MOTOR PROTECTION RELAY: ADR244B

Introduction:

ASHIDA has designed economical & reliable Multifunction ADR244B Protection & Control System having Drawout facility. The Drawout cabinet makes these relay easy to install & handle.

The simple and compact construction of ADITYA series ADR244B relay provides integrated Protection, Control and Monitoring for Electric Motors.

Functional Overview:

Key Protection & Control Functions:

- Four Independent Settings Groups.
- Non Directional Phase & Ground Over Current Function (50/51/51N/51).
- Four Independent Stages for Directional/ Non Directional Phase Over Current Protection.
- Three Stages of Directional / Non Directional Internally Derived (3I0>) / Externally Measured (IE>) Ground Over Current Protection.
- Inverse time Over Current Protection (IEC curves according to IEC60255).
- High Impedance Restricted Earth Fault Protection (64R).

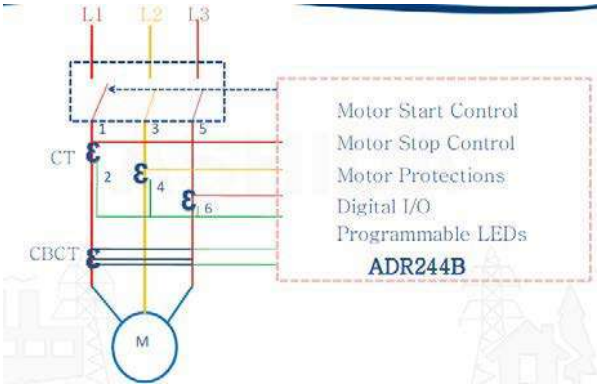
- Inverse & Definite Time Positive & Negative Phase Sequence Over Current Protection (46).
- Broken Conductor Protection (46BC)
- Under and Over Voltage Protections (27 /59).
- Positive & Negative Phase Sequence Over Voltage Protection (47).
- Externally Measured (VN>) / Internally Derived (3Vo>) Over Voltage Protection (59N).
- Locked rotor / Motor stall Protection (50LR)
- Prolong start Protection (66)
- Number starts function
- Phase reversal Protection (47)
- Under current Protection (37)
- Under / Over Power Protection (32P)
- Reverse Power Protection (32R)
- Power factor Protection (55)
- Under and Over Frequency Protection (81U/O)
- SOTF (Optional)
- Breaker Failure detection (50BF)
- VT and CT supervision function
- Trip circuit supervision function
- Programmable Inputs & Outputs
- CB Close / Trip from HMI
- Programmable & Target LEDs for indication with dual colours
- Self Supervision of relay
- Metering function
- Disturbance Recording (10 nos.)
- Event Recording (512 nos.)
- Fault Recording on HMI display (10 nos.)
- Non-Volatile memory.
- Fully communicable with IEC standard open protocol IEC60870-5-103, MODBUS & IEC 61850.
- SCADA communication.
- Single / Dual Ethernet ports (RJ45/ FO) & RS485 port at rear side.
- PC front port communication for convenient relay settings
- User friendly local operation with key pad
- Large Liquid crystal display (20X4) with backlight
- Password Protection
- The relay is provided with Draw out cabinet, when relay is removed from its cabinet, CT secondary terminal will be automatically shorted.
- Measurement of Voltage, current magnitude, symmetrical components, Real, Reactive and Apparent Power, Power factor and frequency.

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:

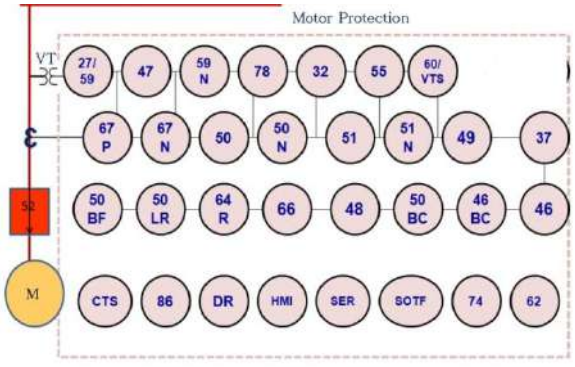
ADR244B numerical multifunction relay designed for electric motor protection applications. Relay designed with fast and selective tripping ensures the stability and availability of electrical power system. ADR244B relay apply for protection of motor feeder to achieve sensitivity and selectivity on phase & ground faults as well as on abnormal conditions.



Motor Protection Application

ANSI Code	Description
27/59	Under/Over Voltage Protection
32	Directional Power Protection
37	Under current Protection
46	Negative Phase Sequence Protection
46BC	Broken Conductor Protection
47	Negative Phase Sequence Over Voltage Protection
48	Motor Prolong Start Protection
49	Thermal Overload Protection
50	Instantaneous/Definite Time Phase Over current Protection
50N	Instantaneous/Definite Time Ground Over current Protection
50BC	Broken Conductor Protection
50BF	Breaker Failure Detection
50LR	Locked rotor Protection
51	Inverse Time Phase Over current Protection
51N	Inverse Time Ground Over current Protection
55	Power factor Protection
59N	Residual Over Voltage Protection
62	Time Delay Stopping or Opening Relay
64R	High Impedance Restricted Earth Fault Protection
60/VTS	VT Supervision Detection
CTS	CT Supervision Detection
66	Number of starts
74	Trip Circuit Supervision
81O/U	Frequency Protection
86	Lockout (Trip command)
SOTF	Switch On To Fault

The Functional Overview of ADR244B:

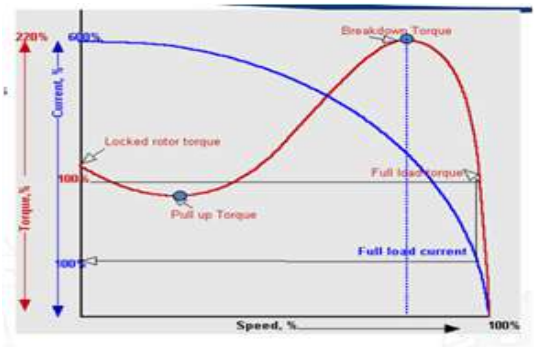


Protection functions Overview: ADR244B

The core functionality of ADR244B relay is equipped with Motor protection & Control functions.

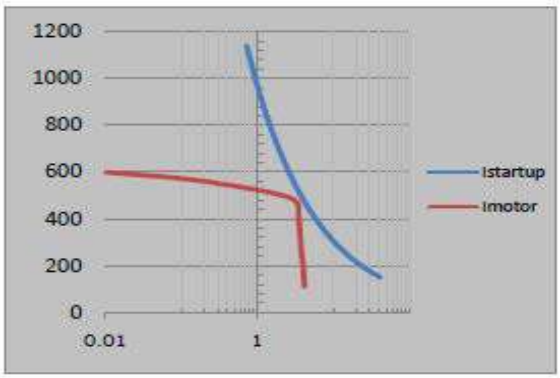
Motor Prolong start Protection (48):

For an induction motor to stall during normal operation (during motor starting conditions), load torque may exceeds very high and above the breakdown torque, may cause damages of stator winding and rotor bars. Stator draws heavy current due to the heavy current flows in rotor bars.



The ADR244B relay detects motor prolong start conditions effectively and provides protections to motor.

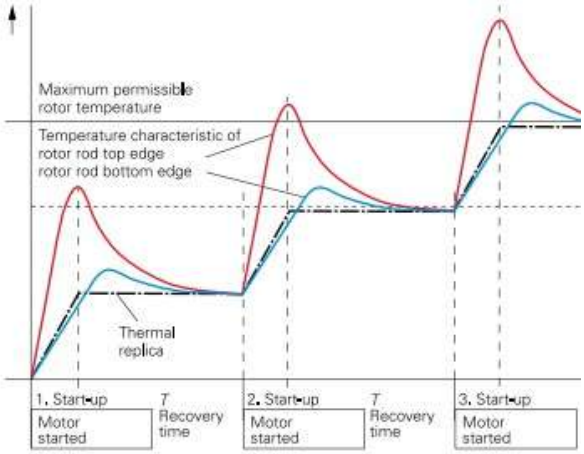
Delay = (Istartup / I)^2 * Tstartup



Number of Starts (66):

Induction motor can be start frequently/periodically based on their rotor bar thermal capacity design. ADR244B provides number of start protection for motor against too many / frequent starts (cold or hot starts per hour) per hour. The rotor temperature rise drastically high if the motor starts frequently (beyond duty cycle mentioned in motor datasheet). The rotor temperature can be calculated from stator current. The number of starts only permits, if the rotor can have sufficient thermal reserves for complete start up. The cooling time between starts allowed to restart motor, when the calculated rotor temperature falls down to safe level.

ADR244B allows user to program number of cold / hot starts per hour as per the information available from motor datasheet. Users can set the number of starts protection (number of starts and time between starts) according to motor start data available from motor datasheet.



Directional / Non Directional Over Current Protection (50/50N/51/51N/51V/67P/67N):

The core functionality of ADR244B relay is equipped with multi function feeder protection. The relay provides Directional and Non Directional phase and ground over

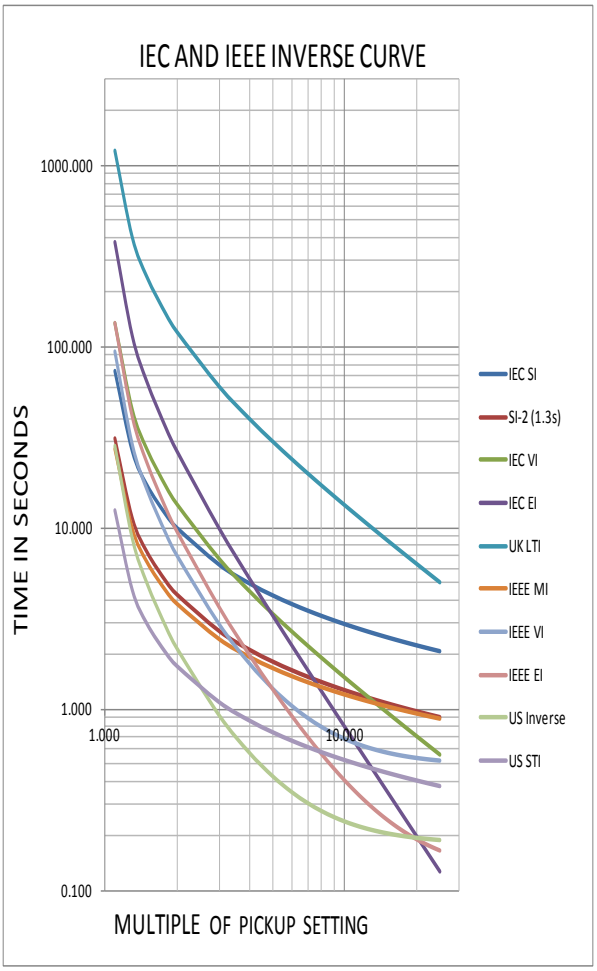
current protection with multiple settings (four stages for phase over current and three stages for ground over current) for various power system applications and wide range of protection settings. The relay is equipped with digital filter algorithms, which provides the rejection of higher harmonics & DC offset. Selectable IEC/IEEE inverse time curves with directional/non directional over current protection will be provide greater selectivity, flexibility and sensitivity to users for better relay co-ordinations.

ADR244B relay provides inverse time over current characteristic for phase and ground over current elements. Each stages of phase and ground over current elements are independently settable with inverse time or definite time characteristic. The following tripping characteristics are available;

- IEC Characteristic Curves
- IEEE Characteristic Curve
- Definite Time Over current
- User Define over current

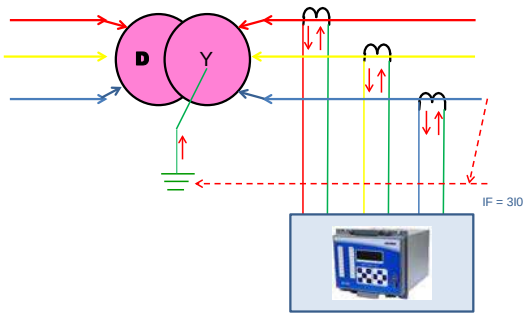
$$t = T^{*}\left\{\frac{K}{\left(\frac{I}{I_s}\right)^{\alpha} - 1} + L\right\}$$

Curve Description	K	a	L
Definite Time	-	-	-
IEC S Inverse	0.14	0.02	0
S Inverse 1.3S	0.06	0.02	0
IEC V Inverse	13.5	1	0
IEC E inverse	80	2	0
UK LT Inverse	120	1	0
IEEE M Inverse	0.0515	0.02	0.114
IEEE V Inverse	19.61	2	0.491
IEEE Inverse	28.2	2	0.1217
US Inverse	5.95	2	0.18
US ST Inverse	0.0239	0.02	0.0169
User Define Curve 1	-	-	-
User Define Curve 2	-	-	-



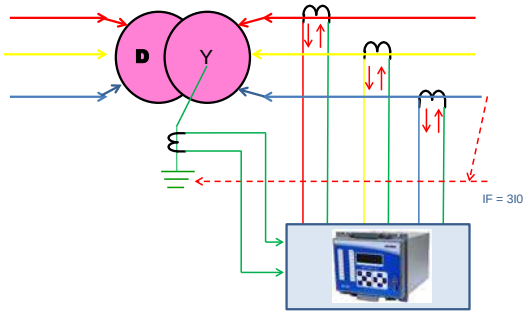
IEC / IEEE Inverse curves for tripping of over current elements

ADR244B relay provides three stages of definite time/inverse time internally derived zero sequence over current (3I0>) protection to detect asymmetrical faults in electrical network. It can be applied to over head transmission line, underground cable, and feeder. The ground current (3I0>) can be calculated from three line currents.

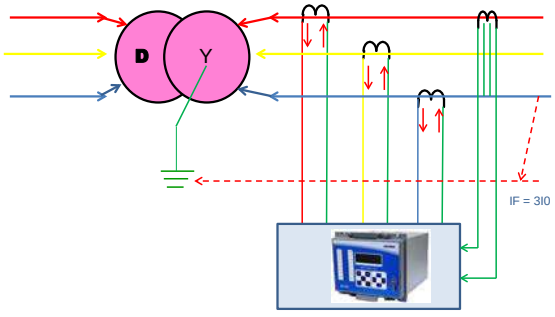


Derived Zero sequence over current from three phases

ADR244B relay provides three stages of externally ground over current protection. ADR244B relay measures ground fault current through neutral CT input. Externally ground CT input can also be applied for high impedance restricted earth fault protection or for sensitive ground fault protection through CBCT.



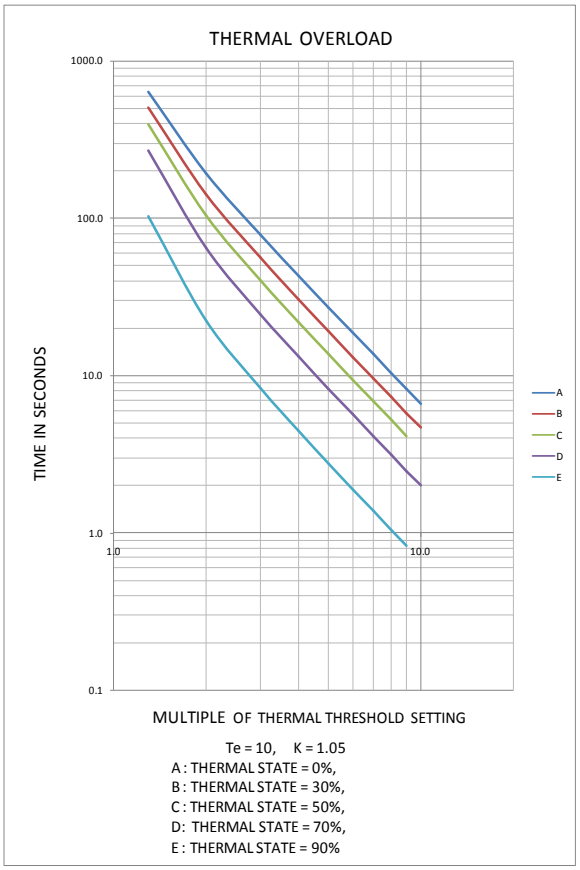
Externally measured ground over current through neutral CT



Externally measured ground over current through CBCT

Thermal overload Protection (49):

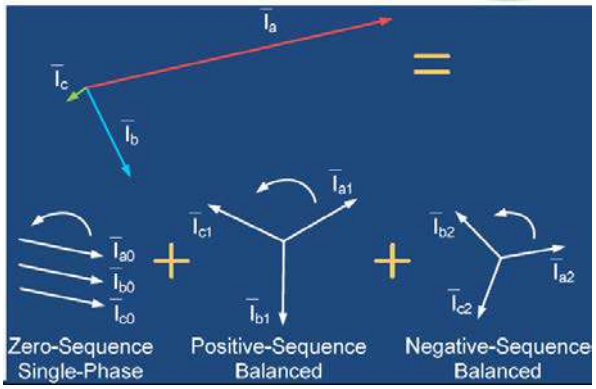
The thermal withstand capability of the power system equipment is affected by overheating prior to a fault. The temperature should not exceed the thermal withstands capability of power system equipment. The RMS currents are measured and analyzed to monitor the thermal state



Graph of Thermal Overload Characteristic.

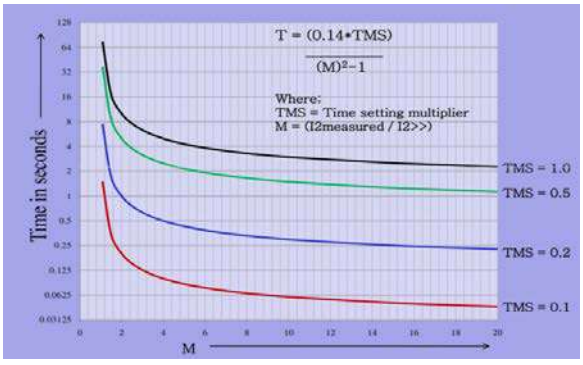
Sequence Over Current Protection (50P/46):

ADR244B provides sequence over current against unbalance faults/condition or high impedance faults over transmission line/under ground cable or over load condition. Sequence over current function is provided in two modes; Positive sequence and Negative sequence over current function. User can select the mode based on their application and requirement.



The negative phase sequence over current element can be programmed as IDMT or definite time characteristic. ADR244B relay provides five selectable IEC & IEEE inverse curves for each stage.

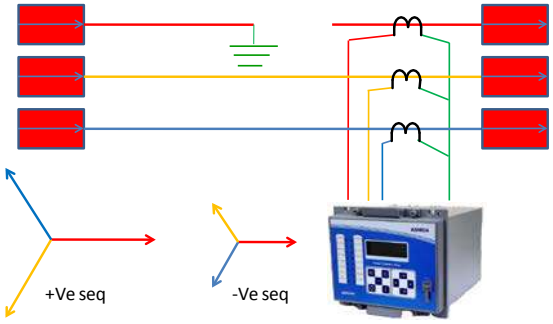
Protection can also be applied in a condition when there is a very high resistive ground fault and ground element may not sense the fault current.



Broken Conductor Protection (46BC):

ADR244B is equipped with Broken conductor detection protection. Broken conductor condition can be detected by the ratio of Negative sequence current to

Positive sequence current (I2/I1). Protection provides higher sensitivity on High resistive fault.

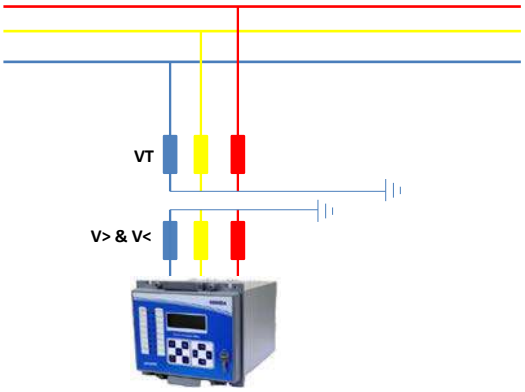


I0 / I1 detection:

ADR244B provide independent I0/I1 function for sensitive ground fault detection. Relay measure the ratio of zero to positive sequence current precisely.

Over & Under Voltage Protections (59 / 27):

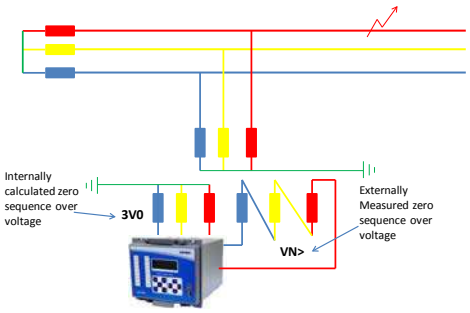
ADR244B relay provides independent phase over and under voltage protections with definite time delay range. Relay also provides the positive sequence over voltage protection with definite time characteristic option. Protection functions can be programmed for alarm signal or trip signal.



Under & Over voltage detection through 3-phase VT connection

Residual Over Voltage Protections (59N):

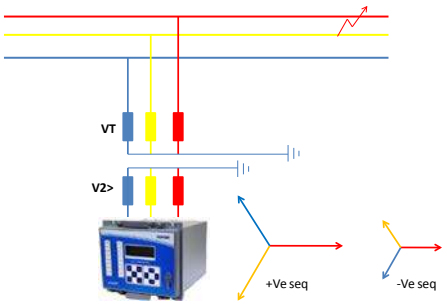
ADR244B relay provides zero sequence / residual over voltage protection with definite time delay range. Protection can be achieved by externally measured residual voltage through open delta VT or the zero sequence voltage internally calculated from three phases.



Zero sequence Over voltage / Externally measured residual Over Voltage detection through 3-phase VT & Open delta VT connections

Sequence Over Voltage Protections (59P / 47):

ADR244B relay provides positive & negative sequence over voltage protections with definite time delay range. It provides protection against high resistive faults and unbalanced loading condition.



Positive / Negative Phase Sequence Over voltage detection through 3-phase VT connection

Directional Power Protection (32):

The directional power protection is designed for protection against reverse power mode and over / under load protection in forward power mode. It can also be settable as a active / reactive power mode. ADR244B provides four elements for power protection with independent definite time delay characteristic.

Frequency Protection (81O/U):

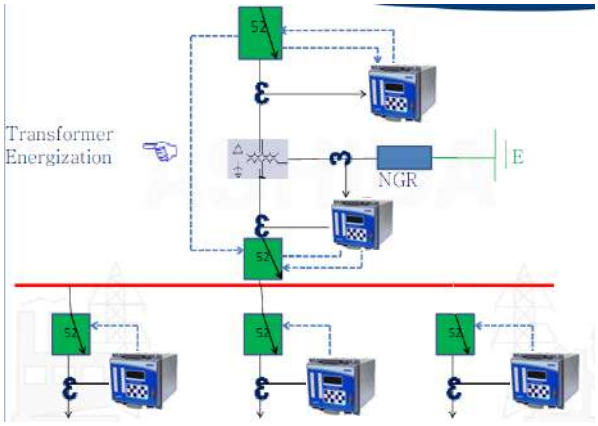
Frequency protection function provides either under or over frequency protection of line/feeder/machine. ADR244B relay provides six independent stages with definite time delay characteristic. Stages can be set in a under or over frequency mode. Protection function can also be used for load shedding scheme.

Breaker Failure detection (50BF):

If the fault current is not interrupted even after a expiry of time delay, circuit breaker failures shall be detected, and should execute trip command to upstream circuit breaker. ADR244B relay incorporates circuit breaker failure protection to detect failure of tripping command execution due to mechanical or electrical problems in circuit breaker.

SOTF

The ADR244B provides SOTF function to protection feeder against switch on to fault condition during feeder/transformer energization. (SOTF can be achived by using Group Change Facility through AProLogic)



Trip circuit supervision (74T):

The trip circuit supervision is used to monitor healthiness of circuit breaker. The trip circuit extends beyond the relay enclosure and passes through more components, such as fuse, wires, relay contacts, auxiliary switch contact and so on. The failure of any component result bypassing the protection. The relay is provide with special trip circuit supervision function which continuously monitor continuity of trip circuit and generate ALARM to take appropriate action.

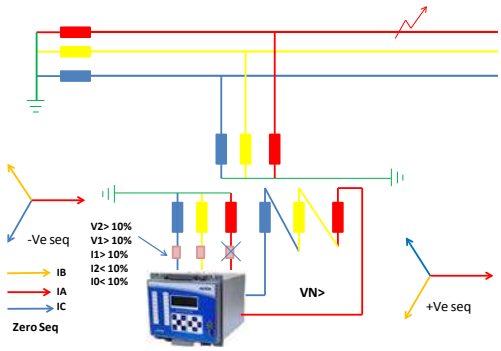
Reclosing / Auto reclosing (79):

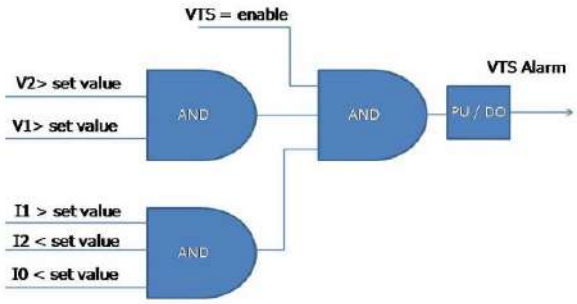
The ADR244B is provided with 4 shot Auto recloser function. Numbers of shots are selectable. There are 4 timers for auto recloser 1) Dead Time for shot 1 (DT1) 2) Dead Time for shot 2 (DT2) 3) Dead Time for shot 3 (DT3) 4) Dead Time for shot 4 (DT4) and 5) Reclaim Time (RT). After clearing the fault ADR244B triggers dead

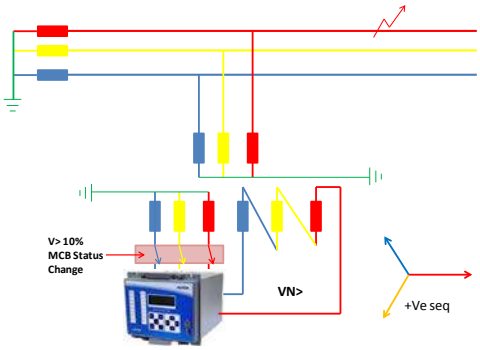
Time 1 i.e. DT1. After the time delay Relay provides reclose command and starts reclaim timer RT. If second fault occurs during RT relay triggers Dead Time 2 i.e. DT2. If the third fault occurs during RT relay triggers Dead Time 3 i.e. DT3, If fourth fault occur during RT relay triggers Dead Time 4 i.e. DT4 and after time delay it again provides reclose command and retriggers RT. If the fifth fault occurs during RT Relay generates Lock-Out alarm and blocks further reclose. The Lock-Out condition can be reset locally as well as remotely by SCADA through communication digital status input.

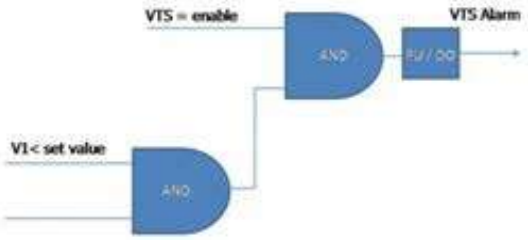
VT supervision function:

ADR244B relay provides VT supervision function to detect a loss of phase voltage input that is caused by failure of fuses or molded case/miniature circuit breaker (MCB). Relay declares the VT supervision when the below logic shall be stratified.







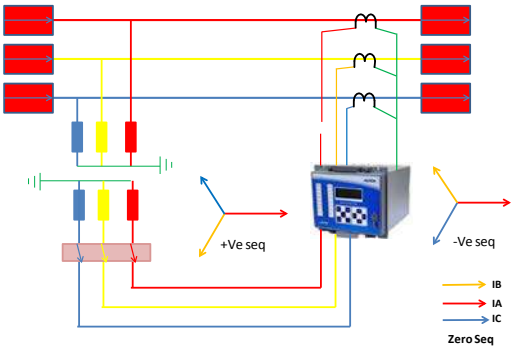


CT supervision function:

ADR244B relay provides CT supervision function for detecting a loss of phase current due to the failure of ct secondary wiring.

If the power system currents are healthy, negligible negative & zero sequence voltage can be derived. If, one or more of the AC current inputs are missing, a negative & zero sequence currents can be derived, even if the actual power system phase currents are healthy. CTS works on these criteria; by detecting a ratio of derived

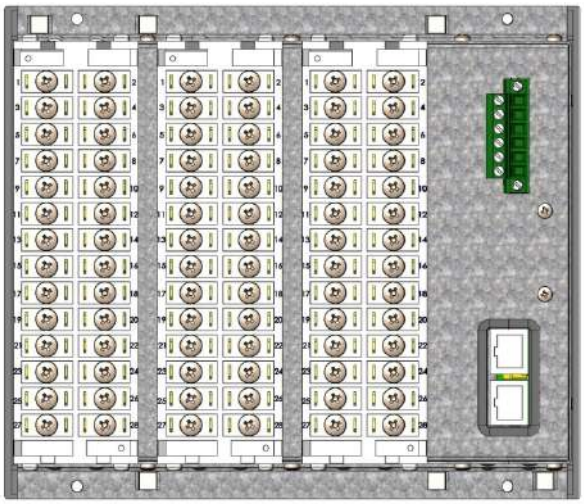
negative to positive sequence currents & ratio of derived zero sequence to positive sequence currents in the absence of a corresponding derived negative & zero sequence voltage from VT.



Programmable Inputs, Outputs & Logic:

The relay is provided with tool known as AproLogic, in which user can program his/her logics as per the requirement, such as Motor reacceleration/ Auto Bus Transfer Scheme (ATS) etc. All type of gates such as OR/NOR/NOT/NAND/AND/XOR/XNOR/SR Flip-flop and counter are available along with Operating and Resetting Timer. For more details please refer to Instruction Manual.

The Draw out version of ADR244B available with 16DI-10DO combination.



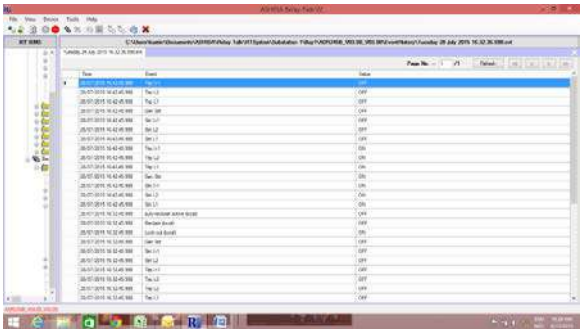
Back side terminal details: Drawout

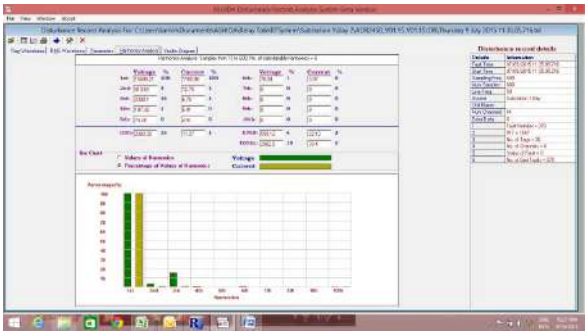
Programmable LEDs and Pushbuttons:

The ADR244B relay provides total 16 nos. of target and programmable LEDs with dual color indications and 2 nos of pushbuttons for circuit breaker close and open from HMI of relay. The LEDs & pushbuttons can be programmed through PC software (RTV2 software).

Event recording:

ADR244B relay provides a feature to record and store 512 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.

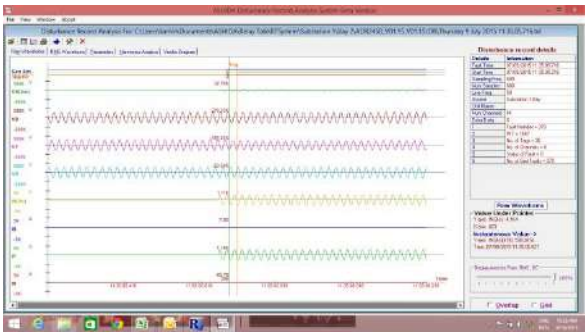




Disturbance recording:

ADR244B 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.

For saving DR two mode of sampling are available, first is RAW samples (DR of 1.5 seconds) & second is 16 samples (DR of 3 seconds), user can set as required.



Fault recording:

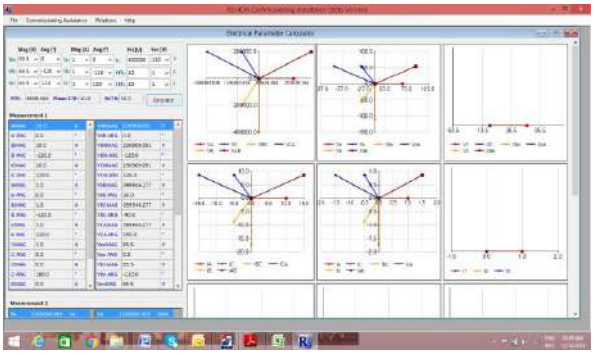
ADR244B relay provides fault recording facility. The fault records can be display either on HMI displayed or in RTV2 software. The relay can record 10 nos. of fault records in non-volatile memory.

Metering:

Online metering feature of ADR244B relay provides metering of parameters (i.e voltage/current magnitude, power, power factor measurement etc.) on HMI display or in RTV2 software.

Relay Assistant:

RTV2 software provides relay assistant tool for testing and commissioning of relay at site/field area.

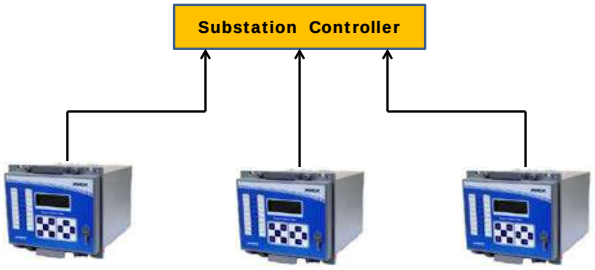


Independent Protection settings groups:

ADR244B relay provides four independent setting groups which allows the relay to operate on different power system conditions.

IEC 60870-5-103 Protocol:

ADR244B 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.



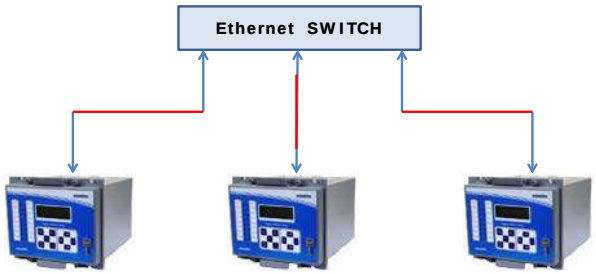
IEC 60870–5–103 star type RS232 copper conductor connection

Ethernate base Protocol (IEC 61850 /MODBUS TCP / IEC104):

ADR244B relay provides internationally standardized protocol such as IEC61850 / IEC104 / MODBUS TCP for substation automation via Ethernet port of protection relays (Ref ordering information for details)

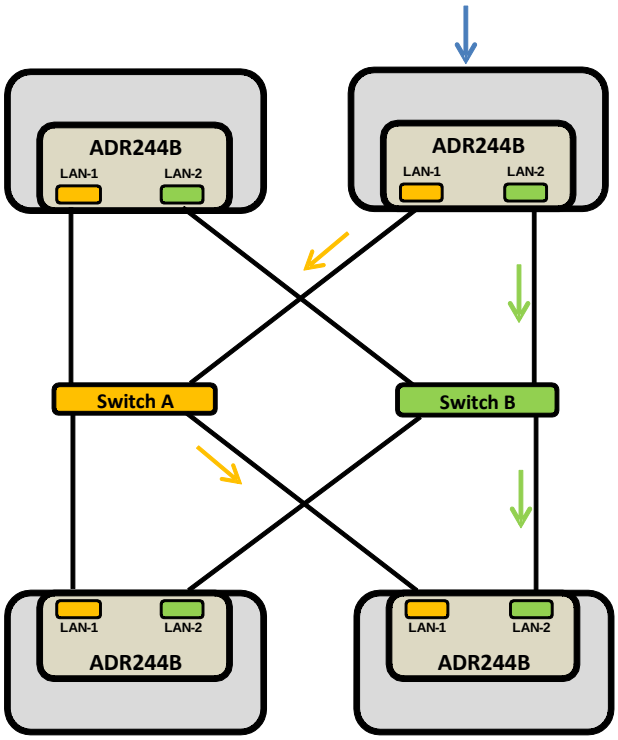
IEC61850 GOOSE and Interoperability:

ADR244B 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. ADR244B support total 16 simultaneous GOOSE signal which can publish and received by other relays having IEC61850 protocol. Similarly ADR244B can able subscribed total 16 nos of simultaneous signal published by other relays and can be use for interlocks. The ADR244B is tested for most of other make relays.

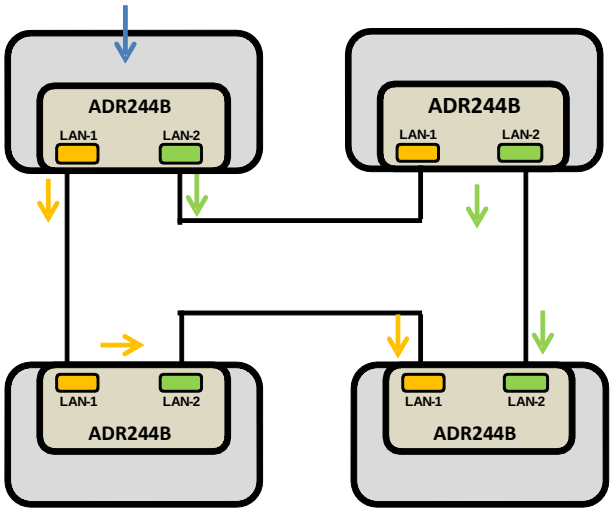


Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR):

Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) provides redundant communication over station bus running the available communication protocols. Redundant communication is obtained through the built-in PRP and HSR features which can be used in star or ring bus architectures.



Parallel Redundancy Protocol (PRP)



High Availability Seamless Redundancy (HRS)

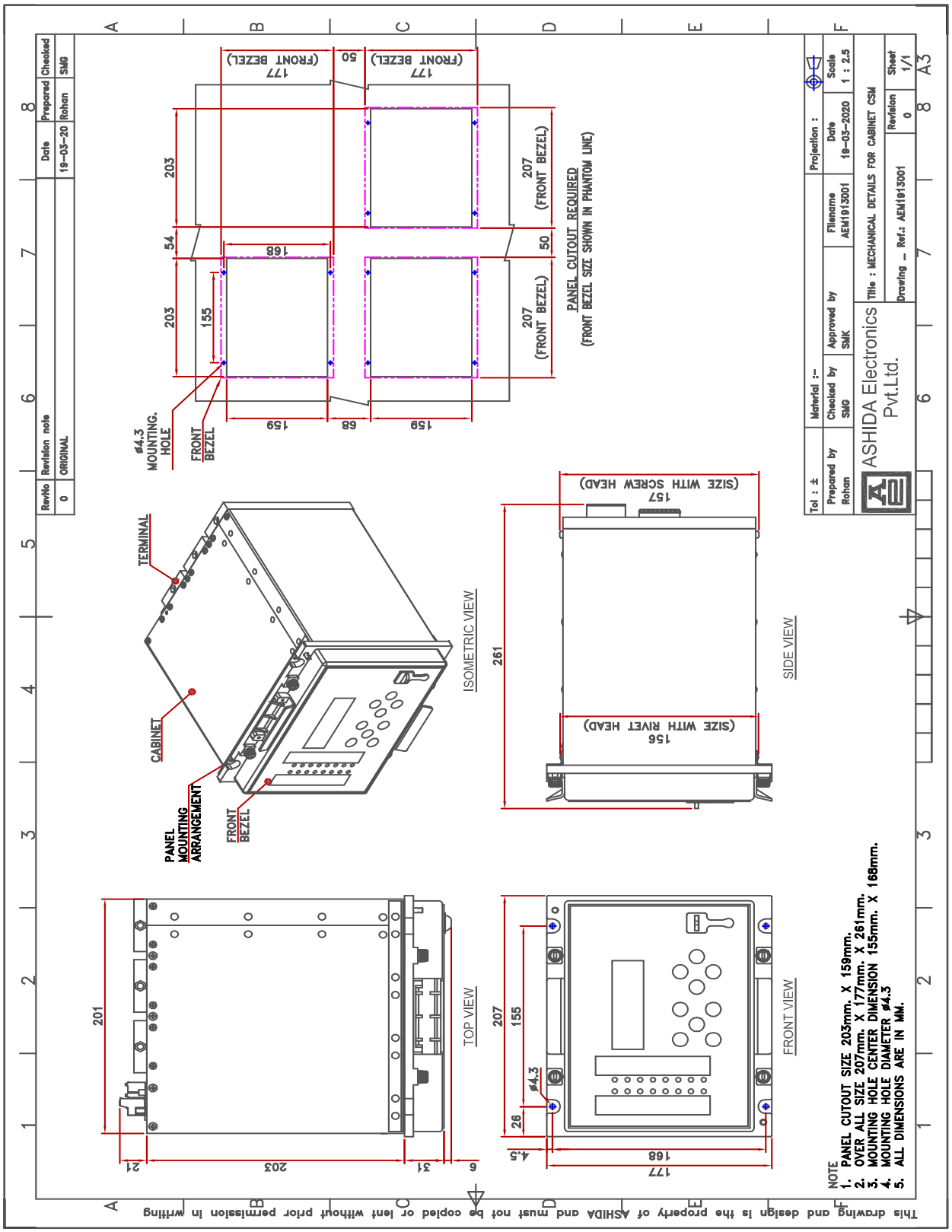
Typical Tests Information:

The Relay Confirm to following standard		
Electromagnetic Compatibility Type Test:		
Sr. No.	**Test**	**Standard**
1	High Frequency Disturbance Test	IEC 60255-26 (ed-3):2013, IEC 60255-22-1
2	Electrostatic Discharge Test	IEC 60255-26 (ed-3):2013, IEC 60255-22-2
3	Fast Transient Disturbance Test	IEC 60255-26 (ed-3):2013, IEC 60255-22-4
4	Surge Immunity Test	IEC 60255-26 (ed-3):2013, IEC 60255-22-5
5	Power Frequency Magnetic Field Immunity Test	IEC 60255-26 (ed-3):2013, IEC 61000-4-8
6	Radiated Electromagnetic Field Disturbance Test	IEC 60255-26 (ed-3):2013, IEC 60255-22-3
7	Conducted Disturbance Induced By Radio Frequency Field	IEC 60255-26 (ed-3):2013, IEC 61000-4-6
8	Power Supply Immunity Test	IEC 60255-26 (ed-3):2013, IEC 60255-11 & IEC 61000-4-11
9	Conducted & Radiated frequency Emission Test	IEC 60255-26 (ed-3):2013, IEC 60255-25
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	IEC 60068-2-1
14	Dry heat test	IEC 60068-2-2
15	Damp heat steady state test	IEC 60068-2-78
16	Change of Temperature	IEC 60068-2-14
17	Damp heat cyclic test	IEC 60068-2-30
18	Enclosure Protection Test (IP54)	IEC 60529
CE compliance		
19	Immunity	IEC 60255-26
20	Emissive Test	IEC 60255-26
21	Low voltage directive	EN 50178
Mechanical tests		
22	Vibration Endurance Test	IEC 60255-21-1
23	Vibration Response Test	IEC 60255-21-1
24	Bump Test	IEC 60255-21-2
25	Shock Withstand Test	IEC 60255-21-2
26	Shock Response Test	IEC 60255-21-2
27	Seismic Test	IEC 60255-21-3

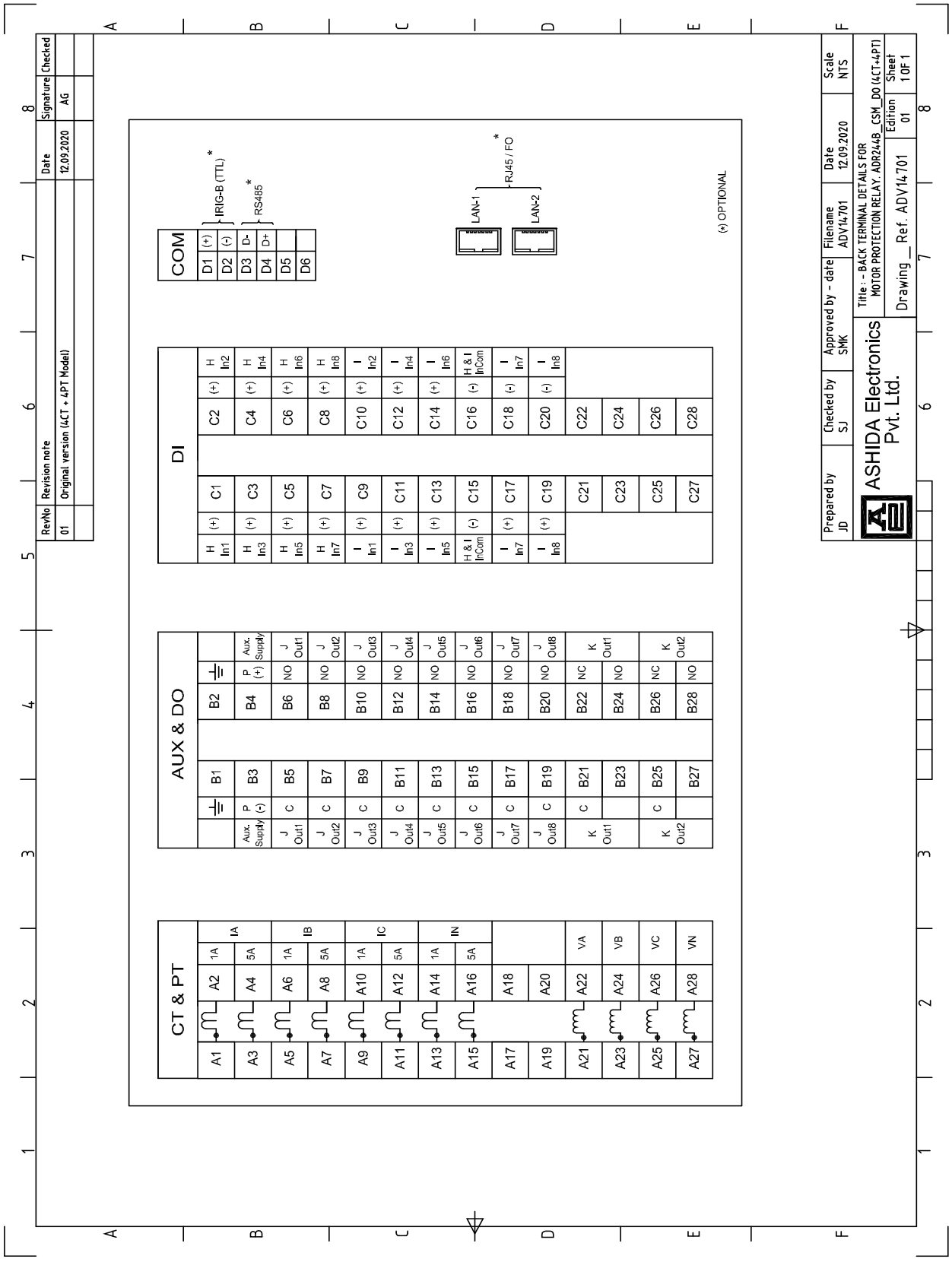
Drawings Information:

	Drawing References	: For Cabinet Type	- AEM1913001
		: For Back Connections	- ADV14701
		: For Typical External Connections	- ADV14801

Mechanical Details

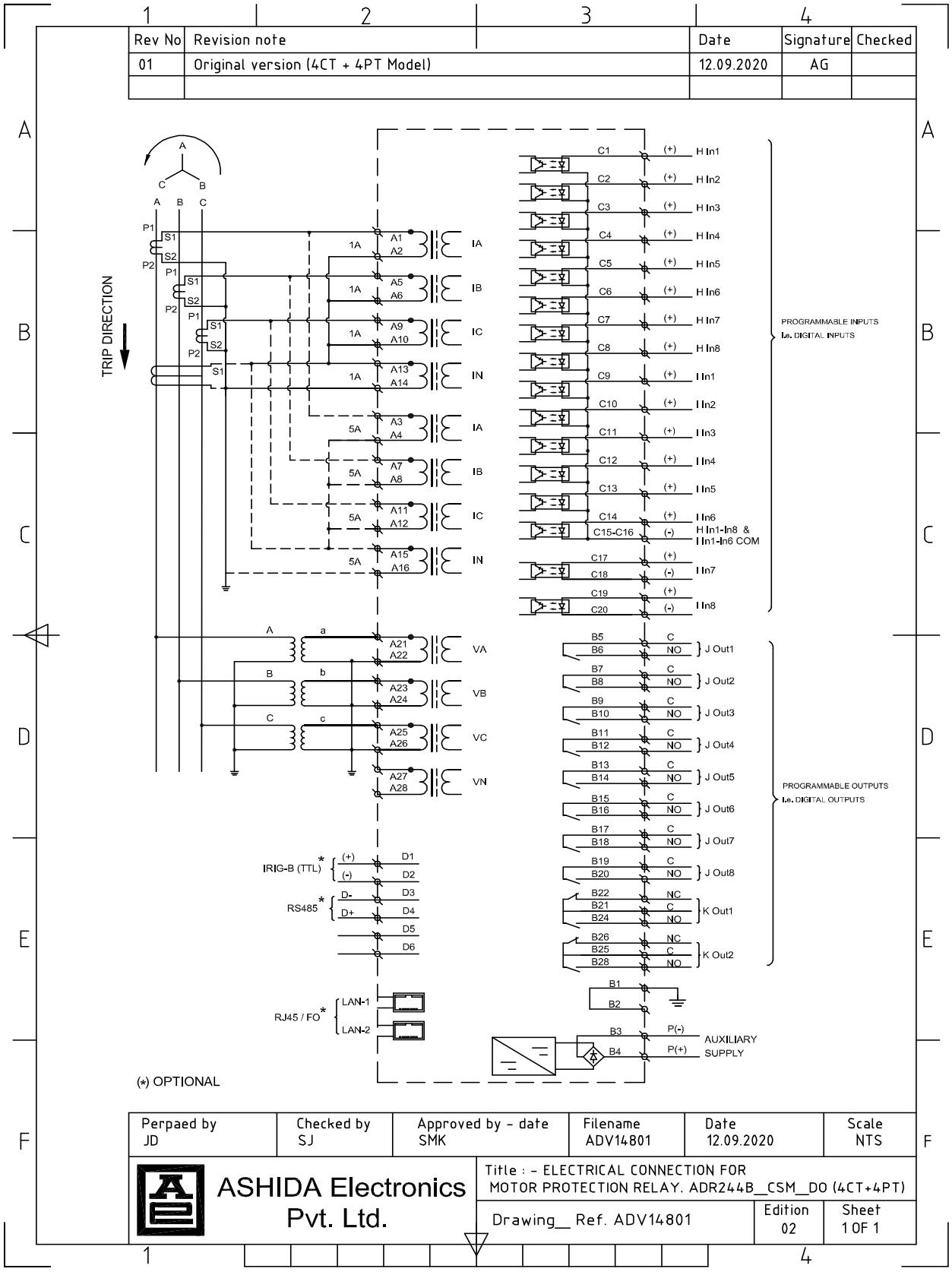


Back Terminal Details:



Electrical Connection Details: :

Rev No	Revision note	Date	Signature	Checked
01	Original version (4CT + 4PT Model)	12.09.2020	AG	



Perpaed by	Checked by	Approved by - date	Filename	Date	Scale
JD	SJ	SMK	ADV14801	12.09.2020	NTS

ASHIDA Electronics Pvt. Ltd.

Title : - ELECTRICAL CONNECTION FOR MOTOR PROTECTION RELAY. ADR244B_CSM_DO (4CT+4PT)

Drawing_ Ref. ADV14801 | Edition 02 | Sheet 1 OF 1

Ordering Information:

Ordering Information												
	1-4	5	6	7	8	9	10	11	12	13	14	15
Model	**244B**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Example	244B	E	0	0	2	0	3	1	0	2	1	H
FEEDER PROTECTION												
Sub Type												
Enhanced Version		E										
Variant												
Standard			0									
Language												
English				0								
Protocol												
IEC 103					0							
IEC 61850					2							
MODBUS TCP					4							
CT / PT & RTD												
Default: 4CT, CT Selection: 1A/5A, 4PT: 63.5V						0						
Digital Outputs												
10 DO							3					
Digital Inputs												
16 DI								1				
DI Setting Threshold												
18VDC									0			
35VDC									1			
77VDC									2			
154VDC									3			
Auxiliary Supply												
24 – 230 VDC / VAC										2		
Cabinet Details												
Draw Out											1	
Communication Ports												
Disable / No Rear Port												0
RS-485 Rear Port												B
10/100 Base-T Ethernet RJ45 Rear Port & RS-485 Rear Port												E
DUAL 10/100 Base-T Ethernet RJ45 Rear Port & RS-485 Rear Port												H
RS-485 Rear Port + IRIGB Port #												I
DUAL FO Ethernet Rear Port & RS-485 Rear Port												N
Single FO Ethernet Rear Port & RS-485 Rear Port												O
DUAL FO Ethernet Rear Port & RS-485 Rear Port (with PRP)												S

General Specifications:

AC Current Inputs:

1A Nominal

5A Nominal

Thermal Withstand Capacity:

250 X In for 1s

50 X In for 3s

4 X In for Continuous duty

Dynamic Thermal rating:

1250 for 10ms

Burden Rating:

< 0.2VA for 1A Nominal

< 0.2VA for 5A Nominal

AC Voltage Inputs:

2 X Vn for Continuous duty

2.6 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: 24 to 230Vac/dc

Burden: < 15watts for DC

Digital Outputs:

Continuous carry: 5A

Make: 30A for 3sec AC/DC

Breaking capacity: 1250VA @ 250Vac,

100 watts @ 250Vdc resistive,

50 watts @ 250Vdc inductive (L/R = 45ms)

Digital Inputs:

Operating range:	Threshold Voltage
24 – 230Vac/dc	18V
48 – 230Vac/dc	35V
110 – 230Vac/dc	77V
220Vdc/230Vac	154V

Communication Ports:

Front Port – USB

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

IRIG-B Port – Demodulated (Optional)

(Burden 10mA (Avg) / 15mA (Peak))

Fiber Optic Port (Optional)

Operating Temperature:

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

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

Humidity: 95% RH

ASHIDA ELECTRONICS PVT LTD.

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ISO 9001 Company

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