Descriptive Bulletin
41-215M

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Distribution Relay System

DPU™ 1500R

The Distribution Protection Unit 1500R (DPU1500R) is an advanced microprocessor-based distribution unit for protecting electrical distribution systems. The DPU1500R offers unique monitoring, metering, and programmable control features for expanding the protective limits normally provided by multiple single-function devices. The accurate metering on the DPU1500R can replace separate meters and reduces wiring on panels.

The 64 cycles per phase oscillographic record analyzer and event log provide detailed system disturbance data. Three groups of settings tables allow for on-line switching between groups for adaptive relaying techniques.

The DPU1500R electronics can be completely withdrawn for convenient relay testing.

Features

- ANSI and IEC time overcurrent characteristic curves provide greater flexibility.
- Isolated Communication ports provide superior remote communications
- Multiple communications protocol support (DNP 3.0 (IEC 870-5) and Modbus®), as well as an open protocol communication structure
- Easy-to-use MMI with graphical display that shows all metered values and programmable settings
- Battery backed-up clock keeps time even during power-down
- Event records and logs are not lost by resetting of targets
- Protection is based on RMS or fundamental values
- Three user-programmable curves accommodate special coordination requirements
- Self-correction of settings tables maintains integrity of user's relay settings
- Optional isolated and hardened serial ports
- Front and rear communication ports for simultaneous local and remote access
- Programmable inputs and outputs with time delays
- Test mode allows monitoring of the unit's functions
- Advanced 32-bit microprocessor technology plus Digital Signal Processor (DSP)

Protective Functions

In each setting group (Primary, Alternate 1, and Alternate 2) the following protection is provided:

- Phase time overcurrent protection - 51P (3I>)
- Phase instantaneous overcurrent protection - 50P-1, 50P-2, 50P-3 (3I>>1, 3I>>2, 3I>>3)
- Ground overcurrent protection - 51N (IN>)
- Ground instantaneous overcurrent protection - 50N-1, 50N-2, 50N-3 (IN>>1, IN>>2, IN>>3)
- Negative sequence overcurrent protection - 46 (Insc>)
- Undervoltage control and alarm 27 (U<)
- Multishot reclosing (O->I) ; each reclose step allows independent programming of protective functions
- Pre-programmed adaptive relay schemes include:
  - Zone sequence coordination
  - Cold load pickup detection
  - Automatic reclose blocking
  - Multiple device trip and single-phase trip modes

Metering and Records

- Optional load profile data-storage of per-phase voltage, watts, and VARs in 5 minute intervals for 13 days expandable up-to 160 days at 60 minute intervals
- Peak demand and demand amperes, voltages, watts, VARS, kWh, kVARh with power factor and frequency
- Optional oscillographic waveform capture and harmonic analysis data storage capability provides up-to 64 cycles of per-phase recorded data
- Operations Summary, including over current trips, breaker operations, and reclosures
- Fault Summary and Fault Record of last 32 trips
- Operations Record of last 128 operations
- Accumulation of breaker interrupting duty

Monitoring and System Highlights

- Accurate fault locator that estimates distance to fault, reducing system downtime
- On-board network-compatible remote interface capabilities that streamline operational data collection
- True 16-bit resolution with 32 samples-per-cycle on each phase for high-resolution oscillographic analysis
- Advanced "Windows"-based oscillographic waveform analysis program displaying analog and digital event data
- Optional 80-character, front panel LCD for changing all settings and viewing all metered data, plus graphical display of harmonic content

Protective Functions Summary

Time overcurrent functions: 51 (I>) - phase and ground

Instantaneous overcurrent function: 50 (I>>) - three

independent functions for phase and three independent functions for ground

Reclosing features: 79M (O->I) - up to four reclosing shots

Phase balance (negative sequence): 46 (Insc>)

Undervoltage: 27 (U<)

Time Overcurrent Functions: 51 (I>)

- One phase setting and one ground setting
- Curve: Thirteen time overcurrent and three user-programmable characteristic curves (see Table 1)
- Pickup: I to 12Ain 0.1 steps or 0.2 to 2.4A in 0.02 steps (based on catalog selection)
- Time dial selections: 1 to 10 in 0.1 steps
- Time delay selections: 0 to 9.99 seconds (s) in 0.01 steps (for Definite Time curve selection only)

Table 1. Time Overcurrent Curves

Curve Definition	
ANSI	**IEC**
Extremely Inverse	Long Time Inverse
Very Inverse	Normal Inverse
Inverse	Very Inverse
Short Time Inverse	Extremely Inverse
Definite Time	
Long Time Extremely Inverse	
Long Time Very Inverse	
Long Time Inverse	
Recloser Curve	
User 1*	
User 2*	
User 3*	

Instantaneous Overcurrent Function: 50 (I>>)

- Three phase settings and three ground settings
- 50P-1 and 50N-1
  - Curve: five overcurrent and three user-programmable characteristic curves (see Table 2)
  - Pickup: 0.5 to 20 x (51P and 51N pickup setting)
  - Time dial selections: 1 to 10 in 0.1 steps
- 50P-2 and 50N-2 time delay: 0 to 9.99 s in 0.01 -second steps
- 50P-3 and 50N-3 standard curve

Table 2. Instantaneous Overcurrent Curves

Curve Definition
Standard Instantaneous
Inverse Instantaneous
Definite Time
Short Time Inverse
Short Time Extremely Inverse
User 1*
User 2*
User 3*

*Only available with the user-programmable curve option.

Reclosing Features: 79 (O->I)

After a fault has occurred, the 79 Reclosing function closes the breaker when the programmed open interval time expires. Zero to four reclosures may be selected, and each reclosure has an independently set open interval timer. The multishot reclose sequence only occurs if the DPU-1500R initiates an overcurrent trip or a programmable 79M (multishot) input is initiated.

At each step in the reclose sequence, you can enable or disable the 50P-1, 50P-2, 50P-3, 51N, 50N-1, 50N-2, or 50N-3 functions, and lockout reclosing as a result of tripping on any one of these functions.

Table 3. 79 Reclosing Function

Function	Range	Increment
No. of Reclosures	0 to 4	1
Open Interval Time	0.1 to 200 s	0.1 s
Reset Time	3 to 200 s	1.0 s

46 (Insc>) - Negative Sequence Overcurrent

- Curve: Thirteen time overcurrent and three user-programmable characteristic curves (see Table 1)
- Pickup: 1 to 12A in 0.1 steps or 0.2 to 2.4A in 0.02 steps (based on catalog selection)
- Time dial selections: 1 to 10 in 0.1 steps
- Time delay selections: 0 to 10.0 s in 0.1 steps (for Definite Time curve selection only)

27 (U<) - Undervoltage

- Pickup: 10 to 200 V in steps of 1 V
- Time delay: 0 to 60 seconds in steps of 1 s

79-CO (O->I-CO) - Cutout Time Function

The 79 Cutout Time (O->I-CO) function allows for the detection of low-level or intermittent faults prior to resetting the reclose sequence. At the end of the selected cutout time period, all overcurrent functions are re-enabled based on the 79-1 (O->I) settings. The 79-CO (O->I-CO) setting is programmable from 1 to 200 seconds.

Cold Load Pickup Time Delay

This function disables the 50-1 (I>>1) and 50-2 (I>>2) instantaneous phase and ground protective functions for a programmable period of time. Use this function to block unintentional tripping due to cold load inrush for a selected time delay between 0 to 254 seconds or minutes with a stop of one second or minute. During the time delay, an output alarm (CLTA) is also asserted.

Two-Phase 50P (3I>>) Tripping

Enabling this function blocks 50P (3I>>) element from tripping the breaker for a single-phase fault condition.

79V (O->IU<)-Reclosing Voltage Block Function

The 79V (O->IU<) voltage block function delays or blocks reclosing when a voltage input is below the 79V (O->IU<) Voltage Block setting.

- 10-200 V range with 1-V steps
- 4-200 second range with 1-second steps

Zone Sequence Coordination (ZSC) Function

The zone sequence coordination function coordinates the instantaneous elements in the reclosing sequence of the upstream device with the downstream reclosing devices. The DPU1500R increments (steps up to the next reclose number) through its reclose sequence after it senses that the fault current has been interrupted by a downstream device.

Fault Locator

The DPU1500R uses a patented fault algorithm to compute an apparent distance to the fault in miles or kilometers and an estimated fault resistance for a homogeneous distribution line. Using the sampled voltage and current quantities and user defined line impedances, the relay calculates the apparent fault distance and estimated fault resistance in the background mode, so as not to interfere with the protective functions of the unit.

Multiple Device Trip Mode

In Multiple Device Trip (MDT) mode a DPU1500R can control up to three single-pole reclosers. A second application for MDT mode allows a single DPU1500R relay on the bus to back up multiple feeder DPU1500Rs. The feeder DPU1500R SELF-CHECK ALARM output contact supervises the tripping logic of the bus relay. This allows the bus relay to trip the feeder breaker, thus avoiding a bus breaker operation. (See Application Note AN-22 on MDT mode.)

79-S (O->I1) Single-Shot Reclosure

The programmable 79S (O->I1) input function initiates a single-shot reclosure when the 52a (XO) and 52b (XI) contact inputs indicate that the breaker has been externally tripped. The close signal is initiated after the 79-1 (O->I) open interval time expires.

79M (O->I) Multishot Reclosure

When the 79M (O->I) input is enabled, a multishot reclose sequence is initiated or continued when the 52a (XO) and 52b (XI) contact inputs indicate that the breaker had been tripped by an external device.

User Interface

You can change settings, monitor metering activities, and view operations records through two interfaces: the man-machine interface and the Windows External Communications Program. In addition, with the Windows External Communications Program you can logically map inputs and outputs to any associated logic function, and download Oscillographic Data Storage files and Load Profile data (see "Optional Features").

Man-Machine Interface (Optional)

The MMI is temperature compensated, allowing clear viewing throughout the entire temperature range (-40° to +70° C) of the DPU1500R.The man-machine interface (MMI) consists of a 4 row by 20 character backlit display and a six-button keypad. The MMI continuously displays rms current magnitudes for Ia, Ib, Ic, and In and the corresponding line-to-neutral voltages (in wye configuration) or line-to-line voltages (in delta configuration). When a fault occurs, the MMI displays the distance to the fault and the four fault current magnitudes until the targets are reset. During the reclose sequence, the time remaining in the open interval or reset time period is also displayed. Relay settings, metering, fault and operations records, and a test mode can be accessed directly from the MMI.

Main Menu

```
Ia:  500   KVan:   -13.00
Ib:  500   KVbm    13.00
Ic:  500   KVcn:   13.00
In:    0   Primary Set
```

Meteringq Display

```
        MAIN MENU
Meter
Settings
Records
```

Display After a Fault Interruption

```
Distance - Km    10.1
Ia:  3320     Ib:  430
ic:  420      In:  331 C
     Reset Time  14
```

Windows External Communications Program (WinECP)

The Windows External Communications Program (WinECP) provides point-to-point communications with the DPU1500R relay. WinECP allows the user to program the settings for the DPU1500R's various functions.

WinECP can be used off-line to explore the capabilities and functionality of the relay. When the software is not communicating to a DPU1500R, the settings and configurations displayed are the factory default values. The relay settings can be edited, then saved to a file, and retrieved for downloading to a DPU1500R later. When the software is connected to a DPU1500R, you can view the records, save them to a file, and view them later.

WinECP contains terminal emulation commands to dial through a modem to access the relay or other devices connected to a remote modem. WinECP is a Windows-based program and can be installed to your computer's hard drive.The initial screen of the WinECP is shown below with other typical screens shown throughout this bulletin.

Metering

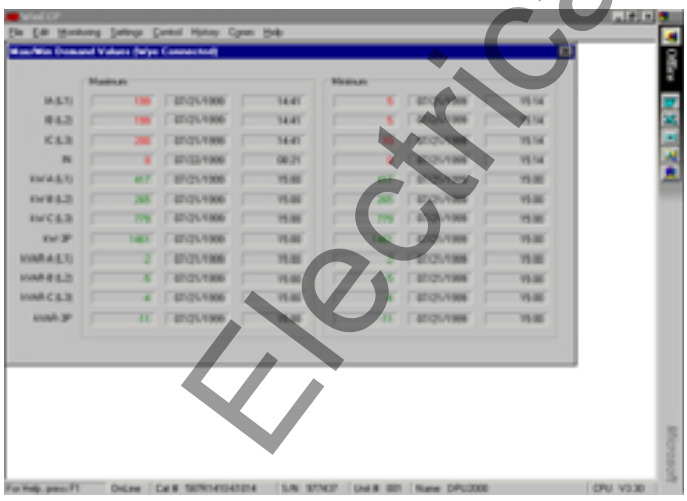
The Meter Menu has the following selectable metered data:

Load Values

- Phase and ground currents (magnitude and angle)
- Zero (I_0), positive (I_1), and negative (I_2) sequence currents
- Phase voltages for wye or delta VTs (volts and angle)
- Positive (V_1) and negative (V_2) sequence voltages
- Kilowatts single-phase and 3-phase for wye VTs and 3-phase for delta VTs
- KiloVARs single-phase and 3-phase for wye VTs and 3-phase for delta VTs
- Kilowatt-hours single-phase for wye and 3-phase for delta VTs
- KiloVAR-hours single-phase for wye and and 3-phase for delta VTs
- Power factor
- Frequency

Demand and Maximum/Minimum Demand Values

Demand and maximum/minimum demand values are metered in single-phase for wye and 3-phase for delta VTs with time and date stamp on the maximum and minimum metered values. The demand currents are calculated by using a log function; these currents replicate the response of thermal demand ammeters. The demand kilowatts and kiloVARs are averaged values that are calculated by using the kilowatt-hours, kiloVAR-hours and the selected demand interval.



Demand Values

- Demand (phase and ground) currents
- Demand kilowatts
- Demand kiloVARs

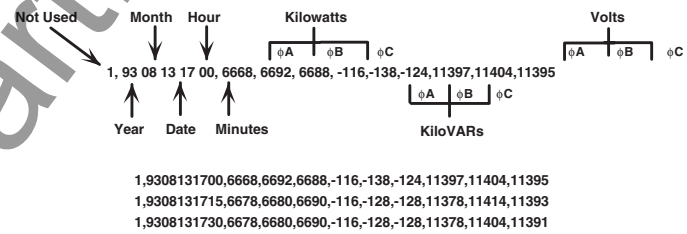
Maximum and Minimum Values

- Maximum and minimum (phase and ground) currents
  - Time and date stamp for maximum and minimum
- Maximum, and minimum kilowatts
  - Time and date stamp for maximum and minimum kilowatts
- Maximum, and minimum kiloVARs
  - Time and date stamp for maximum and minimum kiloVARs

Optional Features

Load Profile

The Load Profile feature stores single-phase **voltage, demand watts, and demand VARs** fora selectable time interval of 5, 15, 30, or 60 minutes (Demand Meter Constant) for which the load profile record will then contain 13.3, 40, 80, or 160 days of information, respectively. The recorded data is stored in a comma-delimited ASCII format, which allows for importing in most text editor programs (word processor or spreadsheet) for load analysis and graphing.



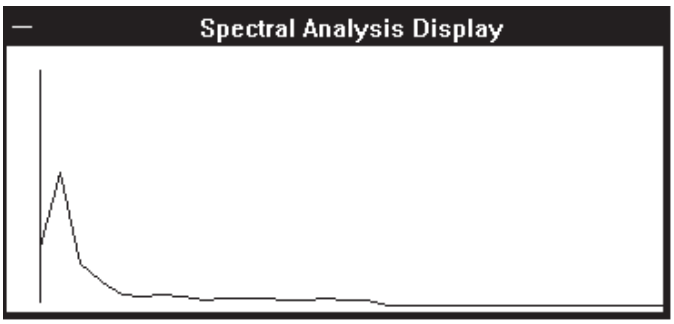
1,9308131700,6668,6692,6688,-116,-138,-124,11397,11404,11395
1,9308131715,6678,6680,6690,-116,-128,-128,11378,11414,11393
1,9308131730,6678,6680,6690,-116,-128,-128,11378,11404,11391

Oscillographic Data Storage (Waveform Capture)

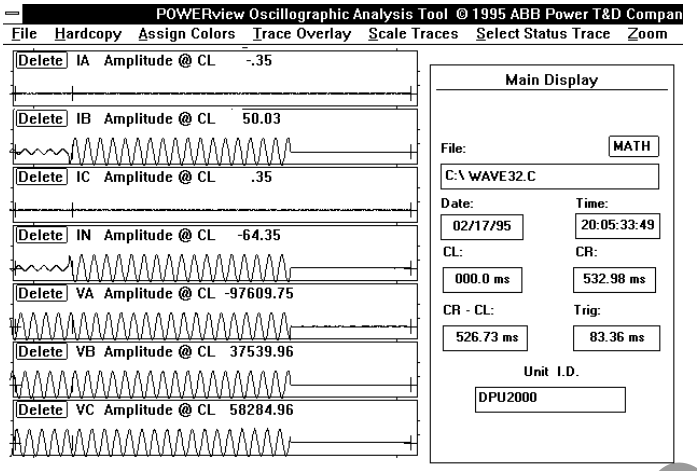
For purposes of fault analysis, the oscillographic data storage captures the waveform data for each of the four input currents and three input voltages. The storage capacity is 64 cycles of each waveform. Fault analysis is enhanced by the Oscillographic Analysis Program, which uses a Microsoft Windows™-based Graphical User Interface.

The DPU1500R can be programmed to capture eight, four, two, or one record(s) containing 8, 16, 32, or 64 cycles of data respectively. Thirty-two points per cycle of resolution for each of the seven analog inputs, the 52a (XO) and 52b (XI) contact inputs, and numerous protective and logic status indications are stored in each waveform record.

To provide as many cycles of prefault and fault data as desired, you can program the trigger position in quarter-cycle increments.



Shows spectral analysis of inputs for power quality analysis.



Shows complete waveform analysis of 3 voltages and 4 currents

Records

Under the Records Menu are selections for the various fault and operations records and summaries, including unreported records kept by the DPU1500R.

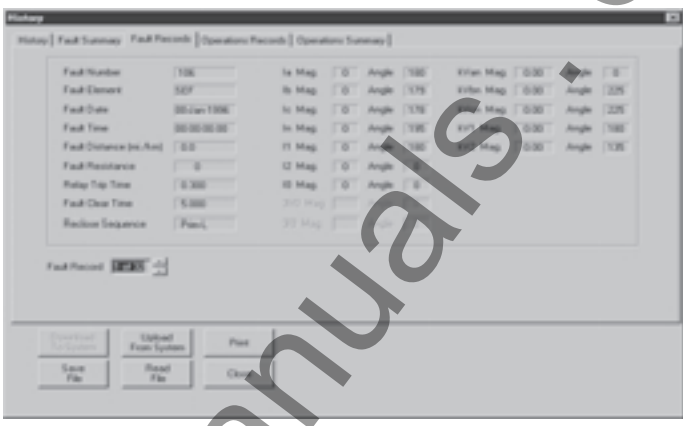
Fault Summary

A summary of the last 32 faults is provided. The fault summary includes the fault number, recloser sequence number, date and time, tripping element, and the phase and neutral currents.

Fault Record

The fault record contains the last 32 faults. The fault record displays one fault at a time and includes the following:

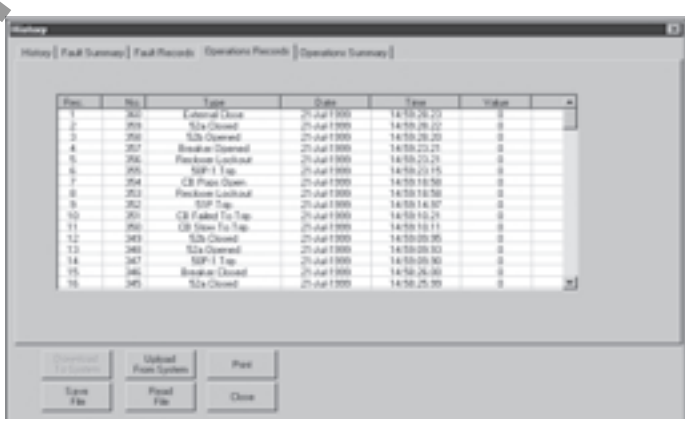
- Fault number
- Reclose sequence number and enabled settings table
- Date and time
- Tripping element
- Apparent distance to the fault
- Phase and neutral currents (magnitude, fault resistance, and angle)
- Positive, negative, and zero sequence currents
- Phase voltages
- Positive and negative sequence voltages
- Relay operate time
- Breaker operate time



Operations Record

This record stores the last 128 operations. Operations include manual opening and closing of the breaker, overcurrent trips and redose sequences, activation of binary inputs and output contacts, alarm conditions, and Functional Test Mode data. The operations record includes the following data:

- Record number
- Operation number
- Description of the operation
- Date and time of the operation



Operations Summary

This record includes the following counters:

- Summation of breaker interruption duty per phase (A, B, and C) in KSI (thousand symmetrical amperes)
- The total number of breaker operations
- Total number of overcurrent trips
- Two recloser (79) counters
- Total number of successful reclosures by sequence number:1st, 2nd, 3rd, and 4th

Communication Ports

The DPU1500R has a nine pin, standard non-isolated RS-232C serial communications interface on the front panel. This port is used to interrogate or program the unit by using the PC-based WinECP. Additional communication port configurations are available on the back panel of the DPU1500R, including:

- Isolated RS-232C (3-wire)
- Isolated RS-485 (3-wire)
- Isolated RS-485 Auxiliary Communication Port (3-wire)
- Isolated INCOM (2-wire) port
- IRIG-B (Unmodulated)

The baud rate selections for the front and rear ports are:

- FRONT 300, 1200, 2400, 4800, or 9600
- REAR 300, 1200, 2400, 4800, 9600, or 19200

An ABB RS-232 to RS-485 converter (Catalog No. 245X2000) can be used to connect a network of DPU1500Rs with RS-485 ports to a communications device (modem) or personal computer. For long runs and high electrical noise environments, fiber-optic communications links are recommended. An ABB RS-485 to fiber-optic converter (Catalog No. 245X4000) can be used to network multiple DPU-1500Rs to a central communications center up to 1000 meters away.

The DPU1500R provides the following communications protocol options:

*ABB Ten-byte-oriented protocol through the front RS-232 and rear RS-232/RS-485 ports

Modbus®

INCOM™ two-wire, RF carrier-based communications system and protocol

DNP3.0 (IEC 870-5) - A byte-oriented protocol based on IEC 870-5-T1 Standard Specifications

*WinECP is provided with the relay and can be used to communicate with the DPU1500R via this protocol.

(NOTE: Protocol documentation available on request for interfacing with the relay.)

Programmable Curve Menu

An external PC-based program, CurveGen, is used to create and program custom time-current curves for the DPU1500R. CurveGen can generate three time-overcurrent curves in addition to the standard curves provided in the DPU1500R. Curve Gen can manipulate the curves in the time and current domains just like any other curve currently programmed into the DPU1500R.

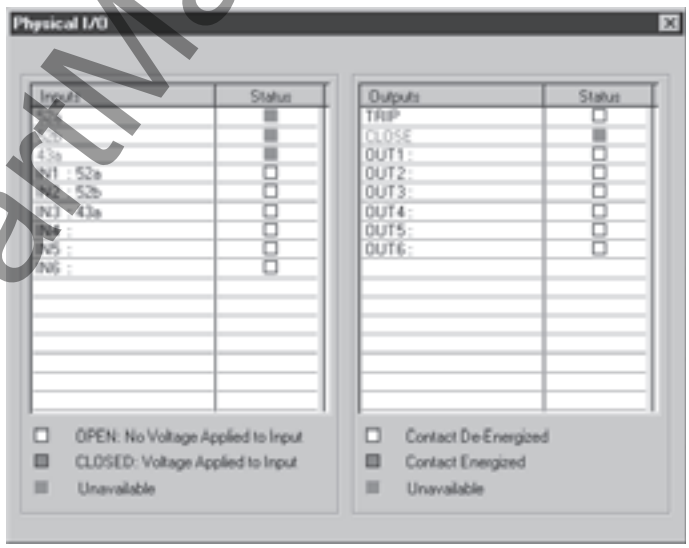
The Programmable Curve menu on the WinECP allows downloading ("Transmit Prog Curve Data") of a curve generated on CurveGen to the DPU1500R as a User 1, 2, or 3 curve. Upload ("Receive Prog Curve Data") an existing user-programmable curve from the DPU1500R to a computer for editing or graphing. Downloading pre-programmed curves that match common recloser curves is also possible.

Monitoring the DPU1500R

WinECP displays options for viewing the physical condition (Energized or De-Energized) and logic state (Open or Closed) of the programmable input and output contacts. This menu is useful in analyzing the programmed logic mapping of the output contacts and contact inputs.

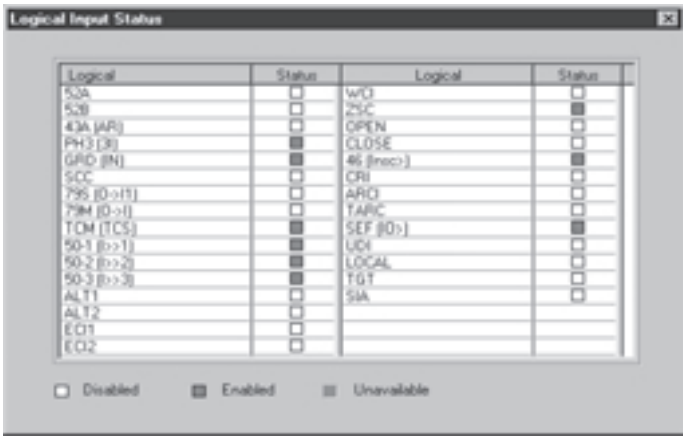
Physical Input/Output Status

This contact input/output screen displays the present physical state of digital input contacts and contact outputs. With this screen you can verify that the logic you programmed for input contacts is responding properly without physically measuring the input voltage status.



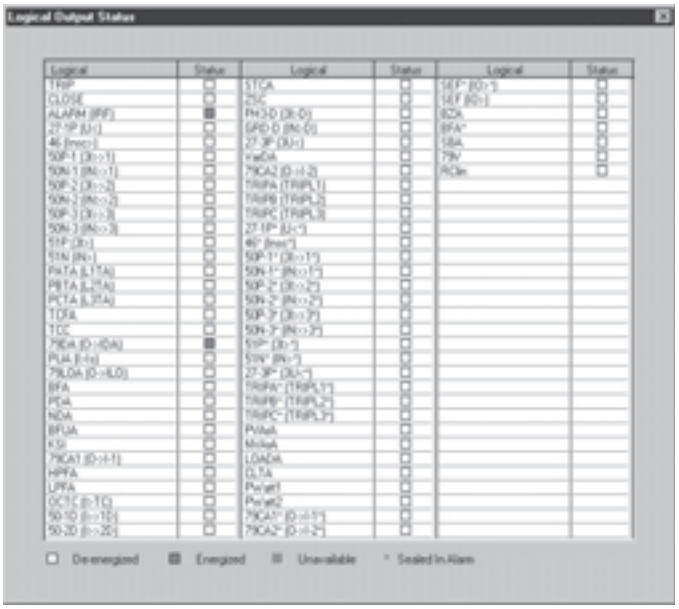
Logical Input Status

The WinECP logical input screen shows the present status of the logical inputs.



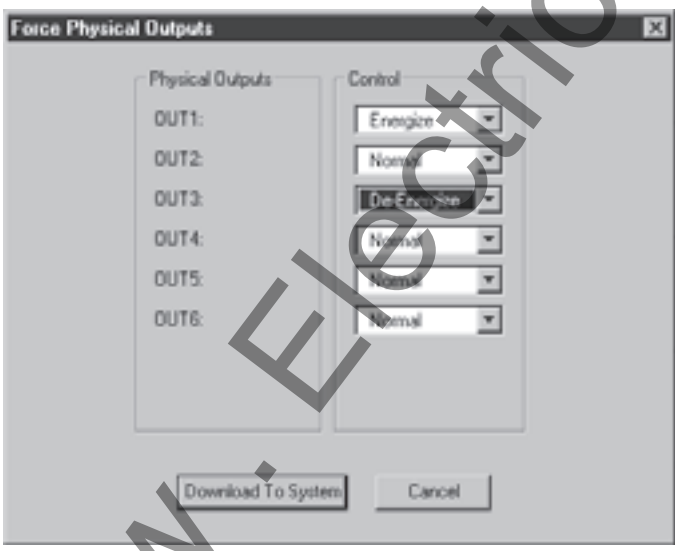
Logical Output Status

The logical output screen shows the present status of the logical outputs, energized or de-energized. Use this screen to verify the proper operation of the relay functions' logic states.



Output Contacts (Password Protected)

The output contact test mode allows activation of all permanently programmed and user-programmed output contacts via the man-machine interface or the communications WinECP.



Programmable Logic Outputs

Up to six (6) user-programmable output contacts are available. Program these contacts by using WinECP. Time delay on pickup can also be programmed to each contact output. The time delay interval is adjustable from 0 to 250 seconds in 0.01 steps. The user-programmable outputs can be configured to indicate the following conditions:

- Trip - Trip Output contact
- Close - Reclose Output contact
- Alarm - Trip Output contact
- BFA - Breaker Failure Alarm
- 79LOA (O->ILO) - Lockout Alarm
- TCFA - Trip Circuit Failure Alarm
- TCC - Tap Changer Cutout contact
- PUA - Overcurrent Pickup Alarm
- 51P (3I>) - Phase Time Overcurrent Trip Alarm
- 51N (IN>) - Ground Time Overcurrent Trip Alarm
- 46 (Insc>) - Negative Sequence Time Overcurrent Trip Alarm
- 50P-1 (3I>>1) - 1st Phase Instantaneous Overcurrent Trip Alarm
- 50N-1 (IN>>1) - 1st Ground Instantaneous Overcurrent Trip Alarm
- 50P-2 (3I>>2) - 2nd Phase Instantaneous Overcurrent Trip Alarm
- 50N-2 (IN>>2) - 2nd Ground Instantaneous Overcurrent Trip Alarm
- 50P-3 (3I>>3) - 3rd Phase Instantaneous Overcurrent Trip Alarm
- 50N-3 (IN>>3) - 3rd Ground Instantaneous Overcurrent Trip Alarm
- PATA (L1TA) - Phase A (L1) LED Target Alarm
- PBTA (L2TA) - Phase B (L2) LED Target Alarm
- PCTA (L3TA) - Phase C (L3) LED Target Alarm
- 27-1P (U<) - Single-Phase Undervoltage Alarm
- 27-3P (3U<) - Three-Phase Undervoltage Alarm
- 79DA (O->DA) - Recloser Disabled Alarm
- 79CA1 (O->I-1) - Recloser Operations Counter 1 Alarm
- 79CA2 (O->I-2) - Recloser Operations Counter 2 Alarm
- OCTC (I>TC) - Overcurrent Trip Counter Alarm
- KSI - KSI Summation Alarm
- PDA - Phase Current Demand Alarm
- NDA - Neutral Current Demand Alarm
- PVARA - Positive Three-Phase kiloVAR Alarm
- NVARA - Negative Three-Phase kiloVAR Alarm
- LOADA - Load Current Alarm
- 50-1D (I>>1D) - 50-1 Instantaneous Function Disabled Alarm
- LPFA - Low Power Factor (lagging) Alarm
- HPFA - High Power Factor (lagging) Alarm
- ZSC - Zone Sequence Coordination Enabled Indicator
- 50-2D (I>>2D) - 50-2 Instantaneous Function Disabled Alarm

List continues next page

- BFUA - Blown Fuse Alarm
- STCA - Settings Table Changed Alarm
- PH3-D (3I>D) - Phase Overcurrent Functions Disabled Alarm
- GRD-D(IN>D) - Ground Overcurrent Functions Disabled Alarm
- VARDA - Three-Phase KiloVAR Demand Alarm
- TRIPA (TRIPL1) - Phase A (L1) Trip
- TRIPB (TRIPL2) - Phase B (L2) Trip
- TRIPC (TRIPL3) - Phase C (L3) Trip
- 27-1P* (U<-1P*) - Single-Phase Undervoltage Seal In Alarm
- 27-3P* (U<-3P*) - Three-Phase Undervoltage Seal In Alarm
- 46* (Insc>*) - Negative Sequence Overcurrent Seal In Alarm
- 50P-1* (3I>>1*) - 1st Phase Instantaneous Overcurrent Seal In Alarm
- 50N-1* (IN>>1*) - 1st Ground Instantaneous Overcurrent Seal In Alarm
- 50P-2* (3I>>2*) - 2nd Phase Instantaneous Overcurrent Seal In Alarm
- 50N-2* (IN>>2*) - 2nd Ground Instantaneous Overcurrent Seal In Alarm
- 50P-3* (3I>>3*) - 3rd Phase Instantaneous Overcurrent Seal In Alarm
- 50N-3* (IN>>3*) -3rd Ground Instantaneous Overcurrent Seal In Alarm
- 51P* (3I>*) - Phase Time Overcurrent Seal In Alarm
- 51N* (IN>*) - Ground Time Overcurrent Seal In Alarm
- TRIPA* (TRIPL1*) - Phase A (L1)Trip Seal In Alarm
- TRIPB* (TRIPL2*) - Phase B (L2)Trip Seal In Alarm
- TRIPC* (TRIPL3*) - Phase C (L3)Trip Seal In Alarm
- CLTA - Cold Load Timer Alarm
- PWATT1 - Positive Watt Alarm 1
- PWATT2 - Positive Watt Alarm 2
- 79CA1* (O->-1*) - Recloser Operations Counter 1 Seal In Alarm
- 79CA2* (O->-2*) - Recloser Operations Counter 2 Seal In Alarm

Note: All output contacts are rated for tripping or alarm duty.

*** Seal In Alarms**

WinECP Output Mapping Logic Screen— *Map each output contact logically AND or OR to any function by mouse-clicking in the selected field.*

Programmable Binary (Contact) Inputs

The DPU1500R also provides eight (8) user-programmable contact inputs that may be configured in an AND or OR logic map and in a normally open or normally closed state. The user-programmable inputs can monitor, enable, initiate, or actuate the following input functions:

- TCM (TCS) - Trip Coil Monitoring monitors the trip path continuity through the trip coil when the breaker is closed
- GRD (IN) - Ground Control enables the 51N (IN), 50N-1 (IN>>1), and 50N-2 (IN>>2) functions
- PH3 (3I) - Phase Control enables the 51P (3I>), 46 (Insc>), 50P-1 (3I>>1), and 50P-2 (3I>>2) functions
- 50-1 (I>>1) - Instantaneous Control enables the 50P-1 (3I>>1) and 50N-1 (IN>>1) functions
- 50-2 (I>>2) - Instantaneous Control enables the 50P-2 (3I>>2) and 50N-2 (IN>>2) functions
- 50-3 (I>>3) - Instantaneous Control enables the 50P-3 (3I>>3) and 50N-3 (IN>>3) functions
- ALT1 enables Alternate 1 Settings table
- ALT2 enables Alternate 2 Settings table
- ZSC enables Zone Sequence Coordination scheme
- SCC monitors Spring Charging contact when breaker is opened
- 79S (O->I1) - Initiates a single-shot reclosure when breaker is opened by another device
- 79M (O->I) - Initiates multishot reclosing when breaker is opened by another device
- OPEN - Initiates Trip Output contact

Programmable Binary (Contact) Inputs (Continued)

- CLOSE - Initiates Close Output contact
- ECI1 - Initiates storage of data in fault summary and fault record
- ECI2 - Initiates storage of data in fault summary and fault record
- WCI - Initiates oscillographic data storage in the waveform capture record
- 46 (Insc>) - Negative Sequence Control enables the 46 (Insc>) function
- CRI - Resets Recloser Counters 1 and 2 and the Overcurrent Trip Counter to zero
- TARC - Initiate Trip and Auto Reclose
- ARCI - Timed Reclose Block
- 52A (XO) - Breaker Contact
- 52B (XI) - Breaker Contact
- 43A (AR) - Recloser Disable

WinECP Input Mapping Logic Screen—*Each input contact can be logically AND or OR to any function. Any input contact can be enabled when closed or when open.*

Miscellaneous Commands

WinECP also lets you:

- Reset targets and alarms.
- Reset minimum and maximum demand values.
- Reset Seal In alarms.
- Set or reset alarms for user-programmable logic functions.
- Set communciation configuration.
- Set security mask.
- Define user display messages.

Built-In Testing

The DPU1500R provides continuous self-testing of its power supply voltages, memory elements, digital signal processor, and program execution. In the event of a system failure, the protective functions are disabled and the self-check alarm contacts are actuated. Self-Test Failures are recorded in the Operations Record.

Diagnostics

- Continuous self-checking of power supply voltages, memory elements, and digital signal processor
- Trip failure detection adjustable from 5 to 60 cycles

DPU1500R Settings Tables Diagnostics

Three copies of each settings table are stored in nonvolatile memory, preventing data loss during control power cycling. A background diagnostics task continuously runs a checksum on each copy of the settings tables.

Functional Test Mode (Password Protected)

The Functional Test Mode allows testing of programmed overcurrent functions and reclose sequences (upon removal of test current) without simulating operation of the 52a (XO) and 52b (XI) contact inputs. The DPU1500R stays in the Functional Test Mode for fifteen minutes or until the Test Mode is exited. The test sequences, including overcurrent trips, are written only into the Operations Record, leaving the other records free from any test data.

Ratings And Tolerances

Current Input Circuits

- 5-A input rating, 16 A continuous and 450 A for 1 second
- 1-A input rating, 3 A continuous and 100 A for 1 second
- Input burden at 0.245 VA at 5 A (1 - 12A range)
- Input burden at 0.014 VA at 1 A (0.2 - 2.4A range)
- Frequency 50 or 60 Hz

Voltage Input Circuit

Voltage ratings based on the VT connection setting.

BURDEN

- 0.04 VA for V(A-N) at 120 Vac

VOLTAGE

- **Wye** Connection: 160V continuous and 480V for 10 seconds
- **Delta** Connection: 260V continuous and 480V for 10 seconds

Contact Input Circuits (Input Burden)

- 2.10 VA at 220 Vdc and 250 Vdc
- 0.52 VA at 125 Vdc and 110 Vdc
- 0.08 VA at 48 Vdc
- 0.02 VA at 24 Vdc

Control Power Requirements

- 48 Vdc model, range = 38 to 58 Vdc
- 110/125/220/250 Vdc models, range = 70 to 280 Vdc
- 24 Vdc model, range = 19 to 29 Vdc

Operating Temperature

- –40º to +70º C

Humidity

- Per ANSI 37.90, up to 95% without condensation

Output Contacts Ratings

125 Vdc

- 30 A tripping
- 5 A continuous
- 0.25 A break inductive

220 Vdc

- 30 A tripping
- 5 A continuous
- 0.1 A break inductive

Transient Immunity

- Surge withstand capability
  - SWC and fast transient tests per ANSI C37.90.1 and IEC 255-22-1 class III and 255-22-4 class IV for all connections except comm or AUX ports
  - Isolated comm ports and AUX ports per ANSI 37.90.1 using oscillatory SWC Test Wave only, and per IEC 255-22-1 class III and 255-22-4 class III
  - EMI test per ANSI C37.90.2

Dielectric

- 3150 Vdc for 1 second, all circuits to ground except comm ports
- 2333 Vdc for 1 second, for isolated communication ports

Weight

- Unboxed 5.36 kg (11.80lbs)
- Boxed 5.67 kg (12.51 lbs)

Uninterruptible Power Supply (UPS) Battery Backup Unit

The UPS may be used as an alternate source to provide dependable backup power only to the DPU-1500R in the event that the primary AC power source is lost. Ordering information and functional characteristics for the UPS are listed below.

Parameter	Information
Battery Type	Nickel cadmium (NiCd), high-temperature cells
Size	Twenty “D” cells, 1.2 V per cell
Capacity	4.3 amp-hours
Temperature Ranges Storage Discharge Charge	 –40º C to 70º C –20º C to 70º C 0º C to 70º C

Ordering Information: *SELECT 24 Vdc rated*

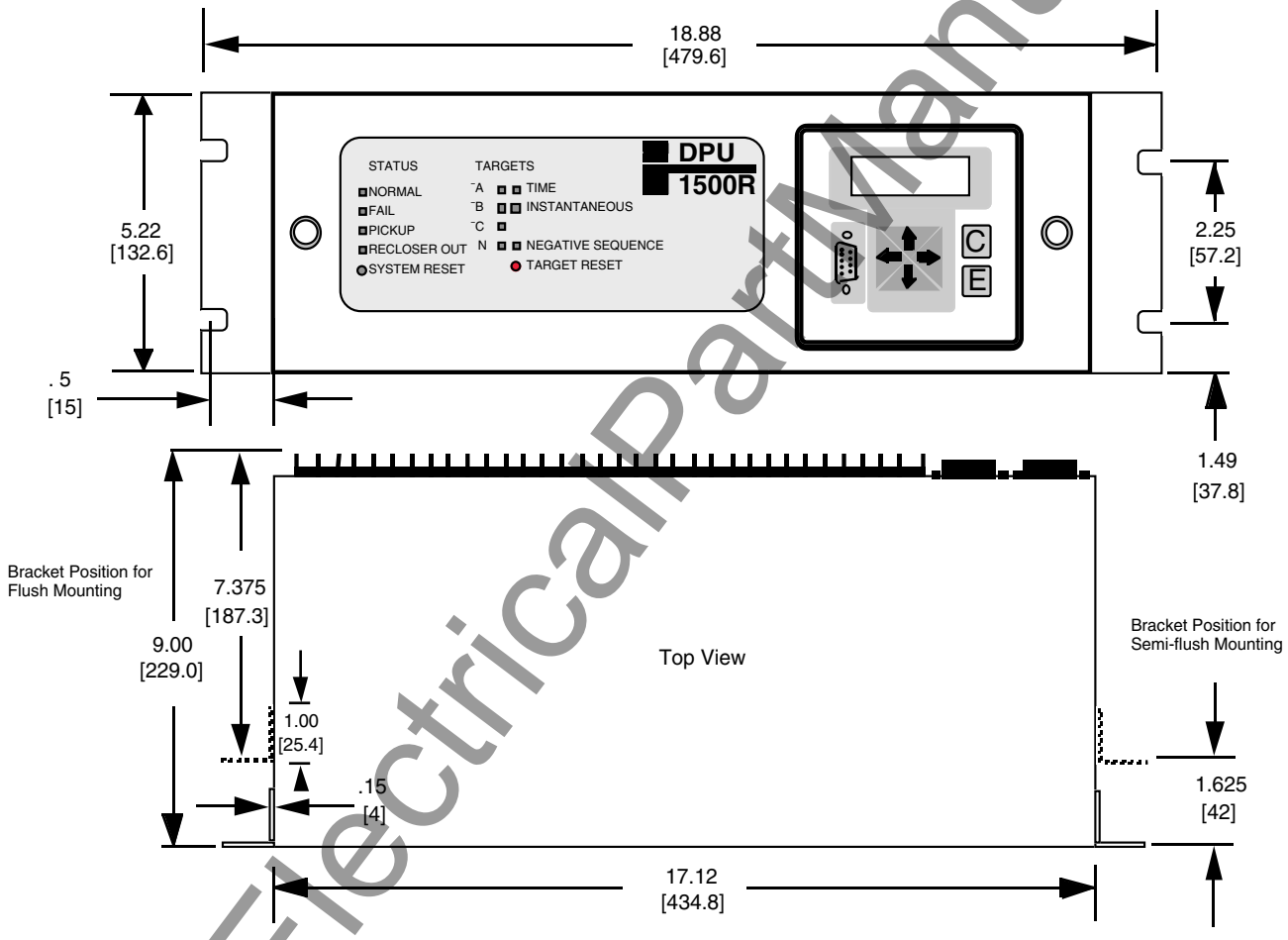
DPU1500R for use with this device

(For more information including mounting dimensions see I.B. 7.11.1.7-11)

Catalog Number	Description
270B0024	UPS charger, NiCd battery pack (20 “D” cells) and the battery support tray
270B0024-LB	UPS charger and the battery support tray
270B0024-LT	UPS charger and the NiCd battery pack (20 “D” cells)
612024-T2	Only the NiCd battery pack (20 “D” cells)

Case Dimensions (Standard 19” Rack Mount 3 Units High)

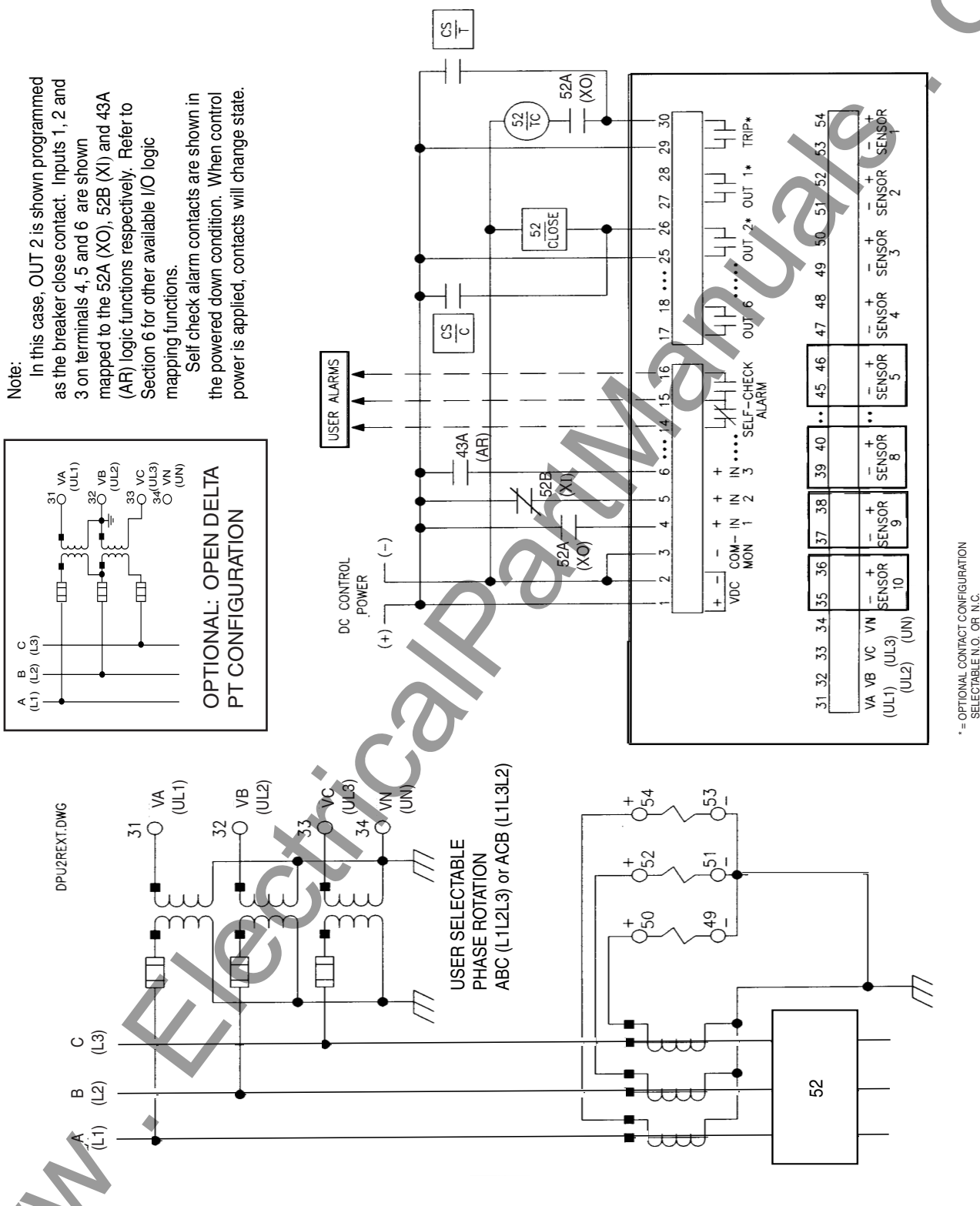
Dimensions are in: inches
[millimeters]



Relay External Connections

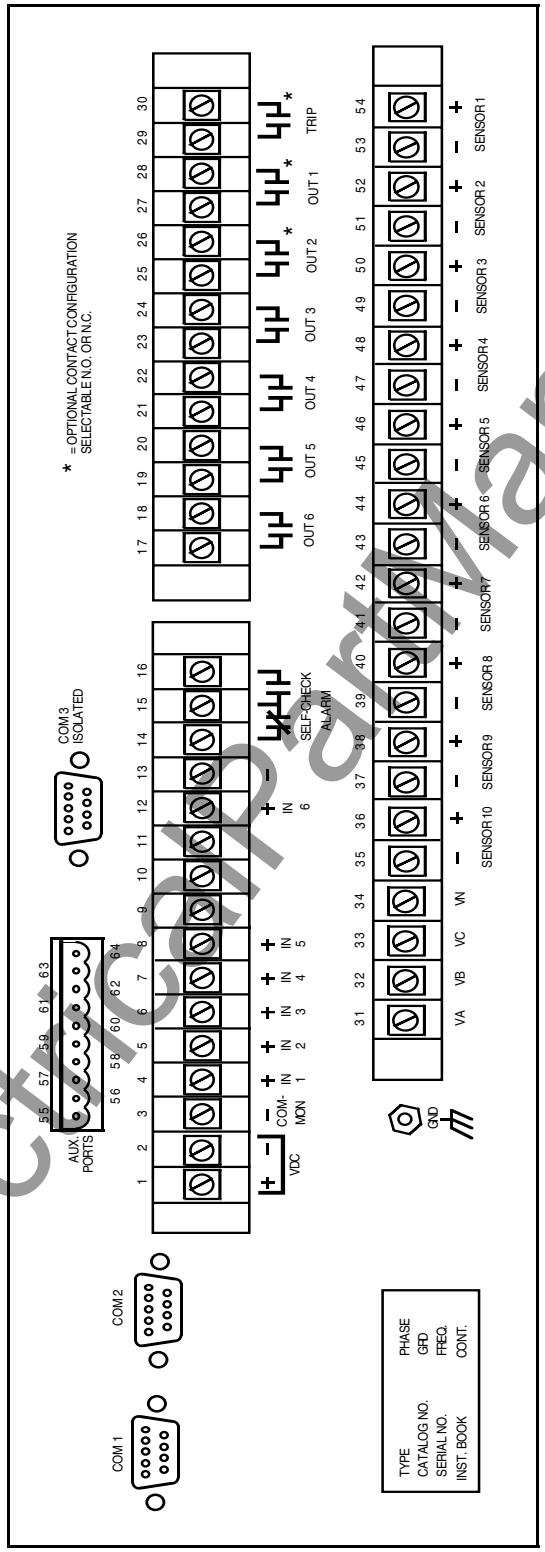
Note:
In this case, OUT 2 is shown programmed as the breaker close contact. Inputs 1, 2 and 3 on terminals 4, 5 and 6 are shown mapped to the 52A (XO), 52B (XI) and 43A (AR) logic functions respectively. Refer to Section 6 for other available I/O logic mapping functions.

Self check alarm contacts are shown in the powered down condition. When control power is applied, contacts will change state.



Typical Minimum External Connections

Rear Terminal Connection



Rear Terminal Blocks and Communications Ports

Ordering Instructions

The DPU1500R has a structured catalog number ordering system. The unit's catalog number is built up from 13 customer-selectable characters. Each character identifies features or functions that can be incorporated into the relay.

Sample Catalog Number

577 R 0 4 1 2 - 6 1 1 1 4

- Configuration
- Current Range
- Control Voltage
- MMI Display and Mounting Orientation
- Rear Communications Port Configuration
- Frequency
- Software Options
- Communications Protocol

How To Order

Using the Ordering Selection sheet, select those special features or options that are required to adapt the DPU1500R to your specific application. Create the catalog number, as shown above, by selecting the associated number or letter that refers to the desired feature or option from each category.

Communication Port Configurations

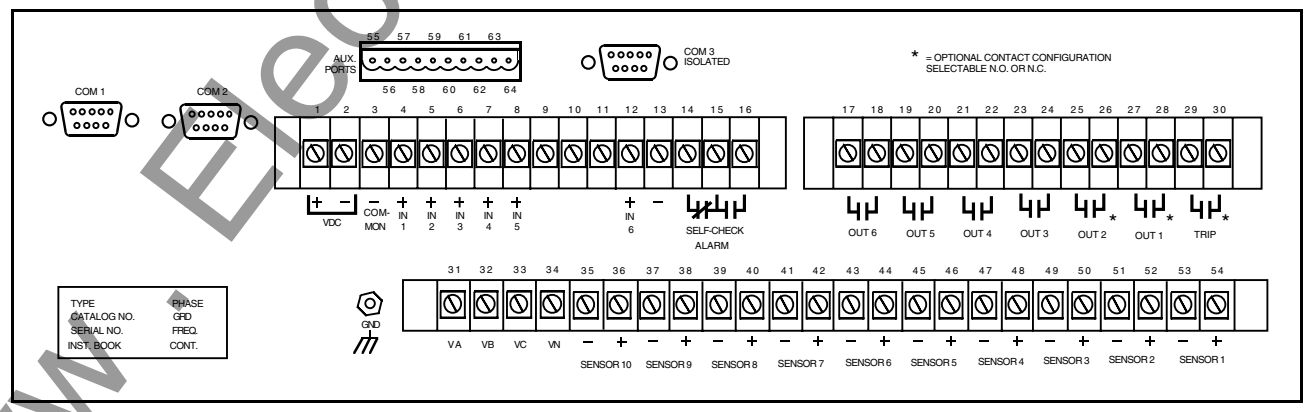
The DPU1500R platform provides several variations of communication ports, such as a 9-pin RS-232, RS-485, and INCOM™. Also available is a list of factory supported common communication protocols for networking the unit.

RS-232 ports are available in two different configurations, Isolated and Non-Isolated. Isolated ports provide isolation between the communication port and the rest of the relay.

COM 1 port is configured as a non-isolated port only. Units having an MMI display use the RS-232 port on the front panel as COM 1, thereby permanently disabling the RS-232 port marked COM 1 on the rear of the unit. Units not having an MMI Display permit the user to select, via jumper setting, either the front or rear (labeled COM 1) RS-232 connectors to act as COM 1.

COM 2 port is a non-isolated configuration and COM 3 port is an isolated configuration. Refer to the list of options to select the most suitable configuration.

The DPU1500R series also features ABB's innovative RS-485 isolated communications capability available when the optional Auxiliary Communication board is installed. This isolated RS-485 configuration provides superior communication quality, recommended for applications in areas of high electrical noise or that require connecting cables longer than 10 feet (3m).



Rear Terminal Blocks and Communication Ports

NOTE: Non-isolated RS-232 ports are susceptible to electrical noise. For that reason it is recommended that connecting cables be no longer than 10 feet (3m) when connecting to a non-isolated port. Devices connected to non-isolated ports must have the same ground return as the 1500R unit.

Refer to the Select Communication Options Table when making option selections.

In addition to the standard front or rear non-isolated RS-232 port (COM 1), the following rear communication port options are available:

Option 0

This option provides RS-232 communication via the non-isolated COM 2 port. Option 0 is suitable only in applications where communication to the unit is local through a direct connection to a PC, or through an isolating communication device. Such a device is an RS-232 to fiber optic converter, which is connected to the DPU1500R by a short cable.

Options 1 through 5 are provided on an independent communication card installed in the unit.

Option 1

This option provides RS-232 communication via the isolated COM 3 port. Option 1 ensures transient immunity and isolation, and should be used where communication cable lengths are greater than 10 feet (3m) or a common ground is not guaranteed. In general, RS-232 communication is limited to a maximum distance of 50 feet (15m). Aux Com and COM 2 ports are disabled in this configuration.

Option 2

This option provides RS-232 communication through the isolated COM 3 port and RS-485 communication via the isolated Aux Com ports. The auxiliary port is an isolated RS-485 configuration that supports several communication protocols (*See Communication Protocol Category On Ordering Sheet*).

Option 3

This option provides INCOM™ availability via the Aux Com port for applications where either the Westinghouse INCOM™, or ABB WRELCOM™, network is used.

Option 4

This option provides RS-485 communication and INCOM™ availability, via the isolated Aux Com port. In this configuration, the INCOM™ port provides the same functionality as option 3.

Option 5

This option provides RS-485 communication via the isolated Aux Com port, and is highly recommended for applications requiring communication over distances of up to 300 feet (100m). This option has an advantage over RS-232 by allowing networking of multiple relays via a simple 3 wire connection.

An RS-485 to RS-232 converter (Catalog Number 245X2000) is available to connect the network to an external device such as a modem or a personal computer.

Communication Protocols

The Select Options Table shows the communication protocols and the respective hardware port assignments that are currently available.

The "Standard" Protocol

The "Standard" protocol referenced throughout this publication refers to the ABB DPU1500R 10 byte ASCII oriented communication protocol. This protocol is standard for COM 1 and is selectable for other rear ports as per the Select Options Table. Windows External Communication Program (WinECP) provided, at no charge, with the relay and uses the standard protocol.

Product specific protocol documents are available from the factory upon request.

Special Software Options

The special software options available on the DPU1500R include Load Profile, User-Defined Curves, and Oscillographic Data. Any combination of these options may be selected.

The table below illustrates all possible hardware configurations for the communication ports and the supported protocols. The Catalog Number Select Option columns list every communication option for which the relays can be configured.

The different protocol variations are outlined under the corresponding communication ports that support them. Select the row containing the protocol combination that best suits your communications requirements and use the corresponding catalog number options to fill in the brackets [ ] of the catalog number.

The auxiliary port labelled IRIG-B receives a demodulated IRIG-B signal for DPU1500R clock synchronization purposes.

For example, if your system requires DNP 3.0 (IEC870-5) protocol, the ordering catalog number would be 577R041[**2**]-6101[**1**] (4th row) or, 577R041[**4**]-6101[**1**](10th row) based on your choice for the second port provided.

REAR PORT ASSIGNMENTS

Catalog Number Select Option				COM 1 NON ISOLATED RS-232	COM 2 NON ISOLATED RS-232	COM 3 ISOLATED RS-232 unless noted	AUX. PORTS RS-485 ISOLATED	61-62 INCOM ISOLATED	63-64 IRIG-B
577R041[ ] - 6101[ ]		**With Display**	**Without Display***						
0	0		ABB Ten Byte	ABB Ten Byte					
1	0		ABB Ten Byte			ABB Ten Byte			
2	1		ABB Ten Byte			ABB Ten Byte	DNP 3.0		
						DNP 3.0	ABB Ten Byte		
2	4		ABB Ten Byte			Modbus®	ABB Ten Byte		IRIG-B
						ABB Ten Byte	Modbus® or ABB Ten Byte		
3	0		ABB Ten Byte					INCOM	IRIG-B
4	1		ABB Ten Byte				DNP 3.0	INCOM	
4	4		ABB Ten Byte				Modbus®	INCOM	IRIG-B
							ABB Ten Byte		
5	0		ABB Ten Byte				ABB Ten Byte		

Select Communication Options Table

An empty selection box indicates communication port is either not provided or is disabled.

* Main board jumper selectable front or rear.

Panel Mounting Kit

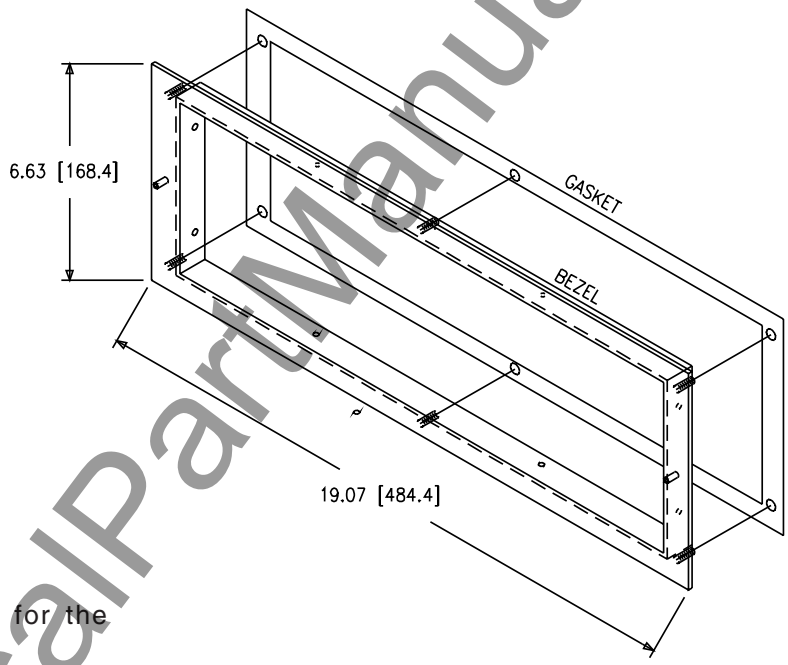
The complete kit will include a bezel, its associated hardware and gasket, as well as a lens cover with its associated hardware. This kit will provide a means for panel mounting and dustproofing.

Ordering Information:	
Horizontal Panel Mounting Kit	604513-K1
Vertical Panel Mounting Kit	604513-K2

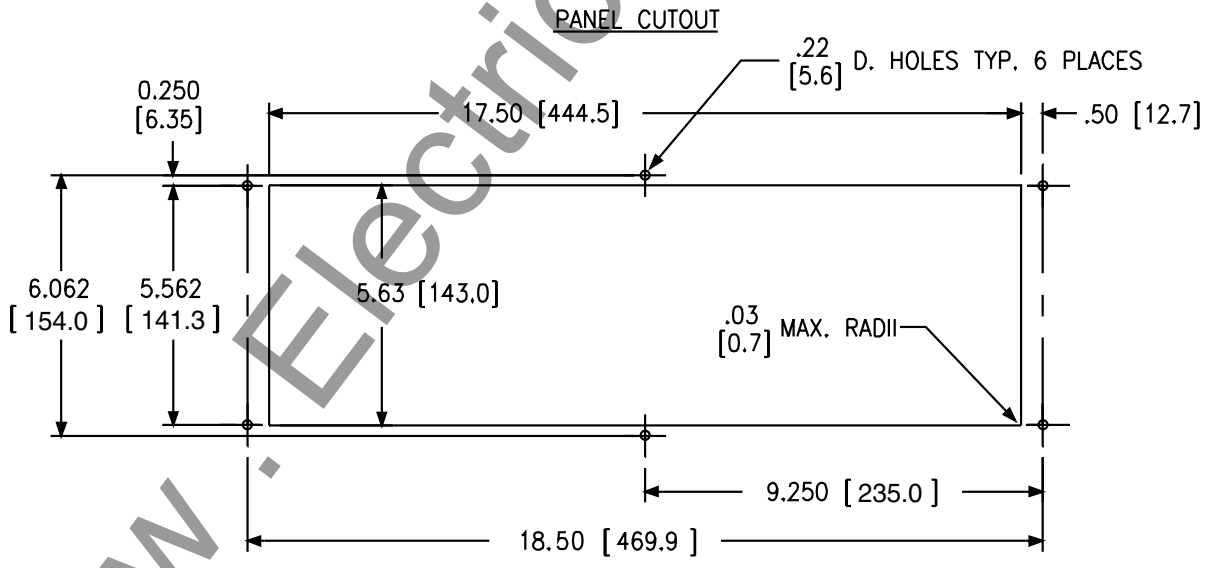
Spare Parts List:	
Bezel/gasket assembly only	604513-K3
Horizontal lens cover assembly	613724-K1
Vertical lens cover assembly	613724-K2

Horizontal Mounting

Note: The Bezel Assembly is available as an option for mounting the DPU1500R units in a panel application.



Note: Below is the panel drilling cutout for the DPU1500R unit and the bezel assembly.



NOTE: DIMENSIONS ARE INCHES [MILLIMETERS]

Ordering Selections

Catalog Number Selection → **5 7 7** **R 0 4 1 1 - 6 1 0 1 0**

User Selections

Configuration
- Standard . . . R
- Sensitive Earth (SE) Fault . . . E

Current Range

Phase	Ground	
Standard or Non Directional Sensitive Earth Fault		
1.0 - 12.0 A	1.0 - 12.0 A	0
1.0 - 12.0 A	0.2 - 2.4 A	1
0.2 - 2.4 A	0.2 - 2.4 A	2
Directional Sensitive Earth Fault		
1.0 - 12.0 A	1.0 - 12.0 A	4
1.0 - 12.0 A	0.2 - 2.4 A	5
0.2 - 2.4 A	0.2 - 2.4 A	6

Control Voltage
- 38 - 58 Vdc . . . 3
- 70 - 280 Vdc . . . 4
- 19 - 39 Vdc . . . 9

Man-Machine Interface
- Horizontal/No Man Machine Interface . . . 0
- Horizontal/Man Machine Interface . . . 1
- Vertical/No Man Machine Interface . . . 5
- Vertical/Man Machine Interface . . . 6

Rear Communications Port
(Front RS-232 port is standard equipment on all units)
- RS-232 (non-isolated) . . . 0
- RS-232 (isolated) . . . 1
- Auxiliary Port & RS-232 (isolated) . . . 2
- INCOM™ (isolated) . . . 3
- Auxiliary Port & INCOM™ (isolated) . . . 4
- RS-485 (isolated) . . . 5

Frequency
- 50 Hertz . . . 5
- 60 Hertz . . . 6

Software Options
- No Oscillographics . . . 0
- Oscillographics . . . 1

- No User Defined Curves (ANSI and IEC Curves Only) . . . 0
- User Defined Curves and ANSI and IEC Curves . . . 1

- No Load Profile . . . 0
- Load Profile . . . 1

Communications Protocol
- Standard (10-Byte protocol) . . . 0
- DNP 3.0 (IEC 870-5) . . . 1
- Modbus® . . . 4