Self Powered Relay : ADR241S_AM-460

Protection Features:

- 4 Element (3 Phase + EF) Over current IDMT/DMT with instant trip.
- Programmable (Non-Volatile) Setting by local keys as well as remote setting by communication port.
- Selection of Curve: Five selectable curve (Normal Inverse 1 (C1), Normal Inverse 2 (C2), Very Inverse (C3), Extremely Inverse (C4), Long Time Inverse (C5)) and Define Time (C6).
- Instantaneous Over-Current Protection with adjustable Timer.
- Inrush current blocking.
- Cold Load pickup for prolong inrush current.
- Switch On To Fault (SOTF) function.
- Trip Circuit Supervision (TCS) function.
- Special Overload setting for Phase.

Relay Design Features:

- Self Power (CT power) with optional Auxiliary supply voltage input.
- Relay can be switch ON using USB input.
- 16x2 LCD display for Parameter and setting display.
- Low energy pulse output tripping for RMU.
- Internal Battery for maintaining LCD display and communication during fault condition.
- Designed using DSP technology.
- Communication Port for SCADA (RS485) as well as Local Testing (USB)
- Open protocol IEC103 and Modbus.
- Continuous monitoring of internal hardware modules and error message generation in case of failure of any critical components.

- External latching type potential free contacts.
- Separate curve setting for phase and EF
- 5 nos. of Fault data stored with keypad interface and time stamping.
- Remote trip (same as selected Auxiliary supply voltage).

Description:

ADR241S is second generation of Numerical Self Power Over current IDMT/DMT Relay. It consist all the necessary protection and monitoring functions required for compact RMU.

The High speed Digital Signal Controller continuously monitors line phase current and E/F current. Along with different status input, through CTs, and optical isolated status connections. The high-speed micro-controller samples these current signals through **A/D converter**. The Digital Signal performs powerful **Numerical Algorithms** to find out RMS of fundamental & harmonic contents of the current. All measurement is tuned to fundamental frequency i.e. 50Hz or 60Hz depending upon setting, thus relay remain stable during distorted waveform by various industrial load. All these measure values are then used for different protection function such as IDMT Over current protection, Instantaneous Over current protection, E/F protection etc. These measured values are also displayed on large 16 x 2 LCD display for metering purpose. The power supply module is special electronics circuit which derived relay power from current following through line. This no any external power supply is need. The minimum 0.2A current is required in any one of the phases or 8% in all phase at balanced condition to build power supply for relay electronics. Relay provides pulse output to trip RMU or compact CB having low energy tripping coil.

Measurement Function:

In normal condition the relay displays actual current flowing through the relay. Using the front keyboard the display can be programmed to show all the settings. If current is in fault range the relay gives trip command. The type of the fault is displayed on LCD display. During the fault condition, the relay measures the fault current and stores it in non-volatile memory. The fault current can be read using keyboard on LCD display.

Impulse Output for the Tripping Coil:

Low Energy tripping coil of the circuit breaker can be connected to the coil terminal marked as (COIL + and –) at back terminal. The trip energy (12 - 24 V DC, 0.1 W/sec) is provided by a capacitor in the protection relay. Length of the trip impulse is 40ms and pause between the individual pulses depends on the impedance of the tripping coil and the current level. Pulsing is continued until the CB operates and the fault current becomes zero.

Self-Supervision Function:

The relay continuously keeps track on its internal hardware and the moment it detects any failure of component, a message is displayed on LCD display. The type of error can be checked by "Error Log" menu. This feature is very useful for giving pre information to avoid mal operation.

Extra Status for SCADA:

The relay had provided with extra status input that can be connected to any contact to be monitored such position of isolator switch etc; the status of this hardware is transmitted to remote SCADA station. This status required auxiliary supply.

Over Current / Earth Fault Protection:

The relay has inverse time over current / earth fault function as well as instantaneous protection for both. Following is summary of different protection functions provided by relay.

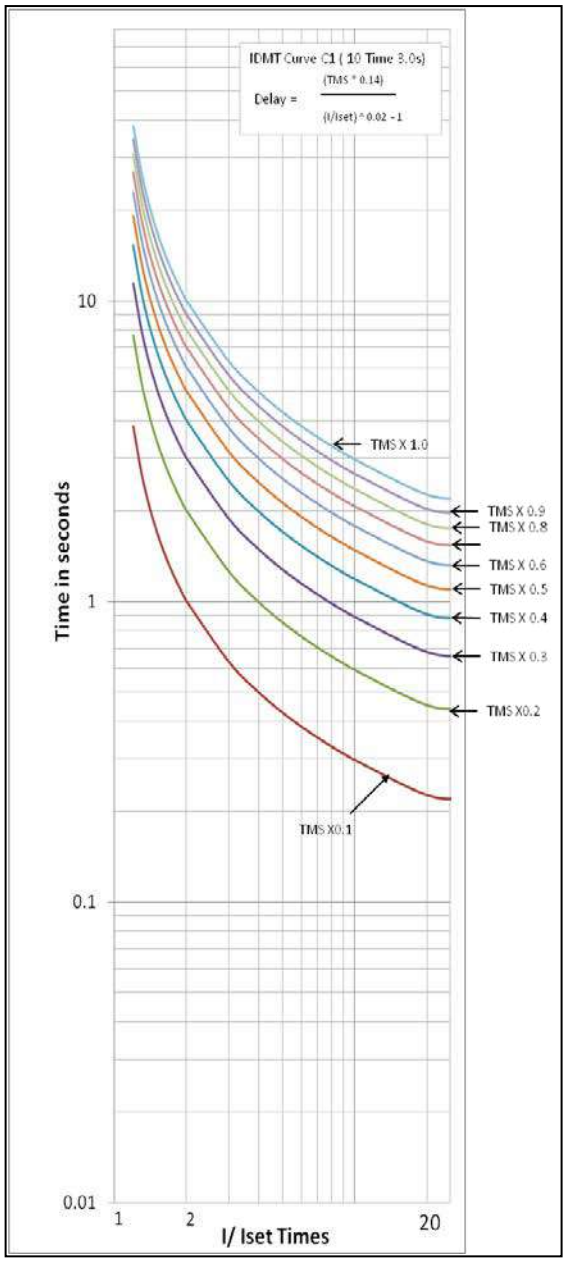
ANSI	IEC	Protection Function
50	IP>>	Instantaneous Over Current Protection
50N	IE>>	Instantaneous Earth Fault Protection
51	tIP>, IP>	Time Over Current Protection (Phase)
51N	tIE>, IE>	Time Over Current Protection (Earth)

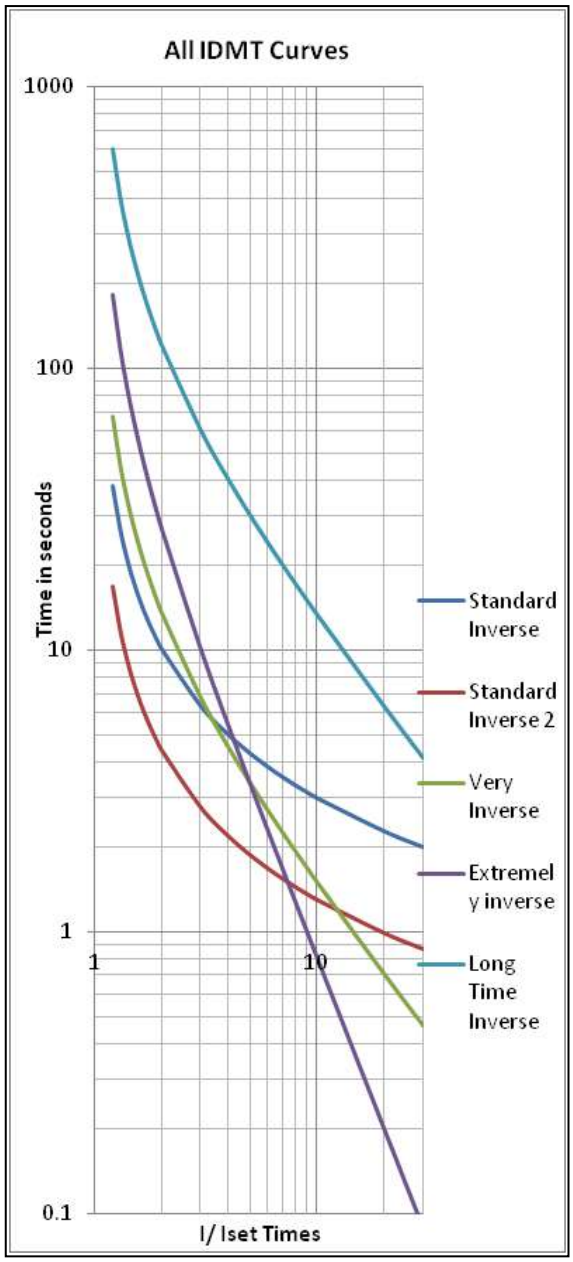
The relay has 4 sensing element 3 O/C and 1 E/F. The tripping current can be set to 20% to 240% in steps of 1% for phase and 10% to 100% in steps of 1% for earth fault by keyboard provided on front panel. These settings are available on display. The unit has selection of IDMT characteristic of IEC standard, Normal Inverse1 (C1), Normal Inverse2 (C2), Very Inverse (C3), Extremely Inverse (C4) and Long Time Inverse (C5). Or define time (C6). Relay is having Time Multiplier Setting (TMS) from x0.01 to x1.2 in steps of x0.01 (separate for phase and EF) for IDMT delay multiplication. Separate operating curve can be programmed for phase and EF.

The each stage thresholds for phase (earth) over current can be selected with an Inverse Definite Minimum Time (IDMT) characteristic. The Time Delay is calculated with a mathematical formula

$$t = T \left(\frac{K}{\left(\frac{I}{Is} \right)^{a} - 1} + L \right)$$

Curve Type	Description	a	b
C1	Standard Inverse_1	0.14	0.02
C2	Standard Inverse_2	0.06	0.02
C3	Very Inverse	13.5	1
C4	Extremely inverse	80	2
C5	Long Time Inverse	120	1
C6	Define Time	-	-





The instantaneous tripping function has range of 50% to 3200% in steps of 50% for phase and 50% to 1200% in steps of 50% for earth fault. The high speed CPU continuously monitors all four current inputs and compares with IDMT as well as instantaneous setting. If any one of the current is above instantaneous setting, the

relay provides immediate trip command bypassing IDMT delay. If input current is less than instantaneous setting but more than IDMT setting, CPU calculates IDMT delay as per selected IDMT characteristic, multiplies it with TMS setting and issue trip command if fault is persist even after this time delay.

Inrush Blocking:

During switching of load there the load take sudden surge of magnetising inrush current. The ordinary protection may sense this current as fault current and give wrong tripping. The ADR241S relay has a special feature of inrush current blocking. The relay detects inrush current then block tripping accordingly.

Cold Load Pickup:

Relay also equipped with cold load pick feature. During switching of load Relay sense closing of RMU by auxiliary contact of RMU (through dedicated Status input marked as CB NO). Once RMU closing is detected relay automatically switch settings to cold load setting (which independently adjustable) for pre define time (adjustable). After this clod load time relay switch back to original setting automatically and avoid wrong operation of relay.

Switch On To Fault (SOTF):

The relay ADR241S provides SOTF function to Protection Feeder/RMU against switch on to fault during feeder Energization.

Trip Circuit Supervision:

The trip circuit supervision is use to monitor healthiness of circuit breaker. The relay is provide with special trip circuit supervision function which continuously monitor continuity of trip coil connected to Relay pulse output. Relay generates TCS ALARM whenever trip coil is open.

Battery Function:

The ADR241S relay is Self Power relay, it takes power from CT Current for its operation, after the tripping operation and when no current is available to view the Fault Current in the different Phases of the relay, Relay takes power from Battery. When there is no CT Current press “BAT ON” Key to view Fault current.

Battery Specification: Capacity 4.5Volt (1.5 x 3) AAA non-rechargeable Lithium battery

When there is no CT Current supplied to the relay, it switches to battery and, after 1 minute relay becomes ‘OFF’ to save the battery life. If any one of the keys (excluding the ‘HW RESET’ key), is been pressed before completion of one minute the time slab of one minute gets retriggered. When the CT current is at 20% the relay gets activated. Battery is located in the battery box on the Front Plate and can be easily replaced by opening the cover.

Note: -

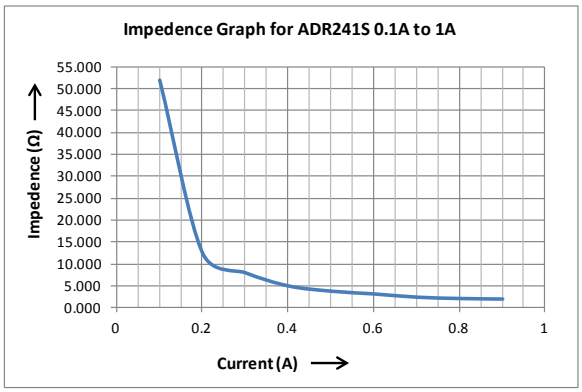
1. The relay uses battery only for indication purpose. Battery is not required for protection purpose.
2. AAA (1.5V x 3) non-rechargeable batteries are placed in Battery Socket.

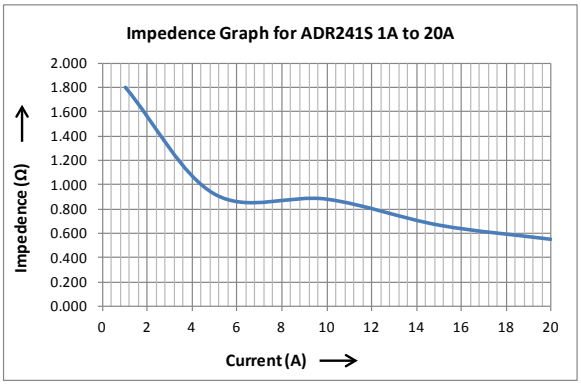
Current transformers Requirement:

The ADR241S relay is self power numerical relay and derived all power required for it internal operation as well as for it CB operation is derived from external CT. The proper operation it necessary to select proper rated CT.

The Impedance to current characteristic of ADR241S is as shown in fig. The graph is non linear, i.e. at low current Z of CT input is high while at high current it is low.

For 1A Rated CT Secondary





Form impedance Graph of ADR241S, the maximum Voltage required across the relay terminal at fault current of 20 times of rated: The Impedance value at 20 Times is 0.55 Ohm

Thus Voltage required is

V Max. = 0.55 x 20 = 11 V

VA Min. required for external CT is

$$VA = \frac{V\ max \times Safety\ Factor}{Over\ Load\ Factor\ of\ CT}$$

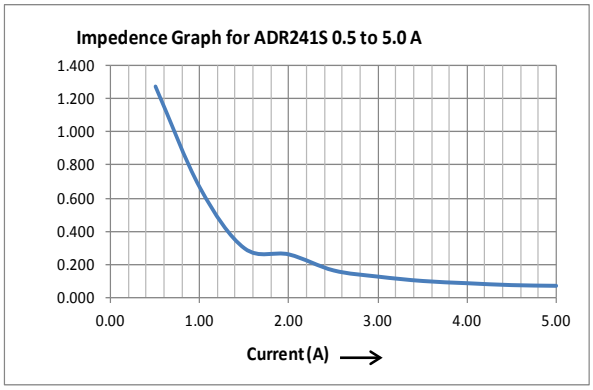
Considering Safety Factor = 2 for Lead resistance / Connecting Impedance Etc.

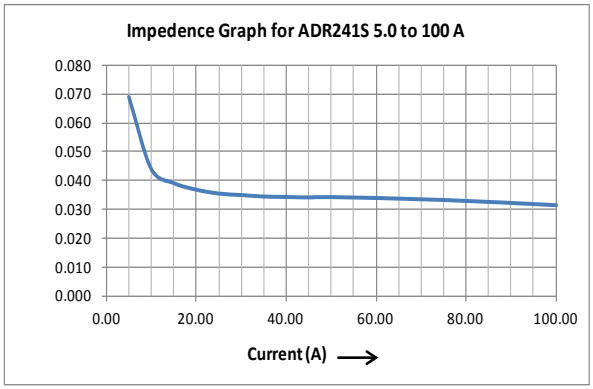
$$VA = \frac{0.55 \times 2}{20} = \frac{11}{20}$$

= 1.1 VA for CT Class 5P20

= 2.2 VA for CT class 5P10 this is minimum VA required for 1A CT secondary.

For 5A Rated CT Secondary





Form impedance Graph of ADR241S, the maximum Voltage required across the relay terminal at fault current of 20 times of rated: The Impedance value at 20 Times is 0.031 Ohm

Thus Voltage required is

V Max. = 0.031 x 100 = 3.10 V

VA Min. required for external CT is

$$VA = \frac{V\ max \times Safety\ Factor}{Over\ Load\ Factor\ of\ CT}$$

Considering Safety Factor = 2 for Lead resistance / Connecting Impedance Etc.

$$VA = \frac{3.1 \times 2}{20} = \frac{6.2}{20}$$

= 0.31 VA for CT Class 5P20

= 0.62 VA for CT class 5P10 this is minimum VA required for 5A CT secondary.

Form Definition of the CT

5 P 10

Tolerance — Protection Class — Over Load Factor

The actual CT design will be carried out by considering the site condition, Transformer capacity, required V max. For the relay and fault level. User should follow necessary design practice.

The recommended current transformers (CT) are as follows.

Rated Secondary Current	1A
Performance	2.0 VA
Rated Secondary Current	5A
Performance	2.0 VA
Precision	5P10
Service Frequency	50-60Hz

Ordering Information:

For ordering following information is needed:

The relay is available with nos. of different option. The option is specified by model no. It is user responsibility to specify correct model no. while ordering.

While Ordering Specify the following Information for ADR241S Relay

ADR241S-AM-460															
MODEL NO:	**4**	**6**	**0**	**0**	**9**	**0**	**1**	**3**	**5**	**0**	**1**	**0**	**0**	**1**	**0**
Sub Type															
Feeder Relay	4	6	0												
Self Power Relay (Low Power)															
Cabinet Size															
CSH(110 x 160 mm)				0	9										
Cabinet Type															
Non-Draw out						0	1								
Auxiliary Supply															
100 V – 230 V AC / DC								3	5						
24 – 50 V DC								3	6						
CT															
1AMP										0	1				
5AMP										0	2				
PT															
Not Applicable												0	0		
Communication Protocol															
Not Applicable														0	0
IEC 103														0	2
IEC 103 & MODBUS														1	0

NOTE: The IEC-103 and MODBUS protocols are software auto selectable i.e. relay will communicate as per the external communication software (IEC-103 or MODBUS) commands.

Auxiliary Supply is must for communication when using RS485 REAR Port

Example

ADR241S – AM460-09-01-35-01-00-10

ADR241S – AM460-09-01-36-01-00-10

ADR241S – AM460-09-01-35-02-00-10

ADR241S – AM460-09-01-36-02-00-10

Relay Settings

General Settings

Sr. No	Setting	Setting Ranges
1.	Password	0000 to 9999
2.	New password	0000 to 9999
3.	SET Hrs	00 to 23 Hrs in step of 1.
4.	SET Mins	00 to 59 Mins in step of 1.
5.	SET Sec	00 to 59 Sec. in step of 1.
6.	SET Date	01 to 31 Days in step of 1.
7.	SET Month	01 to 12 Months in step of 1.
8.	SET Year	00 to 99 Years in step of 1.
9.	Unit Id	01 to 255 in step of 1.
10.	Com Port	0001 – 0002 (0001: Front Port, 0002: Rear Port)
11.	Baud Rate	9600 / 14400
12.	Set Parity	None / Even / Odd
13.	Trip Test	01 / 02 (0001: Yes, 0002: No)
14.	Frequency	0001 / 0002 (0001: 50Hz, 0002: 60Hz)
15.	Ext. Relay	0001 / 0002 (0001: ON, 0002: OFF)
16.	Trip Block	0001 / 0002 (0001: Yes, 0002: No)
17.	CT Primary	10 to 1000 in step of 1Amp.
18.	Inrush Res>>	0001 / 0002 (0001: En, 0002: Dis)
19.	Inrush Res>	0001 / 0002 (0001: En, 0002: Dis)
20.	Rmt Trip En	0001 / 0002 (0001: Yes, 0002: No)
21.	Startup	0001 to 0003 (0001: Disabled, 0002:SOTF, 0003: CL)
22.	TCS En	0001 / 0002 (0001: Yes, 0002: No)
23.	Ann Cont	0001 / 0002 (0001: Type1, 0002: Type2)

Protection Settings

Sr. No	Setting	Setting Ranges
1.	Password	0000 to 9999
2.	Bank	1 to 3 in step of 1
3.	IP>	20% to 240% in step of 1%
4.	IP>TMS	0.01 to 1.200 in step of 0.01
5.	IP> Curve	C1 – C6 in step of 1.
6.	IP> C6 Time	00.1 to 99.9s in step of 0.1s.

7.	IP>>	0.00 to 32.0*In in step of 0.50*In
8.	IP>> Time Delay	0.05 to 1.00s in step of 0.05s
9.	IE>	10% to 100% in step of 1%
10.	IE>TMS	0.01 to 1.200 in step of 0.01
11.	IE> Curve	C1 – C6 in step of 1.
12.	IE> C6 Time	00.1 to 99.9s in step of 0.1s.
13.	IE>>	0.00 to 12.0*In in step of 0.50*In
14.	IE>> Time Delay	0.05 to 1.00s in step of 0.05s
15.	3-ph OL	10% to 200% in step of 1%
16.	OL Delay	1 to 30000s in step of 1s

Cold Load / SOTF Settings

Sr. No	Setting	Setting Ranges
1.	Password	0000 to 9999
2.	CL Enable	0001 – 0002 (0001: En, 0002: Dis)
3.	CL Timer	0.01 to 10.00s in step of 0.01s
4.	IP>	20% to 240% in step of 1%
5.	IP>TMS	0.01 to 1.200 in step of 0.01
6.	IP> Curve	C1 – C6 in step of 1.
7.	IP> C6 Time	00.1 to 99.9s in step of 0.1s.
8.	IP>>	0.00 to 32.0*In in step of 0.50*In
9.	IP>> Time Delay	0.05 to 1.00s in step of 0.05s
10.	IE>	10% to 100% in step of 1%
11.	IE>TMS	0.01 to 1.200 in step of 0.01
12.	IE> Curve	C1 – C6 in step of 1.
13.	IE> C6 Time	00.1 to 99.9s in step of 0.1s.
14.	IE>>	0.00 to 12.0*In in step of 0.50*In
15.	IE>> Time Delay	0.05 to 1.00s in step of 0.05s

Technical Specifications:

Sr. No.	Specification	Particulars
1.	Current Input	: 1 Amp/ 5 Amp. (Specify while Ordering)
2.	VA burden on CTs	: Refer the current transformer requirement chapter of this leaflet.
3.	Thermal Withstand Capacity	: X20 times the normal current for 3sec. : X2.5 Continuous
4.	Minimum current require to energize the relay	: In 1Ø ≥ 20%, 2Ø ≥ 12% and 3Ø ≥ 8%.
5.	Aux. Supply	: 77-250V AC/DC (230VAC) or 18 to 52VDC
6.	VA burden on Aux.	: Less than 10 Watts
7.	Pick up	: 1.05 x Setting ±5%
8.	Reset Value	: 0.95 x Setting ±5% for setting >50% : 0.95 x Setting ±15% for setting <50%
9.	Operating Time	: 5 selectable IDMT curve C1 to C5. Or define time C6 : Instantaneous Time <60ms on 2 times current of setting, In supply ON condition.
10.	Output Contact	: 2 Change over latching type
11.	Contact Rating	: Alarm Duty
12.	Opto-isolated input	: 4Nos. (As per Auxiliary Supply input)
13.	Impulse output for the tripping coil	: 12 V - 24 VDC (Energy < 0.1 W/sec). Suitable for sensitive RMU tripping coil
14.	Operating temperature range	: -10 ºC to +65 ºC
15.	Relative Humidity	: Humidity (RH) 95% maximum
16.	Storage temperature range	: -20 ºC to +80 ºC.

Operational Indicators (Flags):

Sr. No.	Specification	Particulars
1.	ON	: Red LED indicates that the actual current is more than the minimum required current.
	PKP	: Red LED indicates OC/EF relay Pickup.
	TRIP	: Red LED Indicates that Trip pulse is being executed.
	Fault	: Red LED Indicates that Fault occurred HR type

Battery Details:

1.	Battery	: Capacity 4.5Volt (1.5 x 3) AAA Lithium non-rechargeable battery : Recommended Energizer or equivalent.

Drawing References:

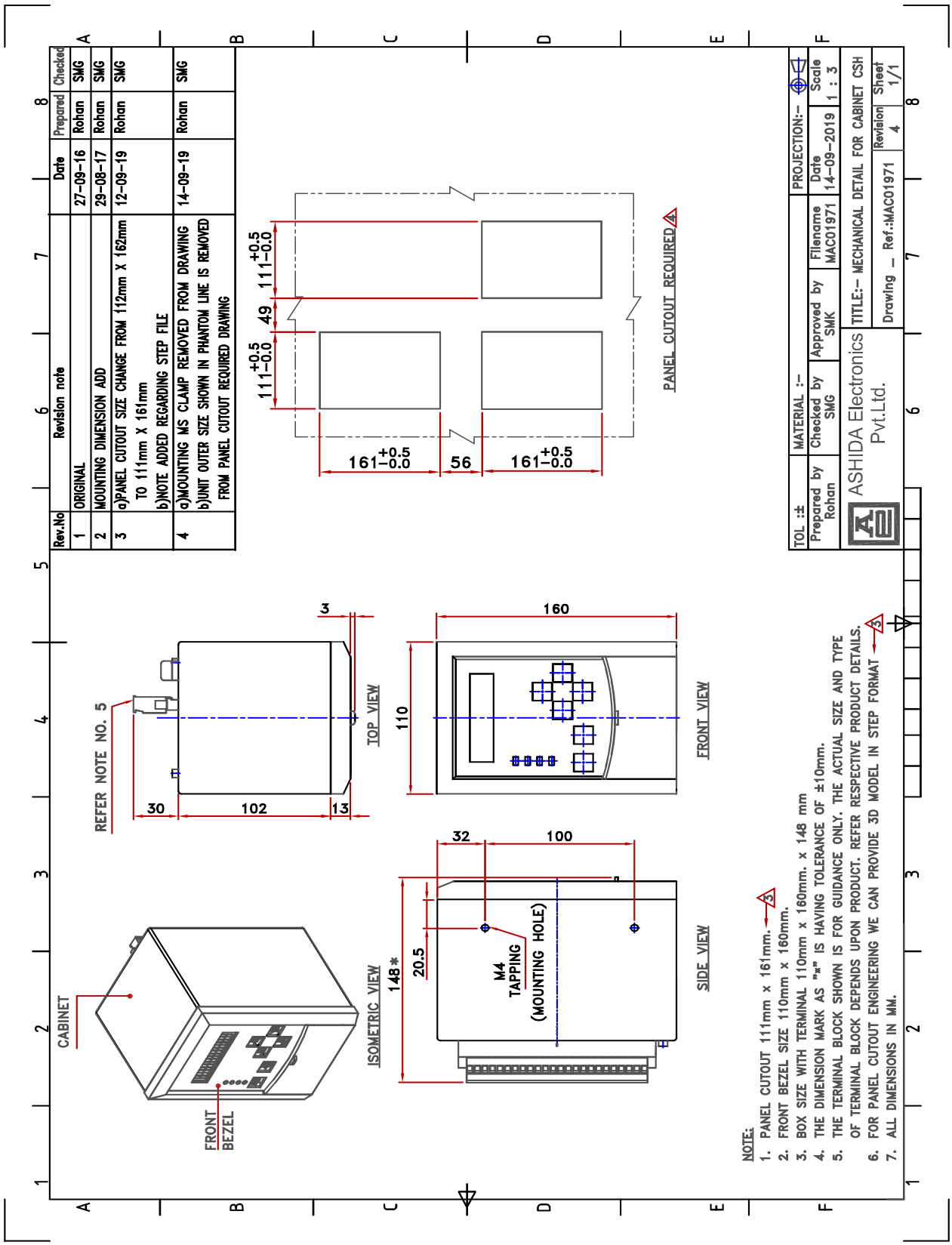
1.	Drawing References	: For Cabinet	MAC01971
		: For Back Terminal	APR08409
		: For Electrical Connection	APR08410

Conformance to Standards:

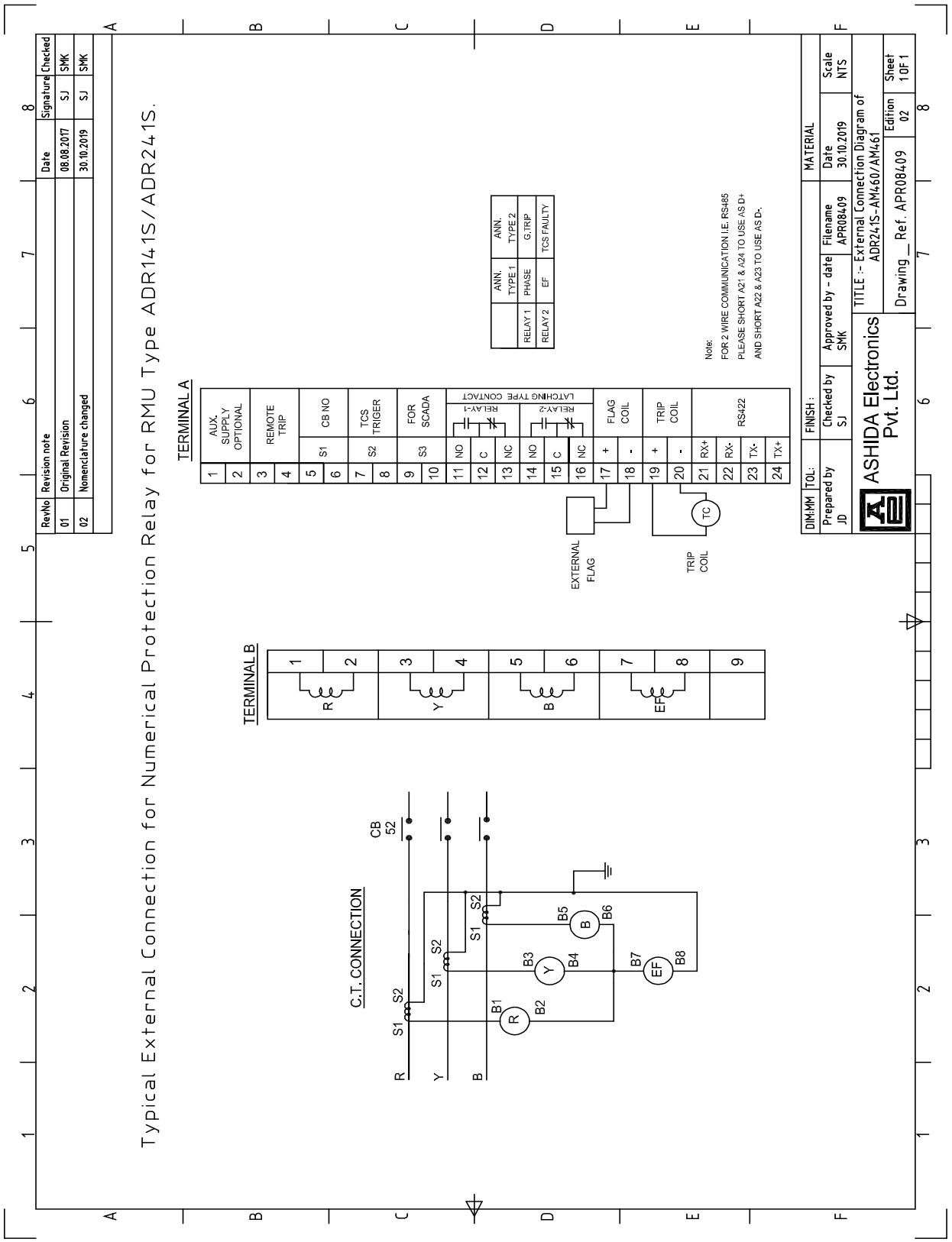
Sr. No.	Specification	Particulars
1.	High Voltage Test	IEC 60255-27
2.	Impulse Voltage Test	IEC 60255-27
3.	High Frequency test	IEC 60255-26:2013
4.	Electro static Discharge	IEC 60255-26:2013
5.	Fast transient interference/bursts	IEC 60255-26:2013
6.	Vibration Test	IEC 60255-21-1
7.	Shock Test	IEC 60255-21-2
8.	Surge Immunity Test	IEC 60255-26:2013
9.	Conducted Emission Test	IEC 60255-26:2013
10.	Radiated Emission Test	IEC 60255-26:2013
11.	Power Frequency Magnetic Test	IEC 60255-26:2013
12.	Conducted Disturbance induced by Radio Frequency field	IEC 60255-26:2013
13.	Radiated Electromagnetic Field Disturbance Test	IEC 60255-26:2013

NOTE: The detail type test reports are available on requests

Mechanical Details:

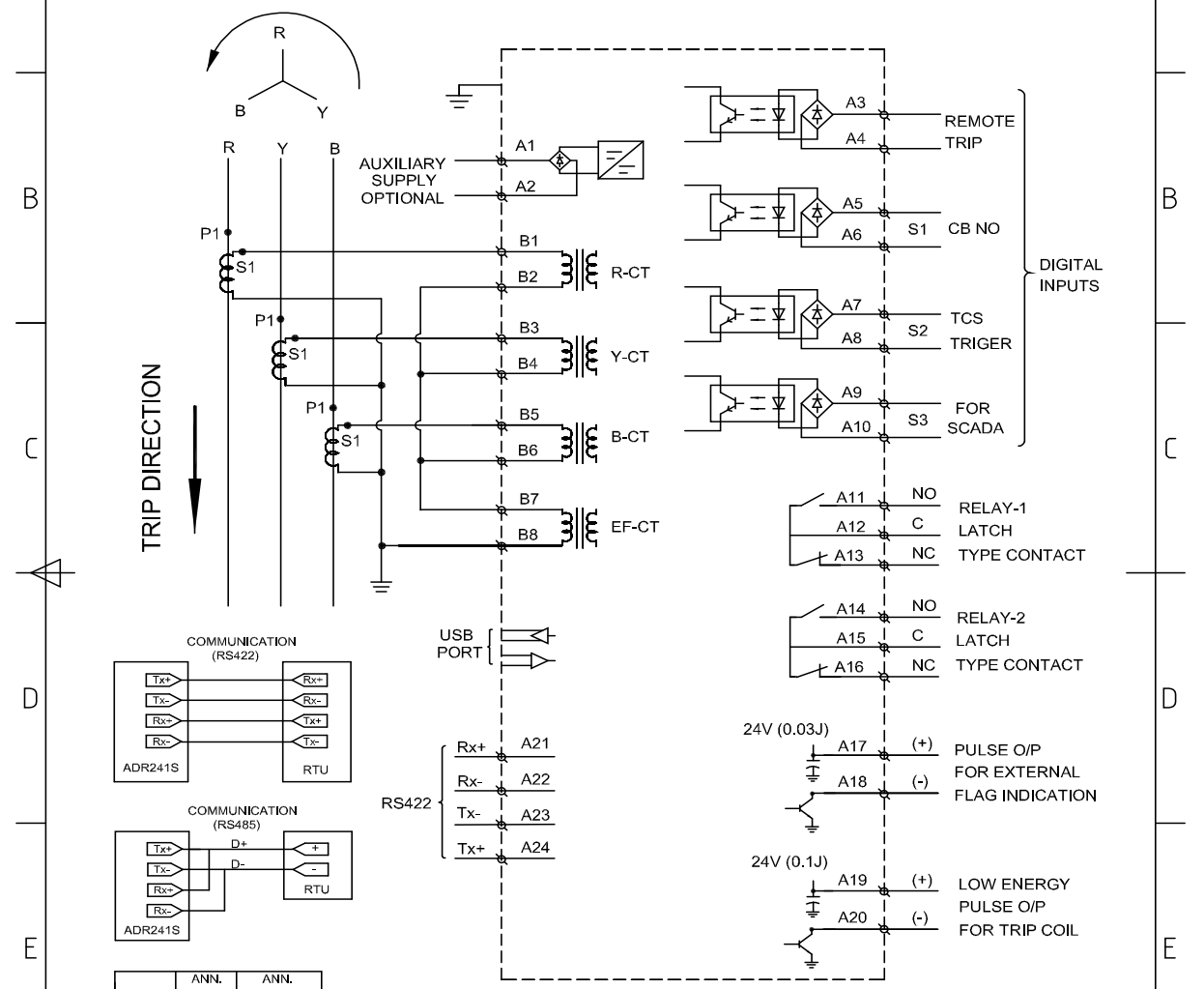


Back Terminal Details:



Electrical Connection Details:

RevNo	Revision note	Date	Signature	Checked
01	Original Revision	08.08.2017	SJ	SMK
02	Nomenclature modified	30.10.2019	SJ	SMK



	ANN. TYPE 1	ANN. TYPE 2
RELAY 1	PHASE	G.TRIP
RELAY 2	EF	TCS FAULTY

Note:
For 2 Wire communication i.e. RS485 please short A21 - A24 to use as D+ and short A22 - A23 to use as D-.

Dim : MM TOL :	FINISH:			MATERIAL:	
Perpaed by JD	Checked by AG	Approved by - date SMK	Filename APR08410	Date 30.10.2019	Scale NTS
ASHIDA Electronics Pvt. Ltd.	TITLE :- Electrical Connection diagram of ADR241S-AM460/AM461				
	Drawing __ Ref.APR08410			Edition 02	Sheet 1 OF 1

ASHIDA Smart Solutions for Power Protection & Control
ISO 9001 Company

ASHIDA Electronics Pvt. Ltd.
ASHIDA House, Plot No. A-308, Road No. 21,
Wagle Industrial Estate, Thane - 400604, INDIA
Tel : +91 - 21 - 2582 7524 / 6129 9100
Fax : +91 - 21 - 2580 4262
Email : sales@ashidaelectronics.com
Web : www.ashidaelectronics