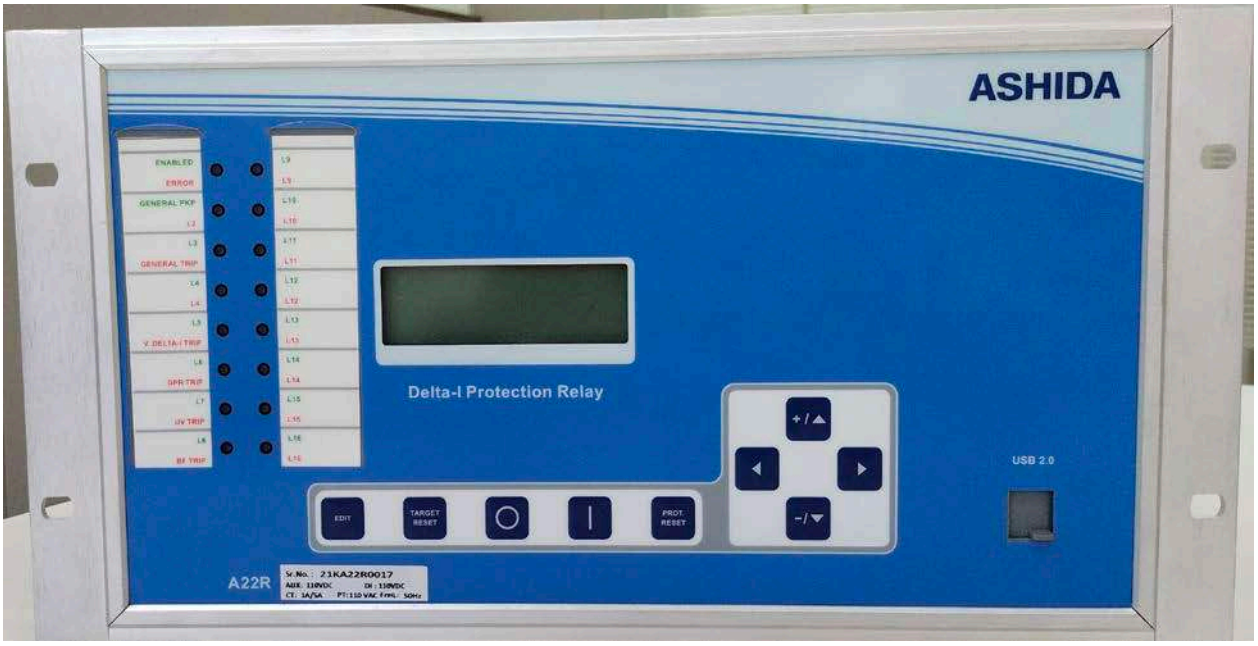


DELTA – I PROTECTION RELAY : A22R

Introduction:

ASHIDA has designed economical & reliable Multifunction A22R Protection & Control System. The simple and compact construction of ADITYA series A22R relay provides integrated Protection, Control and Monitoring.

A22R Delta – I Protection Relay specially designed for traction OHE protection as per RDSO Specifications TI-SPC-PSI-PROTCT-7101.

Functional Overview:

Key Protection & Control Functions:

- Two Independent Settings Groups.
- Delta – I Protection.
- Zone Distance Protections (21).
- Under Voltage Protection (27).
- Trip circuit supervision (TCS).
- Breaker Failure Detection (BF).
- Programmable Inputs & Outputs.
- 16 nos. of Programmable & Target LEDs for indications with dual colours.
- Self Supervision of relay.
- Metering function.
- Event Recording (1024 nos.).
- Fault Recording on HMI display (10 nos.).
- Disturbance Recording (10 nos.)
- Fully communicable with IEC standard open protocol IE C60870-5-103 & IEC 61850.
- SCADA communication.
- Single/Dual Ethernet ports (RJ45), RS485 port.
- PC front port communication for convenient relay settings.
- User friendly local operation with key pad.

- Large Liquid crystal display (20X4) with backlight.
- Password Protection.
- Measurement of Voltage, Current magnitudes, R, X & Z.

Software Support:

- Online / Offline Setting Editor.
- Programmable scheme logic Editor.
- Settings upload / download.
- Online Measurement.
- Disturbance analysis.
- Relay assistant for testing relay at site.

Applications:

The A22R is communicable ASHIDA Vectorial Delta-I Type High Resistive Fault Sensetive Relay which provides protection for AC Traction Overhead Equipment.

Delta I Protection:

The Delta I current is vectorial difference of present sample and historical sample. The time between these two samples is defined as sensitivity of relay. This time is adjustable from 20 ms to 200 ms in step of 5 ms.

To avoid relay mal-operation on sudden load changes the relay is equipped with 2nd harmonics restrain. If 2nd harmonics is more than set value the relay blocks tripping. Also relay monitor 3rd harmonics content, if load is having 3rd harmonic more than set value then relay operating value is automatically increased by preset value as given below.

$$\text{DS V. Delta I} = \frac{\text{V Delta I} * \text{DS setting}}{100} + \text{V. Delta I}$$

The relay also continuously sense the status of feeder protection relay through the MTR INPUT status and give trip command to the breaker only when the feeder relay failed to clear the fault which means if MTR status is high, Delta-I Protection , DeltaZ Protection , Backup DPR Protection and UV Protection will be blocked.

Delta-I relay also has a feature to detect the rate of change of impedance and operates accordingly if function is enable for rate of change of impedance. The rate of change of impedance and operating time is settable.

Backup Distance Protection Relay:

Relay is equipped with backup distance protection function based on impedance using parallelogram characteristic (on R-X plane) to avoid malfunction of relay due to load encroachment.

The A22R Relay applied to a AC traction power systems has three measurement inputs. One is the voltage between catenary and rail, other parameters are catenary and feeder measured currents. The impedance measured at the FS, for a catenary to earth fault is defined as:

Z=V / (I1 – I2) for 2x25 kV Relay

Z=V / I1 for Conventional Relay

Where

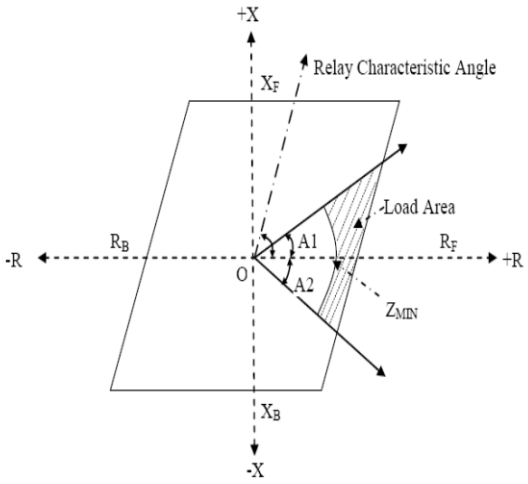
V (Train or Catenary): voltage measured between catenary and rail.

I1: Train (centenary) current in Ampere.

I2: feeder current in Ampere.

The relay continuously measures the impedance of the over head line. If the measured impedance falls into the relay Characterise under the fault condition, then the relay will generate the trip signal. In over head line applications, the margin to the load impedance may enter into relay characteristics then the relay may mal operate. This problem is called load encroachment.

The load impedance area of the polygonal is settable for non tripping in case impedance falls in this area. Polygonal on R-X plane characteristics having forward as well as reverse reach. The forward and backward Resistance (R) and Reactance (X) are settable individually. The protection logic compares the measure R & X value with is characteristic. If R, X value fall within then relay start tripping timer. If impedance is remain in polygonal during this time the relay issue a trip command. Polygonal (on R-X plane) characteristic as shown below;



Zone parallelogram characteristics

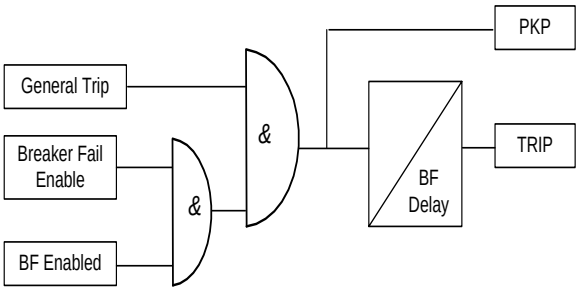
Under-voltage Detection:

The relay is also provided with under-voltage protection features, to prevent closure of the concerned feeder circuit breaker, when the OHE is already in the energized condition (for example, during a feed extension) to avoid any Wrong Phase Coupling between different sub-stations. The setting range is 20 to 110V in steps of 1V and operating time is 0 to 5sec. in the steps of 10msec.

Breaker Failure Detection:

Normally after tripping current should be come Zero with in 100 – 200ms time depend upon type of fault and breaker mechanism. After Fault A22R trigger internal timer (settable from 0.1s to 5.0s) If fault is not cleared during this time then relay declare as Breaker fail (LBB function). And change another contacts. These contacts Mark as BF can be used to trip back up breaker such as LV. or can be used to generate ALARM signal 2 NO contact are

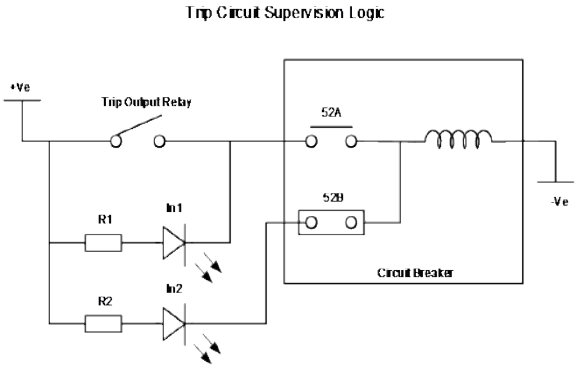
provided for tripping of CBs 1 NO for local Alarm and 1 NO for Tele signalling If more contact are needed then that can be provided using contact multiplication relay in panel.



Breaker Failure Logic

Trip circuit super vision:

In A22R we use two separate digital opto coupler status input in XOR gate which can be used to continuously monitor continuity of trip-circuit. The following diagram explain the logic of trip circuit supervision function.

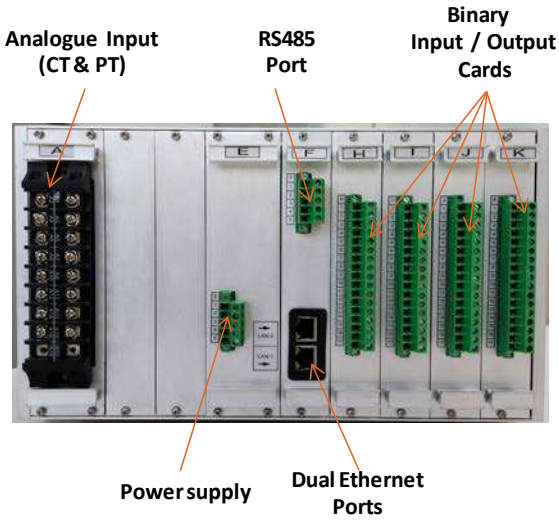


Trip Circuit Superversion Logic

Relay monitor continuity of trip circuit through either normally open (NO) or normally close (NC) contact of CB connected to opto isolator digital input assigned to TCS. If any discontinuity is observed, then the relay generates "TC FAULTY" Alarm after a certain time delay.

Programmable Inputs, Outputs & Logic:

The relay is provided with tool known as AproLogic, in which user can program their logics as per the requirement. All type of gates such OR/ NOR/ NOT/ NAND/ AND/ XOR/ XNOR/ SR Flip-flop and Counters are available along with Operating and Resetting Timer. For more details please refer to Instruction Manual.



Back side Terminals A22R

Programmable LEDs and Pushbuttons:

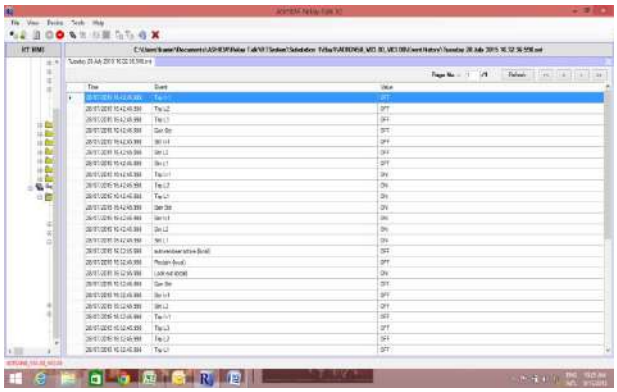
The A22R relay provides total 16 nos. of target and programmable LEDs with dual color indications. The LEDs can be programmed through PC software (RTV2 software).

The A22R also provides the programmable pushbuttons for circuit breaker close and

open from HMI of relay. Pushbuttons can be programmed through HMI or through RTV2 software.

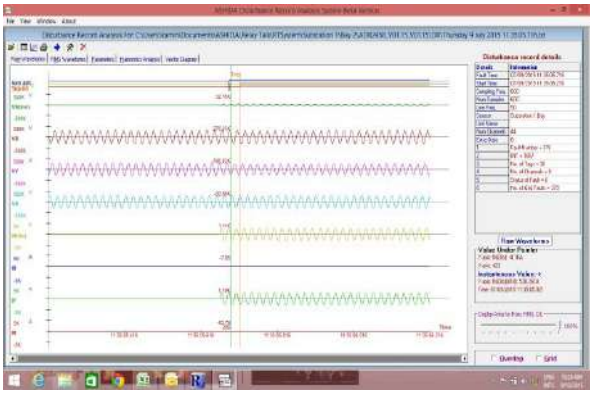
Event recording:

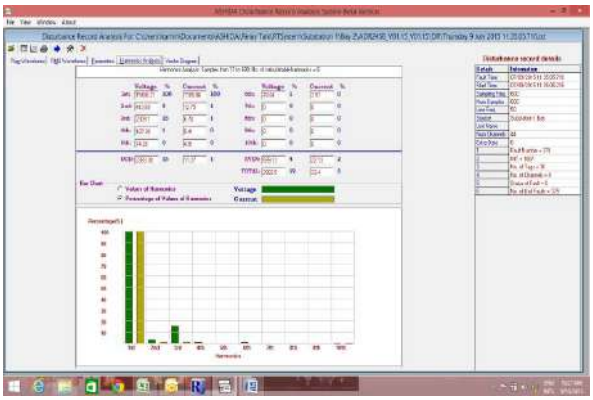
A22R relay provides a feature to record and store 1024 nos. of events (with event time stamping of 1mSec precision) in non-volatile memory through internally by protection and control functions and externally by triggering the digital inputs. And these can be extracted using communication port or can be seen on the LCD. The event can be triggered on time stamp through time synchronization or through internal clock setting.



Disturbance recording:

A22R relay provides built in disturbance recording facility for recoding analogue and digital channels. Relay records 10 nos. of disturbances and stores it in non-volatile memory. Disturbance records can be saved in IEEE COMTRADE format and same can be analyzed in disturbance analysis software.





Fault recording:

A22R relay provides fault recording facility. The fault records can be display either on HMI displayed or in RTV2 software. The relay can record 10 nos. of fault records in non-volatile memory.

Metering:

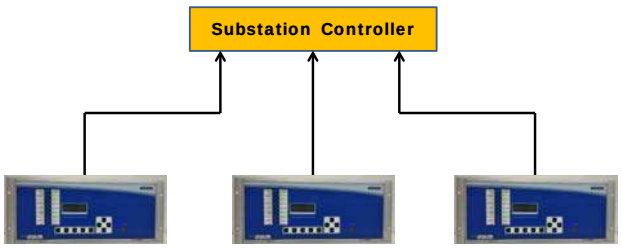
The online metering feature of the A22R relay provides metering of parameters such as current, voltage, R, X, and Z magnitude on the HMI display or in RTV2 software.

Independent Protection settings groups:

A22R relay provides two independent setting groups which allows the relay to operate on different power system conditions.

IEC 60870-5-103 Protocol:

A22R relay provides internationally standardized protocol for communication via RS485 port of protection relays. IEC 60870-5-103 protocol is used worldwide and supported by relay manufacturers.



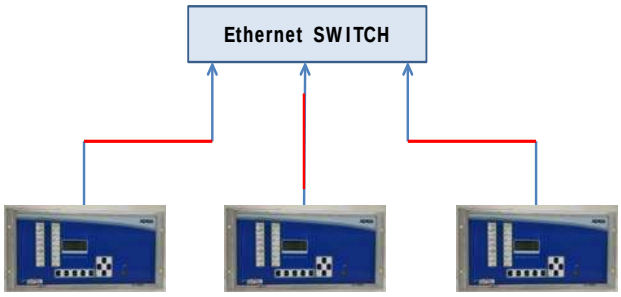
IEC 60870–5–103 star type RS232 copper conductor connection

Ethernate base Protocol:

A22R relay provides internationally standardized IEC61850 Protocol for substation automation via Ethernet port of protection relays (Ref ordering information for details)

IEC61850 GOOSE and Interoperability:

A22R support standard GOOSE messaging for relay to relay communication. Any logical (pickup , trip, etc) and physical (Digital Optical Isolated signal such CBNO /NC etc) can be publish via GOOSE configurator. A22R support total 16 simultaneous GOOSE signal which can publish and received by other relays having IEC61850 protocol. Similarly A22R can able subscribed total 16 nos of simultaneous signal published by other relays and can be use for interlocks. The A22R is tested for most of other make relays.



Relay Settings:

Global:

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ
2.	RID	-
3.	SID	-
4.	System Frequency	50Hz / 60Hz
5.	Opto I/P Supply	Read only
6.	Filter Time	0 to 100ms in steps of 1ms
7.	CB Operation	CB Open / CB Close / No Operation
8.	PB-1 Operation	Disabled/ Enabled / Time Enabled
9.	tPB-1 Pulse	0.10 to 50s in steps of 0.01s
10.	PB-2 Operation	Disabled/ Enabled / Time Enabled
11.	tPB-2 Pulse	0.10 to 50s in steps of 0.01s
12.	Config Port	PORT F/ PORT R / PORT 1
13.	Timesync Master	PORT F/ PORT R / PORT 1
14.	Description	Read only
15.	Model no	Read only
16.	Serial No	Read only
17.	Software Version	Read only
18.	Hardware Version	Read only
19.	Virtual Scheme 1	Disabled / Enabled
20.	Virtual Scheme 2	Disabled / Enabled
21.	Language	Read only

Settings Group

Sr. No	Parameter	Setting / Ranges
1.	Factory Defaults	No Operation / All Settings / Setting Group 1 / Setting Group 2
2.	Active Group	G1 / G2
3.	Copy From	G1 / G2
4.	Copy To	No operation / G1 / G2
5.	G1	Disabled / Enabled / Time Enabled
6.	GroupChange Delay	0 to 400.0s in steps of 0.1s
7.	G2	Disabled / Enabled / Time Enabled
8.	GroupChange Delay	0 to 400.0s in steps of 0.1s

PORT F

Sr. No	Parameter	Setting / Ranges
1.	Unit ID	Read only

2.	Baud Rate	Read only
3.	Set Parity	Read only

PORT 1

Sr. No	Parameter	Setting / Ranges
1.	Unit ID	1 to 250 in steps of 1
2.	IP address	Range 0 to 255 in steps of 1
3.	Subnet mask	Range 0 to 255 in steps of 1
4.	Default gateway	Range 0 to 255 in steps of 1
5.	Pri. SNTP	Range 0 to 255 in steps of 1
6.	Sec. SNTP	Range 0 to 255 in steps of 1
7.	Protocol	Disabled / Enabled
8.	Ethernet Mode	Dual / fixed
9.	Operating Mode	Fail over / Switch mode
10.	Primary	LAN1 / LAN 2

PORT R

Sr. No	Parameter	Setting / Ranges
1.	Unit ID	1 to 250 in steps of 1
2.	Baud Rate	9600 / 19200 / 38400 / 57600
3.	Set Parity	None / Even / Odd

Disturbance

Sr. No	Parameter	Setting / Ranges
1.	Post Trigger	5 to 95% in steps of 1%

DATE AND TIME

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ
2.	Local Time Enable	Fixed / Flexible / Disabled
3.	Local Time Offset	-720 to + 720 in steps of 15 Mins
4.	RP Time Zone	UTC / Local
5.	SET Hours	0 to 23 Hrs in steps of 1.
6.	SET Minutes	0 to 59 Mins in steps of 1.
7.	SET Seconds	0 to 59 Sec. in steps of 1.
8.	SET Date	1 to 31 Days in steps of 1.
9.	SET Month	1 to 12 Months in steps of 1.
10.	SET Year	0 to 99 Years in steps of 1.

CB Control

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ
2.	TCS Enable	Disabled / Logic Low / Logic High
3.	TCS Delay	0.1s to 10s in steps of 0.1s
4.	CB Open S'vision	Disabled / Enabled
5.	CB Open Time	50ms to 1000ms in steps of 10ms
6.	CB Open Alarm	Disabled / Enabled
7.	CB Oper. Counter	10 to 50000 in steps of 1
8.	Sigma I	Disabled / Enabled
9.	CB Rated I	1 to 5000A in steps of 1A
10.	M Constant	0.100 to 5.000 in steps of 0.001
11.	CB Control By	Disabled / Local / Remote / Local + Remote
12.	t CB Open Pulse	00.10 to 50.00sec in steps of 0.01s
13.	t CB Close Pulse	00.10 to 50.00sec in steps of 0.01s
14.	Invalid DPI Dur H	0.1 to 600s in steps of 0.01s
15.	Invalid DPI Dur I	0.1 to 600s in steps of 0.01s

REPORTING

Sr. No	Parameter	Display value on LCD
1.	Event	Display of all digital events with time stamping
2.	Status	Display Status of Digital Input & Digital Output
3.	Fault Record	Display the Records of fault i.e. parameter value, flag of fault & date and time of Fault
4.	Error Log	Display of error generated by Relay if any, in case of failure of hardware
5.	CB Data	Display of Trip Counter; Breaker Operation Counter; Breaker operating time, Recl Cnt
6.	Alarm Record	Display of latest Alarm Record

SYSTEM CONFIG

CT/VT RATIOS

Sr. No	Parameter	Setting / Ranges
1.	CT Secondary	1A / 5A
2.	CT Primary	10 to 30000A in steps of 1A
3.	PT Primary	0.1 to 800KV in steps of 0.01kV L-L
4.	PH VT Secondary	Read only setting

PROTECTION

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ

2.	Delta – I Prot.	Disabled / Enabled
3.	Distance Prot.	Disabled / Enabled
4.	Under Voltage	Disabled / Enabled
5.	Breaker Failure	Disabled / Enabled

RECORD CONTROL

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ
2.	Clear Events	Yes / No
3.	Clear Faults	Yes / No
4.	Clear Disturbance	Yes / No
5.	Clear Error Record	Yes / No
6.	CB Data	Yes / No
7.	Thermal State	Yes / No

OUTPUT & LED TEST

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ
2.	Test Mode	Disabled/Test Mode/Contacts Blocked
3.	Test Output J	0 = Not Operated, 1 = Operated
4.	Test Output K	0 = Not Operated, 1 = Operated
5.	Test Output L	0 = Not Operated, 1 = Operated
6.	Test Output M	0 = Not Operated, 1 = Operated
7.	Test Apply	No Operation/Apply Test/Remove Test
8.	Test LEDs	No Operation / Apply Test

Group 1 Settings

Delta – I Prot.

Sr. No	Parameter	Settings / Ranges
1.	V Delta I Enable	Disabled / Enabled
2.	Delta I	10% to 120% in steps of 1%
3.	Delta T	20ms to 200ms in steps of 5ms.
4.	X Blinder	0.05 to 99.99 ohm in steps of 0.01 ohm
5.	ATD	0ms to 800ms in steps of 10ms
6.	Set DS	0% to 100% in steps of 10%
7.	3rdHarm Thresh	5% to30% in steps of 1%
8.	Dz/dt Enable	Disabled / Enabled
9.	Dz/dt	0.50 to 99.99 ohm in steps of 0.01 ohm
10.	tDz/dt	00 ms to 1000 ms in steps of 20 ms
11.	Zone1 2H BLK	Disabled / Enabled

12.	2H Thresh	10% to 30% in step of 1%
13.	2ndHarm UB Enable	Disabled /only I>/ I> & V<
14.	I> 2HUB	80% to 2800% in steps of 1%
15.	V< 2HUB	5% to 50% in steps of 1%

Distance Prot.

Sr. No	Parameter	Settings / Ranges
1.	Zone Enable	Disabled / Enabled
2.	FWD_RP	0.05 to 99.99 ohm in steps of 0.01 ohm
3.	REV_RP	0.05 to 99.99 ohm in steps of 0.01 ohm
4.	FWD_X	0.05 to 99.99 ohm in steps of 0.01 ohm
5.	REV_X	0.05 to 99.99 ohm in steps of 0.01 ohm
6.	tDZ1	0 to 30s in steps of 0.01s
7.	RCA	50 to 90 Deg in step of 1 Deg
8.	Imin.	10% to 20% in step of 1%
9.	ELOAD Enable	Disabled / Enabled
10.	Zmin	0.2 to 99.99 ohm in steps of 0.01 ohm
11.	AL1	0 to 70 Deg in steps of 1 Deg
12.	AL2	0 to 70 Deg in steps of 1 Deg
13.	Zone 2H BLK	Disabled / Enabled
14.	2H Thresh	10% to 30% in steps of 1%
15.	2ndHarm UB Enable	Disabled /only I>/ I> & V<
16.	I> 2HUB	80% to 2800% in steps of 1%
17.	V< 2HUB	5% to 50% in steps of 1%

Under Voltage

Sr. No	Parameter	Setting / Ranges
1	Password	0000 to zzzz / ZZZZ
2	UV Set	20 to 110V in step of 1V
3	UV Time Delay	0 to 5s in step of 0.1s

Breaker Failure

Sr. No	Parameter	Setting / Ranges
1.	Password	0000 to zzzz / ZZZZ
2.	BF Enable	Disabled/Enabled
3.	BF Delay	0 s to 5s in steps of 0.01s

ACTIVE GROUP

Sr. No	Parameter	Setting / Ranges
1.	G1/ G2	Read only

Typical Tests Information:

Sr. No.	Test	Standard
Electromagnetic Compatibility Type Test:		
1.	Damped Oscillatory Wave Test	IEC 60255-26 & IEC 61000-4-18
2.	Electrostatic Discharge Test	IEC 60255-26 & IEC 61000-4-2
3.	Electrical Fast Transient or Burst Requirements	IEC 60255-26 & IEC 61000-4-4
4.	Surge Immunity Test	IEC 60255-26 & IEC 61000-4-5
5.	Immunity to Conducted Disturbances Induces by Radio Frequency Field	IEC60255-26 & IEC 61000-4-6
6.	Radiated, Radio Frequency, Electromagnetic Field Immunity Test	IEC 60255-26 & IEC 61000-4-3
7.	Power Frequency Immunity Test	IEC 60255-26 & IEC 61000-4-16
Auxiliary Supply Tests		
8.	Effect Of DC Voltage Variation	IEC 60255-1 / IEC 60255-26
9.	A.C. Ripples in DC Auxiliary	IEC 60255-26 & IEC 61000-4-17
Insulation Tests:		
10.	High Voltage Test	IEC 60255-27
11.	Impulse Voltage Test	IEC 60255-27
12.	Insulation Resistance	IEC 60255-27
Environmental tests:		
13.	Cold test (Storage & Operational)	IEC 60255-1/ IEC 60068-2-1
14.	Dry heat test (Storage & Operational)	IEC 60255-1/ IEC 60068-2-2
15.	Damp heat steady state test	IEC 60255-1/ IEC 60068-2-78
16.	Damp heat cyclic test	IEC 60255-1/ IEC 60068-2-30
17.	Change of Temperature	IEC 60255-1/ IEC 60068-2-14
18.	Enclosure Protection Test (IP51)	IEC 60529

Mechanical tests		
19.	Vibration Endurance Test	IEC 60255-21-1
20.	Vibration Response Test	IEC 60255-21-1
21.	Bump Test	IEC 60255-21-2
22.	Shock Withstand Test	IEC 60255-21-2
23.	Shock Response Test	IEC 60255-21-2
24.	Seismic Test	IEC 60255-21-3

Accuracy & Functional Performance Tests		
25.	Making & Breaking Capacity Tests of Contacts	IEC 60255 – 1
26.	Mechanical Endurance Tests	IEC 60255 – 1

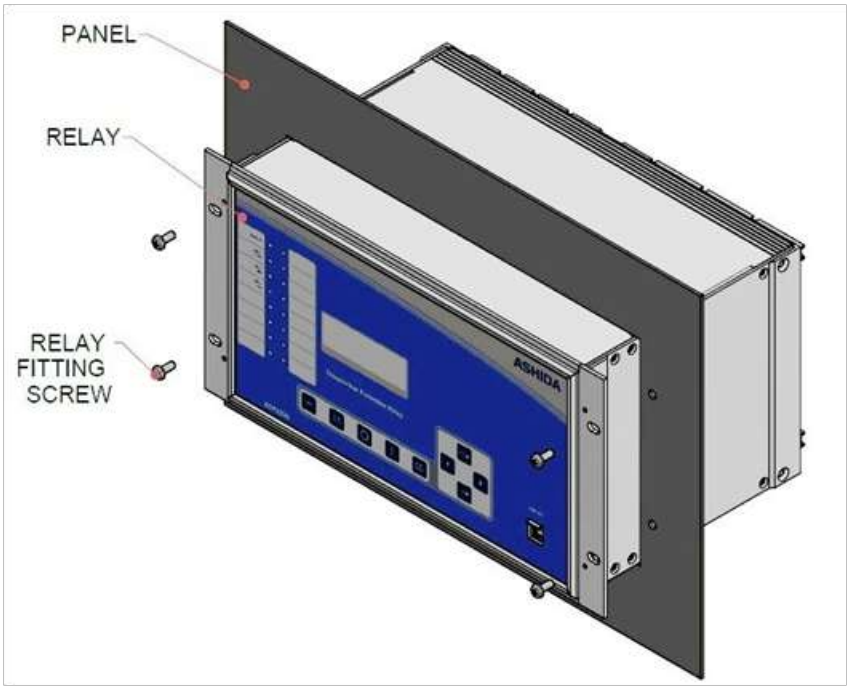
Thermal Withstand Tests		
27.	Over Current Test	IEC 60255-1
28.	Over Voltage Test	IEC 60255-1

***Detailed Type Test Reports are available on request**

Drawings Information:

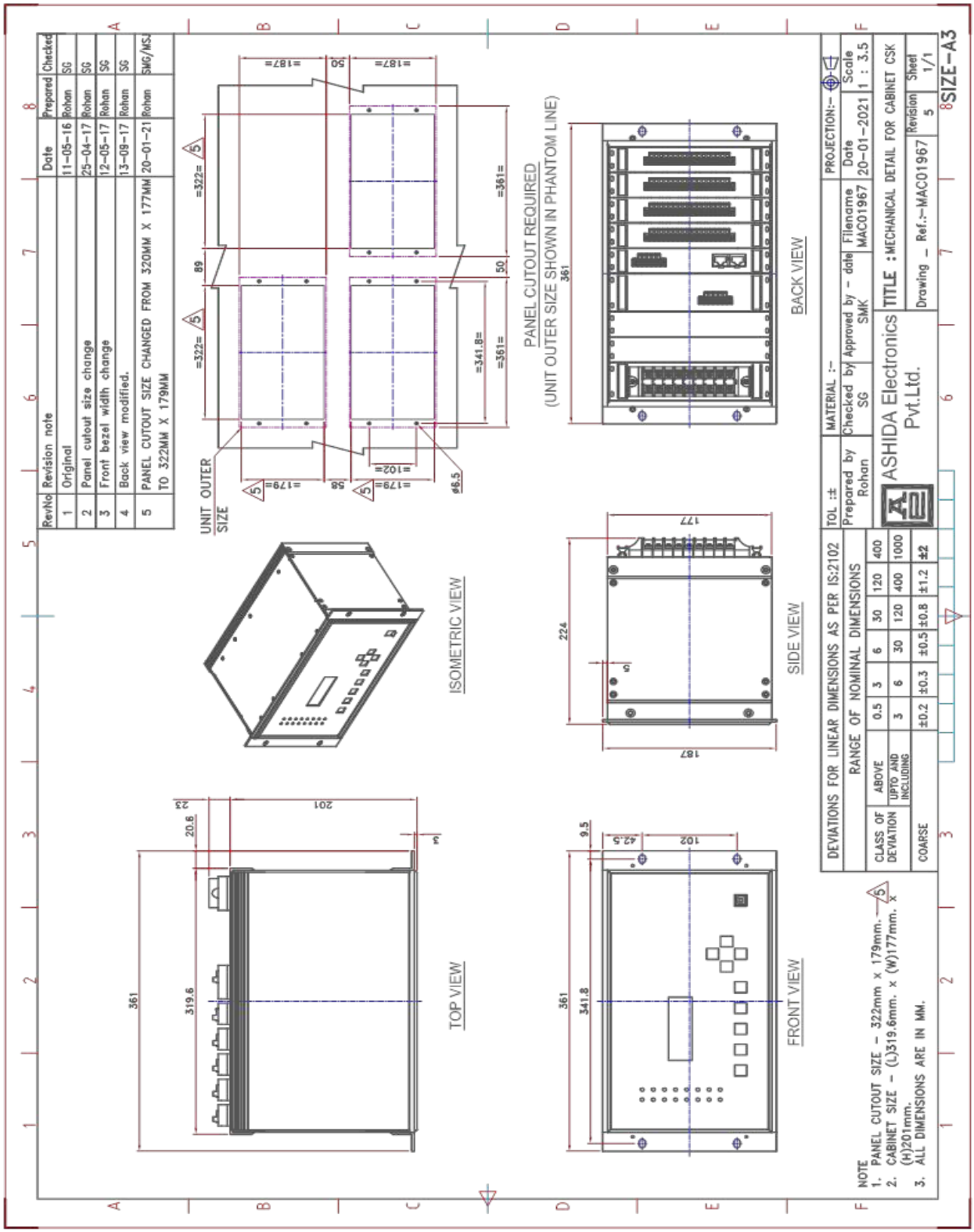
I.	Drawing References	: For Cabinet Type	MAC01967
		: For Back Connections	RLY06403
		: For Typical External Connections	ABD06403

Mounting Information:

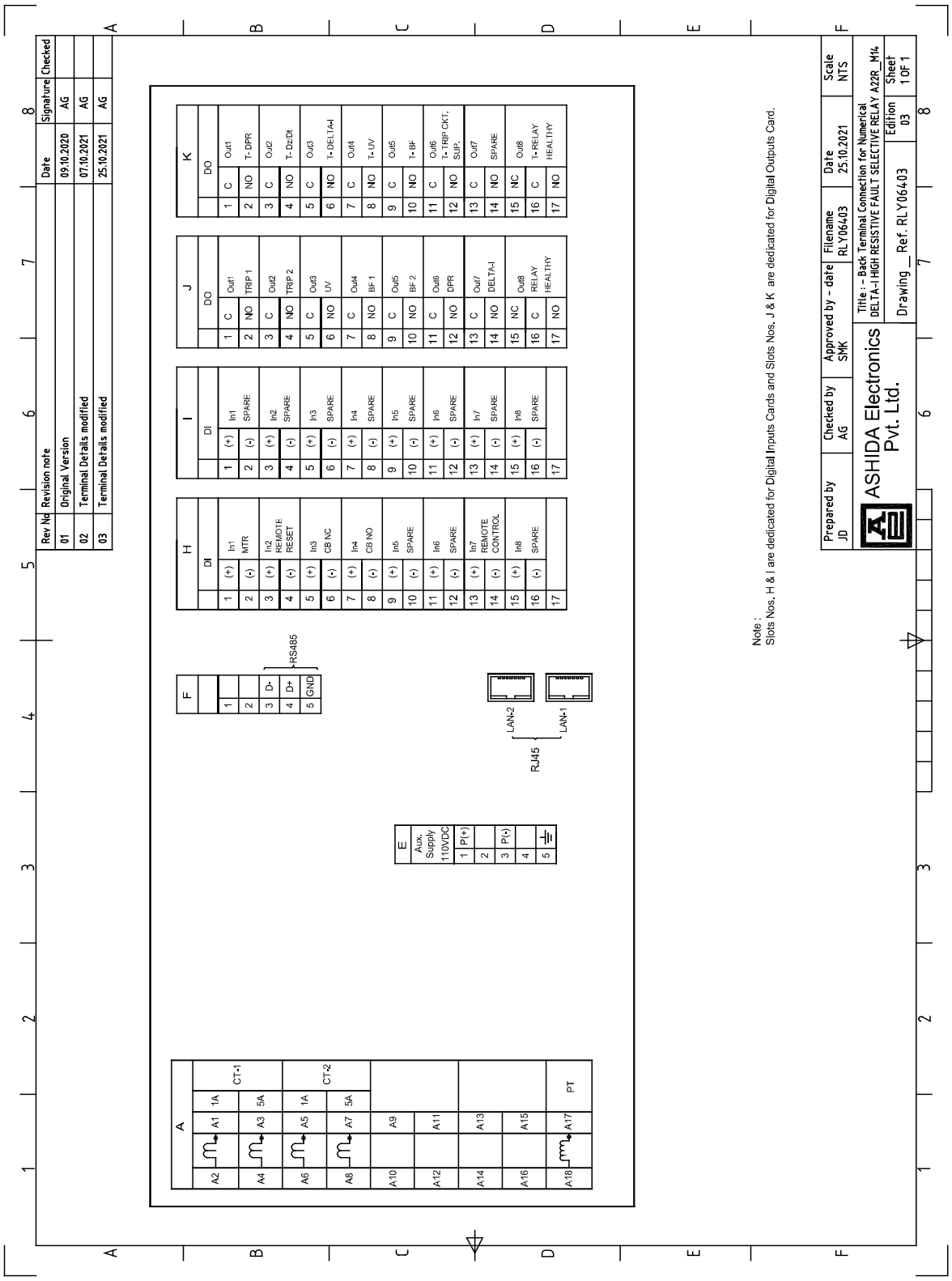


A22R 14” Modular – Rack mounting arrangement

Mechanical Details :

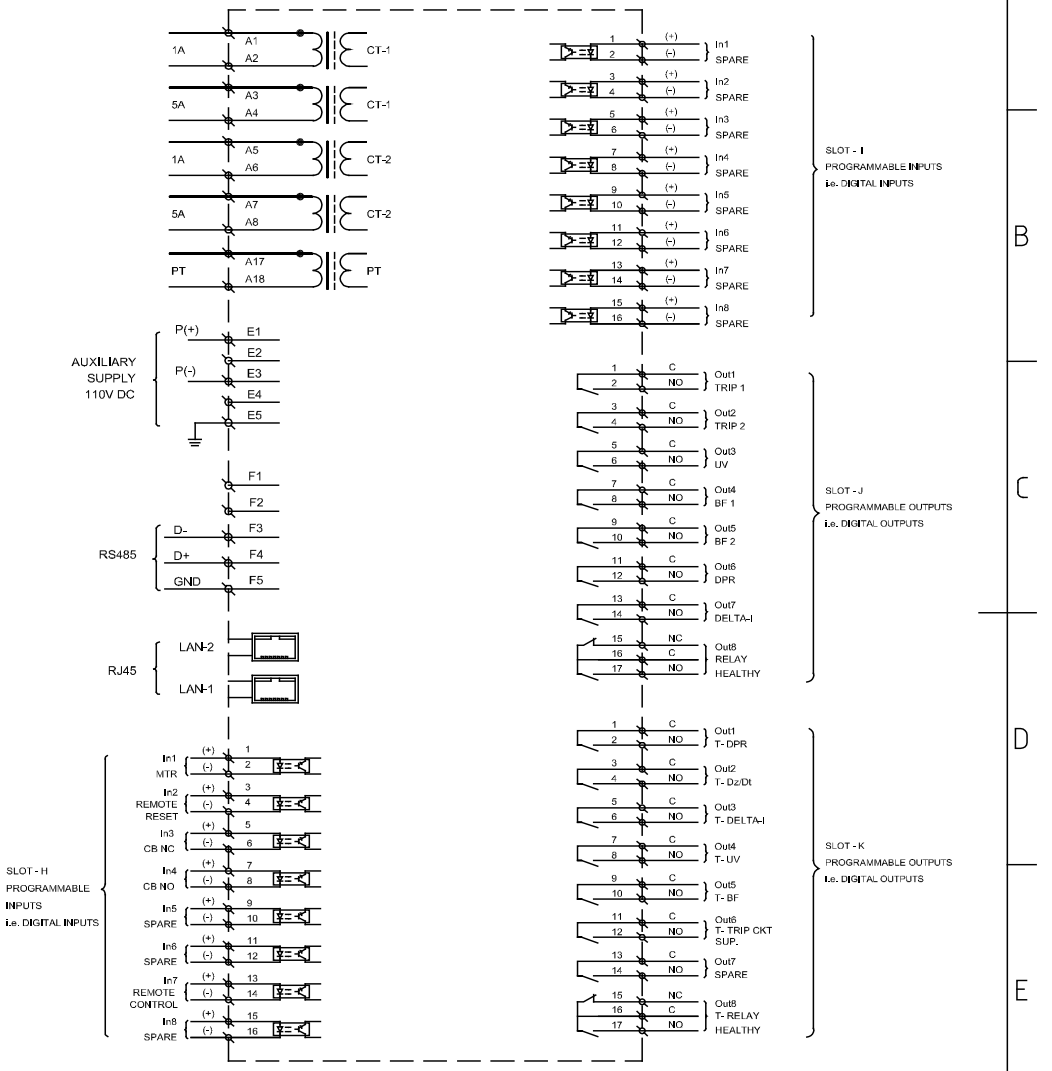


Back Terminal Details :



Electrical Connection Details :

Rev No	Revision note	Date	Signature	Checked
01	Original Version	09.10.2020	AG	
02	Terminal Details modified	07.10.2021	AG	
03	Terminal Details modified	25.10.2021	AG	



Note :
Slots Nos. H & I are dedicated for Digital Inputs Cards and Slots Nos. J & K are dedicated for Digital Outputs Cards.

Perpaed by	Checked by	Approved by – date	Filename	Date	Scale
JD	AG	SMK	ABD06403	25.10.2021	NTS

ASHIDA Electronics Pvt. Ltd.

Title : – BLOCK DIAGRAM FOR NUMERICAL DELTA-I HIGH RESISTIVE FAULT SELECTIVE RELAY A22R_M14

Drawing_ Ref. ABD06403 | Edition 03 | Sheet 1 OF 1

General Specifications:

AC Current Inputs:

1A Nominal

5A Nominal

Thermal Withstand Capacity:

40 X In for 1s

4 X In for Continuous

Burden Rating:

< 0.2VA for 1A Nominal

< 0.2VA for 5A Nominal

AC Voltage Inputs:

1.15 X Vn for Continuous

1.5 X Vn for 10s

Over Voltage Category III

Pollution Degree 2

Rated Insulation Voltage: 2.5kV

Burden: <0.2VA

System Frequency:

50Hz / 60Hz

Frequency Tracking: 45 – 55Hz for 50Hz and 55 55 – 65Hz for 60Hz

Power Supply:

Range: 110 VDC

Burden: <20W with all status & output energies

Digital Outputs:

Continuous carry: 5A at 110 VDC

Make: 30A for 0.2s at 110 VDC

Breaking capacity: 1000 watts @ 110VDC resistive, 30 watts @ 110VDC inductive (L/R = 40ms)

Digital Inputs:

Operating range: 77 – 230 VDC

Communication Ports:

Front Port – USB

Rear Ports – RJ45 (10-100/Base T Copper) & RS485

Operating Temperature:

Operating Temperature: -25^{O}C to +65^{O}C

Storage Temperature: -25^{O}C to +70^{O}C

Humidity: 95% RH

Weight: <5.5kg Approximate

Ordering Information:

Ordering Information												
	1-4	5	6	7	8	9	10	11	12	13	14	15
Model	A22R	X	X	X	X	X	X	X	X	X	X	X
Example	A22R	M	0	0	2	0	1	1	2	3	2	H
V DELTA – I PROTECTION												
Cabinet Details												
Modular Version		M										
Variant												
2x25			0									
Language												
English				0								
Protocol												
IEC 103 (for all other protocol IEC-103 will native)					0							
IEC 61850					2							
CT / PT												
2CT, CT Selection: 1A/5A, 1PT: 110.0V						0						
Digital Outputs												
16 DO							1					
32 DO							3					
Digital Inputs												
16 DI								1				
32 DI								3				
DI Setting Threshold												
18VDC									0			
35VDC									1			
77VDC									2			
154VDC									3			
Auxiliary Supply												
24VDC – 230 VDC										2		
110VDC										3		
Cabinet Details												
Modular Version M-14											2	
Communication Ports												
Disable / No Rear Port												0
RS-485 Rear Port												B
10/100 Base-T Ethernet RJ45 Rear Port												C
10/100 Base-T Ethernet RJ45 Rear Port & RS-485 Rear Port												E

DUAL 10/100 Base-T Ethernet RJ45 Rear Port	F
DUAL 10/100 Base-T Ethernet RJ45 Rear Port & RS-485 Rear Port	H
DUAL 10/100 Base-T Ethernet RJ45 Rear Port & RS-485 Rear Port + IRIGB Port	M
DUAL FO Ethernet Rear Port & RS-485 Rear Port	N

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