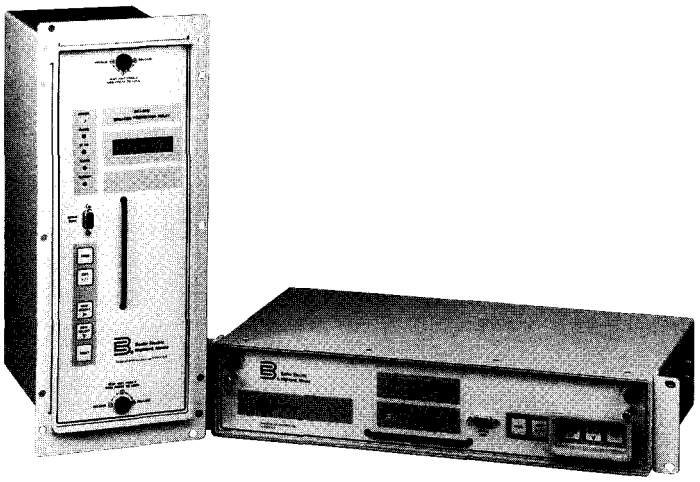

BE1-BPR BREAKER PROTECTION RELAY

The BE1-BPR Breaker Protection Relay provides all the capabilities required for most breaker protection and monitoring functions. It incorporates a simple programming language to allow the user to set up any desired logic between the inputs and outputs.

ADVANTAGES

- Vertical unit to replace obsolete Breaker Fail relays.
- Horizontal unit for rack-mount installations.
- Powerful "BESTlogic" programming language includes the means to setup and control current signal filters, fault detectors, timers, counters and logic gates.
- Many programmable inputs and outputs for virtually any application: Four AC current and seven isolated contact inputs, five control plus one alarm output, RS-232 and RS-485 communication ports.
- User may program the unit for a specific application or select one of three versatile stored programs with the following functions:
    - Breaker-fail protection
    - Breaker opening resistor protection
    - Breaker "sustained arc" protection
    - Breaker contact duty monitoring

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9-2720-00-990

Basler Electric

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FEATURES

- Easy setup from front panel or communications port.
- Drawout construction with shorting bars on current inputs.
- Monitors breaker contact duty separately for each pole.
- Fault data in COMTRADE format at 12 samples per cycle and up to 200 A. (Ref. IEEE C37.111)
- Communicates with PC equipped with off-the-shelf communications software.
- Built-in diagnostics monitor the health of all major internal functions.
- Time margin log reveals margin on breaker fail timers' settings.
- A high speed relay operating within one-quarter cycle of 60 Hz is provided for breaker-fail output.
- Fault detectors reset within one-quarter cycle of 60 Hz.
- Pickup setting on arc detector can be set below 0.1 A.
- Isolated communications ports.
- IRIG-B time code input to set and synchronize time clock.

APPLICATIONS

The BE1-BPR provides both breaker protection and breaker monitoring in a single unit that can communicate with a local or remote computer.

BREAKER PROTECTION

Breaker protection includes breaker fail protection, breaker resistor protection and protection against sustained arcs across one or more open breaker contacts.

Breaker-fail protection is accomplished by initiating a BPR timer from one or more relay trip signal inputs and providing an output to trip upstream breakers if the BPR fault detectors don't drop out before the time expires on the BPR timer.

Breaker opening resistor protection is accomplished by providing an output to block reclosing if BPR calculations determine that additional breaker operations could exceed the maximum resistor power rating.

Open breakers can be protected against sustained arcs by providing an output to close the breaker and allow it to trip again. Such sustained arcs can be initiated by lightning or loss of dielectric strength. Arc current may be limited to line charging current and go undetected by standard fault protection elements. If the arc is allowed to continue for minutes, the breaker will be destroyed due to the internal heat generated. The BPR provides a separate fault detector for detecting low level arcs.

BREAKER MONITORING

Breaker monitoring generally consists of gathering the data necessary to predict when the breaker contacts should be serviced. This practice eliminates the need to perform routine maintenance on breakers that may be in good condition. Data is acquired each time a 52a/b contact input indicates opening of the breaker.

The BPR not only monitors contact wear but also gathers data on breaker-fail timing margins. This information may be used to help the user achieve fast, secure breaker-fail protection. Data is acquired each time the breaker operates.

The BPR also captures fault data on all four current inputs, along with status on all contact inputs and relay outputs.

The BPR stores the last 12 fault records and overwrites the oldest when full. Recording is triggered according to the trigger conditions setup while programming the relay logic.

Fault data is stored in three forms: An oscillographic record in COMTRADE format, a fault data summary report, and a fault record list.

All data captured can be retrieved by a PC equipped with standard off-the-shelf communications software.

FUNCTIONAL DESCRIPTION

The diagram below illustrates the general nature of the BPR relay.

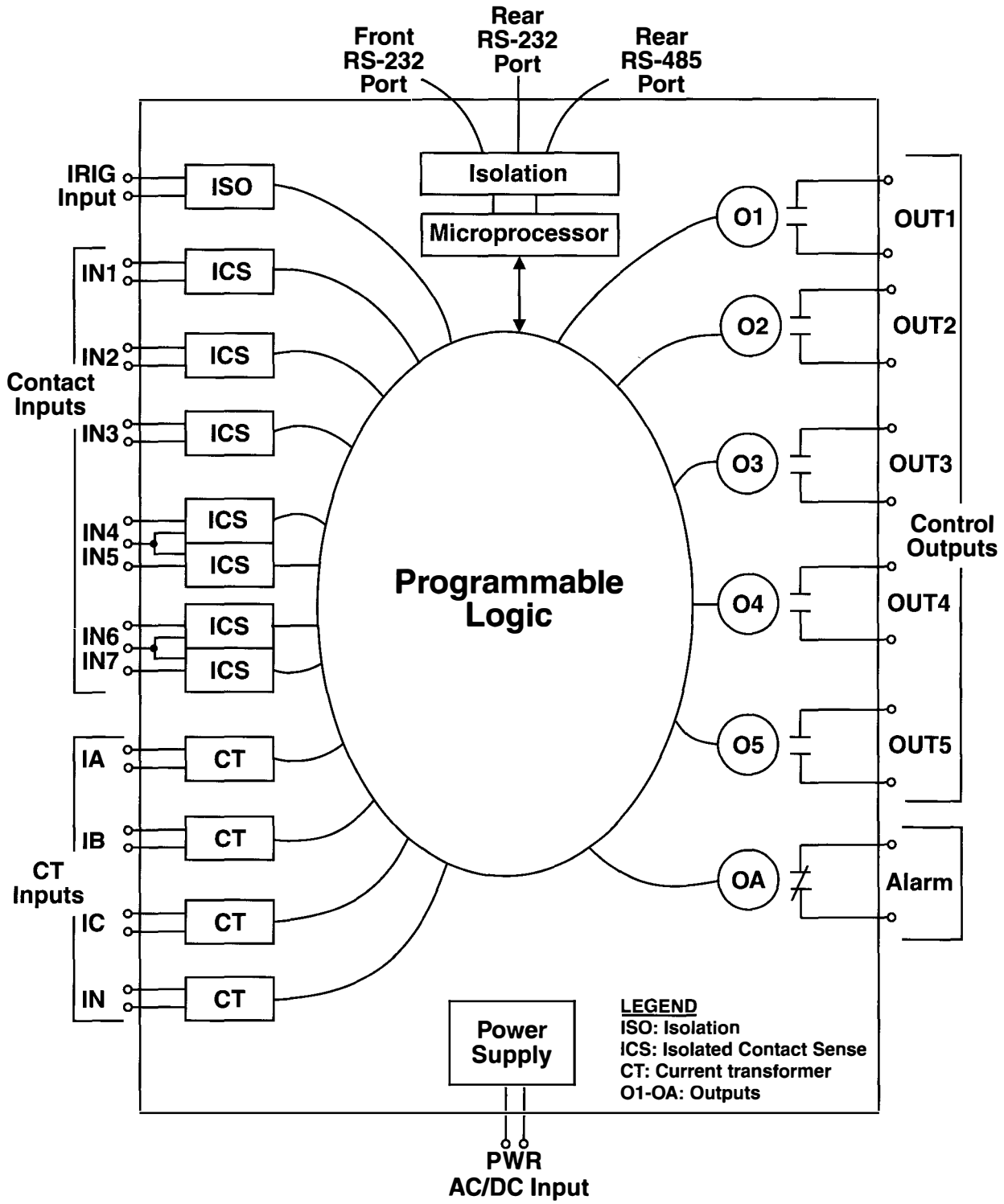

Figure 1 - Functional diagram

FUNCTIONAL DESCRIPTION
(continued)

One example of the programmable logic possible is shown in the diagram below.

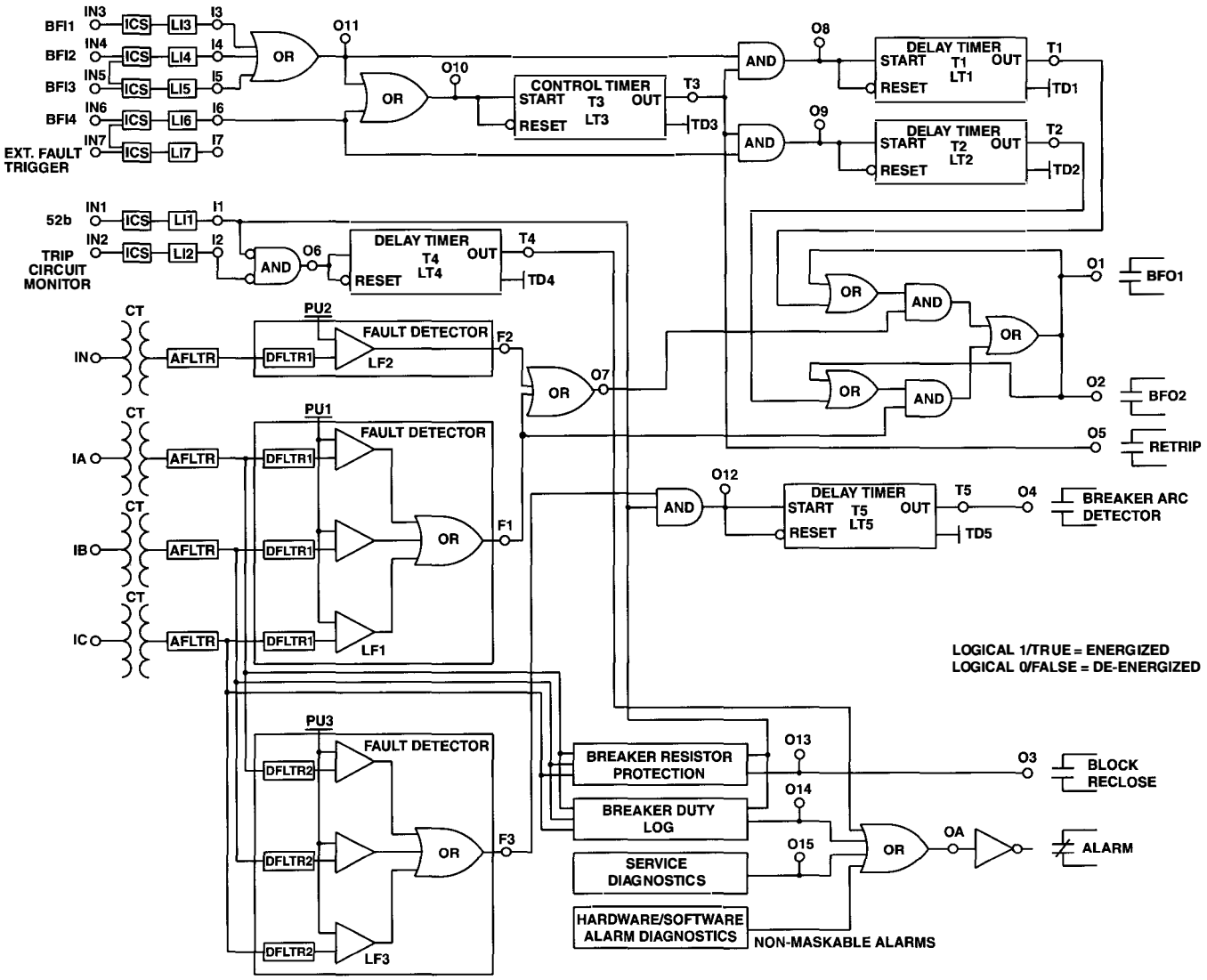

Figure 2 - BFL2E Logic

BFL2E logic in figure 2 provides the following application features:

1. **Three-Pole Tripping BF Logic** (Output latch-in provided and Control timer limits operational window). Three BFI inputs are available at IN3, IN4, and IN5 to start delay timer T1. If the BFI inputs are not reset by the time T1 times out and either the 3-phase (F1) or neutral (F2) fault detector is still picked up, then outputs BFO1 and BFO2 will close to trip the backup breakers. Control timer (T3) is used to limit the breaker failure window of opportunity.

2. **Single-Pole Tripping BF Logic** (Features: Output latch-in provided and Control timer limits operational window). If single-pole tripping is used, a BFI input is available (IN6) to start delay timer T2. This input is only supervised by the 3-phase fault detector (F1). If the BFI input (IN6) is not reset by the time the timer T2 times out and the 3-phase fault detector (F1) is picked up, outputs BFO1 and BFO2 close, tripping the backup breakers. Control timer T3 is used to limit the breaker failure window of opportunity.

FUNCTIONAL DESCRIPTION
(continued)

Neutral fault detector (F2) is not used to supervise the single-pole BF logic because F2 is still picked up by the phase unbalance after the fault clears. Three-phase BF logic is inhibited during this period because there is no 3-phase BFI input active.

3. **Trip Coil Status Monitor**. Standard logic is provided using IN1 to provide breaker status and IN2 for trip circuit continuity.

4. **Breaker Arc Protection**. Standard logic is provided using fault detector (F3) for the moving average fault detector, IN1 for breaker status and O4 for the arc detector output.

5. **Block Reclose Output**. Standard logic is provided using breaker resistor protection output (O3) to drive the Block Reclose output.

6. **Retrip Output**. A Retrip output is provided to give a backup trip signal to the breaker trip coil. This can either provide a separate path to a single trip coil or be hooked to the backup trip coil if available.

7. **External Fault Trigger**. The enhanced BPR relay provides the ability to save COMTRADE fault records for twelve events in memory at one time. An external fault trigger is provided to permit fault data triggering from an external source.

8. **Alarm Output**. An Alarm output is provided to signal relay failure or diagnostic alarm.

PROGRAMMING LANGUAGE

The powerful nature of the BESTlogic programming language can be shown by the simple program used to achieve the logic shown in Figure 2. The program is as follows:

```
LN=BFL2E
LF1=PI,1;          LF2=NI,1;          LF3=PI,2
LI1=1,12;          LI2=1,12;          LI3=1,12
LI4=1,12;          LI5=1,12;          LI6=1,12;          LI7=1,12
LT1=D,O8,/O8;      LT2=D,O9,/O9;      LT3=C,O10,/O10
LT4=D,O6,/O6;      LT5=D,O12,/O12;    LT6=0,0,0
LOA=T4+O14+O15
LO1=O2;            LO2=T1O7+F1T2+O1O7
LO3=O13;           LO4=T5;            LO5=T3;            LO6=/I1/I2
LO7=F1+F2          LO8=T3O11;         LO9=T3I6+T3O9
LO10=I6+O9+O11;    LO11=I3+I4+I5+O8
LO12=F3I1;         LO13=OP_LIMIT;     LO14=DLOG;         LO15=DIAG
```

The first line defines a unique name for the logic set using the LN (Logic Name) command. The next line sets up the fault detectors using the LF (Logic Fault_detector) command. The third and fourth lines define the input contact debounce logic using the LI (Logic Input) command. The fifth and sixth lines set up the timer/counter functions using the LT (Logic Timer/Counter) command. The final six lines define the boolean output logic using the LO (Logic Output) command.

The BESTlogic commands provide an easy way to define functional elements and use them in logical expressions to achieve the operation desired. Once programmed, different logic sets are activated simply by changing the name of the active logic set using the LOGIC command. Please see the instruction manual for details.

COMMUNICATIONS COMMAND DESCRIPTIONS

Command	Function
ACCESS[=<password>]	Read/Change access level in order to change settings
BKRCON [= <Tc(ms)>, <Ti(ms)>, <DMAX(A-S)>]	Read/Change breaker contact data
BKROPS [= <#operations>, <52a/b contact logic>]	Read/Change breaker operations data
BKRRES [= <Ires(A)>, <reset(min)>, <MAXOPS>]	Read/Change breaker resistor data
CAL [x [= <level>]]	Read/Change ADC channel calibration
COM [x [=<ratedps>[,Ay][,Ey][,Hy][,Pyy][,Xy]]	Read/Change the serial communications protocol
CT[P/N [=<ratio>]]	Read/Change the Phase or Neutral CT ratio
DATE [=<dm>/<md>/<yr>]	Read/Change the date
DIAG[=0]	Read/Reset diagnostic log information - alarms
DLOG[p [=<yy>]]	Read/Change the contact duty log
FLOG[x [=0]]	Read fault log or Clear FLOG and FAULT data
FLT<xxx><A/B><.CFG/.DAT>	Read COMTRADE .DAT/.CFG report for fault <xxx>
FREQ [= <hz>]	Read/Change power system frequency
HELP/H	Obtain helpful information
I[p]	Read phase current in primary units
ID [= <id>]	Read/Change relay ID number for polled communications
LF[x [=<type>,<dflt>]]	Read/Change Logic for Fault detector operation
LI[x [=<r>,<db>]]	Read/Change Logic for Contact input
LINFO [<name>]	Read logics available or <name> logic equations
LN [= <name>]	Read/Change custom logic name
LO[x[= <equation>]]	Read/Change Program operation for an output
LOGIC [= <existing name>]	Read/Change the name of the active logic scheme
LT[x [=<Type>,<S/C>,<R>]]	Read/Change Logic for Timer/Counter operation
OUT[x][=<1/0]	Pulse Output ON(1) or OFF(0) for test
PCLK[=<m/d>,<12/24>]	Read/Program date/time format
PDIAG[=LOGIC,TLOG,DLOG,BKR,RESET,CLK,0,0>]	Read/Program diagnostic alarms as ON(1) or OFF(0)
PDISPLAY[=<default_menu>,<default_screen>]	Read/Program the default display screen
PTARGET[= <iiiiiii>, <ooooo>]	Read/Program the target data format
PTLOG[x [=<logic>[[<alarm_type>, <alarm_time]]]	Read/Program Timer log logic, alarm type and alarm time
PU[x [= <level>[,<cycles>]]]	Read/Change an overcurrent pickup level
PW[x[=<pw>,<a>]]	Used to change the password
QUIT	Exit programming mode w/o saving changes
RESET	Reset latched target data
SAVE	Exit programming mode and save changes
SHOWSET	Read relay setup parameters
SNAME [= <num>,<name>]	Read/Change station name for the COMTRADE report
STATUS	Read status of inputs and outputs
TARGET	Read target data
TD[x [= <delay>[,<inst/max_count>]]]	Read/Change timer delay setting
TEST [= <reset/test>]	Read/Reset diagnostic test results or force test
TIME [= <hr>:<mn>:<sc>]	Read/Change the time
TLOG[x]	Read Timer log
TRIGGER[=<logic term>/Y]	Read/Change Trigger logic or trigger a fault record
VER	Read Model, SN, PN and Program data

SPECIFICATIONS

AC CURRENT INPUT
20 amperes, continuous
400 amperes, one second

OVERCURRENT DETECTORS
Three are provided and may be set up for 3-phase or neutral

INSTANTANEOUS OC PICKUP RANGE
0.25 to 9.99 amperes in 0.01 steps

AVERAGING OC PICKUP RANGE
0.05 to 1.00 amperes in 0.01 steps

OVERCURRENT PICKUP TIME
21 ms maximum @ 60 Hz

OVERCURRENT DROP OUT TIME
4.2 ms @ 60 Hz

OSCILLOGRAPHIC RECORDING RANGE
0 to 200 amperes

OSCILLOGRAPHIC RECORDING
12 samples per cycle in COMTRADE format

TIMERS
Six microprocessor controlled timers adjustable from 1 to 999 ms in 1 ms steps or 1 to 65 sec in 0.1 sec steps

REAL TIME CLOCK
Resolution: 1 ms
Stability: 30ppm typical

INPUT CONTACT SENSING RANGE
Same as DC power supply input
Programmable recognition time, 1-99 ms

OUTPUT RELAY SPEED
One-quarter cycle maximum on Output #1
One-half cycle maximum on Outputs #2-5

DISPLAY
2 line x 16 character backlit LCD display

OUTPUT CONTACT RATINGS
Make 30 A and carry for 0.2 sec
Carry 7 A continuous
Break 0.3 A, L/R=0.04, @ 250Vdc

TARGETS
Five diagnostic LEDs are provided plus target display of all I/O contacts

COMMUNICATIONS
Includes front and rear RS-232 ports and an RS-485 port on rear.
Only one port may be active at a time.
Oscillographic records conform to IEEE C37.111 - Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems.
Protocol: String of ASCII characters

ISOLATION
2500 Vac on current inputs
1500 Vac on control inputs and outputs

SURGE WITHSTAND
Qualified to:
ANSI/IEEE C37.90.1 - SWC and fast transient
IEC 255-2 - IEC Impulse

RADIO FREQUENCY INTERFERENCE
Type tested using a five watt tranceiver from 144 to 440 MHz

OPERATING TEMPERATURE
-40°C to +70°C (-40°F to +158°F)

SEISMIC
2g in range of 10 to 500 Hz

CASE SIZE (Vertical unit)
M1 case size
6.61"W x 16.2"H x 9.45"D behind panel

CASE SIZE (Horizontal unit)
Nineteen inch rack mount
19"W x 3.48"H x 9.4"D behind panel
or 8.4"D with movable flanges

POWER SUPPLIES
40 to 150 Vdc (48/125 Vac/dc)
90 to 300 Vdc (125/250 Vac/dc)

ORDERING INFORMATION

PART NUMBER			
VERTICAL	HORIZONTAL	POWER SUPPLY	CONFIGURATION
BE1-BPR-309	BE1-BPR-300	48/125 Vac/dc	Basic model
BE1-BPR-311	BE1-BPR-302	48/125 Vac/dc	Enhanced model
BE1-BPR-310	BE1-BPR-301	125/250 Vac/dc	Basic model
BE1-BPR-312	BE1-BPR-303	125/250 Vac/dc	Enhanced model

The following capabilities are only in the enhanced models:
• Accumulated contact duty • Fault record list • Fault summary report • Oscillographic data

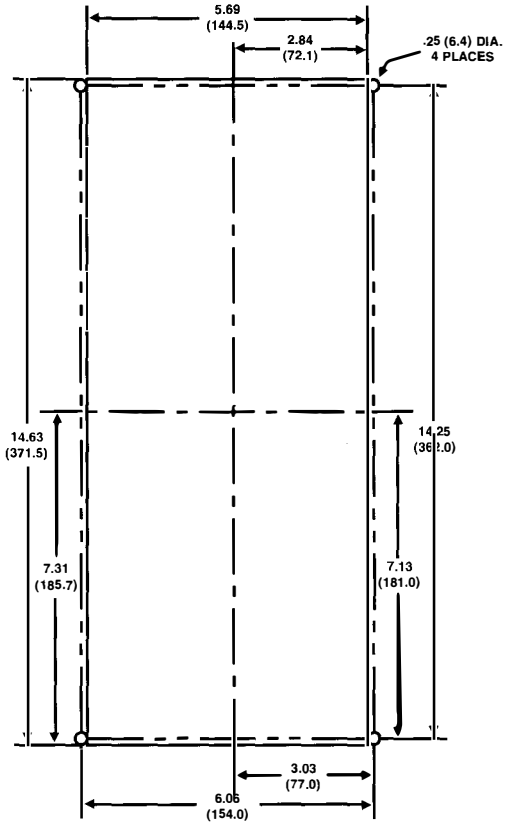

Figure 4 - Panel Cutout Dimensions for Vertical Unit

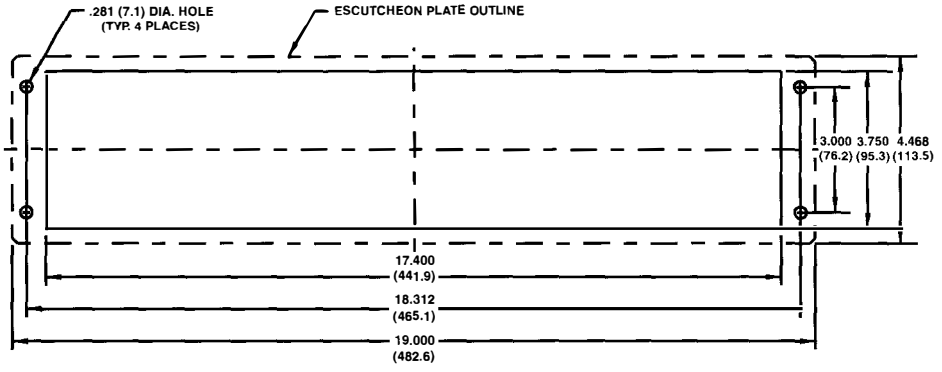

Figure 5 - Panel Cutout Dimensions for Horizontal Unit

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