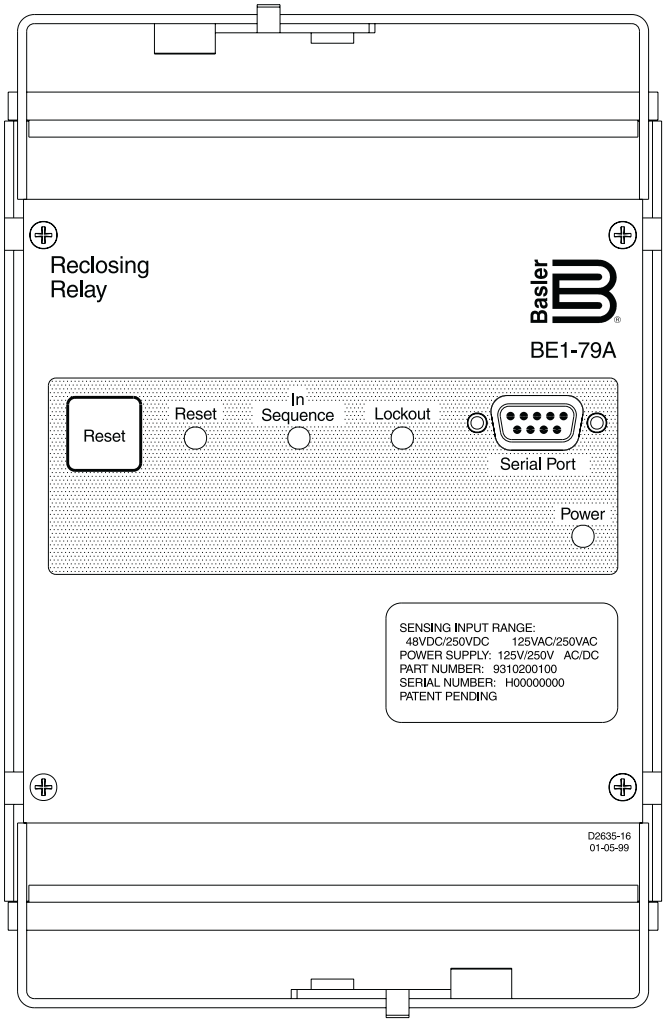
INSTRUCTION MANUAL
for
BE1-79A
RECLOSING RELAY



Basler Electric

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INTRODUCTION

This manual provides information concerning the operation and installation of the BE1-79A Reclosing Relay. To accomplish this, the following is provided.

- Specifications
- Functional Description
- Installation Information
- Testing Procedures

W A R N I N G !
TO AVOID PERSONAL INJURY OR EQUIPMENT DAMAGE, ONLY QUALIFIED PERSONNEL SHOULD PERFORM THE PROCEDURES PRESENTED IN THIS MANUAL.

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It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric Company.

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PRODUCT REVISION HISTORY

The following information provides a historical summary of the changes made to the embedded software (firmware) and hardware of this device. The corresponding revisions made to this instruction manual are also summarized. This revision history is separated into three categories: Software Changes, Hardware Changes, and Manual Revisions. All revisions are listed in chronological order.

Software Version	Changes
1.01- 07/97 1.02 - 12/97	Initial release. (9 3102 00 100, 9 3102 00 101) Initial release. (9 3102 00 200)
1.02 - 06/98	Communication was made consistent with other Basler products by adding line feeds to ASCII data returned by the relay. Revision level of 9 3102 00 100 was advanced to D. Revision level of 9 3102 00 101 was advanced to A.
1.05 - 08/00	This change is to the RS command. C(closed) and O(open) is changed to E(energized) and D(de-energized). This is in conjunction with the addition of the switch on the side that allows selection of NC or NO operation of the RS contact.

Hardware Version	Changes
07/97 12/97	Initial release. (9 3102 00 100, 9 3102 00 101) Initial release. (9 3102 00 200)
10/98	Changed serialization to Hxxxxxxxx
01/00	Contact sensing jumpers added to the digital circuit board of relays with part number 9 3102 00 101 gave inputs V1, V2, V3, and V4 three specific ranges of operating voltage.
08/00	Added a switch to allow for NO or NC operation of the RS contact.

Manual Revision	Changes
A - 09/97	Information pertaining to the power supply holdup feature was added.
B - 05/98	Patent information was added to Section 1. Various errors in Sections 1, 3, and 6 were corrected.
C - 01/00	Information pertaining to the jumper-selectable contact sensing voltage ranges was added. Drawings in Figure 5-1 were changed to show the revised relay case cover. Various errors in Sections 1, 2, 3, and 6 were corrected.
D - 08/00	Changed the manual to reflect modifications to the product. Closed and open for the RS command is now energized and de-energized. Added a switch to Figure 2-3 that allows the RS contact to be selected to NC or NO.

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SECTION 1 • GENERAL INFORMATION

DESCRIPTION

The BE1-79A Multiple Shot Reclosing Relay is an economical, microprocessor based relay that automatically recloses circuit breakers which have been tripped by protective relays or other devices in power transmission and distribution systems. The BE1-79A offers true “plug and play” convenience; it can be installed in an existing GE type S2 case with no wiring changes required. General Electric type ACR11A, ACR11B, ACR11C, ACR11E, and ACR11F reclosing relays can be directly replaced by the BE1-79A. The BE1-79A is also available in a Basler S1 case for new installations.

FEATURES

BE1-79A Multiple Shot Reclosing Relays have the following standard features:

- Rugged construction in a draw-out steel case
- A maximum of four automatic reclosures
- A maximum of four automatic resets
- Lockout function
- Selectable instantaneous or delayed first reclosure
- Selectable internal or external instantaneous jumper
- Selectable normally closed or normally open RS output contact
- Selectable Relay Fail or Lockout *and* Relay Fail output contact
- Selectable contact sensing voltage range

Controls And Indicators

The front panel has indicators to verify relay power and recloser status. A Reset switch is provided to restore the unit to the reset mode by clearing a reclosing sequence or a lockout condition. The left side of the relay cradle has switches to configure the relay for either ACR11A or ACR11B operation. The right side of the cradle has a switch(S4) to select either an internal or external jumper for an instantaneous first relcose. The left side of the cradle has a switch(S5) to select either normally open or normally closed operation of the RS contact.

Communications

All relay settings are read or changed through the Serial Port located on the front panel. The BE1-79A uses ASCII protocol.

Power HoldUp Circuit

The BE1-79A is available with an internal power holdup circuit. This circuitry enables the output contacts to be maintained for a minimum of 40 cycles after nominal operating power is removed from relay terminals 5 and 6.

PRIMARY APPLICATION

The BE1-79A Multiple Shot Reclosing Relay automatically recloses circuit breakers which have been tripped by protective relays or other devices in power transmission and distribution systems.

Over 90% of faults occurring on overhead lines may be cleared by momentarily de-energizing the line. Once the circuit breaker has been opened to de-energize the line, the BE1-79A provides a reliable automatic reclosure. The advantages are:

- Improved Service Continuity - returns the line to service quickly, preserving line integrity and minimizing outage effects on critical loads.
- System Stability - prevents disjointing of the system grid.
- Higher Line Availability - decreases likelihood of permanent loss of line

.

SPECIFICATIONS

BE1-79A relays have the following features and capabilities.

Reclose Timers

Reclose 1, Reclose 2, Reclose 3, and Reclose 4

Range:	0 to 300 seconds
Increments:	0.1 second
Accuracy:	±20 milliseconds ±1%, typical ±50 milliseconds ±1%, maximum

Reset Timers

Reset 1, Reset 2, Reset 3, Reset 4, and Final Reset

Range:	0 to 300 seconds
Increments:	0.1 seconds
Accuracy:	±20 milliseconds ±1%, typical ±50 milliseconds ±1%, maximum

Lockout Timer

Range:	0 to 300 seconds
Increments:	0.1 seconds
Accuracy:	±20 milliseconds ±1%, typical ±50 milliseconds ±1%, maximum

RS Timers

RS Set and RS Reset

Range:	0 to 300 seconds
Increments:	0.1 seconds
Accuracy:	±20 milliseconds ±1%, typical ±50 milliseconds ±1%, maximum

Communication Port

Parameters:	9600 baud, 8N1 half duplex
Protocol:	ASCII

Power Supply

AC or DC operation:	Range: 120 to 240 Vac Range: 125 to 250 Vdc

Power Holdup Time

9 3102 00 101 Relays Only:	40 cycles (670 milliseconds) minimum, after loss of nominal operating voltage

Contact Sensing Inputs

Operating Range

48 Vdc:	38.4 to 275 Vdc
125 Vdc/120 Vac:	100 to 275 Vdc or 96 to 264 Vac
250 Vdc/240 Vac:	200 to 275 Vdc or 192 to 264 Vac
Energizing Level:	≤80 percent of nominal
Current Draw:	1.5 milliamperes maximum per input
Recognition Time:	15 milliseconds for DC, AC(45-65 Hz), typical 25 milliseconds for DC, AC(45-65 Hz), maximum
Drop-Out Time:	15 milliseconds for DC, AC(45-65 Hz), typical 25 milliseconds for DC, AC(45-65 Hz), maximum

Output Contacts

Make and carry for tripping duty:	30 amperes for 0.2 seconds per IEEE C37.90; 7 amperes for 2 minutes 3 amperes continuous
Break Resistive or Inductive:	0.3 amperes at 125 or 250 Vdc (L/R=0.04 maximum)

Environment

Operating Temperature Range:	-40°C to 70°C (-40°F to 158°F)
Storage Temperature Range:	-40°C to 85°C (-40°F to 185°F)
Humidity:	Qualified to IEC 68-2-38, 1st Edition 1974, *Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test*

Electrostatic Discharge (ESD)

8 kV contact discharges and 15 kV air discharges applied in accordance with IEC 801-2 ESD.

Isolation

1500 Vac at 50/60 Hz in accordance with IEEE C37.90
The RS-232 Serial Communication Port is intended only for periodic use and is not subject to the requirements of IEEE C37.90.

Surge Withstand Capability

Oscillatory:	Qualified to IEEE C37.90.1-1989 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.* The RS-232 Serial Communication Port is intended only for periodic use and is not subject to the requirements of IEEE C37.90.1.
Fast Transient:	Qualified to IEEE C37.90.1-1989 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.* The RS-232 Serial Communication Port is intended only for periodic use and is not subject to the requirements of IEEE C37.90.1.

Radio Frequency Interference (RFI)

Type tested using a five watt, hand-held transceiver in the ranges of 144 and 440 megahertz with the antenna placed within six inches of the relay.

Shock

In standard test, the relay has withstood 15 g in each of three mutually perpendicular planes without structural damage or degradation of performance.

Vibration

In standard tests, the relay has withstood 2 g in each of three mutually perpendicular planes, swept over the range of 10 to 500 hertz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance.

Weight

S1: Maximum weight 13 pounds (including case)
S2: Maximum weight 5 pounds (excluding case)

Patent

Patent pending

PART NUMBERS

Table 1-1 lists the case style and special features of each version of the BE1-79A.

Table 1-1. BE1-79A Relay Model Numbers

Part Number	Options	Cradle Style
9 3102 00 100	None	S2
9 3102 00 101	Power Holdup Circuit	S2
9 3102 00 200	Mounting Case Included	S1

SECTION 2 • CONTROLS AND INDICATORS

FRONT PANEL

Figure 2-1 shows the front panel controls and indicators for the BE1-79A Multiple Shot Reclosing Relay.

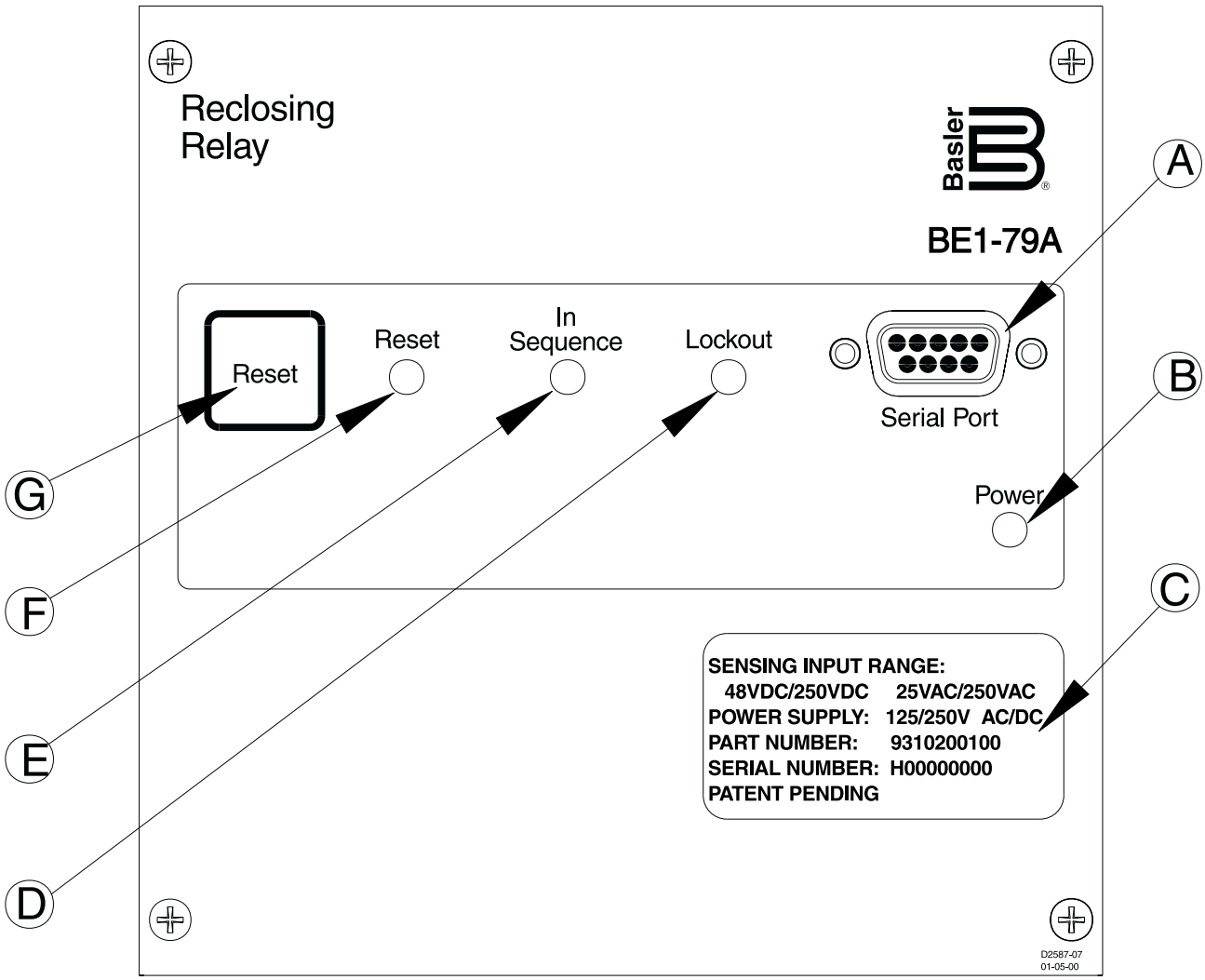

Figure 2-1. BE1-79A Front Panel

The following paragraphs describe each control and indicator and refer to the call-outs of Figure 2-1.

A RS-232 serial communications port. A computer terminal or PC running a terminal emulation program such as Windows® Terminal can be connected to this port so that the user may read or change the relay settings. Communication with the relay uses a simple ASCII command language.

B Power LED. When this LED is ON, it indicates that operating power is applied to the relay.

C Identification label shows the sensing input range, power supply type, serial number, and part number.

D Lockout LED. When illuminated, this LED indicates that the relay is in LOCKOUT.

E In Sequence LED. When this LED is ON, it indicates any one of the following:

- Timing to reclose.
- Timing to reset
- Timing to lockout
- Attempting to reclose
- Attempting to reset

F Reset LED. When illuminated, this LED indicates that the relay is in RESET.

G Reset pushbutton switch. Pressing this momentary switch will clear the In Sequence or Lockout LED and restore the relay to the Reset mode.

STYLE CONFIGURATION SWITCHES

The three switches on the left side of the relay cradle are used to configure the relay for either ACR11A or ACR11B operation. For simplicity, recloser styles ACR11B, ACR11C, ACR11D, ACR11E, and ACR11F will be referred to as ACR11B throughout this manual. Figure 2-2 illustrates the location of switches S1, S2, and S3.

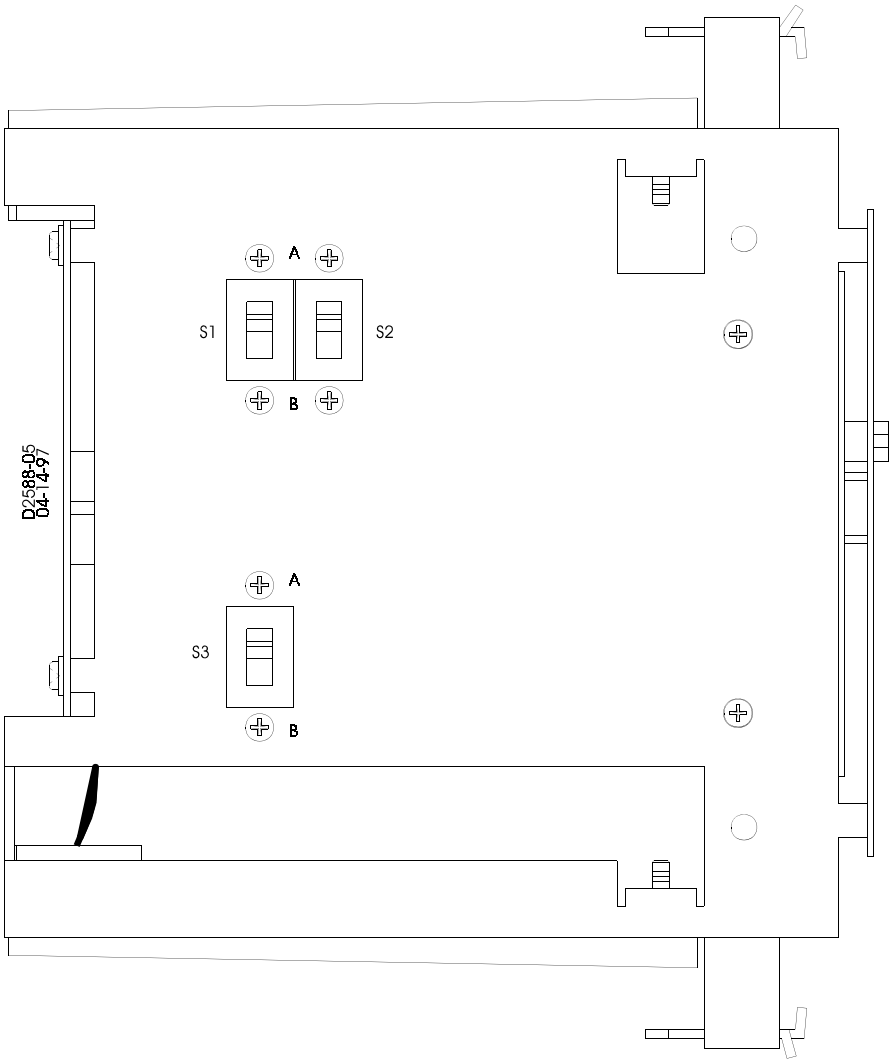

Figure 2-2. Style Configuration Switches

INSTANTANEOUS RECLOSE JUMPER SWITCH

The switches on the right side of the relay cradle are used to select either internal or external jumpering for an instantaneous first reclosure and for selecting normally closed or normally open operation of the RS contact. Figure 2-3 illustrates the location of switch S4, used to select internal or external jumpering, and S5, used to select normally open or normally closed operation of the RS contact.

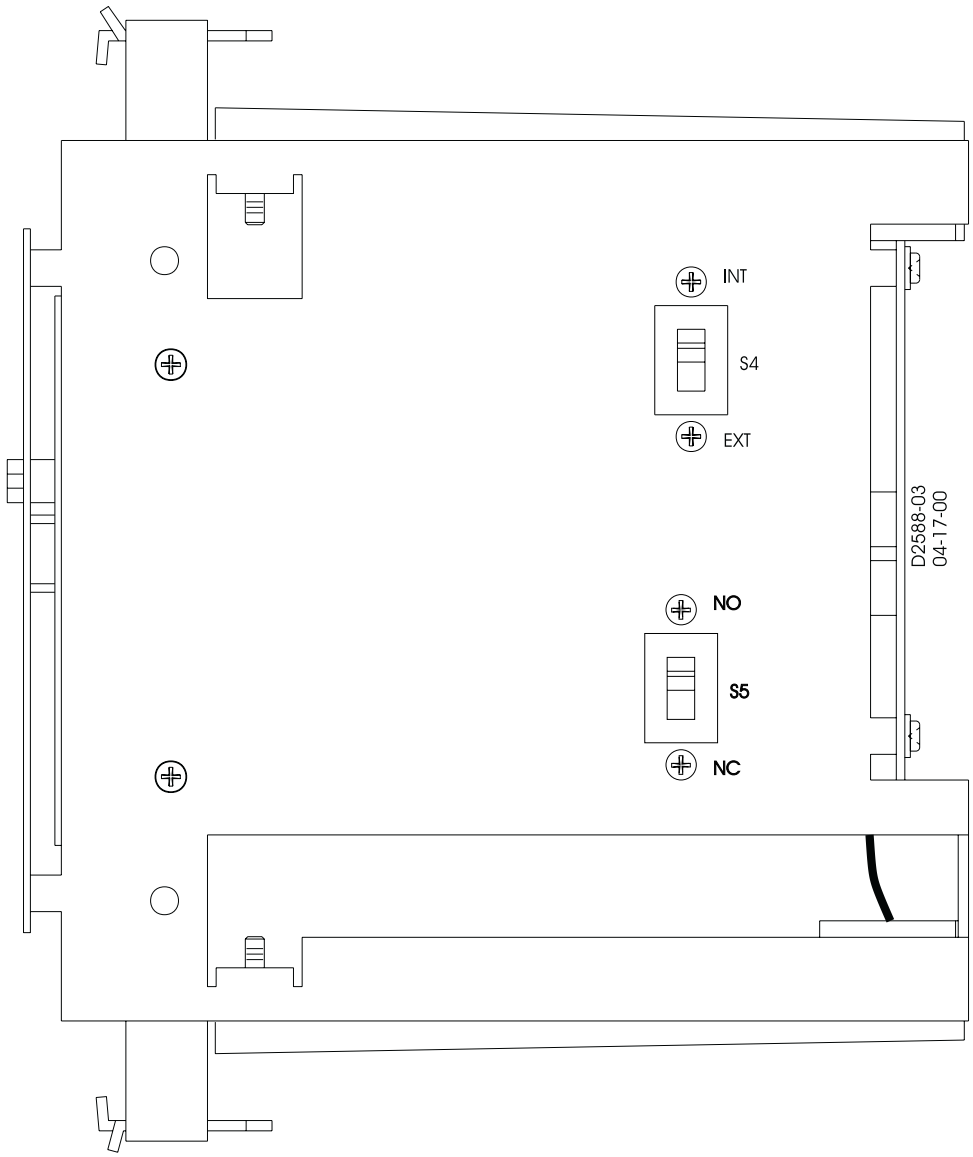

Figure 2-3. Instantaneous Reclose Jumper Switch and RS contact selection switch

SECTION 3 • FUNCTIONAL DESCRIPTION

GENERAL

BE1-79A Multiple Shot Reclosing Relays are microprocessor based devices that provide automatic reclosing of circuit breakers. This section describes the hardware, circuit operation, and software functional descriptions.

HARDWARE

The BE1-79A relay is available in an S1 cradle and case(200 series) or an S2 cradle without a case(100 series).

200 series Description

This BE1-79A consists of a fabricated steel and phenolic enclosure with a draw-out cradle assembly. The case has the same overall dimensions as a Basler Electric or General Electric S1 case.

100 series Description

This BE1-79A consists of a draw-out cradle assembly which is intended for installation in an existing S2 case. A case is not provided with the cradle assembly.

CIRCUIT OPERATION

Circuit operation is divided into *Inputs*, *Microprocessor*, and *Outputs*. Relay circuit functions are illustrated in Figure 3-1 and described in the following paragraphs.

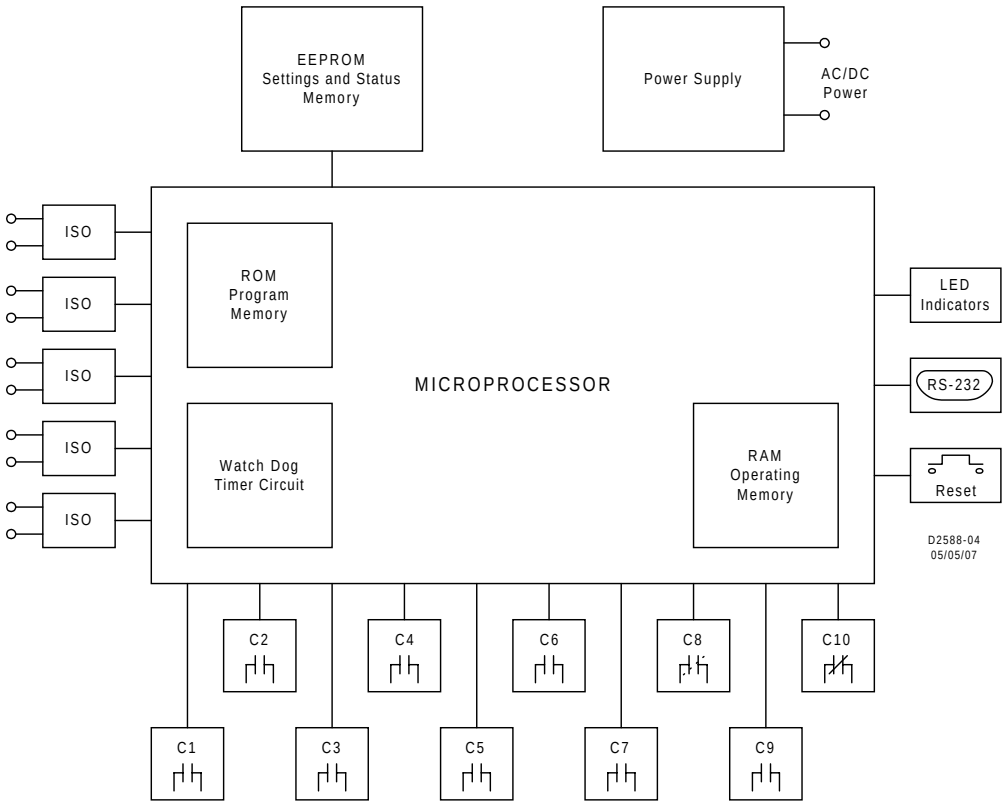

Figure 3-1. Functional Block Diagram

Inputs

There are four types of inputs to the BE1-79A relay. They are:

- Operating AC/DC Power
- Contact Sensing Inputs
- Reset Switch
- Serial Communication Port

Operating AC/DC Power. Operating power for the internal circuitry is applied to the isolated internal switching power supply. The power supply operates over a range of 120 to 240 Vac or 125 to 250 Vdc with no changes in connections or jumpers required. The operating power input is not polarity sensitive and is not disrupted by variations in the supply voltage or frequency over the power supply operating range. The power supply generates 24 Vdc.

Part number 9 3102 00 101 relays are equipped with hold-up circuitry which maintains relay function for a minimum of 40 cycles after nominal operating power is removed.

Contact Sensing Inputs. The contact sensing inputs are designated V1, V2, V3, V4, and V5. Each input uses an opto-isolator to provide isolation from external power sources. Each contact sensing input is rated for 48 Vdc to 250 Vdc and 120 Vac to 240 Vac at 45 to 65 hertz.

Inputs V1 through V4 can operate at any one of three jumper-selectable voltage ranges. Table 3-1 lists the nominal operating voltage for each of the three jumper positions. Each input has a dedicated jumper that is located on the digital circuit board. Jumper P3 controls the operating voltage for V1, P4 controls V2, P5 controls V3 and P6 controls V4. Instructions for placing each jumper in the desired position are provided in Section 5, *Installation*. Input V5 is dedicated to monitoring the relay power supply input and is not jumper selectable.

Table 3-1. Contact Sensing Jumpers

Jumper Position	Nominal Voltge
1	125 Vdc or 120 Vac
2	48 Vdc
3	250Vdc or 240Vac

Note

In certain applications where 240 Vac control voltage is used, control circuit feedback can occur through system inductive coupling. This feedback can result in erroneous signals, causing relay operation. If there is a potential for control circuit feedback, the jumper-selectable voltage range should be changed from the 48 Vdc factory default setting to a higher position. Selections are provided in Table 3-1.

The function of each input depends on the operating configuration of the relay. Tables 3-2 and 3-3 describe the function of each contact sensing input for each relay configuration. The G.E. nomenclature used for each input is provided in parenthesis following each description.

Table 3-2. Contact Sensing Inputs Description For ACR11A Operation

Input	Terminals	Description
V1	3, 4	This input is typically connected to a 52A contact which results in voltage being sensed when the breaker is closed. If V1 senses voltage within three seconds after the Reset 1, 2, 3, or 4 timer expires, a reset will be initiated. If the relay is in Lockout, a reset will be initiated anytime V1 senses voltage. (E Reset)

V2	7, 8	This input is connected to a 52B contact which results in voltage being sensed when the breaker is open. This input is typically used to provide an anti-pump feature. If voltage is removed from V2 during a reclose attempt, the anti-pump feature will prevent a further reclose attempt until the next reclose set time is reached. This prevents multiple reclose attempts for a single reclose setting. (Z)
V3	11, 12	This input is used to monitor the 52B contact while the relay is in a reset condition. When V3 senses voltage, the relay initiates a reclose sequence. (E Operate)
V4	---	This input is not used in this application.
V5	5, 6	This input is internally connected to the relay power supply terminal. A loss of sensing voltage at this input will cause the relay to store all necessary data in memory.

Table 3-3. Contact Sensing Inputs Description For ACR11B Operation

Input	Terminals	Description
V1	3, 4	This input is typically connected to a 52A contact which results in voltage being sensed when the breaker is closed. If V1 senses voltage within three seconds after the Reset 1, 2, 3, or 4 timer expires, a reset will be initiated. If the relay is in Lockout, a reset will be initiated anytime V1 senses voltage. (E Reset)
V2	6, 7	Voltage sensed at this input causes the relay to start a reclose sequence. (Motor)
V3	11, 12	This input is used to monitor the 52B contact while the relay is in a reset condition. When V3 senses voltage, the relay initiates a reclose sequence. (E Operate)
V4	11, 17	This input is connected to a 52B contact which results in voltage being sensed when the breaker is open. This input is typically used to provide an anti-pump feature. If voltage is removed from V4 during a reclose attempt, the anti-pump feature will prevent a further reclose attempt until the next reclose set time is reached. This prevents multiple reclose attempts for a single reclose setting. (Z)
V5	5, 6	This input is internally connected to the relay power supply terminal. A loss of sensing voltage at this input will cause the relay to store all necessary data in memory.

Reset Switch. This momentary switch clears the In Sequence or Lockout LEDs located on the front panel and restores the relay to a reset condition. The reset switch performs the same function as the manual clutch release on the General Electric ACR11 relays. Operating power must be applied to terminals 5 and 6 for a reset to occur.

Serial Communication Port. The serial communication port is a standard RS-232 (DB-9) female connector located on the front panel. This serial port provides the means to configure and read relay settings.

Microprocessor

All reclosing and communication functions are coordinated by the microprocessor. The BE1-79A uses an eight bit microprocessor with integral ROM (read only memory) and RAM (random access memory). The microprocessor is monitored by a watch-dog circuit which will reset the microprocessor if a problem is detected.

Outputs

The BE1-79A has ten outputs. The function of each output depends on the operating configuration of the relay. Tables 3-3 and 3-4 provide a description of each output for each relay configuration.

Table 3-3. Outputs Description for ACR11A Operation

Output	Terminals	Description
C1	---	This output is not used in this application.
C2	13, 14	This output is closed during reset and open when voltage at input V3 is sensed. During a reclose sequence, C2 will remain open until the relay returns to reset. (E1)
C3	15, 16	This output functions as a programmable alarm contact . It can be set to function as a Relay Fail output or a combination Relay Fail/Lockout output. A detailed explanation is provided in the *Alarm Output Command* sub-section of Section 4, *Communication*. (JK)
C4	17, 18	This output is used in conjunction with the anti-pump function. C4 is closed when voltage is sensed at input V2. (Z2)
C5	19, 20	This output is used in conjunction with the anti-pump function. C5 is closed when voltage is sensed at input V2. (Z3)
C6	17, 20	This Reclose output closes for three seconds after a reclose timer expires. (AB)
C7	15, 20	This Anti-Pump output closes for the duration of a reclose timing except if output C6 closes. If C6 closes, output C7 will close only if voltage is sensed at contact sensin input V2. (BC+Z1)✳KL
C8	9, 10	This RS output can be configured as a normally open or normally closed contact. The output can be set to energize for an adjustable duration after the start of a reclose cycle. The interval between the reclose sequence start and C8 energizing is also adjustable. A detailed explanation of programming the RS output is provided in the *RS Contact Setting Command sub-section of* Section 4, *Communication*.
C9	---	This output is not used in this application.
C10	1, 2	This output is closed during a reset condition and open when a reclose timing begins. (E4)

Table 3-4. Outputs Description for ACR11B Operation

Output	Terminals	Description
C1	12, 17	This output will close momentarily when voltage is sensed at input V4 and the relay is in a reset condition. (Z2✳E6)
C2	13, 14	This output is closed during reset and open when voltage at input V3 is sensed. During a reclose sequence, C2 will remain open until the relay returns to reset. (E1)

Output	Terminals	Description
C3	15, 16	This output functions as an programmable alarm contact . It can be set to function as a Relay Fail output or a combination Relay Fail/Lockout output. A detailed explanation is provided in the *Alarm Output Command* sub-section of Section 4, *Communication*. (JK)
C4	18, 19	This output is closed any time that the unit is not in reset. (E5)
C5	17, 19	This Reclose output closes for three seconds after a reclose timer expires. (AB)
C6	14, 17	This Anti-Pump output closes for the duration of a reclose timing except if output C5 closes. If C5 closes, output C6 will close only if voltage is sensed at contact sensing input V4. (BC✳Z1)
C7	8, 20	This output is closed when the relay is in a lockout condition. (HI)
C8	9, 10	This RS output can be configured as a normally open or normally closed contact. The output can be set to energize for an adjustable duration after the start of a reclose cycle. The interval between the reclose sequence start and C8 energizing is also adjustable. A detailed explanation of programming the RS output is provided in the *RS Contact Setting Command sub-section of* Section 4, *Communication*.
C9	5, 8	This output closes when the relay is in reset and voltage is sensed at input V3. C9 will remain closed until the relay reaches either a lockout or reset condition. (GH+E3)
C10	1, 2	This output is closed during a reset condition and open when a reclose timing begins. (E4)

INTERCONNECTIONS

Figure 3-2 illustrates the interconnection of the contact sensing inputs, relay outputs, style configuration switches, and instantaneous reclose jumper switch in the BE1-79A relay. Figure 3-2 shows the relay configured for an ACR11A application. Figure 3-3 shows the relay configured for an ACR11B application with an instantaneous recloser jumper.

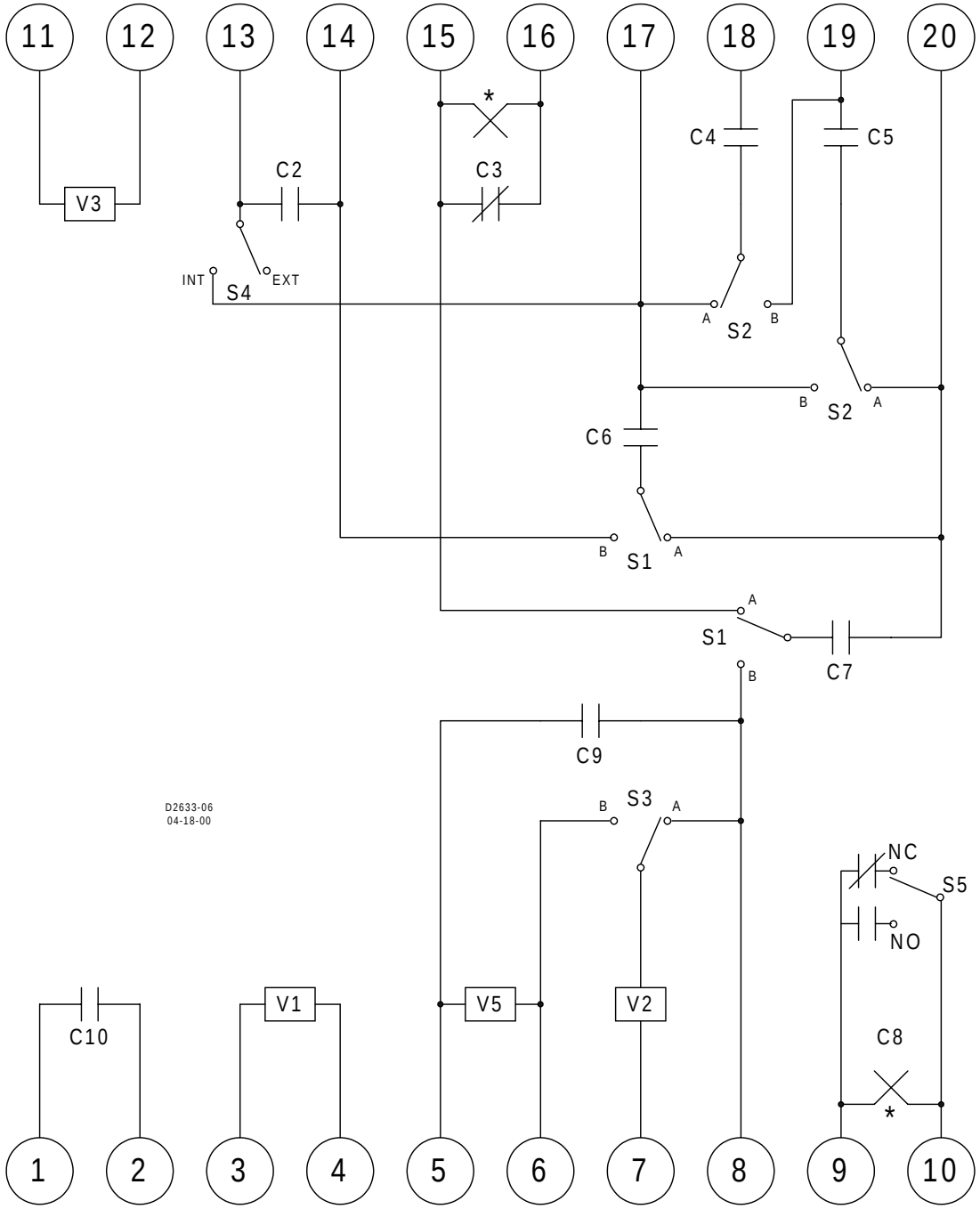

Figure 3-2. Relay Interconnections For ACR11A Applications

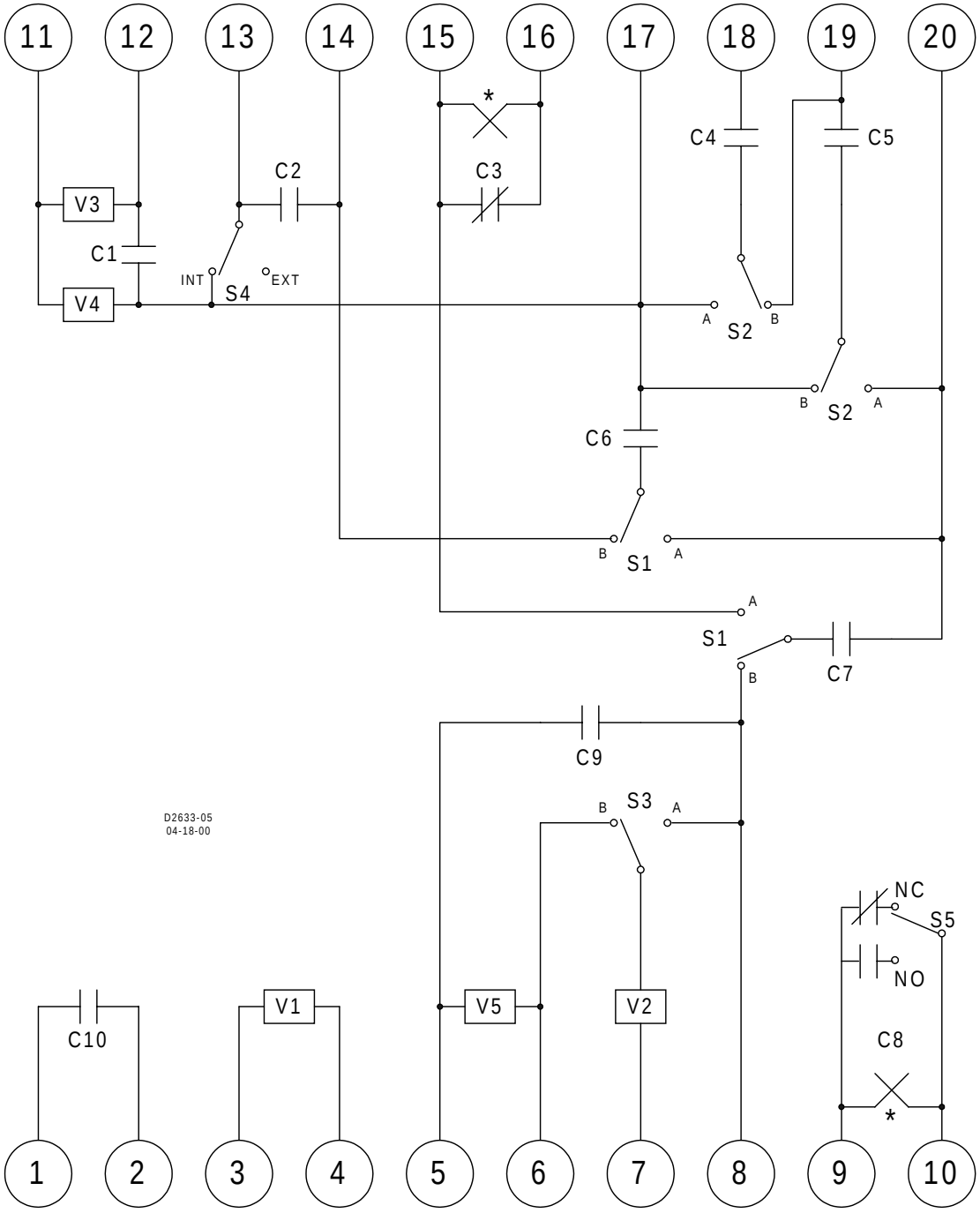

Figure 3-3. Relay Interconnections For ACR11B Applications

RECLOSER OPERATION

The following paragraphs provide information on the software controlled features of the recloser.

Power-Up

The flow chart of Figure 3-4 describes relay operation following the application of operating power. Depending on conditions and the reset delay setting, the interval from power application to the resultant state may be from 0 to 300 seconds.

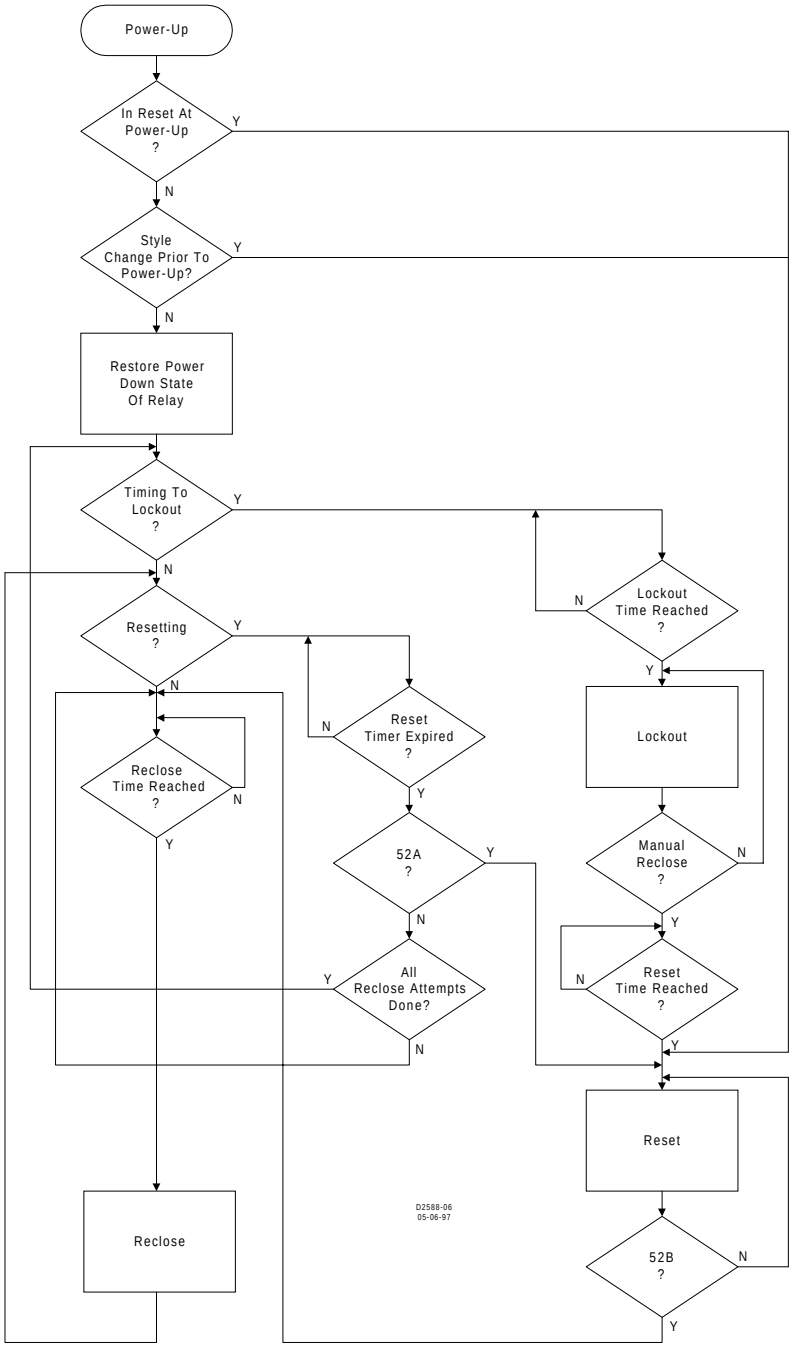

Figure 3-4. Power-Up Flow Chart

Reset

A reclosing sequence may only be initiated when the relay is in reset. Reset is indicated by the front panel Reset LED. For the relay to reach reset, the controlled breaker must be closed during a three second period when the reset timer expires. If the breaker opens prior to this time, the relay will proceed to the next reclosing attempt. If the number of programmed reclosing attempts have been exhausted, the relay will drive to lockout.

Lockout

Lockout, a state inhibiting relay operation, is produced by two conditions:

- Reclose failure
- Number of breaker openings exceeds the number of programmed reclosure attempts

Lockout is indicated by the front panel Lockout LED. The S-ALM command allows output C3 to be programmed to close for a lockout condition. Lockout is terminated when the controlled breaker is closed (manually or by other means) and remains closed for the duration of the final reset time delay setting.

Reclosing Sequences

A reclosing sequence is initiated by the closure of a 52B contact. A reclosing sequence is indicated by the In Sequence LED located on the front panel. The BE1-79A provides up to four automatic reclosures. Each reclose setting is adjustable and has a setting range of 0 to 300 seconds. The number of reclosing attempts may be limited by adjusting any one of the reclose time delay settings to zero. When a breaker trip occurs at this point in the reclosing sequence, lockout will result. An instantaneous first reclose is enabled on relays configured for ACR11B operation by a jumper across case terminals 13 and 17 or a switch mounted on the right side of the relay.

Each of the four reclose settings has a corresponding reset timer. A final reset controls the time between lockout and reset. Each reset setting is adjustable and has a setting range of 0 to 300 seconds. Pressing the momentary front panel reset switch will clear a reclosing sequence and return the relay to the reset mode.

The reclose and reset timer settings of Basler reclosing relays such as the BE1-79 and BE1-79M are based on the breaker opening that immediately precedes each reclose and reset setting. This is not the case with the BE1-79A. Each reclose and reset timer setting is based on the breaker opening that initiates the first reclose timer. Typically, this makes the first reclose setting the shortest time setting and the fourth reclose setting the longest time setting. Figure 3-5 illustrates a BE1-79A reclosing sequence and the relationship of each reclose setting to the breaker openings.

The flow chart of Figure 3-6 is a simplified representation of reclosing sequence initiation and progression.

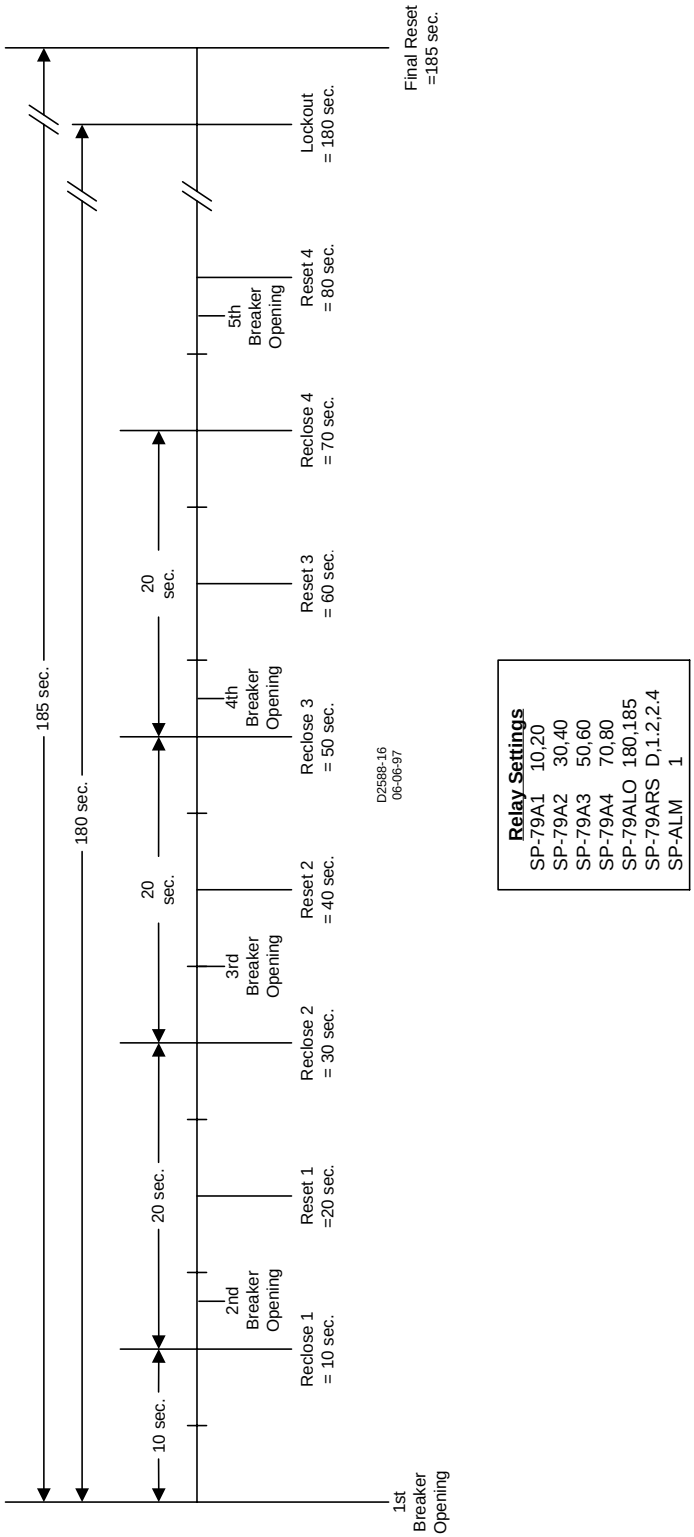

Figure 3-5. BE1-79A Reclose Settings Example

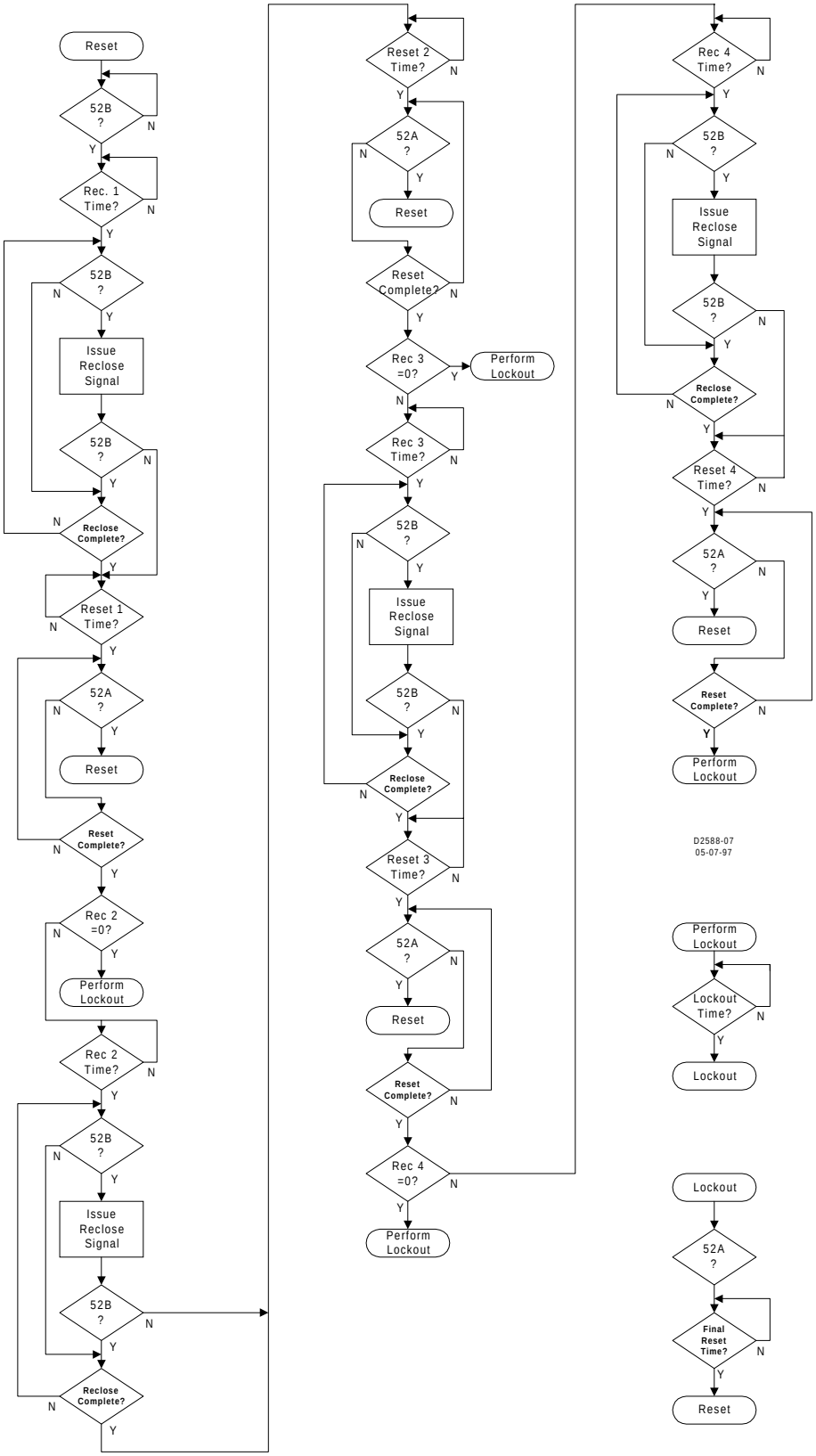

Figure 3-6. Reclosing Flow Chart

SECTION 4 • COMMUNICATION

GENERAL

Communication capability is provided through a standard RS-232 (DB-9) female connector at the front panel of the relay. The relay ASCII communication protocol is compatible with readily available terminal/modem software. The BE1-79A communication port supports half duplex operation.

For the BE1-79A communication port:

- The communications baud rate is fixed at 9600.
- The number of data bits is fixed at 8.
- The parity is fixed at NONE (N).
- The number of stop bits is fixed at 1.

More information about the communication port interface requirements is provided in Section 5, *Installation.*

ASCII COMMAND FORMAT

Each command consists of an ASCII string terminated by a carriage return, <CR>. A line feed <LF> is optional.

Command Format: <CMD>[<;>CMD...]<CR>[<LF>]

Where:

[ ]	Brackets identify optional parameters. Brackets are not part of the command.
< >	Separators used for clarity. They are not part of the command.
CMD	<Name>[n][<=> <Setting-x>...[<,><Setting-x>]]

Where:

Name	Command name. Refer to COMMAND NAME SYNTAX below for further information.
n	Optional command object. (If n is omitted, the command applies to all objects if more than one object is available.)
=	Used to indicate that the command is to change data or settings.
Setting-x	Command setting(s)
,	Commas are used as setting separators.
CR	A carriage return is used to end command and start execution.
LF	A line feed may be used for clarity. It is ignored by the relay.
Spaces	One or more spaces may be added between entries for clarity if desired.

Command Response Format : [<RESPONSE>][<ACK>]

Where:

RESPONSE	Determined by CMD.
ACK	> is returned for a valid command, ? is returned for an invalid command.

Commands received by the BE1-79A consist of two types: requests for information and changes to operating parameters. Commands to change parameters are identified by an equal sign (=). The operating parameters to the right of the equal sign are intended to replace the current operating parameters related to the command.

Some commands may pertain to multiple items. In that case, a numeric identifier is used after the command name to specify a single item. If the identifier is omitted, the command applied to all possible items. For example, the S-791 command could be used to read the first reclose setting or the command S-79 could be used to read all reclose settings.

Changing Settings Through The Serial Port

The ACCESS (A) command is used to access write privileges while changing relay settings. Relay protection functions are disabled when access is granted. Changing the settings through the serial port requires that the operator use the ACCESS command to obtain programming access. The operator enters ACCESS and the relay responds with an acknowledgment of > if the command was received and executed. Any time an invalid command is received, the relay will respond with ? (question mark).

The EXIT command is used to release write privileges while changing relay settings. After the change(s) are made, the new data will be copied to the working settings and saved to non-volatile memory when EXIT is entered. The operator must confirm that the programming is completed and accepted before the changes are actually made. It is important to make all changes to relay settings before executing the EXIT command. This ensures that all intended settings are executed. The relay will return to reset when the EXIT command is entered.

Changing settings through the serial port consists of the following sequence:

Step 1. Enter ACCESS=<CR>

Step 2. Enter commands to change the current settings.

Step 3. Enter EXIT<CR> to clear access and save.

Step 4. Enter Y(yes)<CR> to confirm save.

The <CR> characters placed after commands stand for carriage return or ENTER key. For simplicity they will no longer be shown, but each line entered by the operator must be terminated with a carriage return <CR> or a carriage return - line feed <CR-LF>.

Access And Exit Commands

Detailed information on the ACCESS and EXIT commands is provided in the following paragraphs.

ACCESS Command

Purpose: Read/Set programming access in order to change user settings

Syntax: ACCESS[=]

Access must be changed by entering ACCESS= before any changes to the settings can be made. Relay protection functions are disabled when access is granted. The ACCESS command is valid for a period of five minutes if no new characters are entered. ACCESS by itself may be used to check if programming access is active or disabled. The relay will respond with ACCESS: YES or ACCESS: NO. The available ACCESS privilege is Privilege S: Setting Access. When exiting ACCESS, the unit returns to RESET.

EXIT Command

Purpose: Exit programming mode

Syntax: EXIT

Comments: Exits the programming mode and resets ACCESS privilege to 0.

Changes are made to a scratch-pad copy of the settings. After the change(s) are made, the new data will be saved to non-volatile memory and the new working settings will be initialized when control to make changes is released by entering the EXIT command. After entering EXIT, the user is prompted to confirm that the new data should be saved. The user has three options (Y or N or C). If Y is entered the data will be saved. If N is entered, the changes will be cleared and the old settings will be restored. If C is entered, the EXIT command will be aborted and programming may continue. It is important to make *all* changes to relay parameters before executing the EXIT command. This ensures that all intended settings are executed.

For clarity in the examples, relay responses are printed in the typeface shown in Example 1.

Example 1. Exit after making changes.

EXIT

>SAVE CHANGES (Y/N/C)?	Prompt to Save (Y)es or (N)o or (C)ontinue
>Y	Confirmation to save changes
CHANGES SAVED	Confirmation that changes were saved

Obtaining HELP Information Through The Serial Port

The HELP or H command provides general help information on command syntax and functionality when the manual is not available. Help is available only when the relay is in a Reset condition. Detailed information on this command is provided below:

HELP Command

Purpose: Obtains help on using serial port commands.

Syntax: HELP or H

Comments: The HELP command returns a listing of all available commands along with the proper syntax for each command.

Obtaining A Summary Of All Settings

All relay settings may be listed using the S command. Detailed information on the S command is provided below.

S Command

Purpose: Read all settings back to user.

Syntax: SP-79a[n]

Comments: S by itself may be used to read all relay settings. SP-79A[n] is used to read a specific setting. The S command can be used to make a record of the relay settings after they have been set.

Example 1. Obtain a report of the relay settings.

```
A=
S
SP-79A1 5,10
SP-79A2 15,20
SP-79A3 25,30
SP-79A4 35,40
SP-79ALO 45,50
SP-79ARS D,0,5
SP-ALM 2
>
```

Table 4-1. Default Switch Settings.

Switch	Default
S1	A
S2	A
S3	A
S4	EXT
S5	NC

Reclose And Reset Timer Setting Command

Table 4-2. Internal Default Settings

Command	Default
SP-79A1	0.0,0.0
SP-79A2	0.0,0.0
SP-79A3	0.0,0.0
SP-79A4	0.0,0.0
SP-79ALO	0.0,15.0
SP-79ARS	E,1.5,15.0
SP-ALM	2

SP-79A Command

Purpose: Read or change the reclose and reset timer settings.

Syntax: SP-79A[n][=<reclose time delay>,<reset time delay>]

Comments: n: reclose number or LO for Lockout. See Table 4-2 for setting defaults.

reclose time delay: Adjustable from 0 to 300 seconds in 0.1 second steps. A Reclose 1 setting of zero will cause an instantaneous first reclosure. A setting of zero for any other Reclose timer will the disable the reclose shot.

reset time delay: Adjustable from 0 to 300 seconds in 0.1 second steps. A reset time delay setting of zero will cause the reset will be disabled. A reset time delay setting less than the reclose time setting will cause an immediate reset following the reclose attempt.

Lockout Timer Setting Command

SP-79ALO Command

Purpose: Read or change the lockout timer settings.

Syntax: SP-79ALO[=<lockout time delay>,<final reset time delay>]

Comments: lockout time delay: Adjustable from 0 to 300 seconds in 0.1 second increments. A lockout time delay setting of zero will cause an instantaneous lockout when the breaker opens. A lockout time delay setting that is shorter than a reclose time delay setting will take priority and drive the relay to lockout.

final reset time delay: Adjustable from 0 to 300 seconds in 0.1 second increments. A final reset time delay that is equal to zero or is less than the lockout time delay setting will give an immediate reset following lockout and a manual reclose. See Table 4-2 for setting defaults.

RS Contact Setting Command

SP-79ARS Command

Purpose: Read or change the RS contact settings.

Syntax: SP-79ARS[=<mode>,<apply time>,<remove time>]

Comments: mode: The state of the RS contact, which can be D or E.

D indicates de-energized..

E indicates energized.

apply time: Time from the start of the reclose cycle until the RS contact is applied. The apply time

is adjustable from 0 to 300 seconds in 0.1 second increments.

remove time: Time from the start of the reclose cycle until the RS contact is removed. The remove time is adjustable from 0 to 300 seconds in 0.1 second increments. See Table 4-2 for setting defaults.

Alarm Output Command

SP-ALM Command

Purpose: Read or change the Lockout/Relay Fail output setting.

Syntax: SP-ALM[=<mode>]

Comments: mode: Selects the operating mode of the output, which can be 1 or 2. See Table 4-2 for setting defaults.

1 selects Relay Fail

2 selects Relay Fail and Lockout

Relay Information Command

RG-VER Command

Purpose: Read information about relay hardware/software configuration.

Syntax: RG-VER

Comments: Transmitting the RG-VER command will cause the relay to respond with the relay model number and the software version and date.

SECTION 5 • INSTALLATION

GENERAL

BE1-79A Multiple Shot Reclosing Relays are delivered in sturdy cartons to prevent shipping damages. Upon receipt of the relay, check the Model Number against the requisition and packaging list for agreement. Inspect for damage, and if there is evidence of such, immediately file a claim with the carrier and notify the Basler Electric Regional Sales Office, your Sales Representative or a Sales Representative at Basler Electric, Highland, Illinois.

If the relay is not installed immediately, store it in the original shipping package in a moisture and dust free environment.

MOUNTING

Because the relay is of solid-state design, it does not have to be mounted vertically. Any convenient mounting angle may be chosen. The BE1-79A is available in an S1 cradle with case or an S2 cradle. The S2 cradle is intended for installation in an existing S2 case. Overall dimensions for the S1 case are shown in Figure 5-1. S1 case cutout dimensions are shown in Figure 5-2.

CONNECTIONS

Incorrect wiring may result in damage to the relay. Be sure to use the correct input power for the power supply and the correct input voltage for the contact inputs. Connections should be made with a minimum wire size of 14 AWG. Figure 5-3 is a rear view of the S1 style case showing the terminal connections. Figure 5-4 is a typical connection diagram for an application using an ACR11A style relay. Figure 5-5 shows typical connections for an application using an ACR11B style relay.

APPLICATION

The function of the BE1-79A relay is intended to duplicate the ACR11 reclosers with only minor variations. To ensure that your BE1-79A relay functions properly, you should consider the adjustments and settings described in the following paragraphs.

Style Configuration Switches

Switches S1, S2, and S3, must be set properly for your application. All three switches should be placed in the A (up) position for ACR11A operation. All three switches should be placed in the B (down) position for ACR11B, ACR11C, ACR11E and ACR11F operation.

Instantaneous Reclose Jumper Switch

Use the following guidelines for setting the Instantaneous Reclose Jumper Switch.

- For ACR11A operation, switch S4 should be placed in the EXT (down) position.
- An internal jumper from terminals 13 to 17 for an instantaneous first reclosure (SP-79A1 0.0,X.X) is duplicated by placing switch S4 in the INT (up) position.
- A delayed first reclosure is achieved when S4 is placed in the EXT (down) position.
- If an external jumper is left in place at terminals 13 and 17 for an instantaneous first reclosure, S4 should be placed in the EXT (down) position.
- An internal jumper is not required at terminals 12 and 13 for a delayed first reclosure. S4 should be placed in the EXT (down) position for delayed reclosures.

RS switch 5 is used to control the RS contact for normally open or normally closed configuration. Figure 2-2 and 2-3 of *Controls And Indicators* Section 2 should be consulted for the location and setting positions of the style configuration switches.

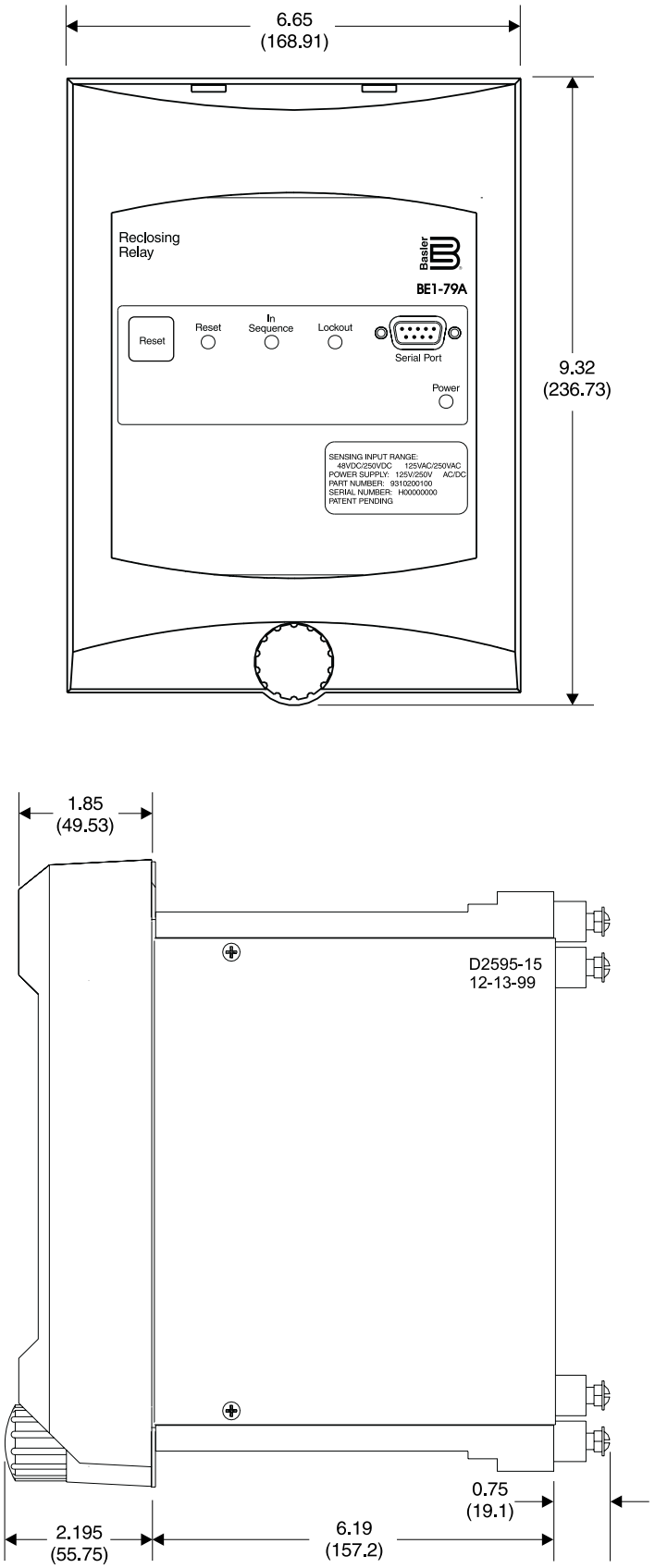

Figure 5-1. BE1-79A S1 Case Overall Dimensions

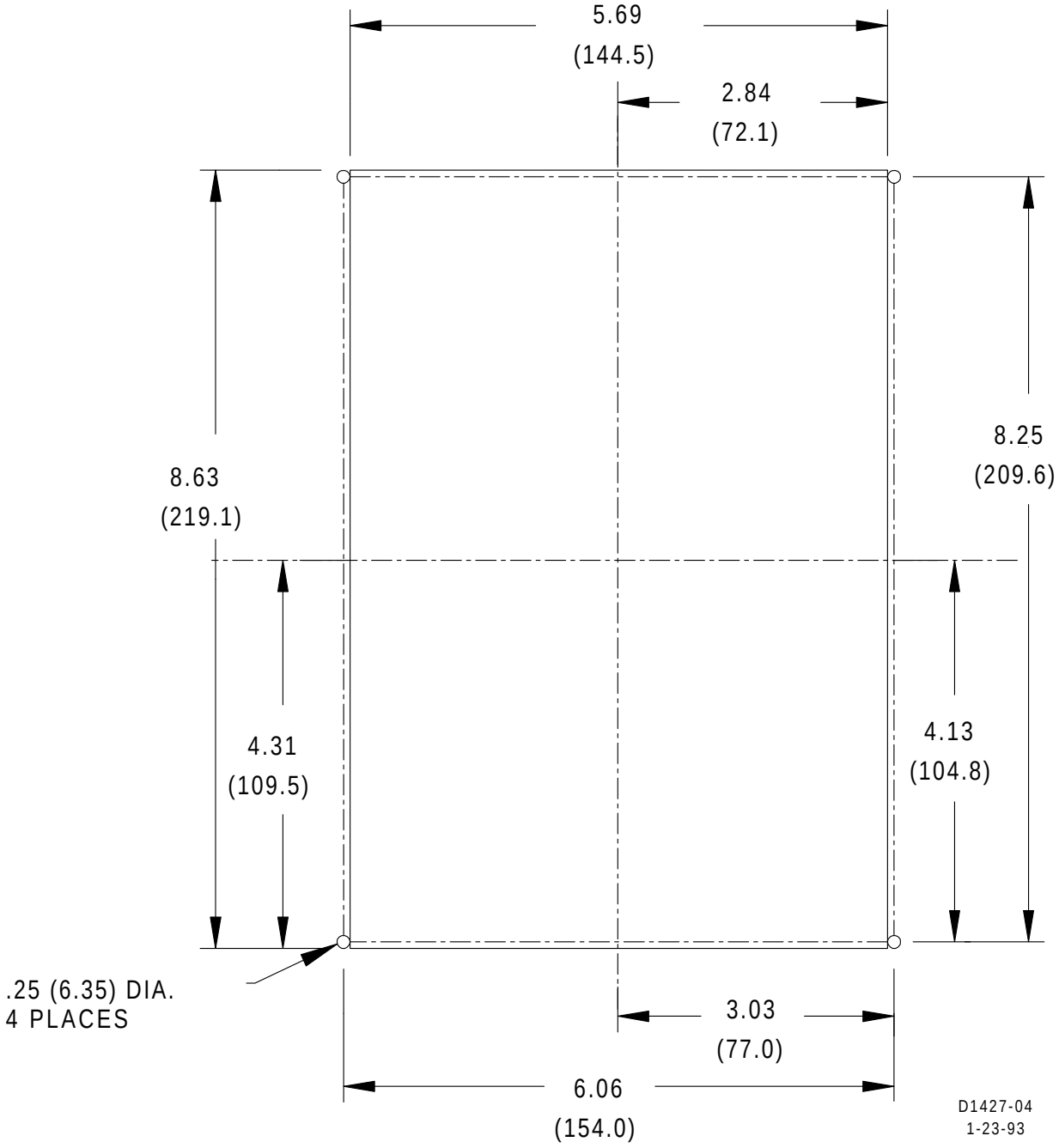

Figure 5-2. S1 Case Cutout Dimensions

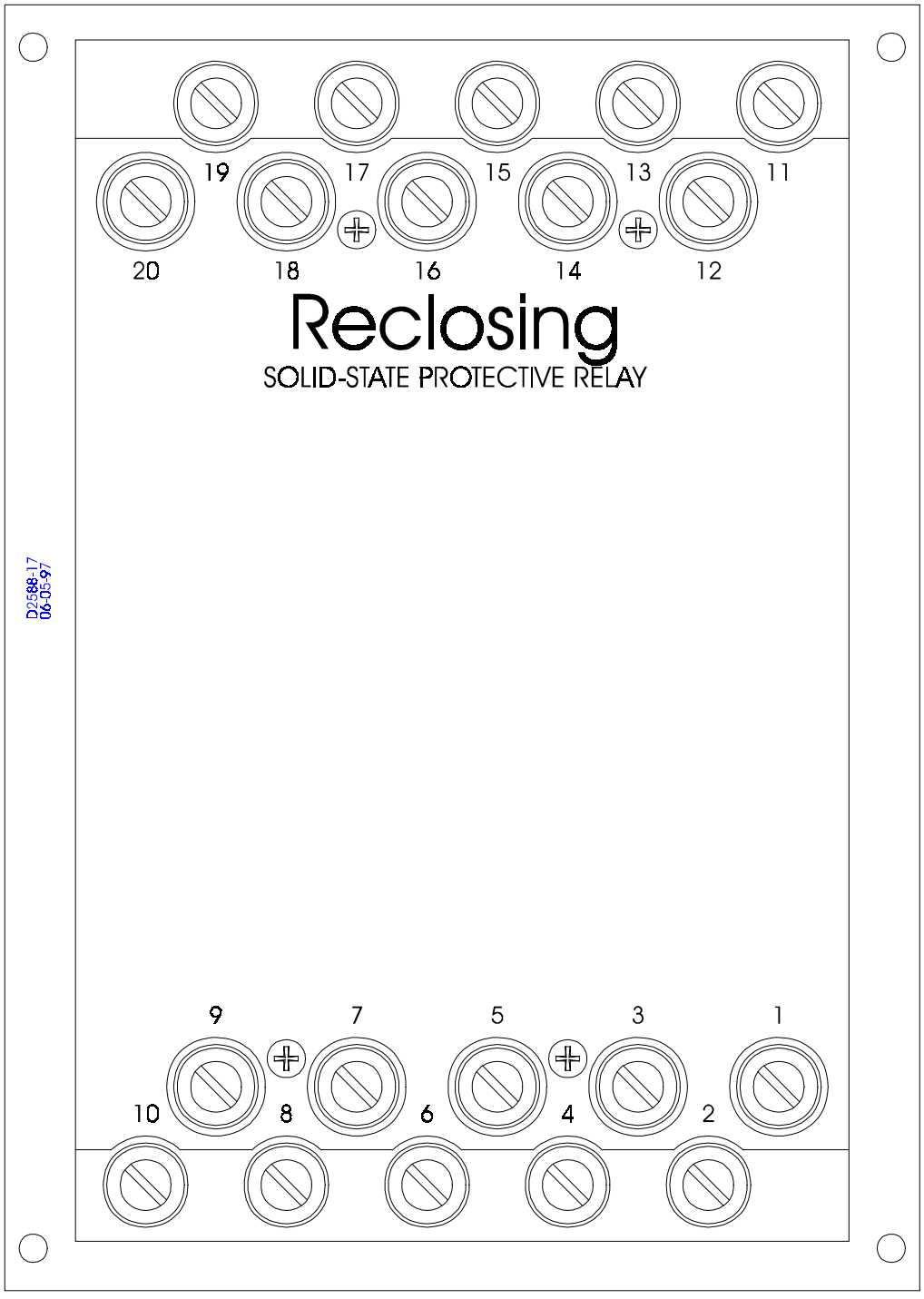

Figure 5-3. S1 Case, Rear View, Terminal Connections

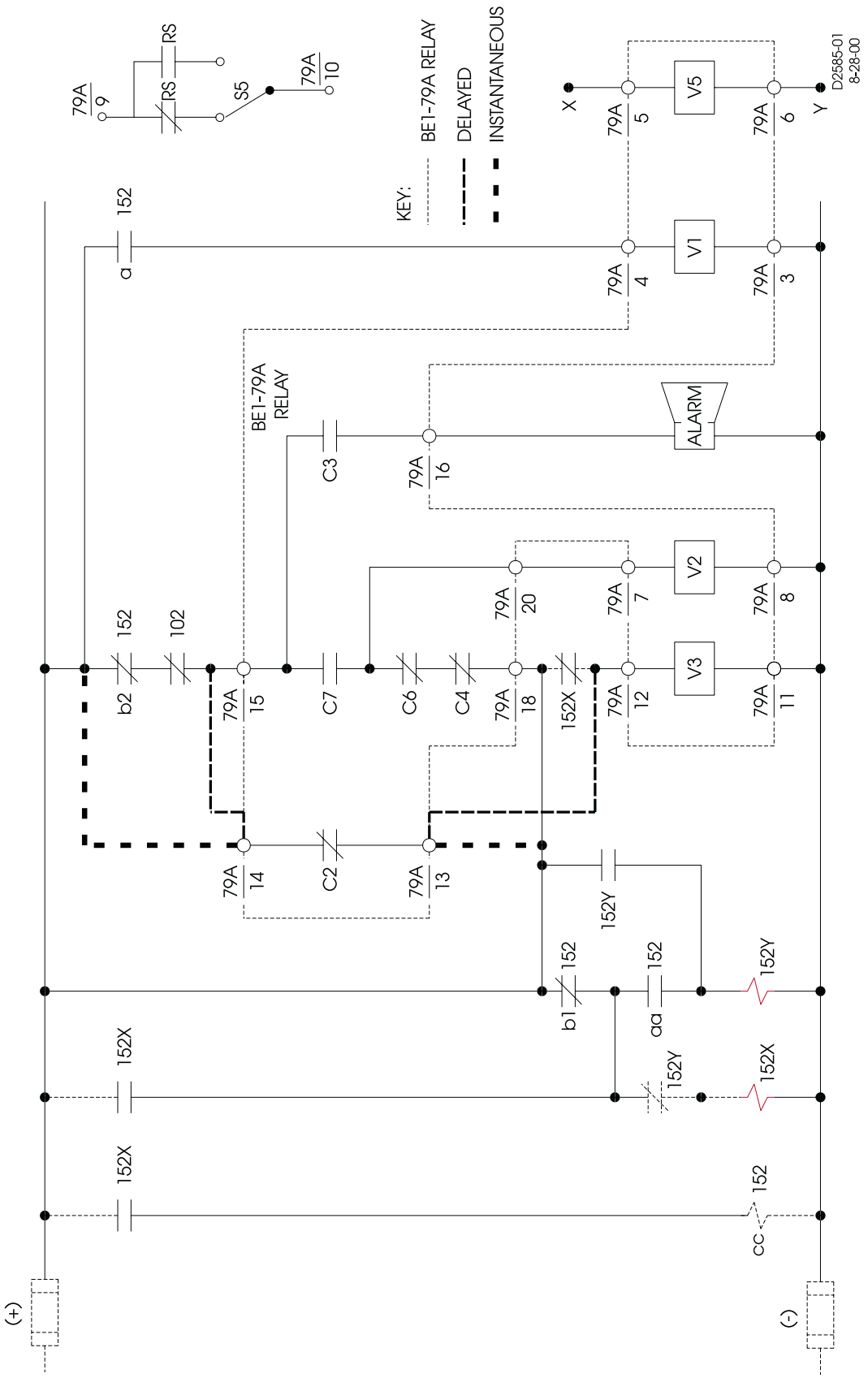

Figure 5-4. Typical Connections for ACR11A Application

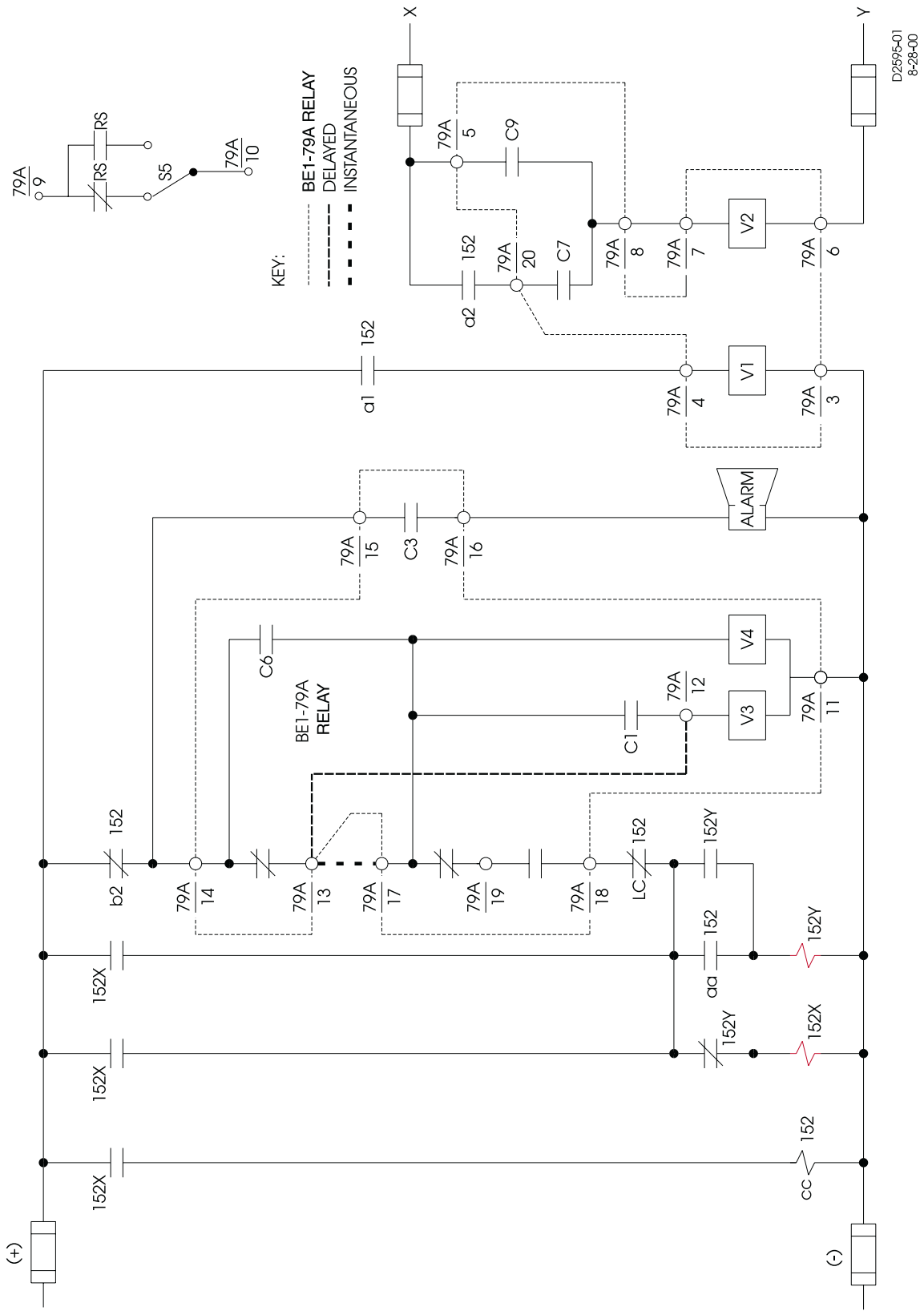

Figure 5-5. Typical Connections for ACR11B Application

Motor Input Voltage

No adjustment is required for the motor voltage applied at terminals 5 and 6. The applied voltage can range from 120 to 240 Vac or 125 to 250 Vdc. These terminals serve as the input to the BE1-79A power supply and control functions.

Contact Sensing Inputs

Energizing levels for contact sensing inputs V1 through V4 are jumper selectable for operation at three nominal voltage levels. Jumper P3 controls the operating voltage for V1, P4 controls V2, P5 controls V3, and P6 controls V4. Nominal voltage levels of 125 Vdc/120 Vac, 48 Vdc, or 250 Vdc/240 Vac may be selected. Figure 5-6 illustrates the three possible jumper positions for P3 through P6. Input V5 is dedicated to monitoring the relay power supply input and is not jumper selectable.

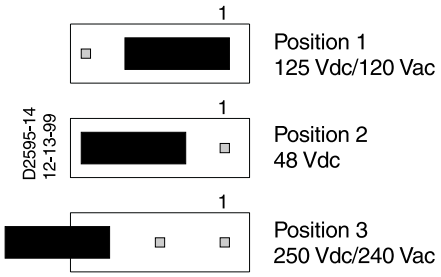

Figure 5-6. Contact Sensing Jumpers

> Note
>
> In certain applications where 240 Vac control voltage is used, control circuit feedback can occur through system inductive coupling. This feedback can result in erroneous signals, causing relay operation. If there is a potential for control circuit feedback, the jumper-selectable voltage range should be changed from the 48 Vdc factory default setting to a higher position. Selections are provided in Table 3-1.

The following paragraphs describe how to locate and change the position of the contact sensing jumpers.

Step 1. Remove the four phillips screws from the front panel and separate the front panel from the relay chassis.

Step 2. Carefully grasp and remove the Digital Circuit Board (top circuit board) from the relay chassis. Take care not to damage any of the circuit board components. Observe all electrostatic discharge (ESD) precautions when handling the circuit board. Place the circuit board on an ESD-safe surface.

Step 3. Locate the four jumper terminal-blocks (P3 through P6) on the circuit board. The jumper terminal-blocks are located on the component side of the circuit board near the rear contact fingers (see Figure 5-7). Each terminal block has three pins and each jumper is factory-installed on pins 2 and 3. Figure 5-6 illustrates each of the three jumper positions.

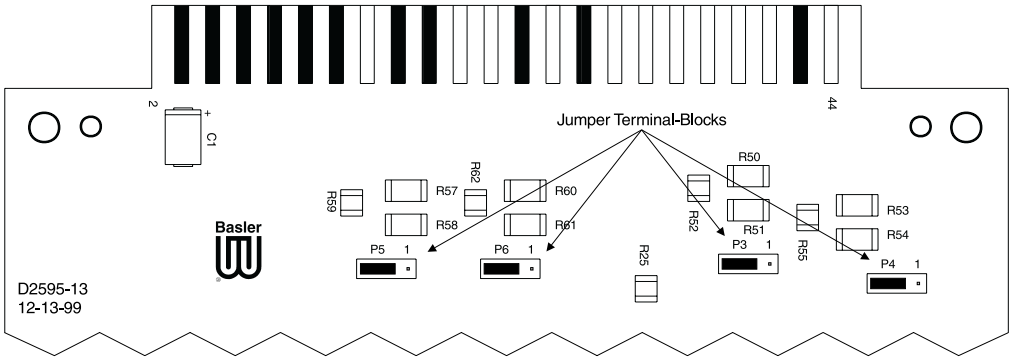

Figure 5-7. Contact Sensing Jumper Locations

Step 4. To select operation at 125 Vdc or 120 Vac, remove the jumper from pins 2 and 3, and position it on pins 1 and 2. To select operation at 250 Vdc or 240 Vac, remove the jumper from pins 2 and 3 and position it on pin 3 for storage. (Only pin 3 of the terminal block should be covered.)

Step 5. When all of the jumpers are positioned for operation in the desired sensing voltage range, prepare to place the circuit board back in the relay chassis.

Step 6. Align the circuit board edges with the white guide markings on the relay chassis. Once aligned, slide the circuit board back into the chassis until the circuit board is seated in its connector. The front of the circuit board should be flush with the front of the relay chassis. (The LEDs and serial port connector will protrude past the front of the chassis.)

Step 7. Place the front panel on the front of the relay chassis and align the four screw holes. Secure the front panel to the relay chassis with the four phillips screws removed in Step 1.

Timing Cams

Double ended cams on the ACR reclosers provide a ten second reset after a reclosure. Single ended cams can be adjusted for any reclose or reset time desired. The single and double ended cams of the ACR reclosers are simulated with the reclose and reset timer settings of the BE1-79A relay. Since the reclose and reset times for each of the four recloses is independently programmable, the function of the ACR reclosers can be duplicated.

Fault Clearing

The BE1-79A allows the instantaneous reclose to be delayed slightly so that faults may de-ionize before a reclosure is initiated. Faults typically are allowed to de-ionize for approximately 13 cycles for distribution voltages and 18 cycles for transmission voltages (including breaker operating time). The inherent delay of the BE1-79A relay is 22 to 48 milliseconds when set at a time delay of zero. The reclose timers may be adjusted in increments of 0.1 seconds which is 6 cycles on a 60 Hertz system.

It is possible to set an ACR recloser for an instantaneous reclose with no voltage applied at terminals 5 and 6. If this unusual application is employed, the user must confirm that voltage is applied to BE1-79A terminals 5 and 6 when a reclose is desired. Terminals 5 and 6 must be energized for a reclose to be initiated.

The power hold-up circuit of part number 9 3102 00 101 relays maintains relay function for a minimum of 40 cycles after nominal operating power is removed. This prevents the relay output contacts from dropping out too quickly in applications where output C10 is used as an instantaneous trip enable contact.

RS Contact

The jumper used in the ACR reclosers to configure the RS contact for normally open or normally closed. This operation is replaced in the 79A by switch 5. The SP-79RS command allows the RS contact operate and reset time to be programmed. Refer to the *RS Contact Setting Command* sub-section of *Communication* Section 4 for a detailed description of the SP-79RS command.

Alarm Output

The SP-ALM command is used to program the alarm output to function as a Relay Fail output or a combination Relay Fail/Lockout output. As a Relay Fail output, the Alarm Output will close if relay operating power is lost. The Alarm Output will also close if the microprocessor detects an abnormal condition such as:

- The BE1-79A is configured for ACR11A operation but recognizes inputs that indicate the relay is operating in an ACR11B system.
- The microprocessor is unsuccessful at storing settings to the EEPROM.

If the microprocessor closes the Alarm Output due to a failure, all three front panel LED indicators will be lit. The failure indicators can be cleared by cycling operating power to the relay.

Refer to the *Alarm Output Command* sub-section of *Communication* Section 4 for a description of the SP-ALM command.

Reset Switch

The front panel reset switch performs the same function as the manual clutch release on the ACR reclosers. Power must be applied to terminals 5 and 6 for this function to perform a reset.

COMMUNICATION CONNECTIONS AND SETTINGS

Communication Connector

The BE1-79A uses a standard RS-232 (DB-9) female connector located on the front panel. Connector pin numbers, functions, names and signal directions are shown in Table 5-1. Figure 5-8 provides a connection diagram for connecting the BE1-79A Relay to a personal computer.

Communication Settings

Communication settings are the formal set of conventions controlling the format and relative timing of message exchange between two communications terminals. The relay settings are fixed at 9600,8N1 where 9600 = baud rate, 8 = number of data bits, N = no parity, and 1 = 1 stop bit. Since the communication settings of the BE1-79A are fixed, you must adjust your communication program settings to match the relay settings.

Table 5-1. RS-232 Pinouts

Pin	Function	Name	Direction
1	Shield	----	N/A
2	Transmit Data	(TXD)	From Relay
3	Receive Data	(RXD)	Into Relay
4	N/C	----	N/A
5	Signal Ground	(GND)	N/A
6	N/C	----	N/A
7	N/C	----	N/A
8	N/C	----	N/A
9	N/C	----	N/A

NOTE

The RS-232 communication ports are not equipped with Request To Send (RTS) and Clear To Send (CTS) control lines. This makes the BE1-79A incompatible with systems that require hardware handshaking or systems that use self-powered RS-232 to RS-485 converters connected to the RS-232 ports.

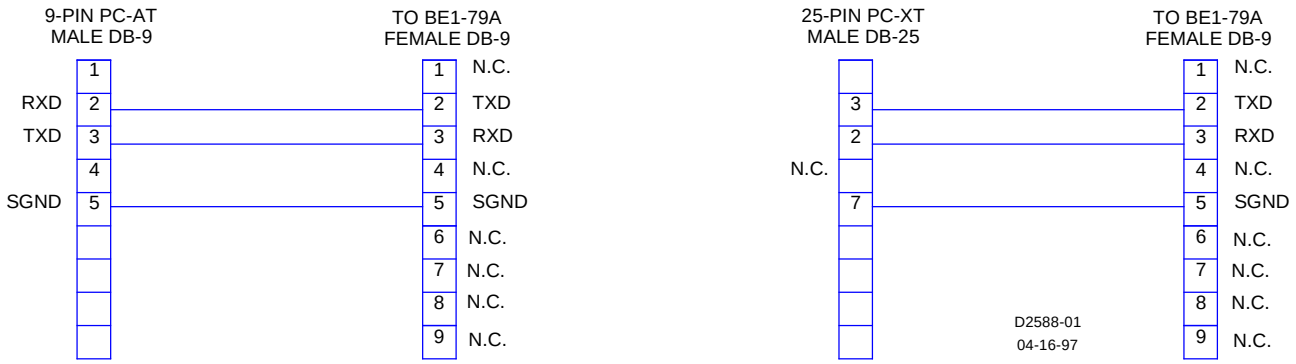

Figure 5-8. Personal Computer To BE1-79A Connections

RELAY INSTALLATION

Perform the following procedure to install the BE1-79A relay.

Step 1. Adjust the Style Configuration Switches and the Instantaneous Reclose Jumper Switch to the correct setting for your application.

Step 2. Insert the BE1-79A relay and close the cradle latches locking the relay into the case.

Step 3. Install the connection plugs.

Step 4. Enter the desired settings through the front serial communication port. Refer to *Section 4, Communications* for information about relay communication and ASCII commands.

Step 5. Install the cover.

SECTION 6 • TESTING

INTRODUCTION

You may prefer to test your relay before installation. To function test BE1-79A relays, perform the procedure provided in the following paragraphs. Figure 6-1 illustrates the necessary connections for testing relays configured for ACR11A style operation. The connections diagram for testing relays configured for ACR11B operation is provided in Figure 6-2.

NOTE

All of the following test procedures specify 120 Vac for relay power and the contact sensing inputs. Therefore, contact sensing jumpers P3, P4, P5, and P6 must be set in position 1 or position 2. The contact sensing circuitry will not function with 120 Vac applied and the contact sensing jumpers set in position 3.

INSTANTANEOUS RECLOSE TESTING

ACR11A Style Testing

Place the relay style configuration switches in the A position. Place the instantaneous reclose jumper switch in the EXT position. Place switch 5 in the NO position.

ACR11B Style Testing

Place the relay style configuration switches in the B position. Place the instantaneous reclose jumper switch in the INT position. Place switch 5 in the NO position.

ACR11A and ACR11B Style Testing

Step 1. Place switch S1 in the 52A position and apply 120 Vac to the relay and test circuit.

Step 2. Connect a computer with a serial port and suitable communications software to relay serial port. Transmit the following settings to the relay.

ACCESS=<cr>
SP-79A1=0.0,5.0<cr>
SP-79A2=10.0,15.0<cr>
SP-79A3=20.0,25.0<cr>
SP-79A4=30.0,35.0<cr>
SP-79ALO=40.0,45.0<cr>
SP-79ARS=D,19.39,0<cr>
EXIT<cr>
Y<cr>

Step 3. Place switch S1 in the 52B position and observe that the following sequence of events occur.

Front panel Reset LED extinguishes.
Reset indicator L1 extinguishes.
Front panel In Sequence LED lights.
Reclose indicator L2 will light immediately and remain lit for three seconds.
After 10 seconds, L2 will light for three seconds.
After 20 seconds, L2 will light for three seconds.
After 30 seconds, L2 will light for three seconds.
After 40 seconds, the front panel Lockout LED and Lockout indicator L3 will light.

Step 4. Place switch S1 in the 52A position and observe that after five seconds, the front panel Reset LED and Reset indicator L1 light.

Step 5. Place switch S1 in the 52B position. When Reclose indicator L2 lights, momentarily place S1 in the 52A position and verify that L2 extinguishes.

Step 6. Place S1 in the 52B position and verify that after ten seconds, Reclose indicator L2 lights for three seconds.

Step 7. Place S1 in the 52A position and verify that after 15 seconds, the front panel Reset LED and the Reset indicator L1 light.

DELAYED RECLOSE TESTING

ACR11A Style Testing

Place the relay style configuration switches in the A position. Place the instantaneous reclose jumper switch in the EXT position. Place switch 5 in the NO position.

ACR11B Style Testing

Place the relay style configuration switches in the B position. Place the instantaneous reclose jumper switch in the EXT position. Place switch 5 in the NO position.

ACR11A and ACR11B Style Testing

Step 1. Place switch S1 in the 52A position and apply 120 Vac to the relay and test circuit.

Step 2. Connect a computer with a serial port and suitable communications software to relay serial port. Transmit the following settings to the relay.

ACCESS=<cr>
SP-79A1=5.0,10.0<cr>
SP-79A2=15.0,20.0<cr>
SP-79A3=25.0,30.0<cr>
SP-79A4=35.0,40.0<cr>
SP-79ALO=45.0,50.0<cr>
SP-79ARS=D,19.39,0<cr>
EXIT<cr>
Y<cr>

Step 3. Place switch S1 in the 52B position and observe that the following sequence of events occur.

Front panel Reset LED extinguishes.
Reset indicator L1 extinguishes.
Front panel In Sequence LED lights.
After 5 seconds, Reclose indicator L2 will light for three seconds.
After 15 seconds, L2 will light for three seconds.
After 25 seconds, L2 will light for three seconds.
After 35 seconds, L2 will light for three seconds.
After 45 seconds, the front panel Lockout LED and Lockout indicator L3 will light.

Step 4. Place switch S1 in the 52A position and observe that after five seconds, the front panel Reset LED and Reset indicator L1 light.

Step 5. Place switch S1 in the 52B position. When Reclose indicator L2 lights five seconds later, momentarily place S1 in the 52A position and verify that L2 extinguishes.

Step 6. Place switch S1 in the 52 B position and verify that after 15 seconds, Reclose indicator L2 lights for three seconds.

Step 7. Place S1 in the 52A position and verify that after 20 seconds, the front panel Reset LED and the Reset indicator L1 illuminates.

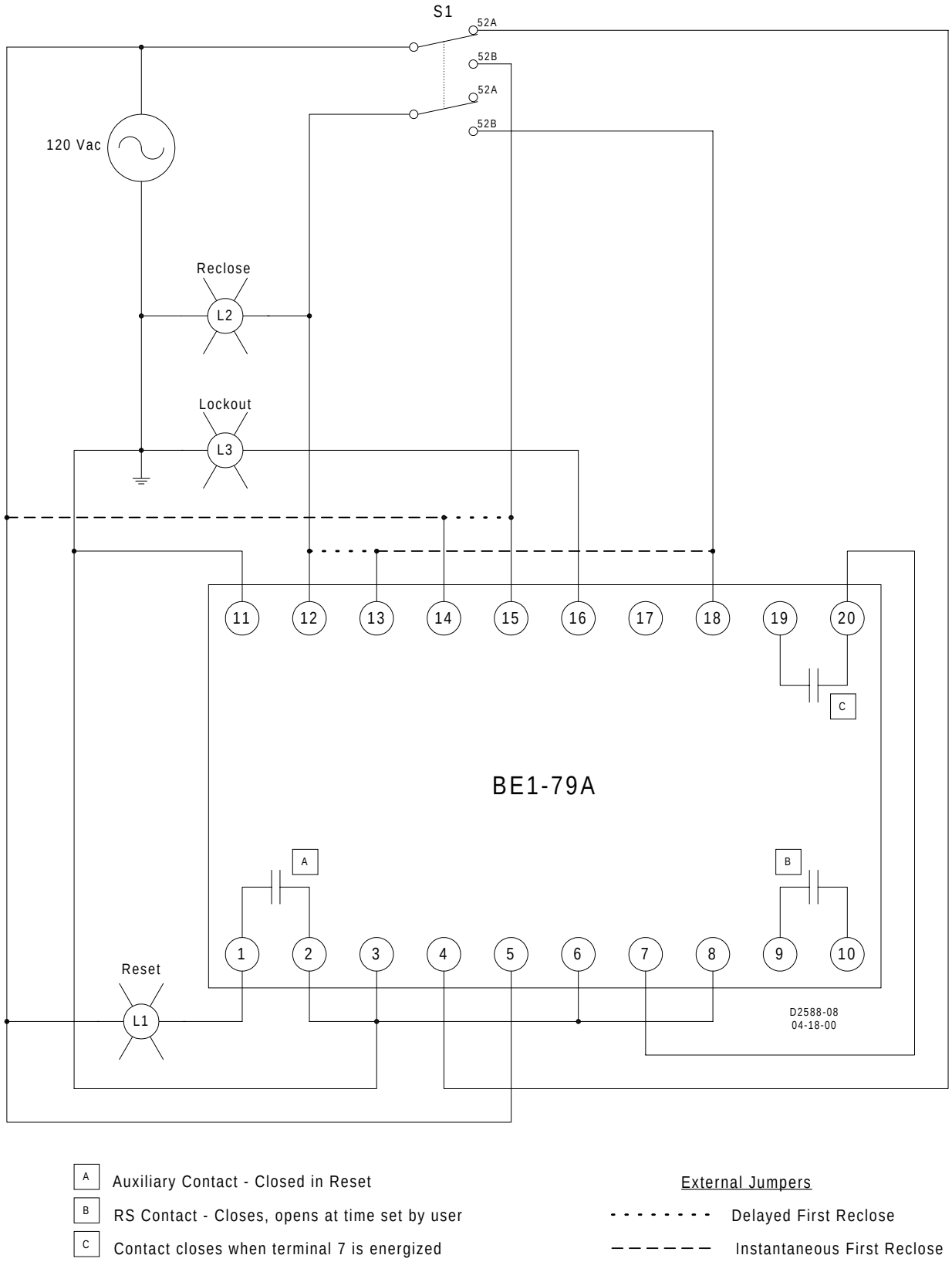

Figure 6-1. Test Connections For ACR11A Style Relays

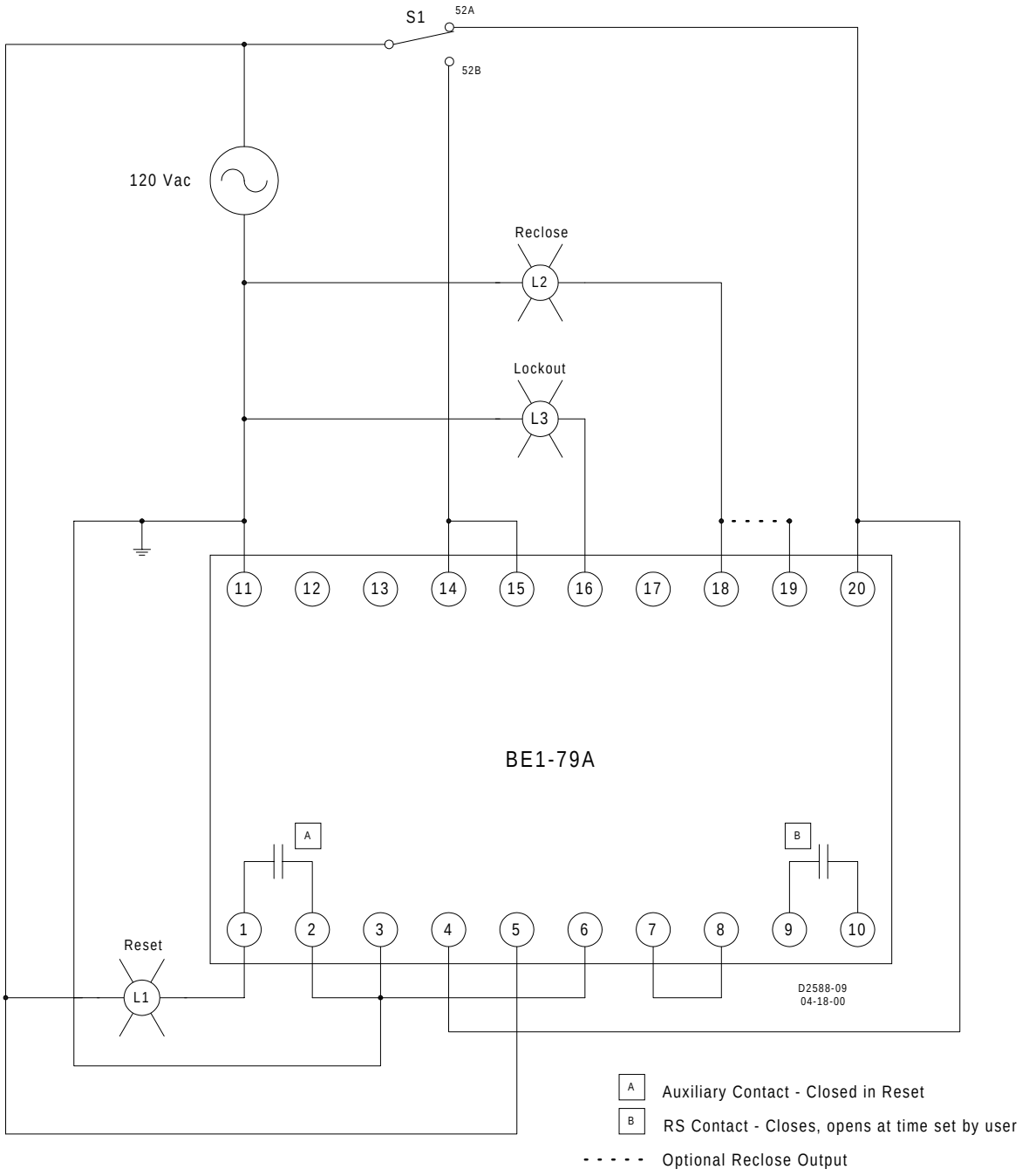

Figure 6-2. Test Connections For ACR11B Style Relays

POWER HOLDUP CIRCUIT TESTING

Part Number 9 3102 00 101 Relays

Remove 120 Vac operating power from terminals 5 and 6. Measure the time from when the operating power is removed until the RS contacts (terminals 9, 10) close. The time should be 1.3 seconds or greater.

SECTION 7 • MAINTENANCE

GENERAL

BE1-79A Multiple Shot Reclosing Relays require no preventative maintenance. However, testing should be performed according to scheduled practices. If the relay fails to function properly, contact the Technical Support Services Department of Basler Electric for a return authorization number before returning the relay for service.