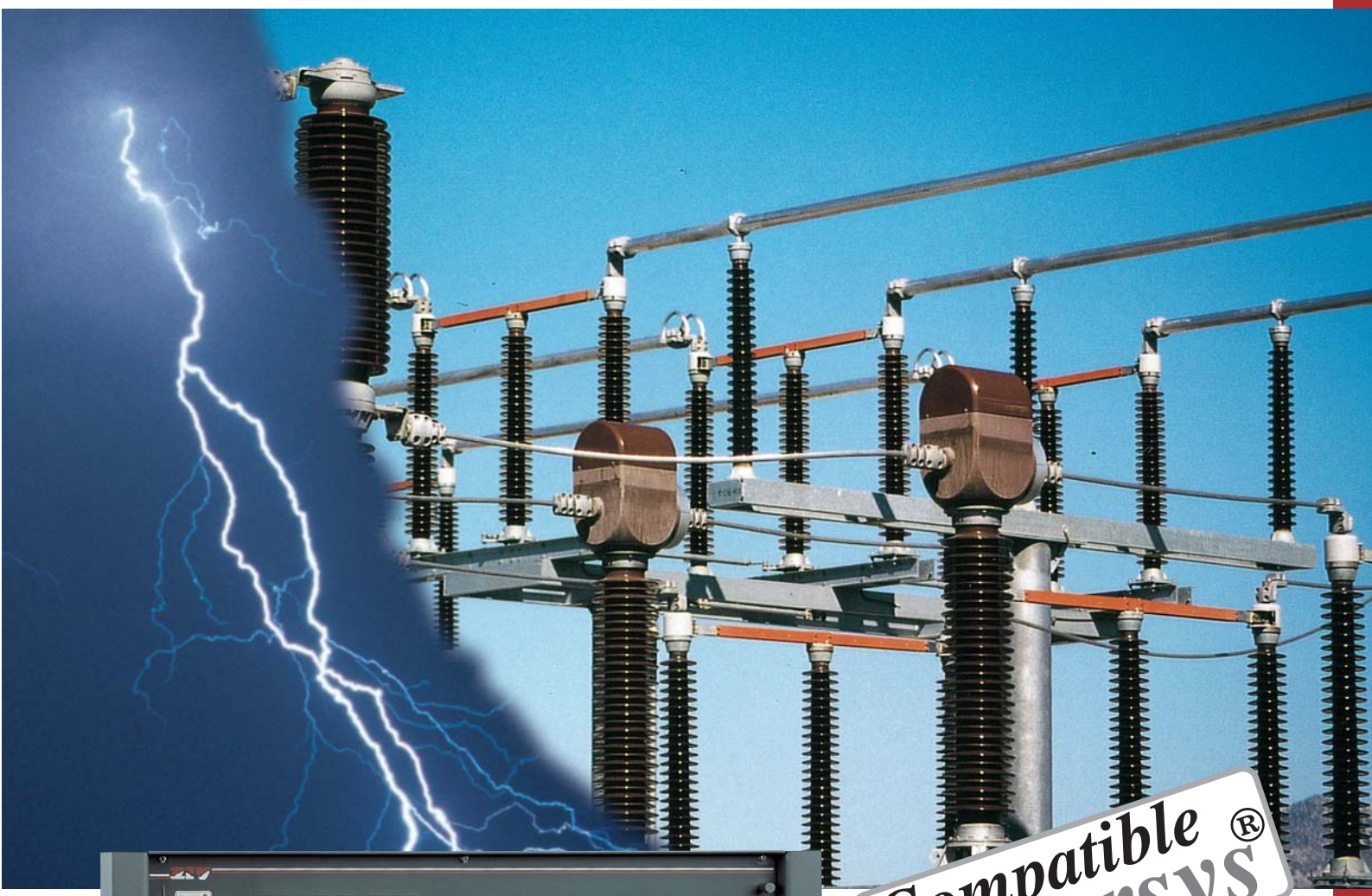


Compatible ZIVersys®

DBN

Busbar Differential Protection Terminal

Protection, Control, Metering and Communications

Description

The **DBN** system is a Distributed Digital Bus Differential Protection System designed for medium to high voltage substations from 30 kV to 500 kV. This wide operation range also provides an economical alternative for distribution substation protection. The distributed architecture of the **DBN** System offers substantial savings by reducing wiring and installation costs. Furthermore, **DBN** Systems can be easily adapted to accommodate substation growth or modifications.

DBN Systems consists of one Differential Central Unit (**DBC**), and a Bay IED (**DBP**) per line on the bus. The **DBN** System can be configured to protect any substation scheme (single-bus, double-bus, transfer bus schemes, sectionalized schemes, etc.) up to 4 buses and 28 lines. Additionally, it is also possible to include up to 4 supervisory bus voltage IEDs.

• Differential Central Unit (DBC)

The Differential Central Unit is comprised of:

- One board containing :
  - · Two digital signal processors, running in parallel, dedicated to the differential protection units.
  - · One 16 bit microprocessor dedicated to the protection logic.
  - · One communications microprocessor dedicated to communicate with the Bay IEDs.
  - · Remote communication ports.
- Boards housing digital inputs, auxiliary outputs and trip and close contacts.
- Communication boards for connection with the Bay IEDs.

• Bay IED (DBP)

The Bay IEDs are comprised of:

- One board with a 16-bit microprocessor which samples phase currents with a sampling frequency of 2.88 kHz (2.4 kHz for 50 Hz models), monitors the status inputs from the breaker and switches, and refreshes the status of the auxiliary outputs. This information is transmitted real time to the Differential Central Unit (**DBC**).
- Boards housing digital inputs, auxiliary outputs and trip and close contacts.

Operation Principle

Phase current values are captured by the Bay IEDs (**DBP**) and transmitted via fiber optics to the Differential Central Unit (**DBC**). The **DBC** calculates the differential phase currents and the restraint currents (up to 241,920 samples per second) for each bus. These calculations involve the evaluation of up to 12 magnitudes (up to 4 buses x 3 phases).

The set of calculated differential and restraint currents is then processed by the main differential elements, as well as the more sensitive supervision elements in the **DBC** to determine the operation of the protection. A differential trip occurs when:

$Id > Id_{lim}$ where $Id_{lim} = k \cdot I\,restraint + S\,(1 - k)$

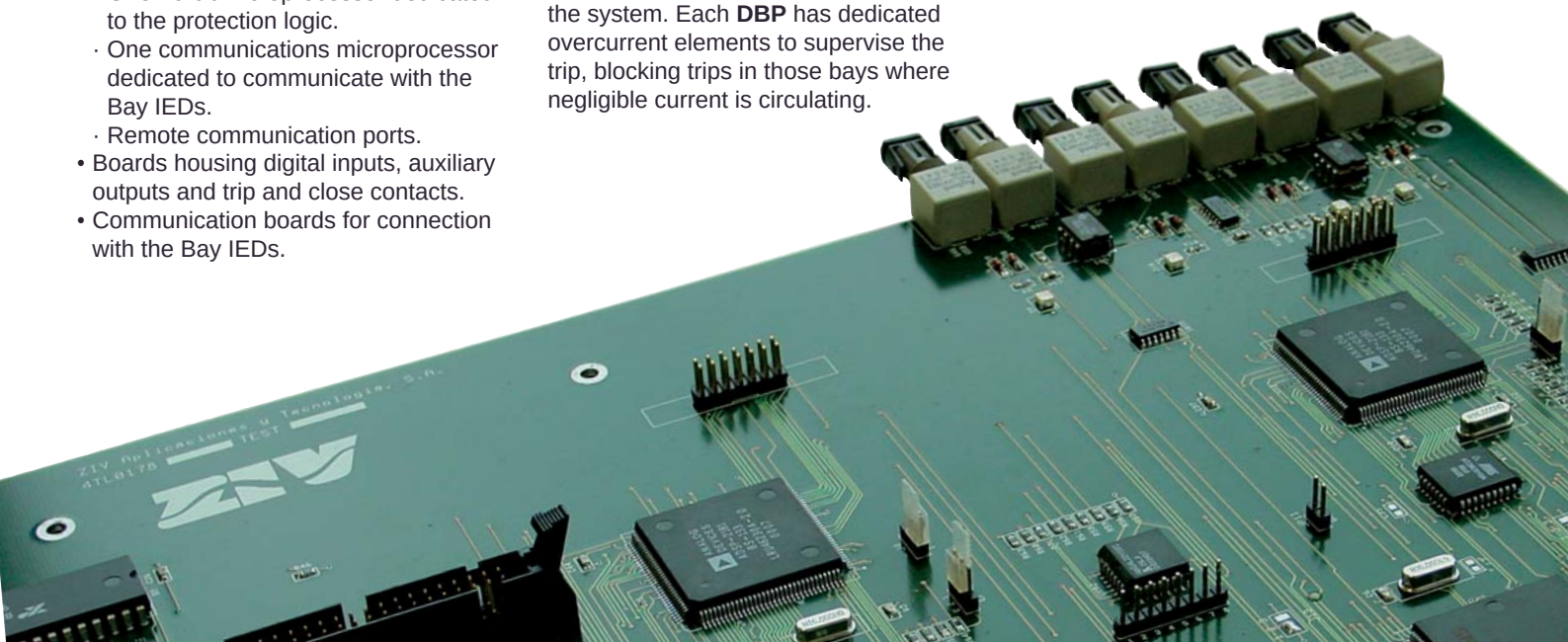
In case of fault conditions the trip command is transmitted to each **DBP** in the system. Each **DBP** has dedicated overcurrent elements to supervise the trip, blocking trips in those bays where negligible current is circulating.

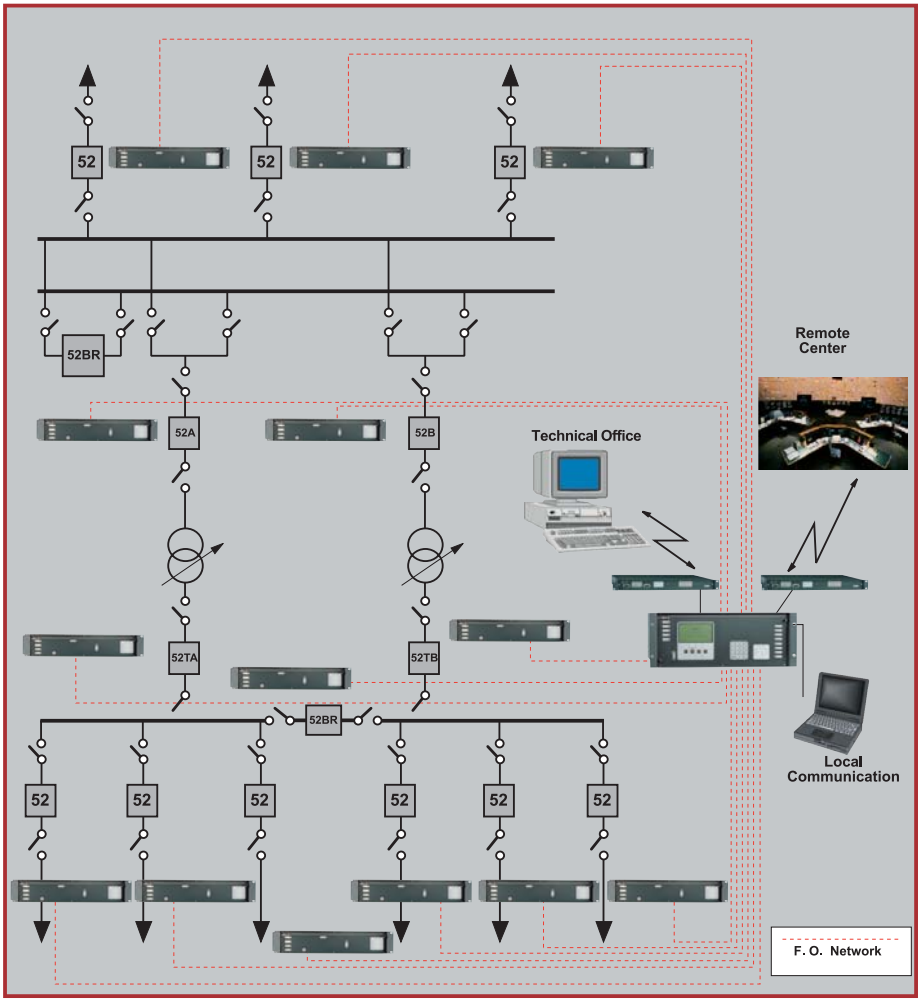
To achieve maximum reliability, the main differential elements are supported by:

- CT saturation detectors which provide a high level of stability.
- External fault detector that prevents trips for faults outside the protected zone
- Elements to determine the fault duration

DBN systems include algorithms to prevent CT saturation effects, and to block the primary differential elements in case the fault is outside of the protected area.

Bus voltage metering elements can be included in the system, providing an additional measure to evaluate the presence of bus faults.





Other Features

- Phase correction via virtual interposing CT software. Allows the use of the existing transformers in retrofit applications.
- Transparent communication system allows the entire substation to be controlled from any IED.
- 3 settings groups per unit.
- Sequence of events log - 100 event capacity with 1 ms resolution.
- Time synchronization system wide. Permits accurate analysis of sequence of events logs.
- Hardware, firmware and communications self test.
- Phase current, differential current, restraint current.
- Bus voltage metering (optional).

DBC Features

- 7 digital status contact inputs (expandable to 14).
- 7 auxiliary outputs (expandable to 14).
- 13 programmable LED targets.
- 2 double trip contacts.
- Optional I/O modules.

DBP Features

- 8 digital status contact inputs (expandable to 16).
- 8 auxiliary outputs (expandable to 16).
- 5 programmable LED targets.
- 1 double trip contact and 1 double lockout contact.
- Optional I/O modules.

Additional Functions

A host of protection elements are included in **DBN** Systems to complement the critical differential protection function.

- **Supervisory Differential Unit**
  The main differential element is supervised by a more sensitive differential element that monitors the entire bus.

- **Differential Alarm Unit**
  These alarm elements detect differential currents not large enough to trip the relay, but that may be an indication of problems on the bus.

- **Lockout Unit**
  Prevents the closing of breakers after a **DBN** trip.

- **Supervisory Overcurrent Unit**
  All trip commands are monitored at each Bay Terminal by overcurrent elements. Trips are blocked in those bays with a negligible current flow

- **Supervisory Undervoltage Unit (optional)** A bus voltage IED can be installed to provide additional means of fault location detection. Trips are blocked for voltage values below the setting value.

- **Breaker Failure**
  This unit resides in each bay IED and provides indication of breaker failure for both single-pole and three-pole trips.

- **Oscillography**

Differential trips are supervised by a more sensitive differential element that monitors the entire bus. The differential trip is complemented by differential alarm elements that constantly supervise the differential current.

Human-Machine Interface

DBN system terminals can be accessed in two different modes:

LOCAL MODE

Alphanumeric Keypad & Display (HMI) – DBC Central Unit

DBC Information Key. Access to primary **DBN** information and functions is available through the **INF** key located on the **DBC** unit. Pressing the **INF** key cycles through various information screens, displaying information and allowing operations such as:

- Phase and bus differential current metering
- Phase and bus restraint current metering
- Bus voltage metering (optional)
- Last trip information reset
- LED Target reset

DBC Keypad. The **DBC** keypad (16 keys in a 4x4 matrix plus 4 function keys) provides the user the ability to access and edit **DBN** functions and settings. Sensitive operations are password protected. This feature allows changes to be performed without the use of a computer.

The **HMI** is menu driven and displayed on the LCD screen (4 line x 20 characters). The following are examples of the menus included in the system

- **Configuration:**
  - password
  - control enable
  - I/O programming
  - communication
  - date and time
- **Settings**:
  - central differential unit
  - current IED
  - voltage IED

The data in the **Information Menu** can be accessed without a password (settings, configuration, metering, records, and operations).

PC Via Serial Port

The different IEDs in the **DBN** system are equipped with an RS-232 front port. Through this port, a PC can communicate locally via a null modem cable with the user-friendly ZIVercom® software installed.

REMOTE MODE

The **DBC** is equipped with a rear communications port. This connection permits remote access via modem, or it can be used to include the **DBN** in an existing system (via RTU, Substation Central Computer or SCADA).

Communications

The communications management software ZIVercom® provides access to the **DBN** systems using a PC. Communication can be established either in local or remote modes:

- **Local mode**: connection via **DBC** or any **DBP** in the system through the front port
- **Remote mode**: connection via **DBC** rear serial port.

The user can reach every IED comprising the **DBN** system, independent of the point of access. The software is structured with user-friendly menus and dialog boxes to access settings, local operations, data records and programming of inputs and outputs. Each screen prompts the user to enter data or make a selection in pull-down menus.

The software is password protected allowing various levels of clearance to individual users.

ZIVercom® allows the user to program IED settings off-line. These settings can be easily stored in the software's database to be uploaded to an IED in the future.

System Architecture

Cabinet mounted **DBN** components are designed as follows:

- **DBC units** - enclosed in a standard 4U high, 19" rack case.
- **DBP units** - enclosed in a standard 2U high, 19" rack case.

Terminal blocks are located at the rear of the enclosures. **DBN** components can be supplied separately for distributed installation in the substation. They can also be supplied mounted and wired in a substation rack cabinet, ready to be connected to the substation terminal block.

Protection Settings

Central Unit General Settings

Unit in service	**YES / NO**
Bus # enable	**YES / NO**
Rated Voltage (*)	**100.00 - 130.00 V**

Bay Units General Settings

Unit In Service	**YES / NO**
Bus	**0 - 4**

Transformer Settings

Transformer Ratios	
CT Ratio ct#	**1 - 3,000**
VT Ratio vt#	**1 - 4,000**
Saturation Currents	
Saturation current ct#	**100 - 30,000**

Central Unit Protection Settings

Differential Units	
Unit # Enable	**YES / NO**
Sensitivity #	**0.5 - 10.0 $I_{ref} \cdot I_n$**
Restrain slope	**40 - 90 %**
Differential Alarm Unit	
Unit enable	**YES / NO**
Sensitivity	**0.1 - 1.00 I_{ref}**
Time delay	**1.0 - 20.0 s**
Supervision Differential Unit	
Sensitivity	**0.5 - 10.0 $I_{ref} \cdot I_n$**
Restrain slope	**40 - 90 %**
Time delay	**1.0 - 20.0 s**

Bay Unit Protection Settings

Overcurrent Units (bay units)	
Unit # Enable	**YES / NO**
Sensitivity #	**0.1 - 100.0 A**
Breaker Failure Unit	
Unit ct# Enable	**YES / NO**
Single phase reset ct#	**0.1 - 12.0 A**
3-phase reset ct#	**0.1 - 12.0 A**
1-phase time delay ct#	**0.00 - 2.00 s**
3-phase time delay ct#	**0.00 - 2.00 s**
No load 3-phase time delay ct#	**0.00 - 2.00 s**
Undervoltage Supervision Units (bus voltage units)	
Unit Enable vt#	**YES / NO**
Sensitivity vt#	**20 - 220 V**

 # = bus number
ct# = 1 to 28 (bay units)
vt# = 29 to 32 (bus voltage units)
(*) Rated voltage available if voltage units are present.

Logic Settings (Central Unit)

Lockout Enable	
by differential unit	**YES / NO**
via digital input	**YES / NO**
by breaker failure unit	**YES / NO**
Bus Transfer #	
0 (no transfer bus)	
1 (1 CT available)	
2 (2 CTs available)	
Transfer Location #	**1 - 28**
Transfer # Positive Polarity Bus	**0 - 4 (*)**
Transfer # Negative Polarity Bus	**0 - 4 (*)**

(*) 0 = transfer connected to bus indicated by switch status.
1, 2, 3 and 4 = transfer connected to bus #

Logic Settings (Bay Unit)

Switch Traveling Time ct#	**1.00 - 120.00 s**

Busbar differential protection DBN

Technical Characteristics

Power Supply Voltage

24-48 Vdc (± 20 %)
110-125 Vdc (± 20 %)
220-250 Vdc (± 20 %)
Quiescent Power Supply Burden: 7 W at 125 V dc

Current Analog Inputs

Rated ac Current (In)	In = 1A rated
	In = 5A rated
Thermal Withstand Capability	4 x In Continuously
	50 x In For 3 s
	100 x In For 1 s
Dynamic limit	240 x In
Current Circuit Burden	In = 5A < 0.2 VA
	In = 1A < 0.05 VA

Voltage Analog Inputs

Rated ac Bus Voltage	Vn = 110Vac for 50 Hz
	120Vac for 60 Hz
Bus Voltage Thermal Withstand Capability	2 x Vn Continuously
	3.6 x Vn for 10 s
Voltage Circuit Burden	Vn = 110 Vac < 0.5 VA

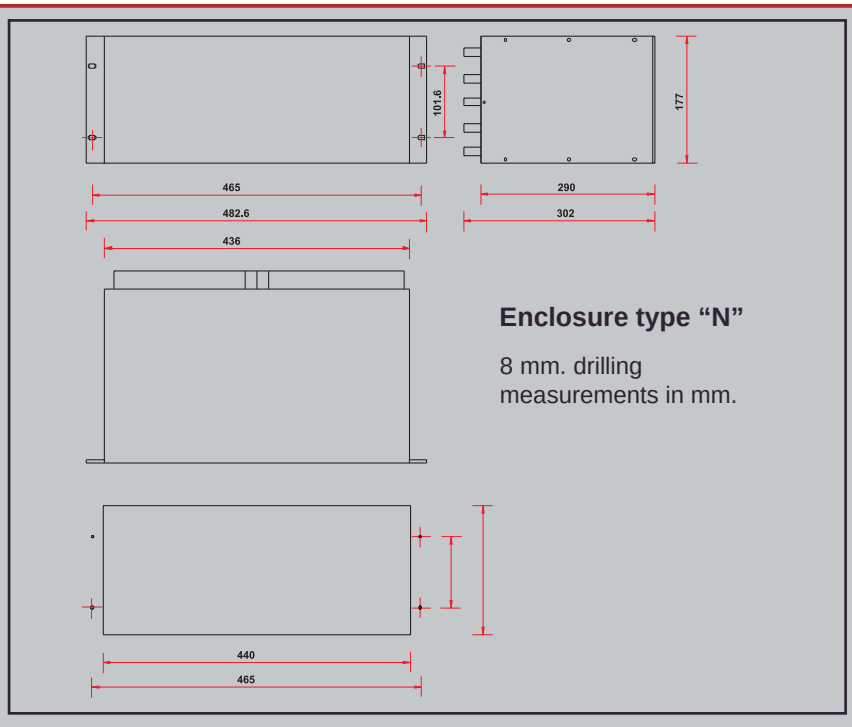
Metering Accuracy

Range 0.1 – 20 In	± 5% (currents)
Range 0.1 – 1.2 Vn	± 5% (voltages)

Status Contact Inputs

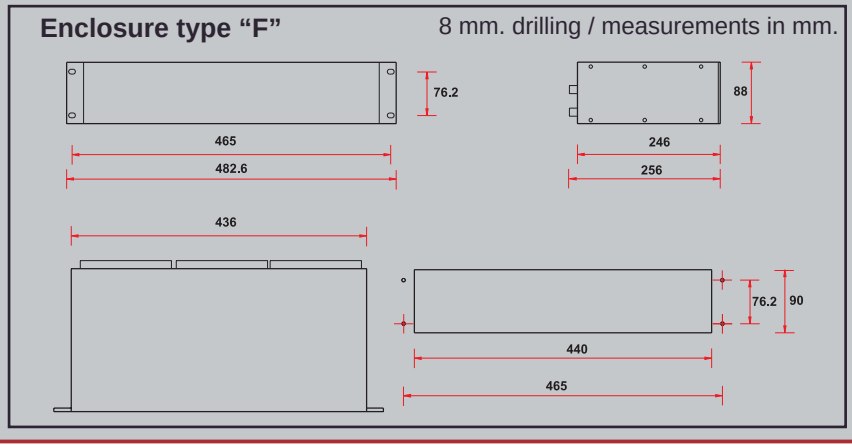
Rated Voltage Input Range	24 - 48 Vdc (± 20%)
	24 - 125 Vdc (± 20%)
	48 - 250 Vdc (± 20%)
Current Drain	< 5 mA

Dimensions



Enclosure type "N"

8 mm. drilling measurements in mm.



Trip & Close Outputs

Continuous	8 A
Make and Carry	30 A
Connection Capability	2500 W
Break (Resistive)	150 W (48Vdc)
	55 W (100 Vdc)
	1250 VA
Switching Voltage	250 Vdc

Auxiliary Contact Outputs

Continuous	3 A
Make and Carry (30 s)	5 A
Connection Capability	2000 W
Break (Resistive)	75 W (48Vdc)
	40 W (100 Vdc)
	1000 VA
Switching Voltage	250 Vdc

Technical Assistance in U.S.A. and Canada

Model Selection

Central Unit

DBC- A 2 _ - _ _ _ _ _ _ _ D

Number of lines	
Up to 14 lines	A
Up to 14 lines + 4 bus voltage units	B
Up to 28 lines	C
Up to 28 lines + 4 bus voltage units	D

Power Supply		
Power Supply	Digital Inputs	
24 - 48 Vdc	24 - 125 Vdc	1
110 - 125 Vdc	24 - 125 Vdc	2
220 - 250 Vdc	48 - 250 Vdc	3

Frequency / Language	
60 Hz / English	2
50 Hz / English	A
50 Hz / Spanish	0
60 Hz / Spanish	C
60 Hz / Portuguese	E

Communications	
RS232 + RS232	1
RS232 + Plastic Fiber (1 mm)	2
RS232 + Glass Fiber (SMA)	3
RS232 + Glass Fiber (ST)	4
RS232 + RS485	5

I / O Module	
Basic	0
Expansion Card	1

Rated Current	
In = 1 A	01
In = 5 A	00

Enclosure	
4 U x 1 19" rack	N

Line Unit

DBP- _ 1 _ - _ _ 0 _ _ _ _ D

Unit Type	
Voltage	A
Current	B

Rated Current	
Voltage unit	0
In = 1 A	E
In = 5 A	N

Power Supply		
Power Supply	Digital Inputs	
24 - 48 Vdc	24 - 125 Vdc	1
110 - 125 Vdc	24 - 125 Vdc	2
220 - 250 Vdc	48 - 250 Vdc	3

Language	
English	2
Spanish	0
Portuguese	E

I / O Module	
Basic	0
Expansion Card	1

Enclosure	
2 U x 1 19" rack	F

Standards and Type Tests

Insulation Test	IEC-255-5
Between Circuits and Ground	2 kV, 50/60 Hz for 1 minute
Between Independent Circuits	2 kV, 50/60 Hz for 1 minute
Impulse Test	IEC-255-5
	5 kV; 1,2/50 µs; 0,5 J

1 MHz Disturbance Test	
IEC-255-22-1 Class III	
Common Mode	2.5 kV
Differential Mode	1.0 kV
Fast Transient Disturbance Test	
IEC-255-22-4 Class IV	
	4 kV ±10%
Radiated Electromagnetic Field Disturbance Test	
IEC-1000-4-3	
Amplitude Modulated	10 V/m
Pulse Modulated	10 V/m
Conducted Electromagnetic Field Disturbance EN 50141	
Amplitude Modulated	10 V
Electrostatic Discharge Test	
IEC-255-22-2 Class IV	
	15 kV ±10%

Radio Frequency Emissivity
EN 55011

Temperature	IEC-255-6
Operating Range	-10° C to +55° C
Storage Range	-25° C to +70° C
Humidity	95% (non condensing)

Power Supply Ripple	
IEC-255-11	
	< 20%

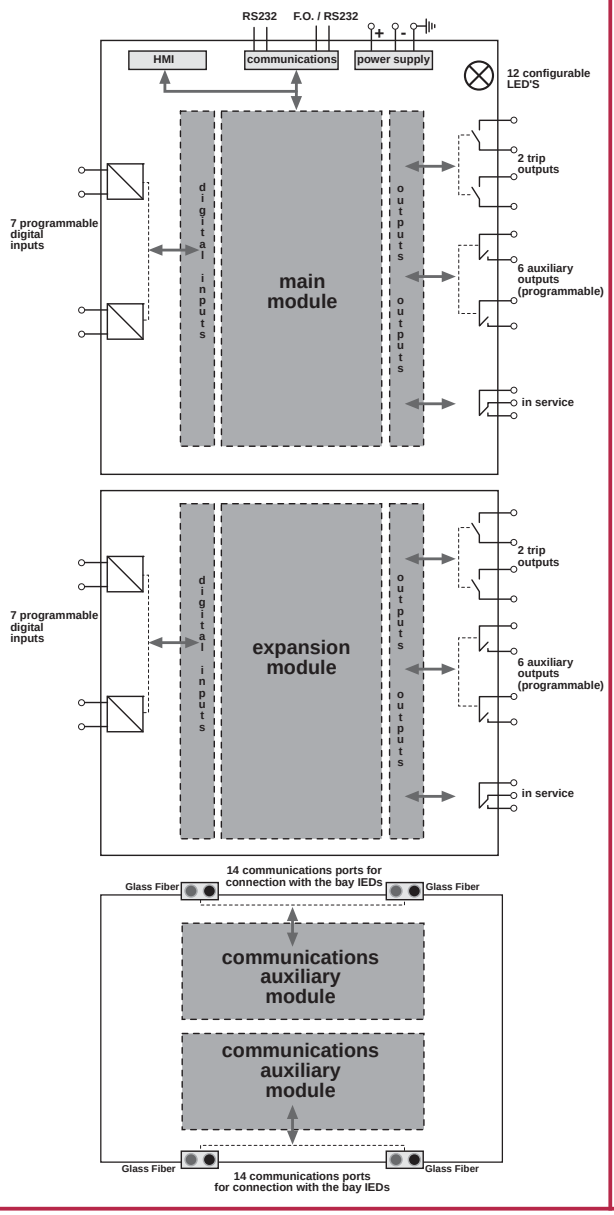
Vibration Test (sinusoidal)	IEC 255-21-1 Class I
Shock and Bump Test	IEC 255-21-2 Class I

DBN terminals comply with the EEC 89/336 standard of electromagnetic compatibility

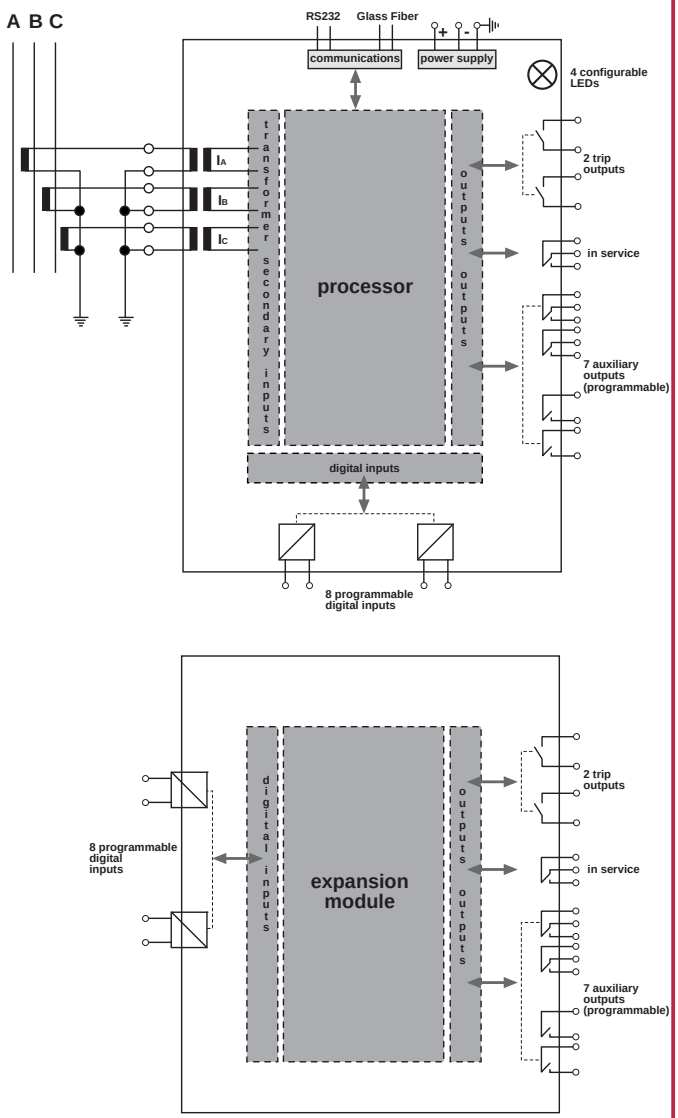
CE

Generic Block Diagram

Central Unit (DBC)



Bay IED (DBP)



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