
***SMARTEYE* Electronic Assembly**

User Manual

Revision 8

Version 096 Rev. 9



SMARTEYE
CORPORATION

www.smarteyecorporation.com

related documents:

SMARTEYE Sender/Receiver Reader User Manual

SMARTEYE Retroreflective Reader User Manual

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1.0 Introduction

A Smarteye system consists of a Smarteye Electronic Assembly (SEA) electrically connected to one or more Smarteye Readers. As many as eight readers can be connected to a single SEA.

Smarteye Readers sense an identification number coded into a Smarteye Label. When a label moves past a reader, signals are sent from the reader, enabling the SEA to determine the label identification number.

Smarteye Labels are typically constructed of 12 gauge steel and come in a variety of lengths to suit specific application requirements. A label contains a pattern of punched slots which can be detected by a reader as the label moves past it. Smarteye Labels are easily installed and well suited to the rugged industrial environment.

A Smarteye Electronic Assembly processes label inputs from Smarteye Readers and communicates this information (in ASCII form) to a control device such as a programmable controller or a host computer. Four different communication modes are supported, including one which provides a parallel input/output interface to a programmable controller.

An optional front panel display allows the SEA to display the activity at each of the readers either in real time or in review. Reader diagnostic information and communication line errors are also displayed.

2.0 SEA Types

The Electronic Assembly comes in two versions: a NEMA-12 type and a Panel Mount style. The NEMA-12 SEA has a sealed cabinet and can be mounted in the open. The Panel Mount SEA has an open-type enclosure and is designed to be mounted in the user's NEMA-12 panel. Either SEA can be ordered with or without a front panel display.

The Electronics Assembly enclosure includes the following major items:

1. AC power terminals, fusing and power switch.
2. Smarteye CPU circuit card.
3. Field interface circuit card with optical isolation circuitry to separate field signals from processor signals. Plug in screw terminals are provided for connection to field wiring from readers. Also included is a plug in screw terminal for communication line connection.
4. Power supplies for readers, CPU, and communication line operation.
5. Optional front panel display.

3.0 SEA Installation

The Smarteye Electronic Assembly is designed to function in the environment found in most industrial facilities. An SEA is often used to support a programmable controller and will operate properly in the same environment. It is rated for operation at temperatures from **0 to 50° C**.

Electromagnetic interference on signal lines will not be a problem if the recommended cables are used for equipment interconnections. The recommended cables will provide adequate shielding.

SEAs should be mounted so the switches are accessible and the front panel display can be seen conveniently.

On NEMA-12 units, conduit should enter the SEA from the bottom. If necessary, conduit may enter through the sides of the SEA. **Installation of the conduit through the top of the SEA is not recommended, as metal chips and pulling compound may fall into the power supplies.**

Mounting dimensions and conduit locations for both the Panel Mount SEA and the NEMA-12 SEA can be found on drawing #SP1062/01-421-1 at the end of this document.

4.0 AC Power/Wiring

The Smarteye Electronic Assembly requires 0.4 amps at 120 VAC (50VA). The input voltage may vary from 100-250 VAC 50-60 Hz. Three terminals for AC power connections are located at the upper right corner of the NEMA-12 enclosure. The Panel Mount SEA has three terminals for AC power connections, located on the exterior right side of the enclosure. These terminals provide connections for L1, N, and ground. A glass type 3 amp fuse is used to protect the hot side of the line for both SEA types. A two-pole power switch opens both sides of the AC line circuit in the OFF position.

The Smarteye Electronic Assembly has been designed to be as immune to AC power line fluctuations as is practical. However; like most electronic equipment, it can be susceptible to 'brownouts' and severe voltage 'spikes'. The SEA should be powered with an AC line which is fed from the secondary of a transformer whose primary is electrically as close to the main power source of the facility as possible. The AC line can supply other, similar electronic equipment such as programmable controllers, but should not power any heavy industrial equipment that causes excessive line fluctuations such as motors, motor starters, welders, etc.

All applicable codes and ordinances should be observed for wiring AC power and ground, particularly the National Electrical Code published by the National Fire Protection Association of Boston, Massachusetts.

5.0 Power Supplies

Two power supplies are included in the Smarteye Electronic Assembly enclosure. A 15 volt supply provides power for the readers connected to the SEA. This supply is completely isolated from the power supply that powers the processor within the enclosure.

A triple output power supply, +5, +12 and -12 volt, provides the power for the CPU circuit card, display card, and the serial data communication link.

Both power supplies include a screw for adjusting their output voltage. Using a voltmeter, the output voltage may be adjusted to the listed nominal value.

The power supplies include automatic current limiting circuitry with automatic recovery, which limits short circuit output current to a safe value. This provides protection against damage due to accidental shorting.

6.0 Communication Line Wiring

Communication line connections are made with screw terminals on a green snap-in plug which mates to the SEA in the lower left corner of the Field Interface circuit board. Six connections are provided. Belden 9730 cable or equivalent (3 shielded pairs, 24 gauge) is recommended for RS422 connections; Belden 8723 or equivalent (2 shielded pairs, 22 gauge) is recommended for RS232 connections. A drawing of the Field Interface board (SP1002/02-420-1) and a detailed wiring drawing (SP1024/01-412-1) can be found in Appendix 'B' at the end of this document.

7.0 Reader Wiring

Pre-wired to each of the three receiver photoeyes in a reader assembly is a six-foot long cable. These three cables are labeled: A, B, C. Pre-wired to the sender photoeye is a single twenty-five foot long unlabeled cable. All four cables must terminate at a field junction box mounted less than six cable feet from the receiver. The junction box should provide six screw terminals labeled: +, -, A, B, C, and SHIELD.

The Smarteye Electronic Assembly is connected to the readers through its Field Interface card. The Field Interface provides eight plug-in screw terminals (black) for the Smarteye Reader connections. Belden 9773 (3 shielded pairs, 18 gauge) is recommended for connecting the Field Interface card to the junction box.

7.1 Reflective Reader Wiring

The case of each photoeye and its cable are tagged A, B or C. Cabling details can be found on drawing #SP1040/01-410-1 (Appendix 'B').

Note:

1. Readers are delivered with the white signal wires of the photoeyes prepared for termination and with the green wires tied back with shrink wrap. The green signal wires are logically inverse to the white wires and are not used.
2. All references to + and - refer to the 15VDC supply of the Smarteye Electronic Assembly.
3. The drain wires of the Belden 9773 cable are normally connected to DC ground at the SEA. This is accomplished with the jumper block (JB1-1) on the Field Interface circuit card. If the distance between the SEA and the reader is greater than 1000 feet, or the environment is electrically noisy, then it may be necessary to connect the drain to DC ground at the reader's junction box. This is accomplished with a jumper wire installed at the junction box. Do not connect the drain at both ends of the cable. Remove the jumper block (JB1-1) at the SEA if a jumper wire is used at the junction box. Never connect the drain to chassis ground.

7.2 Sender/Receiver Reader Wiring

The three receiver cables are labeled A, B, or C. The sender photoeye has a single unlabeled cable.

An optional junction box for the sender is used if extra cable length is required. This junction box should provide two screw terminals labeled: +, -. Cabling details can be found on drawing #SP1054/01-413-1 (Appendix 'B').

Note:

1. Readers are delivered with the white signal wires of the receivers prepared for termination and with black wires tied back with shrink wrap. The black signal wires are logically inverse to the white wires and are not used.
2. All references to + and - refer to the 15 VDC supply of the Smarteye Electronic Assembly.
3. The drain wires of the Belden 9773 cable are normally connected to DC ground at the SEA. This is accomplished with the jumper block (JB1-1) on the Field Interface circuit card. If the distance between the SEA and the reader is greater than 1000 feet, or the environment is electrically noisy, then it may be necessary to connect the drain to DC ground at the reader's junction box. This is accomplished with a jumper wire installed at the junction box. Do not connect the drain at both ends of the cable. Remove the jumper block (JB1-1) at the SEA if a jumper wire is used at the junction box. Never connect the drain to chassis ground.

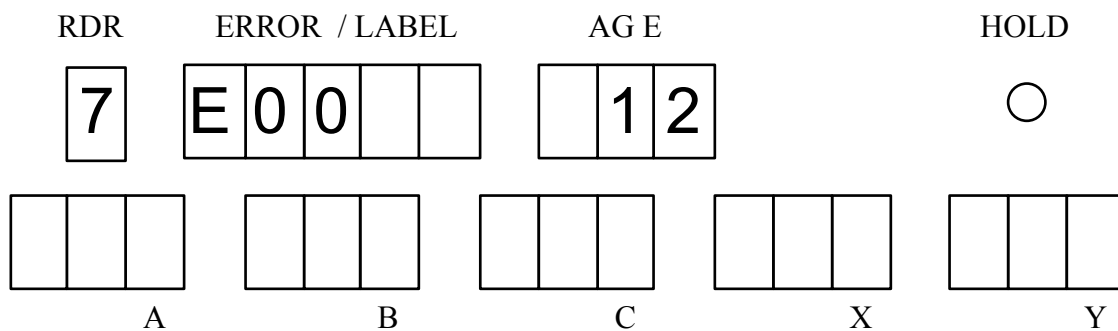
8.0 Power-Up

After the SEA is mounted and the AC power is terminated, an initial checkout can be completed.

When power is applied, the Smarteye Electronic Assembly reads the setup switches and initializes its internal data. If the communication mode is either Handshake, Open-loop, or Parallel, then all readers are brought online and are ready to read labels. If Poll mode is indicated, then readers are offline at power-up and are not put online until an initialization message, 'T' or 'R', is received from the control system.

A Smarteye Electronic Assembly power-up always creates 'error 0' messages for all eight readers.

Check the front panel display as follows: Set the thumbwheel switch to **8**, the Diagnostic-Label-All switch to **All**, and the Back-Hold-Forward switch to **Forward**. Now turn on the SEA and check the front panel display against the diagram below. The 'AGE' field should start counting from zero and continue to increase in seconds. The ERROR / LABEL field should remain as shown, as well as the RDR field.



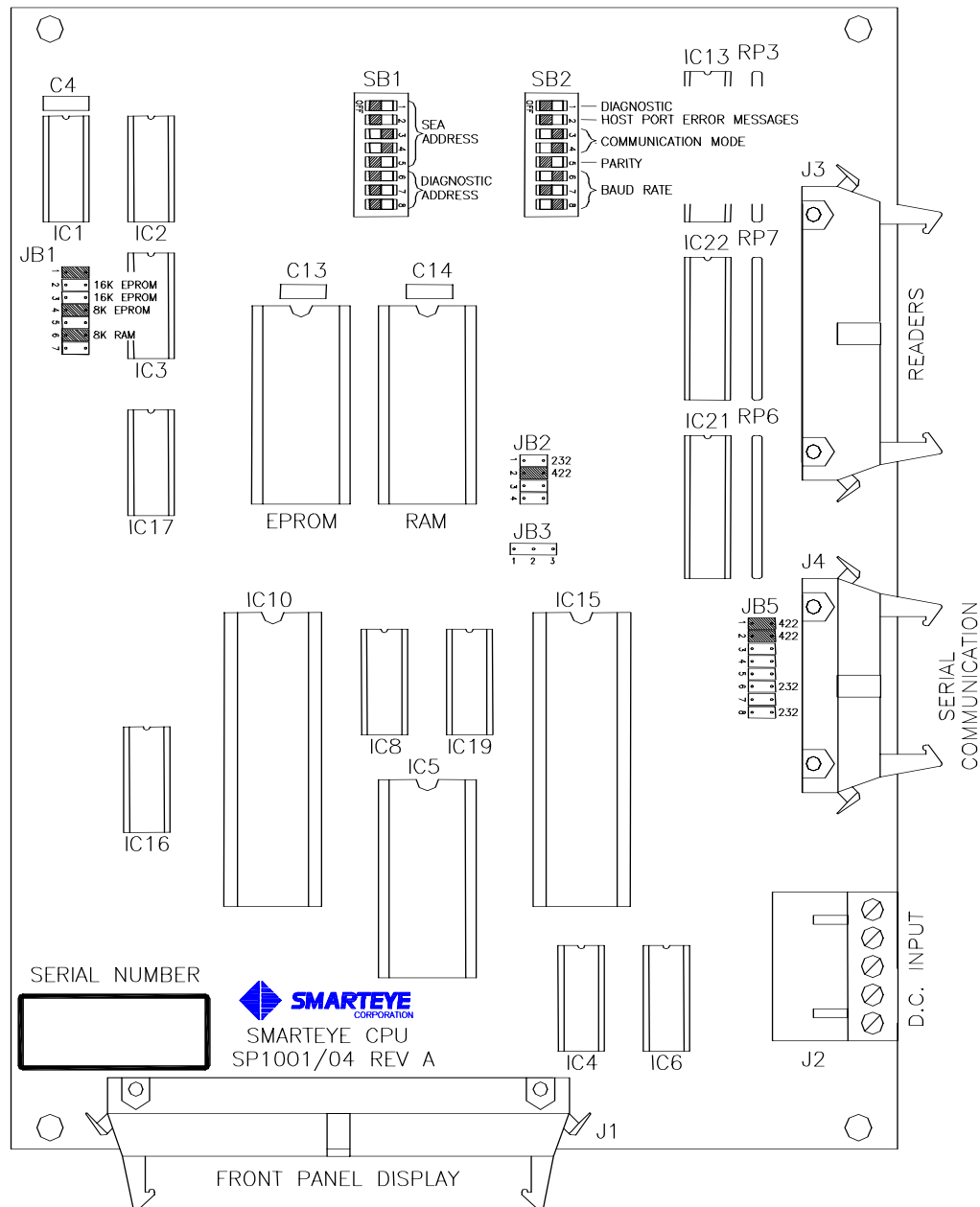
9.0 Smarteye CPU

The intelligence of Smarteye Readers is contained in the Smarteye CPU circuit card. The following features are included in the CPU circuit card hardware:

- Interface to inputs for up to eight readers
- Interface to an RS422 communication line
- Interface to an RS232 communication line
- Switches to set operating parameters
- Jumper blocks to modify connections for communication mode and memory size

The diagrams on the following pages describe the function of the various jumper blocks and switches. Prior to shipment, the switches and jumpers are set to match the anticipated customer environment.

9.1 Switch and Jumper Diagram



9.2 Configuration Legend

DIP Switch

 Switch off (0)

 Switch on (1)

Jumper




 Jumper block not installed

 Jumper block installed

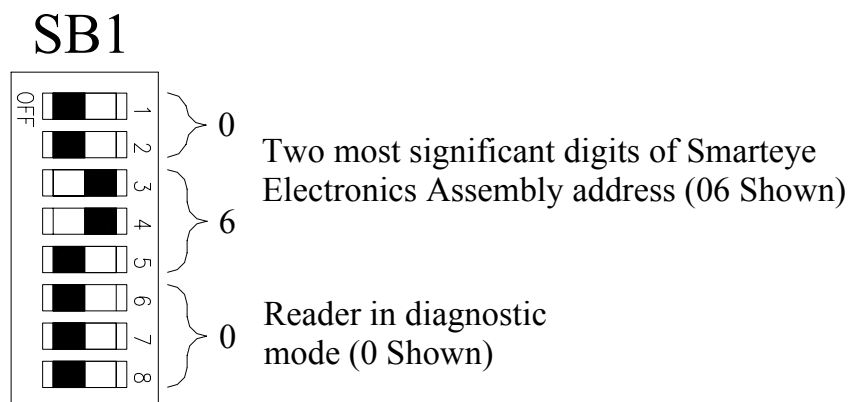
9.3 Memory Configuration (JB1)

EPROM	1	2	3	4	5	
NMC27C64 (8K)	D	D		X		
NMC27C128 (16K)		X	X			
RAM	6	7				
MS6264L-10PI (8K)	X					

X - jumper installed
 D - don't care - jumper can be in or out
 S - user selectable option - (application dependent)

Configuration Example:
 (8K EPROM)
 (8K RAM)
 (JB1)
 1 
 2 • • 16K EPROM
 3 • • 16K EPROM
 4  8K EPROM
 5 • •
 6  8K RAM
 7 • •

9.4 Address Selection (SB1)



Switches 1 through 5 form the first two digits of the address for each reader connected to the SEA. The final digit of a reader's address corresponds to the reader's wired position on the field interface card, LR0 through LR7.

For example, if switches 1 through 5 of SB1 are set as shown above and the reader is wired to terminal strip position LR3, the address of the Reader is 063.

Smarteye Electronic Assembly address 60 (octal) is commonly used since readers 60-67 (octal) convert to the ASCII characters (0-7).

An SEA always addresses a full 8 readers from address xx0 to xx7. The following table shows the address of an SEA as a function of switches 1 through 5 of switch block 1 (SB1.12345).

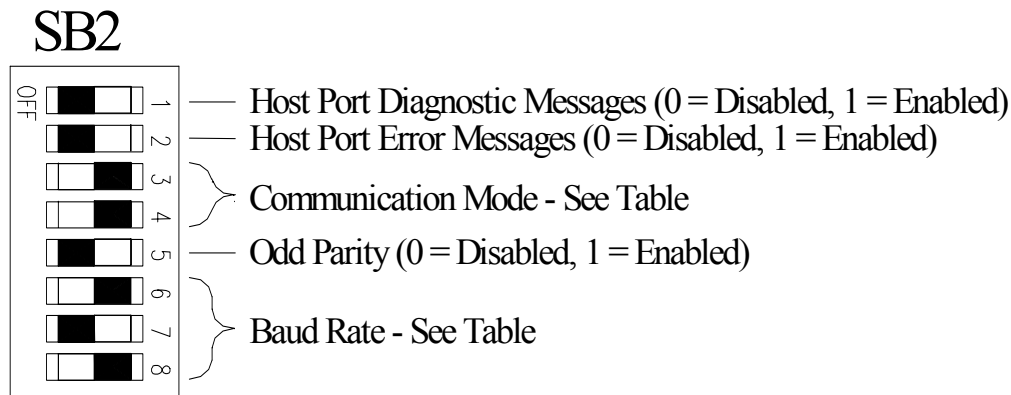
		Address (octal)																																
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
		0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	7
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Switch	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	3																																	
	4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	1
	5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	0	1

9.5 Diagnostic Address Selection (SB1, SB2)

One way to enable diagnostic mode for a particular reader is by setting switches 6, 7, and 8 on switch block 1 (SB1.678) while the SEA is powered up and switch 1 of switch block 2 is on (SB2.1 on). The reader specified by the new positions of SB1.678 is the reader for which diagnostic mode is enabled. See 'Diagnostic Enable' and 'Received Commands' for other ways to enable diagnostic mode.

Reader		0	1	2	3	4	5	6	7
Switch	6	0	0	0	0	1	1	1	1
	7	0	0	1	1	0	0	1	1
	8	0	1	0	1	0	1	0	1

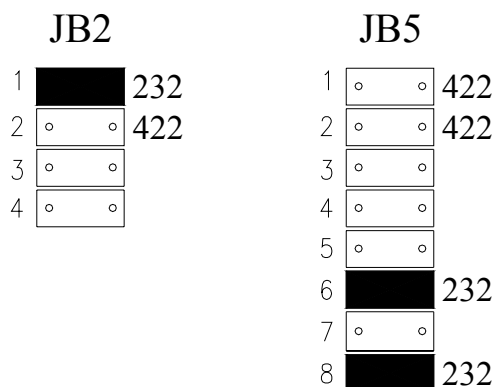
9.6 Communication Format And Baud Rate (SB2)



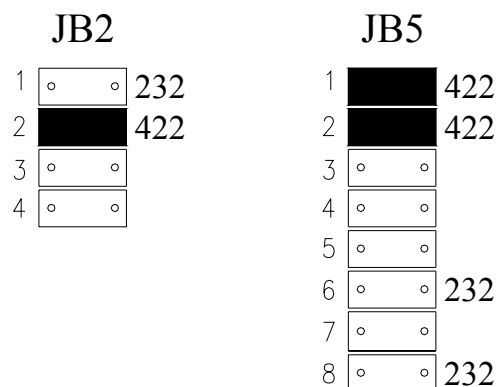
Communication Mode				Baud Rate							
								1	3		
								1	2	4	9 9 8
								3	6	2	4 8 6 2 4
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
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								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0
								0	0	0	0 0 0 0 0

9.9 RS422/RS232 Selection (JB2 and JB5)

RS232 Configuration



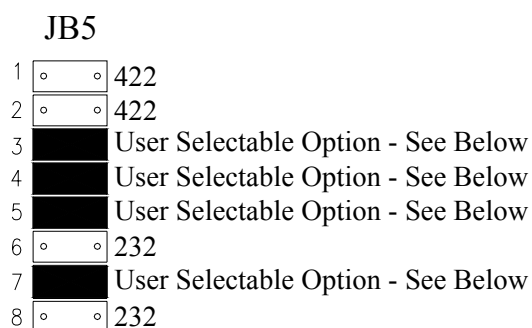
RS422 Configuration



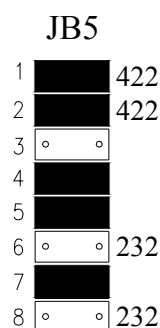
9.10 RS422 Line Termination (JB5)

Jumpers 3, 4, 5, and 7 on JB5 are provided to allow proper termination of the communication line. The type of termination required for a specific application depends on whether the communication line is a point-to-point line or a multidropped (polled) line, and whether the transmitters on the line are ever 'tri-stated'. Tri-state is a high impedance state assumed by an idle RS422 transmitter so that another transmitter can drive the same line.

RS422 Line Termination



RS422 Typical Passive Biasing Configuration



Jumper 3 - Places a 220 ohm resistor across the output of the RS422 driver for simple termination.

Jumper 4 - Places a 220 ohm resistor across the input to the RS422 receiver for simple termination or passive biasing.

Jumper 5 - Ties the noninverting input of the RS422 receiver to 5 volts through a 470 ohm resistor for passive biasing.

Jumper 7 - Ties the inverting input of the RS422 receiver to ground through a 470 ohm resistor for passive biasing.

9.11 Terminating RS422 Point-To-Point

In point-to-point communication, the Smarteye Electronic Assembly's RS422 transmitter is always in an active, low impedance state. This usually insures a stable line and eliminates the need for special termination at the host's receiver inputs.

Likewise, most host transmitters will hold the line stable, eliminating the need for special termination of the SEA's receiver.

The addition of a shunting termination impedance reduces the reflected signal at the receiver and diminishes ringing and overshoot. The negative aspect of termination is that it reduces the magnitude of the received signal. Termination is more likely to be required in applications where the line length is very long and the transmission speed is greater than that used for Smarteye applications.

However, in the event that line termination is desired, 220 ohm terminating resistors have been provided on both the transmitter and receiver lines (jumper 3 and 4 of JB5). 220 ohms significantly reduces signal overshoot and ringing, reasonably matches the recommended cable (Belden 9730) which has a characteristic impedance of 100 ohms, and satisfies RS422 specifications which require a minimum receiver impedance of 90 ohms.

9.12 Terminating RS422 Multidrop (Polled)

A number of Smarteye Electronic Assemblies may be connected to a common host on a single transmission line. In this multidrop configuration, the transmitters of all of the SEAs are connected in parallel to the host's receiver. Similarly, the SEA's receivers are connected in parallel to the host's transmitter.

The following restrictions must be observed in this multidrop configuration:

1. To eliminate the possibility of two Smarteye Electronic Assemblies attempting to transmit at the same time, the master device (host) repeatedly polls slave devices (Smarteye Readers) for data messages. The communication mode of the SEAs must be poll mode.
2. The transmitter of each SEA must tri-state when it is not transmitting.
3. The parallel combination of impedances of the SEA's receivers must be high enough so that the line is not overloaded.

The second and third of these restrictions are considered here.

Because the SEA's transmitters are tri-stated, there are times when all the transmitters are in a high impedance state; i.e., the state of the line is determined by conditions at the host receiver. To insure that the state of the line is predictable in this circumstance, the host receiver should include a passive biasing network. A passive biasing network consists of three resistances: one between +5VDC and the non-inverting input, one across the inputs, and the third connected from the inverting input to DC ground.

Very often an RS422 receiver will include a built-in passive biasing network (fail-safe circuitry). If the host receiver does not include this network, then an external network should be provided to insure reliable communication. In this case, the resistor across the inputs is 220 ohms; the other two are 470 ohms.

The impedance of a built-in passive biasing network will probably be relatively high so that even if one exists, it may be desirable to lower the line impedance. The network described above will accomplish this. (Note that a simple termination resistor across the inputs of a receiver which has built-in passive biasing will lower the receiver input voltage when the line is idle, probably to a value for which the output is indeterminate. This would cause communication errors. The passive biasing network is much safer.)

The jumper tables above show that the receiver of a Smarteye Electronic Assembly may include a simple terminating resistor or a passive biasing network. Since all multidropped SEA's receivers are in parallel, only **one** receiver may be terminated with either the simple resistor or passive biasing. Otherwise, the line load will exceed tolerance levels.

9.13 RS422 Driver Compatibility (JB3)

The Smarteye Electronic Assembly is compatible with a variety of RS422 driver chips. Jumper block 3 (JB3) is used to accommodate the differences between manufacturers. JB3 is configured at the factory and no alterations are necessary.

10.0 Serial Communication

Smarteye Electronic Assembly serial communication is governed by the protocol described in the following paragraphs. All references to messages received and transmitted are from the point of view of a Smarteye Electronic Assembly.

Message flow is usually in only one direction at a time. However, full duplex communication is implemented and during error recovery or when device commands are being received, it is possible that messages may flow in both directions simultaneously. Therefore, another device communicating with a Smarteye Electronic Assembly should be implemented for full duplex.

A Smarteye Electronic Assembly may be set to communicate in one of four modes: Poll mode, Handshake mode, Open-loop mode, or Parallel mode. The first three of these are serial modes and are described in this manual. Parallel communication is not described in this manual. See the Smarteye Parallel Interface User Manual for details.

10.1 Message Conventions

A communication message consists of a string of bytes terminated with an ASCII carriage-return. To represent the bytes in a message string, the following conventions are observed:

A byte with a value that is non-printable ASCII is shown as a character string enclosed in brackets <>.

<lf> = line-feed

<cr> = carriage-return

<id> = binary number representing Reader ID

e.g., <63octal> = Reader wired to terminal 3 of the Smarteye Electronic Assembly with address set to 60 octal.

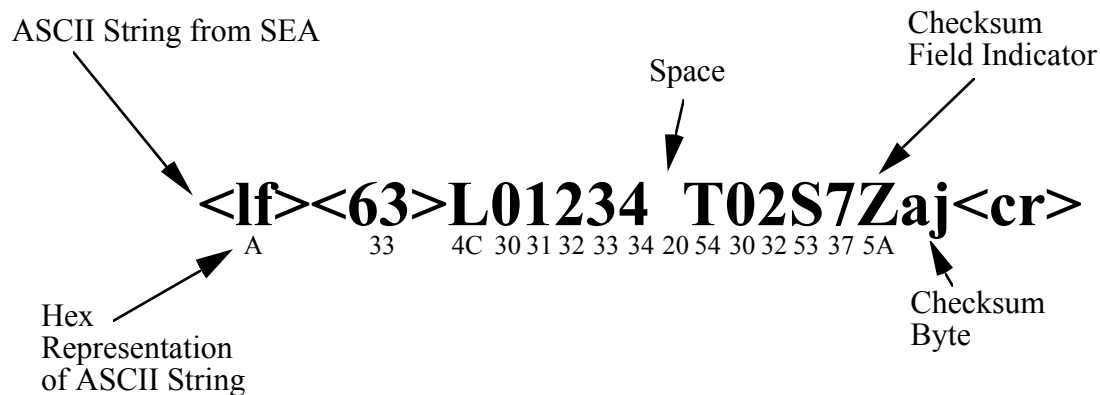
nn... represents a string of ASCII digits. The digits are decimal unless otherwise noted.

s is a sign character preceding an nn... string. Its values are '-', '+', or ' ' (space).

Other bytes are ASCII capital letters, usually indicating the type of numeric field which follows. A letter is also used in a received message to represent a device command.

Zzz is the checksum field where zz is two ASCII lower case letters representing the checksum byte. The checksum byte is obtained as the exclusive-or of all the bytes in the message string up to and including the checksum field indicator, 'Z'. The two checksum characters are obtained for the checksum byte by adding each hexadecimal digit of the byte (values 0 to F) to ASCII 'a', resulting in two lower case letters, each with a value between 'a' and 'p'. See the example calculation below. On received messages, this field is optional; i.e., if the Z field is not found, then the checksum is not calculated.

10.2 Checksum Calculation Example



The exclusive-OR of all Hex bytes above = 09 HEX

$$\begin{array}{r}
 0 \\
 + \quad 61 \\
 \hline
 61
 \end{array}
 \quad
 \begin{array}{r}
 9 \\
 + \quad 61 \\
 \hline
 6A
 \end{array}$$

61 is the Hex representation for an ASCII "a"

The ASCII equivalent of the resulting Hex numbers: 61 and 6A yields the checksum byte "aj"

10.3 Received Poll

<lf><id><cr>

Polli (poll w/o checksum)

<lf><id>Zzz<cr>

Pollz (poll with checksum)

10.4 Received Commands

<lf><id>c<cr>

(command w/o checksum)

<lf><id>cZzz<cr>

(command with checksum)

Where c is replaced by one of the following command characters:

- I - Initialize the reader online
- R - Restart, initialize all readers in the enclosure online
- B - Box poll, request message from any reader in the SEA

- A - Ack the previous device transmission
- N - Nak the previous device transmission
- S - Status inquiry regarding reader
- C - Create diagnostic message for next label at reader
- L - Lock in diagnostic for all labels at reader
- U - Unlock diagnostic at reader
- F - Take reader offline

Note: The Nak command is used when the host detects a line error. Upon receiving a Nak, the SEA will retransmit the original message.

10.5 Messages Transmitted By The SEA

Communication characters include **one start bit, eight data bits, an optional parity bit, and one stop bit.**

The fields in transmitted messages include:

Lnnnnn, Label field, where nnnnn is the number of the carrier which has just passed Reader <id>. The number of digits in the Label field is five (filled with leading '0's, if necessary).

Tnn, time field, indicating the age of the message in tenths of seconds; e.g., T45 indicates a message 4.5 seconds old.

Sn, sequence number, where n ranges from 0 to 9, incremented circularly (modulo 10) for each new message transmitted by the SEA.

Enn, error field. A description of the error for each value of nn may be found in 'Error Messages.'

Asnn, Bsnn, Csnn, Xsnn, and Ysnn diagnostic readings:

Asnn, Bsnn, and Csnn are the trigger point numbers for photoeyes A, B and C.

Xsnn is the alignment error between photoeyes A and B.

Ysnn is the alignment error between photoeyes B and C.

Zzz, checksum, is described in 'Message Conventions.'

A summary of transmitted messages follows. Each message is tagged with a lower case letter. In the following sections, which deal with the various communication modes, a message transmitted as a response to a message received is represented by its lower case tag letter.

10.5.1 Online Idle Message

- | | |
|------------------|------------------------------|
| <lf><id><cr> | i - poll mode |
| <lf><id>Zzz<cr> | z - poll mode, with checksum |
| <lf><id>AZzz<cr> | a - non-poll mode |

10.5.2 Offline Message

<lf><id>NZzz<cr> n - offline

Online/offline notes:

1. All transmitted messages will include a checksum.
2. In poll mode, the offline response occurs only when an online reader is taken offline with the 'F' command. Once a reader is offline, there are no responses to any messages except the command 'I' or 'R'. Each of these commands will first place the reader online, so that the resultant response is the online idle for poll mode.
3. Online idle and offline messages do not include an 'R' (retransmit) field, nor a 'T' (age) field, nor an 'S' (sequence number) field.

Other messages transmitted by a Smarteye Electronic Assembly do include these fields.

10.5.3 Label Message

<lf><id>Lnnnnnn TnnSnZzz<cr> l - label

<lf><id>LnnnnnnRTnnSnZzz<cr> r - retransmit

10.5.4 Error Message

<lf><id>Enn TnnSnZzz<cr> e - error

<lf><id>EnnRTnnSnZzz<cr> r - retransmit

10.5.5 Diagnostic Message

<lf><id>C Asnn Bsnn Csnn Xsnn Ysnn TnnSnZzz<cr> c - diagnostic

<lf><id>C Asnn Bsnn Csnn Xsnn Ysnn RTnnSnZzz<cr> r - retransmit

10.6 Poll Mode

Polled operation allows more than one Smarteye Electronic Assembly to be connected to the same communication line. Messages are sent by a Smarteye Electronic Assembly only in response to a message received. Two types of poll commands are supported: a 'reader poll' solicits a response from a specific reader, while a 'box poll' requests a message from any of the readers in a particular SEA. Box poll effectively increases polling speed by as much as a factor of eight. In either case, if there is no data to be sent, an online idle response is transmitted.

The box poll <id> can be any of the eight readers in an SEA.

Acknowledgement is expected for any message transmitted other than online idle or offline. If a transmitted message is not acknowledged, then the next message received for the same reader will produce retransmission.

At powerup in poll mode, each reader is set offline and remains so until an initialize device command, 'I', is received for the reader or a restart command, 'R', is received for all readers in the SEA. The restart and initialize command will clear the label and diagnostic message buffer in the SEA. The restart on initialize command will not clear the error message buffer in the SEA.

10.6.1 Summary Of Responses - Poll Mode

<u>Received by SEA</u>	SEA Response (status when message received)	
	<u>(online)</u>	<u>(offline)</u>
- Polli	r,l,e,c,i	@
- Pollz	r,l,e,c,z	@
I - Initialize	z	z
A - Ack	@	@
B - Box poll	r,l,e,c,z	@
N - Nak	r,l,e,c,z	@
C - One read diagnostic	r,l,e,c,z	@
L - Lock in diagnostic	r,l,e,c,z	@
U - Unlock diagnostic	r,l,e,c,z	@
S - Status inquiry	r,l,e,c,z	@
R - Restart	z	z
F - Take reader offline	n	@

- @ - no response
- r - retransmission of previous message
- l - label message
- e - error message
- c - diagnostic message
- i - online idle w/o checksum
- z - online idle with checksum
- n - offline

10.7 Handshake Mode

In Handshake mode, each Smarteye Electronic Assembly is connected to the host on its own communication line. Messages are transmitted as soon as data is available without having been solicited by a received message.

The host must send an acknowledgement for each data message transmitted. If a transmitted message is not acknowledged within a specified time (approximately 3 seconds), then retransmission occurs. Messages are also retransmitted when communication errors occur.

If a message is received while acknowledgement is awaited, and it is not the acknowledgement, then retransmission occurs immediately. Usually the response to a received message will be either an 'a' (online idle) or 'n' (offline) message which pertains to the reader of the received message.

However, when an incoming message is received and another message has been prepared for transmission pertaining to any reader, then the prepared message is transmitted. If there is no prepared message and the received message was ack, then no response is made.

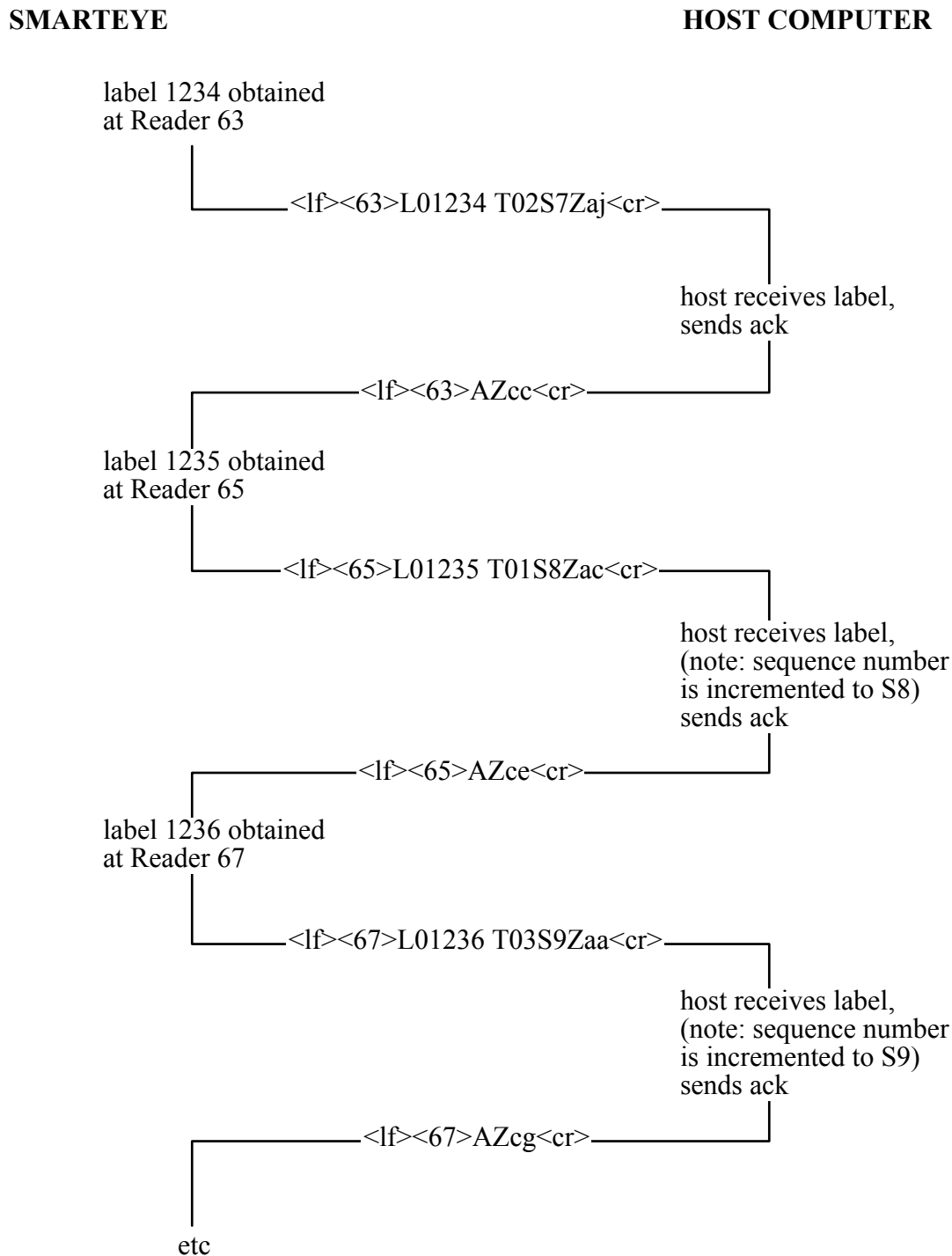
Each reader in an SEA is set online at powerup in Handshake mode.

10.7.1 Summary Of Responses - Handshake Mode

<u>Received by SEA</u>	<u>SEA Response (online or offline)</u>
- Poll	r,l,e,c,a,n
I - Initialize	r,l,e,c,a
A - Ack	l,e,c,@
B - Box poll (Same as "S")	r,l,e,c,a,n
N - Nak	r,l,e,c,a,n
C - One read diagnostic	r,l,e,c,a,n
L - Lock in diagnostic	r,l,e,c,a,n
U - Unlock diagnostic	r,l,e,c,a,n
S - Status inquiry	r,l,e,c,a,n
R - Restart	e,a
F - Take reader offline	r,l,e,c,n
@ - no response	
r - retransmission of previous message	
l - label message	
e - error message	
c - diagnostic message	
a - online idle, non-poll mode	
n - offline	

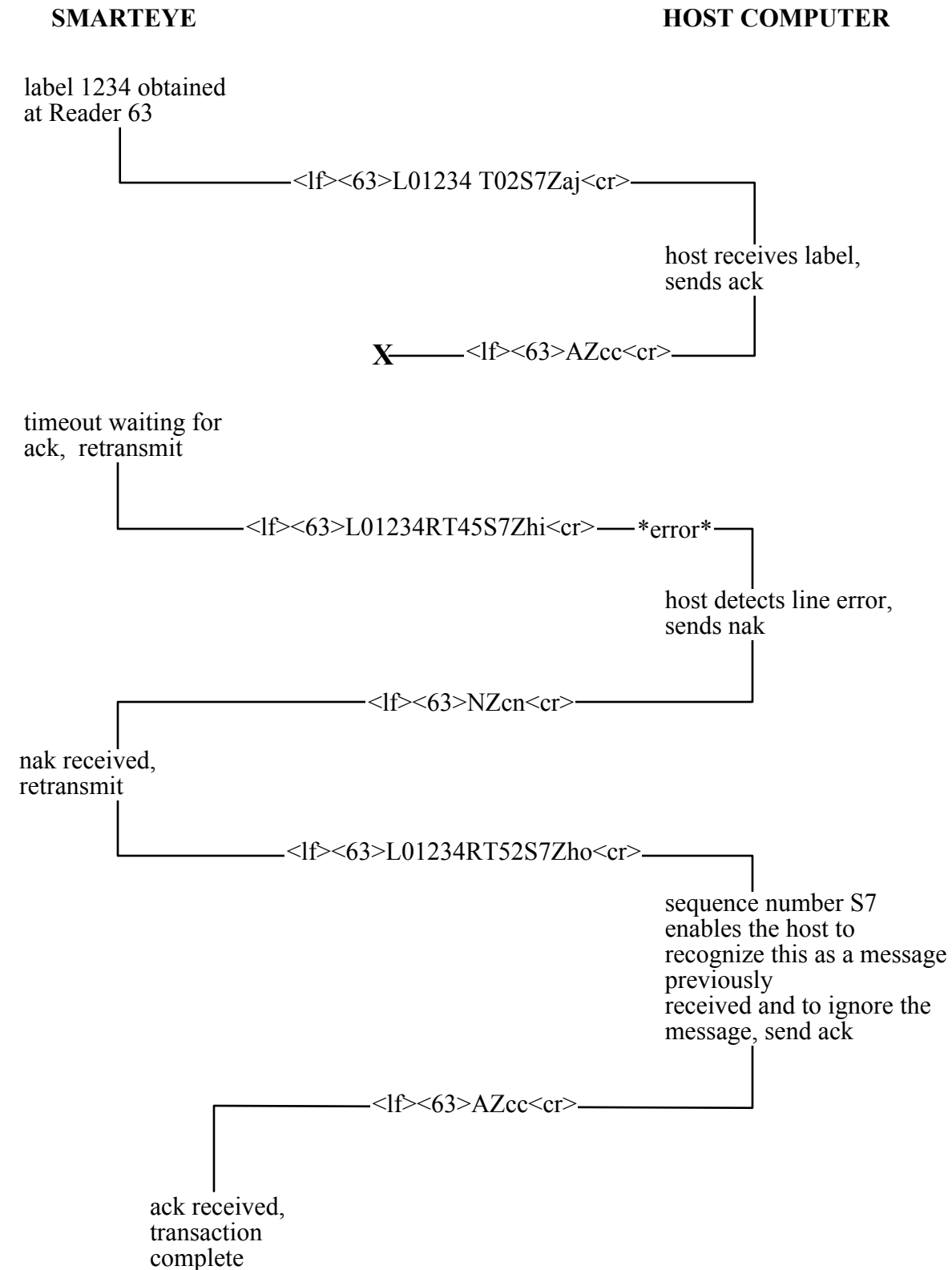
10.7.2 Example #1 - Handshake Mode - Normal Operation

Previous transaction complete, line is quiescent.



10.7.3 Example #2 - Handshake Mode - Abnormal Operation

Previous transaction complete, line is quiescent.



10.8 Open-Loop Mode

In Open-loop mode, each Smarteye Electronic Assembly is connected to the host on its own communication line.

A message prepared for transmission will be transmitted without having been solicited by a received message.

Acknowledgement is not expected. Thus, transmitted messages are not preserved and cannot be retransmitted. The receiver can be a dumb terminal.

Whenever a message is received which is a device command, the command is executed immediately. The next new transmission pertaining to the reader, including one which immediately follows, will reflect the new status.

Usually the response to a received message will be either an 'a' (online idle) or 'n' (offline) message which pertains to the reader of the received message. If, however, when an incoming message is received, another message has been prepared for transmission pertaining to any reader, then the prepared message is transmitted. If there is no prepared message and the received message was ack, then no response is made.

Each reader in an SEA is set online at powerup in Open-loop mode .

10.8.1 Summary Of Responses - Open-Loop Mode

<u>Received by SEA</u>	<u>(online or offline)</u>
- Poll	l,e,c,a,n
I - Initialize	l,e,c,a
A - Ack	l,e,c,@
N - Nak	l,e,c,a,n
C - One read diagnostic	l,e,c,a,n
L - Lock in diagnostic	l,e,c,a,n
U - Unlock diagnostic	l,e,c,a,n
S - Status inquiry	l,e,c,a,n
R - Restart	e,a
F - Take reader offline	l,e,c,n

- @ - no response
- l - label message
- e - error message
- c - diagnostic message
- a - online idle, non-poll mode
- n - offline

11.0 Diagnostic Enable

If a reader is in diagnostic mode, then each time a label passes the reader, a diagnostic message is obtained. The diagnostic message comes in addition to any messages (label message, error message, etc.) which would appear if the reader were not in diagnostic mode.

There are three different methods by which to enable diagnostic mode for a particular reader:

1. Display enable

If a front panel display option is installed, set the thumbwheel switch to select a reader (0-7) and set the selector switch to DIAGNOSTIC. Make sure the Smarteye Electronic Assembly's C.P.U. switch 1 of dipswitch block 2 (SB2.1) is on if you want the diagnostic message to also be sent out the host port. Diagnostic numbers will appear on the display as a label passes the selected reader.

2. SB1 enable

Set switches 6, 7 and 8 of dipswitch block 1 (SB1.6,7,8) on the Electronic Assembly's C.P.U. to the desired reader number and toggle (SB2.1) off and back on. Diagnostic numbers will appear on the front panel display (if installed) as a label passes the selected reader. If you would like the diagnostic message to also be sent out the host port, make sure SB2.1 is on.

3. Remote enable

Send a remote 'C' or 'L' command on the serial communication line. Diagnostic numbers will appear on the serial communication line and the front panel display (if installed) as a label passes the selected reader.

Only one reader at a time in an SEA can be in diagnostic mode. Thus, the following rules determine diagnostic mode when a conflict between the different methods occurs.

1. Display enable has precedence over the other two; i.e., Display enable has effect regardless of the other two.
2. When overlap occurs between SB1 enable and Remote enable, then the last to be enabled takes effect.
3. Remote diagnostic lock ('L' command) is saved if it overlaps Display enable or is displaced by SB1 enable. A saved Remote enable will be restored when neither of the other two are in effect.
4. When Remote enable is in effect, it is unaffected by the receipt of a command of the same type, L or C, for the same reader. If a command of a different type or different reader is received, then Remote enable is reinitialized for the new command.
5. An 'L' command is permanently disabled only with a 'U' command or another 'L' or 'C' command. A 'C' command is disabled when the next label is read, when a 'U' command is received, when another 'L' or 'C' command is received, when it overlaps Display enable, or when it is displaced by SB1 enable.
6. A 'U' command will disable a Remote enable even if the reader referenced in the command is different than the reader of the Remote enable.

12.0 Error Messages

<u>Error Code</u>	<u>Meaning</u>
00	Smarteye Electronic Assembly just powered up.
01	Unrecognizable label, too much data obtained.
04	Unrecognizable label, front and back bits = 0.
05	Unrecognizable label, front and back bits = 1.
Note: Errors 01, 04, and 05 can be the result of parts of a carrier breaking the photoeye beams.	
06	Unrecognizable label, incorrect parity. Check label for obstructions.
07	Parity error in character of host message received.
08	Too many characters in received host message.
10	Unrecognizable host message received.
11	Message transmitted to host is too long.
15	Unrecognizable label, incorrect Hamming code. Check label for obstructions.
16	Unrecognizable label, more than 5 leading zeros.
17	Host message received w/o <cr> terminator.
19	Overload of input data from readers.
20	Checksum error in host message received.
30-39	Unrecognizable label, incorrect number of data bits. LSD (least significant digit) of error is the LSD of the number of data bits in the label read.

Errors 80 through 88 are associated with the Parallel Interface:

80	Smarteye Parallel Interface just powered up.
81	Unrecognized character received by Parallel Interface.
82	Checksum error received by Parallel Interface.
83	Unrecognized message received by Parallel Interface, no <cr> terminator.
84	Non-printable character received by Parallel Interface.
86	Electronics Assembly timeout waiting for message from Parallel Interface in response to message transmitted to it.
87	Checksum error in message received from Parallel Interface.
88	Unrecognized character in message received from Parallel Interface.

Errors 91 through 99 are detected during diagnostic:

- 91 Photoeye A, insufficient number of transitions in time allowed.
- 92 Photoeye B, insufficient number of transitions in time allowed.
- 93 Error 91 and 92 have been detected and displayed by the SEA. Error 93 is sent to the host port (if enabled).
- 94 Photoeye C, insufficient number of transitions in time allowed.
- 95 Error 91 and 94 have been detected and displayed by the SEA. Error 95 is sent to the host port (if enabled).
- 96 Error 92 and 94 have been detected and displayed by the SEA. Error 96 is sent to the host port (if enabled).

Note: Errors 91, 92, and 94 indicate that a photoeye is not transitioning while the other two photoeyes are. Check reader height, photoeye operation, and reader wiring.

- 99 Diagnostic attempt aborted, acceptable hole pattern not found, probably due to label speed variation.

Appendix A Front Panel Display

A.1 Introduction

The Front Panel Display is an SEA option which makes it possible to observe the activity at each of the readers on the plant floor either in real-time or in review.

Besides serving as a display, diagnostic figures can be gathered for a particular reader when this function is enabled by the switches on a Front Panel Display and SB2 switch 2..

Whenever a Smarteye Label passes a Smarteye Reader, information is retained in the Smarteye Electronic Assembly, which includes any or all of the following:

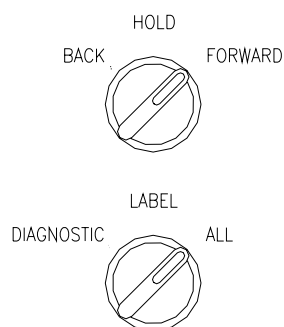
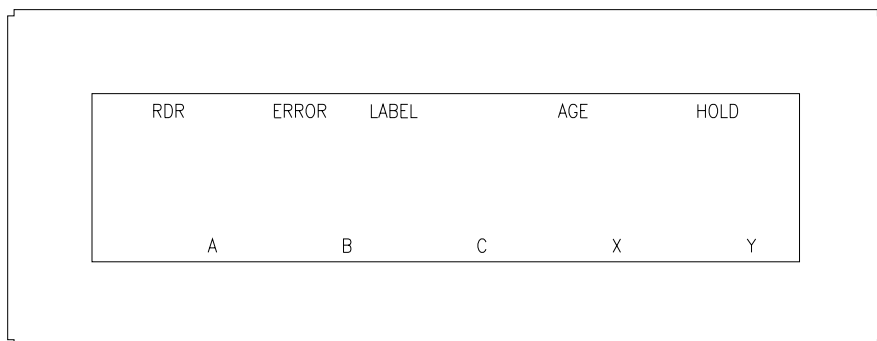
1. Label number
2. An error condition detected while the label was being read
3. Reader diagnostic figures. This information, plus errors detected on the serial communication line, is available for observation with a Front Panel Display. A single reader or all readers may be displayed.

Each item of reader information is retained as a message in a circular queue. Messages are always stored, regardless of the display options selected. The queue has a capacity for 200 messages and messages are stored sequentially in the order of occurrence.

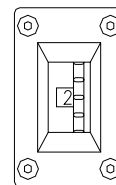
Messages can be displayed as they occur in real-time or, alternatively, the queue can be scanned either backward or forward in time, enabling reconstruction of a recent sequence of events.

The Front Panel Display consists of upper and lower displays, and switches. The switches determine which messages are being requested for display and provide means to enable diagnostic mode for a particular reader. The layout of displays and switches is shown in the following diagram.

A.1.1 NEMA 12 SEA Front Panel Display

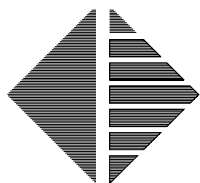


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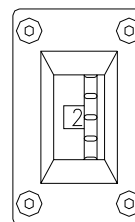
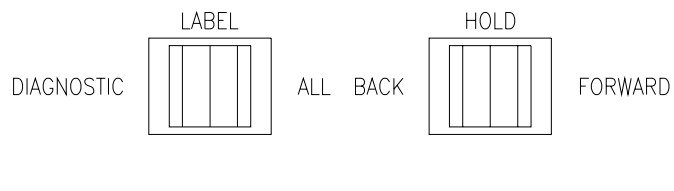
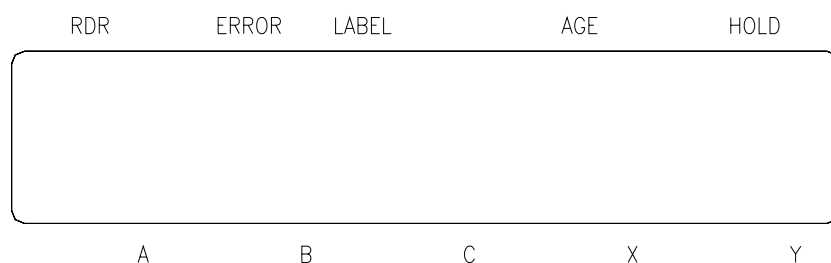


0-7 - SELECT READER
8 - SELECT ALL READERS
OTHER - LAMP TEST/OFF

A.1.2 Panel mount SEA Front Panel Display



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A.2 Display Fields

The display consists of an upper and lower half, each of which is composed of distinct fields. An upper display always identifies the reader and age of a message, as well as label/error data. The fields in the lower display are generally reserved for diagnostic figures (there are a few exceptions, described below).

A.2.1 READER Field

This field shows the reader, 0 to 7, from which the displayed message originated.

A.2.2 ERROR - LABEL Field

This field shows either a successfully read label or an error code for either an error detected while a label was being read or for an error on the serial communication line.

Labels are right justified in the five position field.

Error codes are always three characters, left justified. The leading character is always 'E'. The error for the corresponding error code is described in the 'Error Messages' section of this manual.

'_ _ _ _ _', underlines, are displayed in this field when the switches indicate a request for which there are no messages.

A.2.3 AGE Field

This field indicates how long ago, in seconds, the displayed message originated. The age of a message older than 999 seconds is shown as 999.

A.2.4 HOLD Light

The HOLD light is on when the BACK-HOLD-FORWARD switch is in the HOLD position. The light serves as a warning that messages will not be displayed in real-time (new messages are stored in the queue but will not be seen) until the switch is put in the FORWARD position.

A.2.5 A Field

The A field shows the diagnostic gain value (-99 to 99) for photoeye A of the displayed Reader. See the Smarteye Reader User Manual for diagnostic details.

'E91' (error 91) appears in this field if photoeye A is detected as not transitioning during diagnostic mode.

'LCP' (last-carrier-past) will appear in this field when all of the reader's messages, including the most recent, have been overwritten in the queue by newer messages from other readers, forcing a display of the label of the last-carrier-past the reader. (Last-carrier-past is the label most recently read at a reader and is retained regardless of its age or how many other messages occur in the meantime. It can only be displaced by the successful read of another label at the same reader, which then becomes the new last-carrier-past.)

A.2.6 B Field

The B field shows the diagnostic gain value (-99 to 99) for photoeye B of the displayed reader. See the Smarteye Reader User Manual for diagnostic details.

'E92' (error 92) appears in this field if photoeye B is detected as not transitioning during diagnostic mode.

A.2.7 C Field

The C field shows the diagnostic gain value (-99 to 99) for photoeye C of the displayed reader. See the Smarteye Reader User Manual for diagnostic details.

'E94' (error 94) appears in this field if photoeye C is detected as not transitioning during diagnostic mode.

A.2.8 X Field

The X field shows the diagnostic positional value (-99 to 99) between photoeye A and photoeye B of the displayed reader. See the Smarteye Reader User Manual for diagnostic details.

'E99' in this field means that the diagnostic attempt was aborted; an acceptable hole pattern was not found, probably due to label speed variation.

A.2.9 Y Field

The Y field shows the diagnostic positional value (-99 to 99) between photoeye C and photoeye B of the displayed reader. See the Smarteye Reader User Manual for diagnostic details.

'^ ^ ^' (circumflexes) in this field indicate that the message currently being displayed has been overwritten in the queue with a new message. The current display will not be retrievable again once another request is made with the switches; i.e., the message is lost when either the thumbwheel the DIAGNOSTIC-LABEL-ALL switch or the BACK-HOLD-FORWARD switch changes position.

A.3 Switches

There are three switches on a Front Panel Display. One of these switches, BACK-HOLD-FORWARD, permits a review of messages accumulated in the queue. When left in the FORWARD position, messages are displayed in real-time.

The other two switches, DIAGNOSTIC-LABEL-ALL and the thumbwheel, determine which messages are displayed. Also, diagnostic figures are gathered for a particular reader when the diagnostic function is enabled by these two switches.

A.3.1 BACK-HOLD-FORWARD Switch

Messages are displayed as they occur in real-time if this switch is left in the FORWARD position. (See FORWARD below.) Otherwise, this switch can be used to locate old messages in the queue for review. An old message can be viewed indefinitely with this switch in the HOLD position.

When switching from HOLD to either BACK or FORWARD, the next message in the queue which is in the indicated direction and satisfies the criteria established in the other two switches will be displayed. If the BACK or FORWARD position is continuously maintained, then the first message is displayed for 1.6 seconds, the second message is held for .8 seconds, etc. The display interval is halved for each succeeding message until it is .1 seconds. A .1 second interval applies until the end of the queue in the direction of traverse is reached.

When a label passes a reader, which is in diagnostic mode, the diagnostic figures are determined independent of the label reading. This results in two separate messages, one for diagnostic and another for the label reading. The diagnostic message will arrive first, followed somewhat later by the label or error message. (The two messages may be separated in the queue by messages from other readers.) For the sake of interpretation, it is best to show both messages simultaneously in the display. To this end, when moving forward in the queue and a label/error message is encountered for the same reader as that of the currently displayed message, then the lower display (diagnostic) is not cleared. Likewise, when moving backward and a diagnostic message is encountered for the same reader as that currently displayed, the label/error field is not cleared.

A.3.1.1 Back

BACK is a spring loaded position which causes the next older message in the queue which fits the selection criteria established in the other two switches to be displayed. If the oldest suitable message in the queue is reached, then it remains on display, rendering the BACK position equivalent to the HOLD position.

A.3.1.2 Hold

HOLD will freeze the current message in the display indefinitely. Only the age field will be updated. The HOLD light will be on as a warning that new messages will not be displayed until this switch is put in the FORWARD position (even though new messages are being stored in the queue).

A.3.1.3 Forward

FORWARD is used to step toward newer messages in the queue. When the newest message is reached, then new messages are displayed as they arrive in real-time if they satisfy the criteria of the other two switches.

For viewer comprehension, real-time messages are always displayed for at least .8 seconds. Thus, each message is held for .8 seconds or until another message arrives which displaces it in the display, whichever is longer.

A.3.2 DIAGNOSTIC-LABEL-ALL Switch

This switch provides two display options: label messages only, or all messages. It also provides a means to gather diagnostic figures for a particular reader.

When this switch changes, regardless of the position in the queue of the message currently in the display, the newest message satisfying the new criteria is displayed.

A.3.2.1 Diagnostic Mode

When a reader is in diagnostic mode, a diagnostic message is obtained each time a label passes the reader. Diagnostic messages indicate necessary reader adjustments, if any.

The DIAGNOSTIC position of this switch provides means by which a reader may be put into diagnostic mode locally on the shop floor.

Besides this switch in the DIAGNOSTIC position, a specific reader must be indicated in the thumbwheel switch (position 0-7), in order to put the reader in diagnostic mode.

All messages for the specified reader are displayed with this switch in the DIAGNOSTIC position. If the thumbwheel is in a position other than 0-7, then the DIAGNOSTIC position of this switch is equivalent to the ALL position.

The Display switches provide one means to enable diagnostic mode for a reader. There are two others; see Section 11.0 'Diagnostic Enable'

Only one reader at a time in an SEA can be in diagnostic mode. Enabling diagnostic mode with the Display switches will always have precedence over the other two methods.

A.3.2.2 Label

This position is used to display only label readings, eliminating error and diagnostic messages.

A.3.2.3 All

If the thumbwheel is in position 0-7, then all messages for the specified reader are displayed. If the thumbwheel is in position 8, then all messages queued are displayed.

A.3.3 THUMBWHEEL Switch

This switch is used to:

1. Select a specific reader, position 0-7
2. Select all readers, position 8
3. Perform a brief lamp test and then turn the display off in any position other than 0-8. The lamp test turns all segments of all lights on for 1.6 seconds, then all segments are turned off.

When this switch changes, regardless of the position in the queue of the message currently in the display, the newest message satisfying the new criteria is displayed.

Appendix B Drawings

Electronic Assembly Installation Details - SP1062/01-421

This drawing shows the mounting dimensions of the SEA-8.

Interface Wiring Identification - SP1002/02-420

This drawing shows the field wiring interface.

SEA-8 and Twin Communication Cable Details - SP1024/01-412

This drawing shows the communication wiring details.

Retro-Reflective Reader Cable Details for SEA-8 Applications - SP1040/01-410 (CE model not available)

This drawing shows the Retro-Reflective reader wiring details.

Sender/Receiver Cable Details for SEA-8 Applications - SP1054/01-412 (CE Drawing SP1054/01-414)

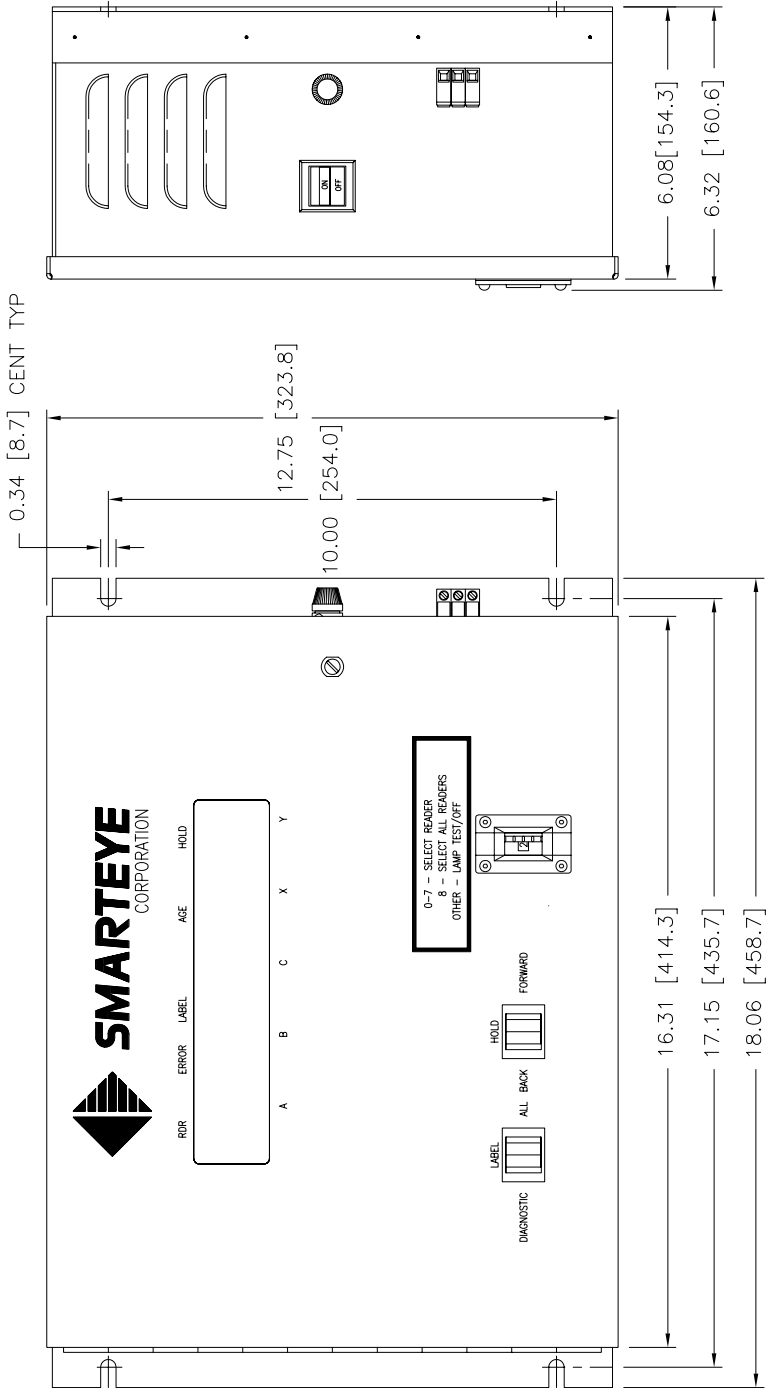
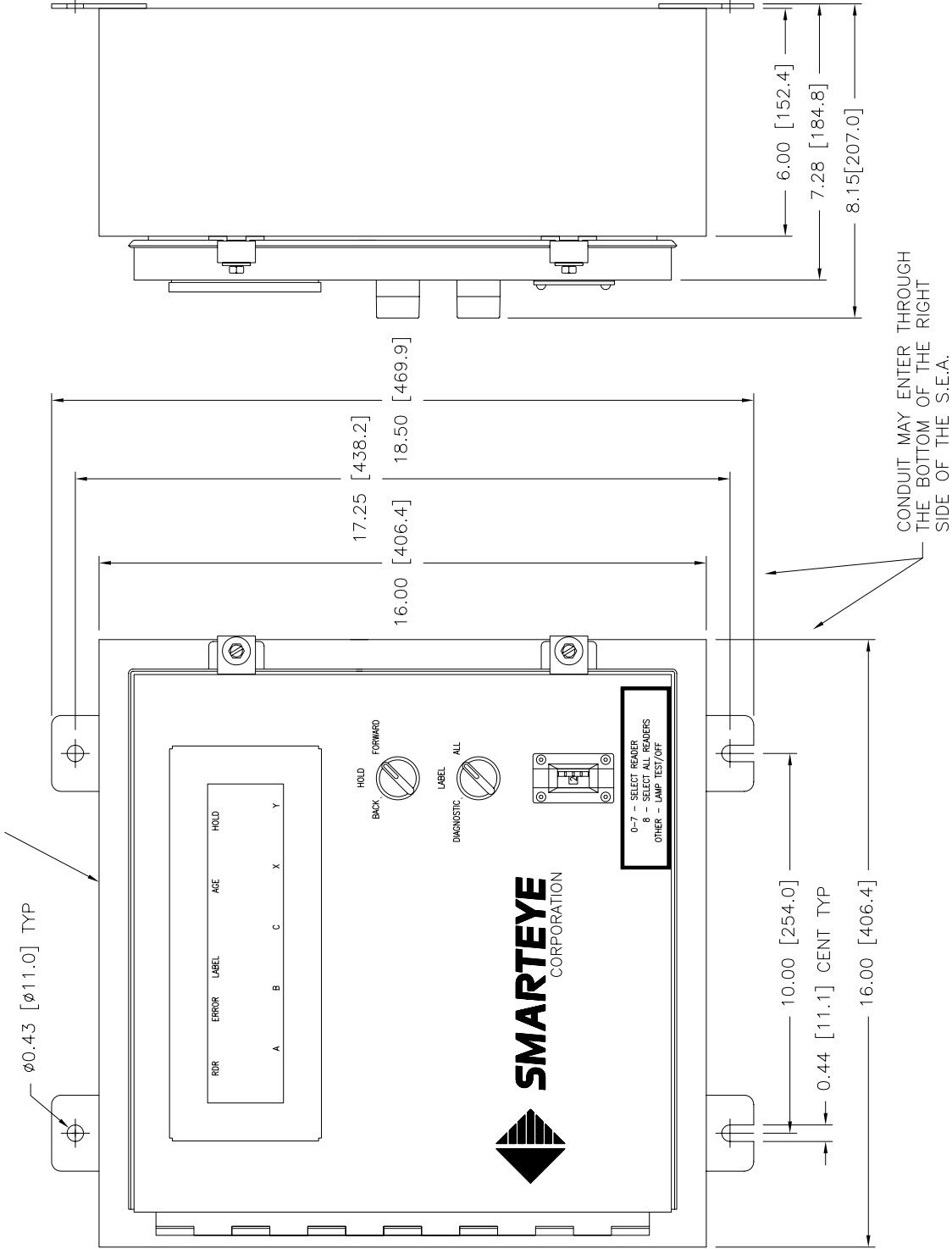
This drawing shows the reader wiring details.

NEMA-12 SMARTEYE ELECTRONIC ASSEMBLY


PANEL MOUNT SMARTEYE ELECTRONIC ASSEMBLY

REV	DESCRIPTION	DATE	APPR. BY
0	INITIAL RELEASE	10/19/90	MDB
1	ADDED LOGO AND REVISED	02/05/91	MDB
	TITLE BLOCK		
2	REVISED DRAWING VERSION		

DO NOT INSTALL CONDUIT THROUGH THE TOP OF THE S.E.A. AS METAL CHIPS AND PULLING COMPOUND MAY FALL INTO THE POWER SUPPLIES



NOTE: NUMBERS IN [] REPRESENT METRIC EQUIVALENT IN MM



SMARTEYE
CORPORATION

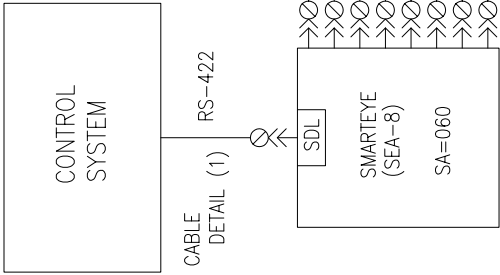
2637 BOND STREET ROCHESTER HILLS, MICHIGAN 48309
PHONE (248) 853-4495 FAX (248) 853-8539

DRAWN BY:	RSA	TITLE:
CHECKED BY:	KLC	SMARTEYE ELECTRONIC
ENGINEER:	MDI	ASSEMBLY
DATE:	10/18/90	INSTALLATION DETAILS
SHEET	1	OF 1
SCALE:	NONE	DRAWING NO. SP1062/02-421
SIZE:	D	

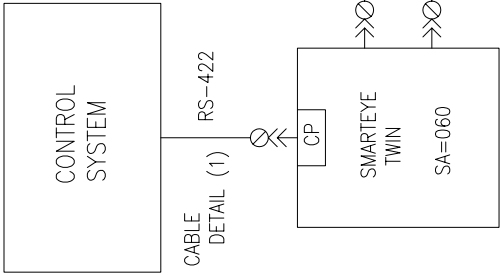
REV	DESCRIPTION	DATE	APPR. BY
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1	ADDED LOGO AND REVISED	2/5/91	MDB
	TITLE BLOCK		

REV	DESCRIPTION	DATE	APPR. BY
0	INITIAL RELEASE	01/10/90	M.D.B.
1	REVISED CABLES AND	08/31/90	K.L.C.
	TITLE BLOCK		
2	REVISED DETAIL (2)	10/03/90	M.D.B.
3	REVISED FOR USE WITH TWIN	5/12/93	RSA

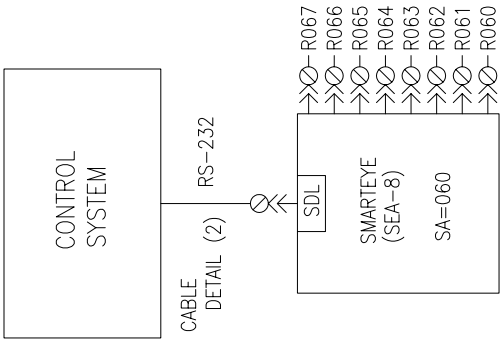
CONFIGURATION #1
(RS-422 POINT TO POINT)



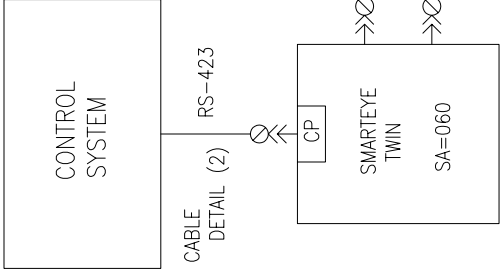
CONFIGURATION #2
(RS-422 POINT TO POINT)



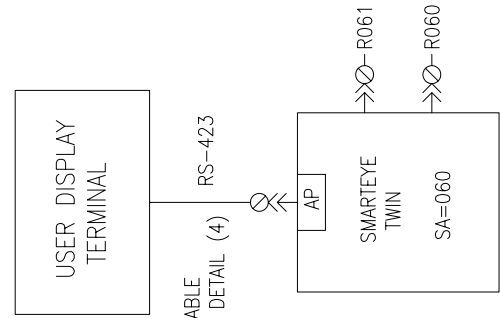
CONFIGURATION #3
(RS-232 POINT TO POINT)



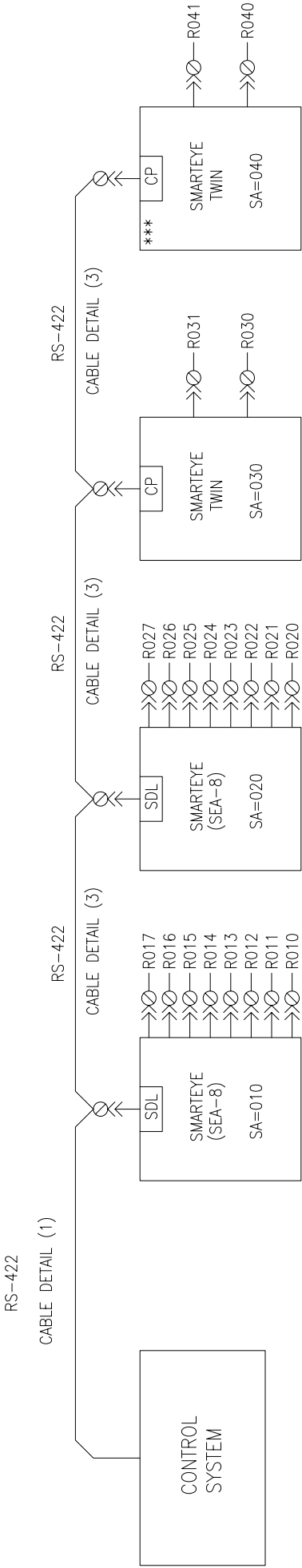
CONFIGURATION #4
(RS-423 POINT TO POINT)



CONFIGURATION #5
(TWIN AUXILIARY PORT)



CONFIGURATION #6
(RS-422 MULTIDROP)



LEGEND

- ↙ - MALE 9-PIN "D" CONNECTOR
- ⊗ - PLUG-IN SCREW TERMINATION
- *** - INDICATES LINE TERMINATION INSTALLED
- NC - NO CONNECTION
- SDL - SERIAL DATA LINE
- SA - STARTING ADDRESS OF SEA-8 OR TWIN
- CP - CONTROL PORT (TWIN)
- AP - AUXILIARY PORT (TWIN)

NOTES:

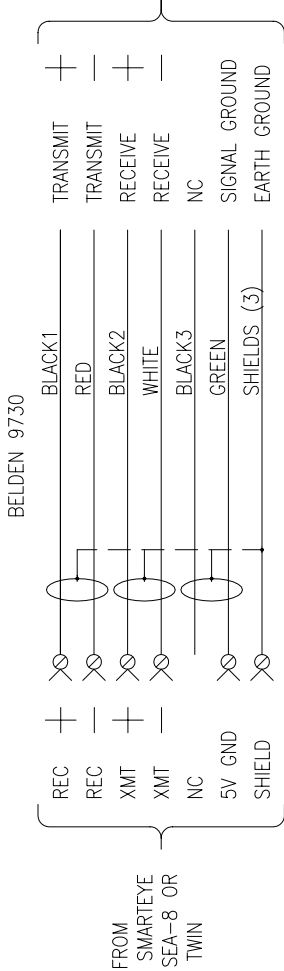
MAXIMUM LENGTH OF RS-422 IS 4000'.

MAXIMUM LENGTH OF RS-232 IS 50'.

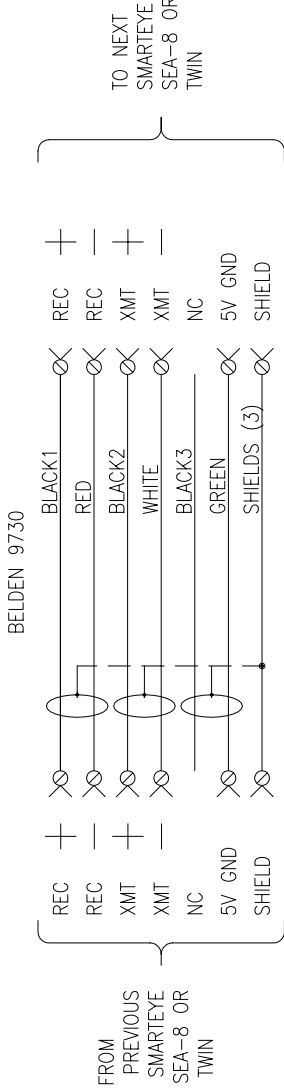
MAXIMUM LENGTH OF RS-423 IS 400' AT 9600 BAUD.

CABLE DETAILS

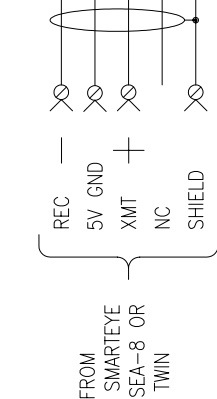
DETAIL (1)
RS-422



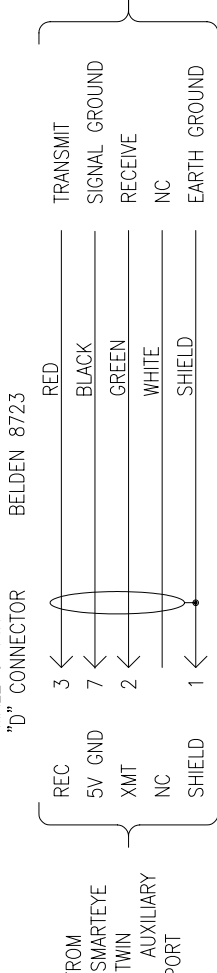
DETAIL (3)
RS-422 MULTIDROP




DETAIL (2)
RS-232 FOR SEA-8, RS-423 FOR TWIN



DETAIL (4)
RS-423





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DRAWN BY:	RSA	TITLE:
CHECKED BY:	KLC	SMARTEYE SEA-8 AND TWIN
ENGINEER:	MDI	COMMUNICATION CABLE DETAILS
DATE:	01/08/90	
SHEET	1 OF 1	
SCALE:	NONE	DRAWING NO. SP1024/01-412
SIZE:	D	

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