MOORE INDUSTRIES

COMMAND REFERENCE GUIDE

Configuring and Operating the:

CAM, DCM, & SCM

September 1992

No. 294-701-08 A

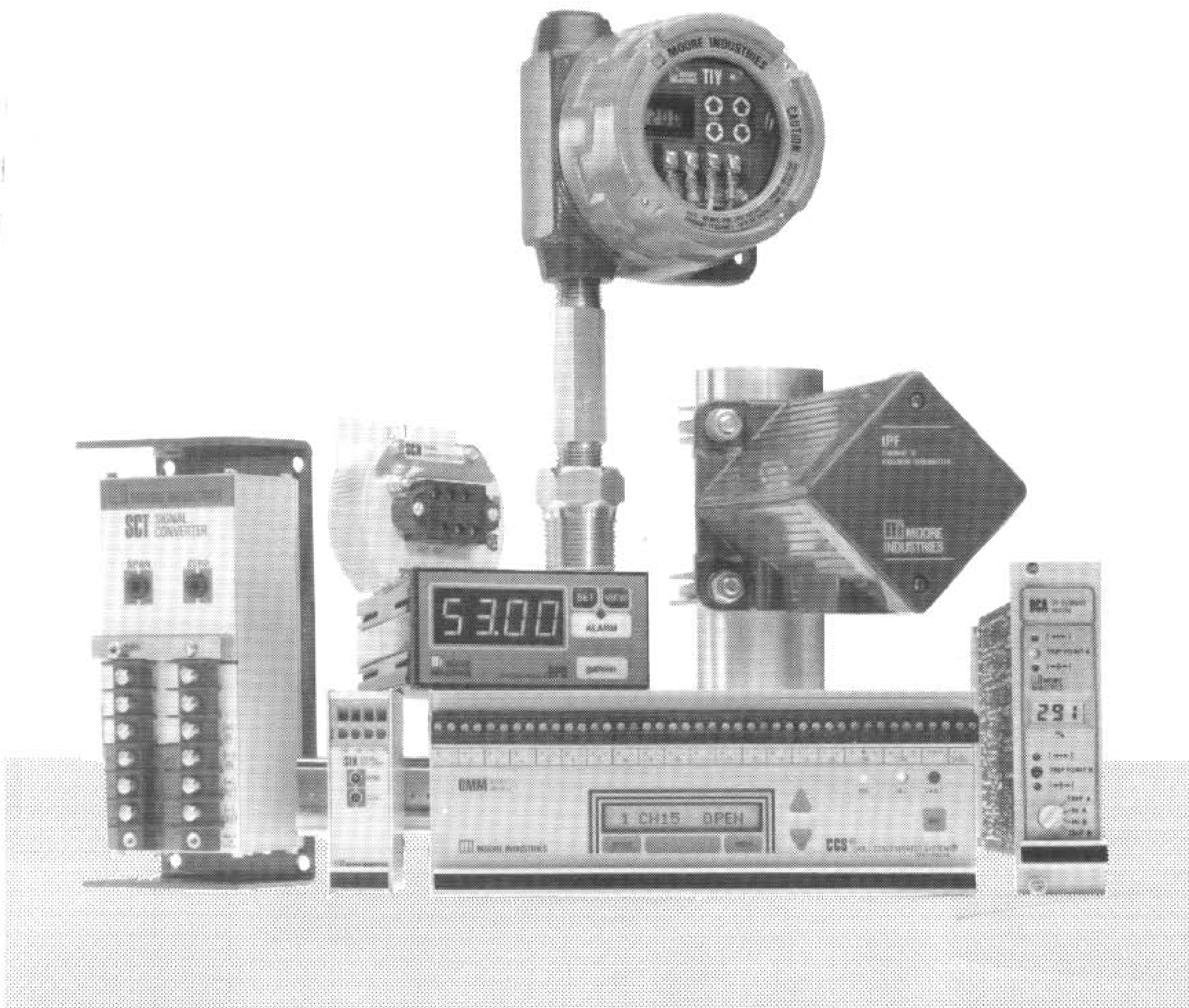


Table of Contents

Introduction

Moore Industries' Sensor-to-Computer Module (SCM), Computer-to-Analog Module (CAM), and Discrete Concentrator Module (DCM) are micro-processor-based interfacing and communications devices used in data acquisition and control (DAC) systems.

This guide provides information on the commands used to configure and control all of the available types of SCM, CAM, and DCM, including information pertaining to operation of units when equipped with the available options. Refer to the appropriate user's manual for information on specifications, options, calibration, installation, maintenance, and trouble-shooting particular to the type of unit being used in your application.

The user's manuals also have information on configuring and operating these devices using Moore Industries' Utility (configuring/calibrating) and Scan (operating/report generating) software.

Additional copies of the user's manuals and of this guide are available through your local Moore Industries' Sales Representative, or directly from the factory.

Conventions. The term "host", as used in this guide, refers to any digital device that is capable of asynchronous ASCII string output at standard RS-232C or RS-485 communications logic levels. The SCM and CAM can each be configured to recognize commands from either of a hosts communications ports, "COM1: " or "COM2:". Examples of typical host devices include DOS-based personal computers (PC), programmable logic controllers (PLC), and "dumb" terminals.

The symbol "Ø" is used to distinguish the numeral zero from upper case (capital) "O" where confusion might otherwise arise.

The symbol "↵" is used to represent "ENTER". The keystroke for "ENTER" – "RETURN" on some keyboards – (ASCII $ØD) is used to terminate all SCM, CAM, and DCM commands.

"Notes" are used to call attention to practices that, unless avoided, could present inconveniences to the user, and may interrupt operation of the unit in the application.

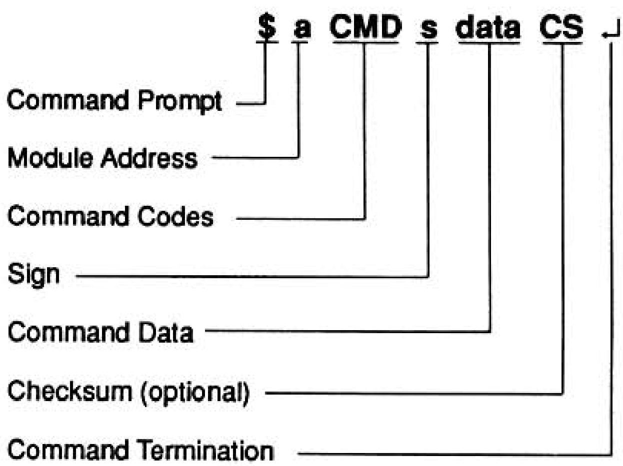
"Cautions" are used to call attention to practices or commands that could permanently alter unit performance or operational specifications.

CAM/DCM/SCM General Command Notes

These devices are configured and operate using a simple command/response protocol, consisting of ASCII strings. ASCII strings (commands) are received by the unit, which has been factory configured to operate at either RS-232C or RS-485 communications logic levels. In response to the commands, units send sensor data (ASCII) back to the host (SCM), provide user-controlled levels of analog output to other current- or voltage-driven devices (CAM), or provide discrete logic level sensing/output (DCM).

Command Format

The following paragraphs describe the various elements of CAM, DCM, and SCM commands. Refer to the breakout diagram below.



COMMAND REFERENCE

Command Prompt. Either the dollar sign character, "$" (hex 24), or the number or pound sign character, "#" (hex 23) is REQUIRED at the start of any SCM or CAM command. This signals the connected unit(s) that a command string is to follow.

"$" is the short form prompt. Commands begun with "$" will be executed upon receipt of the command termination character, and unit responses will consist of a simple confirm character, "*" (hex 2A), or "*" plus the minimum number of characters needed to represent the response data.

"#" is used to initiate the long form of unit commands. The long form is used with the Command or Response Checksumming capability, and in some cases the Acknowledge command, to check the integrity of the host-to-unit communications link. More information about checksums is presented later in this section. The explanation of the Acknowlege command also contains some information about the long form command prompt and checksums.

Module Address. Every CAM, DCM, and SCM command must have as its second character a module or "polling" address. Typically represented by the letter "a" in the user documentation, the address is a user-selected module designator from the printable ASCII character set. It identifies the unit for which the command is intended. The ASCII-Decimal-Hex-Binary conversion table in the appendix of this manual shows the ASCII codes that can be used as module addresses in a shaded area.

NOTE
Do not confuse the Module Address with the Continuous Input Address, used with C-equipped SCM's. Refer to the explanation of the Continuous Input Address command, later in this manual, for more information on the difference between the two types of addresses.

Enabling the Default Mode of operations (connecting the DEFAULT pin of the unit to GND) will cause it to respond to any "legal" address. Improperly addressed commands will be ignored by the connected module, unless the Default Mode is enabled. If several units in a system are all set to their Default Mode, however, and they are simultaneously addressed, communications errors will occur.

NOTE
Each CAM, DCM, or SCM connected to a common communications port in a DAC must be given its own, unique address.

Illegal Addresses. The characters for NULL (hex ØØ), RETURN or ENTER (hex ØD), the dollar sign (hex 24), and the asterisk (hex 23) cannot be used for module address codes. Characters above hex 7F, which comprise the non-printable ASCII values, are also "illegal" address codes.

Command Codes. The text of CAM, DCM, and SCM commands, entered immediately after the Module Address, consist of two- or three-character mnemonics that represent the desired operation.

NOTE
All command codes must be entered in upper case (capital) letters.

Sign. Many commands require numerical values, represented in decimal or hexadecimal characters, in order to complete their syntax. In this guide, when present in the Command Data field of commands, the character "**s**" is used to show that a positive or negative sign is required as part of the numerical value.

Command Data. Characters in the data field can represent either a decimal value, such as +4 V:

$aAO+Ø4ØØØ.ØØ↵

or a hex value, such as ØØFF:

$aDOØØFF↵

Each character pair in the second example is a hex value representing binary data that typically controls some aspect of unit function. The hex numbers "ØØ" and "FF" represent the binary numbers 00000000 and 11111111.

NOTE
When using commands that require decimal characters in the Command Data field, the full nine-character string MUST be used, even if some digits are not significant. A SYNTAX ERROR will be returned if all digits are not used.

Command and Response Checksums. A checksum is the two, lowest order or least significant (right-most) digits in the sum of the hex equivalents for the characters in a command or response. To determine the checksum for a command or response, find the hex equivalents for each character, add them up, and take the two, lowest order (right-most) digits.

EXAMPLE:

In the command:

#5DI↵

The hex value used as a checksum would be E5 (decimal 229).

- **#** (command prompt) = hex 23 = decimal 35
- **5** (example, user-selected module address code) = hex 35 = decimal 53
- **D** (command character) = hex 44 = decimal 68
- **I** (command character) = hex 49 = decimal 73

The characters (ASCII) in a command or response are converted to their hex equivalents, added up, and the last two digits of the sum is appended to the command or response so that the user can check the integrity of the communications link between host and connected unit.

Checksum calculation excludes the Command Termination character. If the check summation results in a hex value with more than two digits, only the two lowest order digits are used. In a hex value of "2AB", for example, only "AB" would be used as a checksum.

NOTE
There is an ASCII/Decimal/Hex/Binary conversion table at the end of this guide.

To use the Checksumming feature, a command is begun with the "long form" command prompt, "#". If desired, the user can calculate a checksum for the command being sent and append the checksum to the end of the command, before the termination character. This is called the command checksum.

When this "long form" command string is received by a unit, it "reads" to the anticipated end of the command, then "looks" for the two-character command checksum. If the checksum is present, the unit calculates its own checksum based on the characters received, and compares it to the checksum that was transmitted. If the two sums agree, the command is either echoed back and executed, or echoed back and held until the user sends a valid Acknowledge command (refer to the explanation of the Acknowledge command, later in this manual for more information on the use of "$aACK↵" with checksums).

If the command checksum and unit-calculated checksums do not agree, the command is aborted and an error message is returned.

Another use of the checksum is when the "long form" command prompt is used, but a user-calculated command checksum is not appended. When the unit does not detect a command checksum, it calculates and transmits its own, appended to an echo of the command as it was received. This is called a response checksum. When using this type of checksum, the user calculates the hex value for the echoed response and compares it to the checksum that the unit transmits. If the two agree, it may be assumed that good communications exists between host and linked unit, and that the command has been executed, or if necessary, that transmitting an Acknowledge command will start the desired operation.

When a command that is begun with the "short form" command prompt, "$", no checksumming is performed, and the command is simply executed as received.

Command Termination. The "ENTER" or "RETURN" key (hex ØD) is used to terminate all CAM, DCM, and SCM commands. The symbol "↵" is used to represent "ENTER" in Moore Industries' user documentation.

An addressed unit does not begin to perform any internal function until the valid Command Termination character is received.

COMMAND REFERENCE

A properly addressed module that receives a second Command Prompt character before a Command Termination character will abort both commands and return to a "ready" status.

Miscellaneous Protocol Notes

Command Length. The length of a command for DCM's and SCM's is limited to 25 characters. The command length for CAM's is 20 characters. Commands that exceed these limits will be ignored or aborted.

Command Timing. When a unit receives a valid command, it first checks for and performs the functions associated with the checksum capability, and the Acknowledge command (if used). It then interprets the instruction, executes the commanded function(s), and transmits the appropriate response back to the host.

All commands incur fixed time delays while this cycle is occurring. Table 1 lists these fixed delays. If, having transmitted a properly formatted command, the addressed unit does not respond within the time frame listed in table 1, it may be assumed that a time-out has occurred. The time-out specifications are based on the time from the receipt of a valid Command Termination character to the transmittal of a response.

Refer to the Troubleshooting Section of the appropriate user's manual for instructions on how to rectify problems with command time-out errors..

In an application that incorporates several modules in a daisy chain (series) connections scheme (RS-232C), each module in the chain must be set to echo every received character, including the carriage return, down to the other units in the chain. This incurs another time delay unit. A unit of delay is based on the unit's baud rate. Refer to table 2, which lists the delays accumulated at the various baud rate settings.

To calculate the total cycle delay for a command in a daisy chain application, add one unit of delay from table 2 to the command delay listed in table 1, for each unit in the daisy chain.

Table 1. *Command Delays*

Command	Delay
HX	≤ 5 milliseconds (msec)
ACK, CB, CE, CP, DI, DO, RA, RAB, RAP, RB, RD, RP, RSU, SB, SP, RIA, RCM, RR, WE	≤ 10 msec
EC, RE, RWT, RID, RIV, RCT, AIB, AIP, AOB, AOP, CIA, CMC, CMD, CME, CMT	≤ 15 msec
WT, CT, SU, AIO, IV, and all others	≤ 100 msec
ID	≤ 130 msec

Table 2. *Baud Rate Delays*

Baud Rate Setting	Delay
300	33.3 milliseconds (msec)
600	16.7 msec
1200	8.33 msec
2400	4.17 msec
4800	2.08 msec
9600	1.04 msec
19200	520 microseconds (µsec)
38400	260 µsec

All modules set at the factory to provide RS-485 (multidrop) communications are set to hold for two units of delay time after receipt of a valid Command Termination character. This is intended to allow for host devices that transmit a carriage return/linefeed combination when the ENTER key is pressed.

The delay can be changed in the Setup window of the Utility software program (refer to the appropriate user's manual), or with the Setup command (Byte #3), explained later in this guide.

CAM, DCM, & SCM Commands' Syntax

The following sections comprise a list of all CAM, DCM, and SCM commands, with information on their application, ulterior requirements, and restrictions.

NOTES

Commands must be entered in capital (upper case) letters.

Every command must include all of the elements shown. Incomplete commnd syntax will result in its being ignored or aborted.

Remember to substitute the appropriate unit address for "a" and the correct calculated checksum for "[checksum]" in the example, unless the unit's Default mode is enabled.

• ACKNOWLEDGE

USE WITH: All units.

COMMAND: **$aACK↵**
RESPONSE: ∗

Acknowledge is used to provide confirmation of host-unit/unit-host communications handshaking. Sending the command by itself, as shown above, indicates that good communications exist. An error message will be returned, or a time-out error will occur if the transmitted Acknowledge does not generate an asterisk (∗) reply.

When used together with the Checksum feature of other commands, Acknowledge can be used to delay the execution of a command until the characters and checksum can be verified. This is especially useful when performing output functions in applications where ambient noise or bus disruptions may be a factor.

EXAMPLE:

The following sequence illustrates the use of the Acknowledge command with checksums. First, a command that effects unit output is entered (CAM Adjust Output Level command) using the long form Command Prompt:

COMMAND: **#aAO+ØØØ12.ØØ↵**
RESPONSE: ∗aAO+ØØØ12.ØØ**66**

Note that in response to the long form Command Prompt, #, the unit echoes the command and appends a checksum, "66". To verify that the correct command was sent, check the echo. Add up the hex equivalents for each character in the echo, and verify the checksum to double-check that the desired command was correctly received by the unit.

When using the Checksum feature, remember that the command will not execute until the Acknowledge command is received:

COMMAND: **$aACK↵**
RESPONSE: ∗

The asterisk response indicates that the AO command was executed.

NOTES

The Command Termination character is not included in checksum calculation.

Parity bits are not included in checksum calculation.

The checksum feature is not intended for use with the Acknowledge command itself. That is, do not attempt to append a checksum to the command:

#aACK↵

An error message will result.

COMMAND REFERENCE

If desired, a checksum can also be appended to the original command. Refer to the explanation of the Command Checksum feature, earlier in this guide, for information on the function of the addressed unit when using Command Checksums.

• ALARMS, ENABLE/DISABLE/CLEAR

USE WITH: Voltage, Current, T/C, and RTD SCM's. Not available with Frequency SCM's, with DCM's, or with CAM's.

ENABLE:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aEA↵**
RESPONSE: ✳

This command configures terminal DO1/HI (when present) to function as a high alarm, and terminal DOØ/LO (when present) to function as a low alarm.

When enabled, these terminals change state when the sensor input goes into an alarm condition defined by the user with the HI and LO commands (refer to Alarms, Set/Read Trip Points).

DISABLE:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aDA↵**
RESPONSE: ✳

This command changes alarm output terminals to discrete output terminals (open collector, transistor switch). The DO1 and DOØ terminals, when present, can function as alarms or as discrete (logic) outputs.

NOTE

Executing the DA command does not effect high/low state of the alarms, or the trip point settings stored in EEPROM. The user-set alarm configuration goes into effect whenever the alarms are enabled.

CLEAR:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCA↵**
RESPONSE: ✳

This command turns both the HI and LO alarms OFF. It is most often used to clear latching alarms.

The $aCA command does not effect the operating configuration of the alarms (enabled/disabled, momentary/latching). When an alarm condition at a terminal persists, the alarm will again "trip" or latch at the end of the very next conversion cycle after a $aCA command is executed.

• ALARMS, SET/READ TRIP POINTS

USE WITH: Voltage, Current, T/C, and RTD SCM's. Not available with Frequency SCM's or with DCM's. Used with CAM's to set high and low Output Level limits.

SET HI ALARM TRIP POINT:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aHIsnnnnn.nnL↵**
RESPONSE: ✳

SET LO ALARM TRIP POINT:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aLOsnnnnn.nnL↵**
RESPONSE: ✳

These commands load user-selected trip points into unit EEPROM. When the alarms at the DOØ/LO and DO1/HI terminals are enabled (EA command) their outputs will change state whenever the sensor input exceeds the HI setting or falls below the LO setting.

NOTE

Disabling the available alarms, or using commands to change the logical state of those discrete terminals, does not effect the HI or LO trip point settings. When enabled, the trip point setting last transmitted goes into effect.

Momentary/Latching. The letter "L" or "M" is appended to the data portion of the command in order to specify how the alarm will function. Appending an "L", for latching, will cause the alarm to remain in the new state until the alarm is cleared with the CA command, or until the complimentary alarm is tripped. Appending an "M", for momentary, will cause the alarm to change state in an alarm condition, and return to a normal state (change back) when the sensor input falls below the HI value or rises above the LO value.

READ HI ALARM SETTING:

COMMAND: **$aRH↵**
RESPONSE: ✳snnnnn.nnL

READ LO ALARM SETTING:

COMMAND: **$aRL↵**
RESPONSE: ✳snnnnn.nnL

The RH and RL commands read back the trip point setting and type of alarm configured at the DO1/HI and DOØ/LO terminals. This information is set and stored in the unit EEPROM.

Appended to the response is a letter signifying either latching (L) or momentary (M) alarm function.

• ANALOG-TO-DIGITAL READ-BACK, TRIM/PERFORM

USE WITH: CAM's equipped with the PRG Option. Not available with standard CAM's, with DCM's, or with any type of SCM.

TRIM READBACK MINIMUM:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aTRN↵**
RESPONSE: ✳

TRIM READBACK MAXIMUM:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aTRX↵**
RESPONSE: ✳

These commands reconcile the readings taken by the PRG-equipped CAM's on-board analog-to-digital (A/D) converter to the calibrated zero and full-scale unit output, which is controlled by the user with the AO command (See "Output Level, Set/Read").

NOTE

*The A/D converter is used to monitor the actual output of the CAM, as opposed to the output level **setting**. The actual output data typically varies over a distinct time period, determined by the unit's slope. Refer to "Slope, Set/Read" and "Output, Set/Read Level" for more information on reading data and reading real-time data.*

Calibrate CAM output using the AO, TMN and TMX commands before trimming the unit's A/D converter (analog readback). For proper trimming, the zero and full-scale values set into CAM EEPROM with the MN and MX commands must be known.

To Calibrate PRG CAM A/D converter:

1. Set calibrated output level to zero with appropriate AO command. Make sure to wait until output slewing is complete (refer to "Slope, Set/Read").
2. Execute TRN command (ACK command optional).

   Unit calculates calibration values and fixes zero on AD converter scale, then stores value in non-volatile EEPROM. Subsequent RAD commands reflect scaling.
3. Set calibrated output level to full-scale with appropriate AO command.
4. Execute TRX command (ACK command optional).

   Unit calculates calibration values and fixes full-scale on AD converter scale, then stores value in non-volatile EEPROM. Subsequent RAD commands reflect scaling.

COMMAND REFERENCE

PERFORM READBACK
(READ ACTUAL (REAL-TIME) DATA):

COMMAND: **$aRAD↵**
RESPONSE: ∗snnnnn.nn

This command is used to read data from the on-board A/D converter in the PRG-equipped CAM.

NOTE
User-selected scaling set with the MN and MX commands effects the data in the response to the RAD command.

• BREAK POINTS, SET/ERASE

USE WITH: Voltage, Current, T/C, RTD, and Frequency SCM's equipped with the PRG Option. Command is not applicable to DCM's, or to CAM's.

SET:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aBPnnsnnnnn.nn↵**
RESPONSE: ∗

ERASE:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aEB↵**
RESPONSE: ∗

The EB command erases all break points from EEPROM. It does not erase endpoint settings (MN and MX commands).

The BP command is used to define the break points along a segmented approximation of a non-linear function curve being calculated by the SCM. The user can program 23 break points (24 segments).

The format for the BP command is as follows:

$ = Command prompt (# may be used for long form)

a = Module address

BP = Break point command

nn = Break point number; hex value between ØØ and 16 that falls between the established end point values set with the MN and MX commands.

s = Sign, Positive or Negative

nnnnn.nn = User-determined value (decimal), that scales the actual sensor data to engineering units. Value must fall between the function end points (MN and MX commands).

Programming:

NOTE
It is recommended that all existing break points be erased (EB command) before setting new break points.

1. Define function data.
2. Erase existing break points (EB command).
3. Clear existing zero (CZ command).
4. Optimize digits displayed in readout (SU command).
5. Enter minimum excitation from application, and program scaling value into EEPROM (MN command).
6. Enter maximum excitation from application, and program scaling value into EEPROM (MX command).

Additionally, for Non-linear Functions:

7. Enter intermediate excitation from application, up to 23 points (linear or non-linear, but between MN and MX excitation levels), and program scaling values into EEPROM (BP command).
8. Verify correct transfer function by inputting various known excitation levels and observing unit readout, either with an external monitoring device (preferred), or with the RAD command.

Figure 1 shows an example of a function that can be represented with user-set break points.

Figure 2 illustrates the technique for extending the scaling end points, with MN and MX commands, of an otherwise "illegal" non-linear function, so that the PRG SCM can perform the transfer function.

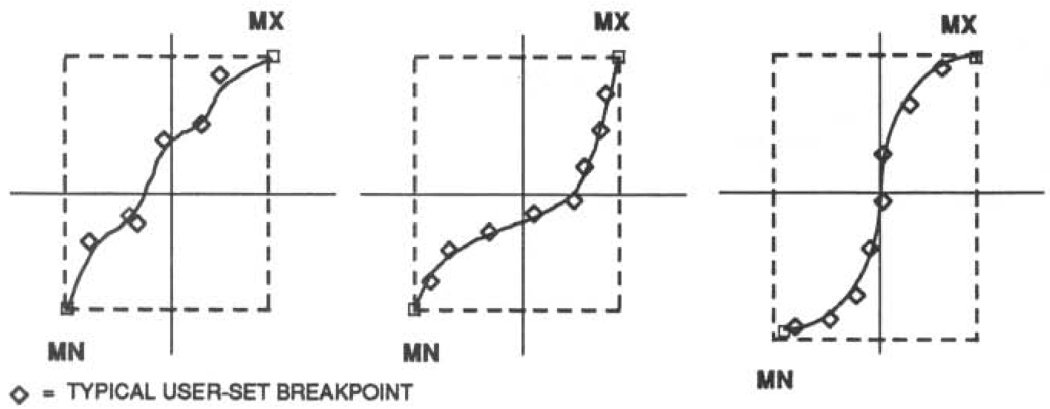


Figure 1. Non-linear Transfer Function Defined with PRG Break Points

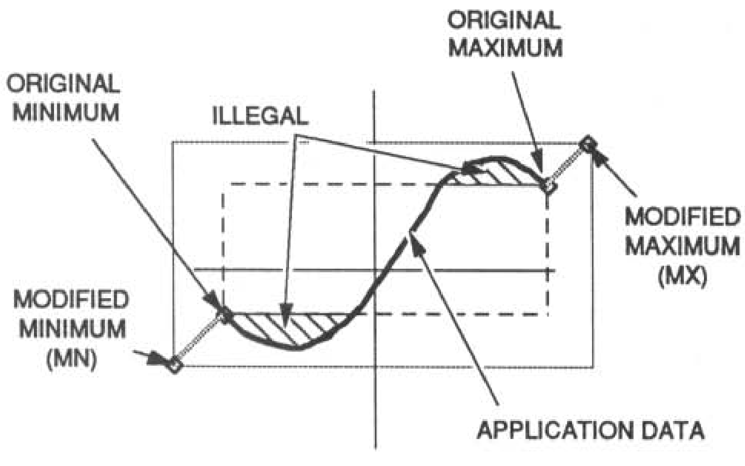


Figure 2. Modifying "Illegal" Transfer Functions

COMMAND REFERENCE

• CONTINUOUS MODE, ENABLE/DISABLE/READ TYPE

USE WITH: DCM's. Not applicable to CAM's or to SCM's, whether equipped with C Option or not.

Special Note – Continuous Mode in C-equipped SCM's and CAM's. The following commands are not applicable to the CAM, or to SCM's (even if equipped with the C Option). Information on the use of these modules with Continuous Mode is presented at the end of this section. Refer also to the explanation of CAM Continuous Mode under Setup command.

ENABLE CHANGE-TRIGGERING

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCMC↵**
RESPONSE: ✳

ENABLE EDGE-TRIGGERING

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCME↵**
RESPONSE: ✳

*ENABLE INPUT-TRIGGERING**

* Accepts output from another SCM with correct Continuous Input Address (refer to explanation of CIA command).

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCMI↵**
RESPONSE: ✳

ENABLE TIMER-TRIGGERING

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCMT↵**
RESPONSE: ✳

Continuous Mode is unit operation that does not require a prompt from the system host. In DCM's, the user chooses a "trigger" type, which enables the unit to provide data under one of the following conditions:

- When the state of any of the unit's discrete input or output terminals changes (CMC).
- When the unit's BØØ/EV terminal receives a positive-going trigger pulse (CME).
- When the unit receives data from another unit that has been configured to provide Continuous Output (CMI). (Refer also to the explanation of Continuous Input Address command, CIA).
- When the unit's internal timer trips (CMT). (The Continuous Timer command, CT, must be set for use with this mode).

Continuous Output Trigger Signal. Each time a DCM in Continuous Mode completes an output data string, a 5 msec low-going output pulse is produced on the DEFAULT• terminal (this momentarily supersedes the normal operation of the DEFAULT terminal (input)).

Use this signal to daisy chain DCM's by connecting the DEFAULT terminal to the BØØ/EV terminal of another DCM configured to operate in Edge-triggered Continuous Mode.

DISABLE CONTINUOUS MODE

COMMAND: **$aCMD↵**
RESPONSE: ✳

The CMD command returns control of the DCM exclusively to the host.

NOTE

It is not necessary to disable Continuous Mode when issuing commands from the host to a DCM operating in Continuous Mode. The unit will respond to both host and internal prompts.

Avoid communications collisions by transmitting host commands immediately after the receipt of an output string from the unit.

READ CONTINUOUS MODE TYPE

COMMAND: **$aRCM↵**
RESPONSE: ∗n

This command reads back the type of Continuous Mode enabled with the CMC, CMD, CME, CMI, or CMT commands. Table 3 lists the possible responses.

Table 3. *RCM Command Responses*

Response	Mode Type
C	Change-triggered
D	Disabled
E	Edge-triggered
I	Input-triggered
T	Timer-triggered

The C Option – Continuous Mode in SCM's. Voltage, Current, T/C, RTD, and Frequency SCM's are capable of Continuous Mode operations when equipped with the C Option. C-equipped SCM's begin to transmit data as soon as appropriate power is applied and the Continuous Enable Terminal is connected to ground.

Table 4 lists the Continuous Enable Terminals for the SCM. The shaded cells in the table are the terminals that must be grounded.

A module in Continuous Mode transmits available data constantly, so unlike the DCM, other aspects of its "normal" operation are not available.

To disable Continuous Mode for these units, disconnect the CONT∗ pin from ground.

Continuous Mode in CAM's. PRG CAM's also have Continuous Mode capability. The option enables the unit's ability to interpret output from Continuous Output SCM's as its input. An incoming data stream from an SCM will be read as an Output Level Adjust command (AO) by a PRG CAM with its Continuous Enable Terminal connected to ground.

PRG CAM Continuous Mode is accessed and controlled with the Setup command and the *DI2* terminal. Refer to the Setup command explanation, later in this guide for more information.

CAUTION

The PRG CAM does not provide any response to Continuous Input. Commands received from other modules are simply executed. Errors in communications, formatting, or address will result in aborted commands. No error messages will be issued.

• CONTINUOUS MODE, SET/ READ INPUT ADDRESS

USE WITH: DCM's configured for Input-triggered Continuous Mode.

SET:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aCIAnn↵**
RESPONSE: ∗

This command loads an address code into DCM EEPROM. This address is that of the Continuous Output module (another DCM) whose output string (data) is to be interpreted as triggering input by this module. The Command Data field, "nn", is the hex code for the desired unit's address.

COMMAND REFERENCE

Table 4. *Continuous Mode Enabling Terminals*

✳	Voltage or Current SCM	Thermocouple SCM	RTD SCM	Frequency SCM	CAM
1	+IN	DO2	C	IN	+OUT
2	–IN	DI1	B	+2.5V	–OUT
3	DO1/HI	DO1/HI	A	SIG. GND	DI2
4	DIØ/EV	DIØ/EV	D	HYSTR.	DI1/UP•
5	DOØ/LO	DOØ/LO	DOØ/LO	DIØ/EV	DIØ/DN•
6	DEFAULT•	DEFAULT•	DEFAULT•	DEFAULT•	DEFAULT•
7	XMT or (Y)DATA	XMT or (Y)DATA	XMT or (Y)DATA	XMT or (Y)DATA	XMT or (Y)DATA
8	RCV or (G)DATA•	RCV or (G)DATA•	RCV or (G)DATA•	RCV or (G)DATA•	RCV or (G)DATA•
9	+VS or (R)+VS	+VS or (R)+VS	+VS or (R)+VS	+VS or (R)+VS	+VS or (R)+VS
10	GND or (B)GND	GND or (B)GND	GND or (B)GND	GND or (B)GND	GND or (B)GND
11	N/A	–IN	N/A	N/A	N/A
12	N/A	+IN	N/A	N/A	N/A

✳ = Unit Terminal Number.

EXAMPLE:

If DCM "5" is to accept as command input only data strings from module "2", for example, "5" must have the address for "2" in its EEPROM:

COMMAND: **$5WE↵**
RESPONSE: ✳
COMMAND: **$5CIA32↵**
RESPONSE: ✳

"32" is the hex code for the desired address, "2".

NOTES

Exercise care in setting the address. Setting the Continuous Input Address to the same character as the Module (polling) address, set with the Setup command, will result in an ?ADDRESS ERROR response and operational dysfunction.

SCM's and CAM's do not make use of the Continuous Input Address command.

It is possible fo give more than one DCM the same Continuous Input Address.

READ CONTINUOUS INPUT ADDRESS

COMMAND: **$aRIA↵**
RESPONSE: ✳nn

This command reads back the Continuous Input address in EEPROM.

• CONTINUOUS MODE, SET/READ TIMER

USE WITH: DCM's with Timer-Triggering Continuous Mode (CMT) Enabled.

SET:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCTsnnnnn.nn↵**
RESPONSE: ✳

This command sets the time interval after which the DCM will transmit an unprompted response to what would otherwise be a Read Data command, RD.

EXAMPLE:

The timer setting is scaled in seconds as follows.

COMMAND: **$5CT+ØØØ1Ø.5Ø↵**
RESPONSE: ✳

DCM 5 will transmit data every 10.5 seconds.

READ CONTINUOUS TIMER SETTING:

COMMAND: **$aRCT↵**
RESPONSE: ✳nnnnn.nn

This command is used to read the timer value set into EEPROM for the Continuous Mode Timer.

• DATA, READ/READ NEW

USE WITH: All units.

NOTE
The New Data command (ND) is not available with DCM's or CAM's.

READ DATA:

COMMAND: **$aRD↵**
RESPONSE: ✳snnnnn.nn

This command reads the data in the unit's microprocessor buffer at the time the RD command is received.

SCM. Data represents input from connected sensors or discrete devices.

CAM. The readback from the RD command is the data being sent to the on-board digital-to-analog converter, i.e., the status of the output ramp.

NOTE
The RD command returns the digital data that the microprocessor is currently sending, not necessarily actual CAM output.

DCM. This command is valid with this type of unit so that it can be included in applications with SCM's. The response to the RD command from a DCM is the fixed value:

✳+99999.99

Short Form, All Units. The RD command is probably the most coined command in the SCM and CAM command set. A special, short form of the command is therefore available. It consists of the command prompt, the valid unit address, the number 1, and the valid SCM/CAM command termination character:

$a1↵

READ NEW DATA:

NOTE
The ND command is not available with DCM's or CAM's.

COMMAND: **$aND↵**
RESPONSE: ✳snnnnn.nn

This command reads the data in the SCM data buffer whenever the New Data Flag is cleared. The New Data Flag is an internal, electronically set circuit that compares incoming buffer data to data already in the buffer. The ND command is used to avoid redundancy and produce maximum data throughput.

COMMAND REFERENCE

This is how the ND command works. Every time the data buffer is read with a Read Data or New Data command, the New Data Flag is cleared. A fast host, operating at a high baud rate, could conceivably read the data buffer several times before the A/D converter updates. The ND command, since it waits for the New Data Flag to be set (by new incoming data) reads only the latest result of the SCM analog-to-digital conversion.

Since the ND command keys on this flag, it is very useful in those applications with hosts that handle communications on an interrupt basis.

Frequency SCM's and Aborting ND. The Frequency SCM, since only an incoming frequency pulse constitutes "new" data, may, on occasion, cause the user to wait interminably for a response to an ND command.

Transmit a a single <control-C> character to terminate an ND wait situation and read the data currently in the data buffer.

• DEVIATION SETPOINT, SET/READ/CLEAR

USE WITH: Voltage, Current, T/C, and RTD SCM's. Not available with Frequency SCM's, with DCM's, or with CAM's.

SET:

COMMAND: **$aWE↵**
RESPONSE: *
COMMAND: **$aSPsnnnnn.nn↵**
RESPONSE: *

—AND—

COMMAND: **$aWE↵**
RESPONSE: *
COMMAND: **$aTZsnnnnn.nn↵**
RESPONSE: *

These commands perform the same function. The difference between them lies which takes precedence over the other. The value written into the output offset register with the TZ command can be overwritten with the SP command.

NOTE

The SP command is also used in the DCM to set the ON/OFF (Logical) state of a terminal, referencing by terminal number (00, 01, 02, 03, etc.). Use $aSPnn *to set terminal ON or OFF. Use* $aSPsnnnnn.nn *to set Deviation Output zero point (not applicable to DCM's).*

SP. This command loads a "sensor nulling" value into the SCM Output Offset Register. It can be used with the user-set HI and LO alarm values in creating a simple on/off controller, or to "null out" sensor data and obtain deviation output.

With the SP command, the Read Data and New Data commands respond with values relative to the user-set zero point.

TZ. This command is used to load a user-selected offset factor into the SCM Output Offset Register. It is most often used to "null out" offset in output data due to trim offsets created by sensors. It can also be used to devise a deviation output application. The user-specified TZ data is multiplied by a factor of –1.

NOTE

It is possible to load a Deviation Output Zero that is out of the specified unit range. This may be of use in applications where a set point is reached only in the event of an overload.

To set a Deviation Output zero point:

1. Apply the known, calibrated input excitation that is to function as application zero.
2. Clear any existing Zero in SCM (CZ command).
3. Erase any existing break point in SCM (EB command).
4. Load offset into SCM Output Offset Register (TZ command $aTZ+00000.00↵).

Subsequent Read Data and Read New Data commands will produce output relative to the user-set zero point (step 4).

READ USER-SET ZERO POINT:

COMMAND: **$aRZ↵**
RESPONSE: ✳snnnnn.nn

This command reads the value stored in the SCM Output Offset Register.

CLEAR USER-SET ZERO POINT:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCZ↵**
RESPONSE: ✳

This command clears the SCM Output Offset Register to zeroes.

• EVENTS COUNTER, READ/CLEAR

USE WITH: Voltage, Current, T/C, Frequency, and DCM's. Not available with RTD SCM's or with CAM's.

READ:

COMMAND: **$aRE↵**
RESPONSE: ✳nnnnnnn

The response to this command is a seven-digit decimal number representing the number of logical state changes at the DIØ/EV or BØØ/EV terminal since the last time the counter was cleared. The counter can be cleared with the Clear Events Counter command, CE, or with the Read & Clear command, EC.

The events counter can record a maximum of 9,999,999 events.

CLEAR EVENTS COUNTER:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aCE↵**
RESPONSE: ✳

This command resets the internal events counter to zero at any time. This command must be executed when the counter reaches 9,999,999 in order for events counting to resume.

<u>NOTE</u>

Trouble clearing the events counter could be attributed to events occurring while the user is entering the CE command. This skewing of the events count can be avoided by using the EC command.

READ & CLEAR EVENTS COUNTER:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aEC↵**
RESPONSE: ✳

This command combines the function of the Read Events command, RE, and the Clear Events command, CE. It reads the current value in the on-board events counter, and sets the value to zero. It eliminates the possibility of accumulating counts between commands in a RE-CE sequence.

• I/O ASSIGNMENT, SET ALL TERMINALS

USE WITH: DCM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

COMMAND: **$aAIOnnnn↵**

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aAIOnnnn↵**
RESPONSE: ✳

This command uses two, two-place hex values to simultaneously configure all discrete terminals as input or output.

The first two (left-most or most significant) hex digits control the settings for terminals BØ8, BØ9, BØA, BØB, BØC, BØD, and BØE (the most significant (left-most) binary digit is ignored). The last two (right-most or least significant) digits control terminals BØØ/EV, BØ1, BØ2, BØ3, and BØ4, BØ5, BØ6, BØ7. Table 5 shows how a typical AIO command is put into effect.

Setting a terminal to logic 1 configures it as an output. A logic Ø configures the terminal as an input.

Table 5. AIO Effect

	(1)								(2)							
	(3)															(4)
(5)	✳	BØE	BØD	BØC	BØB	BØA	BØ9	BØ8	BØ7	BØ6	BØ5	BØ4	BØ3	BØ2	BØ1	BØØ
(6)		11	12	13	14	15	16	17	18	19	20	1	2	3	4	5

NOTE: The BØØ/EV terminal must be configured as an input (logic Ø) in order to function as an Events Counter.

LEGEND:

(1) - Left-most two-place Hex number

(2) - Right-most two-place Hex number

(3) - Left-most (most significant) binary digit

(4) - Right-most (least significant) binary digit

(5) - DCM terminal labeling

(6) - DCM terminal numbers (cardinal)

✳ - Ignored. Terminal does not exist

EXAMPLES OF I/O ASSIGNMENT:

The following sequence configures all terminals to function as outputs.

COMMAND: **$5WE↵**
RESPONSE: ✳
COMMAND: **$5AIOFFFF↵**
RESPONSE: ✳

The following sequence configures all terminals to function as inputs.

COMMAND: **$5WE↵**
RESPONSE: ✳
COMMAND: **✳5AIOØØØØ↵**
RESPONSE: ✳5AIOØØØØ

Refer to the ASCII/Decimal/Hex/Binary conversion table in this manual for configuring other combinations of inputs and outputs on the DCM.

• I/O ASSIGNMENT, SET INDIVIDUAL TERMINAL

USE WITH: DCM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

CONFIGURE AS INPUT:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aAIBnn↵**
RESPONSE: ✳

—OR—

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aAIPnn↵**
RESPONSE: ✳

There are two methods of referencing the operational configuration of terminals on the DCM; by logical bit designator (hex) and by cardinal terminal number (decimal 00, 01, 02, etc.).

AIB. This command references a terminal according to its hex equivalent or bit number. AIB configures the referenced terminal as an input terminal (to accept discrete input). Since the available I/O terminals on the DCM are labeled with a form of the hex designator, this is probably the easiest way to set terminals to function as inputs.

EXAMPLE:

The following shows how to configure terminal BØC as an input.

COMMAND: **$5WE↵**
RESPONSE: *
COMMAND: **$5AIBØC↵**
RESPONSE: *

AIP. The other method of referencing DCM terminals is according to the cardinal terminal numbers. Using the AIP command is slightly more complex, since the terminal numbers of the DCM do not directly correspond to the terminal labeling. Table 6 lists the DCM I/O terminal labels along with their terminal numbers.

EXAMPLES:

The following shows how to configure terminal BØC as an input, referencing the terminal by its ordinal number.

COMMAND: **$5WE↵**
RESPONSE: *
COMMAND: **$5AIB13↵**
RESPONSE: *

Table 6. *DCM Terminals*

Terminal Label	Terminal No.
BØ4	1
BØ3	2
BØ2	3
BØ1	4
BØØ/EV	5
DEFAULT•	6
XMT for RS-232C (Y)DATA for RS-485	7
RCV for RS-232C (G)DATA• for RS-485	8
+VS for RS-232C (R)+VS for RS-485	9
GND for RS-232C (B)GND for RS-485	10
BØE	11
BØD	12
BØC	13
BØB	14
BØA	15
BØ9	16
BØ8	17
BØ7	18
BØ6	19
BØ5	20

COMMAND REFERENCE

CONFIGURE AS OUTPUT:

AOB and **AOP.** The following shows how to configure terminal BØC as an output, referencing the terminal first by its label (hex significance). They work in the same way as the AIP and AIB commands, discussed earlier.

COMMAND: **$aWE↵**
RESPONSE: *
COMMAND: **$aAOBØC↵**
RESPONSE: *

And then by its number (ordinal):

COMMAND: **$aWE↵**
RESPONSE: *
COMMAND: **$aAOP13↵**
RESPONSE: *

These commands are similar to the AI*x* commands, except that they are used to configure individual terminals to provide discrete output (logical 1 or Ø).

See table 6 for a breakout of the DCM terminals.

• I/O ASSIGNMENTS, READ ALL TERMINALS

USE WITH: DCM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

COMMAND: **$aRA↵**
RESPONSE: *nnnn

This command returns a hex value that represents the user-selected input/output (I/O) configuration assigned to the terminals of the DCM with one of the Assign I/O commands.

Use the ASCII/Decimal/Hex/Binary Conversion table at the end of this guide to convert the hex value to binary.

The least significant (right-most) digit in the resultant binary number represents the terminal BØØ/EV. The most significant (left-most) digit does not correspond to a terminal, and is therefore ignored. The next digit (to the right) represents terminal BØE, and so forth.

A binary 1 means the terminal is configured as an output. Binary Ø signifies input configuration.

EXAMPLE:

The following gives a typical response to an RA command.

COMMAND: **$5RA↵**
RESPONSE: *AA55

The hex value "AA" breaks out to the binary value 1Ø1Ø1Ø1Ø; "55" to Ø1Ø1Ø1Ø1. In the case of DCM "5", then, the I/O terminals in this example are configured as shown in table 7.

• I/O ASSIGNMENT, READ INDIVIDUAL TERMINAL

USE WITH: DCM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

COMMAND: **$aRABnn↵**
RESPONSE: *n

—OR—

COMMAND: **$aRAPnn↵**
RESPONSE: *n

Each of these commands gives the same response, but references individual DCM terminals differently. The RAB command uses a hex value to reference a particular terminal, while the RAP command references the terminal based on its terminal number.

The response to these commands, 1 or Ø, indicates whether the terminal has been configured as an input (Ø) or an output (1).

***Table 7.** RA Command Typical Response*

(1)	AA								55							
(2)	1	Ø	1	Ø	1	Ø	1	Ø	Ø	1	Ø	1	Ø	1	Ø	1
(3)	✱	BØE	BØD	BØC	BØB	BØA	BØ9	BØ8	BØ7	BØ6	BØ5	BØ4	BØ3	BØ2	BØ1	BØØ
(4)	✱	input	output	input	output	input	output	input	input	output	input	output	input	output	input	output
(5)		11	12	13	14	15	16	17	18	19	20	1	2	3	4	5

LEGEND

(1) - Hex (response)
(2) - Binary equivalent
(3) - Terminal labeling
(4) - Resulting configuration
(5) - Terminal number (cardinal)
S - Ignored, no terminal exists

• IDENTIFICATION TAG, SET/READ

USE WITH: All units.

SET:

COMMAND: **$aWE↵**
RESPONSE: ✱
COMMAND: **$aIDn....n↵**
RESPONSE: ✱

This command allows the user to set a unit identifier into non-volatile EEPROM. It has no other effect on unit operation.

Tags are limited to a 16-character length. Longer tags will abort the command. Any printable ASCII character, including spaces can be used.

NOTE
Do not use checksums with the ID command.

READ:

COMMAND: **$aRID↵**
RESPONSE: ✱nn..........nn

This command reads back the identification tag.

• INITIAL VALUE, SET/READ

USE WITH: DCM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

SET INITIAL VALUE:

COMMAND: **$aWE↵**
RESPONSE: ✱
COMMAND: **$aIVsnnn↵**
RESPONSE: ✱

READ INITIAL VALUE:

COMMAND: **$aRIV↵**
RESPONSE: ✱nnnn

These commands set and read the user-determined logical state to which all DCM output terminals default.

ALSO REFER TO: Starting Value, Set/Read.

The data specified (or read back) consists of two, two-place hex numbers. The binary equivalent of these hex values indicates the logical state to which each discrete terminal will be set when the unit is first powered up, or in the event that power to the unit is lost then restored, or whenever the Reset command, RR, is received.

Use the ASCII/Decimal/Hex/Binary Conversion table at the end of this guide to convert the hex value to binary.

The least significant (right-most) digit in the resultant binary number represents terminal BØØ/EV. The most significant (left-most) digit is ignored because no terminal exists for it. The next digit (to the right) represents terminal BØE, and so forth.

Input assignments do not effect the Initial Value. Terminals configured as inputs also ignore the command.

• ON/OFF (LOGICAL) STATE, SET ALL TERMINALS

USE WITH: DCM's, and all types of SCM. Not available with CAM's.

COMMAND: **$aDOnnnn↵**
RESPONSE: ✳

This command uses two, two-place hex numbers to simultaneously set all available discrete output terminals to a logical "1" or "Ø". Use the ASCII/Decimal/Hex/Binary Conversion table in this guide to determine the binary value that will produce the desired results.

The least significant (right-most) binary digit always corresponds to the lowest-numbered terminal (the right-most digit is ignored). Terminals assigned inputs ignore this command.

• ON/OFF (LOGICAL) STATE, READ ALL TERMINALS

USE WITH: All units.

COMMAND: **$aDI↵**
RESPONSE: ✳nnnn

The function of this command varies according to the type of module.

Voltage, Current, T/C, RTD, and Frequency SCM's. When used with the SCM, the hex value read back by the DI command represents two bytes of data. The first (left-most in the readout) two-digit number indicates the ON/OFF state of the HI and LO alarms (not applicable to the Frequency SCM).

ØØ =	Both alarms **OFF**
Ø1 =	HI **OFF**, LO **ON**
Ø2 =	HI **ON**, LO **OFF**
Ø3 =	Both alarms **ON**

The last (right-most in the readout) two-digit number is used to represent the logical state, 1 or Ø, of the DIØ/EV terminal (all leading binary digits are ignored).

EXAMPLE:

The following sequence illustrates that the HI alarm is ON, the LO alarm is OFF, and the DIØ/EV terminal state is logic 1.

COMMAND: **$5DI↵**
RESPONSE: SØ2Ø1

DCM's. When used with the DCM, the hex value read back by the DI command represents a binary number whose digits indicate the logical state of all terminals, whether configured as inputs or outputs. Use the ASCII/Decimal/Hex/Binary Conversion table in this guide to determine the binary equivalent.

The least significant (right-most) digit always corresponds to the lowest-numbered terminal (the right-most digit is ignored, with the next digit corresponding to the highest-numbered terminal).

CAM's. When used with CAM's, the hex value read back by the DI command indicates the state of the output slew and the logical state of the discrete input terminals DIØ/DN, DI1/UP, and DI2.

The first (left-most) two-digit number indicates slewing status.

ØØ = Output is **STEADY**
Ø1 = Output is **SLEWING** (up or down)

The last (right-most) two-digit number is a hex value whose binary equivalent indicates the logic of the three discrete inputs. The least significant (right-most) digit corresponds to the lowest-numbered terminal (the right-most digit is ignored, with the next digit corresponding to the highest-numbered terminal).

EXAMPLE:

The following readout indicates that the output of CAM 5 is currently slewing, and that the state (logic) of terminals DIØ/DN, DI1/UP, and DI2 is 1 (Ø7 hex is ØØØØØ111 binary. All leading binary zeroes are ignored).

COMMAND: **$5DI↵**
RESPONSE: ✱Ø1Ø7

• ON/OFF (LOGICAL) STATE, SET/READ INDIVIDUAL TERMINAL

USE WITH: DCM's. Not available with SCM's or with CAM's.

SET TO ON:

COMMAND: **$aWE↵**
RESPONSE: ✱
COMMAND: **$aSBnn↵**
RESPONSE: ✱

—OR—

COMMAND: **$aWE↵**
RESPONSE: ✱
COMMAND: **$aSPnn↵**
RESPONSE: ✱

SET TO OFF:

COMMAND: **$aWE↵**
RESPONSE: ✱
COMMAND: **$aCBnn↵**
RESPONSE: ✱

—OR—

COMMAND: **$aWE↵**
RESPONSE: ✱
COMMAND: **$aCPnn↵**
RESPONSE: ✱

This series of commands is used to set the state of individual terminals of the DCM to ON or OFF. The SB and SP commands set a terminal to ON, and the CB and CP commands set it to OFF.

NOTE
Do not confuse the ON/OFF state of a terminal with its Enabled/Disabled Alarm status.

The difference between each pair of commands is the way in which the terminal is referenced. The SB and CB commands reference terminals hex. The SP and CP commands reference terminals according to the terminal number on the unit itself (cardinal, 00, 01, 02, 03, etc.).

EXAMPLES:

Each of the following examples set the ON/OFF state for the same terminal.

Terminal B09 ON.

COMMAND: **$5WE↵**
RESPONSE: ✱
COMMAND: **$5SBØ9↵**
RESPONSE: ✱

Terminal B09 OFF:

COMMAND: **$5WE↵**
RESPONSE: ✱
COMMAND: **$5CBØ9↵**
RESPONSE: ✱

Terminal #16 (labeled BØ9) ON:

COMMAND: **$5WE↵**
RESPONSE: ✱
COMMAND: **$5SP16↵**
RESPONSE: ✱

COMMAND REFERENCE

Terminal #16 (labeled BØ9) OFF:

COMMAND: **$5WE↵**
RESPONSE: ∗
COMMAND: **$5CP16↵**
RESPONSE: ∗

Refer to table 6 for a list of DCM terminal labels and numbers.

NOTE
The SP command, when used with a 7-place decimal value, is also used to set the zero point for deviation output. (not available in DCM's or CAM's).

READ LOGICAL STATE, INDIVIDUAL TERMINAL

USE WITH: DCM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

COMMAND: **$aRBnn↵**
RESPONSE: ∗n

—OR—

COMMAND: **$aRPnn↵**
RESPONSE: ∗n

Each of these commands gives the same response, but references the individual SCM terminals differently. The RB command uses hex , while RP uses the terminal number.

The response to these commands indicates the logical state of the terminal; 1 or Ø in positive logic.

• OUTPUT LEVEL, SET/READ

USE WITH: CAM's. Not available with SCM's or with DCM's.

SET:

COMMAND: **$aAOsnnnnn.nn↵**
RESPONSE: ∗

—OR—

COMMAND: **$aHXnnnn↵**
RESPONSE: ∗

These commands set the level of analog output provided at the +OUT and –OUT terminals of the CAM. The AO command represents the desired level in the appropriate decimal value. With the HX command, the hex equivalent of the desired output level is used.

AO. When an AO command is transmitted to a standard CAM, the received input is checked against the high and low limits set by the user with the HI and LO commands. If the AO level is outside of these limits, a LIMIT ERROR message will be returned and the AO command will be aborted by the CAM.

If no limit errors are detected, the unit begins ramping output to the level specified, at either the factory-set (standard CAM), or user-set (PRG-equipped, SL-specified) rate.

When equipped with the PRG Option, all AO commands must fall within the limits established by the output limiting commands (refer to Output Level Limits, Set/Read). Any scaling effected by the user must also be used in AO commands (refer to "Scaling Endpoints, Set/Read").

Verification. To make sure that the CAM receives exactly what you send it, use the long form of the AO command (begin with the pound sign, #), and Acknowledge, ACK. The unit will not begin a slew of its output until an ACK is received. Refer to the explanation of the Acknowledge command, and to the section on the Checksum feature, earlier in this manual.

HX. The HX command sends data directly to the CAM's on-board digital-to-analog converter. It changes CAM output without checking limits, scaling, or trimming, and so tends to be faster than the AO command.

The limits of the HX command are:

$aHXØØØØ↵, which sets output to zero.
and
$aHXØFFF↵, which sets output to full-scale.

The CAM ignores the leading zero in all HX commands. User-defined scaling does not apply.

READ OUTPUT LEVEL SETTING:

USE WITH: All CAM's. Not applicable to SCM's or DCM's.

COMMAND: **$aRAO↵**
RESPONSE: ✳snnnnn.nn

This command is used to read back the data sent by the most recent Change Output Level (AO) command. The data is scaled in the same units as the AO command, which, if the unit is equipped with the PRG Option, are user-selected (refer to explanations of the MN and MX commands).

NOTE
The RAO command ***does not indicate the level of output****. It reads back the* ***level-effecting command*** *that was last sent by the user with the AO command.*

READ ACTUAL OUTPUT LEVEL:

USE WITH: CAM's equipped with the PRG Option only. Not applicable to standard CAM's, to SCM's, or to DCM's.

COMMAND: **$aRAD↵**
RESPONSE: ✳snnnnn.nn

This command is used to read data from the on-board, analog-to-digital converter that comes with the PRG-equipped CAM. Note that it differs from the Read Data (RD) command in that its data is a reflection of the ***actual*** analog output, independent of the last output changing (AO) or slope changing (SL) command.

It is intended for use in "realtime" monitoring of the slewing of CAM output.

NOTE
User-selected scaling set with the MN and MX commands also effects the data in the response to the RAD command.

• OUTPUT LEVEL LIMITS, SET/READ

USE WITH: All CAM's. Used for a different function in some types of SCM. Not applicable to DCM's.

SET HIGH LIMIT:
COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aHIsnnnnn.nn↵**
RESPONSE: ✳

SET LOW LIMIT:
COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aLOsnnnnn.nn↵**
RESPONSE: ✳

READ HIGH LIMIT:
COMMAND: **$aRHI↵**
RESPONSE: ✳snnnnn.nn

READ LOW LIMIT:
COMMAND: **$aRLO↵**
RESPONSE: ✳snnnnn.nn

These commands set and read back the output limit settings stored in CAM EEPROM.

NOTE
The RHI and RLO commands also read back the alarm trip points set in SCM's.

COMMAND REFERENCE

When an Output Level-changing command (AO) is received, it is compared to the user-set limits established with the HI and LO commands. If the requested level is "out of range", the unit will abort the AO command and transmit a ?LIMIT ERROR response.

Limits can be disabled by setting them to all nines:

$aHI+99999.99 and **$aLO–99999.99**

NOTES

The HI and LO commands do not restrict the hex-based Output Level-changing command, HX.

When equipped with the PRG Option, scaling factors may be introduced into the CAM EEPROM (refer to the explanation "Scaling, Set/Read Endpoints"). When scaling is used, the range (limits) established with the HI and LO commands must use the same scale.

• OUTPUT LEVEL, TRIM DESIRED TO ACTUAL

USE WITH: All CAM's. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with CAM's.

TRIM MAXIMUM TO ACTUAL:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aTMXsnnnnn.nn↵**
RESPONSE: ✳

TRIM MINIMUM TO ACTUAL:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aTMNsnnnnn.nn↵**
RESPONSE: ✳

These commands are used when calibrating the Output Level-changing command, AO. They trim CAM output so that when the command for full-scale output is transmitted, for example, the unit output will, indeed, be full-scale (within rated tolerances).

The calibration of the CAM consists of a procedure in which the unit is commanded to full-scale output with an appropriate AO command, a reading of the actual analog output is taken, and the TMX command is used to "trim" the transfer function of the microprocessor so that the desired output level is actually achieved by the unit (within rated tolerances).

A similar procedure is used to trim unit zero (TMN).

Once calibrated, any output level within the unit's rated range can be selected by the user, taking into account any user-set scaling factors.

Refer to the Calibration Section of the CAM User's Manual for more detailed information on the use of the TMX and TMN commands in trimming desired output to actual (metered) output.

• RESET MODULE

USE WITH: All units.

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aRR↵**
RESPONSE: ✳

This command is used to effect a reset of the unit EEPROM. It is required after operating parameter changes using the Setup command, SU, and when necessary because of any accidental memory corruption due ambient static or electrical disturbances.

The RR command:

- Halts any output slewing (mid-slew) at the level being produced when the command is received (CAM).
- Does not effect the Events Counter (SCM).
- Does not effect the state or I/O configuration of discrete terminals (DCM).
- Initiates a 2-second microprocessor boot routine, during which time all commands sent to a connected DCM, SCM, or CAM will return a ?NOT READY error.

- Is transmitted automatically by Moore Industries' Utility software program when exiting a valid edit of unit operating parameters in the Setup window.

• RTS, ENABLE HIGH/LOW, DISABLE

USE WITH: All SCM's equipped with the RTS Option. Not available with CAM's, or in any SCM equipped with the C Option. Not applicable to DCM's.

ENABLE HIGH:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aRTS+↵**
RESPONSE: ∗

ENABLE LOW:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aRTS–↵**
RESPONSE: ∗

These commands are used to enable and set the operating characteristics of the Request-to-Send (RTS) Option of the SCM. The RTS signal is propagated at the DOØ/LO terminal of RTS-equipped SCM's. It is provided for use with half-duplex leased line and radio modems, and with other types of non-auto-answer modems.

Refer to the explanation of the RTS timers for information on when, during the command cycle, the RTS signal is propagated.

The RTS+ command sets the send pin "high". It is intended for use with those devices that require a positive-going activation signal. The RTS– command sets the send pin "low", to 0 V.

<u>*NOTE*</u>
The default state of the RTS signal, when enabled, is negative ("low").

The output, when enabled, is open collector. It requires an external pull-up resistor. If available, the DOØ/LO terminal may be connected to an unused digital input pin, which incorporates an internal, 10 kΩ pull-up resistor.

DISABLE RTS:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aRTSD↵**
RESPONSE: ∗

With the RTS Option disabled, the associated user-programmable timer delays will not execute, and the DOØ/LO terminal will revert to its standard function as a discrete output or LO alarm.

• RTS TIMERS, SET/READ

USE WITH: All SCM's equipped with the RTS Option. Not available with CAM's, or in any SCM equipped with the C Option. Not applicable to DCM's.

SET T1:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aT1snnnnn.nn↵**
RESPONSE: ∗

SET T2:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aT2snnnnn.nn↵**
RESPONSE: ∗

SET T3:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aT3snnnnn.nn↵**
RESPONSE: ∗

These commands set the three available timer values used in synchronizing SCM operation to be compatible with radio modems, leased line modems, and other types of modems that do not have auto-answer capability.

COMMAND REFERENCE

Refer to the manufacturer's specifications for the modem being used to determine your timing requirements.

EXAMPLE:

The Command Data field of each command is scaled in milliseconds (msec). To set T2 to 257 msec, for example, enter the following sequence:

COMMAND: **$5WE↵**
RESPONSE: ✳
COMMAND: **$5T2+ØØ257.ØØ↵**
RESPONSE: ✳

The **T1** delay sets a "dead time" interval, which begins immediately after the receipt of the Command Termination character, the carriage return or ENTER (hex ØD). Upon the expiration of the T1 delay, the RTS signal becomes active, and the user-set T2 delay, if implemented, begins.

The **T2** delay sets the interval between activation of the RTS signal and the beginning of the unit's transmission of data to the host. This is intended to allow for modem transmitter turn-on (radio modems), or other "warm up" requirements. At the end of the T2 delay, the RTS-equipped SCM will begin to transmit its response.

When the last character of the SCM response is transmitted, the unit begins the user-set **T3** delay. This is the interval between the transmission of the last character and the trailing edge of the RTS signal, used to turn the modem off.

READ T1:

COMMAND: **$aRT1↵**
RESPONSE: ✳snnnnn.nn

READ T2:

COMMAND: **$aRT2↵**
RESPONSE: ✳snnnnn.nn

READ T3:

COMMAND: **$aRT3↵**
RESPONSE: ✳snnnnn.nn

This command reads the timer values set into RTS-equipped SCM EEPROM with the Set RTS Timer commands, T1, T2, and T3.

• SCALING END POINTS, SET/READ

USE WITH: Voltage, Current, T/C, RTD, or Frequency SCM's equipped with the PRG Option; and PRG-equipped CAM's. Not applicable to DCM's, Not available with non-PRG-equipped units.

SET MINIMUM:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aMNsnnnnn.nn↵**
RESPONSE: ✳

SET MAXIMUM:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aMXsnnnnn.nn↵**
RESPONSE: ✳

CAUTION

Changing the scaling of an SCM or CAM permanently erases the unit's factory correction for linearity. Exercise extreme caution in making changes to end points and break points.

These commands are used to set up a scale for the representation of PRG-equipped SCM and CAM I/O operations. Use the MX command to set the high end point of the desired scale, and the MN command to establish the low end point.

NOTE

When setting up a scale for the PRG SCM, execute the Erase Break Points command, $aEB, and the Clear Zero command, $aCZ, before MN or MX.

Scaling considerations:

- Scaling changes the way commands are *represented* by and to the SCM or CAM. It DOES NOT EFFECT ACTUAL INPUT OR OUTPUT. The MN and MX commands will not change the factory-set range of an SCM or CAM.

- Once a scale has been implemented, all read commands related to the unit I/O will be effected automatically. For instance, they will give a percentage readout or an inverse readout for like-scaled units.
- Starting Values are not effected by scaling.
- HI and LO limit values, if used, must be set according to the scale implemented with the MN and MX commands.
- Commands that effect slope rates (CAM PRG) are not effected by scaling. Changes must always be entered in units of V/second or mA/second, as appropriate.
- The Utility program or the Setup command, $aSUnnnnnnnn, can be used to optimize the resolution of the unit readouts.
- The CAM PRG can accommodate negative and inverse scaling.

Refer to the PRG section of the SCM User's Manual appropriate for the unit being used for information on non-linear scaling the SCM PRG with the MN and MX commands.

EXAMPLE:

The following sequence demonstrates how a user would set up a Current CAM (4-20 mA output) to represent its output in a linear percentage scale, so that 4 mA is zero-percent of the scale and 20 mA is 100-percent.

COMMAND: **$5WE↵**
RESPONSE: ∗
COMMAND: **$5MX+ØØ1ØØ.ØØ↵**
RESPONSE: ∗
COMMAND: **$5WE↵**
RESPONSE: ∗
COMMAND: **$5MN+ØØØØØ.ØØ↵**
RESPONSE: ∗

To command the scaled CAM in the preceding example to output 12 mA (half-scale), then, the user would enter the following sequence:

COMMAND: **$5AO+ØØØ5Ø.ØØ↵**
RESPONSE: ∗

The value used in the command would represent 50-percent of scale, in this case, 12 mA. In the same manner, +ØØØ25.ØØ would correspond to 8 mA, +ØØØ75.ØØ to 16 mA, etc.

The method for establishing a scale for PRG SCM's is similar, except that the user-selected scale applies to the sensor input, and subsequent (post-scaling) Read Data and New Data commands are effected.

READ SCALING ENDPOINT SETTINGS:

COMMAND: **$aRMN↵**
RESPONSE: ∗snnnnn.nn

—AND—

COMMAND: **$aRMX↵**
RESPONSE: ∗snnnnn.nn

RMN. This command reads the scaling value stored in the PRG CAM EEPROM by the user with the Set Minimum Scaling Endpoint command, MN.

RMX. This command read the scaling value stored in the PRG CAM EEPROM by the user with the Set Maximum Scaling Endpoint command, MX.

• SETUP, PERFORM/READ

USE WITH: All units.

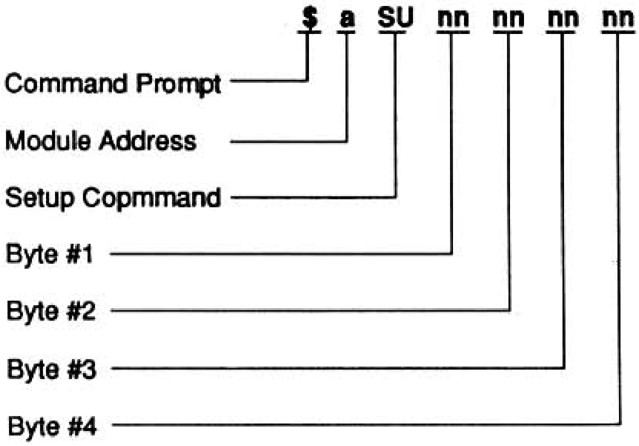
PERFORM/MODIFY UNIT CONFIGURATION:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aSUnnnnnnnn↵**
RESPONSE: ∗

This command can be used to configure/reconfigure most of the operating parameters of the CAM, DCM, or SCM. The Command Data consists of four, two-place hex values, each of which controls distinct aspects of unit operation.

For the purposes of this guide, the discussion of the data area of the SU command is organized under these same four hex values, called "bytes". Refer to the breakout on the next page.

COMMAND REFERENCE



Byte #1:

Byte #1 is the two-place hex value representing the unit's Module (polling) Address. It can be any single, printable ASCII character, with the exception of those represented by NULL (hex ØØ), ENTER or CARRIAGE RETURN (hex ØD), the asterisk character ✳ (hex 2A), the number or pound sign character # (hex 35), or any other of the non-printable ASCII characters (less than hex 2Ø or greater than hex 7E).

Do not confuse the Module Address with the Continuous Input Address, which is used in C-equipped SCM's.

The Module Address can be changed at any time by specifying a new address in Byte #1 of the Setup command. Note that in order to change a unit's address, its current address must be known, or the unit must be placed in Default Mode by grounding the DEFAULT pin (refer to the Calibration Section of the appropriate user's manual for more information on Default Mode operations).

EXAMPLE:

The desired address for a CAM in a user's application is the character "M" (capital or upper case m). The unit's current address is the character "7". To change the address, the following sequence would be used:

COMMAND: **$7WE**↲
RESPONSE: ✳
COMMAND: $7SU**4D**Ø7Ø1CØ↲
RESPONSE: ✳

"4D" is the hex value for the ASCII character "M". After completing the sequence, the module would no longer respond to commands that begin with "$7..." or "#7...". It will respond only to those that begin "$M" or "#M".

NOTE

In multi-unit installations, assigning the same address to more than one unit will result in ?ADDRESS ERROR *responses, and system dysfunction.*

Refer to the ASCII/Decimal/Hex/Binary Conversion table at the end of this guide for assistance in choosing and assigning Module Addresses.

Byte #2:

This two-place hex value configures unit communication parameters. To set these parameters, choose a binary number that sets the appropriate binary digits as required, determine the hex equivalent of that binary value, and use that hex value in Byte #2.

Table 8 lists the available options.

Refer to the ASCII/Decimal/Hex/Binary Conversion table at the end of this guide for assistance in choosing the appropriate binary number.

EXAMPLE:

The desired configuration for SCM 5 in a particular application is:

- Linefeeds ON
- Odd Parity
- 9600 Baud

A typical sequence to effect this configuration might be:

COMMAND: **$5WE**↲
RESPONSE: ✳
COMMAND: $5SU35**E2**Ø1C2↲
RESPONSE: ✳

The "E2" in the sequence is equivalent to the binary value "111ØØØ1Ø", which, according to table 8, will configure the unit as required (in this example).

Table 8. Setup Command Byte #2 Breakout

Communications Function Setting	Binary Digits							
Linefeed OFF	Ø							
Linefeed ON	1							
No Parity (OFF)		Ø	Ø					
No Parity (OFF)		1	Ø					
EVEN Parity		Ø	1					
ODD Parity		1	1					
— Not Used —				Ø	Ø			
38400 Baud						Ø	Ø	Ø
19200 Baud						Ø	Ø	1
9600 Baud						Ø	1	Ø
4800 Baud						Ø	1	1
2400 Baud						1	Ø	Ø
1200 Baud						1	Ø	1
600 Baud						1	1	Ø
300 Baud						1	1	1

Byte #3:

The operating parameters controlled by this next byte (hex value) of setup data depend upon the type of unit being configured. Table 9 lists the available options.

Alarms OFF/ON. Alarms are available on Voltage, Current, T/C, and RTD SCM's. Setting Alarms ON enables the available alarm terminals. Setting Alarms OFF enables the terminal's discrete output. The same configuration can be effected with the Enable Alarms command, EA (Alarms ON), and the Disable Alarms command, DA (Alarms OFF).

Whether the alarms are enabled or disabled, their logic state can be controlled with the Discrete Output command, DO (refer to "ON/OFF/Logical State, Set/Read All Terminals"). Disabling the alarms, or changing the logical state of the discrete terminals does not effect the alarm trip point settings (refer to "Alarms, Set/Read Trip Points").

Alarms, Momentary/Latching. Configuring the available alarms for momentary function means that the alarm condition will "clear itself" whenever sensor input returns to a normal or non-alarm level. Latching alarms remain in the alarm condition until cleared with the Clear Alarms command, CA, or until the other alarm is tripped.

COMMAND REFERENCE

Table 9. Setup Command Byte #3 Breakout

Function	Type of Unit (See NOTE 1)	Binary Digits							
Alarms OFF	SCM's: V, C, T/C, RTD	Ø							
Alarms ON	SCM's: V, C, T/C, RTD	1							
HI Alarm Momentary	SCM's: V, C, T/C		Ø						
HI Alarm Latching	SCM's: V, C, T/C		1						
LO Alarm Momentary	SCM's: V, C, T/C, RTD			Ø					
LO Alarm Latching	SCM's: V, C, T/C, RTD			1					
Disable Continuous Mode	(See NOTE 2)			Ø					
Enable Continuous Mode	(See NOTE 2)			1					
CJC OFF (See NOTE 3)	T/C SCM's				1				
CJC ON (See NOTE 3)	T/C SCM's				Ø				
Limits Disabled	All CAM's				1				
Limits Enabled	All CAM's				Ø				
3-Wire RTD	RTD SCM's				Ø				
4-Wire RTD	RTD SCM's				1				
Negative Edge Trigger	DCM's				Ø				
Positive Edge Trigger	DCM's				1				
Degrees Celsius	T/C SCM's					Ø			
Degrees Farenheit	T/C SCM's					1			
Echo OFF	All units						Ø		
Echo ON	All units						1		
Delay OFF	All units							Ø	Ø
2 Byte Delay	All units							Ø	1
4 Byte Delay	All units							1	Ø
6 Byte Delay	All units							1	1

NOTES:
1. Applies to listed units ONLY. If function does not apply to type unit being used, set parameter to Ø. Where listed, V = Voltage SCM, C = Current SCM, T/C = Thermocouple SCM, F = Frequency SCM. D = Discrete DCM.
2. Applies to both types of CAM. Also applies to Continuous Mode SCM's (C Option equipped), and DCM's.
3. CJC = Cold Junction Compensation.

Continuous Mode Disable/Enable. Continuous Mode is SCM, CAM, or DCM operation without prompting from the system host. Continuous Mode units respond to other, user-selected application-related circumstances (refer to "Continuous Mode, Enable/Disable/Read Type").

Continuous Mode capability is standard on DCM's. All SCM's require the C Option, and CAM's require the PRG Option.

C-equipped SCM's provide data continuously upon power-up, provided that the Continuous Mode enabling pin is grounded (refer to table 6). The DI2 terminal of the PRG CAM must be connected to ground in order for it to operate in Continuous Mode.

CJC OFF/ON. This sets the T/C SCM to calculate output based on a cold junction compensation factor of 0 degrees, Celsius.

Limits Disabled/Enabled. Enabling this capability means that any output level-changing command (AO) is checked against the limits set by the HI and LO commands. If enabled, AO commands that request output outside of these limits will be aborted and the ?LIMIT ERROR response will be returned.

Factory default for this binary digit is Ø.

RTD Type, 3- or 4-wire. This sets the RTD SCM for operation with the appropriate type of RTD sensor. Measurement errors will result if the correct sensor type is not selected.

Edge Trigger, Positive/Negative. This parameter effects the way DCM's are triggered. When configured to respond to an input pulse, this parameter controls which edge of that pulse initiates unit function.

Degrees Celsius/Fahrenheit. T/C and RTD SCM's use this parameter to control the scaling of transmitted data. All other types of SCM and CAM must have this binary digit set to Ø.

Echo OFF/ON. When a unit is configured with echo ON, it re-transmits any received character string. This feature is necessary to fashion multi-unit, RS-232C installations (daisy chains).

NOTE

Echo must be set to OFF in all RS-485 units that are to be incorporated in multi-unit applications. Set Echo to ON in multi-unit RS-232C (daisy chain) applications.

Delays. This is the parameter that controls the turn-around delay between a command and the module response. The delay is useful on host systems that are not fast enough to capture data from quick-responding commands such as Read Data, RD.

The specified delay is added to the typical command delays listed in table 1. Each unit of delay is equal to the amount of time required to transmit one character at the baud rate specified (refer to the explanation of baud rate in the Byte #2 section, earlier).

For example, one unit of delay at 300 baud is 33.3 msec; for 38.4k baud, the delay is 0.26 msec. The number of delay units is selectable from 0 to 6.

NOTE

Some hosts automatically transmit a linefeed character after a carriage return character. CAM's, DCM's, and SCM's are factory-programmed with a 2 unit default delay to avoid communications collisions.

Byte #4:

This byte of configuration data controls the parameters listed in table 10.

Significant Digit Display. Use this parameter to "mask off" insignificant digits in unit readouts with permanent zeroes. The number of significant digits in the DCM is permanently set to 7.

Signal Filters, Large & Small. DCM's and SCM's are equipped with digital filtering elements to screen unwanted noise from sensor signals. Filtering is controlled with these user-set parameters. The filter size is selected by the unit's microprocessor after each analog-to-digital conversion.

COMMAND REFERENCE

Table 10. Setup Command Byte #4 Breakout

Function	Type of Unit (See NOTE 1)	Binary Digits							
4 Digits - s####Ø.ØØ (See NOTE 2)	V, C, T/C, RTD, and F. All CAM's (See NOTE 3)	Ø	Ø						
5 Digits - s#####.ØØ (See NOTE 2)	V, C, T/C, RTD, and F. All CAM's (See NOTE 3)	Ø	1						
6 Digits - s#####.#Ø (See NOTE 2)	V, C, T/C, RTD, and F. All CAM's (See NOTE 3)	1	Ø						
7 Digits - s#####.## (See NOTE 2)	V, C, T/C, RTD, and F. All CAM's (See NOTE 3)	1	1						
0.25 sec Large Filter Time	V, C, T/C, RTD, and F			Ø	Ø	1			
0.5 sec Large Filter Time	V, C, T/C, RTD, and F			Ø	1	Ø			
1.0 sec Large Filter Time	V, C, T/C, RTD, and F			Ø	1	1			
2.0 sec Large Filter Time	V, C, T/C, RTD, and F			1	Ø	Ø			
4.0 sec Large Filter Time	V, C, T/C, RTD, and F			1	Ø	1			
8.0 sec Large Filter Time	V, C, T/C, RTD, and F			1	1	Ø			
16.0 sec Large Filter Time	V, C, T/C, RTD, and F			1	1	1			
Large Filter OFF	V, C, T/C, RTD, and F			Ø	Ø	Ø			
0.25 sec Small Filter Time	V, C, T/C, RTD, and F						Ø	Ø	1
0.5 sec Small Filter Time	V, C, T/C, RTD, and F						Ø	1	Ø
1.0 sec Small Filter Time	V, C, T/C, RTD, and F						Ø	1	1
2.0 sec Small Filter Time	V, C, T/C, RTD, and F						1	Ø	Ø
4.0 sec Small Filter Timer	V, C, T/C, RTD, and F						1	Ø	1
8.0 sec Small Filter Time	V, C, T/C, RTD, and F						1	1	Ø
16.0 sec Small Filter Time	V, C, T/C, RTD, and F						1	1	1
Small Filter OFF	V, C, T/C, RTD, and F						Ø	Ø	Ø
Manual Mode Disable	All CAM's						1		
Manual Mode Enable	All CAM's						Ø		
Manual Up/Down Mode	All CAM's							Ø	Ø
Table concludes on next page.									

Table 10. Setup Command Byte #4 Breakout (concluded)

Function	Type of Unit (See NOTE 1)	Binary Digits							
Controller Input (Factory Default)	All CAM's							Ø	1
Limit Switch Normally Open	All CAM's							1	Ø
Limit Switch Normally Closed	All CAM's							1	1
5 msec Events Counter Filter	D			Ø	1				
20 msec Events Counter Filter	D			1	Ø				
50 msec Events Counter Filter	D			1	1				
Events Counter Filter OFF	D			Ø	Ø				
1 word Data Length (1, 2-place hex number)	D					Ø	Ø	Ø	1
2 word Data Length (2, 2-place hex number)	Default Setting, All units					Ø	Ø	1	Ø
3 word Data Length (3, 2-place hex number)	D					Ø	Ø	1	1
4 word Data Length (4, 2-place hex number)	D					Ø	1	Ø	Ø
5 word Data Length (5, 2-place hex number)	D					Ø	1	Ø	1
6 word Data Length (6, 2-place hex number)	D					Ø	1	1	Ø
7 word Data Length (7, 2-place hex number)	D					Ø	1	1	1
8 word Data Length (8, 2-place hex numbers)	D					1	Ø	Ø	Ø

NOTES:
1. Applies to listed units ONLY. If function does not apply to unit being used, set parameter to Ø. Where listed, V = Voltage SCM, C = Current SCM, T/C = Thermocouple SCM, F = Frequency SCM. D = Discrete SCM.
2. s = sign. # = active digit. Ø = dummy zero.
3. Discrete SCM's factory-set to 7 significant digit display (s#####.##).

COMMAND REFERENCE

Most sensors can benefit from the use of time-constant filtering. With few exceptions, the small constant should be greater than the large constant. This will provide stable reading for steady-state inputs, and fast response to large signal changes.

Signal Filter/Events Counter. The bandwidth of the Events Counter input is controlled with this parameter. It is particularly useful in compensating for electromechanical contact bounce. The default bandwidth is 20 kHz.

Word Length. The default setup for Moore Industries units is 16 bits of data represented by two, two-place hex numbers (two "words"). If using the Discrete unit with other types of devices that use different word lengths, the unit setting can be changed as shown in the table.

<u>NOTE</u>

If changed, always make sure to set the word length to be greater than the maximum word length that is to be requested during unit operations. Requests for data from non-existent terminals can result in an aborted command and the ?SYNTAX ERROR message.

EXAMPLE:

A standard, Voltage SCM is to beoperated in an application with other types of DAC devices capable of operating with 6 words of data (receive/transmit). The word length for this SCM should be changed to 6 so that requests to be echoed through the SCM to the other units are not aborted.

Any requests for less data than is available under the SCM's word length selection (e.g., requests for 4 words of data from a unit with a 6 word setup) will be processed normally. Data from non-existent terminals should be ignored.

Manual Modes. The standard CAM is equipped with discrete terminals that can be used in conjunction with the GND terminal to effect local control and output limiting. The operation of these terminals is controlled with the parameters set in this portion of byte #4.

A Note about Moore Industries' Software. As mentioned, both the SCM, CAM, and DCM can be configured using Moore Industries' Utility software program, which is provided on the distribution diskettes that are shipped with the product. These diskettes also include a copy of the Scan program (a user interface for unit operation), and several compiled terminal emulation routines.

The on-line and user's manuals for these products give instructions for the loading and use of the Utility, Scan, and terminal emulation software packages included with the shipment.

READ SETUP INFORMATION (UNIT CONFIGURATION):

USE WITH: Voltage, Current, T/C, RTD, and Frequency SCM's, and all CAM's.

COMMAND: **$aRS↵**
RESPONSE: ✻nnnnnnnn

—OR—

USE WITH: DCM's.

COMMAND: **$aRSU↵**
RESPONSE: ✻nnnnnnnn

This command reads the all of the data programmed into the unit EEPROM with the Set Up Module Command, SU.

The response is an eight-place hex number that represents four, two-digit bytes of configuration data. Use the SU command or the Setup window in the Utility software program to change the configuration of the CAM, DCM, or SCM.

Table 11 lists the factory defaults for the various types of SCM, CAM, and DCM available from Moore Industries.

***Table 11.** Factory Default RS/RSU Responses*

RS/RSU Response	Unit Type	Range
31070182	**Voltage SCM**	–1 to 1 V
31070142		–5 to 5 V –10 to 10 V
310701C2		–100 to 100 mV –100 to 100 V
31070182	**Current SCM**	–1 to 1 mA
31070142		–10 to 10 mA
310701C2		–100 to 100 mA 4 to 20 mA
31070142	**Thermocouple SCM**	All
31070182	**RTD SCM**	All
310701C0	**Frequency SCM**	All
31070102	**DCM**	All
31070180	**Voltage CAM**	–1 to 1 V 0 to 1 V
31070140		–5 to 5 V –10 to 10 V 0 to 5 V 0 to 10 V
310701C0	**Current CAM**	All

• SLOPE, SET/WRITE TO EEPROM, READ

USE WITH: CAM's equipped with the PRG Option. Not applicable to SCM's or DCM's.

SET:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aMSsnnnnn.nn↵**
RESPONSE: ∗

—AND—

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aSLsnnnnn.nn↵**
RESPONSE: ∗

These commands allow the user to specify the rate at which the CAM output will slew (ramp up or down) to the user-specified level (refer to explanation of AO command). Depending upon the type of unit, the data field is scaled in mA/sec or V/sec, as appropriate.

NOTE

The slope rate in standard CAM's (those not equipped with the PRG Option) is factory-set to 5 seconds from zero to full-scale.

Manual Slope. The MS command specifies the rate for output slewing in Manual Mode. Manual Mode is effected by grounding the DIØ/DN or DI1/UP terminals.

In Manual Mode, the analog output of the unit slews either toward full-scale or zero, based on the open/closed state of the Manual Mode terminals (refer to the CAM User's Manual for more information on Manual Mode).

The setting specified with the MS command (the rate of Manual Mode slewing) is written into non-volatile EEPROM.

COMMAND REFERENCE

Host-controlled Slope. The SL command specifies the rate for output slewing when the CAM is functioning under host control (normal ops). The direction of the CAM output slew Is based on the data transmitted to it with the AO command.

The rate fixed with the SL command is NOT written into EEPROM. Instead, it is maintained in volatile, operational memory. To write SL rate into non-volatile EEPROM, use the WSL command. Unless writing into EEPROM, the setting will be lost if power to the CAM is interrupted, or if a Module Reset, RR, is executed.

NOTE
The Manual Slope rates (manual output slewing rates) supersede the SL-fixed slewing rate when local control is being exercised with the CAM's DIØ/DN and DI1/UP terminals.

WRITE SLOPE (SL) TO EEPROM:

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aWSLsnnnnn.nn↵**
RESPONSE: ∗

Use this command to write the slewing rate value fixed with the SL command into non-volatile EEPROM.

READ SLOPE SETTING IN EEPROM:

COMMAND: **$aRSL↵**
RESPONSE: ∗snnnnn.nn

This command is used to read the slewing rate value stored in the PRG CAM's non-volatile EEPROM WSL command. This is not necessarily the rate being used by the unit, as in those cases where the SL command is executed.

READ MANUAL SLOPE SETTING:

COMMAND: **$aRMS↵**
RESPONSE: ∗snnnnn.nn

This command will read back the user-set, Manual Mode slewing rate in PRG-equipped CAM's, in mA/sec or V/sec as appropriate.

READ PRESENT SLOPE:

COMMAND: **$aRPS↵**
RESPONSE: ∗snnnnn.nn

This command reads back the setting stored in the PRG CAM's volatile, operational memory. This rate is fixed with the SL command, and is not necessarily the same slope stored in unit EEPROM.

The response is scaled in either mA/sec or V/sec, depending upon the type of PRG CAM being read.

• SPAN, TRIM

USE WITH: Voltage, Current, T/C, RTD, and Frequency SCM's. Not available with DCM's or with CAM's.

COMMAND: **$aWE↵**
RESPONSE: ∗
COMMAND: **$aTSsnnnnn.nn↵**
RESPONSE: ∗

This command is the means by which the accuracy of the SCM can be trimmed to compensate for long term drifts due to analog circuit aging or other environmental factors. The practical range of trim is ±10%.

NOTE
The TS command cannot be used to change the basic transfer function or the factory-set range of the SCM.

To use the TS command:

1. Clear existing zero (CZ command).
2. Erase break point if PRG Option is installed (EB command).
3. Apply known input near 90% of unit's rated full-scale.
4. Read data (RD command), and note response.
5. Execute TS command sequence based on response to step 4.

CAUTION
The TS command can destroy factory calibration. Exercise extreme caution in trimming unit span. There is no provision for reading or correcting span trim.

• STARTING VALUE, SET/READ

USE WITH: CAM's equipped with the PRG Option. Not available with Voltage, Current, T/C, RTD, or Frequency SCM's, or with standard CAM's. Not applicable to DCM's.

SET STARTING VALUE:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aSVsnnnnn.nn↵**
RESPONSE: ✳

READ STARTING VALUE:

COMMAND: **$aRSV↵**
RESPONSE: ✳snnnnn.nn

These commands are used to set and read the values stored in CAM EEPROM that will be incorporated into an AO command upon unit startup, power interruption, or reset.

REFER ALSO TO: Initial Value, Set/Read.

The rate used to slew to this Starting Value is stored in the PRG CAM EEPROM. The Starting Value must be within the unit's valid min/max scale.

NOTE
If a LIMIT ERROR is detected by the CAM on startup, the SV value is ignored and the unit slews to the rated zero.

• WATCHDOG TIMER, SET/READ

USE WITH: DCM's, and CAM's equipped with the PRG Option. Not available with any type of SCM.

SET:

COMMAND: **$aWE↵**
RESPONSE: ✳
COMMAND: **$aWTsnnnnn.nn↵**
RESPONSE: ✳

READ:

COMMAND: **$aRWT↵**
RESPONSE: ✳snnnnn.nn

This series of commands set and read back the value stored in the unit EEPROM that is used in conjunction with the Initial (DCM) or Starting (CAM) Value to provide a unit fail-safe configuration. The Watchdog Timer value represents the period after which the unit's discrete output terminals will automatically reset to the Initial or Starting Value setting.

The Command Data field in the WT command and the response to the RWT command are both scaled in minutes.

• WRITE ENABLE

USE WITH: All units.

COMMAND: **$aWE↵**
RESPONSE: ✳

This command is required prior to most of the other commands that alter settings stored in unit EEPROM. Failure to execute this command, or faults in its transmittal to the unit will result in an aborted command and a ?WRITE PROTECTION ERROR response message to the secondary command in the sequence.

Appendix A

COMMAND REFERENCE

A	D	H	B	A	D	H	B	A	D	H	B
^@	0	00	00000000	-	45	2D	00101101	Z	90	5A	01011010
^A	1	01	00000001	.	46	2E	00101110	[	91	5B	01011011
^B	2	02	00000010	/	47	2F	00101111	\	92	5C	01011100
^C	3	03	00000011	0	48	30	00110000	]	93	5D	01011101
^D	4	04	00000100	1	49	31	00110001	^	94	5E	01011110
^E	5	05	00000101	2	50	32	00110010	_	95	5F	01011111
^F	6	06	00000110	3	51	33	00110011	`	96	60	01100000
^G	7	07	00000111	4	52	34	00110100	a	97	61	01100001
^H	8	08	00001000	5	53	35	00110101	b	98	62	01100010
^I	9	09	00001001	6	54	36	00110110	c	99	63	01100011
^J	10	0A	00001010	7	55	37	00110111	d	100	64	01100100
^K	11	0B	00001011	8	56	38	00111000	e	101	65	01100101
^L	12	0C	00001100	9	57	39	00111001	f	102	66	01100110
^M	13	0D	00001101	:	58	3A	00111010	g	103	67	01100111
^N	14	0E	00001110	;	59	3B	00111011	h	104	68	01101000
^O	15	0F	00001111	<	60	3C	00111100	i	105	69	01101001
^P	16	10	00010000	=	61	3D	00111101	j	106	6A	01101010
^Q	17	11	00010001	>	62	3E	00111110	k	107	6B	01101011
^R	18	12	00010010	?	63	3F	00111111	l	108	6C	01101100
^S	19	13	00010011	@	64	40	01000000	m	109	6D	01101101
^T	20	14	00010100	A	65	41	01000001	n	110	6E	01101110
^U	21	15	00010101	B	66	42	01000010	o	111	6F	01101111
^V	22	16	00010110	C	67	43	01000011	p	112	70	01110000
^W	23	17	00010111	D	68	44	01000100	q	113	71	01110001
^X	24	18	00011000	E	69	45	01000101	r	114	72	01110010
^Y	25	19	00011001	F	70	46	01000110	s	115	73	01110011
^Z	26	1A	00011010	G	71	47	01000111	t	116	74	01110100
^[	27	1B	00011011	H	72	48	01001000	u	117	75	01110101
^\	28	1C	00011100	I	73	49	01001001	v	118	76	01110110
^]	29	1D	00011101	J	74	4A	01001010	w	119	77	01110111
^^	30	1E	00011110	K	75	4B	01001011	x	120	78	01111000
^—	31	1F	00011111	L	76	4C	01001100	y	121	79	01111001
(space)	32	20	00100000	M	77	4D	01001101	z	122	7A	01111010
!	33	21	00100001	N	78	4E	01001110	{	123	7B	01111011
"	34	22	00100010	O	79	4F	01001111	|	124	7C	01111100
#	35	23	00100011	P	80	50	01010000	}	125	7D	01111101
$	36	24	00100100	Q	81	51	01010001	~	126	7E	01111110
%	37	25	00100101	R	82	52	01010010		127	7F	01111111
&	38	26	00100110	S	83	53	01010011		128	80	10000000
'	39	27	00100111	T	84	54	01010100		129	81	10000001
(	40	28	00101000	U	85	55	01010101		130	82	10000010
)	41	29	00101001	V	86	56	01010110		131	83	10000011
*	42	2A	00101010	W	87	57	01010111		132	84	10000100
+	43	2B	00101011	X	88	58	01011000		133	85	10000101
,	44	2C	00101100	Y	89	59	01011001		134	86	10000110

Table concluded next page.

COMMAND REFERENCE

A	D	H	B	A	D	H	B	A	D	H	B
	135	87	10000111		180	B4	10110100		225	E1	11100001
	136	88	10001000		181	B5	10110101		226	E2	11100010
	137	89	10001001		182	B6	10110110		227	E3	11100011
	138	8A	10001010		183	B7	10110111		228	E4	11100100
	139	8B	10001011		184	B8	10111000		229	E5	11100101
	140	8C	10001100		185	B9	10111001		230	E6	11100110
	141	8D	10001101		186	BA	10111010		231	E7	11100111
	142	8E	10001110		187	BB	10111011		232	E8	11101000
	143	8F	10001111		188	BC	10111100		233	E9	11101001
	144	90	10010000		189	BD	10111101		234	EA	11101010
	145	91	10010001		190	BE	10111110		235	EB	11101011
	146	92	10010010		191	BF	10111111		236	EC	11101100
	147	93	10010011		192	C0	11000000		237	ED	11101101
	148	94	10010100		193	C1	11000001		238	EE	11101110
	149	95	10010101		194	C2	11000010		239	EF	11101111
	150	96	10010110		195	C3	11000011		240	F0	11110000
	151	97	10010111		196	C4	11000100		241	F1	11110001
	152	98	10011000		197	C5	11000101		242	F2	11110010
	153	99	10011001		198	C6	11000110		243	F3	11110011
	154	9A	10011010		199	C7	11000111		244	F4	11110100
	155	9B	10011011		200	C8	11001000		245	F5	11110101
	156	9C	10011100		201	C9	11001001		246	F6	11110110
	157	9D	10011101		202	CA	11001010		247	F7	11110111
	158	9E	10011110		203	CB	11001011		248	F8	11111000
	159	9F	10011111		204	CC	11001100		249	F9	11111001
	160	A0	10100000		205	CD	11001101		250	FA	11111010
	161	A1	10100001		206	CE	11001110		251	FB	11111011
	162	A2	10100010		207	CF	11001111				
	163	A3	10100011		208	D0	11010000				
	164	A4	10100100		209	D1	11010001				
	165	A5	10100101		210	D2	11010010				
	166	A6	10100110		211	D3	11010011				
	167	A7	10100111		212	D4	11010100				
	168	A8	10101000		213	D5	11010101				
	169	A9	10101001		214	D6	11010110				
	170	AA	10101010		215	D7	11010111				
	171	AB	10101011		216	D8	11011000				
	172	AC	10101100		217	D9	11011001				
	173	AD	10101101		218	DA	11011010				
	174	AE	10101110		219	DB	11011011				
	175	AF	10101111		220	DC	11011100				
	176	B0	10110000		221	DD	11011101				
	177	B1	10110001		222	DE	11011110				
	178	B2	10110010		223	DF	11011111				
	179	B3	10110011		224	E0	11100000				

NOTES:
1. ASCII characters shown in shaded areas are "non-printable"., or used for other unit functions. Do not use these characters as unit addresses.
2. Characters shown in the box in the first part of the table, (Decimal Ø through 13, Hex ØØ through ØD) are the ordinal (hexadecimal) terminal designators.

LEGEND:

A = ASCII (keyboard characters)

D = Decimal

H = Hexadecimal

B = Binary

Index

COMMAND REFERENCE

COMMAND REFERENCE

COMMAND REFERENCE

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

WARRANTY DISCLAIMER

THE COMPANY MAKES NO EXPRESS, IMPLIED OR STATUTORY WARRANTIES (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY GOODS OR SERVICES SOLD BY THE COMPANY. THE COMPANY DISCLAIMS ALL WARRANTIES ARISING FROM ANY COURSE OF DEALING OR TRADE USAGE, AND ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY ACKNOWLEDGES THAT THERE ARE NO WARRANTIES IMPLIED BY CUSTOM OR USAGE IN THE TRADE OF THE BUYER AND OF THE COMPANY, AND THAT ANY PRIOR DEALINGS OF THE BUYER WITH THE COMPANY DO NOT IMPLY THAT THE COMPANY WARRANTS THE GOODS OR SERVICES IN ANY WAY.

ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY AGREES WITH THE COMPANY THAT THE SOLE AND EXCLUSIVE REMEDIES FOR BREACH OF ANY WARRANTY CONCERNING THE GOODS OR SERVICES SHALL BE FOR THE COMPANY, AT ITS OPTION, TO REPAIR OR REPLACE THE GOODS OR SERVICES OR REFUND THE PURCHASE PRICE. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES EVEN IF THE COMPANY FAILS IN ANY ATTEMPT TO REMEDY DEFECTS IN THE GOODS OR SERVICES , BUT IN SUCH CASE THE BUYER SHALL BE ENTITLED TO NO MORE THAN A REFUND OF ALL MONIES PAID TO THE COMPANY BY THE BUYER FOR PURCHASE OF THE GOODS OR SERVICES.

ANY CAUSE OF ACTION FOR BREACH OF ANY WARRANTY BY THE COMPANY SHALL BE BARRED UNLESS THE COMPANY RECEIVES FROM THE BUYER A WRITTEN NOTICE OF THE ALLEGED DEFECT OR BREACH WITHIN TEN DAYS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH, AND NO ACTION FOR THE BREACH OF ANY WARRANTY SHALL BE COMMENCED BY THE BUYER ANY LATER THAN TWELVE MONTHS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH.

RETURN POLICY

For a period of thirty-six (36) months from the date of shipment, and under normal conditions of use and service, Moore Industries ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by The Company), to be defective in material or workmanship. This policy extends to the original Buyer only and not to Buyer's customers or the users of Buyer's products, unless Buyer is an engineering contractor in which case the policy shall extend to Buyer's immediate customer only. This policy shall not apply if the product has been subject to alteration, misuse, accident, neglect or improper application, installation, or operation. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

MOORE INDUSTRIES®

WORLDWIDE • www.miinet.com

United States • info@miinet.com
Tel: (818) 894-7111 • FAX: (818) 891-2816

Australia • sales@mooreind.com.au
Tel: (02) 8536-7200 • FAX: (02) 9525-7296

Belgium • info@mooreind.be
Tel: 03/448.10.18 • FAX: 03/440.17.97

The Netherlands • sales@mooreind.nl
Tel: (0)344-617971 • FAX: (0)344-615920

China • sales@mooreind.sh.cn
Tel: 86-21-62491499 • FAX: 86-21-62490635

United Kingdom • sales@mooreind.com
Tel: 01293 514488 • FAX: 01293 536852