ABB DPU2000R Version 5.0
Addendum to DPU2000R Descriptive Bulletin #41-219M

Product Description

DPU2000R Version 5.0 is a collection of enhancements for the existing DPU2000R relay. Please note Version 5.0 is not a new relay, but a performance and feature enhancement of the present DPU2000R relay system.

These new features are being made available by increasing the processing speed of the existing processor through a faster crystal; thereby keeping the circuitry intact. This enables us to "fit" more relay features into the DPU2000R.

Version 5.0 will is being released in three phases during 2001 and 2002:

Phase I includes the increased speed, three new protective relay functions, described below, and new firmware ("FPI") to make possible much faster flash downloads. This phase is complete and units are shipping.

Phase II includes a new optional Operator Control Interface (OCI). This phase is also complete, and units are scheduled for shipment in early October 2001.

Phase III includes optional Power Quality Monitoring (PQM) capability, DNP3.0 level 2 (with physical IRIG-B port), enhanced digital fault recording (oscillographics) and additional programmable I/O logic enhancements. This phase is scheduled for completion and shipment in 2002.

Summary of Features – Phase I (July 2001)

1) Four zones of non-pilot phase step distance (Device 21) available as a standard function.

This now enables one style of relay, the DPU2000R, to be used on both high side and low side of certain distribution substations. Benefits include standardization on a single subtransmission and feeder protection relay, reduced training, and simplified operation. The flexibility of its settings broadens the applications this new function can provide such as loss of field detection of distribution feeder motor loads.

Specifications and details:
Two forward zones and two reverse zones of impedance protection are available. Each zone has a MHO circle characteristic fixed at the origin of an R-X diagram. Every zone has its own independent set of settings and are defined as follows:

Each Forward Zone		
Select:	Disable / Enable	(Default: Disable)
Phase Reach:	0.1 – 50.0 ohms in 0.1 ohms steps	(Default: 0.5)
Characteristic angle:	10 – 90 degrees in 1 degree steps	(Default: 0.0)
Time Delay:	0.0 to 10 sec. in 0.1 seconds steps	(Default: 0.0)
I_1 Supervision:	1.0 to 6.0 amperes in steps of 0.1 amperes	(Default: 1.0)
21P supervises 51P function:	Disable	(Default: Enable)

Each Reverse Zone		
Select:	Disable / Enable	(Default: Disable)
Phase Reach:	-0.1 – (-50.0) ohms in -0.1 ohms steps	(Default: 0.5)
Characteristic angle:	190 – 270 degrees in 1 degree steps	(Default: 0.0)
Time Delay:	0.0 to 10 sec. in 0.1 seconds steps	(Default: 0.0)
I_1 Supervision:	1.0 to 6.0 amperes in steps of 0.1 amperes	(Default: 1.0)
21P supervises 51P function:	Disable	(Default: Enable)

For the 1 ampere (A) CT DPU relay model or 0.2 to 2.4 A range model, the reaches for all zones are 5 times that of the 5.0 ampere CT model; namely 0.5 – 250.0 ohms in 0.5 ohm steps for the forward reach and -0.5 – (-250.0) ohms. All other settings remain as for the 5 A CT model.

The ability to have any of the zones supervise the phase time overcurrent function is available through a single setting eliminating the need to program feedback logical I/O. When enabled, the 51P function will be blocked from operating whenever the system conditions lie within any defined zone and will not free to operate or "unblocked" whenever conditions exist outside the defined zone.

Each zone provides two logical outputs - a present state output and sealed-in output, the latter defined by an asterisk suffix. They are defined as follows:

Logical Outputs
21P-1(Zone-1), 21P-1*(Zone-1*)
21P-2(Zone-2), 21P-2*(Zone-2*)
21P-3(Zone-3), 21P-3*(Zone-3*)
21P-4(Zone-41), 21P-4*(Zone-4*)

The name defined in parentheses ( ) represents its IEC nomenclature.

History & Records

Targets:	LCD will display “Zone 1 Trip” for 21P-1 trip, “Zone 2 Trip” for 21P-2 trip, Zone 3 Trip” for 21P-3 trip, and “Zone 4 Trip” for 21-P-4 trip. Display resets when faulted data is reset.
Fault Record:	Logged when a 21P zone trips. Fault element types are either “21P-1”, “21P-2”, 21P-3”, “21P-4”. Include fault impedance in fault record. Fault impedance grayed out for all other non-21P fault records.
Fault Summary:	Logged when a 21P zone trips. Fault element type is either “21P-1”, “21P-2”,”21p-3’, or “21P-4” when a 21P zone trips. Includes same information as in other fault summaries.
Operational Record:	21P-1 Zone 1 PUA (Logged when zone element starts timer.) 21P-2 Zone 2 PUA (Logged when zone element starts timer.) 21P-3 Zone 3 PUA (Logged when zone element starts timer.) 21P-4 Zone 4 PUA (Logged when zone element starts timer.) 21P-1 Zone 1 Trip 21P-2 Zone 2 Trip 21P-3 Zone 3 Trip 21P-4 Zone 4 Trip

(2) Negative sequence voltage protection (Device 47), available as a standard DPU2000R function.

Increased sensitivity in the detection of three-phase system imbalances is made possible through this function. Benefits include the detection of a blown fuse on the high-side of a power distribution transformer that left undetected can extend the increased heating effects leading to reduced life and possibly failure of the transformer.

Specifications and details:
The negative sequence voltage unit (device 47) will have outputs for alarm indication or sealed-in outputs. Its settings are defined as follows:

Select:	Disable / Enable	(Default: Disable)
Pickup:	5.0 to 25.0 V_2 in steps of 0.5 volts	(Default: 10)
Time Delay:	0.0 to 60.0 sec. in steps of 0.1 seconds	(Default: 0.0)

The function includes two logical outputs - a present state output and sealed-in output, the latter defined by an asterisk suffix. They are defined as follows:

Logical Outputs

47(V2>):	Phase voltage sequence overvoltage alarm
47*(V2>*):	Phase voltage sequence overvoltage sealed-in alarm

The name defined in parentheses ( ) represents its IEC nomenclature.

History & Records

Targets:	Lights when 47 element trips and resets when Target Reset is issued.
Fault Record:	None
Fault Summary:	None
Operational Record:	47(V2>) – Neg. Phase Sequence Detection
Operations Summary:	None

(3) Three-phase overvoltage protection (Device 59-3), available as a standard DPU2000R function.

This function adds to the logical status of the existing overvoltage function available in today's DPU2000R relay systems as a dedicated logical output *59-3* that asserts whenever all three phase voltages measure above the pick-up setting for the defined time delay. Presently, the overvoltage logic comprises of the logical single logic output *59-1* that asserts whenever any one of the three phase voltages measures above the pick-up setting for the defined time delay.

Specifications and details:
The pick-up setting for the 59-3 device will be the same as 59 function presently available in the DPU2000R relay; namely 70 – 250 volts in 1.0 volt steps. However for an output to occur, all three (3) phases must be at or above the setting of the function.

Logic Outputs
59-3(3U>): Three-phase Overvoltage Alarm
59-3*(3U>*): Three-phase Overvoltage Sealed-in Alarm

History & Records
Fault Record: None
Fault Summary: None
Operational Record: 59-3(3U>) Alarm
59-3*(3U>*) Alarm
Operations Summary: None

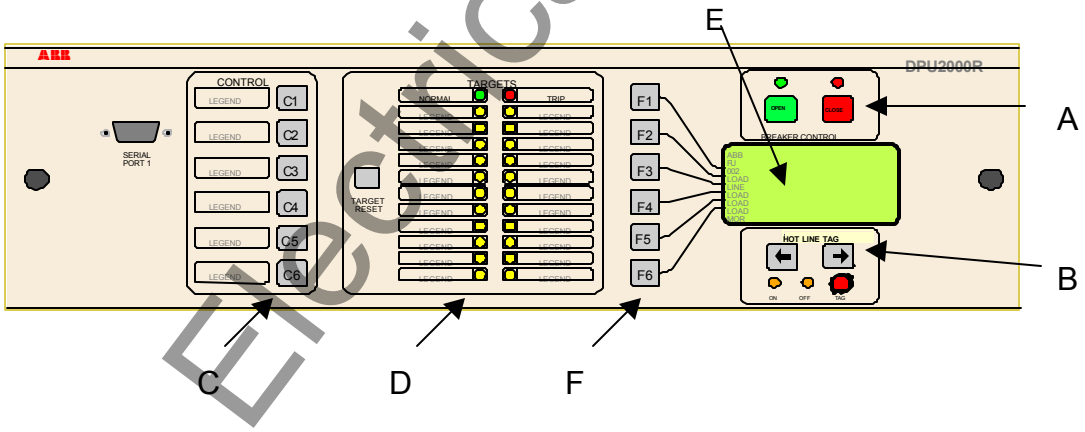
(4) New Firmware Update Management Shortens Flash Time

On Version 5.0 units, flash updates have been shortened significantly to a range of 90 – 120 seconds from the front RS232 port.

Summary of Features – Phase II (Q3 2001)

1) New Operator Control Interface – OCI

A new optional Operator Control Interface(OCI), named the "Enhanced OCI", is available in two versions. The only difference between the two versions is that one version includes a physical "Hot Line Tag" switch and the other version does not include this switch. Both versions are available in horizontal or vertical mounting. The existing "Man Machine Interface" is renamed the "Basic OCI" and remains available.



A. Pushbutton controls for the breaker
B. Optional "Hot Line Tag" pushbutton control switch
C. Six Control Push Buttons to select / de-select relay functions.
D. Expanded Target Information
E. New larger Liquid Crystal Display (LCD) of 8 rows and 21 columns.
F. Six Menu Push Buttons serve as hot keys for single-button navigation

Definition of Hot-Line-Tag Switch:

Hot-Line-Tag is available as an option on the DPU2000R enhanced OCI panel. Many industrial and utility organizations mount a separate "31TR" switch on the panel to remove a breaker from service and physically place a tag on the switch, hence the term "tagging". The inclusion of these switching and tagging functions in the DPU2000R emulates the 31TR mechanical switch. The Hot Line Tag switch is moved through its "ON", "OFF" and "TAG" functions by depressing the arrow key buttons, just as the separate 31TR mechanical switch is moved through its positions by the switch handle. This Hot Line Tag feature includes LEDs that indicate the status of the function. The three positions of the switch are described below:

"ON", which indicates that all breaker closing operations are permitted, including: automating single or multi-shot reclosing, SCADA commanded closing (over network or hard-wired to inputs) or manually initiated closing (using buttons on the front of the relay).

"OFF", which indicates that all automatic reclosing is blocked, but manually-initiated closing using controls on the front of the relay is permitted. SCADA commanded closing may or may not be permitted depending on user preference and configuration.

"TAG", which indicates that all closing operations are blocked: automatic, manual or SCADA. This TAG state is accomplished by the relay logic disabling the logical output "CLOSE".

CONTROL Pushbuttons

Shipped from the factory with the following defaults (provided as a Mylar insert in a sleeve, to the left of the actual button):

C1 BLOCK
RECLOSE

C2 BLOCK
GROUND

C3 BLOCK
INST

C4 BLOCK
REMOTE

C5 ENABLE
ALT 1

C6 ENABLE
ALT 2

For OCI version with Hot Line Tag feature, C1 will initiate the display of a user-defined message on the LCD panel. This is because the "BLOCK RECLOSE" function is provided as part of the "Hot Line Tag" functionality.

A new, customized Mylar insert can be created easily by customers using the ABB-provided Word .doc template. This template will be shipped with all enhanced OCI relays. Steps to follow:

1) Type in the desired name using the same type style as used in the default
2) Print on a standard overhead transparency (or print on paper and then create a standard transparency)
3) Cut on the solid lines
4) Slide into the front panel slots.
5) If necessary, re-map to any DPU2000R logical input using WinECP. Details available in the DPU2000R Instruction Book.

Mode of operation: Press and release toggles the present state, e.g., if previously "De-selected", factory default condition, then pressing and selecting Cx will toggle state to "Selected".

LED TARGETS

Shipped from the factory with the following defaults (provided as a Mylar insert in a sleeve, to the left and right of the actual target light):

Pickup	Phase A
C1 Selected	Phase B
C2 Selected	Phase C
C3 Selected	Neutral
C4 Selected	Time
C5 Selected	INST.
C6 Selected	NEG. SEQ.
Recloser Out	Frequency
Ground Out	Direction
INST. Out	Voltage
Blown Fuse	Distance
(LEDs 2-12)	(LEDs 14-24)

The “C1 Selected” through “C6 Selected” LEDs are provided to let operators know that control button “selections” or “de-selections” have been recognized by the relay.

A new, customized Mylar insert can be created easily by customers using the ABB-provided Word .doc template. This template will be shipped with all enhanced OCI relays. Steps to follow:

1) Type in the desired name using the same type style as used in the default
2) Print on a standard overhead transparency (or print on paper and then create a standard transparency)
3) Cut on the solid lines
4) Slide into the front panel slots.
5) If necessary, re-map to any DPU2000R logical inputs and outputs to match your new design. Details available in the DPU2000R Instruction Book.

All LEDs can be programmed to four sets of inputs and outputs using the latest version of WinECP.

Inputs: Physical and Logical
Mode of Operation: When input is enabled, the target is lit. When input is disabled, the LED is off.
Outputs: Physical and Logical
Mode of Operation: When output is energized(or asserted), the target is lit. When output is de-energized (or de-asserted), the LED is off.

Summary of Features - Phase III (2002)

1) New Monitoring Functions

Power Quality Monitoring (PQM), according the IEEE standard 1159, will be available in two new DPU2000R models, the "P" model (standard model with PQM) and "F" Model (Sensitive Earth Fault model with PQM).

PQM will not be available on the Synchrocheck model due to processor restrictions.

These monitoring functions detect sags, swells, harmonics and momentary interruptions, enabling utilities and industrial users to detect and fix sources of power system problems.

Retrieval of the data initially will be through the Modbus communication interface option (Modbus used most often by industrial customers who have expressed the greatest interest in PQM). Retrieval via other communication protocols will be available in the future.

Enhanced Trip-coil Monitoring circuit will be incorporated in the DPU2000R to verify the continuity of a trip or close coil. The connections for this monitoring capability will be similar to that of Trip Circuit Monitoring, with the exception of connecting the wire to a point between the coil and 52A contact in the trip circuit. Benefits include coil monitoring whether the breaker is open or closed. The present Trip Circuit Monitoring feature prevents a reclose on a failed trip circuit, but can not prevent a close if the coil fails after the breaker opens. This feature can be used to monitor the coil regardless of the breaker position enabling the prevention of a breaker failure whether it is about to be closed or opened.

Enhanced Oscillography Capture takes the digital fault recording capabilities of the GPU2000R with WaveWin support in place of Oscillographics Analysis Tool (OAT). Greater flexibility is provided, and more storage will be provided.

2) New Communication and Automation Functions

The DNP3.0 communication option module on the DPU2000R will be **upgraded to DNP3.0 Level 2** and will include a physical, **built-in IRIG B port.** Benefits include improved response times when connected to SCADA RTUs, and identification of time-coordinated equipment problems.

Greater DPU2000R flexibility and reduced cost in protection, control and automation schemes will be provided with the **addition of user logical inputs and logical outputs, bringing the total to 16in / 16 out.** Complex schemes will be now handled with less programming expense and fewer auxiliary devices. New **pickup and dropout timers** for the physical and feedback outputs will answer trip duration timer concerns when operating multiple breakers and eliminating the need to use outputs or external timing relays to gain additional pickup or output timers.

DPU2000R Catalog Selection Sheet for Version 5.0 Phase II

Updated September 2001

			Cat # 587 (ANSI)	R	0	4	1	1	-	6	1	0	1	0
			687 (IEC)	R	0	4	1	1		6	1	0	1	0
Configuration	Standard		R	R	.	.	.	.		.	.	.	.	.
	Standard with Power Quality Monitoring		P	.	.	.	.	.		.	.	.	.	.
	Standard with Earth Fault Protection		E	.	.	.	.	.		.	.	.	.	.
	Earth Fault Protection and Power Quality Monitoring		F	.	.	.	.	.		.	.	.	.	.
	Standard with Synchronism Check		C	.	.	.	.	.		.	.	.	.	.
Current Range	**Phase**	**Ground**												
	Standard or Non-Directional Sensitive Earth Fault													
	1.0-12A	1.0-12A	0		0	.	.	.		.	.	.	.	.
	1.0-12A	0.2-2.4A	1		.	.	.	.		.	.	.	.	.
	0.2-2.4A	0.2-2.4A	2		.	.	.	.		.	.	.	.	.
	Directional Sensitive Earth Fault													
	1.0-12A	1.0-12A	4		.	.	.	.		.	.	.	.	.
	1.0-12A	0.2-2.4A	5		.	.	.	.		.	.	.	.	.
	0.2-2.4A	0.2-2.4A	6		.	.	.	.		.	.	.	.	.
Control Voltage	38-58 VDC		3			.	.	.		.	.	.	.	.
	70-280 VDC		4			4	.	.		.	.	.	.	.
	19-29 VDC		9			.	.	.		.	.	.	.	.
Operator Control Interface (OCI)	Standard OCI, horizontal mounting……		1				1	.		.	.	.	.	.
	Enhanced OCI, horizontal mounting……..		2				.	.		.	.	.	.	.
	Enhanced OCI, with dedicated "Hot-Line-Tag" Recloser Control for horizontal mounting……..		3				.	.		.	.	.	.	.
	Standard OCI, vertical mounting……		6				.	.		.	.	.	.	.
	Enhanced OCI, vertical mounting……..		7				.	.		.	.	.	.	.
	Enhanced OCI, with dedicated "Hot-Line-Tag Recloser Control for Vertical mounting……		8				.	.		.	.	.	.	.
Rear Communications Port	(Front RS-232 port is standard on all units)													
	RS-232 (isolated) only……		1					1		.	.	.	.	.
	RS485 Port (isolated) & RS-232 Port (isolated)……		2					.		.	.	.	.	.
	INCOM (isolated)……		3					.		.	.	.	.	.
	RS-485 Port (isolated) & INCOM (isolated)……..		4					.		.	.	.	.	.
	RS-485 (isolated) only……		5					.		.	.	.	.	.
	Modbus Plus & RS-232 (non-isolated)……..		6					.		.	.	.	.	.
	Modbus Plus & RS-485 (isolated)……..		7					.		.	.	.	.	.
	Two RS-485 Ports (isolated)……..		8					.		.	.	.	.	.
	Ethernet 10/100 meg twisted pair (RJ45) and 10 meg Fiber Optic (ST connector)……..		E					.		.	.	.	.	.
Frequency	50 Hertz		5							.	.	.	.	.
	60 Hertz		6							6	.	.	.	.
Software	No Oscillographics		0								.	.	.	.
	Oscillographics		1								1	.	.	.
	No User Programmable Curves		0									0	.	.
	User Programmable Curves		1									.	.	.
	Special Recloser Curves		2									.	.	.
	Special Recloser Curves and User Programmable Curves		3									.	.	.
	No Load Profile		0										.	
	Load Profile		1										1	
Communications Protocol	Standard	(ABB 10-Byte Protocol)	0											0
	DNP 3.0	(Com Port digits 2 or 8)	1											.
	Modbus	(Com Ports digits 2 or 8)	4											.
	Modbus Plus	(Com Ports digit 6 or 7)	4											.
	UCA	(Comm Port digit "E")	6											.

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Distribution Relay System

DPU™ 2000R

The Distribution Protection Unit 2000R (DPU2000R) is an advanced microprocessor-based distribution unit for protecting electrical distribution systems. The DPU2000R offers unique protective, monitoring, metering, and programmable control features for expanding the protective limits normally provided by multiple single-function devices. The accurate metering on the DPU2000R 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 DPU2000R 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), PRICOM™, WRELCOM™, Modbus®, Modbus Plus™ etc.), 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 powerdown
- 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 logic monitoring of the unit's functions
- Advanced 32-bit microprocessor technology plus Digital Signal Processor (DSP)
- Windows™ based configuration software included at no charge

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>)
- Phase and ground directional overcurrent protection - 67P, 67N (3I>->, IN>->)
- Two frequency shed and restore sequences with voltage block - 81S, 81R (f<, f>)
- Undervoltage and overvoltage control and alarm - 27/59 (U<, U>)
- Multishot reclosing; 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 records of single-phase voltages, watts, and VARs
- 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
- Oscillographic waveform capture and harmonic analysis data storage capability provides up to 64 cycles of per-phase recorded data
- Operations Summary including overcurrent trips, breaker operations, and reclosures
- Fault summary and records 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

Protective Functions

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>)
Directional overcurrent: 67P/N (3I>->, IN>->) - phase and ground
Frequency: 81S/81R/81O (f<, f>, f>fs) - two independent steps each for load shed, restoration, and overfrequency
Undervoltage: 27 (U<)
Overvoltage: 59 (U>)

Time Overcurrent Functions: 51 (I>)

- One phase setting and one ground setting
- Curve: Various time overcurrent and user-programmable characteristic curves (see Table 1)
- Pickup: 1 to 12 A in 0.1 steps or 0.2 to 2.4 A in 0.02 steps (based on catalog selection)
- Time dial selections: 1 to 10 (.05 to 1.0 IEC)
- 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 (587X)	**IEC (687X)**
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 #8	
User 1*	**Special Recloser Curves
User 2*	
User 3*	

*Only available with the user-programmable curve option.
**Only availabe with the software options 2 & 3.

Instantaneous Overcurrent Function: 50 (I>>)

- Three phase settings and three ground settings
- 50P-1 (3I>>1) and 50N-1 (IN>>1)
  - Curve: Various overcurrent and user-programmable characteristic curves (see Table 2)
  - Pickup: 0.5 to 20 x (51P (3I>) and 51N (IN>) pickup setting)
- Time dial selections: 1 to 10 (0.05 to 1.0 IEC)
- Time delay selections: 0 to 9.99 seconds (s) in 0.01 steps (for Definite Time curve selection only)
- 50P-2 (3I>>2) and 50N-2 (IN>>2) time delay: 0 to 9.99 s in 0.01-second steps 50P-3 (3I>>3) and 50N-3 (IN>>3) standard curve

Table 2. Instantaneous Overcurrent Curves

Curve Definition	
ANSI (587X)	**IEC (687X)**
Standard Instanteous	Standard Instanteous
Inverse Instanteous	Definite Time
Short Time Inverse	User 1*
Definite Time	User 2*
Short Time Extremely Inverse	User 3*
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 (O->I) 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 DPU2000R initiates an overcurrent trip, a programmable 79M (O->I) multishot input is initiated, or 79S (O->I) single shot 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 (O->I) 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

Negative Sequence: 46 (Insc>)

- Curve: Various time overcurrent and user-programmable characteristic curves (see Table 1)
- Pickup: 1 to 12 A in 0.1 steps or 0.2 to 2.4 A 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)

Directional Overcurrent: 67 - Phase and Ground (3I>->, IN>->)

- Curve: Various time overcurrent and user-programmable characteristic curves (see Table 1)
- Pickup: 1 to 12 A in 0.1 steps or 0.2 to 2.4 A 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)
- Positive sequence polarized phase unit, adjustable maximum torque angle: 0 to 355 (I, LEAD V)
- Negative sequence polarized ground unit, adjustable maximum torque angle: 0 to 355 (I, LEAD V)

Frequency: 81(f)

- Two independent steps for load shed, restoration, and overfrequency
- Load shed pickup: 81S-1 (f<1), 81S-2 (f<2)
  - 60-Hz application 56 to 64 Hz in steps of 0.01
  - 50-Hz application 46 to 54 Hz in steps of 0.01
- Shed time delay: 0.08 to 9.98 seconds in steps of 0.02s
- Load restoration: 81R-1 (f>1), 81R-2 (f>2)
  - 60-Hz application 56 to 64 Hz in steps of 0.01
  - 50-Hz application 46 to 54 Hz in steps of 0.01
- Restoration time delay 0 to 7200 seconds in steps of 1 s
- Overfrequency alarming (based on 81 R settings): 81O-1 (f>fs1), 81O-2 (f>fs2)
- Voltage block: 40 to 200 V in steps of 1 V

Undervoltage: 27 (U<)

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

Overvoltage: 59 (U>)

- Pickup: 70 to 250 V in steps of 1 V
- Time delay: 0 to 60 seconds in steps of 1 s

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

The 79 Cutout Time 79-CO (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, overcurrent functions are re-enabled based on the 79-1 (O->I1) 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.

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

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

- 10-200 V range with 1-V steps
- 4-240 second or minute range with 1-second or minute steps

Frequency Loadshed & Restoration Block: 81V (fU<)

The 81V setting blocks the 81S-1 (f<1) and 81S-2 (f<2) underfrequency functions if the voltage drops below the setting, which ranges from 40 to 200 VAC with 1-V steps.

Zone Sequence Coordination (ZSC) Function

The zone sequence coordination function coordinates the instantaneous functions in the reclosing sequence of the upstream device with the downstream reclosing devices. The DPU2000R increments (steps up to the next reclose number) through its reclose sequence after it senses that fault current has been interrupted by a downstream device.

Fault Locator

The DPU2000R 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 DPU2000R can control up to three single-pole reclosers. A second application for MDT mode allows a single DPU2000R relay on the bus to back up multiple feeder DPU2000Rs. The feeder DPU2000R SELF-CHECK ALARM output contact supervises the tripping logic from 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.)

Single-Shot Reclose: 79S (IO->I)

The programmable 79S (IO->I) input function initiates a single-shot reclose 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->I1) open interval time expires.

Multi-Shot Reclose: 79M (O->I)

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 indicated 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 you can download Oscillographic Data Storage files and Load Profile data (see “Optional Features”).

Man-Machine Interface (Optional)

The MMI is temperature conpensated, allowing clear viewing throughout the entire temparature range (-40° to +70° C) of the DPU2000R.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.

Metering Display

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

Main Menu

```
      MAIN MENU
Meter
Settings
Records
```

Display After a Fault Interruption

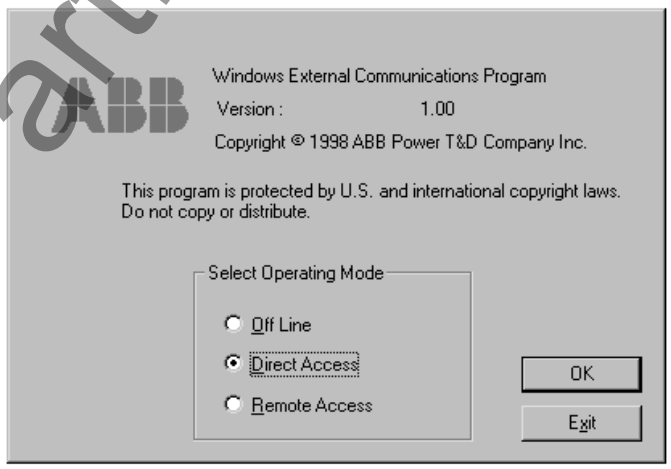
```
Distance - Km   10.1
Ia:  3320     Ib:  430
Ic:  420      In:  331 C
   Reset  Time  14
```

Windows External Communications Program (WinECP)

The Windows External Communications Program (WinECP) provides point-to-point communications with the DPU2000R relay. By using WinECP, you can program the settings for the DPU2000R’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 DPU2000R, 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 DPU2000R later. When the software is connected to a DPU2000R, you can view the records, save them to a file, or 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

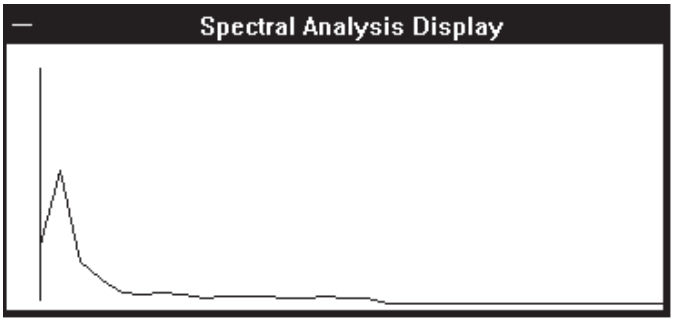
- Maximum and minimum (phase and ground) currents
  - Time and date stamp for maximum and minimum
- Maximum, and minimum kilowatts
  - Time and date stamp for maximum and minimum kilowatts
- Maximum, and minimum kiloVARs
  - Time and date stamp for maximum and minimum kiloVARs

Oscillographic Data Storage (Waveform Capture)

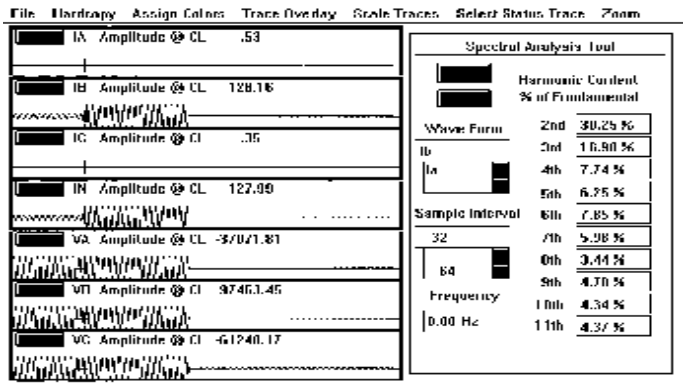
For purposes of fault analysis, the oscillographic data storage captures the waveform data for each of the four input currents and three input voltages. The storage capacity is 64 cycles of each waveform. Fault analysis is enhanced by the Oscillographic Analysis Program, which uses a Microsoft Windows™-based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

The DPU2000R 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 within the entire wave capture record.



Shows spectral analysis of inputs for power quality analysis.

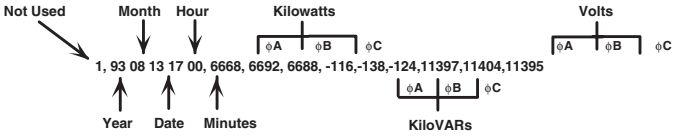


Shows complete waveform analysis of 3 voltages and 4 currents.

Optional Features

Load Profile

The Load Profile feature stores single-phase **voltage, demand watts, and demand VARs** for a 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
```

Records

Under the Records Menu are selections for the various fault and operations records and summaries kept by the DPU2000R.

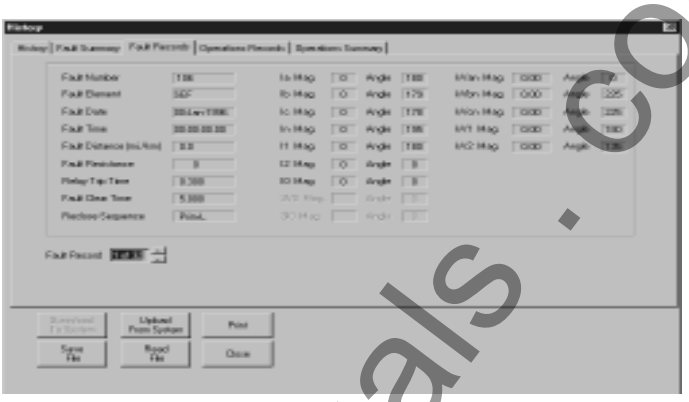
Fault Summary

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:

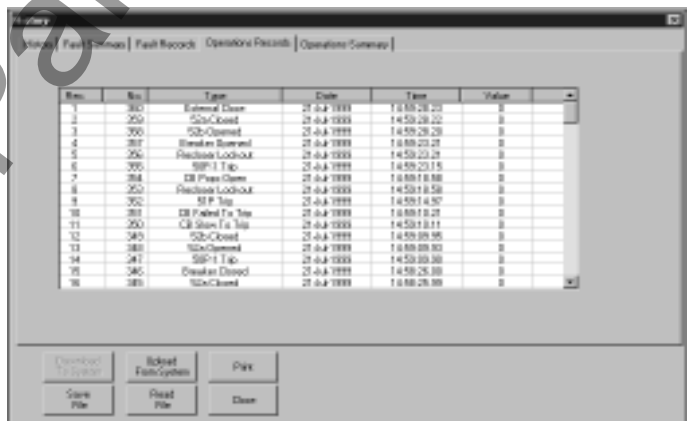
- Fault number
- Reclose sequence number and enabled settings table
- Date and time
- Tripping element
- Apparent distance to the fault
- Phase and neutral currents (magnitude, fault resistance, and angle)
- Positive, negative, and zero sequence currents
- Phase voltages
- Positive and negative sequence 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 DPU2000R 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 WinECP. Additional communication port configurations are available on the back panel of the DPU2000R, including:

- Isolated RS-232C (3-wire)
- Isolated RS-485 (3-wire)
- Isolated RS-485 Auxiliary Communication Port
- 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 DPU2000Rs 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 DPU2000Rs to a central communications center up to 1000 meters away.

The DPU2000R provides the following communications protocol options:

ABB Ten-byte-oriented protocol through the front RS-232 and rear RS-232/RS-485 ports. WinECP is provided with the relay and can be used to communicate with the DPU2000R via this protocol.

Modbus Plus™ - A token ring network capable of high speed communication (1MB per second)

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

DNP 3.0 (IEC 870-5) - A byte-oriented protocol based on IEC 870-5-T1 Standard Specifications

(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 DPU2000R. With CurveGen you can generate three time-overcurrent curves in addition to the standard curves provided in the DPU2000R. You can manipulate the curves in the time and current domains just like any other curve currently programmed into the DPU2000R.

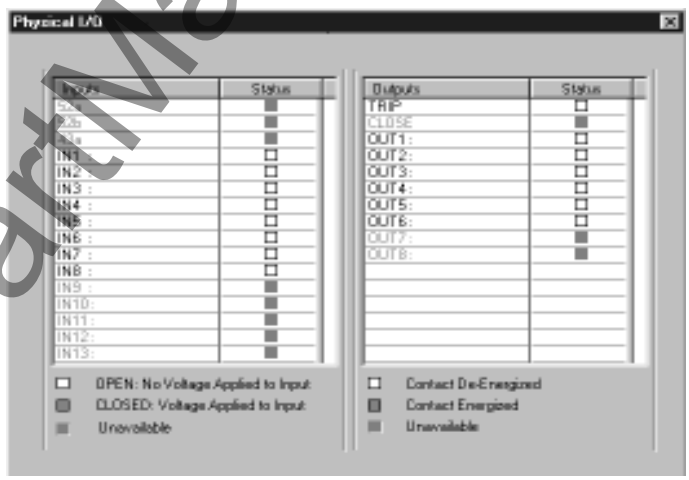
WinECP allows you to download a curve generated on CurveGen to the DPU2000R as a User 1, 2, or 3 curve. Upload an existing user-programmable curve from the DPU2000R to a computer for editing or graphing. Downloading pre-programmed curves that match common recloser curves is also possible.

Monitoring the DPU2000R

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.

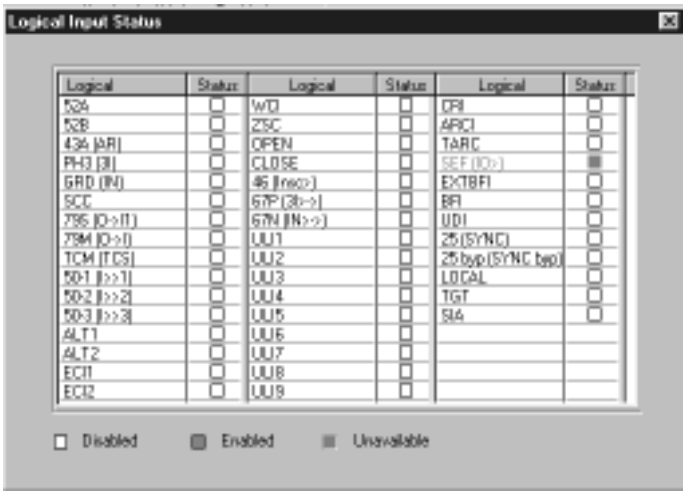
Physical Input/Output Status

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.



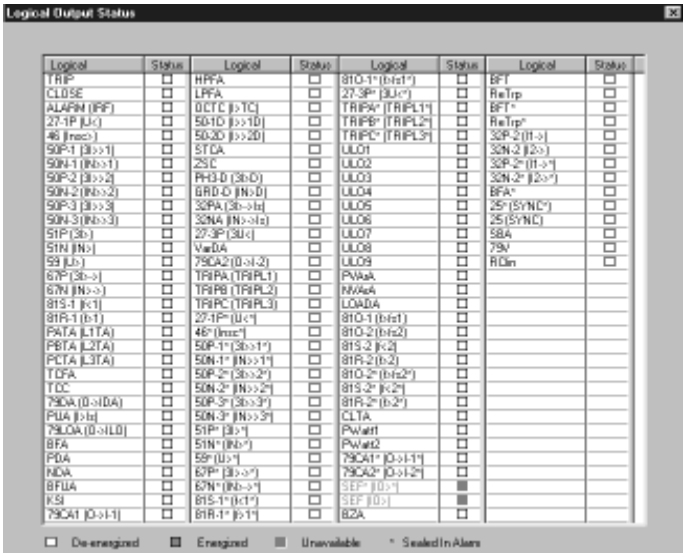
Logical Input Status

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



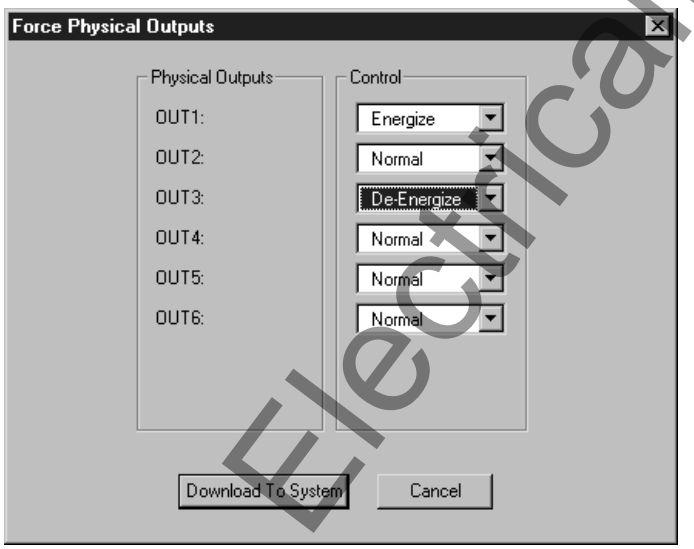
Logical Output Status

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 communicaions WinECP.



Programmable Logic Outputs

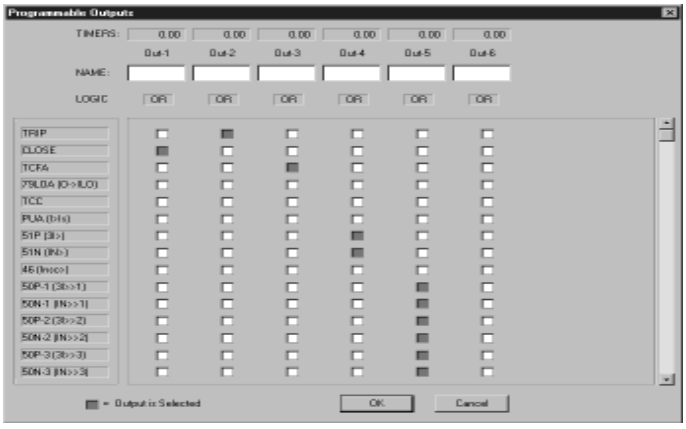
Up to six (6) user-programmable output contacts are available. Program these contacts by using the WinECP. Time delay on pickup can also be programmed to each contact output. The time delay interval is adjustable from 0 to 250 seconds in 0.01 steps. The user-programmable outputs can be configured to 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
- 67P (3I>->) - Phase Directional Time Overcurrent Trip Alarm
- 67N (IN>->) - Ground Directional Time 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
- 81S-1 (f<1) - 1st Frequency Load Shed Trip
- 81R-1 (f>1) - 1st Frequency Load Restoration Closure
- 81O-1 (f>fs1) - 1st Overfrequency Alarm
- 81S-2 (f<2) - 2nd Frequency Load Shed Alarm
- 81R-2 (f>2) - 2nd Frequency Load Restoration Closure
- 81O-2 (f>fs2) - 2nd Overfrequency Alarm
- 27-1P (U<1) - Single-Phase Undervoltage Alarm
- 27-3P (3U<) - Three-Phase Undervoltage Alarm
- 59 (U>) - Single-Phase Overvoltage Alarm

List continues next page

- 79DA (O->IDA) - 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 (I>>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 (I>>2) Instantaneous Function Disabled Alarm
- 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
- 32PA (3I->Is) - 67P (3I>->) Pickup Alarm
- 32NA (IN->Is) - 67N (IN>->) Pickup Alarm
- VARDA - Three-Phase KiloVAR Demand Alarm
- TRIP A (L1) - Phase A (L1) Trip
- TRIP B (L2) - Phase B (L2) Trip
- TRIP C (L3) - Phase C (L3) Trip
- 27-1P* (U<1*) - Single-Phase Undervoltage Seal In Alarm
- 27-3P* (3U<*) - 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
- 59* (U>*) - Single-Phase Overvoltage Seal In Alarm
- 67P* (3I>->*) - Phase Directional Time Overcurrent Seal In Alarm
- 67N* (IN>->*) - Ground Directional Time Overcurrent Seal In Alarm
- 81S-1* (f<1*) - 1st Frequency Load Shed Seal In Alarm
- 81R-1* (f>1*) - 1st Frequency Load Restoration Seal In Alarm
- 81O-1* (f>fs1*) - 1st Overfrequency Seal In Alarm
- 81S-2* (f<2*) - 2nd Frequency Load Shed Seal In Alarm
- 81R-2* (f>2*) - 2nd Frequency Load Restoration Seal In Alarm
- 81O-2* (f>fs2*) - 2nd Overfrequency Seal In Alarm
- TRIP A* (L1*) - Phase A (L1) Trip Seal In Alarm
- TRIP B* (L2*) - Phase B (L2) Trip Seal In Alarm
- TRIP C* (L3*) - Phase C (L3) Trip Seal In Alarm
- ULO1–ULO9 (User Logical Outputs 1 through 9) - Allow you to operate any of the nine user-programmable OUT contacts for a function other than those listed above. Each ULO is asserted by the corresponding User Logical Input or an INCOM/SCADA communications command. For example, ULO 8 is asserted by ULI 8; it cannot be asserted by any other User Logical Input.
- CLTA - Cold Load Timer Alarm
- PWATT1 - Positive Watt Alarm 1
- PWATT2 - Positive Watt Alarm 2
- 79CA1* (O->I-1*) - Recloser Operations Counter 1 Seal In Alarm
- 79CA2* (O->I-2*) - Recloser Operations Counter 2 Seal In Alarm

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

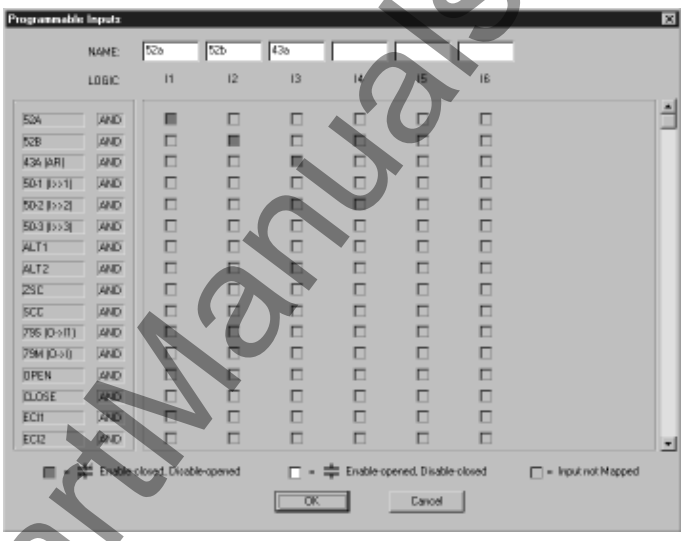


WinECP Output Mapping Logic Screen — *You can map each output contact logically AND or OR to any function.*

Programmable Logic Inputs

The DPU2000R 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 normal closed state. The user-programmable inputs can monitor, enable, initiate, or actuate the following input functions:

- TCM (TCS) - Trip Coil Monitoring monitors 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
- 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
- 67P (3I>->) - Phase Directional Control enables the 67P (3I>->) function
- 67N (IN>->) - Ground Directional Control enables the 67N (IN>->) function
- ULI1–ULI9 (User Logical Inputs 1 through 9) - Allows you to logically AND or OR contact inputs together. User Logical Inputs 1 through 9 are mapped to the corresponding User Logical Outputs 1 through 9 in the Programmable Output Settings. The User Logical Inputs allow you to define functions for the contact inputs that are not listed above.
- 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

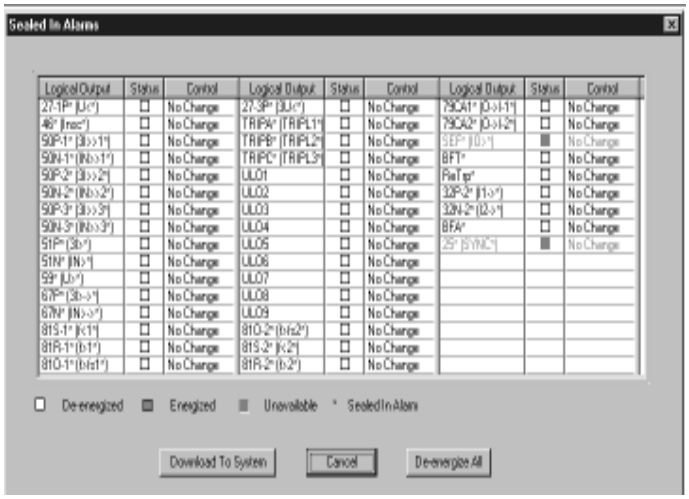


WinECP Input Mapping Logic Screen—*You can map each input contact logically AND or OR to any function. You can program an input contact to be enabled when closed or when open.*

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 communication configuration.
- Set security mask.
- Define user display messages.



WinECP Seal In/User Alarm Screen—*With this screen you can remotely set user-programmable logic functions. You also can reset the programmed output state of each Sealed In Alarm or User Logic Output Contact.*

Built-In Testing

The DPU2000R 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

DPU2000R 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 DPU2000R 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 - 12 A range)
- Input burden at 0.014 VA at 1 A (0.2 - 2.4 A 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

Control Power Burden

- 24 Vdc = 0.7 A @ 19 V
- 48 Vdc = 0.35 A max @ 38 V
- 110/125 Vdc = 0.25 A max @ 70 V
- 220/250 Vdc = 0.16 A max @ 100 V

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

Ratings And Tolerances (Continued)

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 (11.80 lbs)
- 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 DPU2000R 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

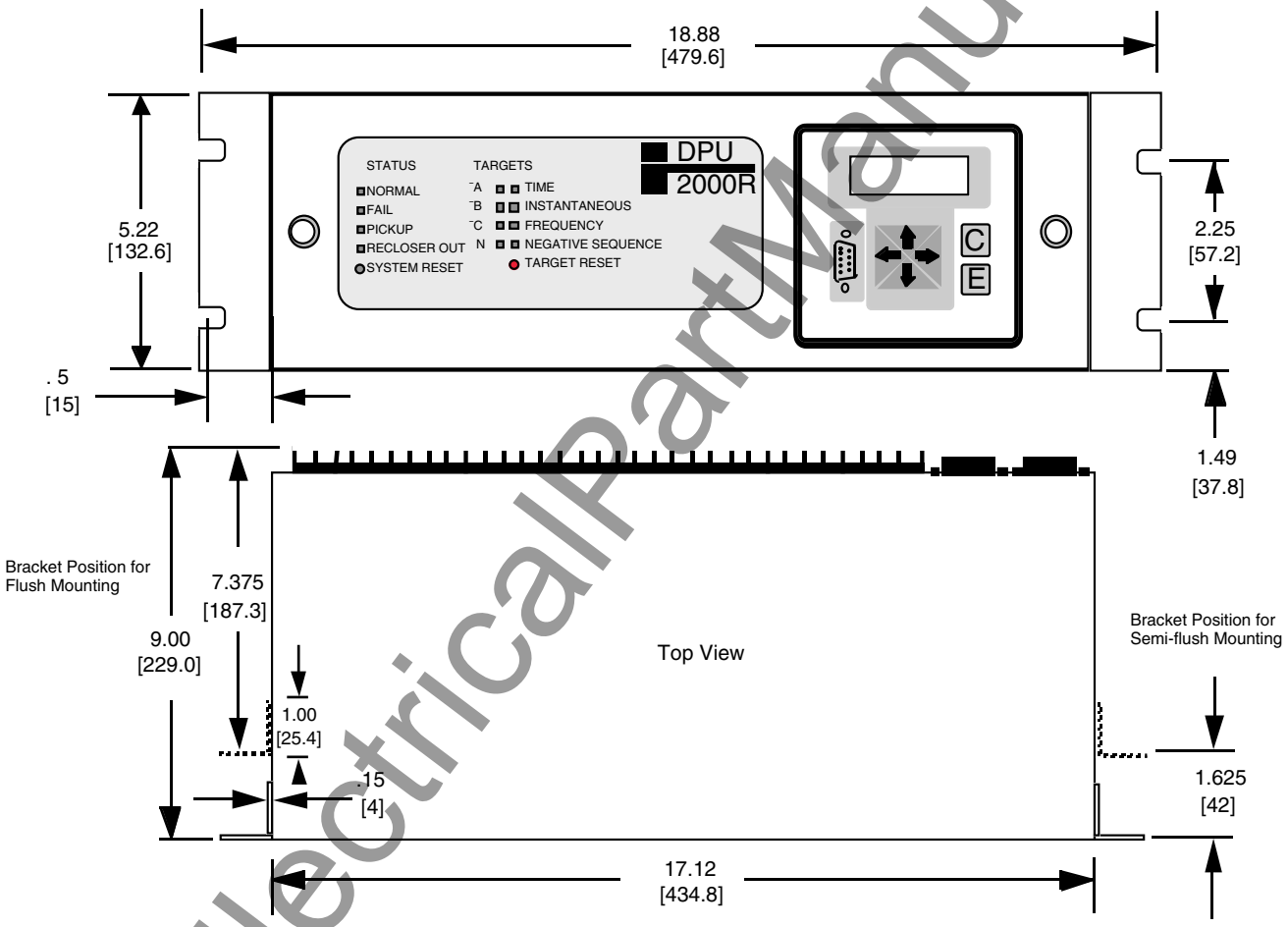
Ordering Information: *SELECT 24 Vdc rated*

DPU2000R for use with this device (For more information including mounting dimensions see I.B. 7.12.1.7-9)

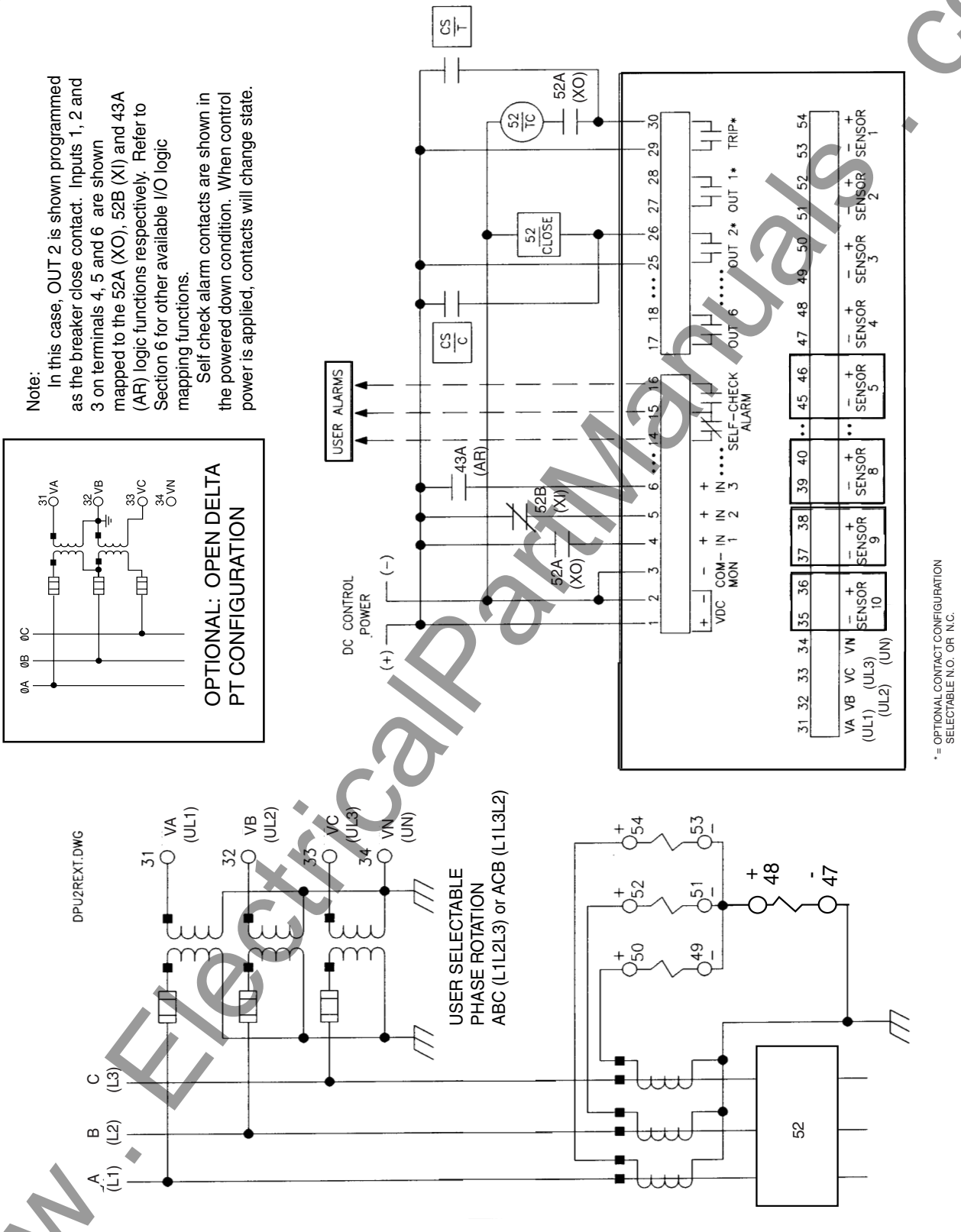
Catalog Number	Description
270B0024	UPS charger, NiCd battery pack (20 "D" cells) and the battery support tray
270B0024-LB	UPS charger and the battery support tray
270B0024-LT	UPS charger and the NiCd battery pack (20 "D" cells)
612024-T2	Only the NiCd battery pack (20 "D" cells)

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

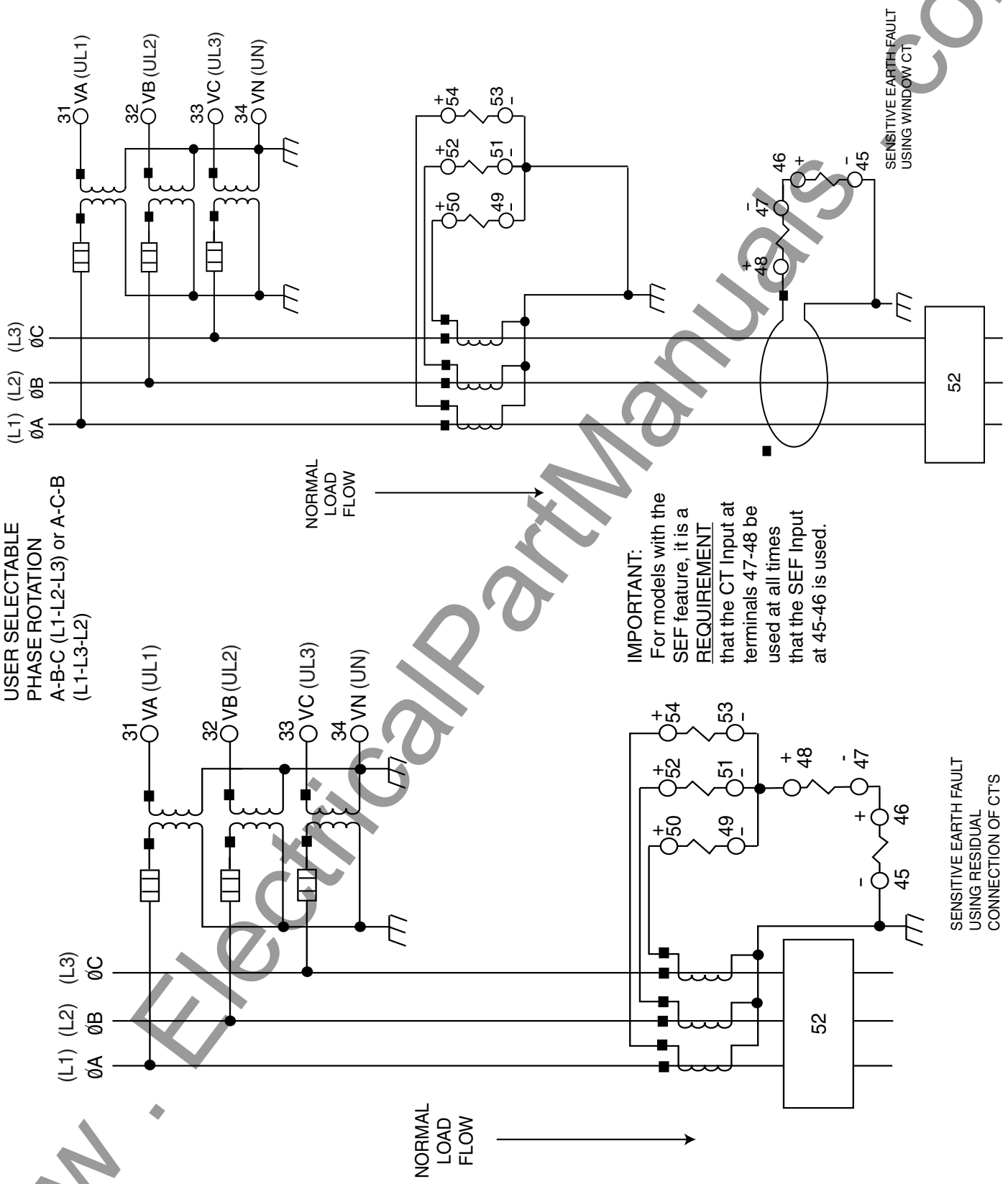
Dimensions are in: inches
[millimeters]



Relay External Connections

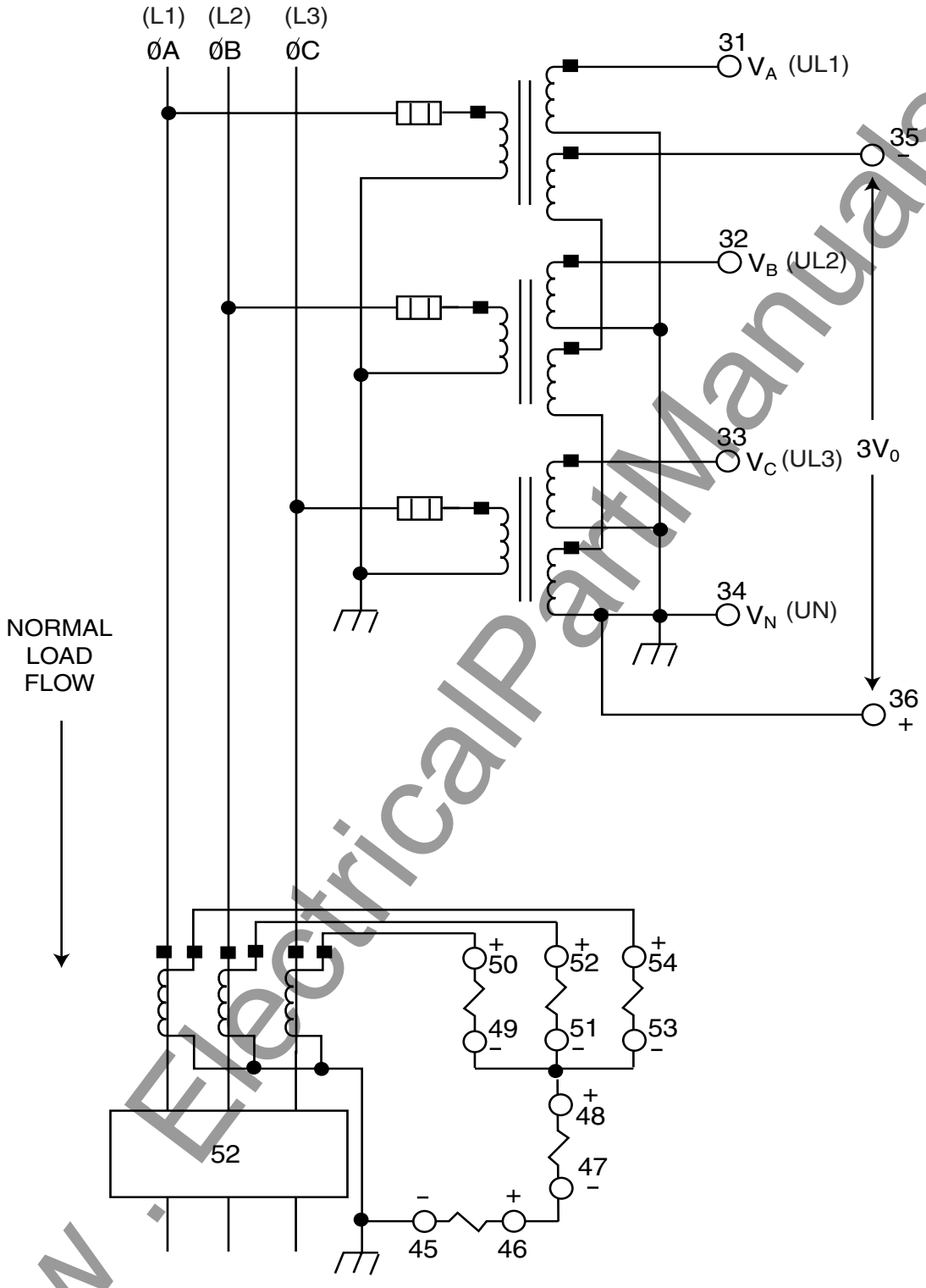


Typical Minimum External Connections



Typical Connections for Units with Sensitive Earth Fault Option

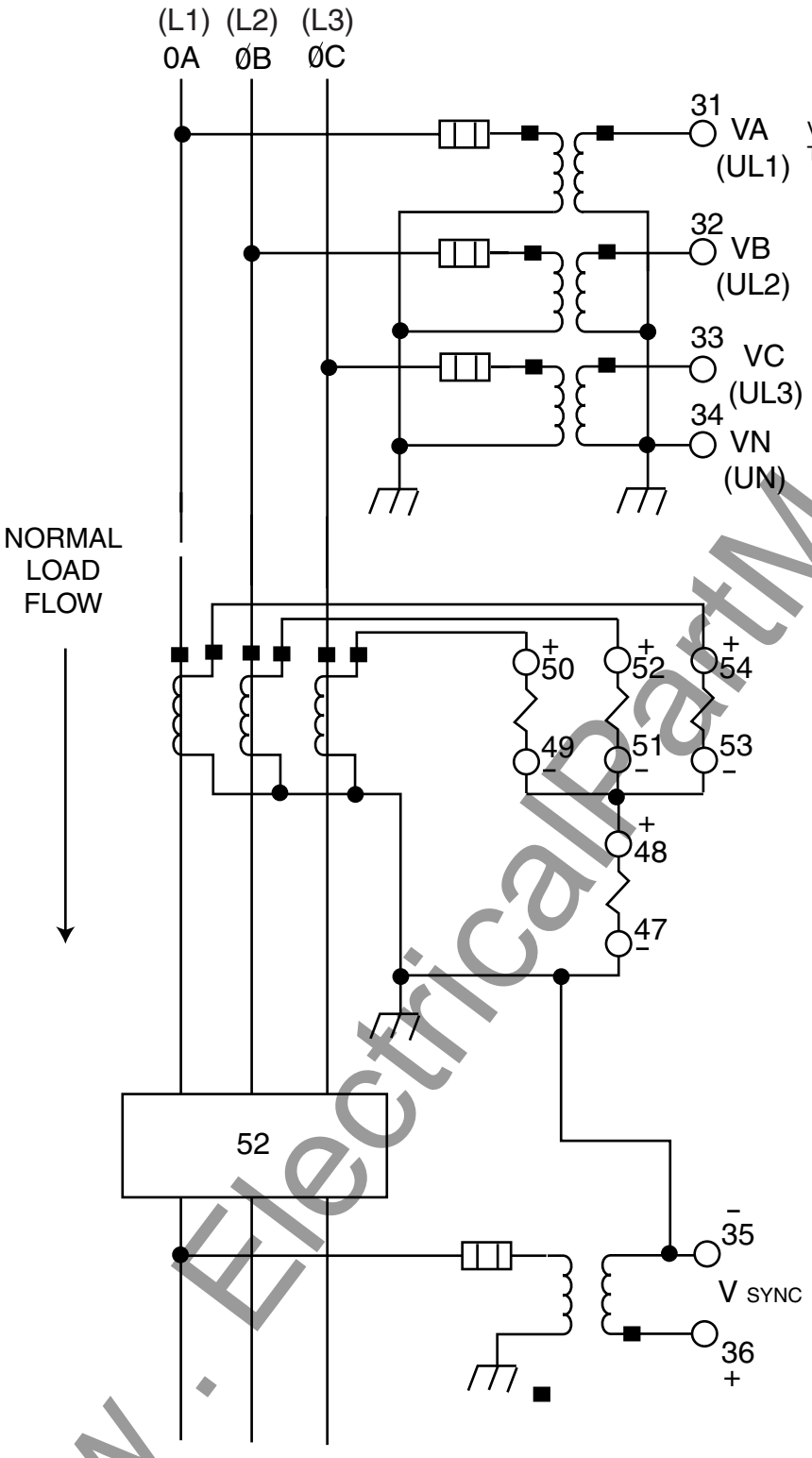
USER SELECTABLE PHASE ROTATION
A-B-C (L1-L2-L3) or A-C-B (L1-L3-L2)



Typical VT and CT Connections for DirectionalSensitive Earth Fault Units

USER SELECTABLE PHASE ROTATION
A-B-C (L1-L2-L3) or A-C-B (L1-L3-L2)

WITH SYNC CHECK OPTION



VT INPUTS 31-32-33 ARE DEFINED AS THE LINE-VT INPUTS. (SEE NOTE 1)

IMPORTANT NOTES:

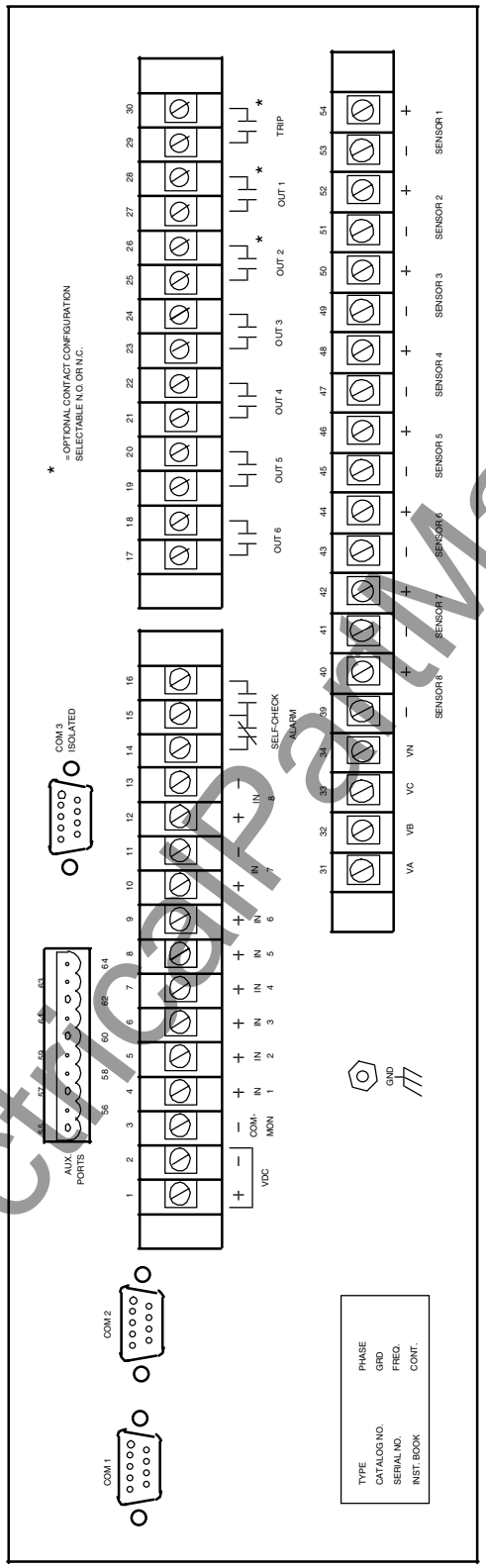
1. Observe the definitions of "Line-Side and "Bus-Side" as they apply to the relay's VT inputs. This is important when using the DEAD-LINE/DEADBUS closing functions of the Sync-check element. These relay designations may not match the actual system arrangement, so care must be taken in selecting the relay settings to obtain the desired mode of operation.

2. If the LINE-VT's are connected line-to-neutral, the Sync-check option allows the BUS-VT to be connected either line-to-neutral, or line-to-line, based on the setting "Bus VT Phase". If the LINE-VT's are connected line-to-line, then the BUS-VT should also be connected line-to-line.

NOTE: VT Input 35-36 is defined as the BUS-VT input (see Notes 1, 2).

Typical Connections with Sync Check Option

Rear Terminal Connection



Rear Terminal Blocks and Communications Ports

Ordering Instructions

The 2000R series of relays have 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

587 R 0 4 1 1 - 6 1 0 1 0

- ANSI/IEC 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 2000R 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

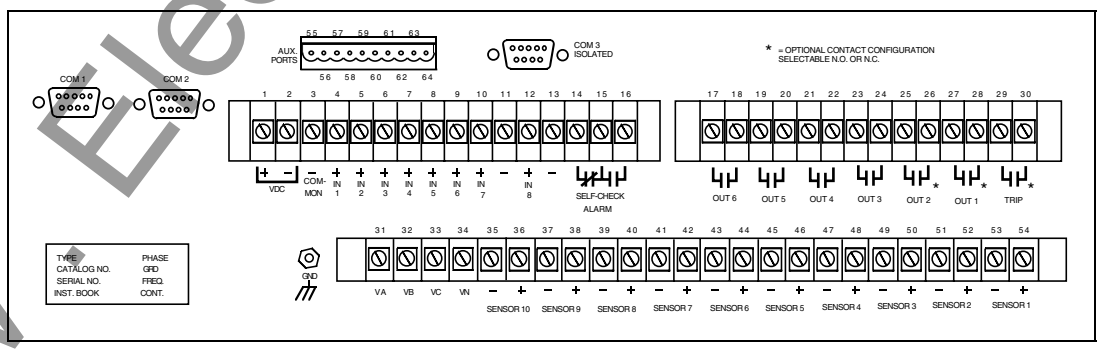
The 2000R platform provides several variations of communication ports, such as a 9-pin RS-232, RS-485, INCOM™ and Modbus Plus™. Also available is a list of factory supported common communication protocols for networking the unit.

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 following list of options to select the most suitable configuration.

The 2000R 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 2000R 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 and is suitable only in applications where communication to the unit is local through a direct connection to a PC or remote through an external isolating communication device , such as an RS-232 to fiber optic converter, which is connected to the relay using a short cable.

Options 1 through 8 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 for transient immunity and isolation and must 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 via 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, in 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.

Option 6

This option provides a Modbus Plus™ interface, via the COM 3 port, and RS-232 communication via the non-isolated COM 2 port.

Option 7

This option provides a Modbus Plus™ interface via the COM 3 and RS-485 communication via the isolated Aux Com port.

Option 8

This option provides RS-485 communication via the isolated COM 3 and Aux Com ports.

Communication Protocols

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

The ABB 10-Byte Protocol

The "Standard" protocol referenced throughout this publication refers to an ABB 2000R series-specific 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. The 2000R series Windows External Communication Program (WinECP) provided, at no charge, with the relay 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 2000R series include Load Profile, Customer Programmable Curves, Special Recloser Curves and Oscillograhic Data. Any combination of these options may be selected.

– 3 character locations in the catalog number define your selection of software options.

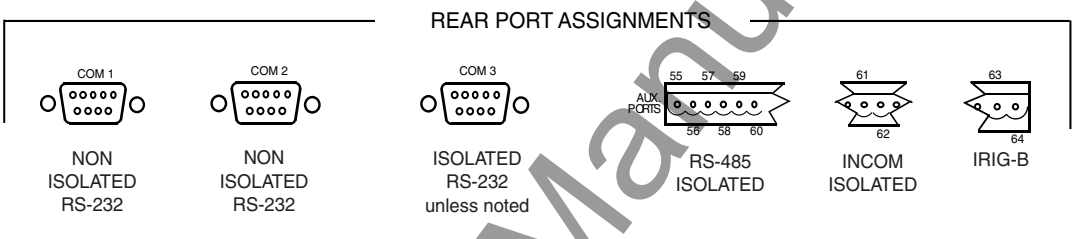
– Special recloser curve options duplicate popular recloser time current characteristic curves. Contact ABB Allentown for curve details.

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 is labelled IRIG-B receives a demodulated IRIG-B signal for 2000R clock synchronization purposes.

For example, if your system requires DNP 3.0 (IEC 870-5) protocol, the ordering catalog number would be 587R041[**2**]-6101[**1**] (4th row), 587R041[**4**]6101[**1**] (10th row) or 587R041[**8**]-6101[**1**] (18th row) based on your choice for the second port provided.



Catalog Number Select Option								
587 or 687 R041[ ] - 6101[ ]		**With Display**	**Without Display***					
0	0		ABB Ten Byte	ABB Ten Byte				
1	0		ABB Ten Byte		ABB Ten Byte			
2	0		ABB Ten Byte		ABB Ten Byte	ABB Ten Byte		IRIG-B
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® #		
3	0		ABB Ten Byte				INCOM	IRIG-B
4	0		ABB Ten Byte			ABB Ten Byte	INCOM	IRIG-B
4	1		ABB Ten Byte			DNP 3.0	INCOM	
4	4		ABB Ten Byte			Modbus®	INCOM	IRIG-B
5	0		ABB Ten Byte			ABB Ten Byte		
6	4		ABB Ten Byte	ABB Ten Byte	Modbus Plus™			
7	4		ABB Ten Byte		Modbus Plus™	ABB Ten Byte		
8	0		ABB Ten Byte		ABB Ten Byte (RS-485)	ABB Ten Byte		IRIG-B
8	1		ABB Ten Byte		ABB Ten Byte (RS 485)	DNP 3.0 (RS 485)		
					DNP 3.0 (RS 485)	ABB Ten Byte (RS 485)		
8	4		ABB Ten Byte		Modbus®	ABB Ten Byte		IRIG-B
					ABB Ten Byte (RS-485) #	Modbus® #		

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.

\# Protocol selectable in settings process, all 4 combinations possible.

Panel Mounting Kit

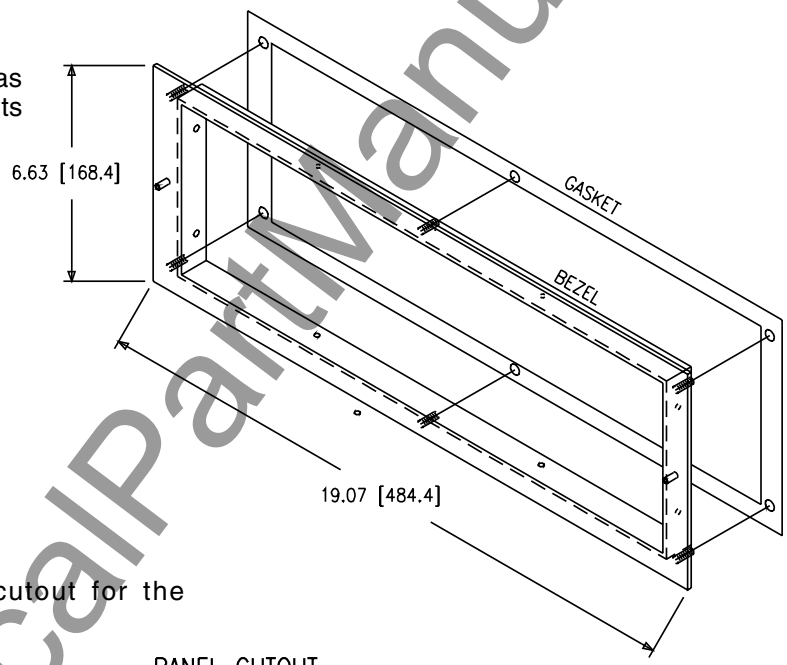
The complete kit will include a bezel, its associated hardware and gasket, as well as a lens cover with its associated hardware. This kit will provide a means for panel mounting and dustproofing.

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

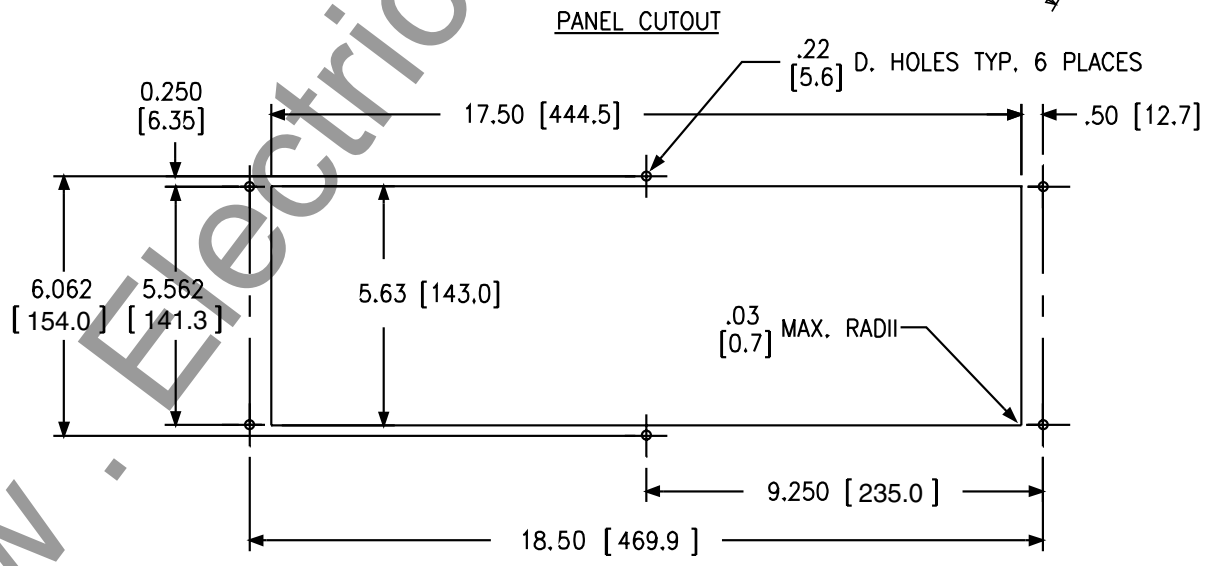
Spare Parts List:	
Bezel/gasket assembly only	604513-K3
Horizontal lens cover assembly	613724-K1
Vertical lens cover assembly	613724-K2

Horizontal Mounting

Note: The Bezel Assembly is available as an option for mounting the DPU2000R units in a panel application.



Note: Below is the panel drilling cutout for the DPU2000R unit and the bezel assembly.



NOTE: DIMENSIONS ARE INCHES [MILLIMETERS]

Ordering Selections

Catalog Number Selection → 5 8 7 (ANSI) / 6 8 7 (IEC)

R 0 4 1 1 - 6 1 0 1 0

User Selections

Configuration
- Standard ..... R
- Sensitive Earth (SE) Fault ..... E
- Standard with Sync Check Option C

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
- Modbus Plus™ & RS-232 (non-isolated) 6
- Modbus Plus™ & RS-485 (isolated) 7
- Dual RS-485 Ports (isolated) 8

Frequency
- 50 Hertz 5
- 60 Hertz 6

Software Options
- Oscillographics (Included) 1
  - No User Defined Curves (ANSI or IEC Curves Only) 0
  - User Defined Curves and ANSI or IEC Curves 1
  - Special Recloser Curves (no ANSI or IEC Curves) 2
  - Special Recloser& User Defined Curves (No ANSI or IEC) 3
    - No Load Profile 0
    - Load Profile 1

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