

DPX-V5

RMU Over current Protection Relay

DPX
Series



Catalogue

Intelligent Measuring & Protection Device

Index

1	Introduction
2	Design
2.1	Operation
2.2	Analog Input
2.3	Front Panel
2.4	Keypads
2.5	LEDs
2.6	Fault Recording
2.7	Event Recording
2.8	Trip Output
2.9	Flag Indicator
2.10	DI : Remote Trip
2.11	Assignment of the output DO's
3	Front Communication
4	Protection Functions
5	Display Mode
6	Battery Pack
7	Horizontal & Vertical Models of DPX
8	Connection Diagram & Terminal Details
9	Technical Data
9.1	Measuring Input
9.2	General Data
9.3	Protection Settings
9.4	Front Communication
9.5	Group Setting
9.6	Cold Load Pickup Setting
9.7	Protection Harmonic Block Setting
9.8	Display Mode Setting
9.9	DO Assignment
9.10	DO Reset
9.11	Communication Setting
9.12	Accuracy
9.13	Relay Contact Rating
9.14	Model Selection Table
9.15	Tripping Characteristics (IEC 255-3 or BS 142)
9.16	Certified Type Test
10	Dimensional Details of Vertical Model
11	Dimensional Details of Horizontal Model
12	Ordering Information

1. Introduction

In the family of protection relay, DPX is numeric multi powered Over-current relay specially designed for ring main units & feeder protection. It combines the following functions in one unit:

DPX is a high tech and cost optimized protection relay for MV switchboards. Specifically in compact switchboards, the DPX can replace the combination of load break switch.

- Relay get energize either from Current, Aux. voltage, Front USB or Internal battery (whichever is available)
- O/C, S/C, E/F and E/F High set protection
- DEFT and Inverse characteristics for O/C and E/F, individually selected for Phase and Earth fault
- Unbalance / Asymmetric Protection
- Potential pulse output for direct triggering the circuit breaker coil.
- Remote Trip DI
- 2 Potential DO Output Contact
- USB port for PC / Laptop Interface
- Circuit Breaker Failure Protection (50BF)
- Cold Load Pickup Protection
- Wide operating ranges of the auxiliary supply voltage (AC/DC)
- Last 5 Fault & 10 Event records with Time stamp
- Two set of setting group

2. Design

Relay will get energized from any of the following available sources

- Aux. Supply
- CT Current
- Internal Battery
- USB Port

In the absence of Aux supply/Battery voltage/USB, LCD will get energized, if CT current is 10% of rated current or above. Trip coil will be operated, if CT current in single phase is at least 20% of rated current or 15% of rated current in three phases. Relay is not powered from Earth CT, so for earth fault protection, phase current is mandatory.

Note: Battery works when no other supply is present i.e. in the absence of Aux Supply and Current.

2.1 Operation

The DPX is a CT operated protection relay with inverse time and definite time protection characteristics.

DPX works with standard CTs with secondary current and with defined VA burden.

DPX provides following protection functions:

- 3 Phase definite time over current and short circuit protection with variable tripping times (ANSI 50/51)
- 3 Phase over current protection with selectable inverse time characteristics and definite time short circuit current element (ANSI 50/51)
- Definite time and inverse time earth over current protection (ANSI 50N/51N).
- Cold Load Pickup
- Circuit Breaker Protection

DPX is provided with three analogue measuring inputs.

The DPX is provided with an input for remote tripping. Tripping is realized via the electric impulse output.

A flag indicator can be installed for signaling occurrence of trip conditions.

Pickup activation of the relay is signaled by a LED on front panel.

2.2 Analog Input

The analog input signal of the CT secondary currents as per the terminal detail in Section 8, are fed to the protective device via separate input transformers. The continuously measured current values are galvanically isolated, analog & digitally filtered and finally fed to the analog/digital converter to get the True RMS value.

2.3 Front Panel

The front panel of the protective device DPX-V5 comprises the following operation and indication elements:

- LCD display with Back light.
- Keypad for setting of the parameters of the relay.
- 2 LED's, 1 LED for Trip Ready/Hardware error annunciation and other LED for Trip/Pickup indication.

2.4 Keypads

The front panel keypad consists of five soft-touch keys. These keys are marked as “▲”, “▼”, “RESET/ENTER”, “” & “”. The “RESET/ENTER” key provides reset function to the relay on long press and “RESET/ENTER” also act as Enter key for MMI.

“” key is used to turn ON the LCD and back-light. When available source (Aux supply, CT current, USB port) is present and no key is pressed for 1 min then LCD gets off.

“” Key is used to ON the LCD when the available source is only battery.

Note: Under Self powered condition (i.e. absence of Auxiliary Supply), Back-light will be available in product if current is more than 20% in all phases or 40% in single phase by pressing “” Key.

Note: Relay goes into sleep mode, user has to press  key to see the display.

2.5 LEDs

There are 2 LEDs on the front panel, In which one is bi-color LEDs (Green/LED).

Trip ready/HW error LED flashes green when it has sufficient energy to operate the Trip coil. Red is the steady indication for HW error

Trip/Pickup LED: Red flashing indicates the Pickup of protection. Red steady indicates the Trip on faulty conditions.

2.6 Fault Recording

DPX records last 5 Faults. In Fault, it saves following information in non-volatile memory.

Value at fault	:	L1, L2, L3, E in Amps
Type of fault	:	SC / OC / Unb / CBFP
Time stamp	:	HH:MM:Sec
Date stamp	:	DD:MM:YY
Trip time of fault	:	xxxxxx Sec

2.7 Event Recording DPX-V5 records last 10 events. It saves following information:

Event Type	:	01
Date	:	DD:MM:YY
Time stamp	:	HH:MM:Sec

* Event Type = 01 (Power ON)

2.8 Trip Output

In presence of Aux supply:

2 Potential Free contacts and 1 Potential O/P (24V@0.2Ws). Duty cycle will depend upon the strength of available current.

In presence of only adequate CT current:

1 Potential Output (24V@0.2Ws). Duty cycle will depend upon the strength of available current.

2.9 Flag Indicator

An output similar to above is provided for operating a magnetic flag (24V@0.02 Ws).

(In presence of only adequate CT current)

2.10 DI : Remote Trip

Irrespective of any pickup or fault user can trip the Circuit breaker, by applying voltage to Remote trip DI also.

2.11 Assignment of the Output DOs

DPX-V5 have 2 output DO's which are user programmable and available only with auxiliary supply. DO reset operation can be configurable in automatic reset or manual reset mode from MMI. In automatic reset mode DO will be reset after the current goes below the pick-up level. In manual mode DO will be reset by pressing reset button.

3. Communication

3.1 RS-485 Communication

The DPX-V5 includes an RS-485 communication port This port is available for MODBUS protocol. DPX-V5 relay has feature to transmit the data such as settings, measurements and faults to the SCADA system. For this communication auxiliary supply is required. A communication failure dose not affects protection function.

3.2 USB Front Communication

The front USB communication port is designed for "CSE LIVELINK" for which the front end Software is provided. The S/w has features of retrieving the records and changing the settings

Note: Relay is plug & play on USB port. It automatically get energizes from USB port itself.

4. Protection Functions

DPX offers 50/51 / 50N/51N / Unbalance / CBFP protections / Cold load pickup.

Over-current Characteristic : DEFT/VINV/EINV/ NINV3.0 /NINV1.3, LINV, RI, HV-FUSE.

Unbalance Protection(46):

This is provided by the relay tripping in phase unbalance greater than setting % difference in terms of maximum phase current Unb: $[(IMAX - IMIN) / IMAX] \times 100[\%]$.

Circuit Breaker Failure Protection [CBFP]

The C.B. failure protection is based on supervision of phase current during tripping events. This protective function becomes active only after tripping. The criteria is whether all phase currents are dropped to below $5\% \times I_n$ within set time of tCBFP. If not, then CB failure is detected.

Cold Load Pickup

In DPX unit, this feature is provided to avoid non desired trips, when line de-energised for a period of time and re-energised later, the load exceed the protection setting without the presence of a fault. To avoid such condition, DPX switches from one protection setting group to another setting group for settable time. After expiry of settable time, it will shift back to original group.

Harmonic based Protection Blocking

To avoid any nuisance tripping, DPX provides harmonic detection & protection blocking feature above 25% and takes 4 cycle to sense the harmonic injection. Relay will hold the tripping for a set time, If harmonic is present with protection pickup. Blocking time & harmonic selection is configurable in the relay.

5. Display Mode

DPX-V5 works in two modes (AutoOFF/Live)

AutoOFF Mode: LCD gets on by pressing back light key & gets off after 1 minute if no key is pressed.

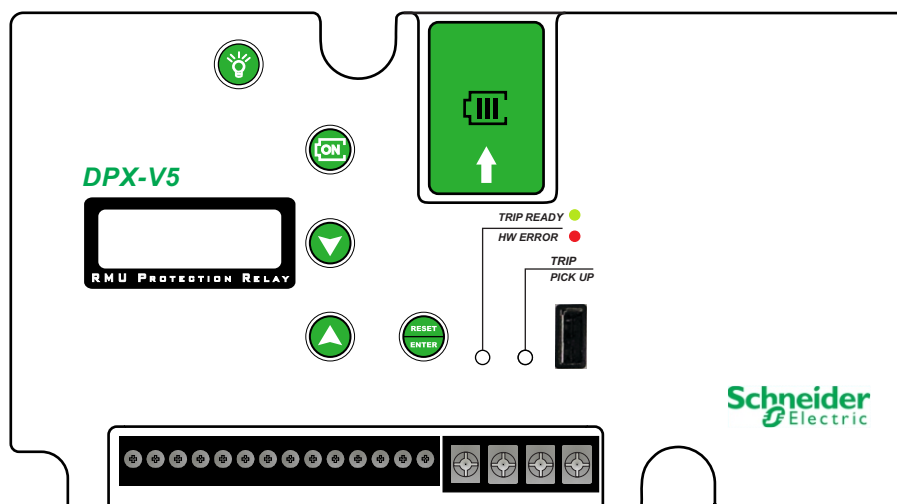
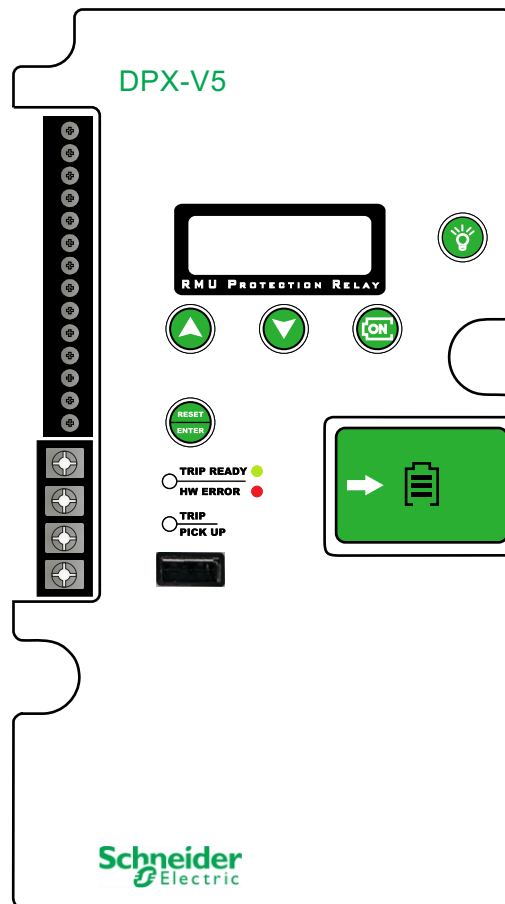
Live Mode: LCD remains on as long as auxiliary supply / phase current is available.

6. Battery Pack

DPX-V5 comes with internal lithium battery pack, which energises its LCD display to view and set the parameters at the time of initial installation especially when the current/voltage is not available in the RMU/switchgear. This battery has a life and so it is not meant for long future use. If the battery is dead, the operator can fetch the fault record data or edit/view the settings using a external USB powerpack which can be plugged to front USB of the relay. User can operate the relay using USB power source. USB powerpack can be supplied as an optional item or the user can use a standard USB power source.

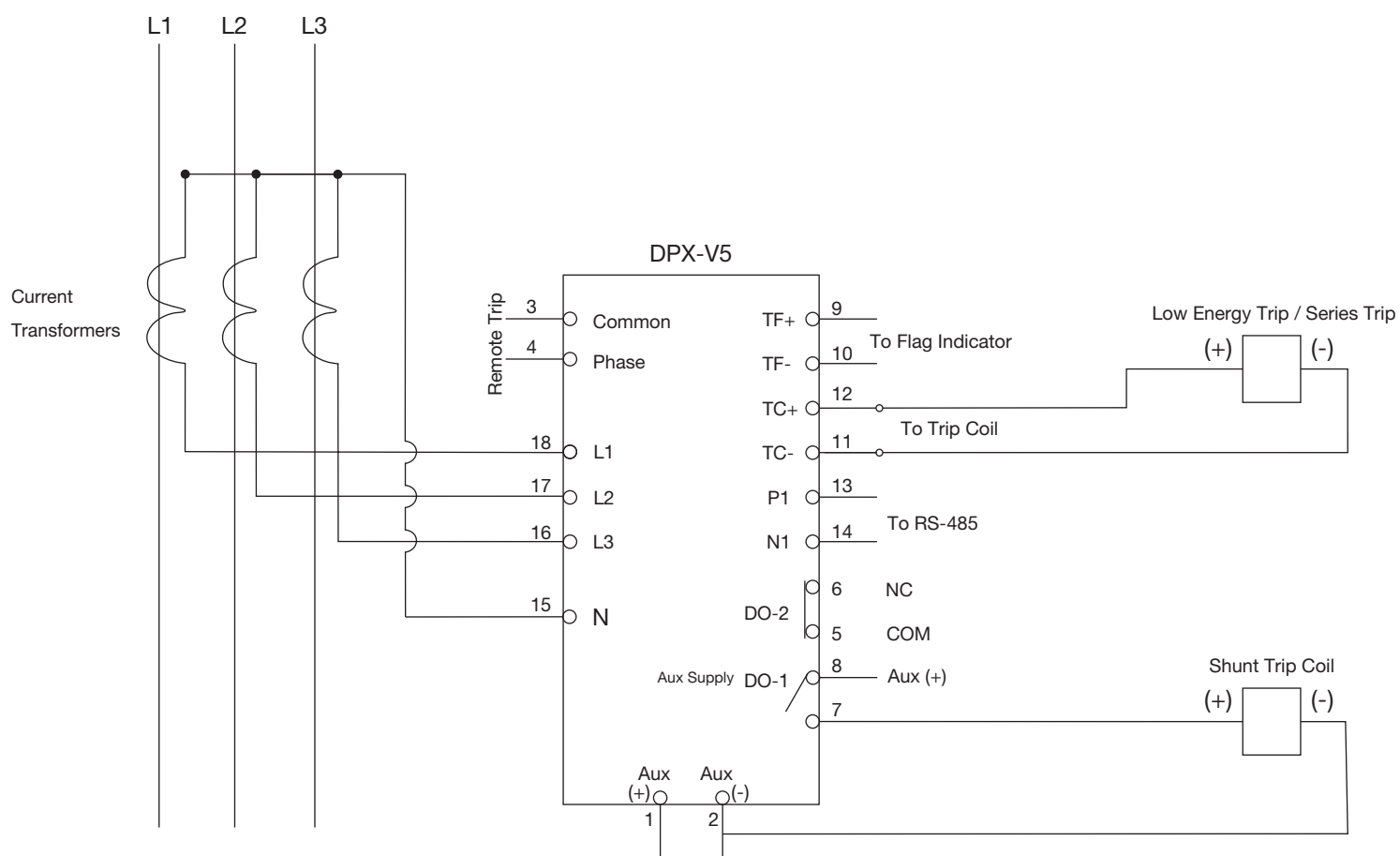
Note : Please note that the DPX-V5 will not charge the battery.

7. Horizontal & Vertical Models of DPX-V5



8. Connection Diagram & Terminal Details

The following shows the terminals back of DPX



Terminal Description

Terminal No.		Terminal Description
1	:	Auxiliary Supply (P)
2	:	Auxiliary Supply (N)
3	:	Remote Trip Digital Input (Common)
4	:	Remote Trip Digital Input (Phase)
5	:	DO-2 (Common)
6	:	DO-2 (NC)
7	:	DO-1 (Common)
8	:	DO-1 (NO)
9	:	Trip Flag (+)
10	:	Trip Flag (-)
11	:	Trip Coil (-)
12	:	Trip Coil (+)
13	:	RS-485 (Com+)
14	:	RS-485 (Com-)
15	:	Neutral
16	:	L3 Phase
17	:	L2 Phase
18	:	L1 Phase

9. Technical Data

9.1 Measuring Input

Rated data	Rated current I_N (1A/5A)		
Frequency:	FN: 50/60 Hz		
Thermal withstand capacity (for $I_N=1A$)	Continuous	:	2.5A
	10s	:	15A
	1s	:	80A
Thermal withstand capacity (for $I_N=5A$)	Continuous	:	10A
	10s	:	40A
	1s	:	80A

VA Burden: (2.5VA @ Rated Current)

9.2 General Data

Rated auxiliary voltage U_H	Universal:	L1: (18V - 40V DC) H: (85V - 260V AC / 100V to 300V DC)
Rated supply for digital input	Normal voltage U_N	L1: 24V DC ($\pm 20\%$) H: (85V - 260V AC / 100V to 300V DC)
Power consumption of Aux supply Quiescent approx. 3W		Operating approx. 6W
Dropout pickup ratio	> 95 %	

9.3 Protection Settings

Parameter	Display	Setting Range	Step
CT Ratio for primary current display	Ct Rt	1-2500	1
Frequency	Freq	50/60Hz	1
Phase Characteristics	PChr	DEFT, EINV, VINV, NINV3.0, NINV1.3 LINV, RI, HV-FUSE	1
Earth Characteristics	EChr	DEFT, EINV, VINV, NINV3.0, NINV1.3 LINV, RI, HV-FUSE	1
1 st Stage phase pickup	I>	0.20 – 2.5 x I_N	0.01 x I_N
DEFT Trip time for 1 st stage over-current	t>	0.1 – 150 s	0.01 s
Inverse TMS for 1 st stage phase over-current	ti>	0.01 – 1.500	0.005
2 nd Stage phase pickup	I>>	0.5 – 30 x I_N	0.05 x I_N
2 nd Stage phase trip time	t>>	0.03 – 20 s	0.01 s
Earth fault 1 st stage pickup	Ie>	0.05 - 2.5 x I_N	0.01 x I_N
DEFT trip time for 1 st stage earth fault	te>	0.05 - 150 s	0.01s
Inverse TMS for 1 st stage earth fault over-current	tie>	0.01 – 1.500	0.005
2 nd Stage earth fault pickup	Ie>>	0.5 – 15 x I_N	0.05 x I_N
2 nd Stage earth fault trip time	te>>	0.04 – 20 s	0.01s
Phase unbalance pickup	Unb	5 - 80%	1%
Phase unbalance trip time	tUnb	0.1-150 s	0.01 s
Enable CBFP protection	CBFP	YES / NO	-
CBFP time	tCBFP	0.05-2.0 s	0.01 s

9.4 Front Communication

Front Port	CSE protocol with “CSE LIVELINK” on USB cable type A/A
------------	--

9.5 Group Setting

Parameter	Display	Setting Range
Group No.	ACT.GRP	Group1 / Group2

9.6 Cold Load pickup Setting

Parameter	Display	Setting Range	Step	Unit
Selection of Cold Load Protection	CldLdPr	DISABLE/ENABLE	-	-
Cold Load Active Time	tCdLd	0.1-20	0.01	Sec

9.7 Protection Harmonic Block Settings

Parameter	Display	Setting Range	Step	Unit
Selection of Harmonic in Phase	PhHrmnc	2nd, 3rd, 5th & 7th	-	-
Selection of Harmonic in Earth	ErtHrmn	2nd, 3rd, 5th & 7th	-	-
Blocking Time in Phase Harmonic	PTmBk	0.10-20.00	00.01	Sec
Blocking Time in Earth Harmonic	ETmBk	0.10-20.00	00.01	Sec

9.8 Display Mode Setting

Parameter	Display	Setting Range	Step	Unit
Display Mode	MOD	AutoOFF/Live/Test	1	-

9.9 DO Assignment

Parameter	Display	Setting Range
Over current	I>	DISABLE/DO1/DO2/DO1DO2
Short Circuit	I>>	DISABLE/DO1/DO2/DO1DO2
Earth Low set	Ie>	DISABLE/DO1/DO2/DO1DO2
Earth High set	Ie>>	DISABLE/DO1/DO2/DO1DO2
Unbalance	Unb	DISABLE/DO1/DO2/DO1DO2
Circuit Breaker Failure Protection	CBFP	DISABLE/DO1/DO2/DO1DO2
Digital Input	Remote	DISABLE/DO1/DO2/DO1DO2
All Fault	AlFlt	DISABLE/DO1/DO2/DO1DO2

9.10 DO Reset

Parameter	Display	Setting Range
Digital output1	DO1	Auto/Manual
Digital output2	DO2	Auto/Manual

9.11 Communication Setting

Parameter	Display	Setting Range
Slave Address	SLV Add	1-32
Baud Rate	BD Rate	9600/19200
Parity	Parity	NONE/EVEN/ODD

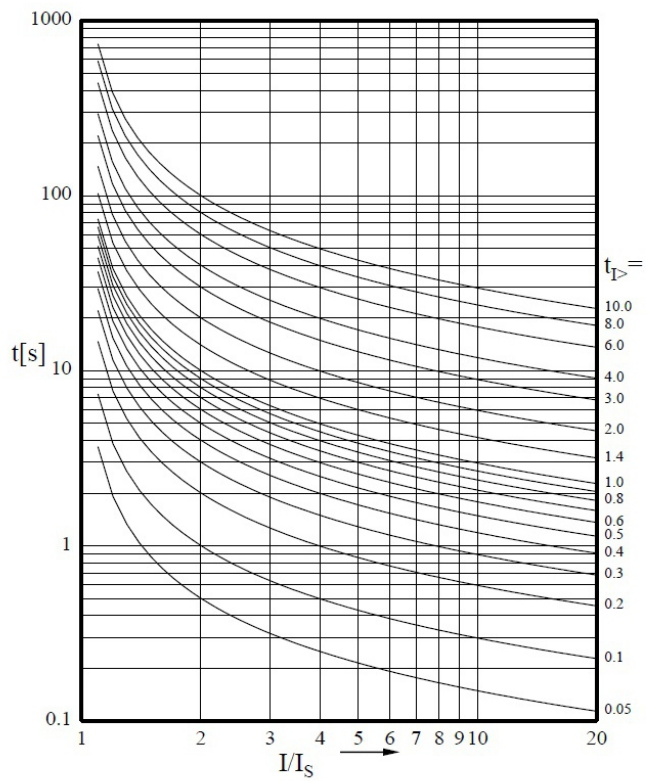
9.12 Accuracy

Tripping times with pre-fault : Pickup accuracy: Boot-up time in self powered mode	DMT: $\pm 5\%$ of the setting value or ± 40 mSec IDMT : Accuracy as per IEC-255-3 (2xIs to 20xIs) For VINV / NINV/RI : $\pm 5\%$ or ± 40 mSec For LINV/EINV/HV-Fuse : $\pm 7.5\%$ or ± 60 mSec +5% ≤ 100 mSec (with Event Recorder ≤ 300 mSec)
---	---

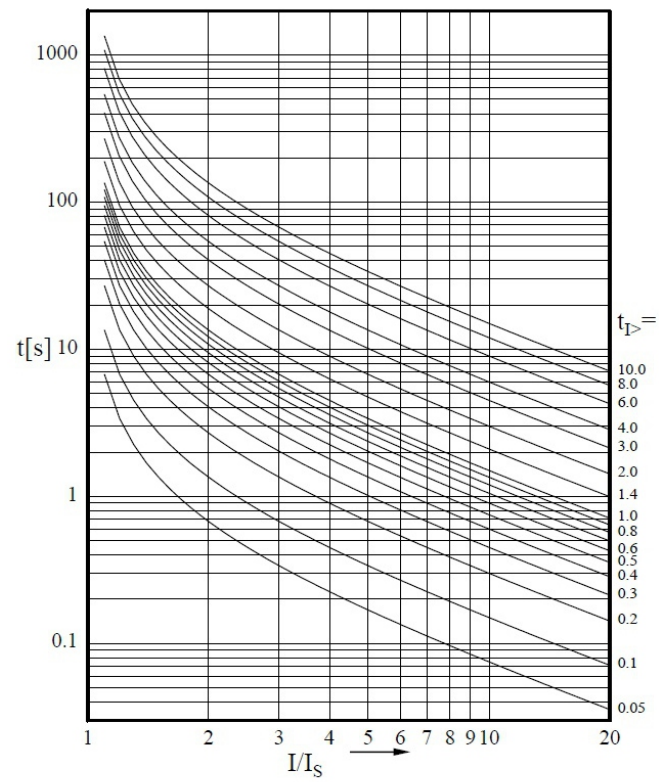
9.13 Measurement Accuracy

S.No	Description	Range	Frequency Range	Accuracy
1	Current	0.05 - 20 xIp	50 / 60 Hz	$\pm 2\%$ / ± 10 mAmp

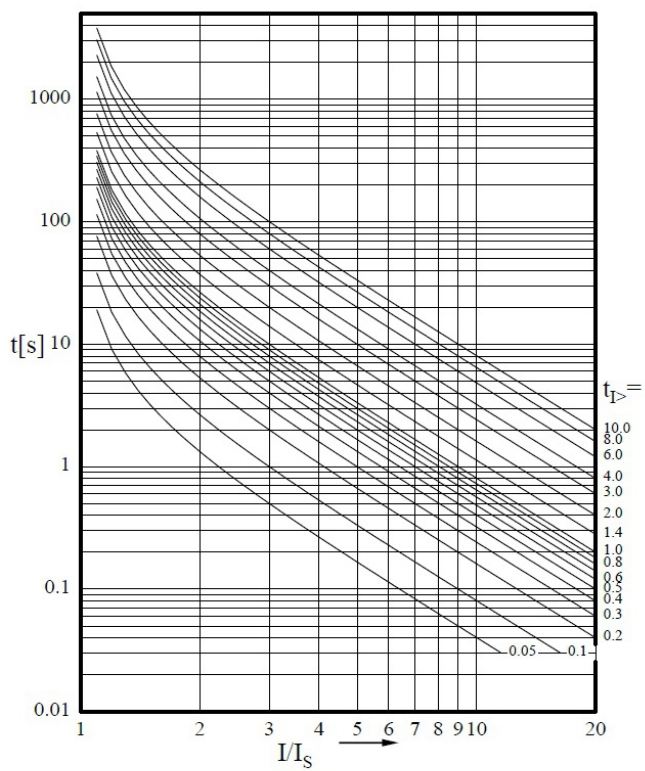
Inverse Time Characteristics



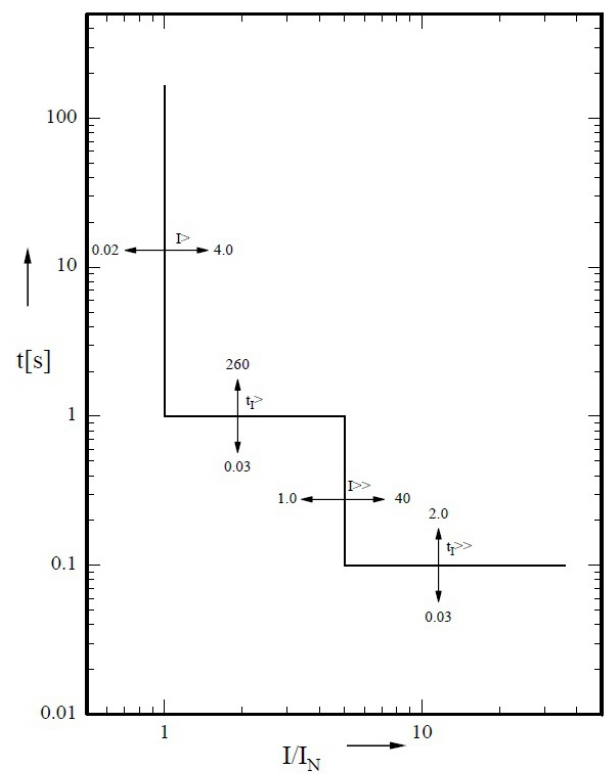
Normal Inverse



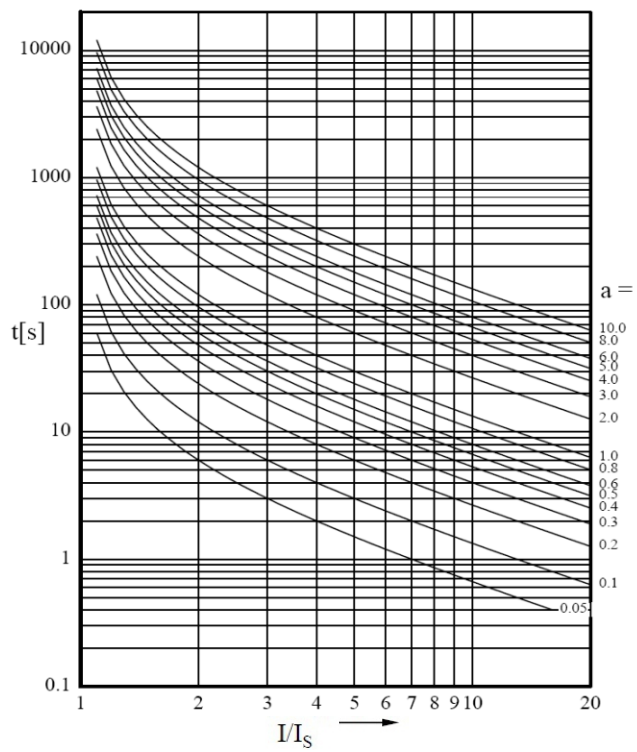
Very Inverse



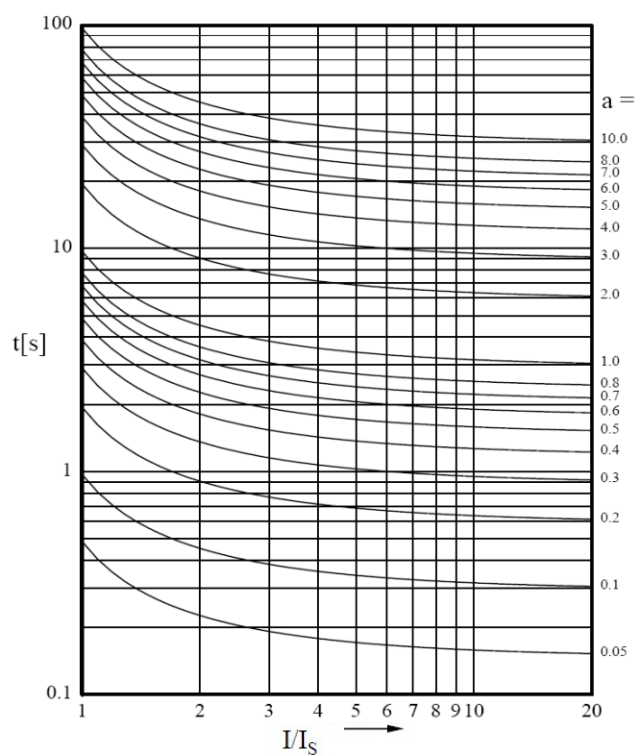
Extremely Inverse



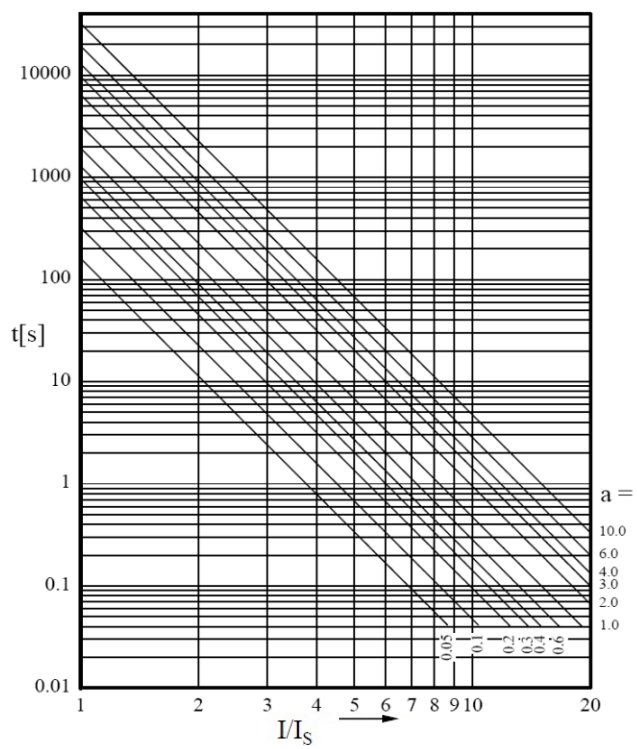
Definite time overcurrent relay



Long time inverse



RI-Inverse



HV-fuse

9.14 Relay Contact Rating

Contact rating	
Contact relay	Dry contact Ag Ni
Make current	Max. 16A for 1s
Carry capacity	6A continuous for All contacts
	Rated voltage: 260V AC/ 30V DC
Breaking characteristics	
Breaking capacity AC	1500VA resistive
	1500VA inductive (PF=0.5)
	220V AC, 6A (cos Ø ≤0.6)
Breaking capacity DC	135V DC, 0.3A (L/R=30ms)
	250V DC, 50W resistive or
	25W inductive (L/R=40ms)
Operation time	<10ms
Durability	
Loaded contact	30000 operation minimum
Unloaded contact	10000 operation minimum

9.15 Features available in DPX-V5

Feature		
Model		DPX V5
CT Rated Current (x In)	1A	Yes
Series Trip		Yes
Dual Power Supply (Self Powered + Auxiliary Powered)		Yes
Cold Load Pickup		Yes
Phase & Earth Over Current Protection		Yes
Circuit Breaker Failure Protection		Yes
USB Front Communication		Yes
Event/Fault Recorder		Yes
LCD display for current values & fault recording		Yes
Potential Free contacts min. 2		Yes
Remote Trip DI		Yes
Battery Backup		Yes
Output Trip Energy		24V@0.2Ws

9.16 Tripping Characteristics (IEC 255-3 or BS 142)

$$\text{Normal Inverse 3.0/1.3} = \frac{0.14/0.06}{(I / I_s)^{0.02} - 1} \times t_i \text{ [s]}$$

I: Injected current
Is: Pickup set level
ti: TMS for inverse characteristic
t: Definite delay in DEFT characteristic

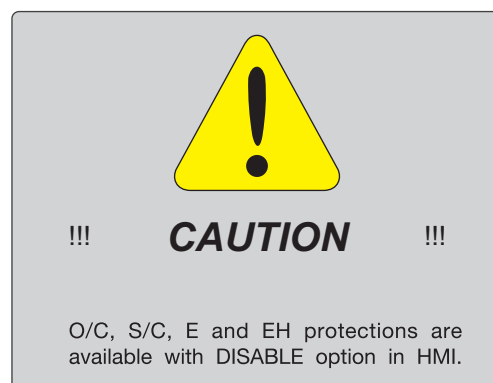
$$\text{Very Inverse} = \frac{13.5}{(I / I_s) - 1} \times t_i \text{ [s]}$$

$$\text{Extremely Inverse} = \frac{80}{(I / I_s)^2 - 1} \times t_i \text{ [s]}$$

$$\text{Long Time Inverse} = \frac{120}{(I / I_s) - 1} \times t_i \text{ [s]}$$

$$\text{RI Inverse} = \frac{1}{(0.339 - \frac{0.236}{(I / I_s)})} \times t_i \text{ [s]}$$

$$\text{HV Fuse} = 10^{\frac{(\log(2 I/I_s)(-3.832)+3.66)}{0.1}} t_i \text{ [s]}$$



9.17 Certified Type Test

Environmental conditions

(Recommended ambient temperature range)

Operating temperature range:

Continuous withstand -25 to +60°C

Limit (Note-1) -25 to +70°C. storage temperature
Range: -25 to +70°C

Note: The upper limit is permissible not for continuous period.

Mechanical Environment.

Vibration Test : IEC 60255-21-1, class 2.

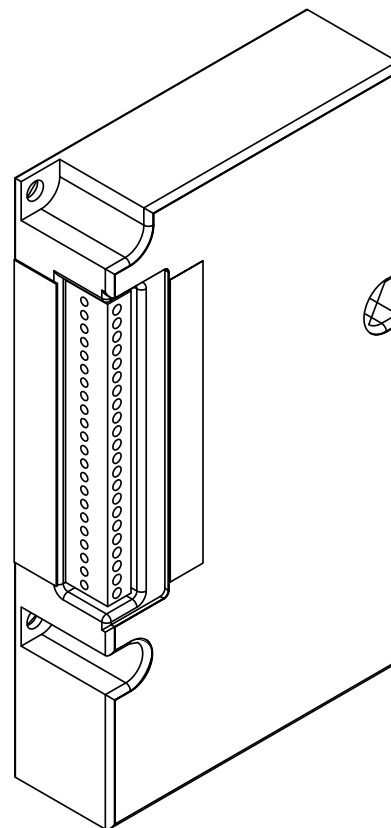
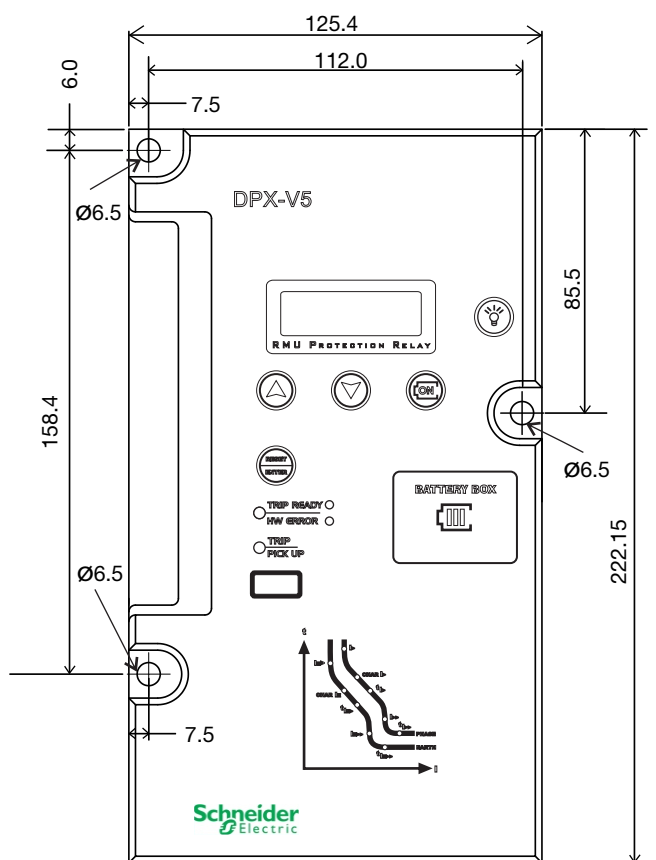
Shock : IEC 60255-21-2, class 1.

S.No	Description of Test	Standard
1	Insulation test	IEC 60255-5
2	Di-electric test	IEC 60255-5
3	5 KV impulse voltage test	IEC 60255-5
4	High freq. interference test severity class 3	IEC 60255-22-1
5	Radio interference suppression test	EN55011 cl 5.1.2
6	Radio interference suppression test	EN55011 cl 5.22.2
7	Radiated radio freq electromagnetic field immunity test	IEC 60255-22-3
8	Conductive RF immunity test	ENV50141
9	Surge immunity	EN61000.4.5
10	ESD test severity class 3	EN61000-4-2
11	Fast transient disturbance test	IEC 60255-22-4
12	Power frequency magnetic field immunity test	IEC 61000-4-8

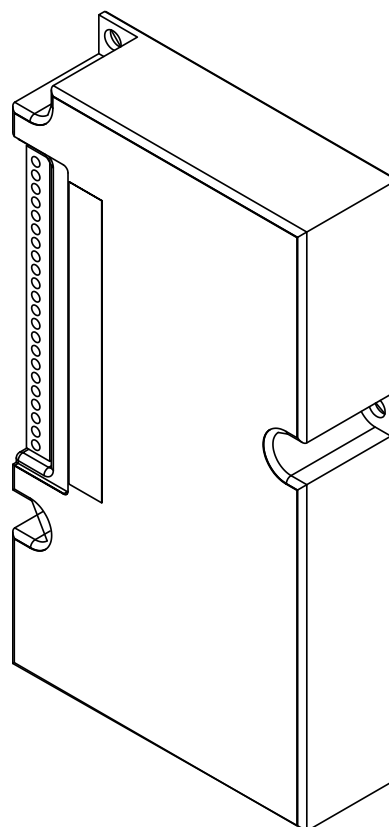
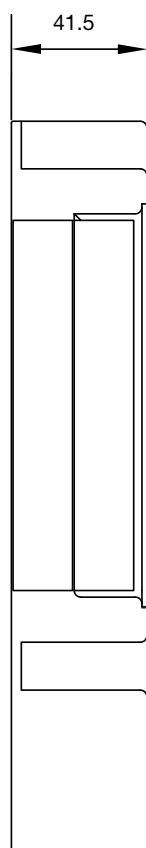
10. Dimensional Details of Vertical Model

(Gen. Tol. : ± 1.0 mm)

Front View

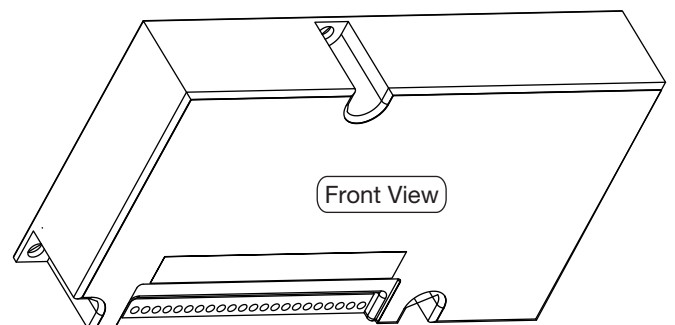
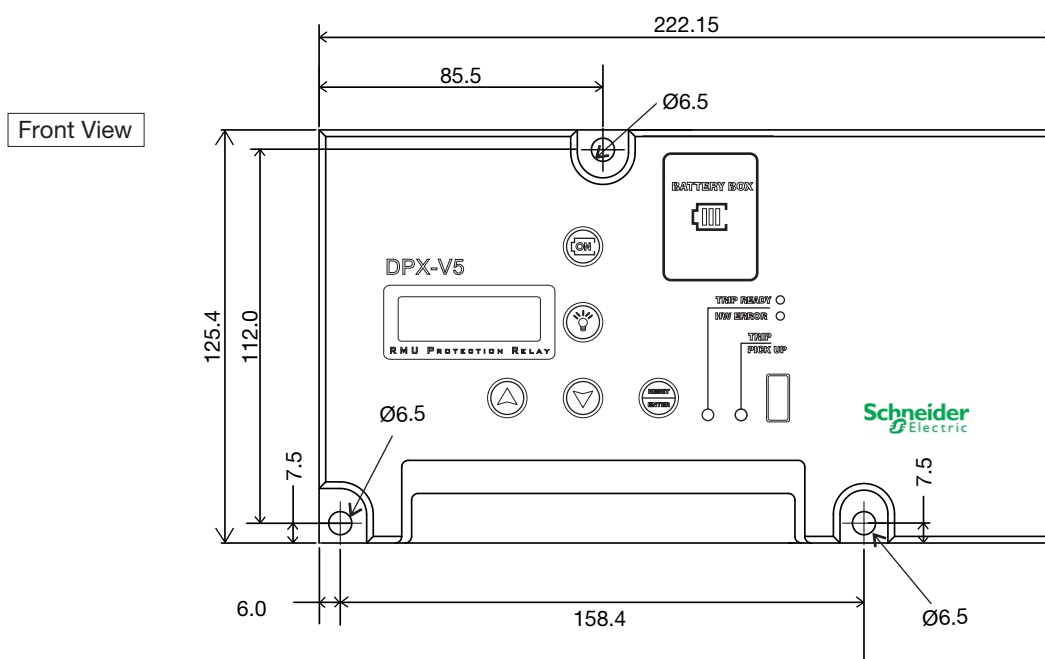


Side View

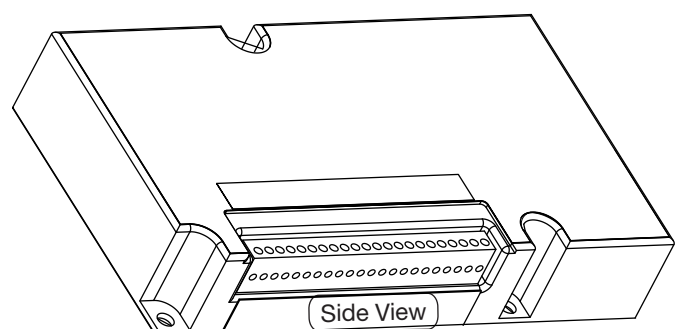
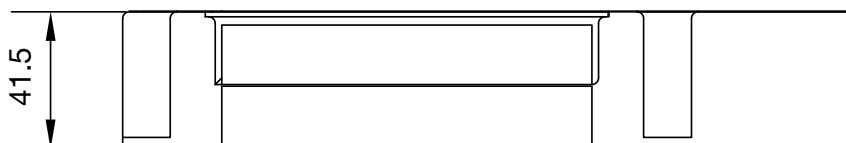


11. Dimensional Details of Horizontal Model

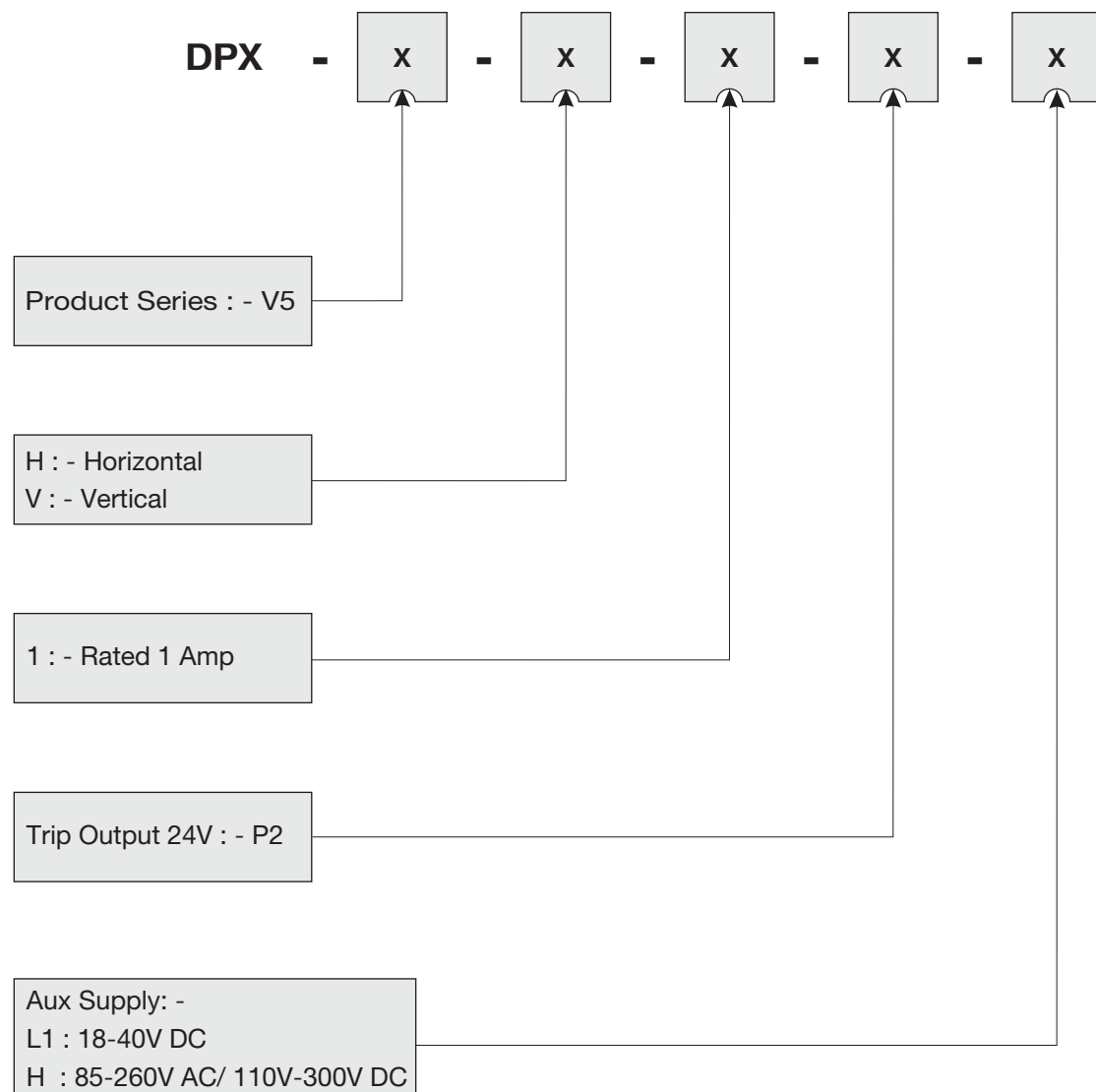
(Gen. Tol. : ± 1.0 mm)



Side View



12. Ordering Information



Revision History

[illegible]

Issue Date : 27.04.13
Rev. No : 30
Rev. Date : 29.11.14