

**SPECIFICATIONS FOR MV AUTOMATED
METERED RING MAIN UNIT FOR BULK
LOAD (400A&630A) UP TO 36KV**

Issue Date: 29/06/2020

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MAIN UNIT FOR BULK LOAD (400A&630A) UP TO 36KV**

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Revision History

#	Date	Revision No.	Revised By	Major Revision Description
1				
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1 Scope

This SEC Distribution Materials Specification specifies the minimum technical requirement for design, materials, manufacturing, testing, inspection and performance for indoor type medium voltage automated metered ring main unit (MRMU) up to 36 KV with load management facility, to be used for bulk loads (400A&630A) in the medium voltage distribution network of the Saudi Electricity Company (SEC) in Saudi Arabia. This MRMU will be used for Distribution Automation System so that the AUTOMATED MRMU shall be remotely controllable using integrated communication devices such as a RTU and a Modem.

2 Cross references to other SEC standards

This material standard specification shall be read in conjunction with SEC specification No. 01-SDMS-01 (latest revision) for General Requirement For All Equipment / Materials, which shall be considered as an integral part of this SDMS. This SDMS shall also be read in conjunction with SEC Purchase Order (PO) requirements

3 Applicable codes and standards

The latest revision of the following codes and standards shall be applicable for the equipment/materials covered in this specification. In case of any deviation, the vendor/manufacture may propose equipment/materials conforming to alternate codes or standards. However, the provisions of SEC standards shall supersede the provisions of these alternate standards in case of any difference.

Standard #	Title
IEC 62271-100	High-voltage alternating-current circuit breakers
IEC 62271-172	HV Alternating current disconnectors and earthing switch
IEC 61869-1	Instruments transformers
IEC 61869-2	Current Transformers
IEC 61869-3	Voltage Transformers
IEC 60255	Electric Relays
IEC 60265	High-voltage switches
IEC 62271-200	AC metal-enclosed switchgear and control gear for rated voltage above 1 kV and up to and including 52 kV
IEC 60337	Control switches (low-voltage switching devices for control and auxiliary circuits, including contactor relays)
IEC 60376	Specification and acceptance of new Sulphur hexafluoride
IEC 60420	High-voltage alternating current fuse-switch combination and fuse-circuit-breaker combination
IEC 60529	Classification of degree of protection provided by enclosures

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Standard #	Title
IEC 60694	Common specifications for HV switchgear and control gear standards
ISO 2063	Metallic coatings – protection of iron and steel against corrosion – metal spraying of Zinc and Aluminum
01-SDMS-01	General requirements for equipment/material
50-SDMS-01	Current Transformers
32-SDMS-11	Automated RMU up to 36kV
12 SDMS-01	Termination, joints & accessories up to 36 kV
11-SDMS-04	Specification For Aluminum Unarmored XLPE/LLDPE Insulated Power Cables For Rated Voltages From 15kv Up To 36kv
DPMS-02 R0	Complete Protection IED Specifications & CTs for Automatic RMU

Table 1: List of applicable standards

4 Material, design and construction requirements

4.1. General

- 4.1.1 The Automated MRMU shall consist of two load break switches and one circuit breaker. The circuit breaker panel shall be in the middle. One additional load break switch panel may be added to either side if requested in the tender.
- 4.1.2 The Automated MRMU shall be indoor, metal-enclosed, single bus-bar type.
- 4.1.3 Insulation medium shall be Air or SF6 gas and fault interruption medium shall be either SF6 gas or vacuum.
- 4.1.4 Degree of protection of the panels shall be class IP-41 as per SEC specification No. 01-SDMS-01 for indoor application. All access to the mechanism shall be protected against dust and moisture.
- 4.1.5 Humidity and moisture condensation control elements with activation and deactivation thermal switch shall be provided in each panel.

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- 4.1.6 Temperature independent gas pressure gauge marked with green (safe) and red (not safe) zones shall be provided. The safe operating zone shall correspond to a temperature range of -10°C to $+55^{\circ}\text{C}$. The unit shall continue to work safely even if the gas pressure inside the tank goes down to the atmospheric pressure. Refilling / re-pressurizing inlet valve, if provided, shall be easily accessible for field refilling.
- 4.1.7 The maximum width of the panels shall be 1000 mm for breaker panel and 750 mm for each load break switch panel. Depth of the panels shall be suitable for 600 mm wide cable trench. The height shall not exceed 2400 mm.
- 4.1.8 The operating mechanisms shall be lockable at each position with padlocks (provided by SEC) having 9 mm shackle diameter and 25 mm clearance. The maximum physical effort required for operating any mechanism shall not exceed 400 Newton. The maximum height of the mechanism operating access shall not exceed 1.5 m.
- 4.1.9 The operating handle shall have anti-reflex action for load break switches and shall be stored in a proper place at the front or side of the unit. Operating handle inserts shall have marking as appropriate to avoid inserting the wrong end during switching operations. It is preferred to have one common handle for all switches.
- 4.1.10 All parts of equal size and shape shall be inter-changeable.
- 4.1.11 All bolted electrical joints shall be secured by fasteners of corrosion-proof materials.

4.2 Current rating

- 4.2.1 Busbars shall be of electrolytic high grade copper. It shall withstand the mechanical stresses of the rated short circuit current. The continuous current rating at the maximum ambient temperature given in SEC specification 01-SDMS-01 shall be 400A or 630A for ring switches and breaker panels.

4.3 Ring switches

- 4.3.1. Ring switches shall be full load break and fault-making type. Ring switches shall be designed for interrupting full rated current as stated in clause 4.2 above, small inductive or capacitive currents involved in disconnecting of unloaded transformers, cables or overhead lines. It shall be suitable for full fault-making current.
- 4.3.2. Ring switch shall consist of a moving contact assembly with three positions: 'ON', 'OFF', and 'Earth'. Two independent manual operating mechanisms for ring and earth switches are also acceptable. The design shall prevent simultaneous closing of the main switch contacts and the earth switch contacts. The earth switch contacts shall be designed to close into a fault and shall have the same short circuit capacity as the main contacts.

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- 4.3.3 The switching operation shall be manual by means of an operating handle and independent fast acting operating mechanism. Closing and opening speeds of the switch shall be independent of the speed with which the operating handle is moved.
- 4.3.4 Ring switch operating mechanism shall have provision for on-site installation (retrofitting) of geared motor mechanism and associated closing and opening coils with necessary contactors for remote and future tele-control operations in the distribution network.

4.4 Circuit Breaker

- 4.4.1 Circuit breaker shall be of fixed type. It shall have Air or SF6 gas as insulation medium and SF6 gas or vacuum as interruption medium.
- 4.4.2 Circuit breaker shall be designed to open, close and trip by local push buttons, remote signals and tripping through protective relay circuit. Local and remote operation selection shall be by a selector switch on the front panel.
- 4.4.3 Circuit breaker shall be provided with manual and electrical switching operation. Geared motor mechanism for spring charging and associated closing and opening coils with necessary contactors for remote and tele-control operations shall be included.
- 4.4.4 Earthing of circuit breaker shall be by means of a switch with same fault level capacity of the breaker..
- 4.4.5 Operating mechanism shall be fast acting and independent of the operator action when operating manually and shall indicate the following positions:
- Circuit breaker ON and OFF
 - Off-Load Isolator ON and OFF
 - Earthing ON and OFF
- 4.4.6 If circuit breaker panel equipped with an off-load isolator switch, it shall be fully interlocked with the circuit breaker.

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4.5 Protective Relay**4.5.1 Relay selection:**

Protection Relay to be used in AUTOMATED MRMU shall be selected from the latest version of SEC-DBU Unified List of Approved Relays (MRMU Relays List) and in compliance with the latest specification of Distribution Protection Material Specifications (DPMS-02). The DC supply of the relay and protection circuits shall be 24V DC. There should also be redundant DC supply (Through UPS). Furthermore, the ordering code of the relay shall be selected based on the following specifications:

- a. Auxiliary – Powered Relay.
- b. Rear Port Communication (Communication Protocol shall be IEC 60870-5-103 / 104, DNP 3.0 or as required by the company).
- c. 24 DC voltage supply

4.5.2 Main Signals related to AUTOMATED MRMU protection system, which shall be transmitted through the RTU, include but not limited to:

- a. Current measurements
- b. WATCHDOG (relay error, relay faulty, protection in service...etc.) shall be configured to the RTU either through hardware connection or through rear port communication (preferably both).
- c. Segregated Phase and Earth fault Protection Operated Signals shall be configured to the RTU via Hard-wired Connection & Serial Communication
- d. Protection DC Supply Fail. (Can be provided via DC MCB & Supervision Function)
- e. Protection Settings, Events and DFRs Records (if applicable).

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4.6 Operations

All operating positions shall be on the front of the unit and position of each of the switches shall be displayed on a mimic diagram. Clear indicators showing 'ON', OFF' and 'Earth' shall be provided on polycarbonate or metal painted labels not less than 15 mm in height and 1.5 mm thick (sticker type labels are not acceptable).

Indicator windows shall not be less than 15 mm in diameter and shall be covered with transparent UV resistant material with adequate mechanical strength.

Indicator	Letters	Background
ON	White	Red
OFF	White	Green
Earth	Black	Yellow

Table 2: Indicators

4.7 Cable Testing Facility (optional)

Ring switches shall have test bushings or test probe insertion facility for high voltage and current injection tests for the cables terminated on ring switches.

Disconnection of cables for testing purposes is not acceptable for automated MRMU 400A&630A.

4.8 Interlocks

Interlocks shall be provided to make the following operations impossible:

- Operation of the ring switch or circuit breaker directly from 'ON' to 'Earth' or from 'Earth' to 'ON'.

The following additional requirements apply if the unit offered has two independent manual operating mechanisms for ring and earth switches:

- Operation of the 'Earth ON / Earth OFF' mechanism of earth switch unless the 'ON/OFF' mechanism of ring switch is in the 'OFF' position.
- Operation of the 'ON/OFF' mechanism of ring switch unless the 'Earth ON / Earth OFF' mechanism of earth switch is in the 'Earth OFF' position.

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- b. Opening of the cable test cover without the associated ring switch being in the 'Earth' position.
- c. Closing ring switch to 'ON' with the test plug inserted and /or the cover open.
- d. Insertion or withdrawal of the test plugs with the switch in any position other than 'Earth' position.
- e. Opening of cable boxes without the associated ring switch or breaker in the 'Earth' position.
- f. Opening the off-load isolator switch (if any) unless the circuit breaker is in OFF position.
- g. Closing the circuit breaker unless the off-load isolator switch (if any) is in ON position.

4.9 Terminations / Cable compartments

- a. Termination in the ring switches and circuit breaker units shall be dry-type inside cable compartment suitable for accepting three core Aluminum or Copper; XLPE insulated cables of outside diameter of 70-110 mm.

Each cable box shall have a bottom plate and cable clamp.

Bottom plate shall be in two halves and the number of cable entry shall be as the following:

	Automated MRMU 400 A	Automated MRMU 630 A
No. of Cable entry hole for each cable box	1 cable hole	2 cables hole

Table 2: No. of Cable entry hole

suitable of 110 mm diameter equipped with rubber bushing. Cable clamp shall be detachable semi-circular halves suitable to hold the cable inside the cable box without cable glands.

- b. Cable shall be terminated using single hole cable lugs suitable for bolt size of M16. Cable termination shall be by means of bolted connection on cable bushing/terminals with cold shrinkable, pre-molded and screened pre-molded termination with right angle/straight boots. Plug-in type termination shall not be used.
- c. Cable bushing/ terminals shall be complete with brass or hot dipped galvanized fasteners (nuts, bolts and washers).
- d. Vertical distance from the top of cable clamp to the centerline of cable bushings/terminals shall be suitable for all type of terminations as mentioned in 12-SDMS-01 (latest revision) . The clearances in the ring and Tee- Off cable compartment shall be sufficient for cable maneuvering for termination applications.

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- e. The design of the cable compartments shall be such that their covers with sidewalls shall be removed to have full access during cable termination.
- f. Removal and installation of cable compartment covers shall be with minimum number of bolts.

4.10 Earthing

A ground bar of not less than 25 x 5 mm copper strip shall be provided bolted to the frame. It shall be located so as to facilitate earthing of cable sheaths and earthing devices. In addition, a terminal having M12 stud and nut shall be provided in the back of the panel with clear grounding mark.

4.11 Voltage Indicators / Phase Comparators

Built-in push-button or continuous indication without push-button type neon voltage indicators shall be provided together with low voltage hot phasing facility on ring switches and circuit breaker panels. The lamps shall be powered by bushing type capacitive voltage dividers.

Internal wiring in cable boxes shall be covered with heat resistant tape/tube, to protect it against flame temperature of gas torch during the cable termination.

4.12 Earth Fault Indicator (EFI)

Earth fault indicator (SEC approved type) with automatic resetting on 220-230V single-phase AC supply, split core type sensor of internal diameter not less than 130 mm shall be supplied. EFI shall be protected inside separate sunshield cover with a mesh front (drawn from the same metal sheet). EFI shall be installed on the left-hand side line-feeder. It shall be with two auxiliaries contacts, one for light signal and the other for remote monitoring. Three-pin plug for testing of EFI by primary current injection shall be provided in separate compartment with screwed cover, below the EFI housing. SEC may require to supply the EFI loose in an outdoor box with 15 meters of control cable for installation on masonry wall. The EFI shall communicate with RTU.

4.13 Auxiliaries supply

The AUTOMATED MRMU shall not require any external auxiliary AC power supply for operation and control. This power supply shall be obtained from a cast resin insulated voltage transformer connected to bus-bar side. Its secondary shall be 220AC and the auxiliaries supply output shall be 24 VDC and capacity shall be adequate for spring charging motors, switching operations, status indications, protective relays, RTU components, necessary contactors for control and monitoring of ring switches and circuit breaker panels and load management devices.

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4.14 Load Management System

The unit shall be equipped with a management system that permits the control and monitoring of the consumer's load during normal conditions and peak time.

In normal conditions, and if the consumer exceeds the contracted load (in KVA), the system shall be capable of giving alarm then trips the breaker after a preset time delay.

During peak time, if the consumer exceeds the load previously determined by SEC, the system shall be capable of giving alarm and tripping / closing the breaker in a sequence and time delay provided by SEC. The system shall restore the power automatically after the peak period is over without the intervention of any operator.

The minimum setting to trip the breaker during peak period shall correspond to 500 KVA of consumer's load.

4.15 Metering and protection equipment

4.15.1 Two single phase voltage transformers according to IEC 61869-3 shall be fitted at the feeder side of the circuit breaker for metering purpose. They shall be dry type, epoxy encapsulated rated as follows:

	Automated MRMU 400 A	Automated MRMU 630 A
Voltage	13.8 KV / 110 V OR 33 KV / 110 V	13.8 kV / 110 V OR 33 KV / 110 V
Frequency	60Hz	60Hz
Burden	100VA	100VA
Class	1	1

Table 3: VT Rated

4.15.2 Dual-ratio primary current transformers for protection and metering according to IEC 61869-2 and SEC specification 50-SDMS-01 shall be fitted in the circuit breaker panel. They shall be dry type, epoxy encapsulated rated as follows:

	Automated MRMU 400 A	Automated MRMU 630 A
Current ratio	400/200/1-1 A	600/300/1-1 A
Burden for protection	15 VA	15 VA
Burden for metering	5 VA	5 VA
Class for protection	5P20	5P20
Class for metering	0.2 SF5	0.2 SF5

Table 4: CT Rated

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The above CT Specification refers to the highest tapping.

4.16 Terminal blocks

- 4.16.1 Terminal blocks for remotely installed three phase three-wire revenue KWH meter shall be provided, identified and clearly marked. These terminal blocks shall have CT shorting and voltage disconnection facility without disturbing the wiring connections.
- 4.16.2 Terminal blocks for current injection test facility for protective relay shall be provided, identified and clearly marked.
- 4.16.3 Terminal blocks for remotely installed alarm shall be provided, to indicate exceeding of the allowed load during the peak period.

4.17 Indicating meters

Digital Indicating meters approved from SEC for three phase current and voltage with phase selector switches shall be provided. Current indicating meters shall be provided with 15 minutes maximum demand indicator.

4.18 Over-pressure Release

In order to ensure maximum personal safety, Metered Ring Main Unit shall be designed to withstand any overpressure due to an internal fault by rupture of a gas escape membrane located at the rear or bottom of the enclosure. The gas shall be led out through a flap in the rear panel to the bottom of the enclosure.

4.19 Nameplate

The switchgear shall be provided with Aluminum /Stainless steel / Brass nameplate showing the following information indelibly marked in Arabic and English:

- Manufacturer's Name
- Country of Origin
- Type/Model
- Vendor's Name
- Reference of SEC specification
- Manufacturer's Serial Number
- SEC Purchase Order Number
- SEC Item Number
- Year of Manufacture

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• Voltage Rating	kV
• Current Rating	Amps
• BIL	kV
• Short Circuit Rating / Duration	kA / Sec
• Rated Frequency	60Hz
• Rated Making Current	kA
• Rated Breaking Current	kA
• Gross Weight	kg

4.20 Circuit Labels

Ring switches and circuit breaker panels shall be provided with circuit number plates of dimension 150 x 50 mm without inscription. Plate shall be made of three-layer traffolyte material (white/black/white) of 3 mm thickness as per SEC drawing No. SEC-01-03.

4.21 Monograms and Danger Plates

Danger plate and SEC monogram as per SEC drawings No. SEC-01-01 and SEC-01-02 respectively shall be provided and installed at the front panel (on SEC approved location) of the switchgear using M5 hot dipped galvanized / stainless steel / brass fasteners (oval head rounded neck bolts with nuts and external tooth lock washers) not removable / accessible from the front i.e. without opening the door / front cover.

SEC shall approve location and samples of danger & monogram plates prior to installation.

5 Automation

5.1 Control functions

Each AUTOMATED MRMU shall be provided with an integrated (Built in) RTU without changing the dimensions of automated MRMU and communication device in order to provide capabilities for remote monitoring and control via the ADMS system. The ADMS system includes standard SCADA and FLISR functionality and advanced capabilities.

AUTOMATED MRMUs shall be capable of supporting these SCADA and FLISR monitoring and control functions. SEC reserves the right to require a demonstration of the AUTOMATED MRMU/RTU capabilities to support ADMS SCADA and FLISR functionality. Please refer to the ADMS specification for ADMS SCADA and FLISR functionality requirements. Design for AUTOMATED MRMU/RTU configuration shall be approved before supply.

RTU control panel shall be available for the following solutions:

- Main Design : RTU (integrated) built in
- Optional Design : RTU Separated cabinet (with plug cable connector solution)

5.1.1 The digital I/O list of signals to be wired to the RTU includes:

Status information (Digital Input)	
Close / Open (Per circuit)	Double Point
Earth (Per circuit)	Double Point
Lock / Unlock (Per circuit)	Double Point
Local/ Remote (Per AUTOMATED MRMU)	Double Point
Gas Pressure (Per AUTOMATED MRMU)	Single Point
Battery Status (Per AUTOMATED MRMU)	Single Point
Control Power Fail (Per AUTOMATED MRMU)	Single Point
Door Open (Per AUTOMATED MRMU)	Single Point
Relay Fail / Healthy	Double Point
Protection Relay operated / Normal	Double Point
Load Management system operated/Normal	Double Point

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Table 5: The digital I/O list

Control signal (Digital Output) to be wired to the RTU

- Close / Open
- Battery Test
- Protection Relay Reset

5.1.2 The analog inputs to be wired to the RTU:

- Phase-to-ground Voltage ($A\phi$, $B\phi$, $C\phi$) for all voltage sensors
- Phase Current ($A\phi$, $B\phi$, $C\phi$, $N\phi$) from all current sensors

And all logical calculated functions needed by an Advanced Distribution Automation System P,Q ,Power factor etc....

5.1.3 Digital I/O LIST & TESTS

Status Input (DI)	Circuit	Result (OK, Fail)	
		Local Indication	Remote (DCC)
LBS1			
Open	1		
Close	1		
Ground	1		
Lock/Unlock	1		
Motor circuit fail	1		
Spare	1		
LBS2			
open	3		
Close	3		
Ground	3		
Lock/Unlock	3		
Motor circuit fail	3		
Spare	3		
CB			
Open	2		

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Status Input (DI)	Circuit	Result (OK, Fail)	
		Local Indication	Remote (DCC)
Close	2		
Ground	2		
Lock/Unlock	2		
Motor circuit fail	2		
Spare	2		
Common (Indication/ Alarm)			
Local	Common		
Remote	Common		
Gas Low	Common		
Door Open	Common		
Battery low	Common		
RTU Self Diagnostic (RTU alarms)	Common		
AC power fail	Common		
DC power fail	Common		
FI: fault indication	Common		
Protection Health Normal/Fail	Common		
Protection Trip (Earth fault)	Common		
Protection Trip (Phase fault)	Common		
Load Management system operate	Common		
Spare	Common		

Table 6: Digital Input (DI)

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Status output (DO)	Circuit	Result (OK, Fail)	
		Local (LAPTOP)	Remote (DCC)
Open (LBS1)	1		
Close (LBS1)	1		
Open (LBS2)	3		
Close (LBS2)	3		
Open (CB)	2		
Close (CB)	2		
Battery test	common		
Reset FI	common		
Spare	common		

Table 7: Digital Output (DO)

Analog Input	Circuit	Injection	Reading			
			Local	Remote DCC	SEC (Specs)*	Test results
CB						
Neutral current	1	IA+IB+IC			± 2 %	
Temperature	Internal	-			± 2 %	
Temperature	External	-			± 2 %	

Table 8: Analog Input (AI)

- ± 2 % is the maximum error for the entire Measurement circuit including (sensor - data Cable - Analog module -RTU etc....)
- The sensor (CT & VT) accuracy is ± 1%

5.1.4 The selected RTU shall have adequate protection against reversed polarity, over current/voltage and under voltage condition.

5.1.5 Remote operating time

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When RTU receives the command from the ADMS SCADA, FLISR or any other authorized master device, the operation shall be done within three (3) seconds which exclude signal transmission time.

5.1.6 All digital inputs shall be time-stamped to 1ms accuracy.

5.1.7 The RTU shall include the following minimum safety features for control outputs:

- a. Select-and-execute sequence for control output.
- b. No control command shall be generated during power up or power down of RTU.
- c. No more than one control point shall be selected at any given time.

When the control switch in the AUTOMATED MRMU is placed in the "local control" position, then control outputs of the RTU may be tested without activating the field device. The RTU shall send a status indication of the local/remote switch to the master station or SCADA.

5.1.8 Control Outputs

The RTU shall provide the capability for a master station (ADMS SCADA or FLISR functions) to set two control outputs which shall be provided for each controllable device after receiving the command using the check before execute sequence.

The appropriate control output shall be operated for a preset time period which is adjustable for each point from 0.1 to 3 seconds

5.1.9 Communication Ports and Protocols

The RTUs minimum requirement for communication ports is as follows:

- Two Ethernet ports
- Two RS232 ports.
- One port for the RTU maintenance and configuration computer.
- One port for local access to the data and connecting a printer.

The RTU shall respond to independent scans and commands from Master Station, maintenance and configuration computer, and the local access computer simultaneously.

There shall be possible to change RTU setting and configuration remotely.

The RTU shall support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port.

The communication protocol of the RTU are as follows:

As a client (slave):

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- DNP3.0 serial and Ethernet
- Fiber
- Modbus RTU and TCP
- IEC 61850
- IEC 60870-5-101/104

As a server (master):

- DNP3.0 serial and Ethernet
- Fiber
- Modbus RTU and TCP
- IEC 61850
- IEC 60870-5-101/104

Capability of time stamp and time synchronization shall be provided

5.1.10 RTU Functions

This document describes the minimum functionalities of the RTU. The minimum functions to be performed are:

- Data gathering. Collect digital status inputs, analog inputs, and information points from devices, relays and/or IED's. RTU shall be multi- center multi-protocol
- Receiving and processing digital and analog control commands from the master station or SCADA.
- RTU shall be compatible with protocol 61850 and 60870-5-101/104 for communication with relays or IEDs.
- RTU shall support Sequence of Events feature.
- RTU shall have an IEC 61131-3 logic engine or similar to allow customized automation schemes.
- The RTU shall have a communication with a human machine interface (HMI) in which the one line diagram can be generated. The HMI shall be mounted on the front of the AUTOMATED MRMU; All control functions shall be inhibited. Interface shall be preferably web-based. It shall be possible to implement the alarming and trending feature. The access to the HMI of the RTU shall be local and remotely. HMI shall be suitable for 75 degrees

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- RTU shall have internal battery backup for memory and data/time. The RTU shall send a status battery indicator to the master station or SCADA.
- RTU shall act as a data concentrator for acquiring data from slave RTU's and exercising supervisory control on slave RTU's
- RTU shall accept polling messages from at least two master stations simultaneously using separate logical databases for each master station.
- RTU shall Communicate simultaneously on all communication ports.
- The RTU shall have the option of redundant communication through the Ethernet ports.
- It shall be possible to export database to an excel or similar software application.
- Data transmission rates up to 9600 baud for serial ports and 10/100 Mbps for TCP/IP
- Ethernet ports.
- RTU shall have the capability of automatic re-start after a power outage.
- RTU shall be scalable. Supplier shall state how the scalability is achieved.
- The RTU shall be designed to perform with a minimum 15 relays or IED's connected with 200 points (variables) per device.
- The RTU shall be capable to calculate all logical functions needed by an Advanced Distribution Management System such as Power factor, Active power , Reactive power
- Distortion , harmonics; it shall be possible to send the output of the logical functions on request.
- The RTU shall determine and send earth fault indication to an Earth fault indication.
- lamp to be mounted in the front of the AUTOMATED MRMU. Earth fault indication shall be also sent to the control center.
- RTU and Control box shall be illuminated by a lamp for easy O&M.
- RTU shall be capable to report by exception in case of any change in the status.
- The RTU shall have Modem -with routing features if needed- to communicate wireless 3G/4G or fiber optics, in accordance with SEC telecom specifications; minimum 4 ports shall be provided

5.2 Cyber security

The RTU shall support features and mechanisms to enable cyber security operations and be configured as follows:

- Application whitelisting shall be implemented on RTU to monitor and ensure that only authorized applications are executed without affecting operations.
- RTU shall be configured to produce and store event logs recording activities, exceptions, faults and information security events.
- RTU shall have the capability to log the following information and activities:
 - Timestamps for each event. System clocks shall be synchronized to a single reference time source to facilitate forensic analysis of actions taken on the device.
 - Incident management activities.
 - Utility programs that can override system and application controls.
 - Cryptographic key management related activities.
 - Logging mechanisms shall not adversely affect device critical functions and performance.
 - RTU shall recover to a secure state in the event of a disruption or failure.
 - RTU shall have access controls implemented at both the software level (such as operating system and applications level) and hardware/device level. Access controls shall be established with the following principles and capabilities:
 - a. *Least privilege* – access shall be limited to only information or resources that are necessary to accomplish a legitimate purpose.
 - b. *Privileged access* – access controls shall establish privileged and non-privileged levels for users and processes. Access controls shall prevent non-privileged users or processes from executing privileged functions (such as installing software or changing system configurations).
- RTU shall at least enforce the following Password change, complexity, re-use, and lockout constraints for access control:

Minimum Age	Maximum Age	Minimum Length	Password Reuse	Complexity Requirements	Account Lockout Threshold	Account Unlock Action
1 day	2 years	10 characters	10 passwords remembered	4 of 4 (uppercase, lowercase, numbers, symbols)	25 invalid attempts within 1 hour	Admin or Supervisor unlock

Table 9: Password Requirement

- RTU shall lock the access after several authentication failures. Device shall be capable of sending an account lock alarm.

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- All RTU shall implement and enable audit and logging capabilities when possible.
- RTU shall be up-to-date with the latest security related patches as much as it is operationally safe and feasible. When it is not possible, a justification shall be provided and countermeasures identified and implemented.
- Any security vulnerability Identified by SEC during RTU lifetime shall be remedied and patched.
- A list of identified potential security risks and best way to mitigate them shall be provided.
- RTU shall be secure by design. Security shall be integrated throughout each phase of systems lifecycle.
- Smart Device shall be properly hardened as per the guidelines provided below to harden networks, operating systems, applications and RTU.
- Appropriate security test cases shall be created to provide scenarios that detail both how the device is intended to be used and how it should not be used.
- Any time data is input by a user, it shall undergo input validation to ensure only proper authorized characters are accepted.
- RTU shall provide the capability to set outputs to a predetermined state if normal operation cannot be maintained because of an attack.
- RTU shall identify and handle error conditions in a manner such that effective remediation can occur without disclosing unnecessary information to an attacker.
- If session IDs are used on a Smart Device, it shall provide the capability to protect the integrity of sessions and reject any usage of invalid session IDs.
- RTU shall support encryption on all supported protocols. If some protocols do not support encryption, then the smart device shall support secure IPsec VPN tunneling.
- Where mobile code is not required, it shall be disabled.
- Any mobile code that is necessary for application operation shall be presented to the Distribution Cyber Security for review and approval to ensure proper protections and restrictions are in place.
- Any approved mobile code shall require proper authentication and authorization of origin and its use shall be monitored.
- RTU shall be able to verify the integrity of the mobile code before allowing code execution.
- Where cryptography is determined to be required, RTU shall use cryptographic algorithms, key sizes, and mechanisms for key establishment and management according to commonly accepted security industry practices and recommendations.
- Established and tested encryption shall be employed to reduce risk of information leakage or tampering.

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- RTU shall utilize established and tested encryption to protect sensitive data at-rest where required.
- RTU utilizing PKI shall provide the capability to operate it according to commonly accepted best practices.
- RTU utilizing PKI as part of their identification or authentication process shall employ validity checking of certificates.
- Certificates CA signature shall be verified to confirm that the certificate has not been tampered since it was first signed.
- RTU utilizing PKI shall consult with CRL or OCSP to determine the revocation status of all certificates.
- RTU shall be able to determine whether a given human, software process, or device user took an action based on the use of non-repudiation techniques.
- RTU shall be able to produce machine-readable report of deployed security settings.

5.3 Power supply

5.3.1 The AUTOMATED MRMU shall not require any external auxiliary AC power supply for operation and control. This power supply shall be obtained from a cast resin insulated voltage transformer connected to bus-bar side. Its secondary output shall be 24 VDC and capacity shall be adequate for spring charging motors, switching operations, status indications, protective relays, RTU components, charge the battery, necessary contactors for control and monitoring of ring switches and circuit breaker panels and load management devices.

To supply power for AUTOMATED MRMU functions, a power source from the AUTOMATED MRMU shall be connected to the Control box with appropriate protective provisions in the Control Box. The power source shall be a single phase AC220V (+/- 10%) /60Hz.

5.3.2 The Charger (220V AC/ 24V DC) power source shall properly feed the AUTOMATED MRMU, the RTU system and charge the battery

5.3.3 All functions of the AUTOMATED MRMU including switching, Monitoring, RTU and Control, shall be powered by the power source and the battery will back up the power source.

5.3.4 A power outlet (AC220V/60Hz) shall be installed in the Control Box to power a portable O&M device such as Lap-top computer.

5.3.5 The battery shall be capable to back up the monitoring, communication and operation of the RTU for 8 hours without AC source. The battery shall be capable of providing power to perform at least 50 operation cycles (open-close) without AC source. The supplier shall size the battery per RMU, specifying the lifetime and the duty cycle of such period of life.

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Batteries shall be maintenance free and sealed. No lead acid batteries are allowed. Battery maintenance shall be possible without power source cut off.

- 5.3.6 Battery shall be rechargeable and shall be suitable for temperature of 70 Degree centigrade.
- 5.3.7 The battery charger shall have temperature compensated to maximize battery life and usable capacity.
- 5.3.8 The charger shall have filter to provide 2% or better ripple voltage when operated on a resistive load (from 5 to 100% full load).
- 5.3.9 The charger shall be provided with protection against overcharging. The supplier shall specify the proposed charging time.
- 5.3.10 It shall be possible to test the battery.
- 5.3.11 All the alarms related to Charger & battery shall be wired to the RTU in order to be transmitted to the control center

5.4 CT-VT Sensors

CT and VT are for Measurement and shall comply to IEC 61869 standard .

5.4.1 CT Sensor :

Two (2) sets of CTs (Each set is composed of three phases CTs):

- 1 set of CTs for LBS
- 1 set of CTs for transformer : If it is possible to transfer the 3 phases transformer load from the meter CTs (real time with angle) to the RTU; there is no need for the set of these CT's.

The CT shall be Bushing mounted. Rogowski type is not accepted.

CT accuracy shall be less than 1% in order to meet the requirement to have an accuracy of 2% for the whole chain (Sensor-data cable-RTU).

CT ratios shall be compatible with the provided RTU.

In addition ,there shall be CT dedicated for the protection as per protection specifications.

5.4.2 VT Sensor :

One (1) set of VTs transformer MV side (Each set is composed of three phases VTs):

If it is possible to transfer the 3 phases Busbar voltages (real time with angle) to the RTU; there is no need for the set of these transformer VT's.

Technology for voltage measurement shall be justified (resistive or capacitive);

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The VT shall be busbar ,bushing or pole mounted.

VT accuracy shall be less than 1% in order to meet the requirement to have an accuracy of 2% for the whole chain (Sensor - data cable -RTU).

VT ratios shall be compatible with the provided RTU.

6 Testing and Inspection

6.1 All equipment shall be type tested at an independent laboratory in accordance with the latest standards and as specified herein and test report shall be submitted for SEC review and approval.

6.2 The switchgear offered shall meet the type test requirements of the standards listed below:

6.2.1 High-voltage switches per IEC 60265

- a. Dielectric Tests
- b. Temperature Rise Tests
- c. Making and Breaking Tests
- d. Peak and Short Circuit Withstand Current Tests
- e. Operation and Mechanical Endurance Tests
- f. Internal arc test certificate

6.2.2 Circuit- breaker per IEC 60056

- a. Dielectric Tests
- b. Temperature Rise Tests
- c. Measurement of the resistance of the main circuit
- d. Short-time and Peak Withstand Current Tests
- e. Mechanical and Environmental Tests
- f. Making and Breaking Tests
- g. Short-circuit Tests

6.2.3 Degree of protection IP41 per IEC 60529

6.3 The switchgear offered shall meet the routine test requirements of the standards listed below:

6.3.1 High-voltage switches per IEC 60265

- a. Power Frequency Voltage Tests

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- b. Voltage Tests on Auxiliary Circuits
- c. Measurement of Resistance of Main Circuit
- d. Operation Tests
- e. Operation and Mechanical Endurance Tests

6.3.2 Circuit breaker per IEC 60056

- a. Power Frequency Voltage Tests
- b. Voltage Withstand Tests on Control and Auxiliary Circuits
- c. Measurement of Resistance of Main Circuit
- d. Mechanical Operating Tests

6.4 SEC reserve the right to visit the factory during manufacture of any or all items covered by this specification, for inspection of material or witness of tests. Accordingly, the manufacturer shall give SEC adequate notice of manufacturing and testing schedule.

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7 Packing and shipment

- 7.1 The switchgear shall be delivered ready for installation (three panels fitted together).
- 7.2 Switchgear shall be individually packed in non-returnable cases as per packing/ shipping requirements in relevant clauses of 01-SDMS-01.
- 7.3 For container shipment, switchgear bolted on wood pallet is acceptable.
- 7.4 Units shall be supplied complete with all operation and installation accessories.

8 Guarantee

- 8.1 Guarantee for the AUTOMATED MRMU and RTU shall be against all defects arising out of faulty design or workmanship or defective material for a period of five (5) years from the date of delivery.
- 8.2 Warranty period for gas tightness shall conform to clause 5.15.3 of IEC 60694. For the maintenance-free version the vendor / manufacturer shall assume full responsibility for no gas leakage during the service life (25years).

In case of gas leak during the service life, all expenses for repairs and replacements shall be borne by vendor / manufacturer.

If no exception to this specification and no list of deviations are submitted, it shall be deemed that, in every respect, automated metered ring main unit offered shall conform to this specification. SEC interpretation of this specification shall be accepted.

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9 Submittals

- 9.1 Vendor shall complete and return one copy of the attached Technical Data Schedule.
- 9.2 Vendor shall provide the following with the Quotation:
- a. Clause by clause compliance with this specification.
 - b. Drawing showing the full constructional detail with dimensions of automated metered rings main unit and all associated accessories.
 - c. Drawing of mounting details with respect to the position of cables in the switchgear room.
 - d. Drawings of cable boxes.
 - e. Schematic Diagrams showing the SLD (control circuit, tripping circuit, closing circuit, voltage supply circuit, VT and CT connections, Alarms, Communication ...etc.).
 - f. Installation and maintenance instructions of the automated metered ring main unit.
 - g. Comprehensive list of manufacturer's recommended spare parts. The quantities offered should be adequate for the initial 5 years of operation. Firm price and delivery period shall be quoted for each item.
 - h. Copy of type test report.
 - i. A certificate from the termination manufacturers that the cable box size in all respect (technical, cable handling and making termination) is suitable for heat & cold shrink and pre-mold terminations
 - j. Descriptive leaflet and literature of automated metered ring main unit offered.
 - k. Checklist of quotation request.
 - l. List of customers in case of new manufacture / vendor.
 - m. Provide connecting cables for (LMS, PROTECTION, RTU, UPS).
- 9.3 Vendor shall provide the following after signing of purchase order:
- a. Details of manufacturing and testing schedules.
 - b. Routine test reports.

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10 Technical data schedule

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SEC Inquiry No:

Item No:

No	Description	SEC Specified Values (*)	Vendor Proposed Values (**)
1	General		
1.1	Design	Metal-Enclosed	*
1.2	Type	Indoor	*
1.3	Number of cubicles	3 or 4	*
1.4	Installation medium	SF6 OR AIR	*
1.5	Degree of Protection	IP-41	*
1.6	Rated Voltage	13.8 kV / 33 KV	*
1.7	Maximum Operating Voltage	15 kV / 36 KV	*
1.8	Rated Frequency	60 Hz	*
1.9	Rated Current	400 A or 630A	*
1.10	Short circuit withstand current for 1 second	21 A / 25 KA	*
1.11	Basic insulation level BIL	As per (01-SDMS-01)	*
1.12	Rated Making Current for Ring switches (peak)	-	*
1.13	Rated Making Current for Earthing Switches (peak)	-	*
1.14	Impulse Withstand Voltage	As per (01-SDMS-01)	*
1.15	Power Frequency Withstand Voltage (1 min.)	As given in (01-SDMS-01)	*
1.16	Internal Arc fault withstand for 1 second	21 kA / 25 KA	*
1.17	Operating handle anti-reflex type	Yes	*
1.18	Max. height of operating access	1.5 m	*
1.19	Max. physical effort required to operate any mechanism.	400 N	*
1.20	Cable testing facility (optional)	-	*
1.21	Interlocks as per clause 4.8	Yes	*
1.22	Provision of gas pressure gauge	-	*

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SEC Inquiry No:

Item No:

No	Description	SEC Specified Values (*)	Vendor Proposed Values (**)
2	CIRCUIT BREAKER		
2.1	Type	Fixed	*
2.2	Insulation medium	SF6 or Air	*
2.3	Interruption medium	SF6 or Vacuum	*
2.4	Rated Voltage	13.8 kV / 33 KV	*
2.5	Maximum Operating Voltage	15 kV / 36 KV	*
2.6	Rated Frequency	60 Hz	*
2.7	Rated Current of CB	400 A/630 A	*
2.8	Rated Short circuit level (1 s)	21 kA / 25 KA	*
2.9	Basic insulation level BIL	As per (01-SDMS-01)	*
2.10	Rated Making Current		*
2.11	Re-striking Voltage Ratio		*
2.12	Duty Cycle		*
2.13	Making time		*
2.14	Opening time		*
2.15	Arc Duration		*
2.16	Total breaking Time		*
2.17	Operating Mechanism	Spring Charged	*
2.18	Protective E/F & O/C relay	As per Latest version of SEC-DBU Unified List of Approved Relays	*
2.19	Provision of isolator switch	-	*
3	TERMINATIONS / CABLE COMPARTMENTS		
3.1	Cable compartment with bottom plate and cable clamp	yes	*
3.2	Two cables of 70-110 mm diameter shall be accepted	Yes or N/A	*
3.3	Two holes of 110 mm in the bottomplate in two halves	Yes or N/A	*
3.4	Fasteners supplied with bushing	yes	*
3.5	Type of termination	Dry type cold / pre-molded	*
3.6	Bolt size for cable termination	M16	*
3.7	Clearance between clamp and bushing	Suitable for cold / pre-molded of terminations	*

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SEC Inquiry No:

Item No:

No	Description	SEC Specified Values (*)	Vendor Proposed Values (**)
4	ACCESSORIES		
4.1	Ground bar 25x5 mm & M12 Stud	yes	*
4.2	Voltage indicator lamps	yes	*
4.3	Phase comparators	yes	*
4.4	Approved type EFI	yes	*
4.5	Auxiliary Powered Protection Relays	yes	*
4.6	Load management system	yes	*
4.7	Voltage transformers rated as per clause 4.15.1	yes	*
4.8	Current transformers rated as per clause 4.15.2	yes	*
4.9	Terminal blocks for KWH meter, relay testing and alarm provided	yes	*
4.10	Indicating meters	yes	*
4.11	Over-pressure release	yes	*
4.12	Name Plate	yes	*
4.13	Circuit labels	yes	*
4.14	SEC Monogram	yes	*
4.15	Danger Plate	yes	*
5	CUBICLE		
5.1	Maximum height	2400 mm	*
5.2	Max. width of CB panel	1000 mm	*
5.3	Max. width of LBS panel	750 mm	*
5.4	Depth suitable for 600 mm cable trench	Yes	*
5.5	Paint finish Method	M16	*
5.6	Finish Color	RAL 7035 (Front side, Right side, Left side)	*
6	Communication		
6.1	Communication Requirements	Conforming to specs	*
6.2	SIM Card Slot Available	YES/NO	*
6.3	SIM Card Size	Standard	*
6.4	Mobile/Cellular Network Type	GPRS/2G/3G/4G/5G/NB-IoT	*

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6.5	Communication Protocols	IEC 60870-5-104/101 /DNP3.0 /IEC 61850	*
6.6	Communication Interface for external comm. modem	Yes (Specify) / No	*
7	Cyber Security Requirements		
7.1	Cyber Security Requirements	Fully Comply/Not Comply	*

(*) – Values to be provided/proposed by the Vendor

(**) – Please provide explanation for deviations, if any

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SEC Inquiry No:

Item No:

- Additional Technical Information or Features Specified by SEC
- Additional Supplementary Data or Features Proposed by Bidder/Vendor/Supplier.
- Other Particulars to be filled-up by the Bidder/Vendor/Supplier.
- List of Deviations and Clauses to which exception is taken by the Bidder/Vendor/Supplier. (Use separate sheet, if necessary).

Description	Manufacturer of Material/Equipment	Vendor/Supplier
Name of Company		
Location and Office Address		
Name and Signature of Authorized Representative with Date		
Official Seal / Stamp		

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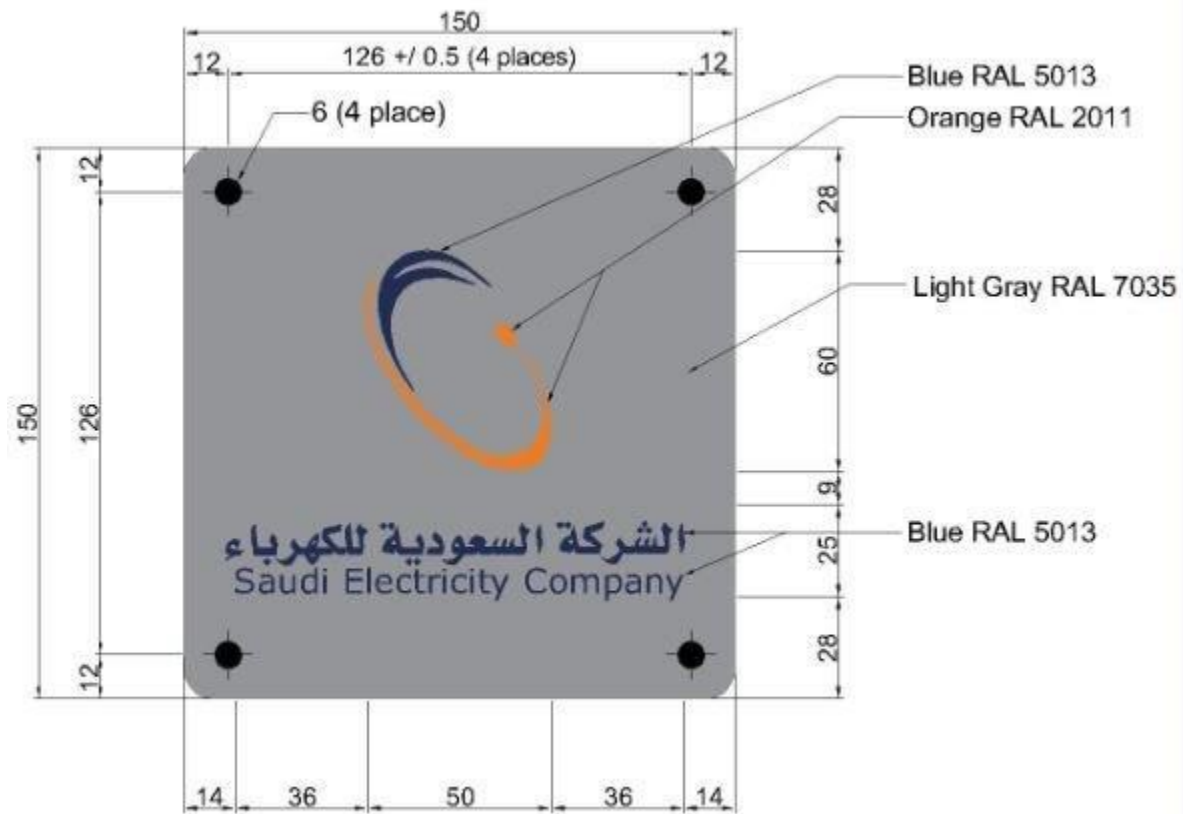
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11 Drawings

11.1 MONOGRAM FOR EQUIPMENT



Note:

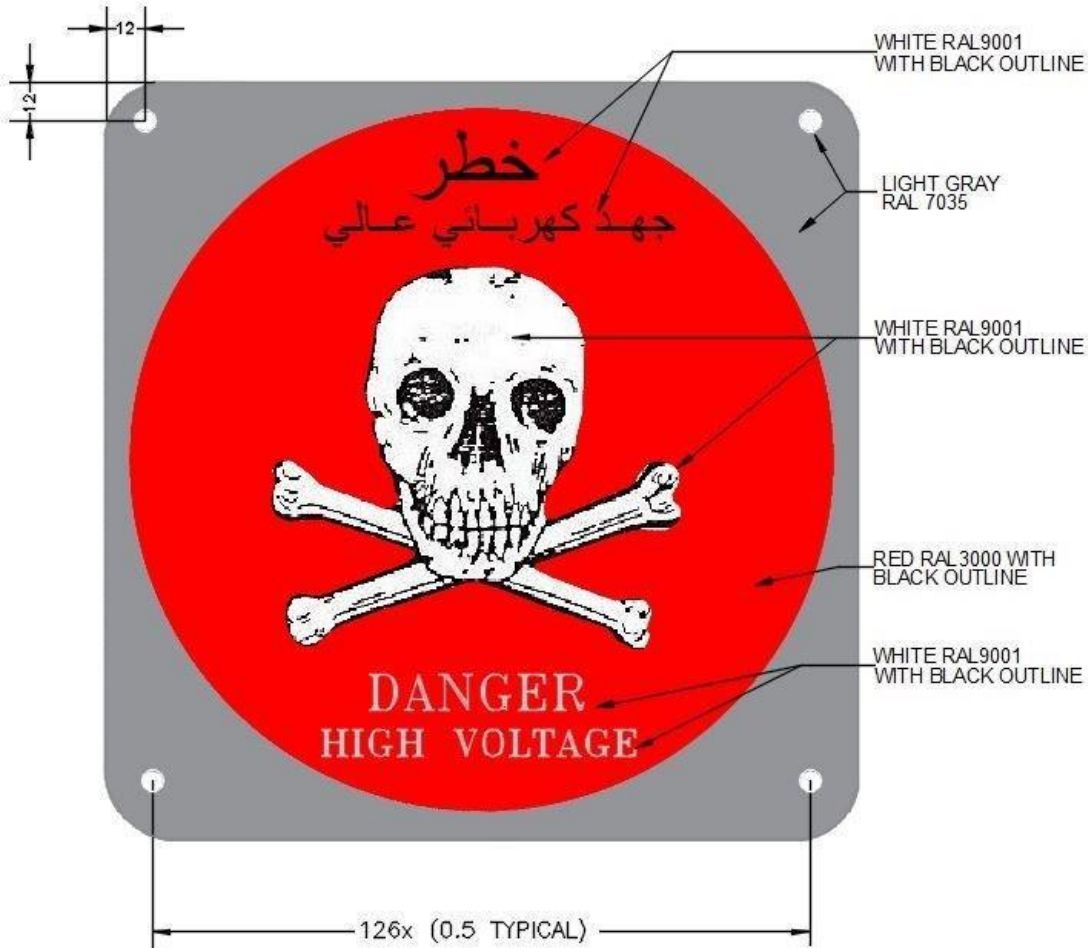
- 1) All Dimension are in millimeters.
- 2) 150 X 150 X 1.5 thick, aluminum plate with three (3) color monogram.
- 3) Specimen for color shades shall be obtain from SEC.
- 4) Size of symbols and lettering shall be proportion to the overall dimension of the monogram.

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11.2 DANGER SIGN FOR EQUIPMENT

Note:

- 1) All dimension are in millimeters.
- 2) 150 x 150 x 1.5 Thick, Aluminum plate for equipment mounting.
- 3) Specimen for color shoes shall be obtained from SCE.
- 4) High gloss enamel paint.
- 5) Size of symbol and lettering shall be proportional to the overall dimension of the sign.
- 6) For the installation of this sign on the parameter fence and gate of the Transmission substation. The size of the sign shall be 510 x 510 and 255x255 respectively, where in the hole centers will be 25 & 15 & hole diameters will be 10 & 6 respectively.
- 7) The sign plate shall have rounded corners and NO sharp rough edges.

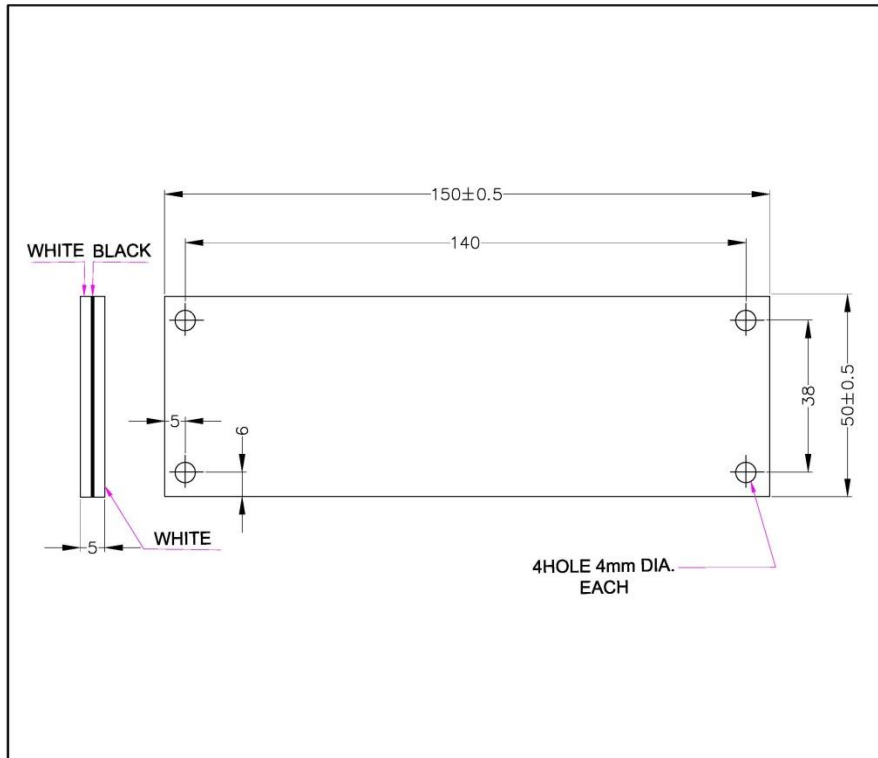
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11.3 CIRCUIT LABEL PLATE



Note:

- 1) Dimension are in millimeters.
- 2) Material Traffolyte white – black – white Thickness 3mm.
- 3) This plate will be used to engrave letters and numbers by using Engraving machine.