

LogicLab



# **DV938 EAC**

## **Automatic Load Shed**

ENEL\* device certified  Enel  
L'ENERGIA CHE TI DEDICHIAMO



## DV938EAC – Automatic Load Shed

**Device for automatic load shedding in HV/MV substation**

- Dual operating mode: with single phase (M1 mode) or with double three phase voltage (M2 Mode)
- Trip threshold for frequency and frequency rate (ANSI 81/81R)
- Trip threshold for voltage and voltage rate (ANSI 27/59/27R in M2)
- Stop threshold for min/max voltage, voltage imbalance, max frequency difference
- Double three-phase systems monitoring automatically selected by the device (M2)
- Up to three rated voltage software selectable: 57V, 100V, 400V
- Up to 1,6 rated voltage operating range
- High accuracy in rms voltage and voltage rate measures
- High accuracy in frequency and frequency rate measures
- Four current loop transmitter units for remote control (4-20mA or  $\pm 5$ mA software selectable)
- Self diagnostic capability
- Fault recorder
- Realtime display tools
- Off-line device parameterization
- Human-Machine Interface (HMI) with 4-lines display, keypad and 16 device status LED
- Ethernet connection 10/100BASE-TX frontside and 100BASE-FX backside
- RS232 frontside connection
- RS232/RS485 backside connection (factory configurable)
- Field connection through two 50 poles rectangular connector
- Parameterization and device management software SpyEAC
- Recordings analysis software LogOsciloEAC



### Introduction

EAC DV938 device was designed to satisfy ENEL and TERNA's requirements for an automatic load shed. DV938 is a last generation digital device equipped with interface that allows different field connections.

Device is equipped with two serial interfaces, one in front and one on the back, either RS232 or RS485 (factory customer selectable), an ethernet 10/100BASE-TX frontal interface and an ethernet optical 100BASE-FX back interface with SC connector. Different options are also available such as a second 10/100BASE-TX back interface, optical interface with ST connector, etc..

An easy to use human-machine interface allows operator to connect directly to DV938; immediate information about device status are given through LED.

DV938 has four analog input voltage channels software configurable. Remote signaling is made possible by 15 digital output relays and 4 current loop transmitter (4÷20mA,  $\pm 5$ mA).

Inside DV938 you find

- 4 minimum/maximum voltage protection threshold (ANSI 27/59);
- 4 minimum-maximum rate voltage threshold (ANSI 27R/59R) ;
- 4 minimum-maximum frequency protection threshold (ANSI 81);
- 4 minimum-maximum rate frequency protection threshold (ANSI 81R).

DV938 works in two ways: the first one uses only one analog voltage input, the second one uses three voltage inputs selected from two different group of three phase voltage. The group can be selected from digital input state.

To prevent incorrect trip, three kinds of stop protections are available:

- minimum/maximum voltage (ANSI 27/59);
- Maximum delta frequency between phases;
- Maximum delta voltage between phases.

Field connection is achieved through two 50 poles rectangular connectors.

DV938 is supplied of two software programs: the first one allowing parametrization and field monitoring, the second one to analyze fault recording (voltage, rate-voltage, frequency, rate-frequency, etc.) of each trip.





# DV938EAC – Automatic Load Shed

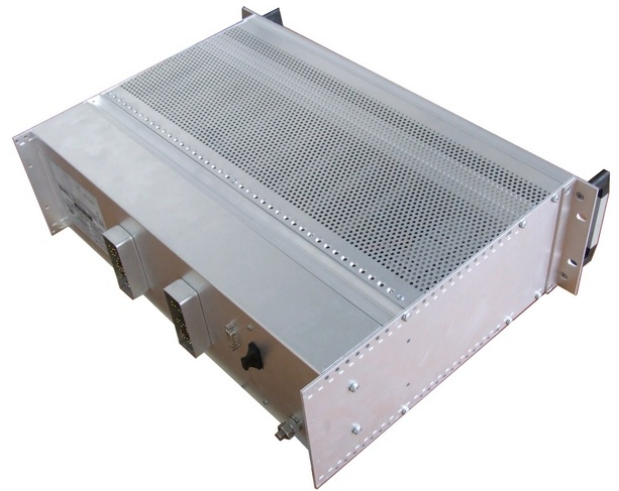
*The LogicLab solution to avoid the collapse*

## Using DV938EAC

According to the modern plan for load shedding to prevent the disconnection of the power plants when a deficit causes a reduction in the frequency, the device DV938EAC should intervene to switch off, temporarily, the minimum load requirements (e.g. hydroelectric power plants in pumping operation, industrial units powered with high voltage ...) in order to halt the continuous drop below the rated frequency.

The algorithms implemented monitor the frequency and frequency rate. The use of the frequency rate allows earlier switch off procedure before reaching too low frequency values.

Obviously the DV938 is equipped with features that prevent the unexpectedly trip due to faults on the network, intended to intervene only in cases of phenomena that lead to the collapse the electrical network.



## Operating mode

The DV938EAC can operate in two modes: M1 and M2. Mode M1 works only with changes in frequency and mode M2, in addition to frequency, it's possible to setup a voltage (min/max) trip.

Mode M1 monitor a single voltage and can be set thresholds for frequency rate (ANSI 81R) and frequency (ANSI 81).

Mode M2 use up to two three phase voltage systems but only one is monitored. The selection of the system is done automatically by DV938EAC according to digital input connected to close status signal of HV switch. In this operating mode you can set the thresholds of frequency (ANSI 81), frequency rate (ANSI 81R), voltage min/max (ANSI 27/59) and voltage rate (ANSI 27R).

For both operating modes there are up to three different thresholds that inhibit the trip. These are intended to prevent the trip in response to fault occurrences in the electrical network.

Mode M1 provides stop thresholds for minimum and maximum voltage, while mode M2 provides stop thresholds for the minimum and maximum, voltage imbalance and maximum difference in frequency.

## The device

LogicLab develops DV938EAC to provide a versatile, precise and easily configurable protection relay.

Each device can operate in both modes, M1 and M2, and the selection can be made with a parameter setting.

Up to three rated voltage are available for each voltage input that can be setup with a software command. For mode M1 is available 57V, 100V and 400V, while the M2 mode is available flow 57V and 100V. The DV938EAC LogicLab has 2 digital inputs and 15 digital output for the acquisition and alarm in the two operating mode. There are also 6 more digital inputs that can be used for custom solutions based on client requirements. Completing the four outputs high accuracy current loop transmitter and software configurable as 4-20mA or  $\pm 5$ mA, associated with measures of frequency, voltage and their rate values.

The connection, either remotely or locally, is guaranteed by numerous communication interfaces and a HMI display, keypad and LEDs.



## DV938EAC – Automatic Load Shed

**Two modes of operation and numerous configurable thresholds**

In this page are listed the trip and stop thresholds in the two operating modes. Each trip and stop threshold can be configured as a minimum or maximum threshold.

The thresholds of frequency, as well as those of voltage for the operating mode M2, and their threshold of rate value can be combined with logical operator AND or OR. The exclusion of the threshold implies the exclusion of the rate value threshold associated with it.

### Operative mode M1

#### Trip threshold

##### **Frequency (ANSI 81)**

Threshold available:	4
Range:	45÷55Hz
Step:	50mHz
Enable:	included/excluded
Periods of measurement:	4÷16
Periods selection:	software
Trip delay time:	≤100ms
User trip delay time:	0,1÷60s
Step:	50ms

##### **Frequency rate (ANSI 81R)**

Threshold available:	4
Range:	-5Hz/s ÷ +5Hz/s
Step:	100mHz/s
Logical operator with 81:	AND/OR
Enable:	included/excluded
Periods of measurement:	4÷16
Periods selection:	software
Trip delay time:	≤250ms
User trip delay time:	0,1÷60s
Step:	50ms

#### Stop threshold

##### **Min/Max voltage**

Threshold available:	3
Range:	0,1÷1,4V <sub>n</sub>
Step:	0,01V <sub>n</sub>
Enable:	included/excluded
Min/Max selection:	software
Stop delay time:	≤50ms
User hold time:	0,1÷60s
Step:	50ms

### Le soglie in modalità M2

#### Trip threshold

##### **Frequency (ANSI 81)**

Threshold available:	4
Range:	45÷55Hz
Step:	50mHz
Enable:	included/excluded
Periods of measurement:	4÷16
Periods selection:	software
Trip delay time:	≤100ms
User trip delay time:	0,1÷60s
Step:	50ms

##### **Frequency rate (ANSI 81R)**

Threshold available:	4
Range:	-5Hz/s ÷ +5Hz/s
Step:	100mHz/s
Logical operator with 81:	AND/OR
Enable:	included/excluded
Periods of measurement:	4÷16
Periods selection:	software
Trip delay time:	≤250ms
User trip delay time:	0,1÷60s
Step:	50ms

##### **Voltage (ANSI 27/59)**

Threshold available:	2
Range:	0,5÷1V <sub>n</sub>
Step:	0,01V <sub>n</sub>
Enable:	included/excluded
Trip delay time:	≤50ms
User trip delay time:	0,1÷60s
Step:	50ms

##### **Voltage rate (ANSI 27R)**

Threshold available:	2
Range:	-0,2V/s ÷ +0,2V/s
Step:	0,0005V <sub>n</sub> /s
Logical operator with 27:	AND/OR
Enable:	included/excluded
Time of measurement:	80÷200ms
Time setup:	software
Trip delay time:	≤120ms
User trip delay time:	0,1÷60s
Step:	50ms

#### Stop threshold

##### **Min/Max voltage**

Threshold available:	3
Range:	0,1÷1,4V <sub>n</sub>
Step:	0,01V <sub>n</sub>
Enable:	included/excluded
Min/Max selection:	software
Stop delay time:	≤50ms
User hold time:	0,1÷60s
Step:	50ms

##### **Voltage imbalance**

$$\beta = \max[(V_4 - \mu), (V_8 - \mu), (V_{12} - \mu)] / \mu$$

$$\text{with } \mu = (V_4 + V_8 + V_{12}) / 3$$

Threshold available:	1
Range:	0,05÷1
Step:	0,05
Enable:	included/excluded
Stop delay time:	≤50ms
User hold time:	0,1÷60s
Step:	50ms

##### **Maximum frequency difference**

$$\gamma = \max[(f_{V4} - f_{V8}), (f_{V8} - f_{V12}), (f_{V12} - f_{V4})]$$

Threshold available:	1
Range:	10÷100mHz
Step:	10mHz
Enable:	inclusa/esclusa
Stop delay time:	≤100ms
User hold time:	0,1÷60s
Step:	50ms





## DV938EAC – Automatic Load Shed

**SpyEAC: the software for local and remote device management**

### SpyEAC

The LogicLab software SpyEAC, usable on a Personal Computer Windows, is delivered with the device for parameterization, configuration and communication.

SpyEAC main features:

- ☐ Communication setup;
- ☐ Operation mode setup M1/M2;
- ☐ Rated voltage setup;
- ☐ Trip threshold setup;
- ☐ Stop threshold setup;
- ☐ Input labelling;
- ☐ Current loop transmitter setup;
- ☐ Realtime display tools for waveform, measures, statistics;
- ☐ Self diagnostic status;
- ☐ Configuration file upload;
- ☐ Recordings management;
- ☐ Firmware upload.

The communication settings allow the user to choose between a serial communication RS232 or Ethernet communications for connection to the device DV938EAC, the settings for Ethernet communications are valid for both 10/100BASE-TX both optical link 100BASE-FX.

Through SpyEAC you can configure the protections, setting the operating mode, the rated voltages, the trip and stop thresholds. For each threshold the user can set all the parameters.

To facilitate the user, for each input can be associated with a label for easier identification.

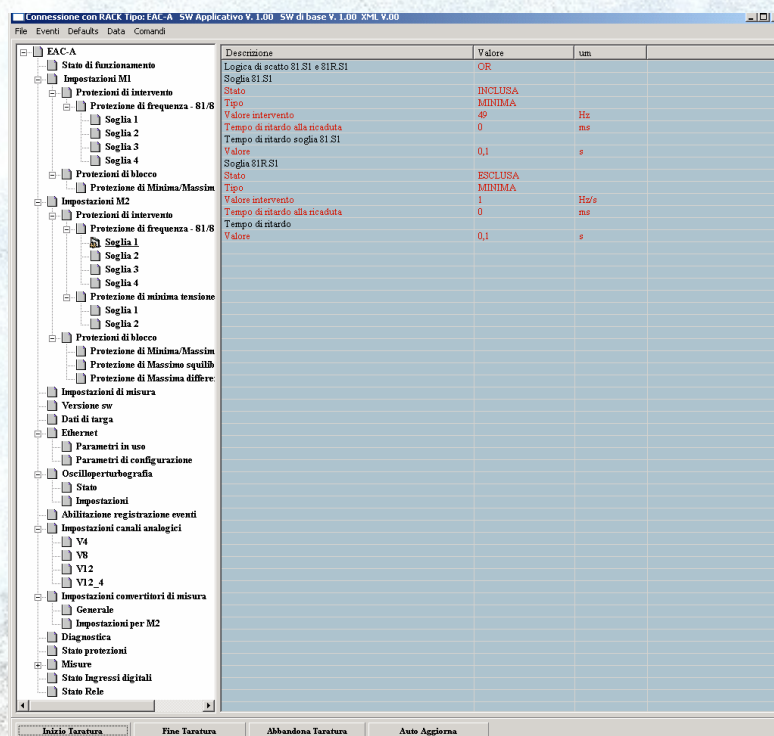


Each current loop transmitter can be configured as 4-20mA or  $\pm 5$ mA through a simple software command. In M2 mode, the user can assign to the output one of the three voltage of three phase system. Included in SpyEAC realtime tools providing a valuable interface for monitoring device and substation tools, the user can display voltage waveforms acquired and the measures waveforms (rms, frequency, derived voltage and frequency) calculated by DV938EAC.

SpyEAC provides the tools for off-line configuration of the device and then, to do the device setup, to upload a configuration file.

Another important tool supplied with the device is the fault recorder utility. Downloading the recordings saved by the DV938EAC is possible to analyze the phenomena of electrical network overload, the trip and stop condition.

Complete the SpyEAC tools the firmware upgrade utility.



## DV938EAC – Automatic Load Shed

### LogOscilloEAC: lo strumento di analisi registrazioni



#### LogOscilloEAC

From experience in Digital Fault Recorder (DFR) DV947 PowerProbe, for analysis of the recordings LogicLab deliver with the device a powerful tool. The software LogicLab LogOscilloEAC, usable on a Personal Computer Windows, allows the user to view, to print and to analyse the recordings previously downloaded with SpyEAC.

Every recording store all the voltage waveform, all measures (frequency, rms, rates), all alarms and all digital inputs.

A window, with simple controls, allows the user to select which waveforms and which alarms, display; it can also assign different colors to different signals.

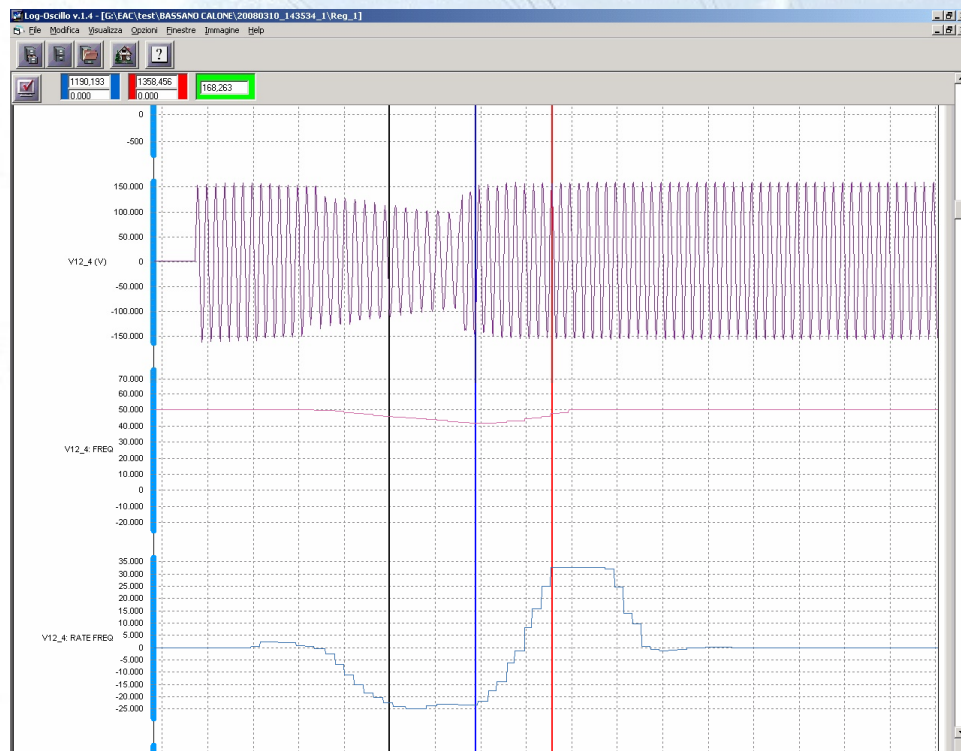
In addition to the waveforms and alarms, you can view the measure in time performed by the device, so the user can easily analyze the phenomenon recorded and the behavior of the device.

These operations are made easier through the use of simple tools:

- ☐ Zoom and unzoom utilities;
- ☐ Waveform overlapping;
- ☐ Time cursors;
- ☐ Time and amplitude value in time cursor position and mouse pointer position;
- ☐ Print waveform.

Among the auxiliary features, the software helps the user documents and reports editing through the export of recordings as images in the format that the user you prefer, or as a pdf.

LogicLab provide the utility that performs the function Export Contrade, which allows you to export recordings in the standard Contrade both in ASCII format and in BINARY format.





# DV938EAC – Automatic Load Shed

## Multiple solutions for local and remote connection

### Communication

The device is designed to interface with modern communication technologies and is designed to meet all the requirements for monitoring and remote management.

On the front side panel one RS232 port and 10/100BASE-TX Ethernet, while on the back a serial port (RS232/RS485) and an optical ethernet port 100BASE-FX (SC) enables the connection locally or remotely through multiple solutions.

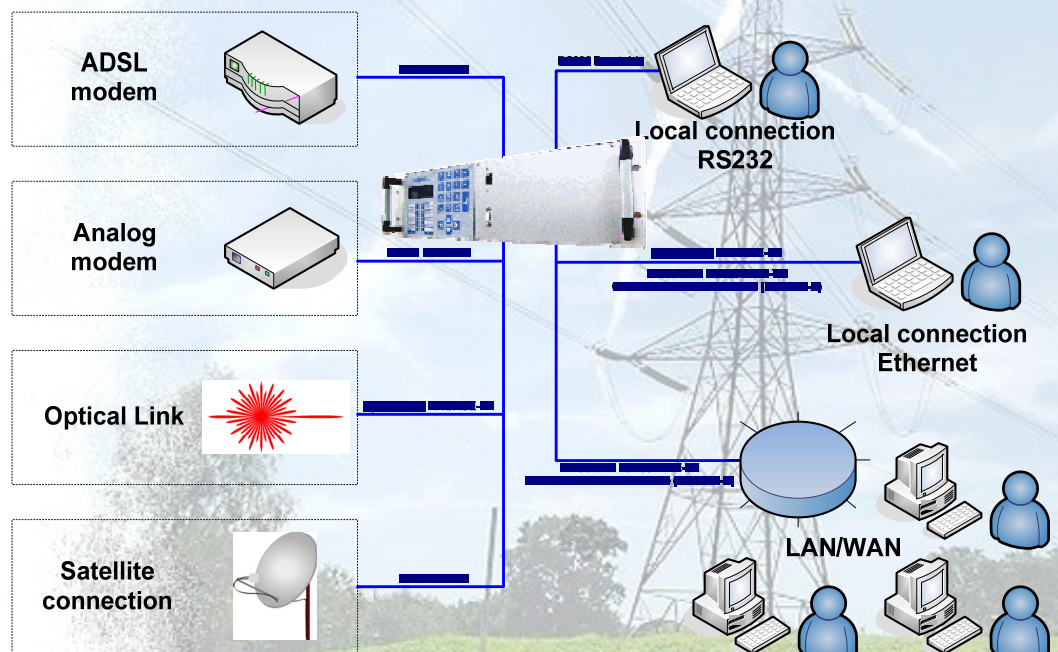
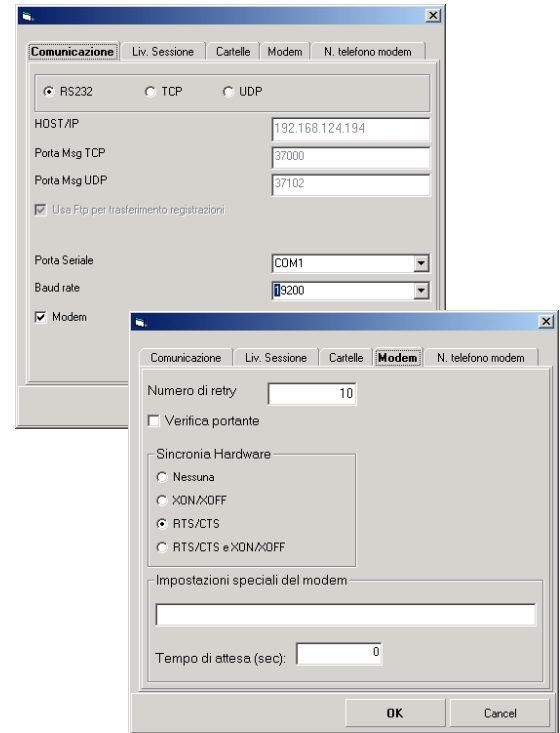
The RS232 connections and wired Ethernet are isolated (Ethernet 10/100BASE-TX: 1500Vrms - RS232/RS485: 2500Vrms), ideal for applications with high safety standards.

Through the serial port back is possible to connect an analog modem or GSM modem, which allows connection to a remote simply by entering the phone number.

The Ethernet ports allow you to use all the modern broadband connections. DV938EAC can be configured as a knot of a LAN/WAN using TCP-IP or UDP protocols. Once assigned the IP address and networked, any PC on the LAN can access the device with SpyEAC.

The Ethernet port can be used for broadband with an ADSL modem or a satellite modem connection where the land connection is a problem.

It is also possible to create a VPN (Virtual Private Network). With the VPN remote the remote device will be seen as if it were connected to the local network.



# DV938EAC – Automatic Load Shed

**Accuracy and reliability at an affordable price**

## Technical data

### Power Supply

Power supply voltage: 110V DC  $\pm$  20%  
 Medium power: 20W  
 Voltage dips and short interruptions  
     Insensitive to 100% of Vaux for 50 ms (min)  
     Insensitive to 50% of Vaux for 100ms (min)

### Dimensions

Height / Width / Depth: 3U / 19" / 34cm

### Voltage inputs

#### 4 isolated voltage input channels

- 6 inputs on 3 voltage channels with fullscale 100V (M2)
- 1 inputs on 1 voltage channel with fullscale 400V (M1)

Dielectric strength 3000V DC (1 min)

Rated Voltage (Vn) M1: 57Vrms  
                                   100Vrms  
                                   400Vrms

Rated Voltage (Vn) M2: 57Vrms  
                                   100Vrms

Operating range: 0.01  $\div$  1.6 Vn

Rated voltage selection (Vn): software

Frequency Range: 10  $\div$  130 Hz

Permanent overload capability: 1.5 Vn

Transient overload capability - not measurable(<10s): 2Vn

Power dissipation: <1VA @Vn = 400V  
                           <0,1VA @Vn = 100V

Accuracy:

- RMS value:  $\pm$ 0,001 Vn
- Voltage rate:  $\pm$ 0,002 Vn/S
- Frequency:  $\pm$ 0,002 Hz @ Vn  
                   <0,01 Hz @ V>0,3Vn  
                   <0,02 Hz @ V<0,3Vn
- Frequency rate:  $\pm$ 0,002 Hz/s

### Alarms (digital outputs)

#### 15 Relays

- Out of order
- 81/81R Threshold 1
- 81/81R Threshold 2
- 81/81R Threshold 3
- 81/81R Threshold 4
- 27/59/27R Threshold 1
- 27/59/27R Threshold 2
- Stop threshold Min/Max voltage and/or voltage imbalance
- Stop threshold maximum frequency difference
- 27/59/27R/81/81R Threshold 1
- 27/59/27R/81/81R Threshold 2
- 81/81R Threshold 3 and/or 4
- General alarm
- Relay available on connector C1
- Relay available on connector C2

Dielectric strength 3300V DC (1 min)

Rated voltage: 110V

Rated current: 5A

Maximum Switching Capacity (L/R=40ms): 0,5A @110V

Endurance (mechanical):  $\geq 10^7$

### Digital inputs

#### 2 isolated inputs

- Input signal close status HV switch (Red line)
- Input signal close status HV switch (Green line)

Dielectric strength 33000V DC (1 min)

Threshold voltage: 60V  $\pm$  10%

Input Voltage (max): 140V

Time resolution: 1 ms

### Current outputs

#### 4 current loop transmitters

Dielectric strength 33000V DC (1 min)

Current range: 4-20mA or  $\pm$ 5mA software selectable

Accuracy: <0,5%

Transient: <200ms

Maximum load: <2K $\Omega$  @  $\pm$ 5mA

<1K $\Omega$  @ 4-20mA

### Communication

HMI with 4 lines display and keypad

16 LED

Local and remote interface

Ethernet 10/100 BASE-TX with auto MDI/MDI-X

Ethernet 100BASE-FX (SC) - optical link

Configurable as knot of a net LAN/WAN

1 RS232 front side (19.200 baud fixed)

1 RS232 back side (up to 115.200 baud)

Remote connection with analog modem (not included)

Isolated communication port

(Ethernet: 1500Vrms – Serials: 2500 Vrms)

Field connection with 50 pins rectangular connectors

### Customizing

Power Supply with different input voltage

Different full-scales on voltage inputs on client demand

Up to 6 digital inputs available for custom application

24V digital input with threshold 18V  $\pm$  10%

Custom range for current outputs

HMI multi functions

Additional Ethernet port 10/100BASE-TX backside

ST connector for ethernet 100BASE-FX optical link

Configuration parameters and thresholds are modifiable at the request within the limits of the device

Integrated WebServer for parameterization with Internet Browser

FTPserver for record download

Different range for recording time

AC digital input

Optional relay outputs

Different logical assignments to alarm

### Standards and specifications compliance

IEC 61000 – 4 – 2 (Level 3)

IEC 61000 – 4 – 3 (Level 3)

IEC 61000 – 4 – 4 (Level 3)

IEC 61000 – 4 – 5 (Level 4)

IEC 61000 – 4 – 6 (Level 3)

IEC 61000 – 4 – 8 (Level 5)

IEC 61000 – 4 – 10 (Level 3)

IEC 61000 – 4 – 12 (Level 3)

IEC 61000 – 4 – 16 (Level 4)

IEC 61000 – 4 – 17 (Level 3)

IEC 61000 – 4 – 29 (Level 3)

ENEL DV938

ENEL REMC01

ENEL REMC02

ENEL RMCE01

ENEL RCLIO1

CEI 45-5

CEI 70-1 IP30 (front) IP20 (case)

COMTRADE standard IEEE Std C37.111-1991

### Parameterization and device management software

#### SpyEAC

Communication interface selection (RS232, UDP, TCP, modem setup)

Software access configuration and folder management

Voltage input full scales setup

Device, Substation, voltage input labelling

Full TCP/IP Ethernet configuration parameters

Backside RS232 throughput configuration

Operating mode selection (M1/M2)

Trip and stop protection threshold setup

Output current setup

Digital input, relay output, protection status

Recording time setup (Pre-trigger time, fault time, post-fault time)

Memory configuration setup (circular buffer or full-fill buffer)

Recording extension setup (disable, on fault time, on post-fault time)

Self-diagnostic device state

Reset and trigger command from PC

Realtime viewing tools (analog and measure waveform, rms measure, statistic)

Automatic download scheduler

Firmware update wizard

Recording management (Id, Date and time, Length, Trigger condition with user label)

Easy-To-Use Recording management (single, selected, all recordings)

Device parameterization file management tools (off-line editing, default file, download file)

### Recordings analysis software LogOscilloEAC

Waveform selection wizard with colours assignment

Automatic selection filters for analog and digital inputs

Decimation value for waveform preview

Dual time cursor

Time and amplitude value in time cursor position

Cursor time difference

Time and amplitude value in mouse cursor position

Windows and vertical zoom tool

Drag-and-Drop capability for waveform overlapping

Signal processing and rms waveform visualization

Signal processing and true rms waveform visualization

Signal processing and spectrum visualization

Spectrum analysis with THD

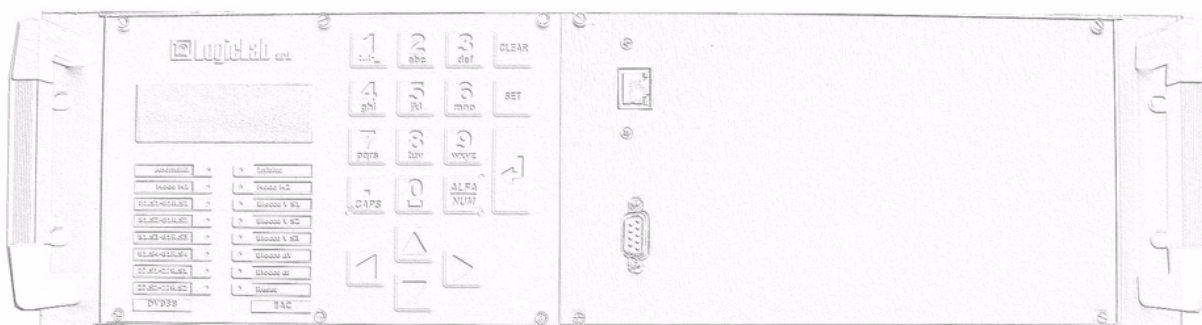
Waveform export tool for image (JPG, BMP, MetaFile, PCX, PostScript, SVG)

Waveform export tool for Acrobat Reader (pdf)

Samples waveform export tool for Excel







<http://www.logiclab.it/en/DV938.htm>

*Contact us for more information.  
The LogicLab staff will be happy to assist you.*

***the images in the document are from software in italian version,  
english version have the same features***

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