

## **General**

The Mini Remote Terminal Unit (Mini RTU) shall be installed at Ring Main Unit (RMU) & Power stations to collect process information and control the (RMU & Substation) equipment's. The supplied Mini RTUs shall be interfaced to field devices such as (Transducers, IEDs, Metering Unit...etc.) using different interfaces and communicate to master station via different protocols as described in the specification though General Packet Radio Service (GPRS) modem.

All the equipment above (Mini RTU and GPRS modem) shall be installed within an enclosure, and all required internal wiring, termination, MCBs, labeling, etc. shall be performed by the supplier.

The supplier shall provide a closed system (enclosure includes mini RTU and GPRS modem) to be installed in the site.

## **Mini RTU**

### **Hardware Components**

- CPU & Power Supply

The Mini RTU shall include one CPU which is responsible for the main processing tasks and for the communication. The main tasks of the CPU are managing and controlling associated actions of I/O.

The CPU shall have the following minimum number of communication ports:

1. Two serial ports each one can communicate through RS-485 communications.

2. Two Ethernet ports for communication with master station and IEDs, which also can be used for configuration purposes.

- Input / Output Units

The Mini RTU shall be equipped with modules (DI & DO) to deal with different data types from field devices.

For commands there should be a 1 out of n check, to ensure that only one command will be activated at a time. All events shall be time stamped with 1ms accuracy.

### **Communication Protocols**

#### 1. Master Station Communication Protocols

The Mini RTU shall be capable to communicate with master station using following tele-control communication protocols

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

#### 2. Communication Protocol between RTU & IEDs

The Mini RTU shall also provide serial / Ethernet interfaces for the communication with subordinated devices like intelligent electronic devices (IEDs). Digital protection relays, metering devices..etc. Following protocols are shall be supported at least

- DNP3.0 serial and Ethernet
- Modbus RTU and TCP

- IEC 60870-5-101/104
- IEC 61850

### **Documentation:**

Comprehensive RTU documentation is required such as:

- Data Sheets for all the components of the RTU
- RTU tool User's Guide
- Communication Interfaces (towards Host and Sub- devices)
- Signal lists in EXCEL

### **Training:**

The supplier shall offer a training for at least 3 EDCO engineers on the RTU, RTU software tools, an example about all the cases shall be demonstrated and explained.

The training can be done online using MS-teams meeting in the site.

### **Cyber Security**

Cyber security features and mechanisms according to attached cyber security requirements. In addition, the following features shall be possible:

- The mini RTU shall have different levels of passwords in order to provide different benefits according to the user type.
- The mini RTU service application shall enforce a high complexity of passwords.
- The mini RTU shall ensure Secured Encrypted communications: SSH, HTTPS, etc.

## **Mini RTU Functions**

As a minimum, the Mini RTUs shall be capable of performing the following functions:

- 1- Data gathering, the mini RTU shall collect digital inputs, and information points from devices relays and/or IEDs.
- 2- The mini RTU shall receive, process, and perform the digital control commands received from the Control Center.
- 3- Mini RTU shall support Sequence of Events feature (SOE)
- 4- The mini RTU shall have internal battery backup for memory and date/time.
- 5- Mini RTU shall be capable to communicate simultaneously on all communication ports.
- 6- The Mini RTU shall support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port.
- 7- Mini RTU shall have the capability of automatic re-start after a power outage without manual intervention.
- 8- Mini RTU modules, shall have light emitting diodes (LEDs) to indicate errors or operating modes
- 9- A special tool (webserver application, special software...etc.) should be used in order to configure the mini RTU, read RMU measurements, indications, events and alarms.
- 10- Any necessary license to operate the RTU or the RTU software shall be proposed separately in the offer (for one laptop), EDCO has the right to decide to not buy it in case it was provided previously.

- 11- The Mini RTU shall provide remote diagnostics capabilities. It shall be possible to connect to the Mini RTU from a remote computer in order to analyze the system and error status, check-up of the configuration or signal values of the RTU remotely, e.g. by means of a Web-Server via LAN/WAN.
- 12- The Mini RTU shall be equipped with Cyber Security Features
- 13- The Mini RTU shall support time synchronized by external GPS equipment or from the control center

**Communication Modem:**

The supplier shall include a ROBUSTEL - R3000 Lite L4L communication modem to perform the communications tasks between the mini RTU and the Control Center.

The modem must contain the following accessories:

- Wall Mounting Kit.
- Power supply.
- one antenna (3G/4G).
- one magnet antenna (3G/4G) (3meters).
- 3x1 pin pluggable terminal block for power supply.
- Ethernet cable.

A 110/24 DC-DC converter (input 110VDC, output 24VDC) shall be supplied with the modem, where the available DC voltage in the SS is 110VDC and the modem can be supplied using 24VDC.

## **Enclosures**

The Enclosures shall include the following items:

- Mini-RTU
- GPRS communication modem.

All required internal wiring, termination, MCBs, labeling, etc. shall be performed by the supplier.

- The enclosures shall be outdoor type, weatherproof and dust proof of coated steel, thickness of the steel not less than 1.5 mm, it shall be thermal coating with thickness not less than 40 microns. The internal and external color and finish of the housing shall be approved by our Engineer.
- The IP degree for the Enclosures cubical should be of IP 54
- Set of holes shall be considered for in design for control cables.
- The housing shall be adequately ventilated and yet shall be so designed that birds, lizards and small rodents etc., cannot gain access to the equipment.
- Steel meshes behind louvers should be used for this purpose.
- External doors of the Enclosures shall be equipped with suitable stoppers to keep doors open in a fixed position during Operation and maintenance.
- External doors of the Enclosures shall be equipped with suitable metal hinges to be screwed onto uprights.
- External doors of the Enclosures shall be equipped with suitable pad lockable lever handle.
- A cooling mechanism shall be included with the system to cool the batteries, converters and the charger.

## Environmental Condition

Climatic conditions according IEC 60870-2-2:

Temperature: -25°C...+55°C (Class C2)

Relative Humidity: 5...95%, non condensing  
(Class C1)

Atmospheric pressure 70 to 106 kPa

Altitude (operation) up to 3000 m

Item	Standard	Test Level
1	Low Temperature (IEC 60068-2-1)	-25°C
2	High Temperature (IEC 60068-2-2)	+70°C
3	Temperature-Humidity (IEC 60068-2-30, cyclic test)	95%
4	Vibration response test, sinusoidal: IEC 60068-2-6 IEC 60255-21-1 Class 1 0,5g (10 – 150 Hz)	0,5g (10 – 150 Hz)

Item	Standard	Test Level
5	Vibration seismic test, sinusoidal: IEC 60068-2-6 IEC 60255-21-3 Class 1: 3,5mm (1 – 9 Hz) IEC 60870-2-2 Class Bm: 3mm (2 – 9 Hz)	3mm (2-9 Hz)
6	Vibration endurance test, sinusoidal: IEC 60068-2-6 IEC 60255-21-1 Class 1: 0,5g (10 – 150 Hz) IEC 60870-2-2 Class Bm: 1g (9 – 200 Hz)	1g (9 – 200 Hz)
7	Vibration high frequency test, sinusoidal: IEC 60068-2-6 IEC 60870-2-2 Class Bm: 1,5g (200 – 500 Hz)	1,5g (200 – 500 Hz)

8	Shock (half sine) IEC 60068-2-27 IEC 60255-21-2 CL1 (15g / 11ms) IEC 60870-2-2 (10g / 11ms)	15g / 11ms and 25g / 10ms
9	Bump (half sine) IEC 60068-2-29 IEC 60870-2-2 Class 1: 10g / 16ms / 1000 pulses	10g / 16ms / 1000 pulses

## Insulation, EMC Immunity and CE Declaration

### Insulation

Item	Standard	Test Level
1	Insulation resistance according IEC 60255-5	>100MΩ / 500V DC
2	Insulation dielectric withstand voltages according IEC 60255-5 (IEC 60870-2-1 class VW3, ANSI/IEEE C37.90-1989, 1,5kV)	2,5kV, 50Hz, 1min
3	Insulation impulse voltage withstand test IEC 60255-5 (IEC 60870-2-1 class VW3)	5kV (1,2/50μs)

### EMC Immunity Tests

Item	Standard	Test Level
1	<b>Electro static discharge immunity</b> IEC 61000-4-2 level 4 (IEC 60870-2-1 A3.1 level 4) (IEC61000-6-2 8/6kV) (IEC 60255-22-2 8/6kV) (ANSI/IEEE C37.90.3-2001, 8kV)	Cubicle: 15/8kV Modules: 8/6kV
2	<b>Radiated electromagnetic field</b> IEC 61000-4-3 (IEC 60870-2-1 A5.1 level 3) (IEC61000-6-2 10V/m) (IEC 60255-22-3 10V/m)	10V/m level 3
3	<b>Electrical Disturbances 1 MHz Burst</b> IEC 60255-22-1 IEC61000-4 IEC61000-18	2.5KV CM, 1.0KV DM

4	<b>Fast Transient Burst Immunity</b> IEC 61000-4-4 (IEC 60870-2-1 A2.3 level 4) (IEC61000-6-2 A/D=2kV, S=1kV) (IEC 60255-22-4 4kV) (ANSI/IEEE C37.90.1-2002, 4kV)	4kV Level 4
5	<b>Surge Immunity</b> IEC 61000-4-5 (IEC 60870-2-1 A2.2 level 3) (IEC61000-6-2 A=1/2kV, S=1kV) (IEC 60255-22-3 2kV)  <b>feeder distributed RTU equipment</b> IEC 61000-4-5 (IEC 60870-2-1 A2.2 level 4) (IEC61000-6-2 A=1/2kV, S=1kV) (IEC 60255-22-3 2kV)	2kV Class 3  4kV Class 4
6	<b>Conducted RF Disturbance Immunity</b> IEC 61000-4-6 (IEC61000-6-2 10V) (IEC 60255-22-6 10V)	10V Level 3
7	<b>Pulse Magnetic Field Immunity</b> IEC 61000-4-9	1000A Level 5
Item	Standard	Test Level
8	<b>Damped Oscillatory Waves</b> IEC 61000-4-12 (IEC 60870-2-1 A2.5 level 3-4) (ANSI/IEEE C37.90.1-2002, 2,5kV)	2,5kV / 1kV Level 3
9	<b>Ring Wave</b> IEC 61000-4-12 (IEC 60870-2-1 A2.4 level 3) (ANSI/IEEE C37.90.1-2002, 2,5kV)	2,5kV Level 4
10	<b>Power Frequency Interference 50Hz</b> IEC 61000-4-16 level 4	30V cont. 300V / 10s
11	<b>AC Ripple on DC Supply</b> IEC 60870-2-1 A1.4 level 2 IEC 61000-4-17 level 3	12%
12	<b>Voltage Dips DC</b> IEC 61000-4-29	-30% for 0,1s -60% for 0,1s

	(IEC 60870-2-1 A1.5 level 1 30% 0,5s)	
13	<b>Voltage Interruption DC</b> IEC 61000-4-29 (IEC 60870-2-1 A1.5 level 1)	-100% for 10ms

#### EMC Emission Tests

Item	Standard	Test Level
1	<b>Enclosure: Radio Interference Field Strength</b> IEC/CISPR 11 / EN50011	30dB (30 – 230MHz) 37dB (230 – 1000MHz)
2	<b>Power Supply: Radio Interference Voltage</b> IEC/CISPR 11 / EN50011	79dB (0,15 – 0,5MHz) 73dB (0,5 – 30MHz)

## Appendix

### Schedule A: Specifications: -

<b>Mini RTU</b>			
	<b>Number of RTUs</b>	<b>1</b>	
<b>Supply Voltage</b>			
	Supply Voltage Value	110 VDC	
	Embedded	Yes	
	Permissible variation in voltage level	+/- 10	
<b>General Specification</b>			
	Time synchronization method	NTP/external GPS or through IEC104	
	Time synchronization period	1ms	
	Communication protocol	IEC 60870-5-104	

		IEC 60870-5-101 Modbus Serial & TCP/IP DNP3 over TCP/IP IEC 61850	
	Diagnostic LED	Yes	
	Operating Temperature	-25°C-+70°C	
	Real time clock resolution	1 ms	
	Execution cycle time	1 ms	
	Number of serial ports	2	
	Baud rate supported	Min. 9600 bit/s (adjustable) or above	
	Number of Ethernet Port	2	
	CPU Watchdog	Yes	
	Availability of events time stamping	Yes	
	Time resolution for SOE events	1 ms	
	Dimensions		
	IP		
	Manufacturer		
	Origin		
<b>DI module</b>			
	Minimum Number of input points for each mini RTU	32	
	Nominal input voltage	110 VDC	
	Max. Input voltage		
	Galvanic isolation (KV AC for 1 min)	>=1 KV	
	Impulse withstand (KV DC for 50 ms)	>=5 KV	
	Short Circuit Protection	Yes	

	Filter	Yes	
<b>DO module</b>			
	Number of output points for each RTU	8	
	Type of contact		
	Max. switching voltage		
	Galvanic isolation (KV AC for 1 min)	$\geq 1$ KV	
	Impulse withstand (KV DC for 50 ms)	$\geq 5$ KV	
	Output closure time range	0.5ms – 30s	
	Short Circuit Protection	Yes	
	Filter	Yes	
<b>Communication Modem</b>			
	Brand	ROBUSTEL - R3000 Lite (L4L)	
	Quantity	1	
	Operating temperature	-40- +75C°	
	110/24 DC-DC Voltage Converter (input 110VDC, output 24VDC) is supplied	yes	
<b>Enclosure</b>			
	IP	54	
	Includes the minRTU and GPRS modem with all necessary wiring, terminations, MCBs... ready to be installed as a closed system.	yes	