COMMUNICATIONS SUPPLEMENT

RS232-C & RS485/422 Data-Link
50XM1000D/N Converter

MICROPROCESSOR-BASED SIGNAL CONVERTER

PN25060

WARNING notices as used in this manual apply to hazards or unsafe practices which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in property damage.

NOTES highlight procedures and contain information which assist the operator in understanding the information contained in this manual.

WARNING

INSTRUCTION MANUALS

Do not install, maintain or operate this equipment without reading, understanding and following the proper ABB Inc. instructions and manuals, otherwise injury or damage may result.

POSSIBLE PROCESS UPSETS

Operation & maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.

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READ FIRST

WARNING

INSTRUCTION MANUALS
Do not install, maintain, or operate this equipment without reading, understanding and following the proper factory-supplied instructions and manuals, otherwise injury or damage may result.

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to the factory for repair must be free of any hazardous materials (acids, alkalis, solvents, etc). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact the factory for authorization prior to returning equipment.

Read these instructions before starting installation;
save these instructions for future reference.

Contacting the Factory. . .

Should assistance be required with any of the company's products, contact the following:

Telephone:

Automation Services Call Center
1-800-HELP-365

E-Mail:

ins.techsupport@us.abb.com

1.0 Data Link Communications

1.1 General Discussion

A digital data link, either RS232-C or RS485/422, can be supplied as an optional feature in the 50XM1000 Signal Converter (see 50XM1000 Instruction Manual Model Number Breakdown, Output Options in Section 1.2). Each of the above options requires the addition of a different hardware module to the converter. The choice of RS232-C communications provides a serial data link between two instruments, e.g., a video display terminal such as a VT100 (or host computer) and the signal converter. RS485 is useful for multi-instrument bus communications and is capable of being expanded to establish a link with up to 32 nodes.

It is common practice to have intelligent instruments (micro-computers) communicate through a network to a centralized control point. This permits plantwide monitoring and supervisory applications by a single operator. The host device uses ASCII PROTOCOL.

When the signal converter is placed in the ASCII communications mode an ASCII terminal, or a computer with the appropriate firmware to emulate an ASCII terminal, can be connected to the data link port. The terminal can then be used to monitor or modify the data base parameters of the converter or other intelligent instruments connected to the data link.

The RS232C interface permits one to one communication between two devices separated by no more than 50 feet (15 m) at baud rates not exceeding 9600 (refer to Figure 1-1).

The RS422A/RS485 interface is a high speed link used by many intelligent instruments. The newer RS485 version, used in the 50XM, permits any transmitter to be shut off or "tri-stated" when not in use. For the company’s instruments, this means that up to 32 instruments may "talk" over one data link. This link can send data at 28.8 k baud over lines up to 4000 feet (1200 m).

It is also possible to communicate with the PC through use of a modem and telephone line. A SCADA Adaptor is required for modem applications. In this arrangement, the number of instruments that may be examined is practically limitless. It should be noted that hardware adapters are available to convert from one type of hardware link to another. In particular, to use a PC with multiple instruments, it might be necessary to purchase one RS232 to RS422/485 converter for use at the PC.

1.1.1 Hardware Implementation

The signal converter may be equipped with one of two different modular PC assemblies for communications, which are:

a) RS232-C (IEC type V24)
b) RS485/422

The RS232-C interface is commonly used in a serial loop (one-to-one). Communications interface RS485 has the capability to serve a larger number of bus-linked users in a multi-drop application.

1.1.1.1 RS232-C Interface (IEC type V24)

RS232-C Engineering Specifications

Electrical transmission mode:	common mode
Number of transmitters:	1
Number of receivers:	1
Cable length maximum:	50 feet (15 m)
Communications rate, maximum:	20 kBaud*
Signal voltage, no load:	±15 volts
Signal voltage under load condition:	±5 volts

RS232-C Installation

I/O TERMINAL ID:

TXD	Transmit Data
RXD	Receive Data
-	Ground

* limited to 9600 baud with 50 feet (15 m) of cable (see Figure 1-1)

1.1.1.2 RS485 Interface

RS485 Engineering Specifications

Electrical transmission mode:	balanced mode
Number of transmitters:	32
Number of receivers:	32
Cable length maximum:	4000 feet (1200 m) (see the following note)
Communications rate, maximum:	10 MBaud
Signal voltage, no load:	5 Volts
Signal voltage under load condition:	1.5 Volts

RS485 Installation

I/O TERMINAL ID:

T+ Transmit Data +

T- Transmit Data -

R+ Receive Data +

R- Receive Data -

NOTE
Refer to applicable system interconnection diagram for signal wiring. Cable length is a function of transmission speed.

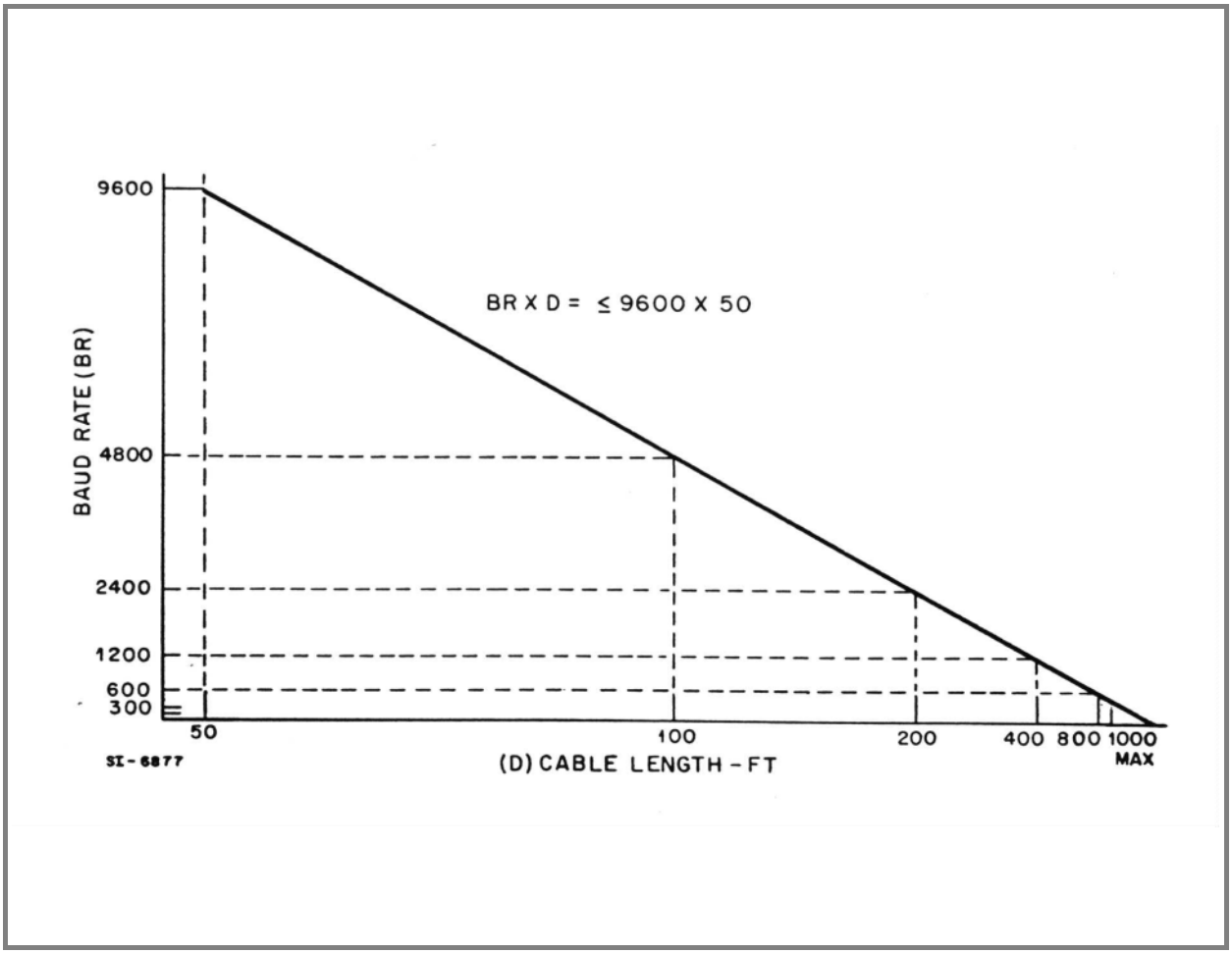

FIGURE 1-1. BAUD RATE VS. CABLE LENGTH FOR RS 232

1.2 ASCII Communications Mode

1.2.1 ASCII Communications Protocol

Communications is always started from the host computer. The signal converter responds only to host inquiries. Any terminal device such as a VT100 or a PC with serial port may be used in this mode but a message must be typed each time a new parameter is desired. Signal converter data may be requested by the host in monitor mode, while data modification by the host is reserved for configuration mode.

Communication via the data link always starts with a 'Start of Header' character (SOH = 01H = <CTRL> A), followed by a 'M' for monitor mode or 'P' for configuration (programming) mode, followed by the two digit instrument address. The address is succeeded by two characters for the requested function, and optionally a maximum of eight data bytes. Carriage return (CR) and line feed (LF) characters are the terminators for a message transfer. A byte is defined as 7 data bits and one stop bit (even parity). An example of signal format is provided in Sub-Section 1.2.2.

The signal converter response also starts with a SOH character, followed by the function characters and optionally up to eight data bytes. Completion of the message is indicated by the CR and LF characters. Message data may be furnished with a minus sign (-) and a decimal point (.) for fractional decimals. Leading or complimentary zeros need not be sent with the message.

All received data is checked by the signal converter in various ways. In addition to checking each transmitted byte for even parity, the converter monitors a message for exact conformance with the protocol conventions (function characters as well as number and type of data). Before the new data is activated, it is examined for validity. In case of nonconformity, an error message is sent back to the host (function character 'X' followed by a two digit error code number). If the data passes the check, it is activated by the 50XM1000 and an acknowledge message of the exact same format as the received message is returned to the host computer. This completes one data exchange.

1.2.2 Monitor Mode

This mode of operation enables the interrogation of all variable parameters as well as status information.

The complimenting protocols are as follows:
a) Host interrogation
Host Computer to signal converter:

```
SOH   M   A1   A0   K1   K0   CR   LF
 .    .    .    .    .    .    .    .
 .    .    .    .    .    .    .    .
 .    .    .    .    .    .    .    Line Feed = 0AH
 .    .    .    .    .    .    Carriage Return = 0DH
 .    .    .    .    two ASCII Function Characters
 .    .    two digit Address in ASCII format.
 .    Monitor Mode
 Start of Header = 01H
```

NOTE
When using a personal computer, the following control characters on the keyboard are used, either individually or in combination, to generate various message characters.

Definition	Message Character	IBM Keyboard	Hex
Start of Header	SOH	<CTRL> A	01
Carriage Return	CR	ENTER	0D
Line Feed	LF	*SHIFT+ENTER	0A
Escape	ESC	*F2	1B

*Applicable only for terminal emulator program EM220. These characters may be generated by other key(s) when using a different emulation program.

b) Response from signal converter
signal converter to host computer:

SOH K1 K0 D7 - D0 CR LF
. . . . . .
. . . . . .
. . . . . Line Feed = 0AH
. . . . Carriage Return = 0DH
. . . maximum 8 ASCII data bytes
. two ASCII Function Characters
Start of Header = 01H

A maximum of eight data bytes including decimal point (.) and minus sign (-) can be sent by the signal converter. The instrument address must always be entered with two digits (00 - 31).

1.2.2.1 Function Characters with Monitor Mode

Function characters are the means of addressing the signal converter operating parameters and status data. Only capital letters are accepted as proper entry. A list of function codes that can be used in monitor mode are given in Table 1-1.

TABLE 1-1. FUNCTION CODES

Display	AN
Damping	DP
Density	DI
Flow Rate in Engr Units	DF
Multiplexed Display	DM
Empty Pipe Detector	DL
Threshold (Empty Pipe Detector)	DS
Error Register 0	ER
Error Register 1	E1
Engr Units for Maximum Flow	EI
Engr Units for Totalizer	EZ
Scaling Factor-Forward Flow	I>
Scaling Factor-Reverse Flow	I<
Current Signal Output	IO
Alarm Current Signal Output	IA
Percentage Flow Rate	M
System Zero Reference	NG
Meter Size	NW
Firmware Version	PR
Maximum Forward Flow Rate (range)	Q>
Maximum Reverse Flow Rate	Q<
Maximum Flow Rate of Meter Size	QN
Status Register	ST
Noise Suppression	SU
Low Flow Cut-off	SM
Language	SP
Totalizer Forward Flow	Z>
Totalizer Reverse Flow	Z<

1.2.2.2 AN: Display

The converter flow rate display units can be in percent or engineering units (e.g. l/min). Data presentation is one digit.

Index No.	Meaning
0	Percent display
1	Engineering units display

Example:

Flow converter with address 00 displays the flow rate in percent.

Host	SOH M 0 0 AN CR LF
Converter	SOH AN 0 CR LF

1.2.2.3 DP: Damping

The damping parameter is presented in seconds, seven data bytes.

Example:

Instrument number 12 is configured for 12.5 seconds damping.

Host	SOH M 1 2 D P CR LF	damping?
Converter	SOH D P 1 2 . 5 0 0 0 CR LF	12.5 s.

1.2.2.4 DI: Density

The density parameter is presented in g/cm^3, seven data bytes.

Example:

Instrument number 03 is configured for 0.8 g/ccm density.

Host	SOH M 0 3 D I CR LF	density?
Converter	SOH D I 0 . 8 0 0 0 0 CR LF	0.8 g/ccm.

1.2.2.5 DF: Flow Rate in Engineering Units

The converter flow rate display is interrogated. Engineering units are as specified under the EI function (1.2.2.11). Data presentation is seven digits.
Example:

The flow rate of converter 00 shall be requested.

Host	SOH M 0 0 E I CR LF	engineering units?
Converter	SOH E I 0 0 1 CR LF	L/minute
Host	SOH M 0 0 D F CR LF	flow rate?
Converter	SOH D F 1 5 . 6 7 0 1 CR LF	15.6701 L/minute

1.2.2.6 DM: Multiplexed Display

Interrogation of the display mode. The presentation is single digit.

Index Number	Meaning
0	Multiplex display mode off
1	Multiplex display mode on

1.2.2.7 DL: Empty Pipe Detector

Interrogation of the empty pipe detector function state (if available). The presentation is single digit.

Index Number	Meaning
0	Empty pipe detector off
1	Empty pipe detector on

1.2.2.8 DS: Threshold Empty Pipe Detector

Interrogation of the current empty pipe detector threshold setting. The presentation is always three digits.

Example:

Instrument at address 12 is requested to report if its empty pipe detector is activated and what the threshold level is.

Host	SOH M 1 2 D L CR LF	detector status?
Converter	SOH D L 1 CR LF	on.
Host	SOH M 1 2 D S CR LF	threshold level?
Converter	SOH D S 0 7 5 CR LF	75.

1.2.2.9 ER: Error Register 0

> NOTE
> Do not confuse data presented in the Error Registers with the error codes described in section 1.3.1 and 1.3.2.

This data register provides information about the processor recorded errors. The eight register bits represent eight different error types which are displayed as ASCII characters with the following format:

```
Bit7   Bit6   Bit5   Bit4   Bit3   Bit2   Bit1   Bit0
.      .      .      .      .      .      .      .
.      .      .      .      .      .      .      .
.      .      .      .      .      .      .      ERROR 1
.      .      .      .      .      .      .      A/D converter
.      .      .      .      .      .      .      positive out of range
.      .      .      .      .      .      ERROR 2
.      .      .      .      .      .      Vref too low
.      .      .      .      .      ERROR 3
.      .      .      .      .      flow rate exceeding 130%
.      .      .      .      ERROR 4
.      .      .      .      external cut off
.      .      .      ERROR 5
.      .      .      NVRAM data corrupted
.      .      ERROR 1.      .      A/D converter negative out of range
.      ERROR 7
.      Vref too high (negative)
ERROR 8
Vref too high (positive)
```

Error messages are valid if the appropriate bits are set in the error register and if bit 7(=1) of the status register is set simultaneously (ST - 1.2.2.24). Data presentation is always eight digits long.

Example:

Instrument 05 is interrogated.

Host	SOH M 0 5 E R CR LF	error?
Converter	SOH E R 0 0 0 0 0 1 0 0 CR LF	error 3.

Converter 05 reports an error: flow rate > 130 %.

1.2.2.10 E1: Error Register 1

See Error Register 0 (1.2.2.9 ER).

Bit7 Bit6 Bit5 Bit4 Bit3 Bit2 Bit1 Bit0

.

.

ERROR 0
empty pipe

(Bit 1 through bit 7 have no meaning.)

1.2.2.11 EI: Engineering Units for Maximum Flow

Units for Qmax DN (QN - 1.2.2.23), Qmax forward and reverse flow rate (Q> - 1.2.2.21), Qmax reverse flow rate (Q< - 1.2.2.22), and current flow rate in engineering units (DF - 1.2.2.5).

Data representation is always three digits.

Index numbers 224, 225 and 226 (US thousand gallons) are configurable (see Table 1-2). Default is in US thousand gallons (refer to 3.3.12).

TABLE 1-2. ENGINEERING FLOW UNIT INDEX

Index Number	Symbol	Definition
000	l/s	Liters
001	l/min	
002	l/h	
016	hl/s	Hectoliters
017	hl/min	
018	hl/h	
032	m^3/s	Cubic Meters
033	m^3/min	
034	m^3/h	
048	igps	Imperial Gallons
049	igpm	
050	igph	
064	mgd	US Gallons
065	gpm	
066	gph	
080	bbl/s	Barrels (31 gal)
081	bbl/min	
082	bbl/h	
096	bls/day	Barrels (42 gal)
097	bls/min	
098	bls/h	
112	kg/s	Kilograms
113	kg/min	
114	kg/h	
128	t/s	Metric Tons
129	t/min	
130	t/h	
144	gram/s	Grams
145	gram/min	
146	gram/h	
160	ml/s	Milliliters
161	ml/min	
162	ml/h	
176	Ml/min	Megaliters (million liters)
177	Ml/h	
178	Ml/day	
192	lbs/s	Pounds
193	lbs/min	
194	lbs/h	
208	uton/min	US Tons
209	uton/h	
210	uton/day	
224	kgal/s	US thousand gallons (configurable)
225	kgal/min	
226	kgal/h	

1.2.2.12 EZ: Engineering Units for Totalizer

This parameter defines the engineering units for the flow totalizers (Z> - 1.2.2.28), reverse flow totalizer (Z< - 1.2.2.29), flow scaling factor (I> - 1.2.2.13).

Data representation is always three digits.

TABLE 1-3. TOTALIZATION UNIT INDEX

Index Number	Symbol	Definition
000	l	Liters
001	hl	Hectoliters
002	m^3	Cubic Meters
003	igal	Imperial Gallons
004	ugal	US Gallons
005	umg	Million US Gallons
006	bbl	Barrels (31 gal)
007	bls	Barrels (42 gal)
008	kg	Kilograms
009	t	Metric Tons
010	g	Grams
011	ml	Milliliters
012	Ml	Megaliters
013	lbs	Pounds
014	uton	US Tons
*015	kgal	US thousand gallons

* configurable

Example:
The Totalizer value of flow converter 07 is to be requested.

Host	SOH M 0 7 E Z CR LF	totalizer engrg. units?
Converter	SOH E Z 0 0 2 CR LF	m^3
Host	SOH M 0 7 Z > CR LF	forward flow totalizer?
Converter	SOH Z > 1 2 4 . 5 0 0 CR LF	124.5 m^3

1.2.2.13 I> : Scaling Factors: Forward and Reverse Flow

Output of the pulse scaling factor for forward flow (pulses/unit). Engineering units are stored with the Totalizer (EZ) parameter (see 1.2.2.12). Data presentation is seven data bytes.

Example:
The pulse scaling factor for forward flow of Signal Converter 07 is to be requested.

Host	SOH M 0 7 E Z CR LF	totalizer engrg. units?
Converter	SOH E Z 0 0 2 CR LF	m^3
Host	SOH M 0 7 I > CR LF	pulse scaling factor-forward flow?
Converter	SOH I > 1 0 . 0 0 0 0 CR LF	10 pulses/m^3

1.2.2.14 I< : Scaling Factor Reverse Flow

See Scaling Factor Forward Flow (1.2.2.13).

1.2.2.15 IO: Current Signal Output

The presently configured current output signal is coded into a three digit parameter.

Index Number	Meaning
000	0-20 mA
001	4-20 mA
002	0-10 mA
003	2-10 mA
004	0-10-20
005	4-12-20

1.2.2.16 IA: Alarm Current Signal Output

In case of an alarm status both the current and frequency outputs will go to the predetermined value. Data presentation is a single digit.

Index Number	Meaning
0	0%
1	130%

1.2.2.17 M: Percentage Flow Rate

In this case only one function character needs to be sent, a second one will be ignored.

Depending on the flow direction the converter will respond either with a '>' for forward flow or with a '<' character for reverse flow as the second function character. Data presentation is six digits .

Example:
The flow rate of converter 08 is interrogated.

Host	SOH M 0 8 M CR LF	flow rate?
Converter	SOH M < 9 0 . 0 1 5 CR LF	90.015% reverse.

1.2.2.18 NG: System Zero Reference

Report the configured system zero reference in Hz. Data presentation is six digits.

Example:
Instrument 07 is requested to send its system zero reference data.

Host	SOH M 0 7 N G CR LF	zero reference?
Converter	SOH N G 1 . 5 6 3 3 CR LF	1.5633 Hz

1.2.2.19 NW: Meter Size (The meter size is reported as a three digit index number.)

TABLE 1-4. INDEX OF METER SIZES

Index Number	Meter Sizes	
	inches	mm
000	1/10	3
001	5/32	4
002	3/16	5
003	1/4	6
004	5/16	8
005	3/8	10
006	1/2	15
007	3/4	20
008	1	25
009	1 1/4	32
010	1 1/2	40
011	2	50
012	2 1/2	65
013	3	80
014	4	100
015	5	125
016	6	150
017	8	200
018	10	250
019	12	300
020	14	350
021	16	400
022	18	450

Index Number	Meter Sizes	
	inches	mm
023	20	500
024	24	600
025	28	700
026	30	750
027	32	800
028	36	900
029	40	1000
030	42	1100
031	48	1200
032	51	1300
033	54	1400
034	60	1500
035	64	1600
036	66	1700
037	72	1800
038	78	2000
043	1/25	1
045	1/12	2
44	1/17	1.5
39	82	2100
40	86	2200
41	90	2300
42	94	2400

Example:

The converter at address 25 is requested to report the meter size.

Host	SOH M 2 5 N W CR LF	meter size?
Converter	SOH N W 0 2 3 CR LF	20 inch (500 mm)

1.2.2.20 PR: Firmware Version

Reporting of the firmware version number. The data length is eight alphanumerics.

Example:

What is the firmware version number of Instrument 09?

Host	SOH M 0 9 P R CR LF	firmware version?
Converter	SOH P R B 123 A11 CR LF	Rev. D.10 implemented

1.2.2.21 Q>: Maximum Flow Rate (Range)

Reporting of the setting of Qmax forward flow rate. Engineering units are stored with parameter EI, section 1.2.2.11. The presentation is seven data bytes.

1.2.2.22 Q<: Maximum Reverse Flow Rate

Reverse flow rate is automatically set to the same value as the forward flow rate (see 1.2.2.21).

1.2.2.23 QN: Maximum Flow Rate of Meter Size

Qmax of set meter size at a flow velocity of 10 m/s. Engineering units are stored with parameter EI, section 1.2.2.11. The presentation is seven data bytes.

Example:

Converter 07 is requested to report Qmax DN, Qmax forward flow and Qmax reverse flow. The engineering units are to be reported first.

Host	SOH M 0 7 E I CR LF	engineering units?
Converter	SOH E I 0 0 1 CR LF	l/min
Host	SOH M 0 7 Q N CR LF	Qmax DN?
Converter	SOH Q N 1 5 0 . 0 0 0 CR LF	150.0 l/min
Host	SOH M 0 7 Q > CR LF	Qmax forward?
Converter	SOH Q > 7 5 . 0 0 0 0 CR LF	75.0 l/min
Host	SOH M 0 7 Q < CR LF	Qmax reverse?
Converter	SOH Q < 7 . 0 0 0 0 0 CR LF	7.0 l/min

1.2.2.24 ST: Status Register

The status register bits are represented as ASCII characters '0' or '1' in the following order:

```
Bit7  Bit6  Bit5  Bit4  Bit3  Bit2  Bit1  Bit0
.     .     .     .     .     .     .     .
.     .     .     .     .     .     .     .
.     .     .     .     .     .     .     forward flow totalizer
.     .     .     .     .     .     .     overflow
.     .     .     .     .     .     reverse flow totalizer
.     .     .     .     .     .     overflow
.     .     .     .     .     internally used
.     .     .     .     parameter change via keypad
.     .     .     .     (automatically reset when being used)
.     .     .     internally used
.     .     low flow cut-off enabled
.     internally used
error register messages are valid
```

Data is presented as eight characters. For example, the "status" response from the instrument at address 09 could be:

Host	SOH M 0 9 S T CR LF	status
Converter	SOH S T 0 0 0 0 0 0 1 1 CR LF	forward and reverse flow totalizers overflow

1.2.2.25 SU: Noise Suppression

Parameter reflects the status of the digital filter. One data byte.

Index Number	Meaning
0	noise suppression off
1	noise suppression on

Example:

Host	SOH M 0 0 S U CR LF	filter instrument 00 on ?
Converter	SOH S U 1 CR LF	yes.

1.2.2.26 SM: Low Flow Cut-Off

Reporting of the low flow cut-off level in percent. Data format is seven bytes long.

Example:

Level of low flow cut-off of instrument 01.

Host	SOH M 0 1 S M CR LF	low flow cut-off?
Converter	SOH S M 1 . 5 0 0 0 0 CR LF	1.5 percent

1.2.2.27 SP: Language

Reporting of the currently set signal converter language as a three digit index number.

TABLE 1-5. LANGUAGE INDEX

Index Number	Language
000	German
001	English
002	French
003	Italian
004	Spanish
005	Finnish
006	Dutch
007	Danish
008	Swedish

Example:

Which language is used for the message display of Converter 23?

Host	SOH M 2 3 S P CR LF	language?
Converter	SOH S P 0 0 1 CR LF	English

1.2.2.28 Z>: Totalizer Forward Flow

Reporting of the forward flow totalizer contents. The presentation is dependent on the forward flow pulse scaling factor. Engineering units are stored in parameter EZ, paragraph 1.2.2.12. Data format is seven data bytes.(See 1.2.2.29 for example.)

1.2.2.29 Z<: Totalizer Reverse Flow

Reporting of the reverse flow totalizer contents. The presentation is dependent on the reverse flow pulse scaling factor. Engineering units are stored in parameter EZ, paragraph 1.2.2.12. Data format is seven data bytes.

Example:
The flow totalizer contents of signal converter 07 are to be interrogated.

Host	SOH M 0 7 E Z CR LF	totalizer engineering units?
Converter	SOH E Z 0 0 2 CR LF	m^3.
Host	SOH M 0 7 Z > CR LF	forward flow total?
Converter	SOH Z > 1 2 4 . 5 0 0 CR LF	124.5 m^3
Host	SOH M 0 7 Q < CR LF	reverse flow total?
Converter	SOH Z < 9 9 9 7 7 . 0 CR LF	99977 $m^{3.}$

1.2.3 Configuration Mode

Configuration mode provides the capability to change parameters or to execute a function. This is made possible by means of the function codes. The host addresses the signal converter as follows:

> NOTE
> Floating point numbers can be 7 characters including the decimal point. Table selection numbers can have leading zeros and be up to 3 characters.

Host Computer to Signal Converter

```
SOH  P  A1  A0  K1  K0  D7 - D0  CR  LF
.    .  .       .       .        .   .
.    .  .       .       .        .   .
.    .  .       .       .        .   Line Feed
.    .  .       .       .       Carriage Return
.    .  .       .      8 ASCII data bytes maximum
.    .  .      two ASCII Function Characters
.    .  two digit address in ASCII format
.    Configuration Mode
Start of Header = 01H
```

Response from Signal Converter:

```
Signal Converter to Host Computer
SOH  K1  K0  D7 - D0  CR  LF
.    .       .        .   .
.    .       .        .   .
.    .       .        .   Line Feed = 0AH
.    .       .       Carriage Return = 0DH
.    .      maximum 8 ASCII data bytes
.    two ASCII Function Characters
Start of Header = 01H
```

If the input is numerically out of limits, the converter responds with an error message:

```
SOH  X  F1  F0  CR  LF
.    .  .   .   .   .
.    .  .   .   .   .
.    .  .   .   .   Line Feed = 0AH
.    .  .   .   Carriage Return = 0DH
.    .  two digit ASCII error code
.    X for Error Message
Start of Header
```

1.2.3.1 Configuration Mode Functions

1.2.3.2 AD: Address

The instrument address of the signal converter can be changed via the communications link. After the change the converter responds to the new instrument address. Maximum three data bytes.

Data value range:

0 < = entry < 100

Possible error message:

Error Code	Cause
22	entry > 99

Example:

Instrument address 01 is changed to address 00.

Host	SOH P 0 1 A D 0 0 CR LF
Converter	SOH A D 0 0 CR LF

1.2.3.3 AN: Display

The converter flow rate display can be in percent or engineering units. Decimal point and minus sign are ignored. Three data bytes maximum. Configuration is implemented by use of an index number:

Index Number	Meaning
0	Percent display
1	Engineering units display

Example:

The signal converter whose address is 06 shall display the flow rate in percent.

Host	SOH P 0 6 A N 0 0 0 CR LF
Converter	SOH A N 0 0 0 CR LF

1.2.3.4 BA: Baud Rate

The signal converter serial communications transmission speed can be reconfigured by changing the BA function parameter. After the change the converter operates with the new baud rate. No response message is issued to this configuration change. In case of an unsuccessful parameter change the converter issues an error message containing the old and still valid baud rate. The transmission baud rate is configured by an encoded index number. Refer to Table 1-6 below.

> NOTE
> The Baud rate can be set higher than the rate at which the particular combination of terminal and converter can operate. Also, any inadvertent change in the baud rate that results in a mis-match between the terminal and the converter can cause a loss of communication. A 1200 Baud rate is recommended as the upper limit for ASCII mode.

TABLE 1-1. BAUD RATE INDEX

Index Number	Baud
000	110
001	300
002	600
003	1200
004	2400
005	4800
006	9600
007	14400
008	28800

Note: The host will have to operate at the new baud rate when this command is given.

Possible error message:

Error Code	Cause
24	entry > 8

Example:

The communications transmission speed of instrument 0 is to be set to 1200 Baud.

Host	SOH P 0 0 B A 3 CR LF
Converter	no response (change successful)

1.2.3.5 DP: Damping

Configuration parameter for signal damping. Maximum of seven data bytes including decimal point. Engineering units are seconds.

Valid data range:

0 < = entry < 100

Possible error messages:

Error Code	Cause
20	entry > = 100.0
21	entry < 0

Example:

The damping of instrument 05 is to be set to 11.5 seconds.

Host	SOH P 0 5 D P 1 1 . 5 CR LF
Converter	SOH D P 1 1 . 5 CR LF

1.2.3.6 DI: Density

Configuration parameter for density in g/cm^3. Maximum of seven data bytes including decimal point.

Valid data range:

0.01 < = entry < 5

Possible error messages:

Error Code	Cause
44	entry > 5.0
45	entry < 0.01
40	Maximum totalizer pulse signal frequency (forward or reverse flow) 10 kHz

Example:

The density parameter of the flow converter with instrument address 15 is to be set to 2.2845 g/cm^3.

Host	SOH P 1 5 D I 2 . 2 8 4 5 CR LF
Converter	SOH D I 2 . 2 8 4 5 CR LF

1.2.3.7 DM: Multiplexed Display

The display mode 'Multiplex Display' can be switched by an index number.

Index Number	Meaning
0	Multiplex display mode off
1	Multiplex display mode on

Example:

Display mode 'Multiplex Display' is to be set for instrument 31.

Host	SOH P 3 1 D M 1 CR LF
Converter	SOH D M 0 0 1 CR LF

1.2.3.8 DR: Empty Pipe Detector

The empty pipe detector function state can be switched by an index code number.

Index Number	Meaning
0	Empty pipe detector off
1	Empty pipe detector on

1.2.3.9 DS: Empty Pipe Detector Threshold

The empty pipe detector threshold setting can be changed within the limits 0 to 155. The data presentation is always three digits in length.

Valid data range:
0 < = entry < 156

Possible error messages:

Error Code	Cause
56	entry > 155

1.2.3.10 EI: Engineering Units for Maximum Flow

The engineering units are configured by a three digit index number for Qmax DN (QN), Qmax forward flow rate (Q>), Qmax reverse flow rate (Q<), and current flow rate (DF) in engineering units. Refer to Table 1-2 for Flow Unit Index.

Possible error messages:

Error Code	Cause
48	wrong index number

Example:
Signal Converter 06 shall be set for a flow rate in l/min:

Host	SOH P 0 6 E I 0 0 1 CR LF
Converter	SOH E I 1 CR LF

1.2.3.11 EZ: Engineering Units for Totalizer

The engineering units are configured by a three digit index number. This parameter defines the units for the forward flow totalizer (Z>), reverse flow totalizer (Z<), flow scaling factor (I>), and reverse flow scaling factor (I<). Refer to Table 1-3 for Totalization Unit Index.
Possible error messages:

Error Code	Cause
52	index number > 9
40	Totalizer pulse frequency > 4 kHz

Example:

The flow converter 06 shall be set for totalizing m^3.

Host	SOH P 0 6 E Z 0 0 2 CR LF
Converter	SOH E Z 2 CR LF

1.2.3.12 I> and I<: Pulse Scaling Factor

I> is the configuration parameter for the forward flow scaling factor (Pulses/engineering unit). I< is the configuration parameter for the reverse flow scaling factor Engineering units are stored with the Units for Totalizer (EZ) parameter. Data presentation is seven data bytes.

Valid data range:

0.001 < = entry < = 1000

Possible error messages:

Error Code	Cause
38 (I> only)	entry > 1000
39 (I> only)	entry < 0.001
40	maximum pulse frequency > 4 kHz

Example:

The pulse scaling factor for Signal Converter 23 is to be set to 100.0 pulses/unit.

Host	SOH P 2 3 I > 1 0 0 . 0 0 0 CR LF
Converter	SOH I > 1 0 0 . 0 0 0 CR LF

1.2.3.13 IO: Current Signal Output

The configured output signal is encoded into a three digit parameter.

Index Number	Meaning
000	0 - 20 mA
001	4 - 20 mA
002	0 - 10 mA
003	2 - 10 mA
004	0 - 10 - 20 mA
005	4 - 12 - 20 mA

Possible error messages:

Error Code	Cause
62	entry >

1.2.3.14 IA: Alarm Current Signal Output

In case of an alarm condition the current and frequency outputs will go to the predetermined value. The maximum data length is three digits.

Index Number	Meaning
0	0%
1	130%

1.2.3.15 LZ: Totalizer Reset

This instruction resets the overflow condition status message (see ST: Status Register, 1.2.2.24) and the totalizers for both flow directions. No data is transmitted.

Example:
The totalizers of instrument 00 are reset.

Host	SOH P 0 0 L Z CR LF
Converter	SOH L Z CR LF

1.2.3.16 LV: Forward Flow Totalizer Reset

This instruction resets the overflow condition status message (see ST: Status Register, 1.2.2.24) and the forward flow totalizer.

Example:
The forward flow totalizer of instrument 00 is to be reset.

Host	SOH P 0 0 L V CR LF
Converter	SOH L V CR LF

1.2.3.17 LR: Reverse Flow Totalizer Reset

This instruction resets the overflow condition status message (see ST: Status Register, 1.2.2.24) and the reverse flow totalizer.

Example:

The reverse flow totalizer of instrument 00 is to be reset.

Host	SOH P 0 0 L R CR LF
Converter	SOH L R CR LF

1.2.3.18 NW: Meter Size

The meter size is configured with a three digit index number. Refer to Table 1-4 for Index of Meter Sizes.

Error Code	Cause
30	entry > 45

1.2.3.19 NG: System Zero Reference

System zero reference may be configured +/- 500 Hz where the flow direction is marked by the sign designator (- for reverse, + for forward flow).

Valid data range:

- 500 < = entry < = 500

Possible error messages:

Error Code	Cause
54	entry > 500 or entry < -500

1.2.3.20 Q> and Q<: Maximum Flow Rate (Range)

Configuration of the setting of Qmax for flow rate. Engineering units are stored with parameter EI, Section 1.2.2.11 (see Table 1-2). The parameter data length is seven data bytes maximum:

Valid data range:

0.05 Qmax DN < = entry < = Qmax DN

Possible error messages:

Error Code	Cause
10	entry > Qmax DN
11	entry < 0.05 Qmax DN

Example:

The maximum forward flow setting of instrument 20 is to be set to Qmax = 125 l/s.

Host	SOH P 2 0 Q > 1 2 5 CR LF
Converter	SOH Q > 1 2 5 CR LF

1.2.3.21 QN: Maximum Flow Rate of Meter Size

If the Range DN parameter is set to "programmable", it is possible to directly configure the Qmax DN parameter. The configuration procedure is as described under 1.2.2.23 for Q>: Max Forward Flow Rate (refer to 3.3.3).

Valid data range:

0 < entry < 9 999 999

Possible error messages:

Error Code	Cause
12	Qmax DN not configurable
13	entry < = 0

1.2.3.22 SM: Low Flow Cut-Off

Configuration of the low flow cut-off parameter in percent. Data length is seven digits maximum.

Valid data range:

0 < = entry < = 10

Possible error messages:

Error Code	Cause
16	entry > 10.0
17	entry < 0.0

Example:

The low flow cut-off parameter of instrument 27 is to be set to 1.5%.

Host	SOH P 2 7 S M 1 . 5 0 0 CR LF
Converter	SOH S M 1 . 5 0 0 0 0 CR LF

1.2.3.23 SP: Language

Configuration of the flow converter's display language as a three digit index number. Refer to Table 1-5 for Language Index.

Possible error messages:

Error Code	Cause
36	entry > 8

1.2.3.24 SU: Noise Suppression

Switching of the noise suppression filter on or off.

Index Number	Meaning
0	filter off
1	filter on

Example:

Noise suppression of instrument 02 has to be switched on.

Host	SOH P 0 2 S U 1 CR LF
Converter	SOH S U 1 CR LF

1.3 Error Messages

The signal converter data received is checked for conformance with the communications protocol and for validity. If an error is detected the converter returns an error message:

```
SOH  X  F1  F0  CR  LF
.    .  .       .   .
.    .  .       .   .
.    .  .       .   Line Feed = 0AH
.    .  .       Carriage Return = 0DH
.    .  two digit error code in ASCII
.    X for error message
Start of Header
```

1.3.1 Protocol and Communications Errors

Error No.	Cause
01	Bad operation mode (M for Monitor Mode and P for Configuration Mode only)
02	Bad function characters
03	Configuration not permitted, since this is a protected calibration parameter
04	Number of data bytes exceeded
05	Parity error

Example:

The instrument at address number 11 should have been configured for 100 l/min. The number of transmitted parameter configuration data bytes however, was eight instead of seven.

Host	SOH P 1 1 Q > 1 0 0 . 0 0 0 0 CR LF
Converter	SOH X 0 4 CR LF

1.3.2 Configuration Error Messages

Error No.	Function Character	Cause
10	Q > Q <	Entry > Qmax DN
11	Q > Q <	Entry < 0.05 Qmax DN
12	QN	Qmax DN not configurable
13	QN	Qmax DN < = 0
16	SM	Entry > 10
17	SM	Entry < 0
20	DP	Entry > = 100
21	DP	Entry < 0
22	AD	Entry > 99
24	BA	Entry > 8
30	NW	Entry > 45
36	SP	Entry > 8
38	I>	Entry > 1000
39	I>	Entry < 0.001
40	I > I < DI EZ	Totalizer frequency > 4 kHz
44	DI	Entry > 5
45	DI	Entry < = 0.01
48	EI	Bad Index Number
52	EZ	Entry > 9
54	NG	Entry > 500 or < -500
56	DS	Entry > 155
62	IO	Entry > 5

1.4 Remote Display

A "live" remote display of the 50XM1000 function can be implemented by use of a data terminal that is connected via the serial communications link. All information which is displayed by the converter's self-contained indicator can also be viewed at the data terminal in this operation mode. Also, the 50XM1000 Converter is configurable from the data terminal.

For communications 1200 or 2400 Baud is recommended. Two typical terminal types are discussed below.

a) ANSI Terminal (i.e. VT100)
b) Data Terminal (Teletype)

1.4.1 ANSI Terminal

Communication with an ANSI terminal is established with the following instruction:

```
SOH  P  A1  A0  ESC  X  A  N  S  I  CR  LF
.    .  .   .   .    .  .  .  .  .  .   .
.    .  .   .   .    .  .  .  .  .  .   Line Feed = 0AH
.    .  .   .   .    .  .  .  .  .  Carriage Return = 0DH
.    .  .   .   .    .  .  .  .  ANSI
.    .  .   .   .    .  X
.    .  .   .   ESC = 1BH
.    .  two digit Instrument Address in ASCII
.    P for Configuration Mode
Start of Header = 01H
```

The connection is terminated with the instruction.

ESC O S

The 50XM1000 Converter transmits and receives control characters for the following functions:

ESC Sequence/Control Character	Function
ESC [2 J ESC H	clear screen and cursor home
ESC [H	cursor home
ESC [2 ; 1 H	position cursor at beginning of second line
ESC [C	move cursor right
ESC [D	move cursor left
BEL	ring bell
<CTRL> J	down
<CTRL> K	up
enter	enter
BSP	clear

For proper communication, the following terminal keys must be available:

TABLE 1-7. ANSI TERMINAL KEYS

Key	**ASCII Character**	**HEX Code**
0	0	30
1	1	31
2	2	32
3	3	33
4	4	34
5	5	35
6	6	36
7	7	37
8	8	38
9	9	39
.	.	2E
RETURN	CR	0D
DEL(BSP)	DEL	7F
-	-	2D
LF	<CTRL> J	0A
VT	<CRTL> K	0B

1.4.2 Data Terminal

If a data terminal is used as a remote display station, the following instruction must be used for establishing communications.

```
SOH  P  A1  A0  ESC  X  T  E  R  M  CR  LF
.    .  .       .    .  .           .   .
.    .  .       .    .  .           .   .
.    .  .       .    .  .           .    Line Feed = 0AH
.    .  .       .    .  .          Carriage Return = 0DH
.    .  .       .    .  TERM
.    .  .       .    X
.    .  .       ESC = 1BH
.    .  two digit Instrument Address in ASCII
.    P for Configuration Mode
Start of Header = 01H
```

The connection is terminated with the instruction.

ESC O S

The 50XM1000 Converter utilizes the following control characters:

Control Character		Function
ASCII	HEX	
CR LF	0D 0A	move cursor to beginning of next line
VT CR	0B 0A	move cursor to beginning of previous line
CR	0D	move cursor to beginning of current line
HT	09	move cursor to right
BS	08	move curser to left
BEL	07	ring bell

For operation, refer to 1.4.1 for terminal key assignment.

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