RS232 Port Protocol and Syntax

EasyDCC Computer Port RS232 PROTOCOL - Version 6 ©2001-20014 by CVP Products

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Errata Location And Copyright Information

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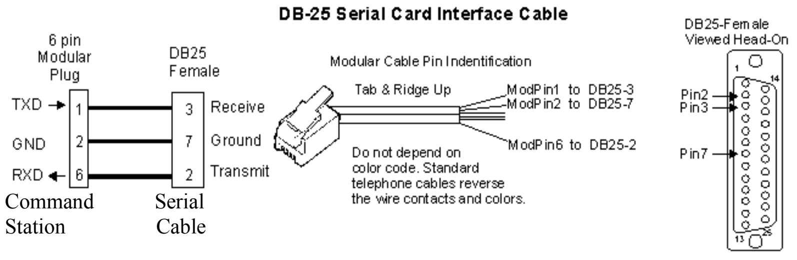
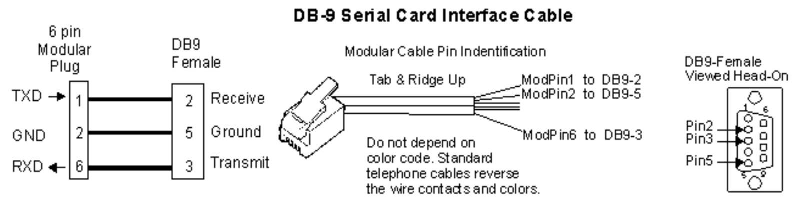
Command Station Software Version And A Note About Programming Skills

Requires Command Station software version 629 or higher. This information is written with the assumption you are familiar with computer communications. It is not written for novice programmers. The Basic Language program fragments are given for illustrative purposes only. Most initial communication problems are due to faulty cabling between EasyDCC and your computer. Look there if you seem to be unable to establish communications.

Interface Cable And Adapters




DB-9 Serial Card Interface Cable
6 pin Modular Plug
DB9 Female
TXD 1 — 2 Receive
GND 2 — 5 Ground
RXD 6 — 3 Transmit
Modular Cable Pin Indentification
Tab & Ridge Up
ModPin1 to DB9-2
ModPin2 to DB9-5
ModPin6 to DB9-3
Do not depend on color code. Standard telephone cables reverse the wire contacts and colors.
DB9-Female Viewed Head-On
Pin2
Pin3
Pin5
1
6

USB to Serial Adapters

If your PC doesn't have a serial port, you must use a USB to Serial Port adapter. We have tested and verified the proper operation of the KEYSPAN adapter, part number USA-19HS. It has a USB connector on one end and a DB9 male connector on the other.

Although we can't claim to have tested every machine, it has worked flawlessly with several different machines that used Windows XP.

The KEYSPAN adapter was used to test the new Command Station Software and has been verified as working properly.

The Command Station uses three connectors of a 6-pin RJ11 (6p6c) telephone-type plug. The Command Station jack has the following pin assignments: Pin 1 = TXOUT, Pin 2 = Ground, Pin 5 = Ground, Pin 6 = RXIN. If you don't want to build your own, then use an adapter.

Communications

Uses a baud rate of 9600. Each byte is 8-bits, no parity, and one stop bit. Only ASCII characters are sent.

3rd Party Software

As of the date on this document, there is one well known program that uses the computer port. If you have any questions, contact them directly since CVP does not offer technical support for the Computer port. for further information. It is the responsibility of the 3rd party to support their own software including updates to support EasyDCC's new features. If you are having problems with their software and EasyDCC, please contact them directly.

DecoderPRO

http://jmri.sourceforge.net/apps/DecoderPro/

Can't Communicate?

If you can not communicate with the Command Station, and your computer's serial settings appear correct, try reversing your cable's the Receive and Transmit pins. The definition of these two pins is somewhat ambiguous and reversal of the pins may solve the problem.

Enable Port's Q-D-S Commands

These 3 commands allow a computer to operate any locomotive and are also used with some decoder programming software. The factory default for these commands is disabled.

To activate the Q-D-S commands, key in **SETUP 0.** To deactivate, use the same keystrokes. Once enabled, the system will remember the status. See page 35 for the messages that appear upon power up.

Enable RS232 Q-D-S Commands

Before using the computer port, you must enable the full set of RS232 commands. This is a manual operation, done with a couple of keystrokes. This command toggles between enabled and disabled. If enabled, the SETUP/ASSIGN Q-D-S Enabled message will appear and you must press ESC to return to the normal screen. If it is active, pressing SETUP 0 will disable the feature and the normal screen will appear. This setting is retained with power off.

❑ **SETUP**

```
Setup/Assign
```

❑ **0** Enables the 3 commands in the RS232 section

```
Setup/Assign
Q-D-S Enabled
```

❑ **ESC** to return to the normal screen

To disable the port, use the same keystroke sequence. The port is also disabled if the Command Station memory is cleared. To tell you that that system has the RS232 port enabled, a new message appears when power is turned on. The revised initiation message stream is shown on page **Error! Bookmark not defined.**

Commands and Command Structure

Hexadecimal Values

The small h following a value defines the value as a hex value. For example, 60Fh means the value is 60F hex. Decimal notation does not have any suffix.

Commands

All received commands must use the ASCII character set (upper case) and be terminated by a Carriage Return (Enter). The command sequences must use the exact number of characters shown, for the command to be executed.

The format below shows the data and the number of characters required. Spaces are shown as delimiters in the command sequences below. The spaces are ignored by the command station and may be used or not used by the User as he desires.

If the command executes, properly or otherwise, various responses will be transmitted and are described at each command description. If the command received was invalid or, for whatever reason, could not be decoded, a response of ?<CR> will be transmitted. This response also indicates that the system is now ready for another command.

SEND Command is primarily for function commands. It allows the sending of a command for a specified number of cycles before being automatically discarded.

QUEUE Command is primarily for speed commands. Once placed in queue, the command is repeated, until removed or overwritten by a new command.

Command Modes

At power-up/reset, the command station will default to the Operation mode. (There are 2 modes: Operation and Programming). In the Operation mode the command station will respond only to Operation Commands; in the Programming mode it will respond only to Programming Commands.

Command Transmission Hierarchy

This is the sequence used by the Command Station to handle inputs from various devices connected to the available ports. All four of these command sources are independent and each could contain a command for the same locomotive which may be confusing (and amusing to watch) as the decoder receives conflicting commands.

Top Priority: Sends commands to the track as dictated by the commands from the handheld throttles (plug-in or wireless).

#2 Priority: Sends commands to the track as dictated by the responses from Throttle A and Throttle B.

#3 Priority: Sends commands to the track as dictated by the contents of the Main Queue. The Q (Queue) RS232-command adds packets to the Main Queue, where they remain until they are removed from the Main Queue by the D (DeQueue) RS232-command.

#4 Priority: Sends commands to the track as dictated by the contents of the Temp Queue. The S (Send packet) RS232-command adds packets to the Temp Queue with a Count specified. The command specified by the packet in the Temp Queue is sent to the track the number of times specified by the Count value, then it is automatically removed from the Temp Queue.

Operation Commands

As most EasyDCC users know, trying to operate a locomotive who's address has been entered into both a Command Station throttle and a handheld throttle causes problems. The same problems arise when trying to operate a locomotive over the RS-232 interface when its address has also been assigned to a Command Station/handheld throttle (or vice-versa). Be sure to de-assign any Command Station Throttle or handheld throttle before sending commands to the specified locomotive address. Current assignments can be found in data table TABLE1 described in the **programming notes** section starting on page 13.

Display Memory

Format:	
F y xxxx	where y=hex number of 16-byte lines (0 implies 16), and xxxx=hex RAM memory address.
Example:	
F 2 0C00	Display 2 16-byte lines of memory starting at location 0C00h (3072 decimal).

The information transmitted is 32 ASCII bytes per line requested, e.g. '01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F', followed by a terminating <CR>, and followed by O<CR>...to indicate system is ready for next command. ("O" indicating ready for next Operation Command).

Kill Main Track

Format:
K No data required. Causes all clocks to Main Track to stop. The Program Track clocks will continue but the Program Track will not be enabled unless Program Mode is selected.

Successful completion of this command will be indicated by transmitting O<CR> to indicate the system is ready for the next command.

Enable Main Track

Format:
E No data required. Causes the Main Track clocks to be resumed.

Successful completion of this command will be indicated by transmitting O<CR> to indicate the system is ready for the next command.

Display Version Number

Format:
V No data required. Causes the version number of the Command Station software and the release date to be sent to the PC.

The information transmitted is 12 ASCII bytes, beginning with a V,containing the information requested (e.g. 'V238 06 02 1997')...for version number 238 , followed by a terminating <CR>, followed by O<CR>...to indicate system is ready for next command.

Queue Packet (see comment regarding "QUEUE" commands on page 2)

Format:

Q xx xx ... xx Where xx is the hex value of each byte of the packet to be placed in the main command queue (up to 6 bytes may be specified, and must include the checksum byte). Once in the main command queue, the packet will be sent each cycle until it is removed by a Dequeue command or replaced by another packet to the same decoder number.

Each cycle will consist of sending to the main track each packet that resulted from information polled from a physical throttle (local and handheld), then sending each packet that has been placed in the main command queue, then sending each packet that has been placed in the temporary command queue (see description of temporary command queue at Send Packet command description).

When a decoder number is the same in a packet being received and in a packet already in the queue, the newest packet will replace the existing one. Two packets addressing the same decoder cannot be in the main command queue. Packets may contain decoder numbers up to 10239 (hex 27FF). The maximum number of packets that may be placed in either queue is 32. (Operational note: If 32 3-byte packets are placed in a queue, that represents a time delay of approximately 1/4 second that is added between packets to any one decoder on the main track.)

Example:

Q 17 67 70	Put a command for loco address 23 for speed 6, forward direction, in the main queue.
Q C6 0C 67 AD	Put a command for loco address 1548 (hex 60C) for speed 6, forward direction, in the main queue.

Successful completion of placing the packet in the queue will be indicated by transmitting O<CR> to indicate the system is ready for the next command. If the packet will cause the queue limit to be exceeded the packet will not be placed in the queue. This will be indicated by transmitting R<CR> . ("R" indicating the command was decoded but Refused). The system will then be ready for another command.

See the section on DATA FORMATS for a description of the basic packet formats.

Dequeue Packet

Format:

D xx xx — Where xx xx is the hex address of the loco (decoder) whose packet is to be removed from the main command queue. The first byte of the address must be 00 to indicate 'short' address. The two msb's of the first byte must be 1's to indicate 'long' address. See Example.

Example:

D C6 0C	Remove command for loco #1548 (60Ch) from main queue.
D 00 17	Remove command for loco #23 (17h), short address, from main queue.
D C0 17	Remove command for loco #23 (17h), long address, from main queue.

Successful completion of removing the packet from the queue will be indicated by transmitting O<CR> to indicate the system is ready for the next command. If the decoder number specified is in the queue more than one time, all entries will be removed. If the decoder number cannot be found in the queue, no action will be taken but the system will not reject the command and will indicate successful completion.

Send Packet (see comment regarding "SEND" commands on page 2)

Format:

S yy xx ...xx — Where yy=the hex value of the number of times to send the packet to the main track, and xx is the hex value of each byte of the packet to be placed in a temporary send queue (up to 6 bytes may be specified, and must include the checksum byte). Once the packet has been sent the number of specified times, it will be removed from the temporary send queue.

Multiple packets for the same decoder may be place in the temporary queue. Packets may contain decoder numbers up to 10239 (hex 27FF). The maximum number of packets that may be placed in the queue is 32. See Operational note at Queue Packet command description.

Example:

S 01 22 85 A7 — Put the command for loco address 34 to turn on functions 1 and 3 in the temporary send queue. After it is sent 1 time, remove it from the queue.

Successful completion of placing the packet in the queue will be indicated by transmitting O<CR> to indicate the system is ready for the next command. If the packet will cause the queue limit to be exceeded the packet will not be placed in the queue. This will be indicated by transmitting R<CR> . The system will then be ready for another command.

See the section on DATA FORMATS for a description of the basic packet formats.

'h' when used with a number, defines this value as a hexadecimal value. For example, the number 270Fh means the value 270F is a hex number and must not be confused with a decimal number.

Read Loco Information

Format:

L xxxx — Where xxxx is the hex address (cannot exceed decimal 9999 or 270Fh) of the loco whose speed, direction, number of speed steps, and function states are to be transmitted to the PC.

Example:
L 1222 Requests speed, direction, speed steps, functions for decimal loco #4642.

The information transmitted is 11 ASCII bytes, beginning with an L,containing the information requested, with the following format:

Lxxxx ss yy zz where xxxx echoes the loco hex address
ss = the speed/direction value
(bit7 = direction; 1:forward, 0:reverse)
(bits 6-0 = speed value...1 through 126)
yy = the speed-step/function 0-4 value
(bit7: 1 = 128 speed steps)
(bit6: 1 = 28 speed steps)
(bit5: 1 = loco address is registered but no throttle is assigned
(bit4: 1 = Function 0 on)
(bit3: 1 = Function 4 on)
(bit2: 1 = Function 3 on)
(bit1: 1 = Function 2 on)
(bit0: 1 = Function 1 on)
zz = the function 5-12 value
(bit7: 1 = Function 12 on)
(bit6: 1 = Function 11 on)
(bit5: 1 = Function 10 on)
(bit4: 1 = Function 9 on)
(bit3: 1 = Function 8 on)
(bit2: 1 = Function 7 on)
(bit1: 1 = Function 6 on)
(bit0: 1 = Function 5 on)
followed by a terminating <CR>,
followed by O<CR>...to indicate system is ready for next command.

If loco xxxx is not in the system, i.e. not registered, the returned values for ss, yy, and zz values will be all zero.

Example:
L 1222 85 05 01...to indicate Loco #4642 (1222h):
has a speed/direction value of hex 85 (indicating forward at 5/126 of full speed),
a speed-step/function 0-4 value of 05 (indicating 14-speed-steps and functions 1 and 3 on),
and a function 5-12 value of 01 (indicating function 5 is on).

<u>Set Loco Characteristics</u>

Format:
C xxxx yy zz Where xxxx is the hex address of the loco (cannot exceed decimal 9999 or 270Fh) to be set and
yy = speed-steps/function 0-4 value and
zz = function 5-12 value

Upon receiving this command, the command station will setup its internal tables and send programming packets to the decoder address xxxx, setting the decoder's speed step value in CV#29 according to the yy value. If the loco addresses are not present, or the locomotive is not capable of main track programming ("OPS" mode programming) then this command can not program the decoder address and will not function properly.

Example:
C 1222 05 01 Setup the speed-step/function 0-4 value and the function 5-12 value of Loco #4642 to 05 and 01 respectively and send programming packets to loco #4642 to set its CV#29 to specify the requested number of speed-steps.
The bits not related to functions and speed are not written to by this command. Those bits do not change value.

Successful completion of setting the loco characteristics will be indicated by transmitting O<CR> to indicate the system is ready for the next command. If the loco address has not previously been registered, this command will register it.

See the description at **Read Loco Information** for a description of the speed-step/function 0-4 value, and the function 5-12 value.

Add Loco(s) to a Consist ... Normal Direction

Format:

GN yy xxxx...xxxx — Add up to 8 loco addresses with a hex value of xxxx (cannot exceed decimal value 9999 or 270Fh) to the consist whose hex number is yy (cannot exceed decimal value 255 or FFh; the loco addresses to be added run in the Normal direction. The consist number specifies a standard consist.

Example:

GN 01 1222 1400 0515

Adds loco 4642, 5120, and 1301 to consist 1 (a standard consist) to run in Normal direction.

If the number of loco addresses specified contain more than 8 addresses, or addresses exceed the consist's capacity (capacity is 8 addresses), those addresses after the first 8 will be ignored. No error message will be returned to notify of the overage.

If the consist number yy already exists as an advanced consist, the command will be ignored. No error message will be returned to indicate the error.

Successful completion of adding the loco(s) to the consist will be indicated by transmitting O<CR> to indicate the system is ready for the next command.

This command performs the same operation as keystrokes, Setup, Consist, nn ADD xxxx, Normal at the Command Station keyboard. Note that for these commands the consist number must be within the 1-255 range. See note at the bottom of this page.

Add Loco(s) to a Consist ... Reverse Direction

Format:

GR yy xxxx...xxxx — Add up to 8 loco addresses with a hex value of xxxx (cannot exceed decimal value 9999 or 270Fh) to the consist whose hex number is yy (cannot exceed decimal value 255 or FFh); the loco addresses to be added run in the Reverse direction. The consist number specifies a standard consist.

Example:

GR 01 1222 1400 0515

Adds loco 4642, 5120, and 1301 to consist 1 (a standard consist) to run in Reverse direction.

If the number of loco addresses specified contain more than 8 addresses, or addresses exceed the consist's capacity (capacity is 8 addresses), those addresses after the first 8 will be ignored. No error message will be returned to notify of the overage.

If the number of loco addresses specified contain more than 8 addresses, or addresses exceed the consist's capacity (capacity is 8 addresses or less), those addresses after the first 8 will be ignored. No error message will be returned to notify of the overage.

If the consist number yy already exists as an advanced consist, the command will be ignored. No error message will be returned to indicate the error.

Successful completion of adding the loco(s) to the consist will be indicated by transmitting O<CR> to indicate the system is ready for the next command.

This command performs the same operation as keystrokes, Setup, Consist, nn ADD xxxx, Reverse at the Command Station keyboard, except nn must be between 1-255.

Standard Consist Number Range Is Restricted For RS232 Port Commands

When working with standard consists from the RS232 port, there is a strict limit on the consist number range. A standard consist number must be within the range of 1 to 255. Do not try to create a standard consist number by using 4-digit loco address. It will not be accepted by the Command Station. This limitation applies only to consists created or edited from the RS323 port. The limit does not apply to consists created via the Command Station keyboard. Standard consists created by the keyboard can only be edited via the RS232 port if they are within the number range of 1-255.

For Best System Performance Use Advanced Consists Only

The best system performance and the most flexible function key assignments are available for advanced consists only.

<u>Subtract Loco(s) from a Consist</u>

Format:

GS yy xxxx....xxxx	Remove up to 8 loco numbers with a hex value of xxxx (cannot exceed decimal value 9999 or 270Fh) from the consist) whose hex number is yy (can not exceed decimal value 255 or FFh. The consist number specifies a standard consist.

Example:

GS 01 1222 1400 0515

Removes loco 4642, 5120 and 1301 from consist 1 (as a standard consist).

Successful completion of removing the loco(s) from the consist will be indicated by transmitting O<CR> to indicate the system is ready for the next command.

If this command attempts to remove a loco number that is not presently in the specified consist, or attempts to remove a loco from an advanced consist, or a non-existent consist, the system **<u>will accep</u>**t the command and will indicate successful completion. No indication will be sent that the consist number was not accepted

This command performs the same operation as keystrokes, Setup, Consist, nn REMOVE xxxx, Reverse at the Command Station keyboard, except nn must be between 1-255.

<u>Kill Consist</u>

Format:

GK yy	Remove all loco addresses from the consist whose hex number is yy (cannot exceed decimal value 255 or FFh.) The consist number specifies a standard consist.

Example:

GK 01	Remove all loco addresses from consist 1 (as a standard consist)

Successful completion of removing all loco addresses from the consist will be indicated by transmitting O<CR> to indicate the system is ready for the next command.

Note: If the specified consist number does not exist, or the specified number is an advanced consist, or a non-existent consist, (but the specified consist number is legal), the system **<u>will accept</u>** the command and will indicate successful completion. No indication will be sent that the consist number was not accepted.

This command performs the same operation as keystrokes, Setup, Consist, nn ADD xxxx, Reverse at the Command Station keyboard, except nn must be between 1-255.

Standard Consist Number Range Is Restricted For RS232 Port Commands

When working with standard consists from the RS232 port, there is a strict limit on the consist number range. A standard consist number must be within the range of 1 to 255. Do not try to create a standard consist number by using 4-digit loco address. It will not be accepted by the Command Station. This limitation applies only to consists created or edited from the RS323 port. The limit does not apply to consists created via the Command Station keyboard. Standard consists created by the keyboard can only be edited via the RS232 port if they are within the number range of 1-255.

<u>Display Consist</u>

Format:

GD yy	Display the contents of the consist whose hex number is yy (yy implies a standard consist and the value cannot exceed decimal value 255 or FFh).

Example:

GD 01	Display all loco addresses from consist #1, which is a standard consist

The information transmitted is at least 7 bytes beginning with the character 'G' and containing the consist number and the number of each loco in that consist (e.g. G02 050F 0736 194A <CR>). If the requested consist does not exist as a standard consist, the information transmitted will be Gyy 0000 <CR>.

Direction Orientation In A Consist

If a loco address in the consist, is in the reverse direction, the most significant bit of the returned 2-byte number will be a 1. For example, if address 050Fh is in the consist in the reverse direction, its address will be returned as 850Fh.

After transmitting the requested information, O<CR> will be transmitted to indicate the system is ready for the next command.

<u>Programming Mode</u>

Format:

M	No data required. Causes the main track to be halted (by stopping the Main Track clocks) and prevents any further packet activity on the Main Track. Any keyboard/display sequence in process will be terminated (as if ESC had been pressed); the display will indicate RS232 programming mode by displaying "Controlled by Computer". No keyboard or pushbutton on the command station will be acknowledged (except the Reset), and no throttle will be polled. These conditions will remain until leaving the Programming mode.

Successful completion of this command will be indicated by transmitting P<CR> to indicate the system is ready for the next command where "P" indicates it is ready for the next programming command.

Until the Programming mode has been exited, only Programming commands will be accepted.

PROGRAMMING COMMANDS

<u>Read CV</u>

Format:

R xxx	Where xxx=hex number of CV to be read.

Example:

R 01D	Read and display the value in the decoders Configuration Variable #29.

The format of the data transmitted to the PC/terminal will be:

CV xxx yy	,where xxx is the CV number echoed, and yy is the hex value read from the CV.

(If the CV cannot be read, the value will be transmitted as "--")

followed by a terminating <CR>,
followed by P<CR>...to indicate system is ready for next command.

Dump 10 CVs
Format:

D xxx	Where xxx=hex number of the starting CV to be read.

Example:

D 041	Read and display the values in the decoders Configuration Variables #65 through #74.

The format of the data transmitted to the PC/terminal will be:
CV xxx yy ,where yy is the hex value read from CV.number xxx
(and repeated for the next 9 sequential CV numbers)
(If any CV cannot be read, its value will be transmitted as "---")

followed by a terminating <CR>,
followed by P<CR>...to indicate system is ready for next command.

Program CV
Format:

P xxx yy	Where xxx=hex number of CV to be programmed and yy is the hex value of the value to be programmed.

Example:

P 003 014	Program CV#3 of the decoder with a value of decimal 20.

Successful completion of this command will be indicated by transmitting P<CR> to indicate the system is ready for the next command.

Read Register
Format:

V x	Where x=register number (1 through 8).

See the section on DATA FORMATS for the meaning of the contents of the registers and a description of the relationships between register numbers and CV numbers for those decoders referred to as Type 1 and Type 2.

Example:

V 2	Read and display the value in register 2.

The format of the data transmitted to the PC/terminal will be:

V x yy	Where yy is the hex value read from the register x.

(If the register cannot be read, the value will be transmitted as "---")

followed by a terminating <CR>,
followed by P<CR>...to indicate system is ready for next command.

Write Register
Format:

S y xx	Where y=register number (1 through 8) and xx=hex value to be written.

See the section on DATA FORMATS for the meaning of the contents of the registers and a description of the relationships between register numbers and CV numbers for those decoders referred to as Type 1 and Type 2.

Example:

S 1 003	Program register 1 of the decoder with the value of 3.

Successful completion of this command will be indicated by transmitting P<CR> to indicate the system is ready for the next command.

Exit Programming Mode

Format:

X	No data required. Causes the main track to resume normal operation. The command station display will indicate Status OK, throttle polling will resume, the keyboard and front panel pushbuttons will be enabled, and packets will again be sent to the main track.

Successful completion of this command will be indicated by transmitting O<CR> to indicate the system is ready for the next command.<"O" indicating ready for next Operation Command>

Once the Programming mode has been exited, only Operation commands will be accepted.

DATA FORMATS

Basic Packet Format – Main Track Programming (Ops Mode Programming)

Generally, each packet consists of : address, instruction, checksum. See the DCC-RPs for more details on packet construction. Examples shown below include checksum (XOR bitwise)

Binary: 0aaaaaaa 00000000	Reset decoder a:a
Example (hex) : 17 00 17	Reset decoder 23 (hex 17)
Binary: 0aaaaaaa 00000001	Hard Reset decoder a:a (set to defaults)
Example (hex) : 17 01 16	Hard Reset decoder 23 (hex 17)
Binary: 0aaaaaaa 00010010 0xxxxxxx	Set consist address of decoder a:a to x:x (dir=norm)
Example (hex) : 17 12 05 00	Set decoder 23's consist address to 05 (dir=norm)
Binary: 0aaaaaaa 00010011 0xxxxxxx	Set consist address of decoder a:a to x:x (dir=reverse)
Example (hex) : 27 13 11 25	Set decoder 39's consist address to 17 (dir=reverse)
Binary: 0aaaaaaa 00111111 0sssssss	Send speed s:s, reverse direction, to decoder a:a
Example (hex) : 17 3F 1F 37	Send decoder 23 a speed of 31 (of 126), reverse direction.
	(A speed value of 0 = stop; 01 = emergency stop)
Binary: 0aaaaaaa 00111111 1sssssss	Send speed s:s, forward direction, to decoder a:a
Example (hex) : 17 3F 9F B7	Send decoder 23 a speed of 31 (of 126), forward direction.
	(A speed value of 0 = stop; 01 = emergency stop)

<u>If decoder has been setup to accept 14 speed-steps</u>

Binary: 0aaaaaaa 010xdddd	Send speed d:d, reverse direction, to decoder a:a, with x = F0 state.
Example (hex) : 21 48 66	Send decoder 33 a speed of 7 (of 14), reverse direction, with F0 off.
	(A speed value of 0 = stop; 01 = emergency stop)

<u>If decoder has been setup to accept 14 speed-steps</u>

Binary: 0aaaaaaa 011xdddd	Send speed d:d, forward direction, to decoder a:a, with x = F0 state.
Example (hex) : 21 76 57	Send decoder 33 a speed of 6 (of 14), forward direction, with F0 on.
	(A speed value of 0 = stop; 01 = emergency stop)

If decoder has been setup to accept 28 speed-steps

Binary: 0aaaaaaa 010ddddd
Example (hex) : 21 47 66

Send speed d:d, reverse direction, to decoder a:a
Send decoder 33 a speed of 7 (of 28), reverse direction.

Speed values to 28-speed-step decoders have the following meanings (values are shown in hex):
00 = stop
01 = emergency stop
11 = emergency stop
02 = 1st speed step
12 = 2nd speed step
03 = 3rd speed step
13 = 4th speed step, etc

If decoder has been setup to accept 28 speed-steps

Binary: 0aaaaaaa 011ddddd
Example (hex) : 21 67 66

Send speed d:d, forward direction, to decoder a:a
Send decoder 33 a speed of 7 (of 28), forward direction.

Speed values to 28-speed-step decoders have the following meanings (values are shown in hex):
00 = stop
01 = emergency stop
11 = emergency stop
02 = 1st speed step
12 = 2nd speed step
03 = 3rd speed step
13 = 4th speed step, etc

Binary: 0aaaaaaa 100ddddd
Example (hex) : 33 91 A2

Send 5 auxiliary functions (0,4,3,2,1) to decoder a:a (1=on)
Send decoder 51 a command to turn F0 and F1 on, and F2 F3 and F4 off.
(If decoder is setup for 14 speed steps, F0 is controlled by speed packet)

Binary: 0aaaaaaa 1011dddd
Example (hex) : 1A B8 A2

Send 4 auxiliary functions (8,7,6,5) to decoder a:a (1=on)
Send decoder 26 a command to turn F8 on, and F5,F6 and F7 off.

Binary: 0aaaaaaa 1010dddd
Example (hex) : 1A B8 A2

Send 4 auxiliary functions (12,11,10,9) to decoder a:a (1=on)
Send decoder 26 a command to turn F12 on, and F9,F10 and F11 off.

Binary: 0aaaaaaa 11110010 dddddddd
Example 10 F2 0B E9

Send decoder a:a an acceleration adjustment value of d:d (for CV #23)
Send decoder 16 an acceleration adjustment value of +11.

Negative adjustment values are permitted - See RP 9.2.2

Binary: 0aaaaaaa 11110011 dddddddd
Example 10 F3 10 F3

Send decoder a:a a deceleration adjustment value of d:d (for CV #24)
Send decoder 16 a deceleration adjustment value of +16.

Negative adjustment values are permitted - See RP 9.2.2

Binary:
0aaaaaaa 111010cc cccccccc 11110bbb
Example 12 E8 1C F2 14

Command decoder a:a to write a zero in bit b:b of CV# c:c. (-1)
Command decoder 18 to write a zero in bit 2 of CV# 29.
(CV writes require 2 identical back-to-back packets)
Note that the field specifying the CV# contains the CV number minus 1, i.e. 1Ch = CV#29

Binary:
0aaaaaaa 111010cc cccccccc 11111bbb
Example 12 E8 1C FA 1C

Command decoder a:a to write a one in bit b:b of CV c:c. (-1)
Command decoder 18 to write a zero in bit 2 of CV 29.
(CV writes require 2 identical back-to-back packets)

Binary:	
0aaaaaaa 111011cc cccccccc dddddddd	Command decoder a:a to write the value d:d in CV c:c. (-1)
Example 13 EC 03 64 98	Command decoder 19 to write 100 in CV 04.
	(CV writes require 2 identical back-to-back packets)

Binary: 10aaaaaa 1aaa0ddd	De-activate output d:d of <u>Accessory</u> decoder a:a
	(aaa in second byte are complemented MSBs of address)
Example 93 F3 60	De-activate output 3 of Accessory decoder 19

This command <u>is not</u> understood by most accessory decoders, including the AD4.

Binary: 10aaaaaa 1aaa1ddd	Activate output d:d of <u>Accessory</u> decoder a:a
	(aaa in second byte are complemented MSBs of address)

This command is used to set the decoder to either reverse or normal as shown in the example below:

Example 83 F9 7A	Activate decoder card #5, output A, reverse
Example 83 F8 78	Activate decoder card #5, output A, normal

Long Addresses
If a decoder has been setup to accept 14-bit addresses (long addresses) replace the first byte (0aaaaaaa) of each of the above decoder packets with two bytes formatted thus (11aaaaaa aaaaaaaa). The value of this 14-bitaddress field cannot exceed 10239 (27FF hex).

If the decoder has extended addressing enabled (14-bit address) the decoder's address is sent in the first 2 bytes. The format of the 2 bytes is: 11aaaaaa aaaaaaaa.

Format for 14-bit address : Binary: 11aaaaaa aaaaaaaa 00111111 0sssssss
Example: To send loco address 1023 a reverse speed of 31 is: C3 FF 3F 1F 1C

Decoder Registers and Configuration Variables

<u>Type 3 Decoders (Direct Mode Addressing Capable)</u>
Those decoders whose programmable Configuration Variables may be accessed directly (Direct Mode) are referred to as Type 3 decoders in EasyDCC documents. A definition of the CVs is provided in the NMRA DCC Recommended Practices 9.2.2.

<u>Type 2 Decoders (Page Mode Addressing)</u>
Those decoders whose programmable CVs are accessed indirectly through Paged Addressing are referred to as Type 2 decoders in EasyDCC documents. These decoders have 6 accessible registers with the following meanings:

Register 1 =	Data Register 0
Register 2 =	Data Register 1
Register 3 =	Data Register 2
Register 4 =	Data Register 3
Register 5 =	Basic Configuration Register (see description of CV#29 in NMRA document)
Register 6 =	Page Register

The 'page' consists of Data Registers 0 through 3; the Page Register is the 'pointer' into CV memory.
If the Page Register contains 1, Data Registers 0 through 3 represent CV#s 0 through 3.
If the Page Register contains 2, Data Registers 0 through 3 represent CV#s 4 through 7.
If the Page Register contains 3, Data Registers 0 through 3 represent CV#s 8 through 11, etc.

<u>Type 1 Decoders – (Register mode addressing) Mobile</u>
Those decoders whose programmable CVs consist entirely of 8 accessible registers (Physical Register Addressing) are referred to as Type 1 decoders in EasyDCC documents. These 8 registers have the following meanings:

Register 1 =	Decoder address (see description of CV#1 in NMRA document)
Register 2 =	Start voltage (see description of CV#2 in NMRA document)
Register 3 =	Acceleration (see description of CV#3 in NMRA document)
Register 4 =	Deceleration (see description of CV#4 in NMRA document)
Register 5 =	Basic Configuration Register (see description of CV#29 in NMRA document)
Register 6 =	Reserved for Page Register
Register 7 =	Version Number (see description of CV#7 in NMRA document)

Register 8 =	Manufacturer ID Number (see description of CV#8 in NMRA document)

Type 1 Decoders – (Register mode Addressing) Accessory

Those Accessory decoders whose programmable CVs consist entirely of 8 accessible registers (Physical Register Addressing), also referred to as Type 1 decoders in EasyDCC documents, have slighty different register meanings:

Register 1 =	Decoder lower address (see description of CV#512 in NMRA document)
Register 2 =	Decoder upper address (see description of CV#512 in NMRA document)
Register 3 =	undefined
Register 4 =	undefined
Register 5 =	Configuration Register (see description of CV#540 in NMRA document)
Register 6 =	Reserved for Page Register
Register 7 =	Version Number (see description of CV#7 in NMRA document)
Register 8 =	Manufacturer ID Number (see description of CV#520 in NMRA document)

Programming Notes

This information is provided for advanced programmers only. No technical support is provided for development of PC based programs.

Modifying Standard Consists

This information should be kept in mind when developing programs that add (or delete) loco addresses to (or from) a standard consist. This includes RS232 commands GN....., GR..... & GS......

1. If the command is sent to add a loco address to a consist, and that loco address is already in the consist, the command will simply be ignored.

2. If the command is sent to remove a loco address from a consist, and that loco address is not in the consist, the command will simply be ignored.

3. If the command is sent to add a loco address to a consist, and there is no room for the loco address to be added, the command will simply be ignored.

4. If the command is sent to remove a loco address from a consist, and that consist does not exist, the command will simply be ignored.

5. If a command is sent to add a loco address to a Standard consist, and that loco address is already in an Advanced consist, no action will be taken and the command will be ignored.

6. If a command is sent to add a loco address to an Advanced consist, and that loco address is already in an Advanced consist, the loco address will be REMOVED from its previous consist and added to the consist specified.

7. If a command is sent to add a loco address to a Standard consist, and that loco address is already in a Standard consist, the loco address will remain in its previous consist AND be added to the consist specified.

8. When messages arrive at the Command Station's RS232 port, the command station checks that the incoming message format is correct and that there is room in the queue for it. The Command Station does not check the validity of the contents.

Locations For Data Tables In Command Station RAM

Updated 12/15/2006 ©2002-2006 by CVP Products

```
LORAM     EQU    00020H  ;LOW RAM (FOR      CHECKING MEMORY)
....4 byte pattern here (BB BA BE BB) verifies that RAM battery is 'good'.

DECODRAM  EQU    00032H       ;STORAGE FOR DECODER TYPE
....1 byte containing 1,2 or 3 to indicate default decoder type

CHAREA    EQU    00100H       ;Command sequence from PC
....Last character string received from PC, including CR

SPTAB     EQU    00700H       ;Speed table (33 values)
....Index by throttle ID# (Ignore ID #0)
....Last speed value for each throttle ID# (throttle may no onger be active but this
was the last value it sent).
      80H = stop,
      81H-FEH = 1-126 clicks forward
      7FH-02H = 1-126 clicks reverse
      (Throttle A has throttle ID# 33H)
      (Throttle B has throttle ID# 32H)

CHTAB     EQU    00800H   ;Loco characteristic Table (speed steps,
  F(x)) (255 values)
....Index by TABLE2 pointer
      e.g. Address 0801H = data for loco address at TABLE2 , address 2301H
....ignore address 0800H]
....Characteristics/function state of each loco
            bit7   1=128 speed steps
            bit6   1=28 speed steps
            bit5
            bit4   F(0) 1=lamps on, 0=lamps off
            bit3   F(4)
            bit2   F(3)
            bit1   F(2)
            bit0   F(1)

F3TAB       EQU   00A00H      ;Fcns F12-F5 (255 values...ignore A00H)

F2TAB     EQU    00B00H    ;Loco descriptors (255 values)
....Index by TABLE2 pointer
    [e.g. Address 0B01H = data for loco address at TABLE2; ignore address 0B00H]
         bit7   1=this loco address declared inactive (candidate for purging)
         bit6   1=this loco address may be declared inactive in 16 hours
         bit5   1=this loco address is in a standard consist
         bit4   1=this loco address is in an advanced consist

Loco numbers may be declared inactive if not accessed for 16 hours (of power on time).
An inactive number is not purged from the system unless a TABLE2 overflow would result
from registering a new number.

NRTAB1      EQU   00C00H      ;(31 values)Timer for responding throttles. Refreshes
functions F0-F4 when throttle quits responding.

NRTAB2      EQU   00E00H      ;(31 values)Timer for responding throttles.
            Flags system to refresh track when throttle quits responding.

CABTAB    EQU    00D00H    ;Keep tabs on throttles (31 values)
....Index by throttle ID# (Ignore ID #0)
      Shows which throttles have answered when polled.
      If entry=0, throttle has not answered in approximately 2 minutes and
      is declared inactive.
```

```
When the throttle answers a poll, a value of 255 is entered and the value is
decremented every second that the throttle fails to answer.

NRTAB2    EQU    00C00H      ;Timer for active, but non-responding, throttles.
      A value of 80 is entered whenever a throttle responds. The value is decremented
      every non-response of the throttle. When a value of zero is reached, a track
      refresh is initiated.

SPEEDTAB  EQU    00F00H   ;8 speed tables (256)
      ....Storage for 8 groups of 28 values each for writing to CVs
      67-94.

MAINQ     EQU    01000H       ;Main Queue (256)
    ....Main Queue where packet information for 32 packets (8 bytes
      of info per packet).
      Byte 1: bit3=0, this packet slot is available.
            bit3=1, this packet slot is filled,
                  bits 2-0 = # of pkt bytes.
      Byte 2: reserved
      Byte 3-8: 1st through 6th packet byte (3 min, 6 max)

TEMPQ     EQU    01100H ;Temporary Queue (256)
    ....Temporary Queue where packet information for 32 packets
      (8 bytes of info per packet).
      Byte 1: bit3=0, this packet slot is available.
            bit3=1, this packet slot is filled,
            bits 2-0 = # of pkt bytes.
      Byte 2: Number of times to send packet.
      Byte 3-8: 1st through 6th packet byte (3 min, 6 max)


GANGTAB   EQU    01200H       ;Route numbers [64X64bytes]
      ....Index by accy route#; 64 routes, each route has 32 2-byte output
      address block (Ignore route #0...Only route numbers 1-63 allowed)
      Each of the 32 output addresses has the following format:
      Byte 1: bit7=0, for this route, switch (at output address) is Normal
      bit7=1, for this route, switch (at output address) is Reverse
      bit3-0, MSB of the output address.
      Byte 2: 8 LSBs of the output address.

TABLE1    EQU    02200H       ;Throttle IDs vs loco#s assigned (33x2)
....Index by throttle ID# x 2...2 bytes per entry (Ignore ID #0).
      Shows 4-digit loco/consist address assigned to each throttle ID#
      (Throttle A has throttle ID# 33)
      (Throttle B has throttle ID# 32)

TABLE2    EQU    02300H       ;Active loco (consist) MSbytes (255 entries)
...1 byte per entry (ignore entry at 2300H)
      Lists MSByte of each registered loco/consist address in the system.
      CHTAB, F2TAB and T2E are corresponding tables for the entries in TABLE2.
            bit7: 1=This entry is a standard consist
            bit6: 1=This entry is an advanced consist
            bit5-0: 6 MSBs of 14-bit address
      (The 8 LSBs of the 14-bit address are found in T2E.)
```

```
TABLE3    EQU    02400H       ;Standard Consist table (16x127)
...16 bytes per entry (ignore 1st 16 bytes in TABLE3...always zero)
      Lists (at 2 bytes per loco address) the 8 loco addresses contained in
      the consist. The first 2-byte entry of each block is the consist number.
      For each loco address:
      Byte1...bit7 = loco direction (1=reverse)
            bit5-0 = 6 MSBs of loco address
      Byte2...8 LSBs of loco address.

TABLE4    EQU    02C00H       ;Advanced consist table (16x100)
...Index by advanced consist number x 16; 16 bytes per entry (ignore cons#0)
      Lists (at 2 bytes per loco address) the 8 loco addresses contained in
      the consist.
      For each loco address:
      Byte1...bit7 = loco direction (1=reverse)
            bit5-0 = 6 MSBs of loco address
      Byte2...8 LSBs of loco address.

T2E   EQU   03400H      ;List the 8 LSBs of each registered loco (consist) number in
the system, corresponding to the MSByte entries in TABLE2. (255 entries)
```

Example Basic Programs

The following basic program fragments illustrate the EasyDCC communication port usage and are provide for illustrative purposes only. No technical support is available.

Example 1: 'SEND THE DEQUEUE COMMAND (D XX XX)

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 D$ = "DC013"    'Dequeue C013 packet
11 PRINT #1, D$
25 LINE INPUT #1, z$
30 PRINT z$
70 LINE INPUT "enter"; L$ 'Stop and manually cause repeat
75 IF L$ = "X" THEN GOTO 195
90 GOTO 10
195 CLOSE
200 END
```

Eample 2: 'DUMP THE CONTENTS OF 10 CVs STARTING AT CV#XXX [D XXX]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "M"        'GO INTO PROGR MODE
15 LINE INPUT #1, z$
20 PRINT z$
25 LINE INPUT "PROGR Mode, enter to Read CV " ; L$
30 R$ = "D001"
35 PRINT #1, R$
40 LINE INPUT #1, z$
41 PRINT z$
42 LINE INPUT #1, z$
43 PRINT z$
44 LINE INPUT #1, z$
45 PRINT z$
46 LINE INPUT #1, z$
47 PRINT z$
48 LINE INPUT #1, z$
49 PRINT z$
50 LINE INPUT #1, z$
51 PRINT z$
52 LINE INPUT #1, z$
53 PRINT z$
54 LINE INPUT #1, z$
55 PRINT z$
56 LINE INPUT #1, z$
57 PRINT z$
58 LINE INPUT #1, z$
59 PRINT z$
60 LINE INPUT #1, C$
61 PRINT C$
62 PRINT #1, "X"
63 LINE INPUT #1, z$
64 PRINT z$
70 LINE INPUT "OPER Mode, enter to repeat "; L$
75 IF L$ = "X" THEN GOTO 195
80 GOTO 10
195 CLOSE
200 END
```

Example 3: 'EXERCISES THE CONSIST-ADD (Normal) COMMAND [GNyy xx---xx]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 Q$ = "GN050010 0105 1112"      'Add 10H, 105H, 1112H, 13H TO CONSIST# 5
15 PRINT #1, Q$
20 LINE INPUT #1, z$
25 PRINT z$
70 LINE INPUT "enter"; a$ 'manual repeat
75 IF a$ = "X" THEN GOTO 190
90 GOTO 10
190 CLOSE
200 END
```

Example 4: 'EXERCISES THE CONSIST-ADD (Reverse) COMMAND [GRyy xx---xx]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 Q$ = "GR05 1108 0014"      'Add 1108H, 14H TO CONSIST# 5
15 PRINT #1, Q$
20 LINE INPUT #1, z$
25 PRINT z$
70 LINE INPUT "enter"; a$ 'manual repeat
75 IF a$ = "X" THEN GOTO 190
90 GOTO 10
190 CLOSE
200 END
```

Eample 5: 'EXERCISES THE CONSIST-KILL COMMAND [GKyy]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 Q$ = "GK05"      'Kill CONSIST 5
15 PRINT #1, Q$
20 LINE INPUT #1, z$
25 PRINT z$
70 LINE INPUT "enter"; a$ 'manual repeat
75 IF a$ = "X" THEN GOTO 190
90 GOTO 10
190 CLOSE
200 END
```

Example 6: 'EXERCISES THE CONSIST-SUBTRACT COMMAND [GSyy xx---xx]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 Q$ = "GS05 0105 0014"      'Remove 105H, 14H FROM CONSIST # 5
15 PRINT #1, Q$
20 LINE INPUT #1, z$
25 PRINT z$
70 LINE INPUT "enter"; a$ 'manual repeat
75 IF a$ = "X" THEN GOTO 190
90 GOTO 10
190 CLOSE
200 END
```

Example 7: 'DISPLAY CONSIST CONTENTS [GD XX]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 L$ = "GD05"
11 PRINT #1, L$
25 LINE INPUT #1, z$
30 PRINT z$
35 LINE INPUT #1, C$
40 PRINT C$
70 LINE INPUT "enter"; I$ 'Stop and manually cause repeat
75 IF I$ = "X" THEN GOTO 195
90 GOTO 10
195 CLOSE
200 END
```

Example 8: 'EXERCISES THE K & E COMMANDS

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "K"  'send K (KILL MAIN)
20 LINE INPUT #1, z$
30 PRINT z$
40 PRINT
50 LINE INPUT "Main Track Disabled, enter to enable"; L$ 'Stop before sending E
60 PRINT #1, "E"   'send E (ENABLE MAIN)
70 LINE INPUT #1, z$
80 PRINT z$
85 PRINT
90 LINE INPUT "Main Track Enabled, enter to disable "; L$ 'Stop and manually repeat
95 IF L$ = "X" THEN GOTO 195
100 GOTO 10
195 CLOSE
200 END
```

Eample 9: 'SET LOCO CHARACTERISTICS [C XX YY ZZ]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 L$ = "C 0258 01 00"    'LOCO ADDESS 600, F1 ON
11 PRINT #1, L$
35 LINE INPUT #1, C$
40 PRINT C$
70 LINE INPUT "enter"; I$ 'Stop and manually cause repeat
75 IF I$ = "X" THEN GOTO 195
90 GOTO 10
195 CLOSE
200 END
```

Example 10: 'EXERCISES THE M & X COMMANDS

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "M"   'send M (ENTER PROG MODE)
20 LINE INPUT #1, z$
30 PRINT z$
40 PRINT
50 LINE INPUT "PROGR mode, enter for OPER mode"; L$ 'Stop before sending X
60 PRINT #1, "X"   'send X (ENTER OPER MODE)
70 LINE INPUT #1, z$
80 PRINT z$
85 PRINT
90 LINE INPUT "OPER mode, enter for PROGR mode "; L$ 'Manually repeat
95 IF L$ = "X" THEN GOTO 195
100 GOTO 10
195 CLOSE
200 END
```

Eample 11: 'EXERCISES THE Qxxxxxxxxxxx COMMAND

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 Q$ = "QC13E3F9F5F"     "forward at speed 31 (of 126) for loco number hex 13E
15 PRINT #1, Q$
20 LINE INPUT #1, z$
25 PRINT z$
70 LINE INPUT "enter"; a$ 'manual repeat
75 IF a$ = "X" THEN GOTO 190
90 GOTO 10
190 CLOSE
200 END
```

Example 12: 'READ THE MEMORY CONTENTS STARTING AT 1000H (MAINQ)

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 F$ = "F11000" 'Read 16 bytes, starting at 1000H
11 PRINT #1, F$
25 LINE INPUT #1, z$
30 PRINT z$
35 LINE INPUT #1, C$
40 PRINT C$
70 LINE INPUT "enter"; L$ 'Stop and manually cause repeat
75 IF L$ = "X" THEN GOTO 195
90 GOTO 10
195 CLOSE
200 END
```

Example 13: 'READ THE CONTENTS OF CV#XXX

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "M"        'GO INTO PROGR MODE
15 LINE INPUT #1, z$
20 PRINT z$
25 LINE INPUT "PROGR mode, enter to Read CV"; L$
30 R$ = "R002" ‘Read CV2
35 PRINT #1, R$
40 LINE INPUT #1, z$
45 PRINT z$
50 LINE INPUT #1, C$
55 PRINT C$
56 PRINT #1, "X"        'GO BACK TO OPER MODE
57 LINE INPUT #1, z$
58 PRINT z$
60 LINE INPUT "OPER Mode, enter to repeat "; L$
65 IF L$ = "X" THEN GOTO 195
70 GOTO 10
195 CLOSE
200 END
```

Example 14: 'READ LOCO INFORMATION [L XX]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 L$ = "L014A" ‘Loco address 330
11 PRINT #1, L$
25 LINE INPUT #1, z$
30 PRINT z$
35 LINE INPUT #1, C$
40 PRINT C$
70 LINE INPUT "enter"; I$ 'Stop and manually cause repeat
75 IF I$ = "X" THEN GOTO 195
90 GOTO 10
195 CLOSE
200 END
```

Eample 15: 'READ THE CONTENTS OF REGR#X

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "M"        'GO INTO PROGR MODE
15 LINE INPUT #1, z$
20 PRINT z$
25 LINE INPUT "PROGR Mode, enter to Read Regr"; L$
30 R$ = "V2"
35 PRINT #1, R$
40 LINE INPUT #1, z$
45 PRINT z$
50 LINE INPUT #1, C$
55 PRINT C$
56 PRINT #1, "X"
57 LINE INPUT #1, z$
58 PRINT z$
60 LINE INPUT "OPER Mode, enter to repeat "; L$
65 IF L$ = "X" THEN GOTO 195
```

```
70 GOTO 10
195 CLOSE
200 END
```

Example 16: 'EXERCISES THE Syyxxxxxxxxxxxx COMMAND OF THE EASYDCC

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 S$ = "S07108494"    'Send  packet 7 times
15 PRINT #1, S$
20 LINE INPUT #1, z$
25 PRINT z$
70 LINE INPUT "enter "; a$ 'manual repeat
75 IF a$ = "X" THEN GOTO 195
90 GOTO 10
195 CLOSE
200 END
```

Example 17: 'EXERCISES THE V COMMAND

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, “V”   'send V (SEND VERSION #)
20 LINE INPUT #1, z$
30 PRINT z$
35 LINE INPUT #1, z$
40 PRINT z$
50 LINE INPUT "enter"; L$ 'Stop
55 IF L$ = "X" THEN GOTO 195
100 GOTO 10
195 CLOSE
200 END
```

Example 18: 'PROGRAM A CV PXXXYY

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "M"        'GO INTO PROGR MODE
15 LINE INPUT #1, z$
20 PRINT z$
25 LINE INPUT "PROGR Mode, enter to Write CV"; L$
30 W$ = "P00212"        'Write 12H into CV#2
35 PRINT #1, W$
50 LINE INPUT #1, C$
55 PRINT C$
56 PRINT #1, "X"
57 LINE INPUT #1, z$
58 PRINT z$
60 LINE INPUT "OPER Mode, enter to repeat "; L$
65 IF L$ = "X" THEN GOTO 195
70 GOTO 30
170 PRINT #1, "X"
175 LINE INPUT #1, z$
180 PRINT z$
195 CLOSE
200 END
```

Example 19: 'WRITE TO A DECODER REGISTER [Syxx]

```
7 CLS
8 OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR RANDOM AS #1
9 LINE INPUT "ENTER TO START TRANSACTION"; K$
10 PRINT #1, "M"        'GO INTO PROGR MODE
15 LINE INPUT #1, z$
20 PRINT z$
25 LINE INPUT "PROGR Mode, enter to Write Regr"; L$
30 W$ = "S223"        'Write 23H into Regr#2 (CV#2)
35 PRINT #1, W$
50 LINE INPUT #1, C$
55 PRINT C$
56 PRINT #1, "X"
57 LINE INPUT #1, z$
58 PRINT z$
60 LINE INPUT "OPER Mode, enter to repeat "; L$
65 IF L$ = "X" THEN GOTO 195
70 GOTO 30
170 PRINT #1, "X"
175 LINE INPUT #1, z$
180 PRINT z$
195 CLOSE
200 END
```

Decimal To Hexadecimal Conversion Chart

Some decoder manuals, like Digitrax, use the Hexadecimal number system for showing values used during decoder programming. Your EasyDCC system uses conventional decimal numbers. To use a hexadecimal value, say from a decoder's CV value table, you must convert it to a decimal number. Don't be fooled by "normal" looking numbers such as 30. The 30 may actually be 30-hex which is the same as 48 decimal.

This chart is an easy way to convert. Find the Hexadecimal number in the column labeled Hex. Adjacent to the number is its decimal equivalent.

DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX
0	00	43	2B	86	56	129	81	172	AC	215	D7
1	01	44	2C	87	57	130	82	173	AD	216	D8
2	02	45	2D	88	58	131	83	174	AE	217	D9
3	03	46	2E	89	59	132	84	175	AF	218	DA
4	04	47	2F	90	5A	133	85	176	B0	219	DB
5	05	48	30	91	5B	134	86	177	B1	220	DC
6	06	49	31	92	5C	135	87	178	B2	221	DD
7	07	50	32	93	5D	136	88	179	B3	222	DE
8	08	51	33	94	5E	137	89	180	B4	223	DF
9	09	52	34	95	5F	138	8A	181	B5	224	E0
10	0A	53	35	96	60	139	8B	182	B6	225	E1
11	0B	54	36	97	61	140	8C	183	B7	226	E2
12	0C	55	37	98	62	141	8D	184	B8	227	E3
13	0D	56	38	99	63	142	8E	185	B9	228	E4
14	0E	57	39	100	64	143	8F	186	BA	229	E5
15	0F	58	3A	101	65	144	90	187	BB	230	E6
16	10	59	3B	102	66	145	91	188	BC	231	E7
17	11	60	3C	103	67	146	92	189	BD	232	E8
18	12	61	3D	104	68	147	93	190	BE	233	E9
19	13	62	3E	105	69	148	94	191	BF	234	EA
20	14	63	3F	106	6A	149	95	192	C0	235	EB
21	15	64	40	107	6B	150	96	193	C1	236	EC
22	16	65	41	108	6C	151	97	194	C2	237	ED
23	17	66	42	109	6D	152	98	195	C3	238	EE
24	18	67	43	110	6E	153	99	196	C4	239	EF
25	19	68	44	111	6F	154	9A	197	C5	240	F0
26	1A	69	45	112	70	155	9B	198	C6	241	F1
27	1B	70	46	113	71	156	9C	199	C7	242	F2
28	1C	71	47	114	72	157	9D	200	C8	243	F3
29	1D	72	48	115	73	158	9E	201	C9	244	F4
30	1E	73	49	116	74	159	9F	202	CA	245	F5
31	1F	74	4A	117	75	160	A0	203	CB	246	F6
32	20	75	4B	118	76	161	A1	204	CC	247	F7
33	21	76	4C	119	77	162	A2	205	CD	248	F8
34	22	77	4D	120	78	163	A3	206	CE	249	F9
35	23	78	4E	121	79	164	A4	207	CF	250	FA
36	24	79	4F	122	7A	165	A5	208	D0	251	FB
37	25	80	50	123	7B	166	A6	209	D1	252	FC
38	26	81	51	124	7C	167	A7	210	D2	253	FD
39	27	82	52	125	7D	168	A8	211	D3	254	FE
40	28	83	53	126	7E	169	A9	212	D4	255	FF
41	29	84	54	127	7F	170	AA	213	D5	-	-
42	2A	85	55	128	80	171	AB	214	D6	-	-