ICP passes the parity bit values on to the client.

If the Add/Remove Parity option is enabled, the following procedures are followed:

- On the transmit side, the ICP calculates and inserts the parity values into in the parity bit positions of the data words.
- On the receive side, the ICP clears the parity bits (after checking them for error), and passes on zero values to the client in those bit positions of the data words.

ICP detection and reporting of parity errors in the received messages, as described in Section 1.2 on page 14, takes place regardless of the Add/Remove Parity option setting.

2.13 Receive Frame Size (26)

The Receive Frame Size option configures the maximum number of data words for a valid receive frame (single message). If an oversize frame is detected, the ICP performs the end-of-message error processing described in Section 1.2 on page 14.

The Receive Frame Size can not be configured to be larger than the amount of data that a communication buffer can hold. For a discussion of communication buffer sizing, see the *Military/Government Protocols Programmer Guide*. An attempt to increase the Receive Frame Size above the communication buffer data size results in the rejection to the client of the Configure Link command. Furthermore, an attempt to enable a CD2 link when its Receive Frame Size is too large for the communication buffers results in the rejection to the client of the Enable Link command; this happens if the communication buffers have been sized by the client to a length shorter than the default Receive Frame Size. (When comparing these two sizes, keep in mind that the Receive Frame Size is specified as a number of 16-bit words, whereas the communication buffer length is specified as a number of 8-bit bytes.)

2.14 Data Direction (29)

The Data Direction option configures the transmit and receive use to which the link is to be put. This option may specify both transmit and receive (the default), transmit-

only, or receive-only. If transmit-only is selected, no receive data will be taken from the link and passed to the client. If receive-only is selected, no transmit data will be accepted from the client or transmitted to the link.

2.15 Blocking Interval (36)

The Blocking Interval option sets the link's blocking interval, in milliseconds. The blocking interval is the length of time during which an input data segmentation buffer will collect received messages from a link before sending the buffer to the client with the Input Data Block command. (The buffer will be sent sooner if it fills.) This option overrides, for the specified link only, the interval already in place that has been initialized by ICP startup or assigned by an ICP configuration command.

Chapter

3 CD2 Command and Response Specifics

The following protocol-specific details were not completely covered in the *Military/Government Protocols Programmer Guide*:

1. The CD2 protocol selection code for the Configure Link Protocol command (and the obsolete Set Protocol command) is 11.

2. The Link Status Report (function code 31) and Link Status Notification (function code 35) sent by the ICP to the client is a Type II report.

3. The Link Statistics Report (function code 32) includes the counts of:
   - messages received (word 3)
   - parity errors (word 4)
   - receive character overruns (word 6)
   - transmit character underruns (word 7)
   - messages received with no errors (word 8)
   - messages received with errors (word 9)
   - EOM errors (word 13)
   - messages transmitted (word 17)
   - lost receive messages (no receive buffer) (word 18)

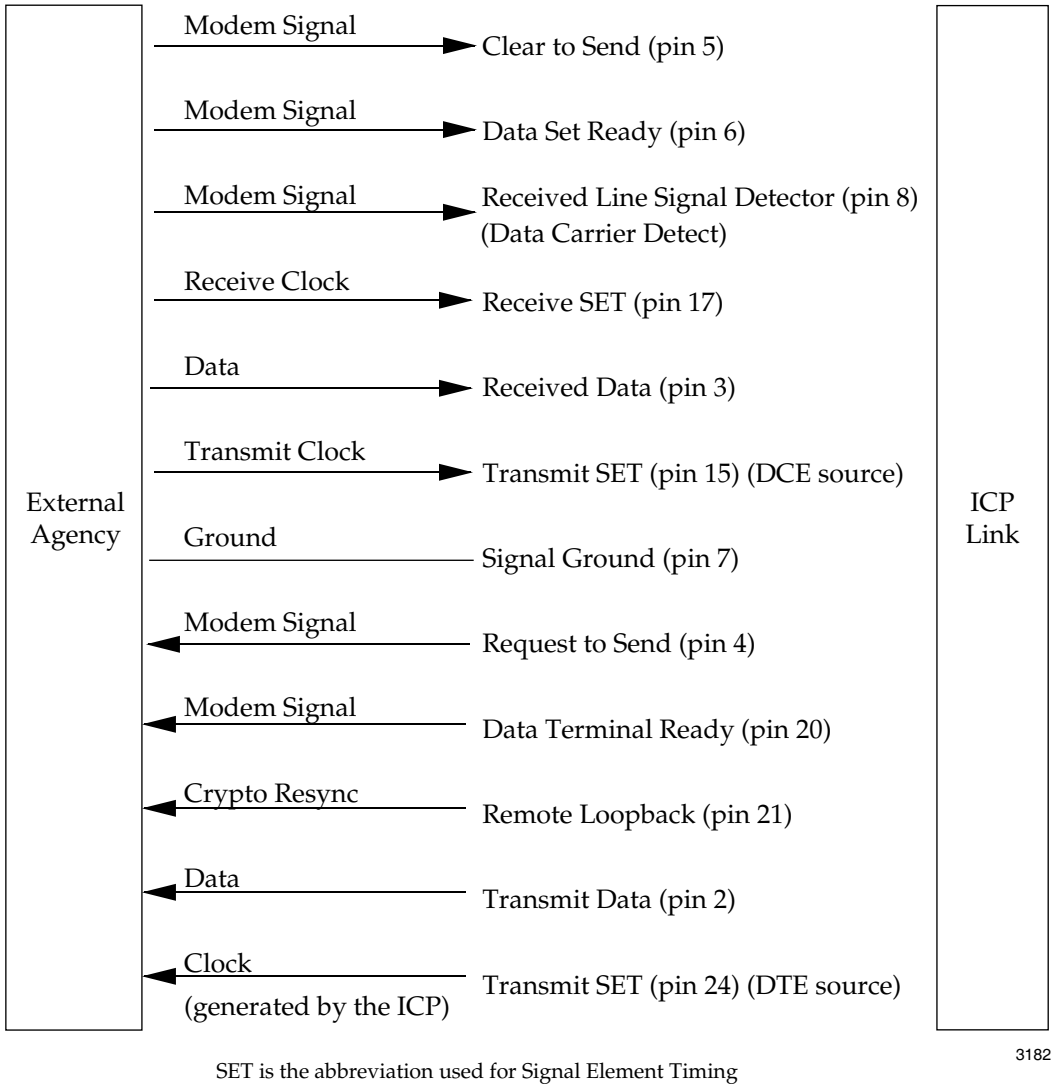
4. CD2 supports the Link-Trace Function of the Military/Government Protocols (refer to Chapter 6 of the *Military/Government Protocols Programmer Guide*).

5. If messages greater than 16 bytes (i.e., eight 13-bit CD2 data words) are anticipated, then the ICP communication buffers must be sized large enough to hold the largest anticipated CD2 message (transmitted or received).

Appendix

A CD2 Electrical and Physical Interface

The CD2 EIA-232C electrical and physical interfaces are shown in Figure A–1. The EIA-449 interfaces are shown in Figure A–2.



SET is the abbreviation used for Signal Element Timing

Figure A–1: EIA-232C Physical Connection

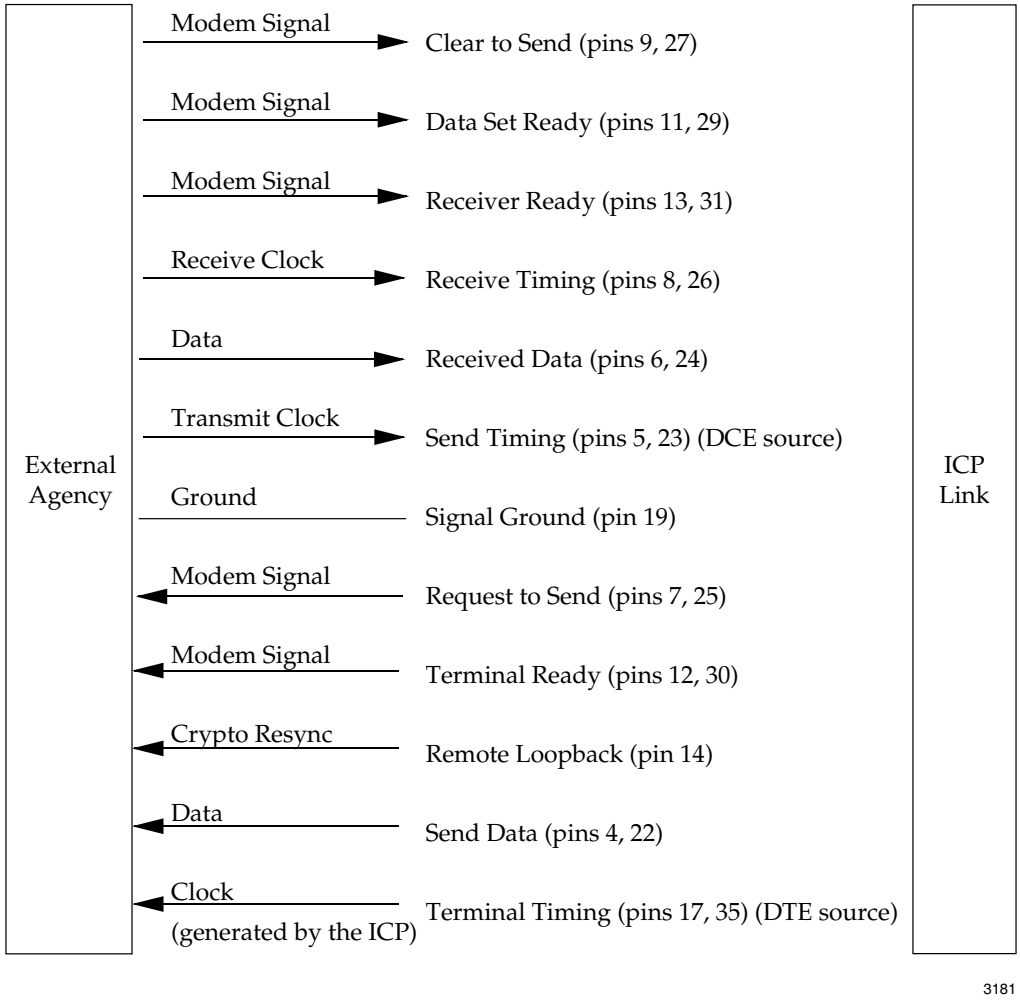


Figure A–2: EIA-449 Physical Connection

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