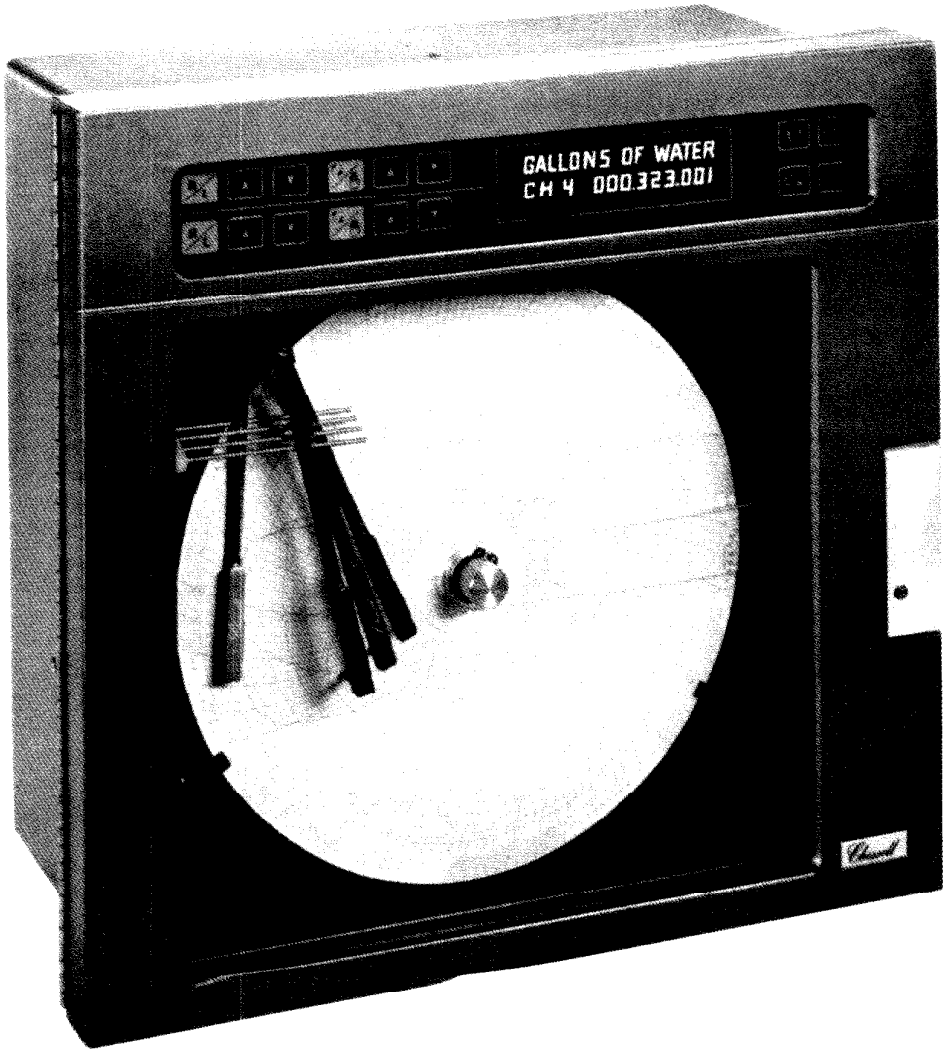
MODEL 390

COMMUNICATIONS HANDBOOK



Part No. HA203392

Chessell

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1. Warranty Statement

This Chessell product is warranted against defects in materials and workmanship for twelve months from the date of shipment. During the warranty period Chessell Corporation will, at its option, either repair or replace products which prove to be defective.

Within areas designated for service travel by Chessell or its representatives, warranty service will be provided at the buyer's facility at no charge. Outside the service areas warranty service at the buyer's facility can be provided only upon prior agreement by Chessell or its representative, and the buyer may be required to pay round-trip travel expenses.

In all cases the buyer has the option of returning the product for warranty service to a facility designated by Chessell or its representatives. The buyer shall prepay shipping charges for products returned to a service facility, and Chessell or its representatives shall pay for return of the products to the buyer.

Limitation of Warranty

The foregoing warranty shall not apply to defects arising from:

Improper or inadequate maintenance by the user

Improper or inadequate site preparation

Unauthorized modification or misuse

Operation of the product in unfavorable environments, especially high temperature, high humidity, corrosive or other damaging atmospheres

Disclaimer

No other warranty is expressed or implied. Chessell Corporation specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Exclusive remedies

The remedies provided above are the buyer's sole and exclusive remedies. Chessell Corporation shall not be liable for any direct, indirect, special incidental, or consequential damages.

Calibration Accuracy

This Chessell product was thoroughly tested to ensure compliance with published specifications. All instruments used in production and final test are regularly inspected to maintain accuracy of calibration, traceable to the National Bureau of Standards. The user should be satisfied that the performance of the product as received meets expectations and, as part of a program of planned maintenance,

should periodically check calibration accuracy against reliable standards.

CAUTION

The product cover(s) should not be removed by other than qualified service personnel. High or lethal voltages may be present at exposed points on the chassis if power is applied. Chessell Corporation shall not be liable for personal injury or property damage suffered in servicing the product. The product should not be modified or repaired in a manner at variance with procedures established by Chessell.

2. Use of This Manual

This manual applies to an optional function available for the Circular Chart Recorder. The reader should be familiar with the specifications, operation, and maintenance of the basic recorder before attempting to use this manual.

The operation, protocol, and installation of the communications option are explained in this document. The functional meaning and use of individual data items received or transmitted to the recorder are explained in the basic recorder manual and the controller option manual.

The instrument's communication option makes it possible to obtain or change any value or state in the instrument from a remote host, with the following specific exceptions. Changes can be made while the instrument is operating and even while the controller option is in automatic.

Exceptions:

1. The host may not configure comms. For instance, the host cannot change the instrument's baud rate.

2. The host cannot calibrate the instrument.

3. The host cannot read the value of an input channel if that channel has been used as the output of a derived variable. The host can set the configuration of that channel, with the exception of tag string and units. The host can, of course, set the tag string and units of the derived variable output replacing the channel.

3. Installation

The communications package provided with the recorder allows for field configuration of RS 422 or RS 232. A set of jumpers located on the right bottom edge of the option card, just above the comms terminations, should be set for the desired type of interface. Set all five identically.

In addition to the electrical installation outlined below, the comms package must be configured, via the keypad, for such things as baud rate, parity, etc. See section 4.2 for configuration instructions.

3.1. RS 232 Installation

Three conductors are necessary for RS 232 C. These are the transmit line, the receive line, and signal common. Optionally, the CTS line, and a shield ground may be installed.

The recorder can be configured (see section 4.2) to monitor the CTS input. This signal is produced at the host's CTS output pin. This input to the recorder causes the recorder to temporarily halt transmission while it is low. It is used by hosts which need to meter receptions. Check the manual for your host equipment to determine whether CTS is necessary.

In some RS 232 configurations, a DTR (data terminal ready) line is implemented. This line is used to halt tranmissions from the host when the data terminal (in this case the recorder) is not ready for reception. The DTR line is not necessary with this recorder because it is always ready to receive.

If a cable shield is used, it should be grounded at the host's shield ground pin. (Number 1 on a 'D' connector.). Do not ground the shield on both ends as a ground loop will be the result. Also, do not use the shield for signal common. A good shielded cable would be a twisted pair, with third conductor plus shield.

The labels appearing at the communications terminals on the recorder indicate pin assignments for an RS 422 interface. The following table shows the pin assignments for RS 232, as well as their 'D' connector equivalents.

label	'D' connector	function
$\overline{TX}$	pin 2	RS 232 transmit line
$\overline{RX}$	pin 3	RS 232 receive line
RX	pin 5	RS 232 CTS (host is ready to receive)
0V	pin 7	RS 232 signal common (not shield)

3.2. RS 422 Installation

The RS 422 interface standard allows the user to implement a multi-drop link, in contrast with the point-to-point RS 232 interface above. This means that several

recorders may be linked to the host through one cable.

Wiring a full duplex RS 422 interface requires a cable with two twisted pairs, a common ground line, and an optional (but recommended) shield. Note that the common ground and the shield are not the same. Do not use a shield as common, as a ground loop will result. Shields should only be connected on one side, usually the host's chassis ground.

Figure 2 shows an RS 422 wiring diagram for a host with two recorders. The terminating resistor (RT) is installed on the last recorder on the cable. The purpose of this resistor is to reduce reflections along the transmission line. It is not necessary for short linelength installations. The value of RT for a typical 120 ohm transmission line is 220 ohms.

The receiver in the host (the computer) is shown with two resistors of value 2RT. These serve to pull the line to a known state when all of the recorder transmitters are quiet (tri-stated). If a 5 V supply is not available on the host, use one of the recorders to bias the line. A 5V termination is provided on the recorder for this purpose.

The recommended maximum length for an RS 422 link is 4000 ft. at 9600 Baud.

Layout of 'D' connector in RS 422 interface:

pin 1 : shield
pin 2 : common ground
pin 3 : RX +
pin 4 : RX -
pin 5 : TX +
pin 6 : TX -

3.3. Testing the Installation

The recorder contains a self test function for testing its' own circuits, and the user's installation. This test can be accessed via the communications menu. Scroll through the main configuration menu to the question, "COMMUNICATIONS", then press ENTER. Scroll once to the question "SELF TEST". Press ENTER and read the result, PASSED or FAILED. Press ENTER to repeat the test.

The test causes a tail-to-mouth test of the communications port, at three internally generated baud rates. Some simple external wiring is necessary to perform the test. See figures 3 and 4 for details. Figure 3 should be used when the comms jumpers located on the option card are in the RS232 position. Figure 4 should be used for the RS422 installation.

If the user determines that the test passes at the terminals of the recorder, the jumpers depicted in figures 3 and 4 could be moved to the end of the user's cable, to test for cable faults.

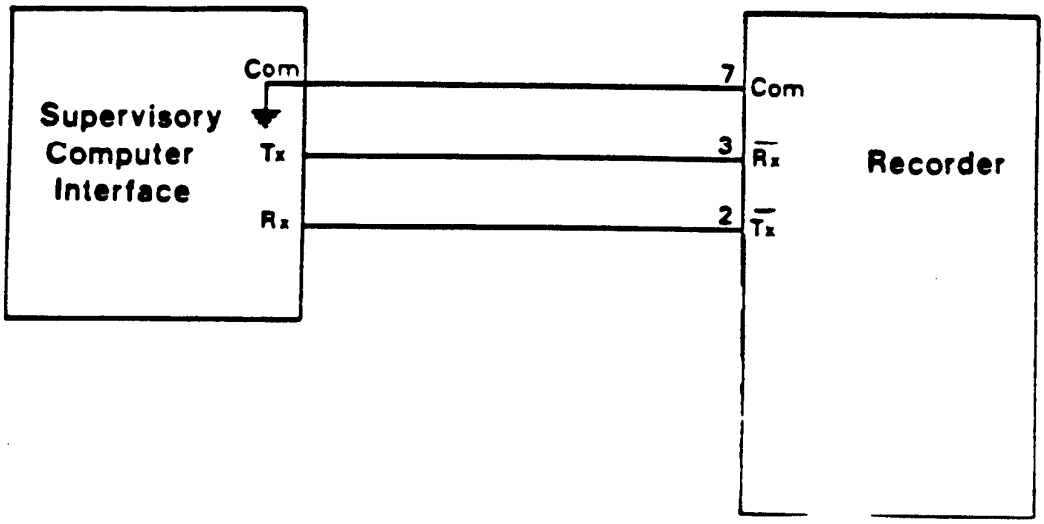


Figure 1 - RS 232 Installation

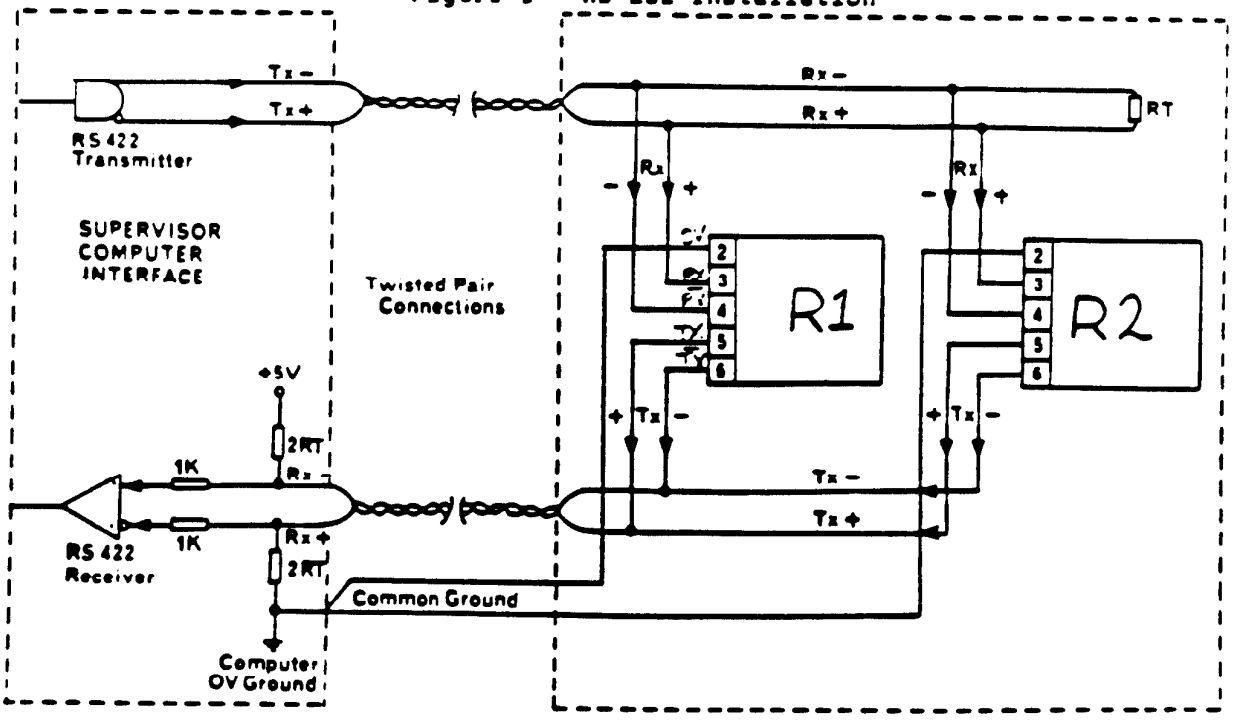


Figure 2 - RS 422 Installation

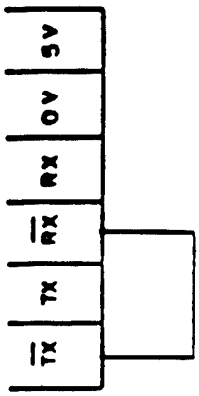


Figure 3 - RS 232 Self Test Wiring

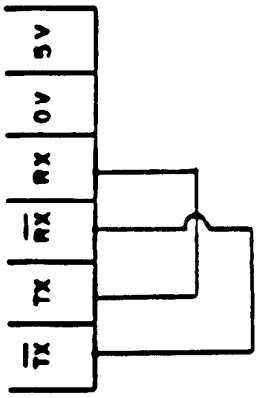


Figure 4 - RS 422 Self Test Wiring

4. User Interface

The user interface for the communications package consists of 1 message which appears in the run mode scroll, and a short configuration menu.

The run mode scroll message informs the user of the state of the host:

HOST ENABLED -or- HOST DISABLED

See below for an explanation of the meaning of this state. The message appears after the last installed option. (In a fully configured unit, it would appear after the last setpoint generator display.) The message doesn't appear when host scheme 3 is selected.

4.1. Host-Keypad Interlock

The unit provides three methods (schemes) for resolving conflicts between local programming changes (keypad) and host programming changes via the comms port. Each scheme addresses the needs of different users.

Each of these schemes is available for selection via the comms configuration menu described in the next subsection.

The unit will always respond to a valid poll from the remote computer via the comms port, if comms is installed. Polling is never disabled. However, changes received from the remote computer, or HOST, will only be acted upon if the state "Host Enabled" exists in the unit. Host Enabled allows protocol selections.

The host and the keypad are mutually exclusive. At no time can the keypad and the host change the unit configuration simultaneously. All control of the unit is included under this rule. When the host is enabled, even the manual output and local setpoint keys on the left side of the panel will not operate. The only operation which the keypad can perform when the host is enabled is scrolling and freezing the display. The configuration menus cannot be entered, since the side arrow key will not operate.

There is one configuration menu which the keypad can enter even when the host is enabled. This is the comms configuration menu. This allows the selection of another scheme. The comms protocol contains no commands for changing the scheme, baud rate, etc. To prevent selection of another scheme, set the program disable switch to the DI position. This will prevent access to even the comms configuration menu.

The three schemes for managing the state Host Enabled are described below.

4.1.1. Scheme 1

This scheme is intended for users who wish to regain local control (keypad control) quickly and easily, during a critical event when the host is managing the control loops and recorder.

When scheme 1 is selected, the host will be disabled immediately when any key on the left hand side of the keypad (control keys) or the side arrow key, or the CD contact input is activated. This means that if an operator wants to drive down the output value for a loop manually, he can press the manual output down key and simultaneously reduce output and prevent the host from interfering.

The host can be re-enabled via the comms configuration menu as described in the next subsection.

4.1.2. Scheme 2

This scheme is intended for users who wish to restrict the operators ability to disable the host, or who wish to interlock the selection with an external event.

When scheme 2 is selected, the host will always be enabled when the CD contact input is open, and will be disabled when the contact is closed. The keypad has no effect on the state of the host.

Selecting scheme 2 has the effect of removing the "Host Enable?" question from the comms configuration menu.

4.1.3. Scheme 3

This scheme is intended for users who never want the host to have an effect on performance. They only want the comms port installed for interrogation (polling) purposes.

With scheme 3 selected, the host is never enabled. The question "Host Enable?" is removed from the comms configuration menu. Also, the message which is added to the operating scroll, informing the user of the state of the host, is removed. This is a simplification intended for users with no interest in that state.

4.2. Configuring Communications

The configuration menu is accessed by freezing on the HOST message while in run mode, by pressing the 'ENTER' key, and then pressing the side arrow key. It can also be accessed via the main configuration menu under any channel reading, by pressing 'ENTER' on the 'COMMUNICATIONS?' message.

There are two choices presented under 'COMMUNICATIONS?'. The first is configuration. Press 'ENTER' to configure the comms package. The second deals with comms self test, which is explained in section 3.3.

The following paragraphs describe each entry.

Host Enable/Disable - The first selection sets the state of the host. A full explanation of this selection is provided in the previous subsection. This selection will not appear if scheme 2 or scheme 3 is selected.

If 'ENTER' is pressed while 'CONFIGURE COMMS' is displayed, the following entries become available.

Group ID - Enter the group ID number (0 - 7) for this instrument.

Unit ID - Enter the unit base number (0, 4, 8, or C) for this instrument(see section 2).

Mode - Enter ANSI or ASCII. The ANSI mode is the normal form of the protocol, using all control characters. The ASCII mode is useful when dumb terminals are connected to the instrument, since it replaces non-printing control characters with substituted punctuation marks, and eliminates the BCC character. Use ANSI whenever possible.

Baud Rate - Select from 300, 600, 1200, 2400, 4800, or 9600 bits / second.

Parity - Select odd, even, or no parity. This entry causes the instrument to produce this parity in transmission. The instrument doesn't check received parity.

Handshake - This entry determines whether or not the instrument recognizes the host's CTS signal line. In the opposite direction, the instrument is always ready to receive data.

XON/XOFF - This entry determines whether or not the instrument recognizes the XON/XOFF handshake from the host. The instrument never produces an xoff.

Scheme - Select the host enabling scheme, 1, 2, or 3. See previous subsection for explanation of use.

4.3. Configuring for Recording Comms Values (External)

The recorder can be configured to record values transmitted to it via the communications link, instead of measurements done at it's input terminals. In order to do this, the input range selection in the channel configuration menu should be selected as "EXTERNAL". If EXTERNAL is chosen, the linearization menu

will not appear, but all other input configuration choices will, such as chart span, totalization, etc. When EXTERNAL is chosen the recorder will request the decimal point position to be used for the display of the transmitted value.

Choosing the external input range causes the recorder to ignore the physical input channel involved and instead use the comms reported value for the chart, the totalizer, and alarming. Configuration of linearization type is ignored for external inputs. However, derived variables, such as flow and relative humidity, may use external inputs in their equations.

The selection of EXTERNAL range will only appear on recorders which have the communications option installed.

The update rate of an external input is dependent upon the frequency at which the host transmits the value, but can never be greater than 2 hertz.

5. Protocol

A protocol defines the control codes, data sequencing and so on required for the successful use of a data link. The recorder supports two operator selectable protocols: ASCII and ANSI. With the exceptions noted in section 5.3, these two protocols are identical.

The protocol used in this recorder is derived from ANSI Standard X3.28 - 2.5 - A4. This character oriented protocol supports multi-drop linkage for host communication with several recorders. Peer to peer communication between recorders is not supported. A longitudinal redundancy check is used with the ANSI protocol to insure data integrity (see section 5.4).

In the following sections, the details of the protocol are explained. Several terms may require clarification.

Poll - This term refers to the sequence in which a host interrogates a recorder, but has no effect on it's configuration.

Selection - This term refers to the sequence in which the host changes the configuration or data values of the recorder by downlinking data.

Host - On the link, one station will be able to transmit without being addressed. This station is the link master, the supervisor, or host. Normally, this station is a computer, although it could be a simple dumb terminal. The host station polls and selects other stations, the recorders. The recorders never poll the host or select the host, only respond to polls and acknowledge selections.

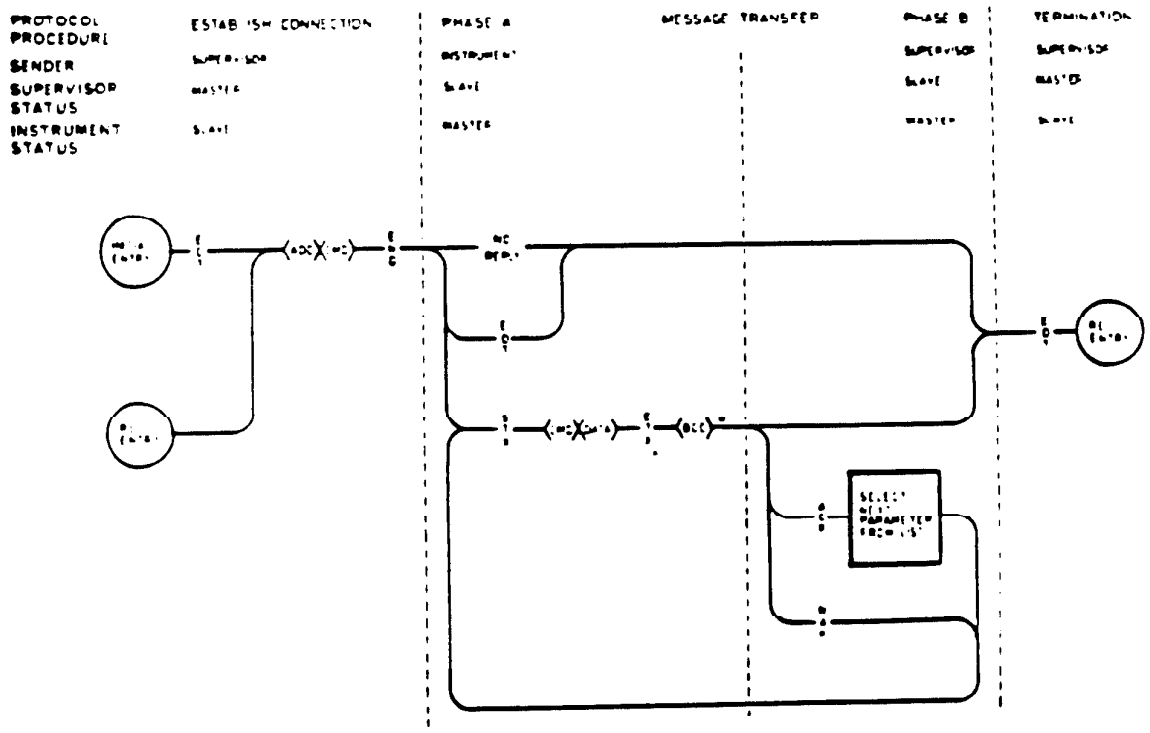


Figure 5 - Polling Sequence

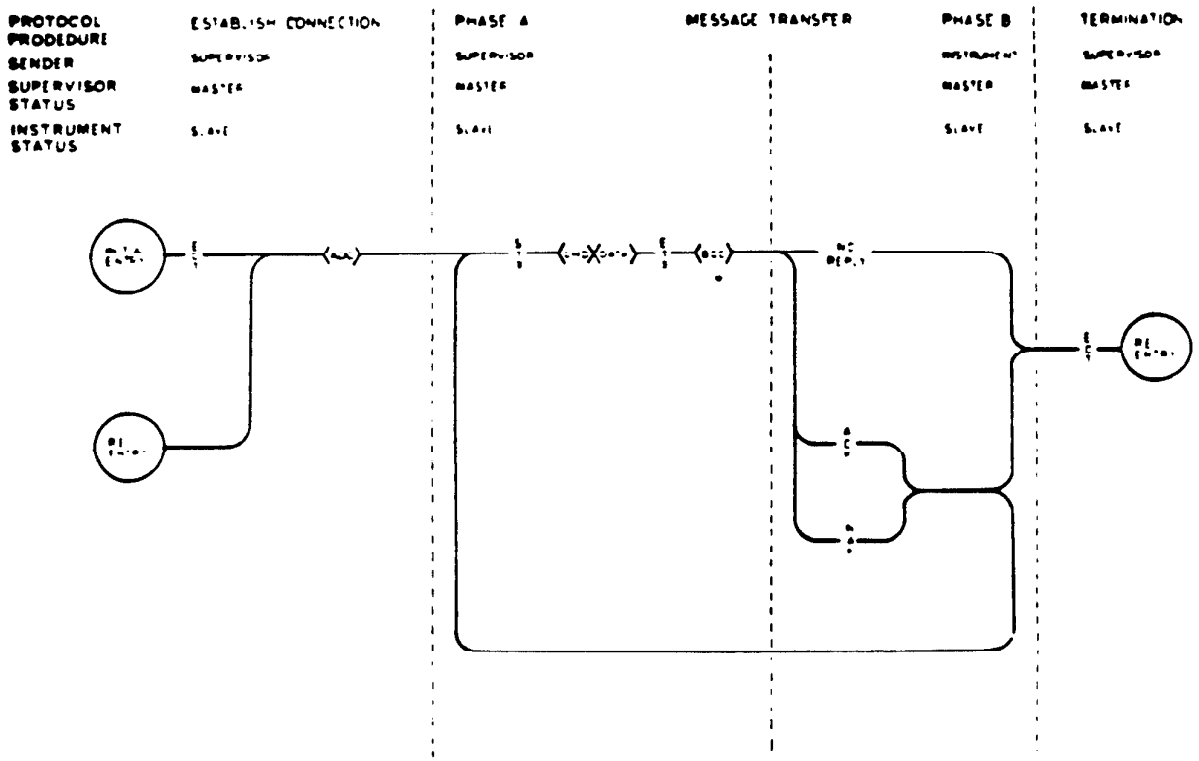


Figure 6 - Selection Sequence

5.1. Poll Sequence

The sequence of characters sent to the instrument to poll a parameter is:

'EOT' 'G' 'G' 'U' 'U' 'CN' 'C1' 'C2' 'ENQ'

where: 'G' = group id being addressed
'U' = unit id being addressed
'CN' = channel no. being addressed
'C1', 'C2' = command mneumonic

In response to the poll message, the instrument will respond with one of the following messages:

Poll Completed - The instrument will reply with:

'STX' 'CN' 'C1' 'C2' 'D1' 'D2' ... 'Dn' 'ETX' 'bcc'

where: 'D1' ... 'Dn' = data field unique to each command
'bcc' = longitudinal redundancy check character

The host may respond with 'NAK' which causes retransmission of the parameter polled; 'ACK' which causes the next parameter in sequence to be polled or may poll a new parameter using the full poll sequence. The order of commands in scrolled polling can be found in figure 8.

Poll Incomplete - The instrument may recognize it's address, but not the command mneumonic. In this case, it will reply with:

'STX' 'CN' 'C1' 'C2' 'EOT'

In this case, the host may not respond with 'ACK' or 'NAK', but must use the full poll sequence to reestablish connection.

Message Not Recognized - The instrument will remain quiet if it doesn't recognize its' address. Serial link errors, such as parity, overflow, etc. will result in no response.

5.2. Selection Sequence

The sequence of bytes sent to the instrument to write to a parameter is:

'EOT' 'G' 'G' 'U' 'U' 'STX' 'CN' 'C1' 'C2' 'D1' ... 'Dn' 'ETX' 'bcc'

In response to the selection message, the instrument will reply with one of three messages:

Selection Completed - The instrument will respond with the single character 'ACK' indicating that the message was accepted as correct, and the selection has

been performed. At this stage, the host may either re-enter the selection procedure at the point 'STX', to access a paramter in the same logical unit, or may access a nev parameter using the entire selection sequence.

Selection Incomplete - The instrument will respond with the single byte 'NAK' indicating that there vas an error in the selection message. The host may not re-enter the selection procedure in this case.

Message Not Recognized - There will be no response if the instrument does not recognize the message.

5.3. ANSI vs. ASCII Protocol

The ANSI protocol is the protocol presented in the previous sections, including non-printing control characters and longitudinal redundancy check. (BCC)

The ASCII protocol is identical to the ANSI protocol, except that it contains no non-printing control codes, and no BCC. The purpose of the ASCII protocol is to service links to dumb terminals where no computer is present. (Polling and Selection are being done manually).

The following table summarizes the replacements necessary to eliminate non-printing control codes.

Function	ANSI prot.	HEX	ASCII prot.	HEX
start of text	STX	02	"	22
end of text	ETX	03	#	23
end of transmission	EOT	04	$	24
enquiry	ENQ	05	%	25
acknovledge	ACK	06	&	26
negative acknovledge	NAK	15	(	28

5.4. Computation of BCC

The longitudinal redundancy character (BCC) is the hexidecimal value derived by the exclusive or of the characters included from the channel number (CN) to the ETX in a message transfer.

example:

poll response: STX '2' 'P' 'V' '1' '2' '.' '3' '4' 'ETX' 'bcc'

bcc = 32H xor 50H xor 56H xor 31H ..... xor 34H xor 03H
= 1DH

Transmitted literally, no conversion to ascii hex.

6. Instrument Addressing

There are three components in the communications addressing scheme. These are:

Group ID : '0' to '7'

Unit Address: '0' to '9', 'A', 'B', 'C', 'D', 'E', 'F'

Channel Address : '0' to '9', 'A', 'B', 'C', 'D', 'E', 'F'

The communications package consists of four logically independent, addressable units. These are:

- unit 0 - the base instrument (ex. chart speed)
- unit 1 - the recorder channel inputs and pens
- unit 2 - the control loops
- unit 3 - the setpoint generator

Each recorder occupies a space of four units in it's group. Therefore, four recorders can be installed as one group. One link can address eight groups, therefore one multi-drop link can address thirty-two recorders.

Two addressing values are programmed via the keypad. These are the group ID and the base unit address.

Each recorder must be programmed with a 'base' unit address, in order to identify itself among others in a group. This base unit address can be selected from the following possible values: '0', '4', '8', or 'C'. Each unit is addressed relative to the base unit. For example, to poll a value in the setpoint generator installed with base unit '8', unit 'B' should be addressed.

Each unit can be polled for its' identification via command 'II'. The responses are:

- unit 0 - '3900'
- unit 1 - '3901'
- unit 2 - '3902'
- unit 3 - '3903'

The following table summarizes the allocation of units and channels in the recorder:

Base Unit • 0: Instrument

channel 1: retransmission output 1 A
channel 2: retransmission output 1 B
channel 3: retransmission output 2 A
channel 4: retransmission output 2 B

Base Unit • 1: Input Channels

channel 1: recorder channel 1
channel 2: recorder channel 2
channel 3: recorder channel 3
channel 4: recorder channel 4

Base Unit • 2: Controllers

channel 1: loop 1
channel 2: loop 2

Base Unit • 3: Setpoint Generator

channels used only in the VS command to specify
a starting segment number. See VS command.

7. Data Character Formats

7.1. Numeric Formats

Format	Sign	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
1	+	N	N	N	N	.					
	+	N	N	N	.	N					
	+	N	N	.	N	N					
	+	N	.	N	N	N					
	+	.	N	N	N	N					
1	-	N	N	N	N	-					
	-	N	N	N	-	N					
	-	N	N	-	N	N					
	-	N	-	N	N	N					
	-	-	N	N	N	N					
3	+	N	N	.	N	N					
4	+	N	N	N	.	N					
5	n/a	>	H	H	H	H					
6	+	N	N								
7	+	N									
10	+	N	N	N	N	.					
17	+	N	N	N	N	N	N	N	N	N	.

Key:

N = decimal digit ('0' -> '9')

H = hexidecimal digit ('0' -> '9', 'A' -> 'F')
(upper case)

7.2. Character Formats

Engineering Units Strings (format 'eng')

1	2	3	4	5	6	7
'	D	A	A	A	A	A

Tag Strings (format 'tag')

									1	1	1	1	1	1	1	1
1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
'	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Key:

A = alphanumeric character

'A' -> 'Z', '0' -> '9',

' ', '!', ''', '*', '/',

')', '+', '-' '='

D = decimal point position

'0' : x x x x .
'1' : x x x . x
'2' : x x . x x
'3' : x . x x x

ex: 1GAL/H creates 130.5 GAL/H

Note - The ASCII mode of the protocol uses several printing ascii characters as control characters. In order to include one of these characters in a tag string or engineering unit string, make the following substitutions:

to program '*', send 'a'
to program '@', send 'b'
to program '$', send 'c'
to program '%', send 'd'
to program '(', send 'e'

8. Response Timing

The recorder responds to commands in varying amounts of time, depending upon the particular item being polled. There are two classes of mneumonics identified for commands. Each class has a different latency.

The following table shows the response latency class for each mneumonic in the communications package. The following paragraphs describe each class.

Note in the following table that most items which are normally polled by a supervisory host, such as channel readings, are in the faster class 1.

Class 1 Poll/Select

Class 1 items are stored in the option board and are therfore immediately available to the communications package.

The average time between the last received character and the first transmitted response character is 5 mS. There is a probability of 10% that this latency will rise to a maximum of 70 mS.

Class 2 Poll/Select

Class 2 items are stored in the main board. Therefore, latency is increased due to communication requirements between the option board and the main board. Also, some entries require extensive associated calculations which must run concurrently with other instrument functions.

This class has an average latency of 300 mS., with a 25% probability that the latency will rise to a maximum of 750 mS.

Message Latency Classes

CM	Unit Class	Function (• = all units)
AA	•	1	Alarm Acknowledge
A1	1	2	Alarm 1 Setpoint
A2	1	2	Alarm 2 Setpoint
AM	1	3	Alarms Configuration
AP	3	2	Activate Program
BL	•	1	Block Length
CC	1	2	Cycle Rate B
CD	1	2	Channel Tag String
CE	•	1	Last Comms Error
CF	0	1	Installed Options
CF	1	3	Input Type
CF	2	2	Loop Configuration
CH	2	2	Cycle Rate A
CJ	1	2	Cold Junction Sensor Temperature
CS	0	2	Chart Speed
CS	3	1	Cycle Status
DB	2	1	Duplex Output Deadband
DS	0	1	Contact Inputs/Relay Outputs
DV	1	2	Derived Variable Identifier
EP	3	2	Enter Program
ER	2	1	Deviation
ET	3	1	Elapsed Time
EU	1	2	Engineering Units String
E(n)	1	2	Derived Variable Exponents
FH	1	2	Channel Units Reference High Value
FL	1	2	Channel Units Reference Low Value
HA	2	2	Deviation Alarm High Setpoint
HB	2	2	Cutback High
HF	2	2	Feedforward Signal High Range Value
HS	2	2	Setpoint High Limit
HO	2	2	Output High Limit
HT	2	2	Secondary Tuning High Trip Point
IF	1	2	Input Filter Constant
IH	1	2	Channel Input Reference High Value
IH	2	2	Loop Span High Value
II	•	1	Unit Identifier
IL	1	2	Channel Input Reference Low Value
IL	2	2	Loop Span Low Value
IS	3	2	Insert Segment
JS	3	2	Jump
K(n)	1	2	Derived Variable Mantissas

LA	2	2	Deviation Alarm Low Setpoint
LB	2	2	Cutback Low
LF	2	2	Feedforward Signal Low Range Value
LO	2	2	Output Low Limit
LS	2	2	Setpoint Low Limit
LT	2	2	Secondary Tuning Low Trip Point
MN	0	1	Mode Number
MN	1	1	Mode Number
MN	2	1	Mode Number
MN	3	1	Mode Number
OH	1	2	Chart High Value
OL	1	2	Chart Low Value
OP	2	1	Output Value
OP	3	2	Open Program
OR	2	2	Slew Rate Limit
PV	1	1	Measured Value
PV	2	1	Process Variable
RH	0	2	Retransmission High Scale
RI	0	2	Retransmission Source
RL	0	2	Retransmission Low Scale
SB	2	2	Remote Setpoint Bias
SG	3	2	Segments
SL	2	1	Local Setpoint
SP	2	1	Working Setpoint
SR	2	2	Remote Setpoint Ratio
SS	3	2	Segment Status
TC	1	2	Totalizer Control
TD	1	2	Totalizer Cutoff Point
TF	1	2	Totalization Factor Mantissa
TG	1	2	Totalization Factor Exponent
TO	1	2	Totalizer Output Factor Mantissa
TP	1	2	Totalizer Output Factor Exponent
TT	1	2	Totalizer Tag String
TV	1	2	Totalizer Value
T1	3	1	Trace 1 Value
T2	3	1	Trace 2 Value
U1	3	2	Trace 1 Units String
U2	3	2	Trace 2 Units String
VS	3	2	View Segment
VO	0	2	Version Number
XC	2	2	Primary Control Direction
XD	2	2	Primary Rate Time
XI	2	2	Primary Reset Time
XP	2	2	Primary Proportional Band
YC	2	2	Secondary Control Direction
YD	2	2	Secondary Rate Time
YI	2	2	Secondary Reset Time
YP	2	2	Secondary Proportional Band
ZA	2	2	Deviation Alarm Hysteresis
Z1	1	2	Alarm 1 Hysteresis
Z2	1	2	Alarm 2 Hysteresis
Z3	1	2	Alarm 1 Hi/Lo Deadband
Z4	1	2	Alarm 2 Hi/Lo Deadband

1H	1	2	Comms Reporting High Limit
1L	1	2	Comms Reporting Low Limit

9. Commands

9.1. Commands Common to All Units

The following commands can be accessed in any of the four addressable units.

9.1.1.
BL - Block Length

Function: maximum length of any exchange
(necessary buffer size)

Access: R/O Latency Class: 1 Format: 10
Units: n/a
Channel Addressing: must be valid for the unit addressed.
Comments: always returns 0128.

9.1.2.
II - Instrument Identifier

Function: unit identifier

Access: R/O Latency Class: 1 Format: 5

Units: n/a
Channel Addressing: must be valid for the unit addressed.

Comments: this command returns the normalized unit number being addressed. Normalized means that the base unit number programmed into the instrument is removed. For example, addressing unit 7 in a recorder whose base unit number is 4, would result in a normalized unit number of 3.

Unit 0 returns ... >3900
Unit 1 returns ... >3901
Unit 2 returns ... >3902
Unit 3 returns ... >3903

9.1.3.
CE - Comms Error

Function: last communications error (see figure 7)

Access: R/clear Latency Class: 1 Format: 6
Units: n/a
Channel Addressing: must be valid for the unit addressed.
Comments: cleared by CE poll to any unit

9.1.4.
AA - Alarm Acknovledge

Function: return the state of all instrument alarms
clear unacknovledged alarm bit in mode numbers
of units 1 and 2.

Access: R/clear Latency Class: 1 Format: 5
Units: n/a
Channel Addressing: must be valid for the unit addressed.

Comments: bit 15 -> bit 10: n/a
bit 9: loop 2 deviation alarm
bit 8: loop 1 deviation alarm
bit 7: pen 4, alarm #2
bit 6: pen 4, alarm #1
bit 5: pen 3, alarm #2
bit 4: pen 3, alarm #1
bit 3: pen 2, alarm #2
bit 2: pen 2, alarm #1
bit 1: pen 1, alarm #2
bit 0: pen 1, alarm #1

9.2. Instrument Unit

9.2.1. Instrument Unit - Non-Channel Specific Commands

9.2.1.1.
CF - Instrument Options

Function: get information concerning options installed in this instrument.

Access: R/O Latency Class: 1 Format: S
Units: n/a
Channel Addressing: not used, but must be valid (1 - 4)

Comments:
bit 15: pen 4 installed
bit 14: pen 3 installed
bit 13: pen 2 installed
bit 12: pen 1 installed
bit 11: totalizer 4 installed
bit 10: totalizer 3 installed
bit 9: totalizer 2 installed
bit 8: totalizer 1 installed
bit 7: retrans. installed on output 1A
bit 6: retrans. installed on output 1B
bit 5: retrans. installed on output 2A
bit 4: retrans. installed on output 2B
bit 3: loop 1 installed
bit 2: loop 2 installed
bit 1: setpoint generator installed
bit 0: special linearization installed

9.2.1.2.
CS - Chart Speed

Function: set/get current chart speed

Access: R/W Latency Class: 2 Format: 10
Units: hours Limits: 0000. -> 4096.
Channel Addressing: not used, but must be valid (1 - 4)
Rules for Selection: host enabled

9.2.1.3.
DS - Contact Inputs/Relay Outputs

Function: return state of option card contact inputs
set state of main card relay outputs

Access: R/W Latency Class: 1 Format: 5
Units: n/a
Channel Addressing: not used, but must be valid (1 - 4)
Rules for Selection: host enabled

Comments: The state of the relays, as set by the host, is kept through a power interruption, so that the relays will resume the selected states when power returns. However, the selected states are reset to 'off' when the host is disabled for any reason. Also, other instrument functions, such as alarms and setpoint generator events, are combined with the comms selected states. ANY function asking for 'ON' will turn on the relay. Carefully allocate the use of relay functions.

Remember that the recorder's relays are energized when their selected states are 'OFF'. This is because it is desired to have alarm contacts close on a power failure. Pay attention to Normally Open, Normally Closed wiring.

contact inputs returned on poll (1 = contact closed)
relay outputs set on select (1 = de-energize relay coil)
('ON' condition)

bit 15 -> 7: not used
bit 6: cd
bit 5: reset
bit 4: hold
bit 3: rl1 ..... -or- relay #4
bit 2: am1 ..... -or- relay #3
bit 1: rl2 ..... -or- relay #2
bit 0: am2 ..... -or- relay #1

9.2.1.4.
MN - Mode Number

Function: mode number (a status word)

Access: R/clear Latency Class: 1 Format: 5
Units: n/a
Channel Addressing: not used, but must be valid (1 - 4)
Comments: bit 15: always 0
bit 14: always 0
bit 13: 1 = host enabled (can use selection)
bit 12: 1 = memory lost (clear via reprogramming)

bit 11: always 0
bit 10: always 0
bit 9: 1 = reset occured (clear via MN poll)
bit 8: always 0

bit 7 -> 4: either = 0 1 0 0 (Recorder)
or = 0 0 1 1 (Recorder / Controller)
(depends upon installed options)

bit 3 -> 0: always = 0 0 0 0

9.2.1.5.
VO - Version Number

Function: firmware version number

Access: R/O Latency Class: 1 Format: 5
Units: n/a
Channel Addressing: not used, but must be valid (1 - 4)
Comments: format example: >0402 means version 4.2

9.2.2. Instrument Unit - Channel Specific Commands

9.2.2.1.
RI - Retransmission Source

Function: set/get programmed source of this retransmission signal output.

Access: R/W Latency Class: 2 Format: 6
Units: n/a Limits: 0 -> 12
Channel Addressing: channel = retrans. output number
Rules for Selection: host enabled
retrans. installed on this output

Comments: 00 = off
01 = recorder channel 1
02 = recorder channel 2
03 = recorder channel 3
04 = recorder channel 4
05 = setpoint generator trace 1
06 = setpoint generator trace 2
07 = loop 1 working setpoint
08 = loop 1 deviation
09 = loop 2 working setpoint
10 = loop 2 deviation
11 = loop 1 output
12 = loop 2 output

9.2.2.2.
RL - Retransmission Low Scale

9.2.2.3.
RH - Retransmission High Scale

Function: set/get engineering unit value representing 4 (20) mA. for this retransmission output.

Access: R/W Latency Class: 1 Format: 1
Units: same as source's Limits: none
Channel Addressing: channel = retrans. output number
Rules for Selection: host enabled
retrans. installed on this output

9.3. Input/Recorder Unit

9.3.1. Input Unit - Non-Channel Specific Commands

9.3.1.1.
CJ - Cold Junction Sensor Temperature

Function: get the temperature of the cold junction compensation sensor, common to all input channels.

Access: R/O Latency Class: 2 Format: 4
Units: deg C
Channel Addressing: not used, but must be valid (1 - 4)

9.3.1.2.
DV - Derived Variable Identifier

Function: get the part number of the derived variable equation installed in this instrument. The part number takes the form: "RNnnnnnn "

Access: R/O Latency Class: 2 Format: tag
Units: n/a
Channel Addressing: not used, but must be valid (1 - 4)

9.3.1.3.
K(n) - Derived Variable Mantissas

Function: set/get mantissas of the numbered coefficients of derived variable equation. Commands = K0, K1, -> K9 Must be combined with exponents E0, E1, -> E9.

Access: R/W Latency Class: 2 Format: 1
Units: n/a Limits: 9-999 -> 9.999
Channel Addressing: not used, but must be valid (1 - 4)
Rules for Selection: host enabled
derived variable installed
this numbered coeff. is adjustable
Comments: Coefficients consist of mantissa and exponent:
2.003 x 10 ^ 13 (scientific notation)

In order to change a coefficient, the mantissa and then the corresponding exponent must be selected. The new value is not stored when the mantissa is written, and the exponent will always be combined with the mantissa which was last written.

The K, E numbers correspond to the order of appearance of the coefficients on the display during programming.

9.3.1.4.
E(n) - Derived Variable Exponents

Function: set/get exponents of the numbered coefficients of derived variable equation. Commands = E0, E1, -> E9 Must be combined with mantissas K0, K1, -> K9.

Access: R/W Latency Class: 2 Format: 1
Units: n/a Limits: 0031- -> 0031.
Channel Addressing: not used, but must be valid (1 - 4)
Rules for Selection: host enabled
derived variable installed
this numbered coeff. is adjustable
Comments: See K(n) above.

9.3.1.5.
MN - Mode Number

Function: mode number (a status word)

Access: R/clear Latency Class: 1 Format: 5
Units: n/a
Channel Addressing: not used, but must be valid (1 - 4)
Comments: bit 15: 1 = unacknowledged alarm (clear via AA)
bit 14: always 0
bit 13: 1 = host enabled (can use selection)
bit 12: 1 = memory lost (clear via reprogramming)

bit 11: always 0
bit 10: 1H, 1L violated by 10% (any PV out of range)
bit 9: 1 = reset occured (clear via MN poll)
bit 8: always 0

bit 7 -> 4: always = 0 1 0 0 (Recorder)

bit 3 -> 0: always = 0 0 0 0

9.3.2. Input Unit - Channel Specific Commands

9.3.2.1.
A1 - Alarm 1 Setpoint

9.3.2.2.
A2 - Alarm 2 Setpoint

Function: set/get channel's alarm 1 (2) setpoint.

Access: R/W Latency Class: 2 Format: 1
Units: same as channel PV Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.3.
AM - Alarms Configuration

Function: set/get type and relay assignment of both alarms
for this recorder channel.

Access: R/W Latency Class: 2 Format: 5
Units: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

Comments: bit 15 -> bit 13: 0 = alarm 1 is off
1 = alarm 1 is high alarm
2 = alarm 1 is low alarm
3 = alarm 1 is hi/lo alarm
4 = alarm 1 is rate of change (hours)
5 = alarm 1 is rate of change (mins.)
6 = alarm 1 is rate of change (secs.)

bit 12 -> bit 10: 0 = no alarm 1 relay
1 = alarm 1 drives relay 1
2 = alarm 1 drives relay 2
3 = alarm 1 drives relay 3
4 = alarm 1 drives relay 4

bit 9 -> bit 8 : n/a

bit 7 -> bit 5: 0 = alarm 2 is off
1 = alarm 2 is high alarm
2 = alarm 2 is low alarm
3 = alarm 2 is hi/lo alarm
4 = alarm 2 is rate of change (hours)
5 = alarm 2 is rate of change (mins.)
6 = alarm 2 is rate of change (secs.)

bit 4 -> bit 2: 0 = no alarm 2 relay
1 = alarm 2 drives relay 1
2 = alarm 2 drives relay 2
3 = alarm 2 drives relay 3
4 = alarm 2 drives relay 4

bit 1: n/a

bit 0: 1 = alarms access enabled

9.3.2.4.
Z1 - Alarm 1 Hysteresis

9.3.2.5.
Z2 - Alarm 2 Hysteresis

Function: set/get hysteresis value for this channel's alarm 1 (2) setpoint.

Access: R/W Latency Class: 2 Format: 1
Units: same as channel's PV Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.6.
Z3 - Alarm 1 Hi/Lo Deadband

9.3.2.7.
Z4 - Alarm 2 Hi/Lo Deadband

Function: set/get hysteresis value for this channel's alarm 1 (2) hi/lo alarm deadband.

Access: R/W Latency Class: 2 Format: 1
Units: same as channel's PV Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.8.
CF - Input Type

Function: set/get the configuration of this input channel.

Access: R/W Latency Class: 2 Format: 5
Units: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

Comments: bit 15 -> bit 12: input range

0 : 0 - 20 mV.	2 : 100 ohm	4 : pneumatic
1 : 0 - 80 mV.	3 : 0 -5	5 : external

bit 11 -> bit 7: linearization type

00 : off	14 : Direct TC type B
01 : linear	15 : Direct TC type E
02 : square root	16 : Direct TC type J
03 : 3/2 power	17 : Direct TC type K
04 : 5/2 power	18 : Direct TC type R
05 : retrans. TC type B	19 : Direct TC type S
06 : retrans. TC type E	20 : Direct TC type T
07 : retrans. TC type J	21 : Direct RTD (ANSI)
08 : retrans. TC type K	22 : Direct RTD (DIN)
09 : retrans. TC type R	23 : special linearization
10 : retrans. TC type S	
11 : retrans. TC type T	
12 : retrans. RTD (ANSI)	
13 : retrans. RTD (DIN)	

bit 6 -> bit 5: units

0 : deg C 1 : deg F 2 : other

9.3.2.9.
IF - Input Filter Constant

Function: set/get the input filter constant for this channel.

Access: R/W Latency Class: 2 Format: 7
Units: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

Comments:
0 = 2.5 sec.
1 = 5 sec.
2 = 10 sec.
3 = 20 sec.
4 = 40 sec.
5 = 80 sec.
6 = 0 sec. (off)

9.3.2.10.
EU - Engineering Units String

Function: set/get engineering units string, and decimal position, for this channel. Not used if input type is TC or RTD.

Access: R/W Latency Class: 2 Format: eng
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
Comments: This string duplicates the programming entry under ENG. UNITS - OTHER in the instrument programming menu.

9.3.2.11.
FL - Channel Units Low Reference Value

9.3.2.12.
FH - Channel Units High Reference Value

Function: set/get engineering units value representing the voltage or resistance entered under Input Low (High) Reference Value.

Access: R/W Latency Class: 2 Format: 1
Units: same as channel's Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.13.
IL - Channel Input Low Reference Value

9.3.2.14.
IH - Channel Input High Reference Value

Function: set/get voltage or resistance value representing channel's low (high) units reference value.

Access: R/W Latency Class: 2 Format: 1
Units: mVolts, Volts, ohms Limits: none
(type dependent)
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.15.
OL - Chart Low Value

9.3.2.16.
OH - Chart High Value

Function: set/get engineering units value representing low (high) end of chart for this pen.

Access: R/W Latency Class: 2 Format: 1
Units: same as channel's Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.17.
1L - Comms Reporting Low Limit

9.3.2.18.
1H - Comms Reporting High Limit

Function: set/get engineering units value used to determine PV low (high) condition for this channel. PV low (high) is active whenever the value of PV falls 10% below (above) this value.
(10% of 1H - 1L)

Access: R/W Latency Class: 1 Format: 1
Units: same as channels Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
Comments: This function has no effect on instrument performance, and is only used for communications purposes.

9.3.2.19.
PV - Measured Value

Function: set/get measured value of channel.

Access: R/W Latency Class: 1 Format: 1
Units: same as channel's Limits: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
input range 'EXTERNAL' selected
(see section 4.3)

9.3.2.20.
CD - Channel Tag String

Function: set/get channel's tag string

Access: R/W Latency Class: 2 Format: tag
Units: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed

9.3.2.21.
TC - Totalizer Control

Function: set/get control settings for this channel's totalizer

Access: R/W Latency Class: 2 Format: 5
Units: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel
Comments: bit 15 -> bit 8: n/a
bit 7 : 1 = reset totalizer
bit 6 : 1 = totalizer on
bit 5 -> bit 2: n/a
bit 1 : 1 = totalizer counter output on
bit 0 : 1 = totalizer is resetable from keypad

9.3.2.22.
TD - Totalizer Lov Cutoff Point

Function: set/get totalizer lov cutoff point for this channel's totalizer.

Access: R/W Latency Class: 2 Format: 1
Units: same as channel's Limits: none
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel

9.3.2.23.
TF - Totalization Factor Mantissa

Function: set/get totalization time factor for this channel's totalizer. This command sets mantissa.

Access: R/W Latency Class: 2 Format: 1
Units: seconds Limits: 9-999 -> 9.999
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel

Comments: This value is entered in scientific notation. It must be written (selected) mantissa first, then exponent.
An example: 1.230 x 10^9 -> TF 1.230 TG 0009.
(see 'TG' below)

9.3.2.24.
TG - Totalization Factor Exponent

Function: set/get totalization time factor for this channel's totalizer. This command sets exponent.

Access: R/W Latency Class: 2 Format: 1
Units: seconds Limits: 0031- -> 0031.
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel

Comments: see 'TF' above.

9.3.2.25.
TO - Totalization Output Factor Mantissa

Function: set/get totalization counts factor for this channel's totalizer counter output. This command sets mantissa.

Access: R/W Latency Class: 2 Format: 1
Units: n/a Limits: 9-999 -> 9.999
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel

Comments: This value is entered in scientific notation. It must be written (selected) mantissa first, then exponent.
An example: 1.230 x 10^9 -> TO 1.230 TP 0009.
(see 'TP' below)

9.3.2.26.
TP - Totalization Output Factor Exponent

Function: set/get totalization counts factor for this channel's totalizer counter output. This command sets exponent.

Access: R/W Latency Class: 2 Format: 1
Units: n/a Limits: 0031- -> 0031.
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel

Comments: see 'TO' above.

9.3.2.27.
TV - Totalizer Value

Function: set/get this channel's totalizer value.

Access: R/O Latency Class: 2 Format: 17
Units: counts Limits: n/a
Channel Addressing: channel = recorder channel number

9.3.2.28.
TT - Totalizer Tag String

Function: set/get channel's totalizer tag string

Access: R/W Latency Class: 2 Format: tag
Units: n/a
Channel Addressing: channel = recorder channel number
Rules for Selection: host enabled
this channel installed
totalizer installed on this channel

9.4. Controller Unit

9.4.1.
MN - Mode Number

```
Function: mode number ( a status word )

Access: R/W        Latency Class: 1     Format:  5
Units:  n/a
Channel Addressing: not used, but must be valid loop ( 1 or 2 )
Comments: bit 15: 1 = unacknowledged dev. alarm ( clear via AA )
          bit 14: always 0
          bit 13: 1 = host enabled ( can use selection )
          bit 12: 1 = memory lost ( clear via reprogramming )

          bit 11: always 0
          bit 10: always 0
          bit  9: 1 = reset occured ( clear via MN poll )
          bit  8: always 0

          bit 7 -> 4: always = 0 0 0 1  ( type 1 controller )

          bit  3: 1 = loop 1 remote     ( R/W )
          bit  2: 1 = loop 1 auto       ( R/W )
          bit  1: 1 = loop 2 remote     ( R/W )
          bit  0: 1 = loop 2 auto       ( R/W )
```

9.4.2.
CF - Loop Configuration Word

Function: set/get configuration of loop

Access: R/W Latency Class: 2 Format: 5
Units: n/a
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments:

bit 15: 0 = single output 1 = duplex output

bit 14: 0 = slew rate on auto only 1 = slew rate on man. and auto

bit 13 -> 12:
0 0 = rem. sp. off
0 1 = rem. sp. from channel
1 0 = rem. sp. from setpoint gen.
1 1 = rem. sp. from loop 1(loop 2 only)

bit 11: 0 = rate on DEV 1 = rate on PV

bit 10: 1 = setpoint tracking on

bit 9 -> 7:
0 0 0 = secondary tuning off
0 0 1 = secondary trip on PV value
0 1 0 = secondary trip on SP value
0 1 1 = secondary trip on DEV value
1 0 0 = secondary trip on output sign

bit 6 -> 5:
0 0 = feedforward off
0 1 = feedforward source = ch. 3
1 0 = feedforward source = ch. 4

bit 4 -> 2:
0 0 0 = no relay on deviation alarm
0 0 1 = relay #1 on deviation alarm
0 1 0 = relay #2 on deviation alarm
0 1 1 = relay #3 on deviation alarm
1 0 0 = relay #4 on deviation alarm

9.4.3.
ER - Deviation Value

Function: get deviation value of this loop (PV - SP)

Access: R/O Latency Class: 1 Format: 1
Units: same as loop PV input
Channel Addressing: channel = loop number

9.4.4.
OP - Output Value

Function: set/get current output value of this loop

Access: R/W Latency Class: 1 Format: 1
Units: percent Limits: programmed
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
loop in manual
Comments: poll returns current output
selection sets manual output

9.4.5.
PV - Process Variable

Function: get current PV input value

Access: R/O Latency Class: 1 Format: 1
Units: set by input channel
Channel Addressing: channel = loop number

9.4.6.
SP - Actual (Working) Setpoint

Function: get value of working setpoint for this loop.

Access: R/O Latency Class: 1 Format: 1
Units: same as PV input
Channel Addressing: channel = loop number

9.4.7.
SL - Local Setpoint

Function: set/get value of local setpoint for this loop.

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input Limits: programmed
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: value will be accepted, but not used,
if loop is in remote mode.

9.4.8.
LS - Setpoint Low Limit

9.4.9.
HS - Setpoint High Limit

Function: set/get value of setpoint low (high) limit.

Access: R/W Latency Class: 2 Format: 1
Units: same as PV input Limits: none
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: limit is applied to local and remote
setpoints.

9.4.10.
SR - Remote Setpoint Ratio

Function: set/get coefficient applied to remote setpoint.

Access: R/W Latency Class: 1 Format: 1
Units: unitless Limits: 0.000 -> 9.999
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.11.
SB - Remote Setpoint Bias

Function: set/get bias applied to remote setpoint.

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input Limits: none
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.12.
LB - Cutback Low

9.4.13.
HB - Cutback High

Function: set/get negative (positive) deviation value at which cutback is activated

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input Limits: low: negative, high: postive
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.14.
LO - Output Low Limit

9.4.15.
HO - Output High Limit

Function: set/get low (high) limit of auto or manual output.

Access: R/W Latency Class: 2 Format: 1
Units: percent Limits: -100.0 -> 100.0
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.16.
OR - Slew Rate Limit

Function: set/get rate of change limit on output value

Access: R/W Latency Class: 1 Format: 1
Units: percent / min. Limits: 0. -> 9999.
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: 0 entry disables slew rate limiting

9.4.17.
DB - Duplex Output Deadband

Function: set/get deadband value used around zero value of duplex output.

Access: R/W Latency Class: 1 Format: 4
Units: percent Limits: 0 -> 100.
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.16.
CH - Cycle Rate A (Heat)

Function: set/get the full period of this loop's 'A' output, used if that output is DAT type.

Access: R/W Latency Class: 1 Format: 10
Units: seconds Limits: 2 -> 250
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.19.
CC - Cycle Rate B (Cool)

Function: set/get the full period of this loop's 'B' output, used if that output is DAT type.

Access: R/W Latency Class: 1 Format: 10
Units: seconds Limits: 2 -> 250
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.20.
LF - Feedforward Signal Low Range Value

Function: set/get engineering units value representing 0.0 % feedforward action.

Access: R/W Latency Class: 1 Format: 1
Units: same as feedforward channel's
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.21.
HF - Feedforward Signal High Range Value

Function: set/get engineering units value representing 100.0 % feedforward action.

Access: R/W Latency Class: 1 Format: 1
Units: same as feedforward channel's
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.22.
XP - Primary Proportional Band

9.4.23.
YP - Secondary Proportional Band

Function: set/get proportional band value for the primary (secondary) tuning set of this loop.

Access: R/W Latency Class: 1 Format: 4
Units: percent Limits: 0.1 -> 200.0
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: selection causes bumpless transfer if loop is in auto mode

9.4.24.
XI - Primary Reset Time

9.4.25.
YI - Secondary Reset Time

Function: set/get reset time setting for this loop's primary (secondary) tuning set.

Access: R/W Latency Class: 1 Format: 4
Units: minutes / repeat Limits: 0.0 - 999.9
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: selection causes bumpless transfer if loop is in auto mode

9.4.26.
XD - Primary Rate Time

9.4.27.
YD - Secondary Rate Time

Function: set/get rate time for this loop's primary (secondary) tuning set.

Access: R/W Latency Class: 1 Format: 3
Units: minutes Limits: 0.00 -> 99.99
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: selection causes bumpless transfer if loop is in auto mode

9.4.28.
XC - Primary Control Direction

9.4.29.
YC - Secondary Control Direction

Function: set/get control direction setting for this loop's primary (secondary) tuning set.

Access: R/W Latency Class: 1 Format: 7
Units: n/a
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed
Comments: possible values: 0 = direct acting controller
1 = reverse acting controller

9.4.30.
LT - Secondary Tuning Low Trip Point

9.4.31.
HT - Secondary Tuning High Trip Point

Function: set/get lower (upper) band boundary for secondary tuning.

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input's Limits: none
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.32.
IL - Loop Span Low Value

9.4.33.
IH - Loop Span High Value

Function: set/get low (high) end of loop span, used in calculating tuning constants.

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input's Limits: none
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.34.
LA - Deviation Alarm Low Setpoint

9.4.35.
HA - Deviation Alarm High Setpoint

Function: set/get deviation alarm negative (positive) setpoint.

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input's Limits: <= 0 (>= 0)
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.4.36.
ZA - Deviation Alarm Hysteresis

Function: set/get hysteresis value applied to high and low deviation alarm setpoints.

Access: R/W Latency Class: 1 Format: 1
Units: same as PV input's Limits: none
Channel Addressing: channel = loop number
Rules for Selection: host enabled
loop installed

9.5. Setpoint Generator Unit

9.5.1. MN - Mode Number

Function: mode number (a status word)

Access: R/W Latency Class: 1 Format: 5
Units: n/a
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed

Comments: bit 15: always 0
bit 14: always 0
bit 13: 1 = host enabled (can use selection)
bit 12: 1 = memory lost (clear via reprogramming)

bit 11: always 0
bit 10: always 0
bit 9: 1 = reset occured (clear via MN poll)
bit 8: always 0

bit 7 -> 4: always = 1 0 0 0 (Programmer)

bit 3: 0 = program in reset mode (R/W)
bit 2: 0 = program in hold mode (R/W)
bit 1: 1 = 60 X mode (R/W)
bit 0: 1 = program done (R/O)

60 X mode setting only takes effect after a program reset.
A program must be active for control to be accepted.

9.5.2. CS - Cycle Status

Function: get the current program cycling status

Access: R/O Latency Class: 1 Format: see comments
Channel Addressing: not used, but must be valid, (0 - 9, A - C)

Comments: D1 D2 D3 : current cycle segment no.
D4 D5 D6 : current cycle destination segment no.
D7 D8 D9 : current cycle counts

9.5.3.
SS - Segment Status

Function: get the current segment status

Access: R/O Latency Class: 1 Format: see comments
Channel Addressing: not used, but must be valid, (0 - 9, A - C)

Comments: D1 D2 D3 : current segment no.
D4 D5 D6 : minutes remaining in segment
D7 D8 : current event states

>event states : ascii hex. digits where:
bit 0 = event 1
bit 1 = event 2
bit 2 = event 3
bit 3 = event 4

9.5.4.
JS - Jump

Function: cause a jump of segments in active program

Access: W/O Latency Class: 2 Format: 10
Units: destination segment number limits: 2 -> 127
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed
a program is active
active program is in 'hold' state
destination greater than current segment no.
(only forward jumps)

9.5.5.
T1 - Trace 1 Value

9.5.6.
T2 - Trace 2 Value

Function: get the current value of trace 1 (2)

Access: R/O Latency Class: 1 Format: 1
Units: programmed
Channel Addressing: not used, but must be valid, (0 - 9, A - C)

9.5.7.
I1 - Trace 1 Initial Value Source

9.5.8.
I2 - Trace 2 Initial Value Source

Function: set/get the initial value source for a trace.

Access: R/W Latency Class: 2 Format: 7
Units: n/a Limits: 1 -> 4
Channel Addressing: not used, but must be valid, (0 - 9, A - C)

Comments: 1 = recorder chan. 1
2 = recorder chan. 2
3 = recorder chan. 3
4 = recorder chan. 4

9.5.9.
U1 - Trace 1 Units String

9.5.10.
U2 - Trace 2 Units String

Function: set/get the engineering units defined for
trace 1 (2)

Access: R/W Latency Class: 2 Format: eng
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed

9.5.11.
AP - Activate a Program

Function: Activate the specified program. Deactivate the current active program. On poll, get the active program.

Access: R/W Latency Class: 2 Format: 7
Units: program number Limits: 0 -> 4
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed

Comments: Activating program '0' causes 'PROG INACTIVE' mode.

9.5.12.
ET - Elapsed Time

Function: get the current elapsed time.

Access: R/O Latency Class: 2 Format: see comments
Channel Addressing: not used, but must be valid, (0 - 9, A - C)

Comments: format = DDHHMM where:
DD = days
HH = hours
MM = minutes

9.5.13.
EP - Enter Program

Function: Enter the specified program from the editing buffer contents.

Access: W/O Latency Class: 2 Format: 7
Units: program number Limits: 1 -> 4
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed
cannot save the active program

Comments: Works in combination with OP (open program) and editing commands. OP copies a specified program into a buffer inside the instrument. The editing commands change the contents of this buffer. EP copies the buffer contents into the specified program.
Programs may be copied by simply opening the source program, and then entering the destination program.

9.5.14.
OP - Open Program

Function: Copy the specified program into the editing buffer.

Access: W/O Latency Class: 2 Format: 7
Units: program number Limits: 1 -> 4
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed

Comments: See 'EP' above.

9.5.15.
RS - Replace a Segment

Function: replace the specified segment in the current contents of the editing buffer.

Access: W/O Latency Class: 2 Format: see 'VS' below
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed
a program open

Comments: the new segment is addressed and formatted as shown in the 'segment structure' comments contained in the 'VS' section below.

9.5.16.
IS - Insert a Segment

Function: Insert the specified segment in the current contents of the editing buffer. The new segment will be placed just before the current segment bearing the specified segment number. All following segments will be renumbered.

Access: W/O Latency Class: 2 Format: see 'VS' below
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed
a program open

Comments: the new segment is addressed and formatted as shown in the 'segment structure' comments contained in the 'VS' section below.

9.5.17.
DS - Delete a Segment

Function: Delete the specified segment in the current contents of the editing buffer. All following segments will be renumbered.

Access: W/O Latency Class: 2 Format: N N N
Units: segment to delete Limits: 001 -> 127
Channel Addressing: not used, but must be valid, (0 - 9, A - C)
Rules for Selection: host enabled
setpoint generator installed
a program open

9.5.18.
VS - View Segment

Function: get one segment from the current contents of the editing buffer.

Access: R/O Latency Class: 2
Rules for Selection: host enabled
setpoint generator installed
a program open

Comments: In order to address individual segments, the channel address is used. The channel address specifies a particular starting segment number. Segments in between these segments may be viewed by scrolling, (repeated 'ACK's). The starting points are as follows:

Channel Addr.	Segment	Channel Addr.	Segment
0	1	7	70
1	10	8	80
2	20	9	90
3	30	A	100
4	40	B	110
5	50	C	120
6	60		

For example, to view segment 32, the following dialogue takes place:

Host: GGUU3VS
Rcdr: contents of segment 30
Host: ACK
Rcdr: contents of segment 31
Host: ACK
Rcdr: contents of segment 32

Segment Structure

```
Target Segment:          D1   D2   D3  : segment number
                                  D4  : T
                D5   D6  D7   D8   D9  : target value 1
                D10  D11 D12  D13  D14 : target value 2
                              D15  D16 : event states
                         D17  D18  D19 : duration

          >target value : format 1, dec. pt. as programmed
          >segment number, duration : N N N
          >event states : H H = ascii hex. value where:

                        bit 0 : event 1
                        bit 1 : event 2
                        bit 2 : event 3
                        bit 3 : event 4

Cycle Segment:           D1   D2   D3  : segment number
                                  D4  : C
                         D5   D6   D7  : destination segment
                         D8   D9   D10 : cycle count

          >destination, cycle count : N N N

End Segment:             D1   D2   D3  : segment number
( repeating type )                D4  : E
                                  D5  : C
                         D6   D7   D8  : destination segment

End Segment:             D1   D2   D3  : segment number
( stop type )                     D4  : E
                                  D5  : S
```

10. Dialogue Examples

Several example exchanges between the host and a recorder are presented here for clarification. Both the ANSI and ASCII forms of the dialogues are presented. The following addressing configuration is assumed for these examples:

Group ID : 2
Base Unit No. : 4

10.1. Poll for Channel Reading

In the following example, the host is polling for the value of channel 2. Channel 2 has a value of 13.57.

ANSI Protocol

H:'EOT' '2' '2' '5' '5' '2' 'P' 'V' 'ENQ'

R:'STX' '2' 'P' 'V' '1' '3' '.' '5' '7' 'ETX' 'bcc'

ASCII Protocol

H:'$' '2' '2' '5' '5' '2' 'P' 'V' '%'

R:'*' '2' 'P' 'V' '1' '3' '.' '5' '7' '#'

10.2. Selection to Change Loop Local SP

In this example, the host wants to change the value of loop 1 local setpoint to 1005. deg F.

ANSI Protocol

H:'EOT' '2' '2' '6' '6' 'STX' '1' 'S' 'L' '1' '0' '0' '5' '.' 'ETX' 'bcc'

R:'ACK'

ASCII Protocol

H:'$' '2' '2' '6' '6' '*' '1' 'S' 'L' '1' '1' '0' '0' '5' '.' '#'

R:'&'

Unit 0 - Instrument Unit - Non-Channel Specific Commands

II MN DS CS CF

Unit 0 - Instrument Unit - Channel Specific Commands

RH RL RI

Unit 1 - Recorder Unit - Non-Channel Specific Commands

II MN CJ (list 1)

DV KO EO K1 E1 K2 E2 .... K9 E9 (list 2)

Unit 1 - Recorder Unit - Channel Specific Commands

FL FH IL IH OL OH CF IF CD EU 1L 1H (list 1)

A1 A2 Z1 Z2 Z3 Z4 AM (list 2)

PV TV TC TD TF TG TT TO TP (list 3)

Unit 2 - Controller Unit - Channel Specific Commands

II MN PV SP ER OP SL (list 1)

XP XI XD XC YP YI YD YC SR SB (list 2)

CF LS HS LO HO IL IH LB HB OR DB CH CC LF HF LT HT (list 3)

LA HA ZA (list 4)

Unit 3 - Setpoint Generator Unit

II MN T1 T2 SS CS ET AP

Figure 8 - Poll Scrolling Order

01	Incomplete poll. (probably an unrecognized command)
02	Received BCC character invalid in selection.
03	Read attempted on a write only parameter.
04	Write attempted on a read only parameter.
13	Channel number addressed not in valid range for addressed unit.
31	Invalid numeric format for selection command.
37	Selection rejected, host is disabled.
38	The derived variable constant addressed is not implemented in the particular equation installed in this instrument.
39	An option applicable to this command is not installed in this instrument. Could also be caused by data content.
44	Selection rejected due to local setpoint in tracking mode.
45	Selection rejected due to controller in automatic mode.
46	Selection rejected due to output tracking in cascade config.
47	Data out of limits for this command.
50	Program save rejected, selected program is active.
51	Program save rejected, contains forward cycle destination.
52	Program save rejected, contains cycle, cycle destination.
53	SPG control rejected, no program active.
54	SPG change rejected, program not in hold.
55	SPG jump rejected, destination backward or off the end.
56	SPG jump rejected, destination is an empty segment.
57	Segment poll rejected, segment specified is empty.
60	SPG change rejected, no program open.

Figure 9 - Error Codes

CHR	HEX	CHR	HEX	CHR	HEX	CHR	HEX
nul	00	SP	20	@	40	`	60
SOH	01	!	21	A	41	a	61
STX	02	"	22	B	42	b	62
ETX	03	#	23	C	43	c	63
EOT	04	$	24	D	44	d	64
ENQ	05	%	25	E	45	e	65
ACK	06	&	26	F	46	f	66
BEL	07	'	27	G	47	g	67
BS	08	(	28	H	48	h	68
HT	09	)	29	I	49	i	69
LF	0A	*	2A	J	4A	j	6A
VT	0B	+	2B	K	4B	k	6B
FF	0C	,	2C	L	4C	l	6C
CR	0D	-	2D	M	4D	m	6D
SO	0E	.	2E	N	4E	n	6E
SI	0F	/	2F	O	4F	o	6F
DLE	10	0	30	P	50	p	70
DC1	11	1	31	Q	51	q	71
DC2	12	2	32	R	52	r	72
DC3	13	3	33	S	53	s	73
DC4	14	4	34	T	54	t	74
NAK	15	5	35	U	55	u	75
SYN	16	6	36	V	56	v	76
ETB	17	7	37	W	57	w	77
CAN	18	8	38	X	58	x	78
EM	19	9	39	Y	59	y	79
SUB	1A	:	3A	Z	5A	z	7A
ESC	1B	;	3B	[	5B	{	7B
FS	1C	<	3C	backslash	5C	|	7C
GS	1D	=	3D	]	5D	}	7D
RS	1E	>	3E	^	5E	~	7E
US	1F	?	3F	_	5F	DEL	7F

Figure 10 - ASCII Character Set

11. Technical Specifications

11.1. Communications Specifications

Electrical Standard:	RS 422 or RS 232 C
Baud Rates:	300, 600, 1200, 2400, 4800, 9600
Data Bits:	1 start bit, 8 data bits, 1 stop bit
Parity:	on input to recorder: ignored on output: selectable (odd, even, none)
Handshake:	selectable support for CTS selectable support for XON/XOFF
RS422 Tri-State:	the transmit driver will tri-state in a maximum of 4.5 milliseconds after the last transmitted bit.
Terminations:	screw terminal
Protocol:	based on ANSI X3.28-2.5-A4 binary synchronous (BISYNC) addressing suitable for multi-drop links
Capabilities:	All functions which can be activated through the keypanel of this recorder can be activated through the communication port, exceptingcalibration and communications configuration.

11.2. Option Card Description

The option card is mounted to the case of the recorder adjacent to the Main CPU card assembly. This microprocessor based printed circuit card subassembly contains the circuitry required to support the following options:

2 Loops of PID Control

Serial Communications (RS232 or RS422)

Setpoint Generation

Retransmission

Refer to figure 11 for the following discussion.

Power Supply:

The power supply circuit on the option card converts the unregulated motor voltage into the following voltages:

+5.0 V which supplies the microprocessor and support logic.

Two unregulated power supplies of +15V and -15V for the controller output cards.

Isolated +5.0V for the serial communications circuitry.

The power supply circuit is a square wave DC to DC converter design. The unregulated motor supply voltage is used to drive transformer T1 with a square wave via transistors TR3 and TR4. Regulation of the output voltages is performed by pulse width modulation via switching regulator controller U1. The feedback control is performed by monitoring the 5.0 V output from transformer T1 at the junction of L1 and C5.

Microprocessor and Digital Logic:

The option card uses a standard microprocessor system architecture consisting of an eight bit 6303 CMOS processor with 32k bytes of program memory and 4k bytes of battery backed up CMOS RAM memory. The microprocessor uses a multiplexed address and data bus to control all the I/O operations and memory transfers. The address data is demultiplexed by latch U14. The output of U14 supplies the lower order portion of the address bus to the system memory. The high order address decoding logic is decoded by U13 which generates the strobes for the peripherial interface circuits.

The option card microprocessor communicates with the main CPU card assembly via tri-state latches U6 and U7. These two latches provide an eight bit data path between the two assemblies.

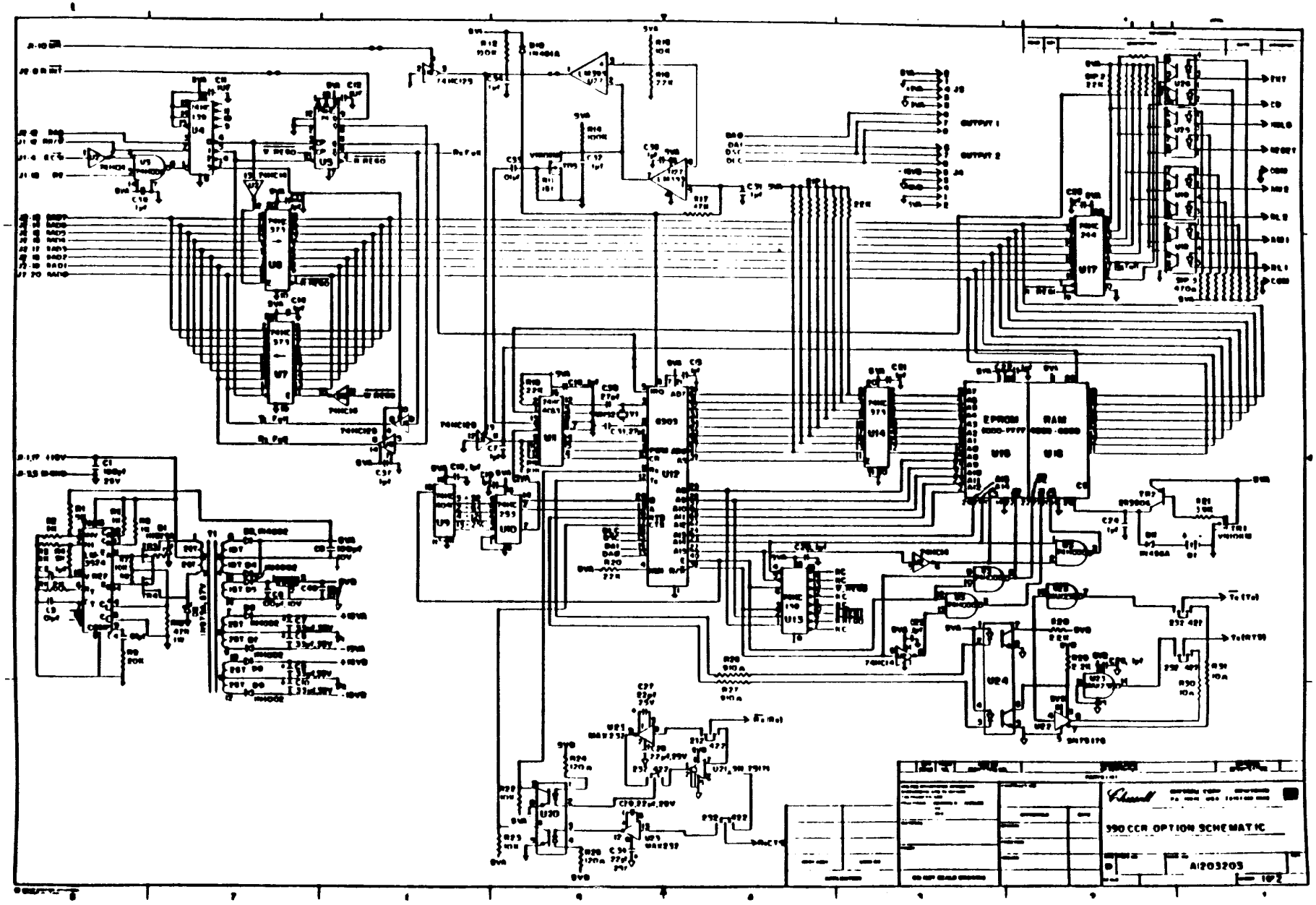
The contact inputs are optically isolated and interfaced to the microprocessor data bus via tri-state buffer U17.

The interface to the two output cards is controlled directly from the microprocessor by means of the 6303 parallel port. The transfer of data to the output cards is performed in a bit serial mode via a data signal, clock signal and load signal.

Serial Communications:

The serial communications interface circuit consists of U21 and U23 that provide the level shifting required for RS-232 or RS-422. The serial communications signal inputs and outputs are optically isolated by isolators U20 and U24.

The baud rate clock generation is performed by U9 which divides the microprocessor clock frequency to the required baud rate frequency.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