



## ASHIDA NUMERICAL MOTOR PROTECTION RELAY Type A21M

### Introduction:

ASHIDA has designed economical & reliable Multifunction A21M Protection & Control System. The simple and compact construction of A2 series, A21M relay provides integrated Protection, Control and Monitoring functions for Electric Motors.

### Functional Overview:

#### Key Protection & Control Functions:

- Two Independent Settings Groups
- Thermal Overload Protection (49)
- Non Directional Phase & Ground Over Current Function (50/51/51N/50N)
- Three Independent Stages for Non Directional Phase Over Current Protection.
- Three Stages of Non Directional Ground Over Current Protection.
- Internally Derived Ground Over Current (3I0>) Protection
- Sensitive Earth Fault Protection (50SEF)
- Inverse Time Over Current Protection (IEC & IEEE curves)
- High Impedance Restricted Earth Fault Protection (64R)
- Inverse & Definite time Negative Sequence Over Current Protection (46)
- Load Jam Protection (50LR)
- Prolong start Protection (66)
- Too many starts / Number starts function
- Under current Protection (37)
- Breaker Failure detection (50BF)
- Speed switch input

- Emergency start
- Trip circuit supervision function
- Programmable Inputs & Outputs
- Watchdog contact
- CB Close / Trip from HMI
- Programmable & Target LEDs for indication with dual colours (8 nos.)
- Self Supervision of relay
- Metering function
- Disturbance Recording (5 nos.)
- Event Recording (512 nos.)
- Fault Recording on HMI display (5nos.)
- Non-Volatile memory.
- Fully communicable with IEC standard open protocol IEC60870-5-103, MODBUS & DNP3.
- Separate communication port for SCADA Communication
- PC front port communication for convenient relay settings
- User friendly local operation with key pad
- Liquid crystal display (16x2) with backlight
- Password Protection.
- Measurement of current magnitude, symmetrical components, Thermal state, Load current, Time to thermal trip, Number of thermal trip, Last Start Time, Last Start current, Number of hot start and cold start allow, Time to next start, Number of emergency start, Motor run time, Breaker operating time, breaker operating counter, trip counter.

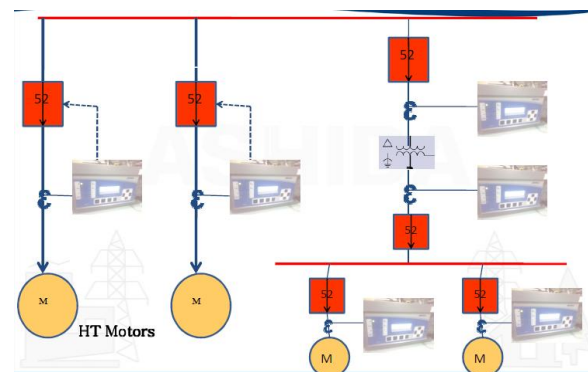
### Software Support:

- Setting Editor
- Programmable scheme logic Editor
- Settings upload / download
- Offline Settings Editor
- Online Measurement
- Disturbance analysis
- Event analysis/Fault History
- Relay Assistant Tool for Testing and Commissioning relay

### Applications:

A21M 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.

A21M relay apply for protection, control & monitoring of radial and ring main feeder to achieve sensitivity and selectivity on phase & ground faults as well as on abnormal conditions.



**Motor Protection application**

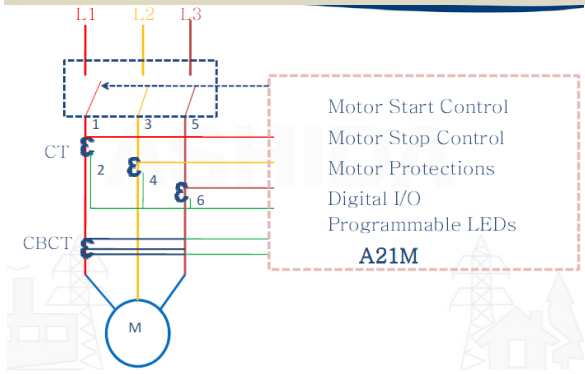
ANSI Code	Description
37	Under current Protection
46	Negative Sequence Protection
50	Instantaneous/Definite Time Phase Over current Protection
51	Inverse Time Phase Over current Protection
50N	Instantaneous/Definite Time Ground Over current Protection
51N	Inverse Time Ground Over current Protection
51H/NH	Harmonic blocking/unblocking
50H/NH	Harmonic blocking/unblocking
50SEF	Sensitive earth fault
64G	High Impedance Restricted Earth Fault Protection
50BF	Breaker Failure
49	Thermal overload Protection
50LR	Locked rotor Protection
48	Prolong start Protection
66	Number of starts
86	Lockout (Trip command)

**Protection Function Overview**

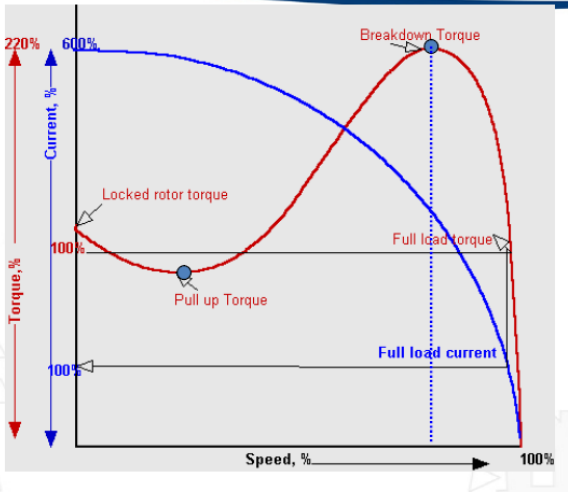
The core functionality of A21M relay is equipped with Motor protection & Control functions.

**Motor Prolong start Protection (48):**

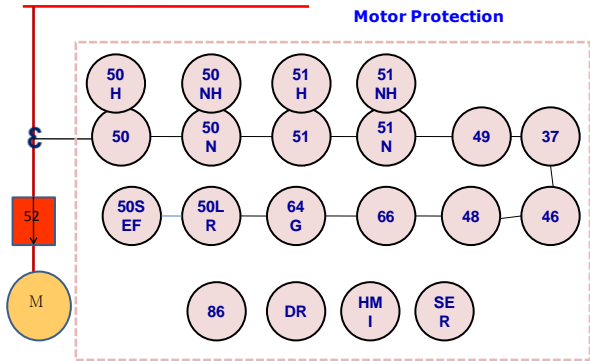
For an induction motor to stall during normal operation (during motor starting conditions), load torque may exceeds very high and above the breakdown torque, may cause damages of stator winding and rotor bars. Stator draws heavy current due to the heavy current flows in rotor bars.



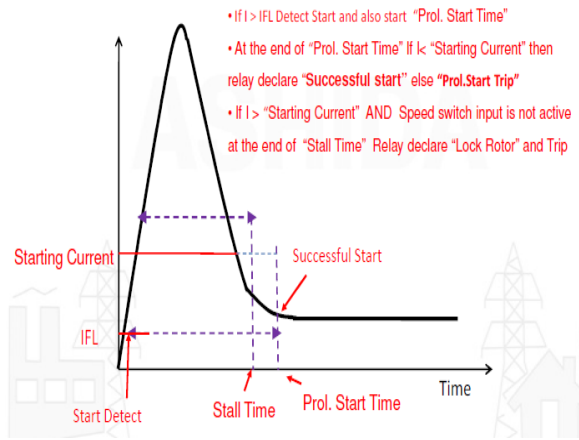
**Motor Protection application**



**The functional over view of A21M;**



The A21M relay detects motor prolong start conditions effectively and provides protections to motor.

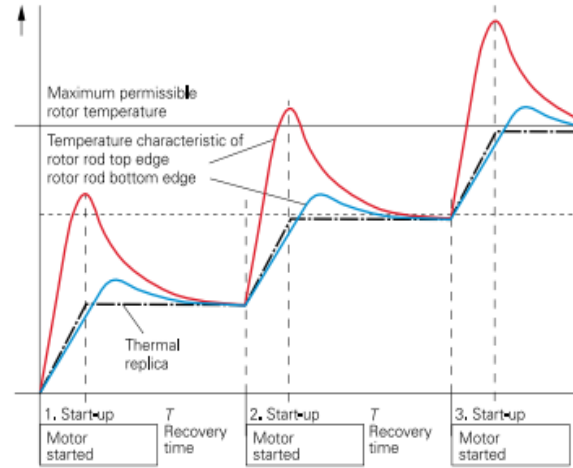


**Number of Starts (48/66):**

Induction motor can be start frequently/periodically based on their rotor bar thermal capacity design. A21M 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 startup. The cooling time between starts allowed to restart motor, when the calculated rotor temperature falls down to safe level.

A21M 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

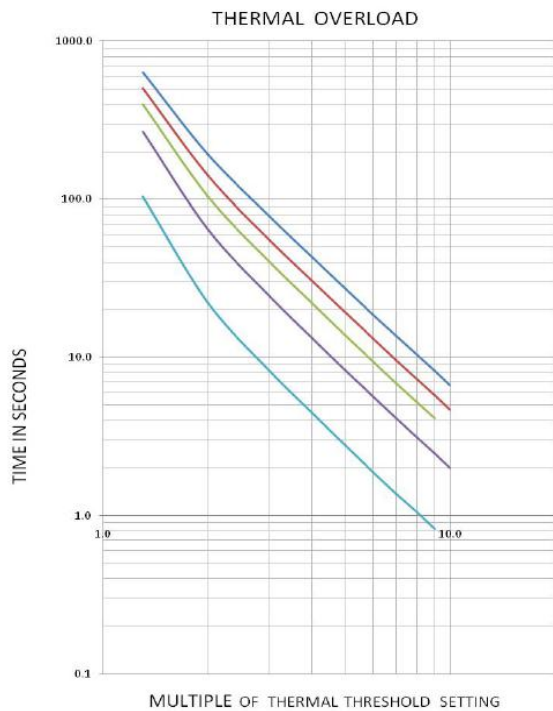
time between starts) according to motor start data available from motor datasheet.



**Thermal overload Protection (49):**

Stator winding and Rotor bars of induction motor can over heats during motor running and starting conditions. To monitor the thermal state of motor a thermal replica method used in A21M relay. Two independent heating time constants ( $Th.Tcanst.1$  &  $Th.Tcanst.2$ ) can set in A21M relay for stator and rotor thermal over load protection. These heating time constants can be set in relay according to time constants data available from motor datasheet. Negative and Positive sequence current are taken in to account, so that any abnormal heating condition (i.e. heating during single phasing) can be detected.

$$I_{eq} = \sqrt{(I_{rms}^2 + K I^2)}$$



A21M relay provides thermal alarm function to indicate the thermal content level of motor exceeded on threshold level.

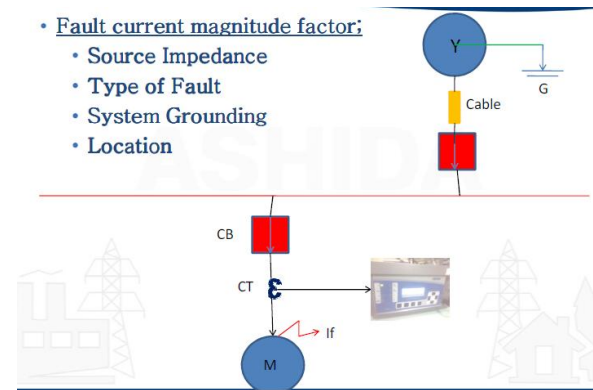
**Load Jam Protection (50LR):  
(Motor Stall / Locked Rotor )**

For an induction motor to stall during normal operation (during motor running conditions), load torque may exceeds the breakdown torque. Damages can be done due to heavy current flows in stator winding and rotor bars.

The A21M relay detects motor stall / locked rotor conditions effectively and provides protections to motor against motor stall during running condition.

**Non Directional Over Current  
Protection (50/50N/51/51N):**

The relay provides Non Directional phase and ground over current protection (Three stages for phase over current and ground over current) against short-circuit and ground faults in motor.

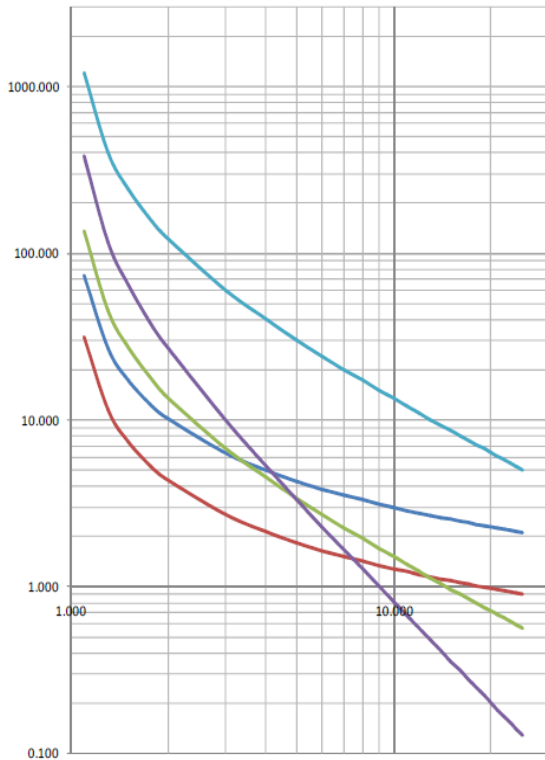


The function is equipped with digital filter algorithms, providing the rejection of higher harmonics & DC offset. Selectable IEC / IEEE inverse time curves with non directional over current protection will be providing greater selectivity, flexibility and sensitivity to users for better relay co-ordinations.

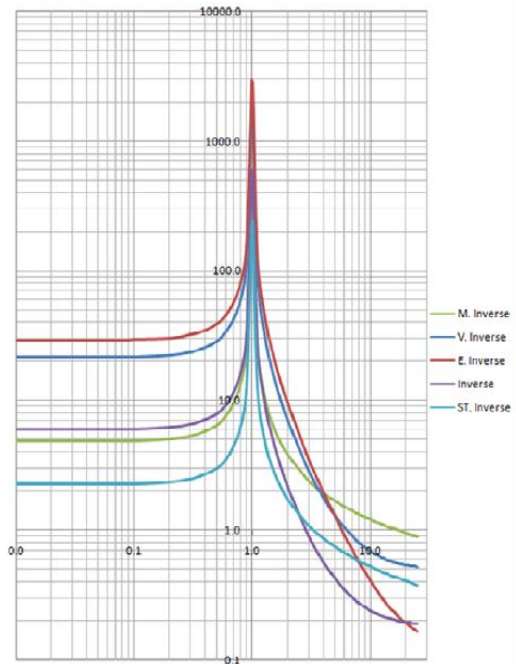
A21M relay provides inverse time over current characteristic for phase and ground over current elements. Each stages of phase and ground over current elements are independently settable with inverse time or definite time characteristic. The following tripping characteristics are available;

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

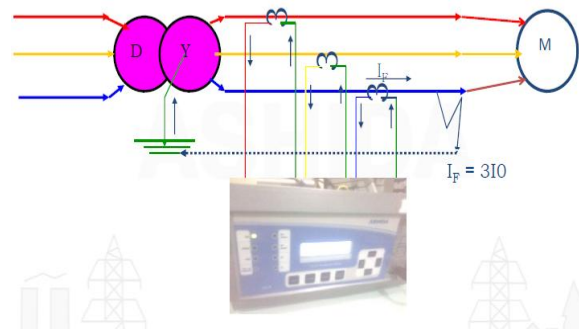
Description	Standard	K	α	L
IEC S Inverse	IEC	0.14	0.02	0
S Inverse 1.3 Sec	---	0.06	0.02	0
IEC V Inverse	IEC	13.5	1	0
IEC E Inverse	IEC	80	2	0
UK LT Inverse	UK	120	1	0
IEEE M Inverse	IEEE	0.0515	0.02	0.114
IEEE V Inverse	IEEE	19.61	2	0.491
IEEE E Inverse	IEEE	28.2	2	0.1217
US Inverse	C08	5.95	2	0.18
US ST Inverse	C02	0.02394	0.02	0.01694



A21M relay provides the inverse time dropout characteristic (electromechanical relay reset) for IEEE curves. The output of protection function shall be reset after dropout time delay.



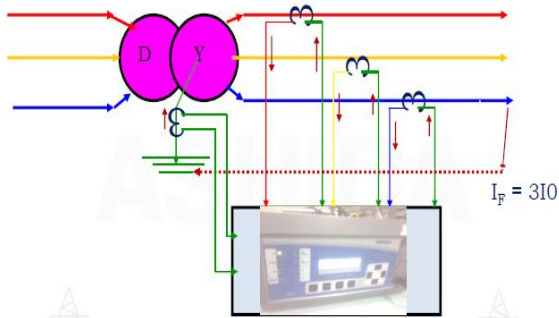
A21M relay provides three stages of definite time/inverse time internally derived zero sequence over current ( $3I_0 >$ ) protection to detects asymmetrical faults in electrical network. It can apply to overhead transmission line, underground cable, and feeder. The ground current ( $3I_0 >$ ) calculated from three line currents.



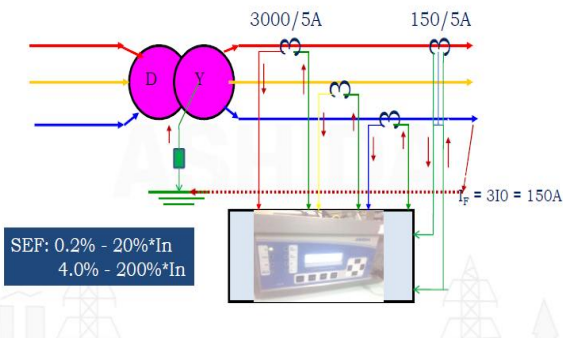
**Derived Zero sequence over current from three phases**

A21M relay provides three stages of externally ground over current protection. A21M relay measures ground fault current through neutral CT input. Externally ground

CT input can also apply for high impedance restricted earth fault protection or sensitive ground fault protection through CBCT.



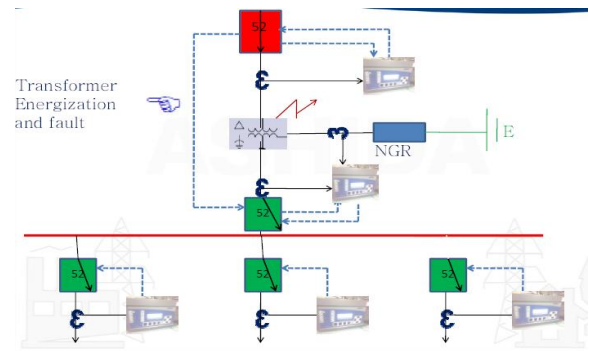
**Externally measured ground over current through neutral CT**



**Externally measured ground over current through CBCT**

**Harmonic blocking / unblocking (50H/51H/50NH/51NH):**

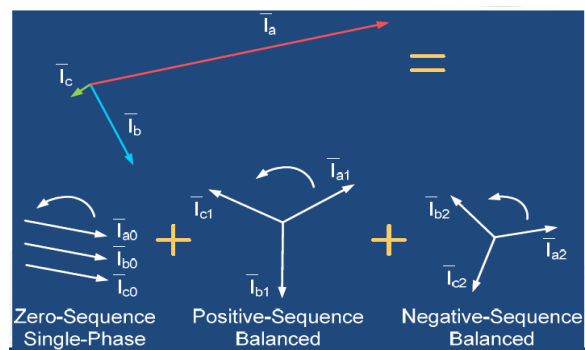
Harmonic blocking / unblocking(Inrush Blocking) feature equipped in A21M relay provides stability on inrush current during transformer energization when the protection relay applies for transformer feeder as a feeder protection application. Harmonic blocking / unblocking feature is independent for each stage of phase and ground over current protection.



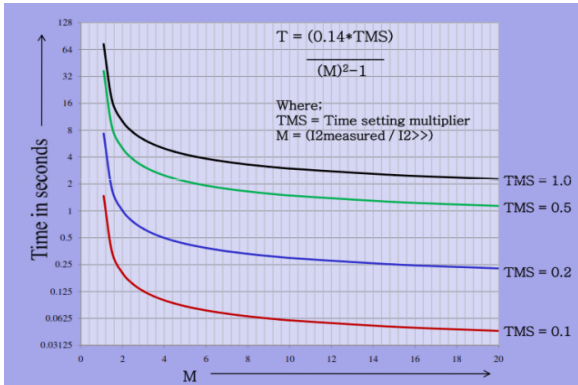
**Negative sequence Over Current Protection (46):**

The unbalanced of stator current or the negative sequence current flows generate double line frequency current ( $120 \times 2 \times F/P$ ) that flows in rotor bars. This current flows in rotor surface or in damper winding causes the excessive vibration on rotor shaft and generate severe heating ( $I^2Rt = \text{heat} = K$ ) in rotor bars.

Three independent stages of Definite and Inverse time Negative sequence over current protection will be providing protection unbalanced faults and load conditions. Protection can also apply in condition when there is a very high resistive ground fault and ground element may not sense the fault current.

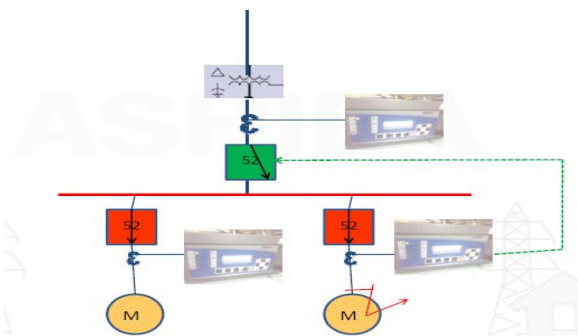


The negative phase sequence over current element can be programmed as IDMT or definite time characteristic. A21M relay provides ten selectable IEC / IEEE inverse curves for each stage.



**Breaker Failure detection (50BF):**

If the fault current is not interrupted after a time delay expired, circuit breaker failures detected, and execute trip command to upstream circuit breaker. A21M relay incorporates circuit breaker failure protection to detect failure of tripping command execution due to mechanical or electrical problems in circuit breaker.



**Under Current Protection (37):**

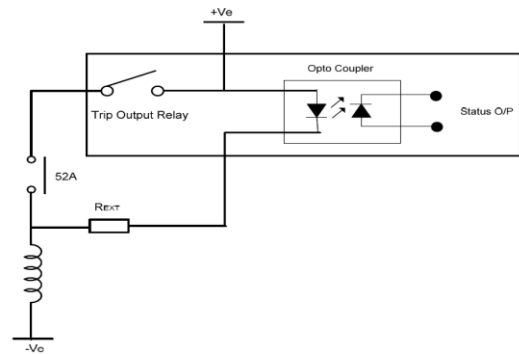
Under current protection can be apply, when the motor load fall down to certain minimum load level. A21M relay provides

under current protection with definite time delay feature.

**Trip circuit supervision (74T):**

Any binary inputs for circuit breaker poles can be used for monitoring the circuit breaker trip coils including connecting cables. Relay initiate alarm whenever the circuit breaker control/DC circuitry gets interrupted.

The A21M is having 6 nos. of digital inputs and any one shall be assigned/used to continuously monitor healthiness of trip-circuit.



**Programmable Inputs & Outputs:**

The A21M relay equipped with 6 nos. of programmable digital outputs and 6 nos. of optically isolated digital inputs. One digital inputs shall be configured for trip circuit supervision monitoring and remaining 5 nos. are the programmable digital inputs to be configured for desired applications.





**Back Terminal**

**Programmable LEDs and Pushbuttons:**

The A21M relay provides total 8 nos. of target & programmable LEDs with dual colours indication. The LEDs can be programmed either through HMI or through PC software (RTV2 software).

**Front View Details:**

The A21M relay front view details;



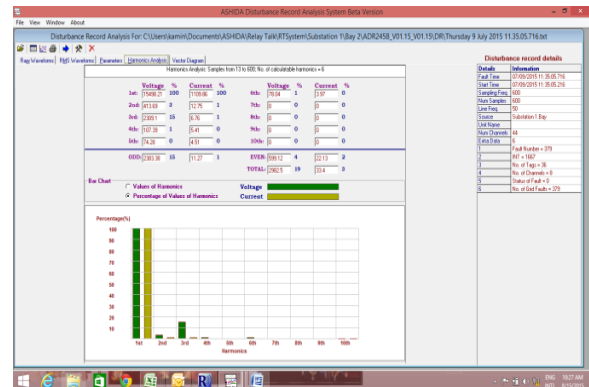
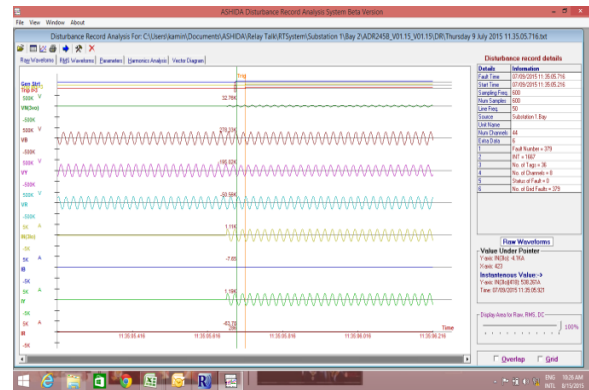
**Event recording:**

A21M relay is providing feature to record and store 512 nos. of events in non-volatile memory through internally by protection and control functions and externally by triggering of digital inputs, and can be extracted using communication port or

viewed on front of LCD display. The event shall be trigger on time stamp through time synchronization or internal clock setting.

**Disturbance recording:**

A21M relay provides built in disturbance recording facility for recoding of analogue and digital channels. Relay records 5 nos. of disturbances and store in to non-volatile memory. Disturbance records can be saved in IEEE COMTRADE format and same can be analyzed in disturbance analysis software.



**Fault recording:**

A21M relay is providing fault record facility. The fault records can be display either on HMI display or in RTV2 software. The relay

can records 5 nos. of fault records in non-volatile memory.

**Metering:**

Online metering feature of A21M relay is providing metering of parameters (i.e. Current Magnitude, Symmetrical components, Thermal states, Breaker operation counter, Breaker trip counter, Breaker operating time etc.) on HMI display or in RTV2 software.

**Motor start report:**

A21M relay records motor start data during starting of motor. Relay records the motor start time and current and stores motor start reports in non-volatile memory. Start time recording facility up to 200s.

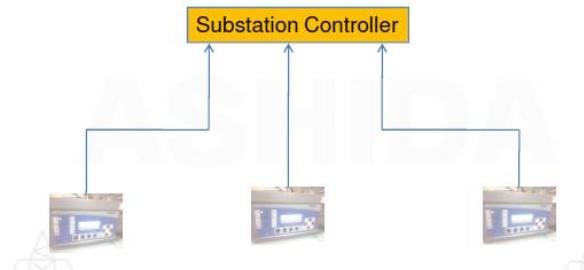


**Independent Protection settings groups:**

A21M relay provides two independent settings groups to allow operate relay on different power system operating conditions.

**IEC 60870-5-103 Protocol:**

A21M relay provides internationally standardized protocol for communication via RS485 port of protection relays. IEC 60870-5-103 protocol used worldwide and supported by relay manufacturers.



**Typical Tests Information:**

<b>The Relay Confirm to following standard</b>			
<b>Electromagnetic Compatibility Type Test:</b>			
<b>Sr. No.</b>	<b>Standard</b>		<b>Test</b>
1.	High Frequency Disturbance Test	IEC60255-22-1	: Frequency : 1MHz Damped Oscillatory : Longitudinal :2.5 KV Common Mode, 1 KV Differential Mode : Duration: sec duration 2 sec. : On Mains Port.
2.	Electrostatic Discharge Test-Direct Application	IEC60255-22-2	: IEC 61000-4-2. : Contact discharge: 2, 4, 6 & 8 KV, : Air discharge: 2, 4 8 & 15 KV : Polarity: both +ve and -Ve polarities.
3.	Fast Transient Disturbance Test	IEC60255-22-4	: Class A : 4KV; 5/50ns; 5KHz & 100KHz: Repetition rate 300ms; Both polarities; Ri = 50Ω; duration 1 min.
4.	Surge Immunity Test	IEC60255-26 & IEC61000-4-5	: Differential Mode = 2kV : Common Mode = 4kV : 1.2/50μs, 8/20μs 5 surges of each polarity
5.	Power Frequency Immunity Test	IEC60255-22-7	: Class-A
6.	Pulse Magnetic Field Immunity Test	IEC61000-4-9	: TEST LEVEL 5, TEST specifications = 1000A/m field applied in all planes
7.	Radiated Electromagnetic Field Disturbance Test	IEC60255-22-3 & IEC61000-4-3	: 10V/m, Performance Class-A : 10V/m, freq = 80MHz to 1GHz, 1.4 – 2.7 GHz and 30 V/m, freq = 800 – 960 MHz , 1.4 – 2 GHz : SPF = 80, 160, 380, 450, 900, 1850 & 2150 MHz

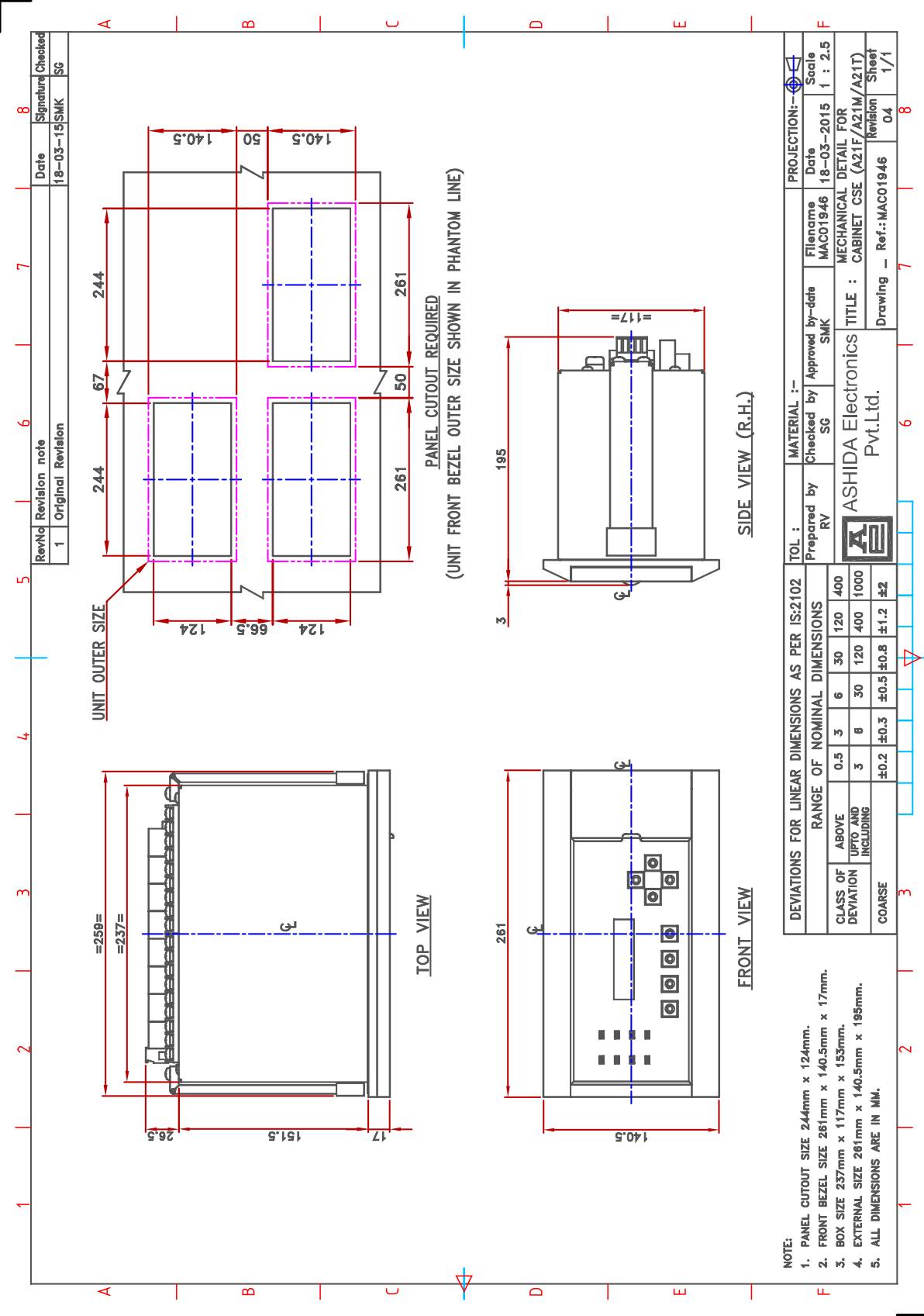
			80% AM at 1kHz.
8.	Conducted Disturbance Induced By Radio Frequency Field	IEC60255-26	: Freq. 150kHz - 80MHz, Amplitude 10 V, Modulation 80% AM @ 1 KHz. SPF = 27 and 68 MHz
9.	Power Frequency Magnetic Field Immunity Test	IEC61000-4-8	: 1000A/m FOR 3s, 100A/m for 1minute.
10.	Power Supply Immunity Test	IEC60255-11 & IEC61000-4-11	: DC voltage dip: 40% dip 200ms and 70% for 500ms for DC 10 & 20ms without loss of protection for DC 30ms, 50ms, 100ms, 200ms, 300ms, 0.5s, 1s and 5s with temporary loss of protection for DC  : AC voltage dip: 10, 20ms without loss of protection for AC 50ms, 100ms, 200ms, 0.5s, 5s with temporary loss of protection
11.	Conducted & Radiated frequency Emission Test	IEC60255-25	: Conducted 0.15MHz - 0.5MHz, 79dB (microV) Q-Peak, 66dB (microV) for average 0.5MHz - 30MHz, 73dB (microV) Q-Peak, 60dB (microV) for average  Radiated (3mtr) 30MHz - 230MHz, 50dB (microV) Q-Peak, 230MHz - 1GHz, 57dB (microV) Q-Peak,
<b>Insulation Tests:</b>			
12.	High Voltage Test	IEC60255-27	: At 2kV 50Hz between all terminal connected together and earth for 1 minutes
13.	Impulse Voltage Test	IEC60255-27	: Test voltage: 5KV (peak) 1.2 / 50us, : Energy :0.5 J, : Polarity : + ve and - Ve : Nos. of impulses : 3 positive and 3 negative impulse : Duration between Impulses : 5 sec.
14.	Insulation Resistance	IEC60255-27	: $\geq 100M\Omega$ @ 500V DC
<b>Environmental tests:</b>			
15.	Cold test		: IEC-60068-2-1
16.	Dry heat test		: IEC-60068-2-2
17.	Damp heat test, steady state		: IEC-60068-2-78
18.	Change of Temperature		: IEC-60068-2-14
19.	Damp heat test, cyclic		: IEC-60068-2-30
20.	Enclosure Protection Test (IP52)		: IEC 60529
<b>CE compliance</b>			

21.	Immunity	: IEC-60255-26
22.	Emissive Test	: IEC- 60255-26
23.	Low voltage directive	: EN-50178
<b>Mechanical tests</b>		
24.	Vibration Endurance Test	: IEC 60255-21-1 class 2 : Frequency Range = 10Hz - 250Hz, acceleration. = 2gn : Sweep rate 1 octave/min; 20 cycle in 3 orthogonal axis.
25.	Vibration Response Test	: IEC 60255-21-1 class 2 : Frequency Range = 10Hz - 150Hz , acceleration. = 1gn : Sweep rate 1 octave/min; Displacement =0.075mm, in 3 orthogonal axis.

	Bump Test	: IEC 60255-21-2 Class-2 : 1000 bumps / direction of 20gn peak acceleration and 16ms pulse duration in each of the two opposite direction per axis as per No. of axes. 3.
26.	Shock Withstand Test	: IEC 60255-21-2 Class-2 : 3 shocks of 30gn peak acceleration and 11ms pulse in each of two opposite direction. No. of axis : 3
27.	Shock Response Test	: IEC 60255-21-2 Class-2 : 3 shocks of 10gn peak acceleration and 11ms pulse in each of two opposite direction. No. of axis : 3
28.	Seismic Test	: IEC 60255-21-3 Class-2 : Sweep 1/Axis (@a sweep rate of 1 octave/minute) vibration in the frequency range (1-35 Hz) at displacement X-axis: 7.5mm, Y-axis: 3.5mm amplitude of 3.5mm with acceleration of X-axis: 2gn, Y-axis: 1gn.

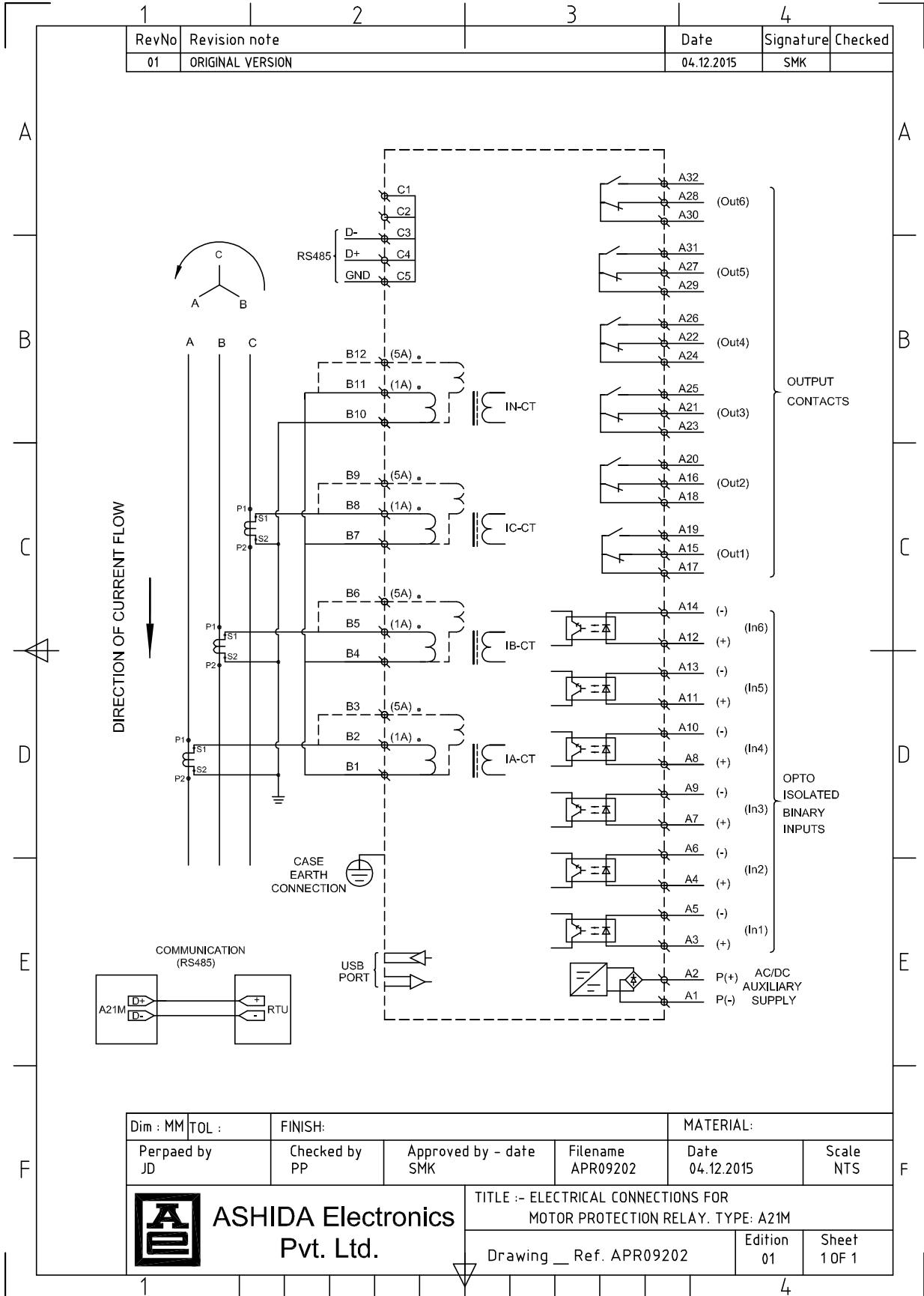
Note: Type test report is available on request











## General Specifications:

### **AC Current Inputs:**

1A Nominal

5A Nominal

Continuous Thermal Rating:

100 X In for 1s

50 X In for 3s

4 X In for Continuous duty for Phase and Ground

2 X In for SEF CT

Dynamic Thermal rating

200X In for dynamic timing

Burden Rating:

< 0.2VA for current(In)

### **System Frequency:**

50Hz / 60Hz

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

### **Power Supply:**

Range: 24 to 230Vac/dc

Burden: < 10watts for DC

### **Digital Outputs:**

Continuous carry: 5A

Make: 30A for 0.5s & 15A for 3s

Breaking capacity: 1250VA @ 250Vac, 100 watts @ 250Vdc resistive, 50 watts @ 250Vdc inductive (L/R = 45ms)

### **Digital Inputs:**

Operating range: 24 – 230Vac/dc

### **Communication Ports:**

Front Port – USB

Rear Ports – RS485

### **Operating Temperature:**

-25°C to +65°C

Storage Temperature: -25°C to +70°C

Humidity: 95% RH

Weight: < 3.4kg

**Ordering Information:**

Ordering Information												
	1 -- 4	5	6	7	8	9	10	11	12	13	14	15
Model	A21M	X	X	X	X	X	X	X	X	X	X	X
Example	A21FM	B	0	0	1	0	0	0	0	2	0	A
<b>Cabinet Details</b>												
Basic Version		B										
<b>Software Details</b>												
Standard			0									
Customer Specific			C									
<b>Language</b>												
English				0								
<b>Protocol</b>												
IEC 103					0							
IEC 103 & MODBUS					1							
IEC 103 & DNP.3					2							
Customer Specific					C							
<b>CT &amp; PT</b>												
PH & EF CT: 1/5 Amp Selectable ( Standard EF CT)						0						
PH & EF CT: 1/5 Amp Selectable ( Sensitive EF CT)						1						
<b>DO</b>												
Default - (B - 6DO)							0					
<b>DI</b>												
Default - (B - 6DI)								0				
<b>DI Setting(Threshold value)</b>												
18VDC / 16VAC									0			
35VDC / 33VAC									1			
77VDC / 75VAC									2			
154VDC / 152VAC									3			
<b>Auxiliary Supply</b>												
24VDC - 48VDC										1		
24 – 230 VAC/DC										2		
110VDC - 250VDC										3		
Customer Specific										C		
<b>Case Detail</b>												
Non Draw out											0	
<b>Communication Port</b>												
Disable / NO rear port												0
RS 422 rear port												A
RS 485 rear port												B

ASHIDA ELECTRONICS PVT LTD. All rights reserved. All brand or product names appearing in this document are the trademark or registered trademark of their respective holders. No ASHIDA trademarks may be used without written permission.

The information in this document is provided for informational use only and is subject to change without legal notice. ASHIDA ELECTRONICS PVT LTD. has approved only the English language document.