

# BE1-700V



Digital Voltage/Frequency  
Protective Relay



**The BE1-700V is a compact multifunction numeric relay that provides phase, zero sequence, and negative sequence voltage protection including over and under frequency, plus control and metering functions in an integrated system. Four shot reclosing with separate Pilot Initiate is available as an option. An onboard Ethernet option can provide Modbus/TCP connectivity or can provide web and email capabilities.**

## ADVANTAGES

- All of the advantages of a fully numeric product in an economical "voltage only" protection package.
- Compact design requires minimal panel space for underfrequency and undervoltage load shedding applications.
- Adds Oscillography, Sequence of Events, and Metering when single function voltage relays are replaced with the BE1-700V.
- Zero sequence voltage (3V0) used to detect single phase ground faults on high resistance or ungrounded systems can be calculated based on the applied 3-phase 4-wire sensing voltage, or applied from a separate zero sequence source (optional VX input).
- With the optional 4-shot recloser, including a pilot initiate path and auxiliary voltage input, replace existing network (transmission, sub-transmission) automatic reclosing schemes.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system.
- Optional BESTNet Ethernet package provides metering and status web pages, settings and configuration via Ethernet, and email notification of user-defined events.

## DEVICE FUNCTIONS

24	25 Option	27	47
59	60	62	81
79 Option	BESTNet ETHERNET Option	Modbus TCP Option	Modbus RTU Option

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## WINDOWS® SOFTWARE

Interface for setting and communicating with Basler numeric relays

## ADDITIONAL INFORMATION

### Instruction Manual

Request publication 9376700990

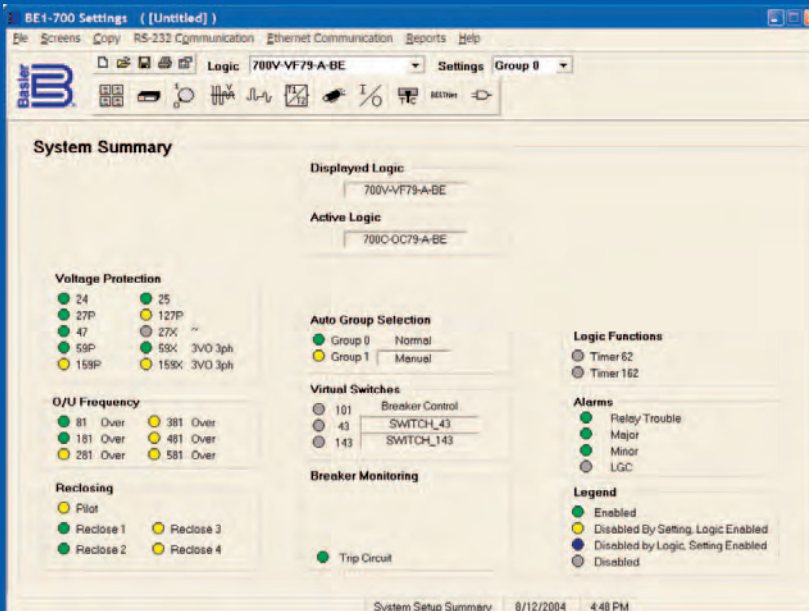
### MODBUS™ Instruction Manual

Request publication 9376700991

**All connections  
PLUGGABLE!**

## BESTCOMS™ SOFTWARE

Free, easy to use settings program



BESTCOMS Screen, showing at a glance which relay functions have been enabled

### BESTCOMS allows you to:

- Enter settings and BESTlogic logic equations for the BE1-700
- Save settings to a file
- Save BESTlogic logic schemes (without settings) to a "Logic Library" file
- Print settings
- Upload and download settings via Serial port
- Upload and download settings via Ethernet (with BESTNet option)
- View real-time metering and status when connected to a relay
- View fault records and SER data when connected to a relay
- View COMTRADE oscillographic records (with included BESTwave program)
- FREE! with every order

## APPLICATIONS

The BE1-700V Digital Voltage/Frequency Protective Relay provides single and three phase, zero sequence, and negative sequence voltage protection including over and under frequency. Its unique capabilities make it ideally suited for applications with the following requirements. The BE1-700V is intended for use in:

- Applications that require the flexibility provided by wide setting ranges and multiple setting groups.
- Applications that require the economy and space savings provided by a multifunction, multiphase unit. This one unit can provide all of the voltage protection, as well as local and remote indication, metering, and control functions required on a typical bus, feeder, or line.
- Applications where bus, feeder, or line voltages and frequencies must be monitored.
- Any under or over voltage or frequency protection application, i.e. bus, feeder, line, motor, generator, cogeneration, etc.
- Applications that require a fundamental digital signal processing (DSP) algorithm to provide rejection of harmonics and low transient overreach.
- Applications where the capabilities of intelligent electronic devices (IEDs) are used to decrease relay costs and to protect against abnormal situations.
- Applications that require communication capability.
- Applications using Ethernet communication, programmable email notifications, and live metering information via an embedded web server (with BESTNet option).
- Applications requiring Modbus/TCP Ethernet communications (with Modbus/TCP option).



The BE1-700V is a multifunction, numeric relay that provides a comprehensive mix of protective, control and metering functions in an integrated system. This system is suitable for any voltage and frequency application including bus, feeder, line, generator/motor applications and cogeneration applications.

The unit has one set of three phase and neutral voltage sensing inputs to provide all common protective functions for typical power system voltage and frequency protection applications.

Two independent communications ports, along with built-in support for Modbus™ or Modbus/TCP, provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. The standard IRIG-B port provides time synchronization from a master clock.

Real time metering provides voltage frequency telemetry for the protection application. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

### BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-700V is implemented

as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 7 and 7a show each of the independent blocks available for use in the BE1-700V.

Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-700V relay can store, as user settings, one user programmable, custom logic scheme. To save you time, several preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTlogic settings.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices.

It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figures 1 through 5 show typical external connections, and Figure 6 shows rear panel connections.



Available with BESTNet Easy Ethernet

### BESTNet ETHERNET OPTION

The BESTNet option connects your BE1-700V relay to the wired world.

#### BESTNET features include:

- Embedded web server with metering, status, and fault summary information\*
- Email alerts of as many as seven user-defined conditions\*\*
- Full BESTCOMS support over Ethernet
- Full Basler ASCII protocol for terminal mode communications (TELNET) or custom programmed application access
- Support for DHCP or static IP addressing. IP Discovery function included in BESTCOMS.

\* A web browser with a Java™ Runtime environment installed is required to view web pages.

\*\* An external SMTP email server must be available to use email alerts.

General Status		System Info	
Relay Trouble	NONE	Relay ID	BE1-700
Major Alarm	NONE	Station ID	SUBSTATION_1
Minor Alarm	NONE		
Logic Alarm	NONE		
Targets	NONE		
Breaker	CLOSED		
Recloser	OFF		

Network Settings	
MAC	00:40:90:23:04:C4
E-Mail	0.0.0.0
DHCP	on
IP Address	192.168.1.106
IP Subnet Mask	255.255.255.0
IP Gateway	192.168.1.1

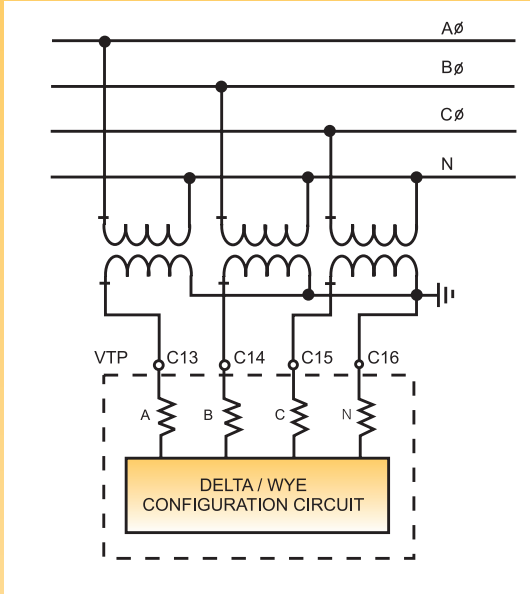
Version Info	
Model Number	BE1-700
Style Number	N4R2X5N
App Program	VER 1.01.00 07/01/2004
Boot Program	VER 2.08.01 04/05/2004
Serial Number	H12345678

Sample BESTNet Web Page

### Modbus/TCP ETHERNET OPTION

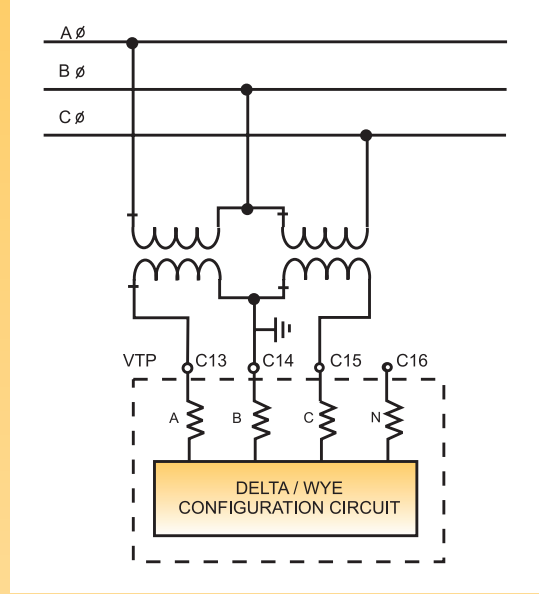
Instead of the BESTNet option, the BE1-700 can be ordered with the Modbus/TCP option. With Modbus/TCP, your BE1-700 relay offers a true Modbus/TCP protocol connection via an internal 10/100 BaseT port. No clumsy external adaptors are required! Simply plug in an Ethernet cable and your BE1-700 is part of your Modbus/TCP network.

NOTE: Modbus/TCP and BESTNet are mutually exclusive. The Ethernet port can be used for BESTNet or Modbus/TCP, but not both.



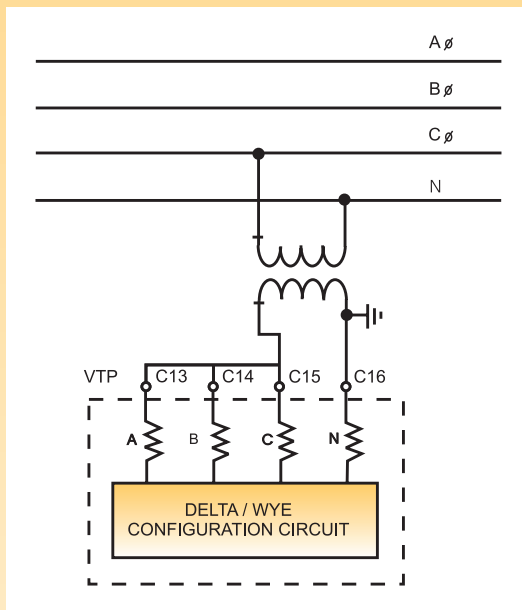
**A) 3 Phase VT 4 Wire Connection**

Provides 3 element metering; 27P and 59P can be P-N or P-P.



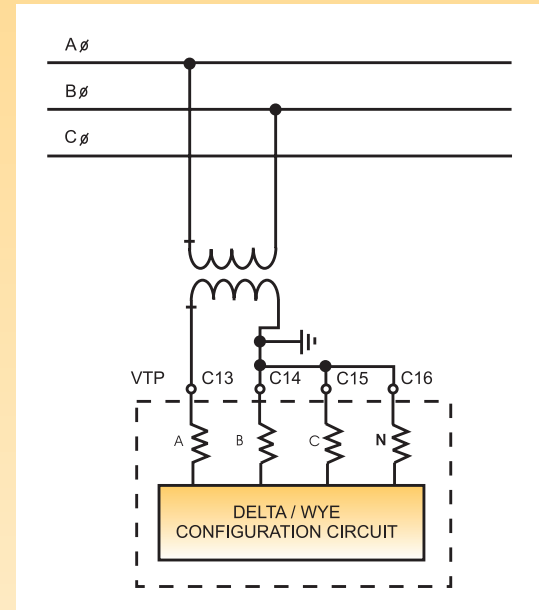
**B) 3 Phase VT 3 Wire Connection**

Provides 2 element metering; 27P and 59P can be P-N or P-P; 59N (3E0) is disabled.



**C) 1 Phase VT L-N Connection**

VT primary can be connected to any phase, A-N, B-N, C-N. One element metering; 47(V2) and 59N(3E0) disabled; 27P and 59P are P-N.



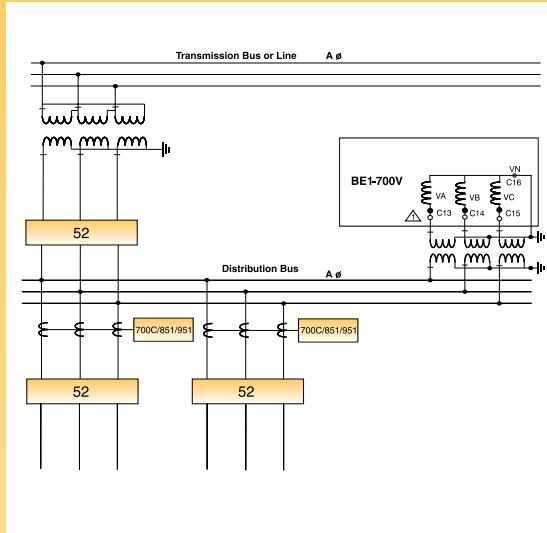
**D) 1 Phase VT L-L Connection**

VT primary can be connected to any phase, A-B, B-C, C-A. One element metering (-30 degrees); 47(V2) and 59N(3E0) disabled; 27P and 59P are P-P.

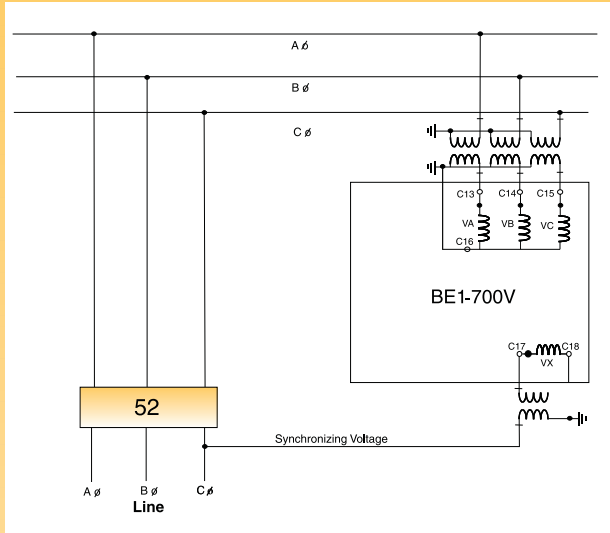
**Figure 1 – Accommodates a Variety of Common Voltage Connections**



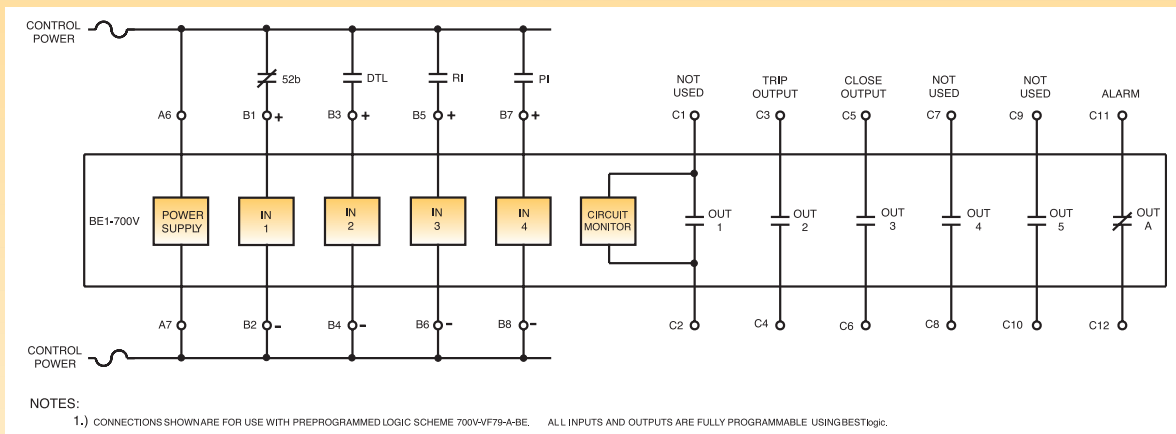
## TYPICAL APPLICATION FOR THE BE1-700V WITH RECLOSING OPTION



**Figure 2 – Bus Voltage Protection including UF Load Shed**



**Figure 3 – Network Reclosing Application**



**Figure 4 – Typical External Connections**

FEATURES  
 SPECIFICATIONS  
 FUNCTIONAL DESCRIPTION  
 ORDERING INFORMATION  
 BESTlogic  
 APPLICATIONS

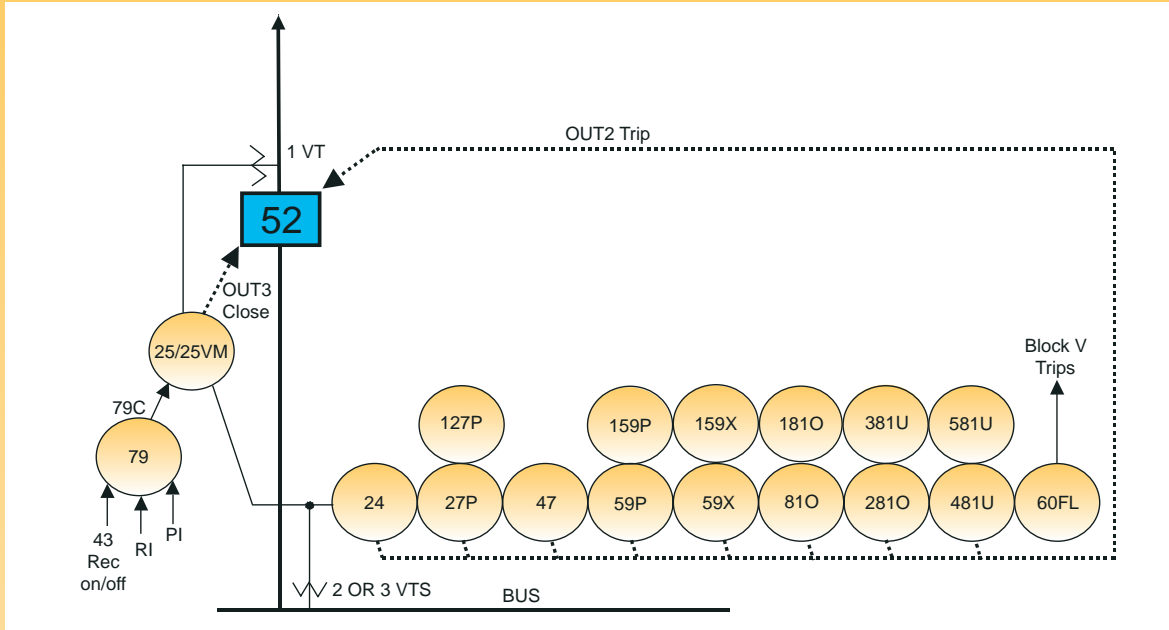


Figure 5 - Typical Application Single Line

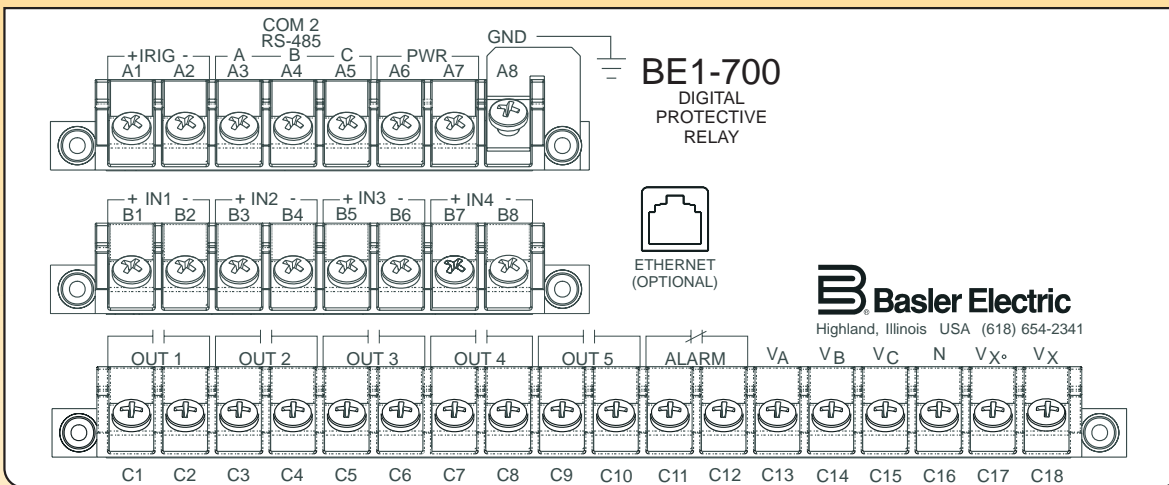


Figure 6 - BE1-700V Voltage/Frequency Relay Rear Panel Connections

### Pluggable Connectors

Each rear panel terminal block may be unplugged after removing its two mounting screws. This allows prewiring of terminal blocks or replacement of the relay without wiring changes.

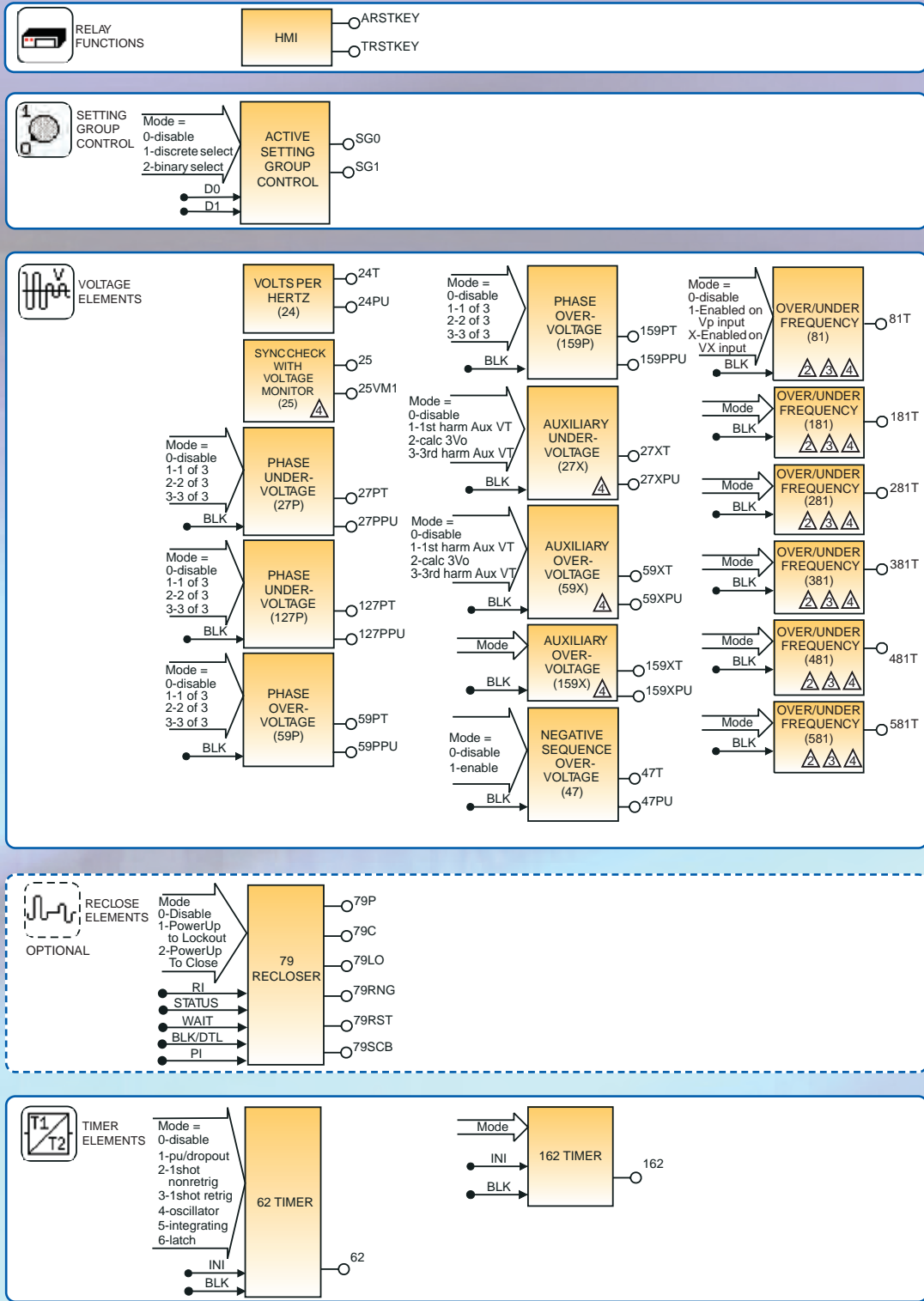
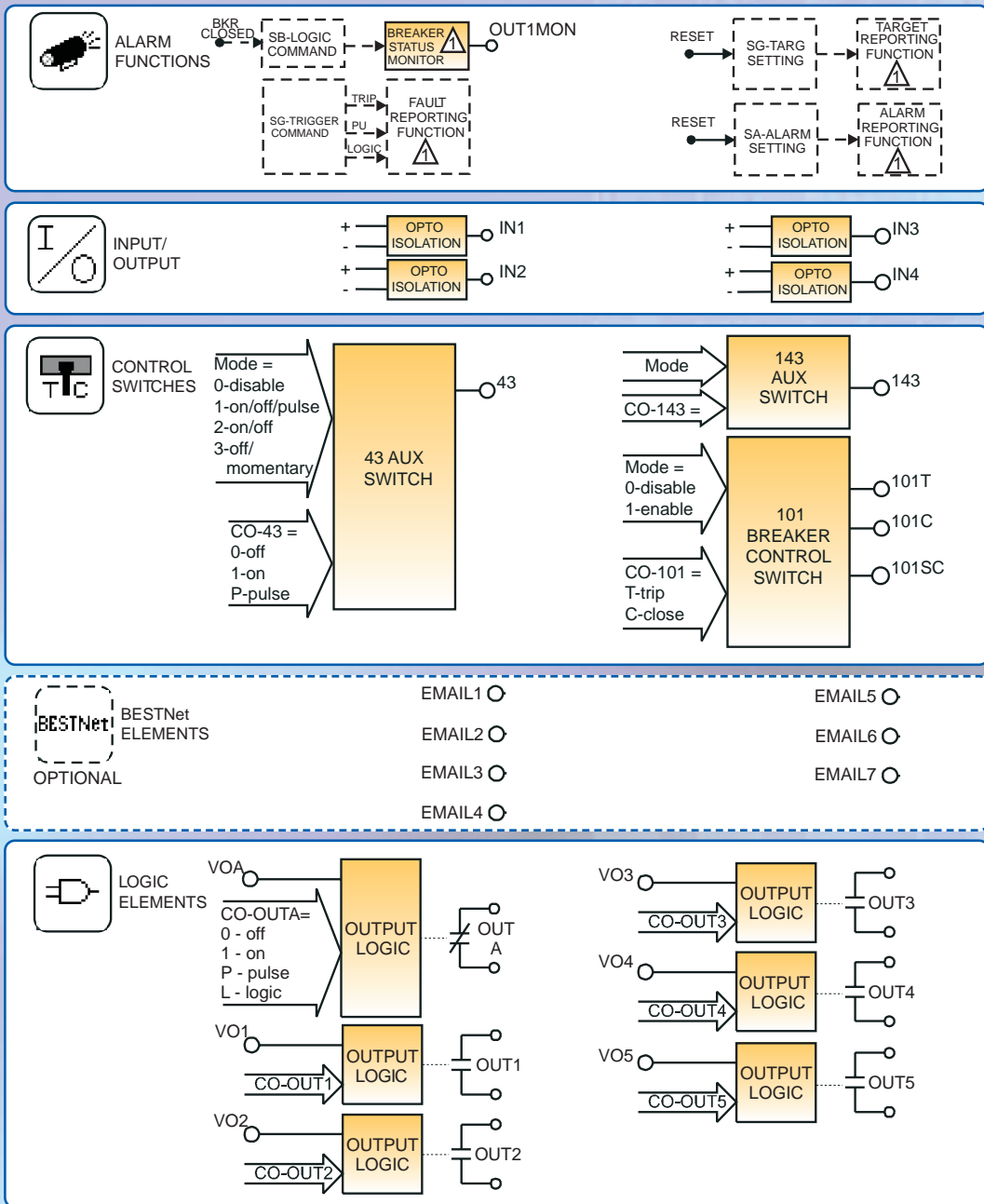


Figure 7 - BE1-700V BESTlogic Function Blocks



**NOTES**

- 1 Not included in BESTlogic settings.
- 2 Under/Over is setting parameter for all 81 elements.
- 3 Each frequency element can be assigned to monitor 3 $\phi$  VT input (VP) or optional Auxiliary VT input (VX).
- 4 Optional VX input cannot support simultaneous monitoring of two different voltage sources: i.e., a 25-VX (bus or line VT) source and a 59N-VX (broken delta) source cannot be simultaneously applied to the VX input. The user must choose one application at a time for the VX input.

**Figure 7A – BE1-700V BESTlogic Function Blocks**



## GENERAL SPECIFICATIONS

### PHASE AC VOLTAGE INPUTS

Continuous: 300V, Line to Line  
 One Sec. rating: 600V, Line to Neutral  
 Burden: Less than 1VA @ 300Vac

### AUXILIARY AC VOLTAGE INPUT

Continuous: 150V  
 One Sec. rating: 600V  
 Burden: Less than 1VA @ 150Vac

### A/D CONVERTER

Sampling Rate: 12/cycle, adjusted to input frequency 10-75Hz

### POWER SUPPLY

Option 1: 48VDC  
 Option 2: 120VAC, 125VDC  
 Option 3: 24VDC  
 Option 4: 240VAC, 250VDC  
 Burden: 6 W continuous, 8 W maximum with all outputs energized

### OUTPUT CONTACTS

Make and carry: 30A (0.2sec)  
 Continuous: 7A  
 Break: 0.3A DC (L/R=0.04)

### CONTROL INPUTS

Wetting  
 Voltage range: Same as control power supply option.

Power Supply Option	Turn-on Voltage Range (VDC)	Burden
1) 48 Vdc	26-38 V	13 k ohms
2) 120 Vac/125 Vdc	69-100 V	25 k ohms
3) 24 Vdc	5-8 V	7 k ohms
4) 240 Vac/250 Vdc	138-200 V	54 k ohms

Control inputs recognize both DC and AC voltages.

### SERIAL COMMUNICATION PORTS

Response Time: <100mSec for metering and control functions  
 Baud Rate: 300-19200  
 Protocols: Front RS-232: ASCII  
 Rear RS-485: ASCII standard, Modbus optional

### ETHERNET PORT (OPTIONAL)

Type: 10/100 BaseT, RJ-45 connector  
 Protocols: BESTNet or Modbus/TCP, see Page 4

### MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70° C (-40°F to 158°F)\*
  - Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- \* Display contrast may be impaired below -20°C.

### CONFORMS TO STANDARDS:

- IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
- IEC 1000-4-3 (EN 61000-4-3) Radiated RF Immunity
- IEC 1000-4-4 (EN 61000-4-4) Electrical Fast Transient
- IEC 1000-4-5 (EN 61000-4-5) Surge-Lightning Strikes
- IEC 1000-4-6 (EN 61000-4-6) RF Conducted
- IEC 1000-4-8 (EN 61000-4-8) Power Freq. Magnetic Field
- IEC 1000-4-11 (EN 61000-4-11) Voltage Dips and Interruptions
- IEC 255-5: 1977 Insulation Tests For Relays
- IEC 255-11: 1979 Interruptions to and AC (Ripple) in DC
- IEC 255-22-1: 1988 1MHz Burst Disturbance
- IEC 255-22-2: 1996 Electrostatic Discharge
- IEC 255-22-3: 1989 Radiated Disturbance
- IEC 255-22-4: 1992 Fast Transient Disturbance
- IEEE C37.90.1: 2002 Surge Withstand Capability
- IEEE C37.90.1: 2002 Surge Withstand Capability
- IEEE C37.90.2: 1995 Radiated Electromagnetic Interference
- IEC 68-2-1: 1990 Test A. Cold
- IEC 68-2-2: 1974 Test B. Dry Heat
- IEC 68-2-3: 1969 Test Ca. Damp Heat
- IEC 68-2-30: 1980 Damp Heat Cyclic 12+12 Hour
- IEC 68-2-56: 1988 Damp Heat Steady State
- IEC 255-21-1 Vibration Tests
- IEC 255-21-2 Shock and Bump Tests

### CERTIFICATIONS

UL recognized per Standard 508 and Standard CAN/CSA-C22-2 Number 14-M91, UL File Number E97033. Gost R certified #POCC US.ME05.B03391.

### CASE SIZE

10.5" wide, 4.46" high, 7.81" behind panel (.29" front projection) (266.7 mm wide, 113.23 mm high, 198.49 mm behind panel; 7.38 mm front projection)

### SHIPPING WEIGHT

4.33 pounds (1.96 kg) maximum

### WARRANTY

7 years



### PERFORMANCE SPECIFICATIONS

#### VOLTS/HZ (24)

Pickup: 0.5 – 6V/Hz  
 Delay Time: Inverse Squared Curve

$$T_T = \frac{D_T}{(M-1)^2} \quad T_R = D_R \times \frac{ET}{FST \times 100}$$

$T_T$  = Time to Trip  
 $T_R$  = Time to Reset  
 $D_T$  = Time Dial, Trip  
 $D_R$  = Time Dial, Rest

$$M = \frac{\text{Actual V/Hz}}{\text{Pickup V/Hz}} \quad ET = \text{Elapsed Time}$$

FST = Full Scale Trip Time ( $T_T$ )

#### SYNC CHECK (25)

Delta Phase Angle: 1 – 45 degrees  
 Delta Voltage Magnitude: 1 – 20V  
 Delta Frequency: 0.01 – 0.50Hz

#### SYNC CHECK, VOLTAGE MONITOR (25VM)

Dead Threshold: 10 – 150V  
 Live Threshold: 10 – 150V  
 Dropout Time Delay: 0.050 – 60.0sec  
 Logic: Dead Phase/Dead Aux.  
 Dead Phase/Live Aux.  
 Live Phase/Dead Aux.

#### PHASE OVER/UNDERVOLTAGE

##### (27P, 59P, 127P, 159)

Mode: 1 of 3; 2 of 3; 3 of 3  
 Pickup: 10.0-300V<sub>L-L</sub> or 10.0-300V<sub>L-N</sub>  
 Delay Time: 0.050 – 600 sec.

#### NEGATIVE SEQUENCE OVERVOLTAGE (47)

Pickup: 1.0 – 300V<sub>L-N</sub>  
 Delay Time: 0.050 – 600sec.

#### AUXILIARY / 3V0 OVER/UNDERVOLTAGE

##### (27X, 59X, 159X)

Mode: Fundamental  $V_x$ , 3 phase Residual (3V0), 3<sup>rd</sup> Harmonic  $V_x$

Pickup: 1.0 – 150V  
 Delay Time: 0.050 – 600 Sec.

#### GENERAL PURPOSE LOGIC TIMERS (62, 162)

Mode: PU/DO  
 1 Shot, Non-Retrig.  
 1 Shot, Retrig.  
 Integrating  
 Latch

T1 and T2 Delay Time: 0.000 – 9999 Sec.  
 Time Accuracy:  $\pm 0.5\%$  or  $\pm 3/4$  cyc

#### RECLOSER (79)

Mode: Power up to close, Power up to lockout  
 Reclose Attempts: 0 – 4 Total Reclose Attempts  
 1 Pilot or Delayed Reclose  
 3 Additional Delayed Recloses

Reclose, Reset, Fail,  
 Max. Cycle Timers: 0.100 – 600 Sec.  
 Time Accuracy:  $\pm 0.5\%$  or  $\pm 1/4$  cyc/-0 cyc

#### VOLTAGE PICKUP ACCURACY (All 27, 47 and 59)

Phase ( $V_{L-L}$  or  $V_{L-N}$ ):  $\pm 2\%$  or  $\pm 0.5V$   
 Phase 3V0 and V2:  $\pm 2\%$  or  $\pm 0.5V$

#### DEFINITE TIME ACCURACY

##### UNLESS OTHERWISE STATED (All 27, 47 and 59)

Definite Time Accuracy:  $\pm 0.5\%$  or  $\pm 1$  cyc

#### SETTING GROUPS

Setting Groups: 2  
 Control Modes: Automatic: CLP; Dynamic load or unbalance  
 External: Discrete input logic;  
 Binary: Input Logic

#### METERING

Phase Voltage Range: 3W 0 – 300V<sub>L-L</sub>  
 4W 0 – 300V<sub>L-L</sub>

Phase Voltage Accuracy:  $\pm 0.5\%$  for 50V <  $V_{L-L}$  < 300V

Frequency: 10 – 75Hz  
 Frequency Accuracy: 0.01Hz

#### BREAKER MONITORING

Op Counter Alarm Range: 0 – 99999

#### FREQUENCY (81, 181, 281, 381, 481, 581)

Mode: Over, Under  
 Pickup (O/U): 20.00-70.00Hz  
 Over/Undervoltage Inhibit: 15-150V  
 Delay Time: 0.000-600 sec.  
 Time Accuracy:  $\pm 0.5\%$  + 1 cyc/-0cyc (min. trip time affected by min. 3 cycle security count)

### GUIDEFORM SPECS



Available on e-catalog CD,  
 online at [www.basler.com](http://www.basler.com),  
 or from your representative

# BE1-700V

Digital Voltage/Frequency  
Protective Relay

## SAMPLE STYLE NUMBER

The style number identification chart below defines the electrical characteristics and operation features included in the BE1-700V relay. For example, if the style number were BE1-700 N4R4X5N, the device would have the following:

**BE1-700** Digital Protective Relay

**(N4)** – 3-phase Sensing with Independent Auxiliary Input and sync-check

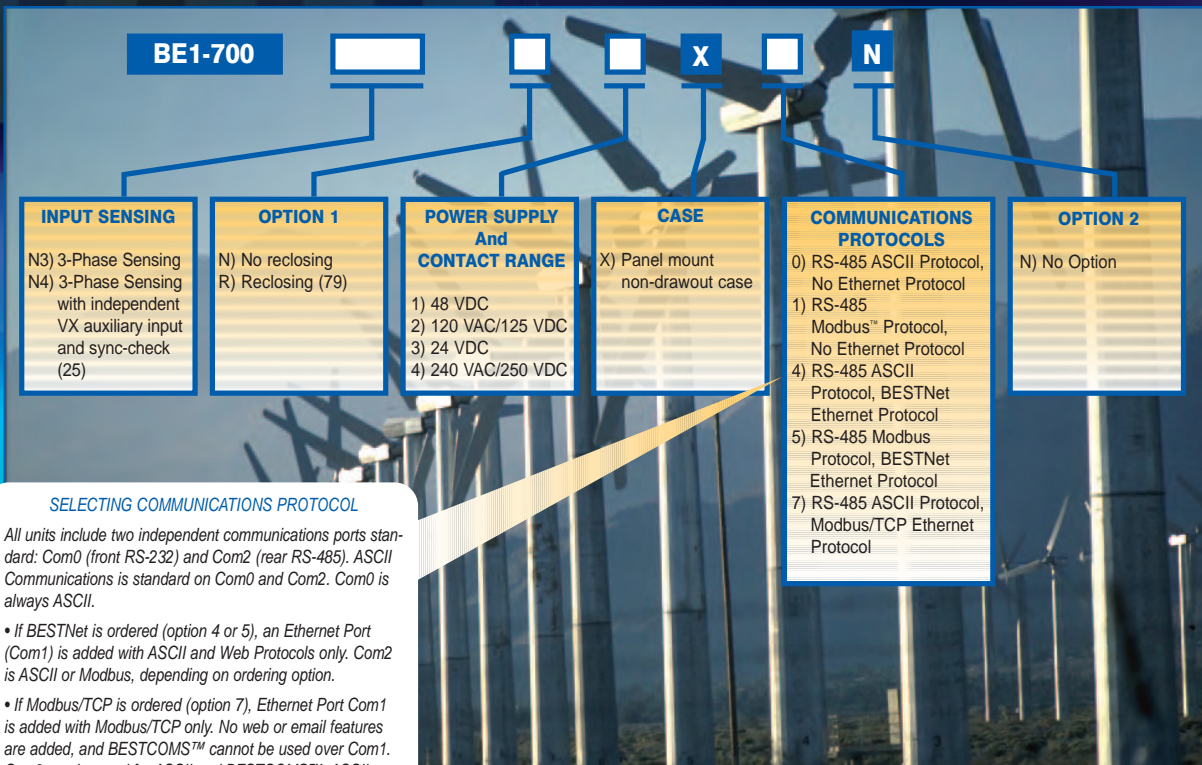
**(R)** – Reclosing

**(4)** – 240 VAC/250 VDC Power Supply

**(X)** – Panel mount, non-drawout case

**(5)** – Modbus on RS-485 port, BESTNet Ethernet protocol

**(N)** – Not applicable



ISO 9001-2000  
Highland, IL USA Taylor, TX USA  
Wasselonne, France Suzhou, China

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