

# EDL Programmer's Guide

November 2001

Pacific Crest Corporation  
990 Richard Avenue, Suite 110  
Santa Clara, CA 95050  
(408) 653-2070  
(408) 748-9984 (fax)  
[sales@pacrst.com](mailto:sales@pacrst.com)  
<http://www.pacrst.com>

P/N: M00574

# Notice

PACIFIC CREST CORPORATION MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Pacific Crest Corporation shall not be liable for errors contained herein, or for incidental consequential damages in connection with the furnishing, performance, or use of this material.

This document contains proprietary information that is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated into another language without the prior written consent of Pacific Crest Corporation.

The information contained in this document is subject to change without notice.

© Copyright 2001 Pacific Crest Corporation

# EDL Programmer's Guide

## Introduction

This section contains information that will help system developers design and debug DTE software that interfaces with the Pacific Crest Corporation (PCC) modem. With this help, a developer should be able to implement systems making maximum use of the PCC modem's capabilities.

## Transparent Mode Operation

In the transparent modes of operation, the PCC modem receives and transmits data to and from the DTE in a transparent fashion. Any framing or protocol information, added by the modem and sent with the data, is stripped by the receiving modem. In essence, the interface works like a hard-wired connection.

### **When to Use Transparent Mode**

Transparent operation provides a drop-in replacement for wire-line communication systems, in many cases without changes to existing software. The existing software must be capable of handling the occurrence of data loss, which can potentially occur with radio interference.

Commercial communication software often provides XMODEM or other high-level protocol for data communication that can be used with the PCC modem in transparent mode. We recommend the use of transparent mode in the case where the DTE provides its own data packetizing and packet handshaking.

Because of the simplicity of the packet interface, we encourage all developers to make use of the highly reliable data interface available in packet mode operation.

## Packet Mode Operation

There are two types of packets sent to the radio modem. These are Control Packets and Data Packets. Control Packets are used to set and get settings of the radio modem, such as baud rate, data protocols, and channel selection. Data Packets are used to transmit data to a remote modem. (see Programmer's Guide: Data Packets)

Packet operation makes use of a structured data interface with the DTE to provide an extremely reliable means of communicating data from point-to-point or point-to-multipoint. In order to take advantage of this mode, the DTE needs to present data and commands to the radio modem in a structured format. The radio modem transmits data or status values to the associated DTE in a structured data format. This section defines the format of data, and the commands that are available to transmit packets, configure the radio modem, and to obtain modem setting status.

All packets sent to and received from the radio modem by the DTE start with an SOH (start of header) character. The last byte in the data packet consists of a checksum calculated as the one's compliment of the sum of all bytes in the packet following the SOH character. The SOH character is a byte value of 0x01.

(Note that references to all binary data bytes use the C programming language convention for hexadecimal notation. 0x00 is a one-byte (8 data bits) hexadecimal notation for a 0 value byte. 0xff is the one-byte hexadecimal notation for 255.)

## Accessing Packet/Command Mode

There are 4 ways that the PCC modem can be put into Packet/Command Mode:

(1) At power-up: During the first 0.5 sec that the PCC modem is powered up, it monitors the RS-232 port for a special command which places it into Command Mode. This method is reserved for ENVIRONMENTAL DATA LINK CONFIGURATION PROGRAM and various diagnostic programs.

(2) Programmed for 'Digipeat' or 'Packet' mode: If the modem has already been programmed for either of these 2 modes, then once the PCC modem has completed its power-up sequence, it will remain in Command Mode.

(3) Via an RS-232 (Hard) BREAK condition: If the "BREAK-to-Command" configuration option has been selected and programmed, then whenever the PCC modem detects the BREAK condition on the RS-232 input line from the DTE, then it will drop into Command Mode until it is reset via one of the RESET commands, or the power is removed.

(4) Via "Soft-BREAK": The "Soft-BREAK" feature allows a means for the user to force the modem into Command Mode regardless of the current DTE-DCE protocol and without having to cycle the modem power.

If the modem detects "silence" from the DTE of longer than 1 second, followed by the exact ASCII character string "+++", followed by another silent period of 1 second, then the modem will drop into command mode. Any valid command may be issued, including the "Warm RESET", thus enabling temporary Channel, Squelch, etc. changes without requiring they first be Programmed (followed by a "Cold" RESET).

The "Soft-BREAK" operates independently of the "BREAK-to-Command" feature.

## Control Packets

As an example, the command to change the radio channel to channel 2 requires that the following stream of four bytes be sent to the radio modem:

0x01 0x03 0x02 0xfa

With

0x01 - SOH character

0x03 - Command number for SETCHAN

0x02 - Control byte value (Channel number to select)

0xfa - Checksum

The checksum in the above example is calculated as the sum of the command number (0x03) and the command parameter (0x02). The resulting value (0x05) is 1's complimented to produce the checksum (0xfa).

Every command or data packet sent to the modem is acknowledged with a status response. The status response is formatted beginning with an SOH character, followed by a status type indicator which consists of the associated command

number with the most significant bit set, followed by one or more status bytes, followed by a single byte checksum as calculated above.

To continue with the above example, after receiving the SETCHAN command given above, the radio modem would respond with the following 4-byte status packet:

0x01 0x83 0x00 0x7c

With

0x01 - SOH character

0x83 - Status response for SETCHAN

0x00 - Status value - OK, channel switched

0x7c - Checksum

Upon receipt of the status packet, the DTE is notified that the channel has been changed as requested.

If the DTE provides the radio modem with an illegal command parameter, then the radio modem responds with a status response indicating the error. For example, if the DTE requests the modem to change to channel 16 (0x10), then an error condition will result. The radio modem only supports channel numbers 0 through 15. The data packets sent to and received from the modem are as follows:

DTE sends: 0x01 0x03 0x10 0xec

DCE responds: 0x01 0x83 0x01 0x7b

This command format is consistent across the line of radio modem products manufactured by Pacific Crest Corporation. As new products become available, backward compatibility is guaranteed with these commands.

### **Command Queuing**

Only one command can be sent at a time to the radio modem. Attempts to send a second command to the radio modem before the current command is acknowledged may cause erroneous behavior. Do not queue commands by sending more than one at a time.

### **Command Syncing**

Losing sync with the DTE may occur if the SOH character is garbled or missing from the data stream. Since the radio modem searches for the SOH character to indicate the beginning of a packet, if the SOH character is lost, then the following data will be discarded. Causes for losing sync include the DTE accidentally being turned off during a command execution, or the serial cable becoming disconnected. To regain sync, the DTE should repeat a simple status request command until the proper response is received.

# Programmer's Guide: Control Packet Commands

## Commands

Set DCE-DTE Baud (SETBAUD).....	9
Get DCE-DTE Baud (GETBAUD).....	10
Set Channel (SETCHAN).....	11
Get Channel (GETCHAN).....	12
Set Link Speed (SETLINK).....	13
Get Link Speed (GETLINK).....	14
Set Protocol (SETPROT).....	15
Get Protocol (GETPROT).....	16
Set Forward-Error-Correction (SETFEC).....	17
Get Forward-Error-Correction (GETFEC).....	18
Set Scrambler (SETSCRAM).....	19
* Trimble Navigation.....	19
Get Scrambler (GETSCRAM).....	20
Set EOT (SETEOT).....	21
Get EOT (GETEOT).....	22
Set Local Address (SETADDR).....	23
Get Local Address (GETADDR).....	24
Set Retries (SETRETRY).....	25
Get Retries (GETRETRY).....	26
Low Power Mode (LOWPWR).....	27
Set Destination Address (SETDEST).....	28
Get Destination Address (GETDEST).....	29
Set Parity (SETPAR).....	30
Get Parity (GETPAR).....	31
Set TX ACK Time-out (SETACKTO).....	32
Get TX ACK Time-out (GETACKTO).....	33
Set Digipeater Delay (SETDGDLY).....	34
Get Digipeater Delay (GETDGDLY).....	35
Reset (RESET).....	36
Program (PROGRAM).....	37
Set Digisquelch (SETSQLCH).....	38
Get Digisquelch (GETSQLCH).....	39
Get Temperature Sensor Reading (GETTEMP).....	40



Get Signal to Noise Ratio (GETSNR).....	41
Get the Signal Strength Readings (GETRSSI).....	42
Get the Voltage Indication Readings (GETVOLT).....	43
Set Modulation Format (SETMOD).....	44
Get Modulation Format (GETMOD).....	45
Set CSMA (SETCSMA).....	46
Get CSMA (GETCSMA).....	47
Set Local Node (SETNODE).....	48
Get Local Node (GETNODE).....	49
Program's Guide: Data Packets.....	51
Optimal Packet Length.....	52
Modem Response.....	53
Packet Queuing.....	53
Broadcast Packet.....	54
Updating the Radio Modem Channel Table.....	55

## Set DCE-DTE Baud (SETBAUD)

### Description:

This command is used to set the DTE-DCE interface baud rate. If the status response to the command indicates no errors, then the user should immediately switch the DTE to the new baud rate prior to continuing interaction with the modem.

Command number:	0x01.
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 = 19.2 kbps 0x01 = 9.6 kbps 0x02 = 4.8 kbps 0x03 = 2.4 kbps 0x04 = 1.2 kbps 0x05 = reserved 0x06 = reserved 0x07 = reserved 0x08 = 38.4 kbps
Modem STATUS response:	0x81
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK 0x01 = Illegal baud rate select

### Example:

DTE sets radio modem to 9.6 kbps. The modem responds with OK. Upon receiving the OK response, the DTE should immediately switch to the new baud rate.

DTE sends: 0x01 0x01 0x01 0xfd  
DCE responds: 0x01 0x81 0x00 0x7e

## Get DCE-DTE Baud (GETBAUD)

### Description:

Returns the current baud rate setting of the modem. (This command may appear unnecessary, but is actually used by the configuration program. It is also included to maintain a consistent set of commands.)

Command number:	0x02
Number of CNTRL bytes:	0
Modem response:	0x82
Number of STATUS bytes:	1
STATUS byte values:	0x00 = 19.2 kbps
	0x01 = 9.6 kbps
	0x02 = 4.8 kbps
	0x03 = 2.4 kbps
	0x04 = 1.2 kbps
	0x05 = reserved
	0x06 = reserved
	0x07 = reserved
	0x08 = 38.4 kbps

### Example:

DTE requests current baud rate setting. Modem responds with "1.2 kbps".

DTE sends: 0x01 0x02 0xfd  
DCE responds: 0x01 0x82 0x04 0x79

## Set Channel (SETCHAN)

### Description:

Select one of the sixteen programmed channels. A channel consists of a preassigned frequency pair (TX and RX). Channel numbers range from 0 to 15. Only programmed channels can be selected.

Command number:	0x03
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 to 0x0f
Modem response:	0x83
Number of STATUS bytes:	1
STATUS byte values:	0x00 - OK 0x01 - Illegal channel number 0x02 - Channel not programmed

### Examples:

DTE requests the modem to switch to the frequencies programmed into channel 2. The radio modem responds with OK - channel 2 selected.

DTE sends: 0x01 0x03 0x02 0xfa  
DCE responds: 0x01 0x83 0x00 0x7c

DTE requests the modem to switch to a channel that has not been programmed in the radio modem. The radio modem responds with the error condition.

DTE sends: 0x01 0x03 0x08 0xf4  
DCE responds: 0x01 0x83 0x02 0x7a

## Get Channel (GETCHAN)

### Description:

Get the current radio channel number. A channel consists of a pair of frequencies, one for TX and one for RX which have been programmed into the modem. The user should maintain a record of the frequencies assigned to each channel.

Command number:	0x04
Number of CNTRL bytes:	0
Modem STATUS response:	0x84
Number of STATUS bytes:	1
STATUS byte values:	0x00 to 0x0f

### Example:

DTE requests current channel. The modem responds with "2".

DTE sends: 0x01 0x04 0xfb  
DCE responds: 0x01 0x84 0x02 0x79

## Set Link Speed (SETLINK)

### Description:

Sets the RF link speed. This is the speed at which data is transmitted over the RF link. The data byte throughput is dependent on the speed of the RF link, as well as the status of FEC and the DTE protocol selected.

Command number:	0x05
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 = reserved
	0x01 = reserved
	0x02 = 4.8 kbps
	0x03 = 9.6 kbps
	0x04 = 19.2 kbps
Modem STATUS response:	0x85
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK
	0x01 = Illegal link speed select

### Example:

DTE sets RF link speed to 9.6 kbps

DTE sends: 0x01 0x05 0x03 0xf7

DCE responds: 0x01 0x85 0x00 0x7a

## Get Link Speed (GETLINK)

### Description:

Get the current link speed.

Command number:	0x06
Number of CNTRL bytes:	0
Modem STATUS response:	0x86
Number of STATUS bytes:	1
STATUS byte values:	0x00 = reserved
	0x01 = reserved
	0x02 = 4.8 kbps
	0x03 = 9.6 kbps
	0x04 = 19.2 kbps

Example: DTE queries for current link speed. The modem responds with "4.8 kbps".

DTE sends: 0x01 0x06 0xf9  
DCE responds: 0x01 0x86 0x02 0x77

## Set Protocol (SETPROT)

### Description:

Sets the modem to the selected protocol or mode. The protocol manages the DTE-DCE interface. Six protocols are currently supported, Transparent with EOT Character, Transparent with EOT Time-out, Packet, Auto-repeater, Fast Asynchronous, and TrimTalk\*. Note that if this command is used to set the protocol from Packet to Transparent mode operation, then the only way to return to packet is through a modem reset operation.

The most significant bit of the protocol variable is used to enable or disable the BREAK – to – command mode. If the most significant bit is set, then a hardware BREAK signal from the DTE will cause the local modem to switch to packet (command) mode, regardless of the current mode setting.

Command number:	0x07
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 = Transparent w EOT time-out
	0x01 = Transparent w EOT character
	0x02 = Packet
	0x03 = Auto-repeater
	0x04 = Fast Asynchronous
	0x05 = TrimTalk*

	BREAK enabled
	0x80, 0x81, 0x82, 0x83, 0x84, 0x85

Modem STATUS response:	0x87
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK
	0x01 = Illegal protocol select

Example: DTE select auto-repeater protocol.

DTE sends:	0x01 0x07 0x03 0xf5
DCE responds:	0x01 0x87 0x00 0x78

\*Trimble Navigation



## Get Protocol (GETPROT)

### Description:

Returns the current protocol selection. If the most significant bit of the variable is set, then the BREAK – to – command feature is enabled.

Command number:	0x08
Number of CNTRL bytes:	0
Modem STATUS response:	0x88
Number of STATUS bytes:	1
STATUS byte values:	0x00 = Transparent w EOT time-out
	0x01 = Transparent w EOT character
	0x02 = Packet
	0x03 = Auto-repeater
	0x04 = Fast asynchronous
	0x05 = TrimTalk*
	 BREAK enabled
	0x80, 0x81, 0x82, 0x83, 0x84

### Example:

DTE queries for current protocol setting. The modem responds with "Packet".

DTE sends: 0x01 0x08 0xf7  
DCE responds: 0x01 0x88 0x02 0x75

\*Trimble Navigation

## Set Forward-Error-Correction (SETFEC)

### Description:

Enables or disables Forward Error Correction. The PCC modem firmware currently supports a block code encoding. Data is interleaved to provide burst error correction capabilities.

Command number: 0x09  
Number of CNTRL bytes: 1  
CNTRL byte values: 0x00 = FEC off  
0x01 = Hamming FEC on

Modem STATUS return: 0x89  
Number of STATUS bytes: 1  
STATUS byte values: 0x00 = OK  
0x01 = Illegal FEC selection

### Example:

DTE disables FEC

DTE sends: 0x01 0x09 0x00 0xf6  
DCE responds: 0x01 0x89 0x00 0x76

## Get Forward-Error-Correction (GETFEC)

### Description:

Get the current FEC status

Command number:	0x0a
Number of CNTRL bytes:	0
Modem STATUS return:	0x8a
Number of STATUS bytes:	1
STATUS byte values:	0x00 = FEC off 0x01 = Hamming FEC on

### Example:

DTE queries FEC status. The modem responds with "ON".

DTE sends: 0x01 0x0a 0xf5  
DCE responds: 0x01 0x8a 0x01 0x74

## Set Scrambler (SETSCRAM)

### Description:

Enables or disables the data scrambler. For optimal operation of the GMSK and 4 Level FSK modulation, the data received should contain approximately the same number of ones and zeroes. When scrambling is enabled, the data passed to the modem is scrambled with an exclusive OR operation using a 256 byte pseudo-random bit table. We recommend that the scrambler be enabled unless data scrambling is performed by the DTE. Any scrambling performed by the DTE should attempt to minimize the occurrence of long sequences of ones or zeroes data bits.

Note: Scramble is forced ON when operating in TrimTalk\* Mode.

Command number:	0x0b
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 = Scrambler off 0x01 = Scrambler on
Modem STATUS response:	0x8b
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK 0x01 = Illegal scrambler selection

### Example:

DTE enables data scrambling

DTE sends: 0x01 0x0b 0x01 0xf3  
DCE responds: 0x01 0x8b 0x00 0x74

\* Trimble Navigation

## Get Scrambler (GETSCRAM)

### Description:

Gets the status of the data scrambler

Command number:	0x0c
Number of CNTRL bytes:	0
Modem STATUS response:	0x8c
Number of STATUS bytes:	1
STATUS byte values:	0x00 = Scrambler off 0x01 = Scrambler on

### Example:

DTE queries status of data scrambler. The modem responds with "ON".

DTE sends: 0x01 0x0c 0xf3  
DCE responds: 0x01 0x8c 0x01 0x72

## Set EOT (SETEOT)

### Description:

This command is used to set the decimal equivalent to the ASCII character that will be used to signal EOT. In Transparent w/ Time-out Mode this command is used to set the time-out value in units of .01 seconds.

Command number:	0x0d
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 to 0xff (As appropriate for the mode)

Modem STATUS response:	0x8d
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

DTE sets EOT character to Carriage Return

DTE sends:	0x01 0x0d 0x0d 0xe5
DCE responds:	0x01 0x8d 0x00 0x72

## Get EOT (GETEOT)

### Description:

The command is used to get the current setting for the EOT character or time-out value (depending on the mode of operation).

Command number:	0x0e
Number of CNTRL bytes:	0
Modem STATUS response:	0x8e
Number of STATUS bytes:	1
STATUS byte value:	0x00 to 0xff (As appropriate for mode)

### Example:

DTE queries radio modem for the current operating mode. The modem responds with "2".

DTE sends: 0x01 0x0e 0xf1  
DCE responds: 0x01 0x8e 0x02 0x6f

## Set Local Address (SETADDR)

### Description:

This command is used to set the local radio modem address. The address field is used in packet mode for designating the source and destination of a packet. Set each modem in the network of modems to a unique address. Address values can range from 0x00 to 0xfe (0-254 decimal). Address 0xff (255 decimal) is reserved as a broadcast address. By sending a packet to address 255, all radio modems in the network will receive the packet. Note that broadcast packets are not acknowledged.

Command number:	0x0f
Number of CNTRL bytes:	1
CNTRL byte values:	Local modem address

Modem STATUS response:	0x8f
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

The DTE sets the local modem to address 0x15 (=21 decimal).

DTE sends:	0x01 0x0f 0x15 0xdb
DCE responds:	0x01 0x8f 0x00 0x70



## Get Local Address (GETADDR)

### Description:

This command returns the value assigned for the address of the radio modem.

Command number:	0x10
Number of CNTRL bytes:	0
Modem STATUS response:	0x90
Number of STATUS bytes:	1
STATUS byte values:	Local modem address

### Example:

Query the local modem for its address. The modem responds with address 0x24 (36 decimal)

DTE sends: 0x01 0x10 0xef  
DCE responds: 0x01 0x90 0x24 0x4b

## Set Retries (SETRETRY)

### Description:

This command is used to set the number of automatic retries the local modem executes in attempting to send a non-bradcast data packet when in packet mode. The local modem will retry the transmission if the remote modem does not acknowledge the receipt of the packet. The number of retries can be set from 0 to 255. Do not set the number of retries too high, especially if transmitting large packets. Doing so may cause an unacceptable backup of incoming local data possibly resulting in data loss.

Command number:	0x11
Number of CNTRL bytes:	1
CNTRL byte values:	Number of retries

Modem STATUS response:	0x91
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

The DTE sets the number of automatic retries to 3.

DTE sends:	0x01 0x11 0x03 0xeb
DCE responds:	0x01 0x91 0x00 0x6e

## Get Retries (GETRETRY)

### Description:

This command is used to get the maximum number of automatic retries the local modem executes in attempting to send a non-broadcast data packet. The local modem will retry the transmission if the remote modem does not acknowledge the packet.

Command number:	0x12
Number of CNTRL bytes:	0
Modem STATUS response:	0x92
Number of STATUS bytes:	1
STATUS byte values:	Number of retries

### Example:

The DTE queries the current setting for number of retries. The modem responds with "3".

DTE sends: 0x01 0x12 0xed  
DCE responds: 0x01 0x92 0x03 0x6a

## Low Power Mode (LOWPWR)

### Description:

This command puts the radio modem into a low-power operating mode consuming approximately one-half the power of normal RX operating modes. In this mode, the power LED is turned OFF and only blinks ON for one-half a second approximately every 10 seconds. Exit LOWPWR mode by sending any data (command) to the serial interface.

Command number:	0x13
Number of CNTRL bytes:	0
Modem STATUS response:	0x93
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

The DTE places the radio modem into the low power mode.

DTE sends: 0x01 0x13 0xec  
DCE responds: 0x01 0x93 0x00 0x6c

## Set Destination Address (SETDEST)

### Description:

This command is used to set the destination address used in transparent mode only. Address 255 destination is a broadcast address. All modems in a network will receive the data sent to address 255.

Command number:	0x14
Number of CNTRL bytes:	1
CNTRL byte values:	Destination address

Modem STATUS response:	0x94
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

The DTE sets the destination address to 3.

DTE sends:	0x01 0x14 0x03 0xe8
DCE responds:	0x01 0x94 0x00 0x6b

## Get Destination Address (GETDEST)

### Description:

This command returns the destination address setting of the modem.

Command number:	0x15
Number of CNTRL bytes:	0
Modem STATUS response:	0x95
Number of STATUS bytes:	1
STATUS byte values:	Destination address

### Example:

The DTE queries to modem for its destination address, which is 3.

DTE sends: 0x01 0x15 0xea  
DCE responds: 0x01 0x95 0x03 0x67

## Set Parity (SETPAR)

### Description:

This command is used to set the DTE-DCE parity. The radio modem supports none, even and odd parity. The DCE responds to this command in the current port configuration, and then immediately switches to the new parity setting.

Command number:	0x16
Number of CNTRL bytes:	1
CNTRL byte values:	0x00 = None 0x01 = Even 0x02 = Odd
Modem STATUS response:	0x96
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK 0x01 = Illegal selection

### Example:

The DTE sets the parity to odd.

DTE sends: 0x01 0x16 0x02 0xe7  
DCE responds: 0x01 0x96 0x00 0x69

## Get Parity (GETPAR)

### Description:

This command returns the DTE-DCE parity setting.

Command number:	0x17
Number of CNTRL bytes:	0
Modem STATUS response:	0x97
Number of STATUS bytes:	1
STATUS byte values:	0x00 = None
	0x01 = Even
	0x02 = Odd

### Example:

The DTE queries to modem for its parity, which is "odd".

DTE sends:	0x01 0x17 0xe8
DCE responds:	0x01 0x97 0x02 0x66



## Set TX ACK Time-out (SETACKTO)

### Description:

This command is used to set the amount of time the transmitting modem will wait for an acknowledgment before rebroadcasting or failing the packet transmission. Setting the time-out value allows the optimization of the timing in situations where one or more digipeaters are in the path between the transmitting and receiving modems. Units are in tenths of a second plus .1 seconds.

Command number:           0x18  
Number of CNTRL bytes:     2  
CNTRL byte values:         0x0000 to 0xffff (.1 second to 6553.6 seconds)

Modem STATUS response:    0x98  
Number of STATUS bytes:    1  
STATUS byte values:        0x00 = OK

### Example:

The DTE sets the ACK time-out value to 1 second for a multi-hop packet transmission. (.9 seconds + .1 seconds = 1 second)

DTE sends:     0x01 0x18 0x09 0xde  
DCE responds: 0x01 0x98 0x00 0x67

## Get TX ACK Time-out (GETACKTO)

### Description:

This command returns the TX ACK time-out setting.

Command number:	0x19
Number of CNTRL bytes:	0
Modem STATUS response:	0x99
Number of STATUS bytes:	2
STATUS byte values:	0x0000 to 0xffff (.1 seconds to 6553.6 seconds)

### Example:

The DTE queries to modem for its TX ACK time-out setting, which is “.2 seconds”.

DTE sends: 0x01 0x19 0xe6  
DCE responds: 0x01 0x99 0x00 0x01 0x65

## Set Digipeater Delay (SETDGDLY)

### Description:

This command is used in digipeater mode to define a delay before digipeating the set of data. This is useful in circumstances where multiple repeaters are in range of the transmitting station. Each unit of repeater delay is 10 milliseconds.

Command number:	0x1a
Number of CNTRL bytes:	2
CNTRL byte values:	0x0000 to 0xffff (.01 second to 655.36 seconds)
Modem STATUS response:	0x9a
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

A digipeater in a network may be within range of one other digipeater. The other digipeater uses a holdoff delay of zero seconds. This digipeater wants to hold off 1 second to allow the other digipeater repeat time plus acknowledgment. A digipeater delay is set to 100 (0x0064). The modem responds with "OK".

DTE sends: 0x01 0x1a 0x00 0x64 0x81

DCE responds: 0x01 0x9a 0x00 0x65

## Get Digipeater Delay (GETDGDLY)

### Description:

This command returns the digipeater delay setting.

Command number:	0x1b
Number of CNTRL bytes:	0
Modem STATUS response:	0x9b
Number of STATUS bytes:	2
STATUS byte values:	0x0000 to 0xffff (.01 seconds to 655.36 seconds)

### Example:

The DTE queries to modem for its digipeater delay setting, which is zero (0x0000).

DTE sends: 0x01 0x1b 0xe4

DCE responds: 0x01 0xab 0x00 0x00 0x54

## Reset (RESET)

### Description:

This command is used to restart the PCC modem in either of two states:

1. Using the power-up configuration parameters that have been programmed (saved) into EEPROM. (see the PROGRAM command 0x1e), or
2. Using the current configuration parameters that the user may have chosen to alter but not re-program (save), facilitating such activities as Channel or Digisquelch changes without having to issue a PROGRAM command and re-power the modem. A "warm" reset returns the modem to the protocol/mode (ex transparent) that was in effect before the modem entered command mode.

Command number: 0x1d

Number of CNTRL bytes: 1

CNTRL byte values: 0x00 = "cold" restart from EEPROM settings  
0x01 = "warm" restart from current configuration settings

Modem STATUS response: 0x9d

Number of STATUS bytes: 1

STATUS byte values: 0x00 = OK

### Example:

The DTE resets the modem.

DTE sends: 0x01 0x1d 0x00 0xe2

DCE responds: 0x01 0x9d 0x00 0x62

## Program (PROGRAM)

### Description:

This command is used to program the current configuration into the PCC modem. After being programmed, the current configuration will be set during a power-up or “cold” RESET command. This is a means for setting the default power-up state of the PCC modem, including channel selection, DTE-DCE baud rate, etc.

Command number:	0x1e
Number of CNTRL bytes:	0
Modem STATUS response:	0x9e
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK

### Example:

The DTE programs the current settings into the DCE.

DTE sends: 0x01 0x1e 0xe1  
DCE responds: 0x01 0x9e 0x00 0x61



Caution: This command takes considerably longer (up to 4 seconds) than the other commands to complete. Allow for this extra time before issuing subsequent commands such as a “cold” RESET, or before cycling the power to the modem. Premature termination of this command can destroy critical configuration settings.

## Set Digisquelch (SETSQLCH)

### Description:

The SETSQLCH command (Set Digisquelch) sets the level of radio signal required to activate the receiver. The factory default setting of "High" provides maximum effective sensitivity to incoming signals. This is the preferred setting for most applications. "Moderate" and "Low" sensitivity settings are available for use if local electrical noise or distant radio signals falsely activate the receiver. Use of these settings may reduce the operational range between units. The "Off" setting is provided for test purposes and is not recommended for normal use. Selecting "Off" results in transmit-only operation.

Command number:           0x29  
Number of CNTRL bytes:    1  
                              0x00 = High sensitivity  
                              0x01 = Moderate sensitivity  
                              0x02 = Low sensitivity  
                              0x03 = Off

Modem STATUS response:    0xa9  
Number of STATUS bytes:    1  
STATUS byte values:        0x00 = OK  
                              0x01 = Illegal selection

### Example:

Due to a particularly noisy environment, the user is seeing a carrier detect flickering due to ambient noise. Set digisquelch to moderate to reduce the interference problem.

DTE sends:     0x01 0x29 0x01 0xd5  
DCE responds: 0x01 0xa9 0x00 0x56

## Get Digisquelch (GETSQLCH)

### Description:

This command is used to get the current digisquelch setting.

Command number:	0x2a
Number of CNTRL bytes:	0
Modem STATUS response:	0xaa
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK 0x00 to 0x03

### Example:

DTE queries for the digisquelch setting. Modem responds with "High".

DTE sends:	0x01 0x2a 0xd5
DCE responds:	0x01 0xaa 0x00 0x55



## Get Temperature Sensor Reading (GETTEMP)

### Description:

Returns the temperature sensor reading (in A/D counts) averaged over 8 samples (at 1 sample every 256 msec).

Where 'adc' is the value returned by this command (converted to a decimal),  
Then the value of the temperature in °C is:

$$\text{Temp}(\text{°C}) = \text{adc} - 51$$

Command number:	0x50
Number of CNTRL bytes:	0
Modem STATUS response:	0xd0
Number of STATUS bytes:	1
STATUS byte values:	0x00 to 0xff

### Example:

DTE queries for the temperature sensor reading which is 70 A/D.

DTE sends: 0x01 0x50 0xaf  
DCE responds: 0x01 0xd0 0x46 0xe9

## Get the Signal to Noise of Last Reception (GETSNR)

### Description:

Returns the raw A/D count value of the last reception at the beginning of the last received packet. The value indicates the % high time of this PWM signal, from 0x00 = 0% to 0xff = 100%.

The actual SNR value (db) depends on the 'BT' setting (0.3 or 0.5). So, where 'adc' is the value returned by this command, the values of SNR for the 2 BT settings are:

BT = 0.3:        SNR(dBm) = (adc/17.1)

BT = 0.5:        SNR(dBm) = adc/20.5

Command number:        0x51

Number of CNTRL bytes:    0

Modem STATUS response:    0xd0

Number of STATUS bytes:    1

STATUS byte values:        0x00 to 0xff

### Example:

DTE queries for the SNR which is 12.

DTE sends:    0x01 0x51 0xae

DCE responds: 0x01 0xd1 0x0C 0x22

## Get the Signal Strength Reading (GETRSSI)

### Description:

Returns the raw A/D count values of the rssi signals corresponding to the latest value, and the preamble of the last received packet.

Where 'adc' is the value returned by this command, the value of the RSSI in 'dBm' is:

$$\text{RSSI(dBm)} = (\text{adc} - 255) / 6.6 - 98$$

Ex. If abc = 128, then RSSI = -117 dBm

Command number:	0x52
Number of CNTRL bytes:	0
Modem STATUS response:	0xd0
Number of STATUS bytes:	2
STATUS byte values:	0x0000 to 0xffff

### Example:

DTE queries for the temperature signal strength where abc = 128:

DTE sends: 0x01 0x59 0xad  
DCE responds: 0x01 0xd2 0x73 0x75 0x45

## Get the Voltage Indication Readings (GETVOLT)

### Description:

Returns an A/D count which corresponds to the DC input voltage. For the A00606 modem board: \$ff indicates ~9.1 VDC, \$82 is the midpoint of ~ 12.5 VDC, and \$04 (min A/D) indicates ~16.0 VDC. The mapping is linear for all modem boards at 27.5mV per A/D count, but other boards have an ADC offset for a given voltage (ex. The A00348 board with diode D2 (instead of a fuse) has ADC counts \$20 higher than the A00606, so it can only detect voltages down to ~10.0 VDC).

The equation to convert ADC to VDC (for the A00606) is:

$$\text{Voltage} = 16.0 - 0.0275 * C \quad (\text{where 'C' = decimal A/D count})$$

The equation to convert ADC to VDC (for the A00348 w. D2) is:

$$\text{Voltage} = 16.0 - 0.0275 * C(C-32) \quad (\text{where 'C' = decimal A/D count})$$

Command number:	0x53
Number of CNTRL bytes:	0
Modem STATUS response:	0xd0
Number of STATUS bytes:	1
STATUS byte values:	0x00 to 0xff

### Example:

DTE queries for the voltage indication reading which is 3.

DTE sends: 0x01 0x53 0xad  
DCE responds: 0x01 0xd3 0x03 0x02 0x27

## Set Modulation Format (SETMOD)

### Description:

This command is used to select either GMSK or 4-Level FSK modulation for modem transmission and reception. GMSK can be used for 4800 and 9600 baud RF link rates, while 4-Level FSK can be used for 9600 and 19,200 baud RF link rates.

Command number: 0x2b  
Number of CNTRL bytes: 1  
0x00 = GMSK Format  
0x01 = 4-Level FSK Format

Modem STATUS response: 0xab  
Number of STATUS bytes: 1  
0x00 = OK  
0x01 = invalid modulation format code  
0x02 = invalid modulation/link baud combination

### Example:

The user wants to set the modem for 4-Level FSK communication format.

DTE sends: 0x01 0x2b 0x01 0xd3  
DCE responds: 0x01 0xab 0x00 0x54

## Get Modulation Format (GETMOD)

### Description:

This command is used to select either GMSK or 4-Level FSK modulation for modem transmission and reception. GMSK can be used for 4800 and 9600 baud RF link rates, while 4-Level FSK can be used for 9600 and 19,200 baud RF link rates.

Command number:           0x2c  
Number of CNTRL bytes:    0

Modem STATUS response:   0xac  
Number of STATUS bytes:   1

0x00 = GMSK Format

0x01 = 4-Level FSK Format

### Example:

The user wants to check the current modulation format of the modem, and the modem responds that it is presently set to 4-Level FSK.

DTE sends:    0x01 0x2c 0xd3

DCE responds: 0x01 0xac 0x01 0x52

## Set CSMA (SETCSMA)

### Description:

This command is used to turn on or off the CSMA algorithm. The algorithm, when turned on, minimizes the chances of data collision. If CSMA is turned off, then the radio modem will transmit immediately without regard to external carrier activity. Most regulatory agencies require that CSMA be turned on.

Command number:	0x54
Number of CNTRL bytes:	1
	0x00 = CSMA off
	0x01 = CSMA on
Modem STATUS response:	0xd4
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK
	0x01 = Illegal selection

### Example:

The user wants to assure a specific timing of the transmitted signal and does not care about data collision.

DTE sends: 0x01 0x54 0x00 0xab  
DCE responds: 0x01 0xd4 0x00 0x2b

## Get CSMA (GETCSMA)

### Description:

This command is used to get the current CSMA setting.

Command number:	0x55
Number of CNTRL bytes:	0
Modem STATUS response:	0xd5
Number of STATUS bytes:	1
STATUS byte values:	0x00 = CSMA off 0x01 = CSMA on

### Example:

DTE queries for the CSMA setting. Modem responds with "Off."

DTE sends: 0x01 0x55 0xaa  
DCE responds: 0x01 0xd5 0x00 0x2a



## Set Local Node Repeating (SETNODE)

### Description:

This command is used to define the operation of the local node (radio modem) when it receives a packet that is addressed to another modem. The local node can repeat the packet (re-broadcast it) or do nothing. This allows for an implementation of a network of radio modems, some providing repeating functions as well as terminal node functions.

Command number:	0x58
Number of CNTRL bytes:	1
	0x00 = Local node is non-repeater
	0x01 = Local node is repeater
Modem STATUS response:	0xd8
Number of STATUS bytes:	1
STATUS byte values:	0x00 = OK
	0x01 = Illegal selection

### Example:

The local node is ideally situated to repeat information from one area to the next. The system designer wants to enable its repeater function.

DTE sends: 0x01 0x58 0x01 0xa6  
DCE responds: 0x01 0xd8 0x00 0x27

## Get Local Node Repeating (GETNODE)

### Description:

This command is used to get the current local node setting with respect to repeating.

Command number:	0x59
Number of CNTRL bytes:	0
Modem STATUS response:	0xd9
Number of STATUS bytes:	1
STATUS byte values:	0x00 = local node is non-repeater 0x01 = local node is repeater

### Example:

DTE queries for the local node setting. Modem responds with "non-repeater".

DTE sends: 0x01 0x59 0xa6  
DCE responds: 0x01 0xd9 0x00 0x26

This page intentionally left blank.

## Programmer's Guide: Data Packets

Data packets are used to transmit and receive data to and from a remote modem. The packets are passed to the modem in a fixed format, and delimited with SOH and checksum bytes. Figure 1 shows the format of the data stream passed to and from the radio modem.

Value	Description
0x01	SOH Character
0x00	Data Packet Command ID
Destination or Source Address	When transmitting a packet, the DTE sets this field to the address of the destination. When receiving a packet, this field contains the address of the transmitting modem.
Number of bytes (MSB)	Most significant byte of the number of data bytes in the packet.
Number of bytes (LSB)	Least significant byte of the number of data bytes in the packet.
Byte 1	First byte of data.
Byte 2	Second byte of data
...	etc.
Checksum	One's compliment of all of the bytes in the packet excluding the SOH byte.

Figure 1 - Data Packet Structure

Note that the Destination/Source address field is defined in the context of whether the packet is being transmitted, or received. For the transmitter, this 8-bit field is set to the destination address. When a packet is received, this field is replaced by the receiving modem to contain the source address of the radio modem that originated the transmission.

The total number of bytes that can be transmitted in a single packet is 10k. The maximum value of the Number of bytes field must not exceed 0x2800 (10,240 decimal).

Example:

To send a packet of three data bytes, which correspond to '0', '1', '2' (0x30, 0x31, 0x32) from a modem with local address set to 5, to a modem with local address set to 8, send the following data stream to the modem:

0x01	0x00	0x08	0x00	0x03	0x30	0x31	0x32	0x61
SOH								
	Command ID							
		Dest Address						
			Len MSB					
				Len LSB				
					'0'			
						'1'		
							'2'	
								Checksum

The receiving modem would pass through the following data stream to the receiving DTE:

0x01	0x00	0x05	0x00	0x03	0x30	0x31	0x32	0x64
SOH								
	Status ID							
		Source Address						
			Len MSB					
				Len LSB				
					'0'			
						'1'		
							'2'	
								Checksum

## Optimal Packet Length

The maximum number of data bytes which can be sent in a single packet are 10k (10,240) bytes. Blocks of data larger than this must be divided and sent to the modem by the DTE. Because of the nature of radio frequency data communication, it is recommended to keep the data packets much shorter than the maximum. Mobile situations with substantial fade possibilities generally

require packets less than 512 bytes. Fixed point-to-point applications can utilize much larger data packets.

## Modem Response

Upon receipt of the data packet to transmit from the DTE, the modem performs a CSMA algorithm to gain access to the currently selected channel. It then keys the transmitter and provides synchronization information for remote modem synch. It then codes the data (if FEC is enabled), scrambles the data (if scrambling enabled), and transmits the data.

Upon successful reception, the remote modem transmits an ACK packet to the sending modem, and passes the data packet to its associated DTE (address field indicates packet source). Figure 2 shows the format of the packet used to signal the sending DTE that the delivery of the packet was successful.

0x01	SOH Character
0x80	Data packet status ID
0x00	Status OK
0x7f	Checksum

Figure 2 - ACK Packet Structure

If the remote modem does not respond with any type of acknowledgment, then the local modem retries the data transmission up to the programmed number of retries. If the remote modem still fails to acknowledge, then the local modem returns the Data Status Packet in Figure 3 to its DTE.

0x01	SOH Character
0x80	Data packet status ID
0x01	Status - No response
0x7e	Checksum

Figure 3 - NAK Packet Structure

## Packet Queuing

The current revision of PCC modem prohibits queuing of data packets. Only one packet should be sent to the radio modem at a time. The packet must be acknowledged prior to sending data for another packet, or for that matter another command, to the radio modem. While this limitation reduces the throughput of the radio modem, it provides the simplest interface for the DTE.

## Broadcast Packets

Packets addressed to modem address 0xff are designated as broadcast packets. All radio modems listening on the same frequency will receive the broadcast data packet and pass it on to the associated DTE. Note that broadcast packets are not acknowledged by the receiving modems. The status response from the transmitting radio modem will always indicate OK. This does not mean that all recipients of a broadcast packet received the data without error – only that the modem has completed the requested transmission.

# Updating the Radio Modem Channel Table

## Introduction

The channel table is stored in PCC modem memory and contains information for the dealer or factory programmed operating frequencies. For each programmed channel, a pair of frequencies are defined, one for transmission (TX), the other for reception (RX). In most instances the TX and RX channels will be programmed with the same frequency. An exception to this is a frequency pair used in a dispatch or auto-repeater application.

## Updating

In situations where the user wishes to add additional channels to the radio modem, the channel table must be updated. Because of FCC regulations, users are not allowed to arbitrarily change frequencies of operation. The FCC has enacted these regulations to minimize the illegal use of frequencies. Only authorized radio dealers and manufacturers can update the information contained in the channel table to allow access to a new frequency pair.

To facilitate field updates of the channel table, Pacific Crest Corporation provides a program called ENVIRONMENTAL DATA LINK CONFIGURATION PROGRAM and associated data files. The data files contain the information for updating the channel table of a single PCC modem based on serial number access. To request a channel update, you will need to supply Pacific Crest Corporation or its authorized dealers with the channel numbers, TX frequency and RX frequency information, and radio modem serial number. The ENVIRONMENTAL DATA LINK CONFIGURATION PROGRAM and associated data file will be mailed or e-mailed to the user. There is a nominal charge for this service to cover labor, the cost of the diskette, and shipping & handling.