RESEARCH DESIGNS & STANDARDS ORGANIZATION

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DRAFT

Functional Requirement Specification for

UNINTERRUPTED POWER SUPPLY(UPS)

FOR SIGNALING INSTALLATIONS

TABLE OF CONTENTS:

1.0 FOREWORD:

This FRS is intended to cover the technical provisions.
This FRS requires reference to the latest version of following specifications/Documents:

1.	IEC 62040-1	Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements.
2.	IEC 62040-2	Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements
3.	IEC 62040-3	Uninterruptible power systems (UPS)- Part 3: Method of specifying the performance and test requirements
4.	IEC-61643	Surge Protective Devices connected to low-voltage power distribution systems
5.	IEC 60688	Electrical measuring transducers for converting AC and DC. electrical quantities to analogue or digital signals.
6.	IEC61326	Electrical equipment for measurement, control and laboratory use –EMC requirements
7.	IEC61312	Protection against Lightning Electromagnetic Impulse
8.	IEC61024	Protection of structures against Lightning
9.	EN55022	European Standard for Information Technology Equipment
10.	EN 50121*	Railway Applications - Characteristics of Railway Systems that affect EMC behaviour
11.	EN50129	Railway Application Safety Related Electronic System for Signaling
12.	IS:9000	Basic environmental testing procedure for electronic and electrical item
13.	MILHBDK217F	Military handbook " Reliability Prediction of Electronic Equipment".
14.	ISO 9001	Quality Systems- model for quality assurance in design, development, production, installation and serving.
15.	RDSO/SPN/165/2012	SMPS based Integrated Power Supply system.
16.	IRS: :S 63	PVC insulated underground unscreened cable for Railway signalling.
17.	IRS: S 76	PVC insulated indoor cables for Railway signalling.

18.	RDSO/SPN/197	Code of Practice for Earthing and Bonding System.
19.	IRS:S88/2004	Low Maintenance Lead Acid Battery.
20.	IRS:S 93/96(A)	Valve Regulated Lead Acid Sealed Maintenance Free Stationary Battery.
21.	IRS:S74/89	Voltage Regulator-Ferro Resonant.
22.	IRS:S23	Electrical Signalling & Interlocking Equipment.
23.	RDSO/SPN/144/2006	Safety & reliability requirements of electronic signalling equipment
24.	IRS:S-72/88	Signal Power Transformer 230/110 V

Note:

1. Whenever, reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification.

2. The requirement conforms to the provisions of Indian Electricity rules and other statutory regulations currently in force.

2.0 ABBREVIATIONS:

SNO.	Abbreviation	Expanded Form
1.	AC	Alternating Current
2.	ACDB	AC/DC Distribution Box
3.	Amp	Ampere
4.	BOM	Bill of Material
5.	CRCA	Cold Rolled Cold Annealed
6.	DC	Direct Current
7.	DG	Diesel Generator
8.	DSP	Digital Signal Processors
9.	EMC	Electromagnetic Compatibility
10.	EMI	Electromagnetic Interference
11.	FRLS	Fire Retardant low Smoke
12.	Hz	Hertz
13.	I/O	Input/output
14.	IPS	Integrated Power Supply
15.	IEC	International Electro technical Commission
16.	IEEE	Institute of Electrical and Electronics Engineers
17.	IGBT	Insulated Gate Bipolar Transistor
18.	IP	Ingress Protection

19.	LCD	Liquid Crystal Display
20.	LED	Light Emitting Diode
21.	MTBF	Mean Time Between Failure
22.	MTTR	Mean Time to Repair
23.	MCCB	Moulded Case Circuit Breaker
24.	OS	Operating System
25.	PCB	Printed Circuit Board
26.	PC	Personal Computer
27.	PWM	Pulse Width Modulation
28.	PIV	Peak Inverse Voltage
29.	PO	Purchase Order
30.	PU	Per Unit
31.	PVC	Poly Vinyl Chloride
32.	QA	Quality Assurance
33.	QAP	Quality Assurance Program
34.	RDSO	Research Designs and Standards Organization
35.	RTC	Real Time Clock
36.	RE	Railway Electrification
37.	ROM	Read Only Memory
38.	RFI	Radio Frequency Interference
39.	SEM	Signal Engineering Manual
40.	SM	Station Master
41.	STR	Schedule of Technical Requirements
42.	SMPS	Switch Mode Power Supply
43.	SPN	Single Phase Neutral
44.	SSW	Static Switch
45.	UPS	Uninterrupted Power Supply
46.	OV	Over Voltage
47.	UV	Under Voltage

3.0 SCOPE:

This document contains the functional requirement of Uninterrupted Power Supply (UPS) for Signalling System with 230V AC single or 415 V AC three Phase input (as per requirement).

To ensure that the specification is not restrictive to propriety systems, the functional requirements have been laid down and device specific details are avoided to keep scope of widely available systems without any propriety hardware and protocols. This specification covers Uninterrupted Power Supply (UPS) system. It addresses the requirement of applications requiring UPS of high reliability and mission critical requirement for signalling.

Note: This Functional requirement is released for development of Specification of Uninterrupted Power Supply (UPS) for signalling system. Development of system together with initial trials & further improvisation based on the experience will be done in the course of time.

4.0 SYSTEM REQUIREMENT:

The UPS system is an integrated system comprising of static rectifiers, battery, static inverters, static switches, built in isolated output transformer, manual by pass switch and other optional as specified in data sheet like Input Isolation Transformer, accessories required for completeness of the system and satisfactory performance of the system.

The battery charger/charging is an integral part of rectifier module. The charger shall be designed to charge the battery in constant voltage, constant current mode. The charger should be capable to recharge the battery from discharged condition to its full capacity in 8 to 10 hrs.(Normal float and boost voltage for VRLA battery should be 2.25 V and 2.3 V/Cell respectively).

The Inverter shall be IGBT based PWM type and with DSP based control technology. All components should be of a high quality and reliability and may be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and switching surges etc.

The UPS system shall be configured in parallel redundant system. The configuration of the UPS should be such that both the UPSs use a common/ separate battery bank. At any given point of time both UPS shall share average 50%-50% load.

In the event of failure of any UPS the load will be automatically transferred to the other UPS. In the event of failure of both UPS, load will be directly connected to mains supply through static bypass switch within 0(zero) msec.

The UPS system shall be of online true double conversion type with efficiency of more than 90%. The design of the UPS should be such as to minimize the risk of short circuits and will ensure human and operational safety.

The Power Supply System shall perform satisfactorily in a room at an ambient temperature of -10^{0}C to +70^{o}C and altitude not exceeding 1000 meters above MSL.

The designed MTBF of UPS and AC-DC Converter shall not be less than 1, 25,000 hours and MTTR 20 minutes with spares available.

4.1 RECTIFIER / CHARGER:

Incoming AC supply will be converted to DC through full wave IGBT based PWM rectifier. The rectifier operates according to the constant voltage current limiting principle and incorporates a "Soft Start" feature to gradually accept load on initial energizing.

The rectifier section of the UPS system should be capable of precise regulation to prevent damage to the battery. The output voltage of rectifier, without the battery, stabilized within +1% of set value during load variation between 0 to 100% of the rectifiers and specified mains input supply voltage variation.

Suitable protection should be provided in the control circuits to guard against instability of phase-controlled rectifiers due to electrical oscillations which may be present in the input supply as caused by emergency DG set.

The UPS system should be galvanically isolated from input power supply system by providing double wound transformers. All the transformers should be vacuum impregnated dry type suitable for location inside the panel. All rectifiers must have a double wound transformer at its input.

An RFI filter should be provided and immune to EMI interference.

Transient/surge protection circuit should be provided in the input circuit of rectifier to protect the UPS from surges & voltage spikes.

The UPS system should be designed to draw a power from mains supply at a minimum power factor of 0.90 while working at rated load in normal operating UPS configuration.

The rectifiers/chargers should be designed to completely charge the VRLA batteries in a maximum time of 10 hours after complete discharge and at the same time meeting the inverter input requirements when the inverter is delivering its rated output at 0.8 power factor. Facilities provided to initiate battery rapid charge operation by manual & automatic means. An auto charging sequence should also provide for the Boost and float charging based on current sensing. In addition to above, the charging would be transferred from Boost to float mode automatically.

The DC rectifier should sense the battery charging current and adjust the DC bus voltage to maintain the charging current to pre-set level. A separate current limit

circuit should be provided for adjustment of battery current. The rectifier should be protected against reverse battery connection at DC link voltage bus. Subsequent to a discharge cycle when battery is connected to rectifier, the battery current should be monitored, controlled and limited to set value automatically irrespective of the inverter input current.

The battery may be taken out of service for maintenance, during which period the inverter will continue to operate by drawing power from the rectifier. Ripple content at the DC link will not exceed 2% even with battery disconnected.

The UPS should have setting facility of voltage cut off and correction algorithms for safe discharge limit of battery even at variable load.

4.2 INVERTER:

The inverter should be IGBT with PWM Technology based current limiting type (short circuit proof) and have nominal output voltage and frequency as specified in the data sheet. The inverter output voltage and frequency will not exceed the operational tolerances, as measured at the output terminals of the unit during the following conditions of UPS loading: Load variations between 0-100% of the rated output of UPS Load power factor over the range of 0.8 lagging to unity. DC input voltages over the range corresponding to battery Boost charge and battery discharge operation during the specified discharge times.

The UPS output voltage waveform should be sinusoidal with a relative harmonic content not exceeding 5% for non-linear and 3% for linear loads.

The inverter should control the output voltage of the UPS such as to maintain synchronism with the mains bypass voltage during variations in mains frequency up to the limits specified. During variations in mains frequency exceeding these limits, the inverter will revert to internal frequency control.

It should be possible to vary the inverter output voltage steplessly within ± 10V of the specified output voltage. This adjustment can be done when the inverter is in operation.

The steady state output voltage and frequency (free running) variation of inverters will not exceed ± 1% from the set value for specified input power supply conditions from no load to full load condition and load power factor variation from 0.8 lag to1.0.

It should be possible to have voltage regulation at load end during more cable distance between UPS & load and having load variation. UPS must have facility of Output voltage compensation algorithm for cable length and IR to meet such requirements.

The UPS system should be able to operate satisfactorily on rated loads (in KVA) with power factors in the range of 0.8 lag to 1.0.

The UPS should be having capacity to deliver overload of 125% for 10 minutes and 150% for 1 minute. UPS provided with current limit circuit to avoid excessive loading beyond its permissible overload withstand capability.

The inverter should 'phase locked' to the bypass power supply as long as bypass supply frequency remain within ± 6% of nominal. When bypass supply frequency variation exceeds the above limits, the inverter should de-linked from mains. Free running frequency tolerance limit is not exceeding ± 0.1%. Facility should also be provided for adjustment of range of synchronizing frequency.

The UPS system output voltage variation should not exceed ± 10% and complete recovery to normal steady state within100ms during following condition.

a) 100% step load and unload
b) Momentary interruption in power supply
c) Load transfer to bypass supply
d) Complete load transfer to other healthy inverter when one of the two parallel inverters develop a fault.

UPS system should be suitable both for floating output or earthing of one leg / star point in case of single phase/ three phase system respectively.

4.3 STATIC SWITCH:

Fully rated static switch is provided at the inverter output and bypass supply to ensure positive isolation of faulty inverter section such that the other inverter and bypass circuits do not feed into the fault leading to under voltage / trip. The short time rating of the static switch is 10 times the rated output for the duration more than the fault clearing time of the type of fuse provided. Facility is provided to manually and automatically initiate transfer of the load from inverters to the bypass supply and from bypass supply to the inverter. Under voltage and over voltage sensing levels to initiate transfer is adjustable. The maximum transfer time between inverters and bypass supply will not exceed 4 msec and 20 msec in synchronous and asynchronous mode respectively.

The criteria for load transfer:

(a) Load transfer from inverter to the bypass supply is as follows:

i) The load transfer is possible when: The bypass output voltage is within rated UPS output voltage and the mains bypass frequency is within ± 6%.

ii) Auto-transfer of the load from inverter to bypass supply will be initiated when:

The inverter output voltage drops below 95% of nominal output voltage under steady state condition and/or if the inverter output voltage falls below 90% of the nominal value under transient conditions.

Or

The inverter output voltage exceeds 105% of the nominal output voltage under steady state condition and/or if the inverter output voltage reaches 110% of the nominal value under transient conditions.

Or

The inverter output current exceeds its tolerable limits as per OEM specification.

(b) Re-transfer of load from bypass supply to the inverter is as follows:

The load transfer will be possible when-

The inverter output voltage is within ± 5% of nominal output voltage for more than 5 sec. and inverter output and bypass supply are synchronized. Re-transfer of load from by pass to the inverter will be done manually only unless otherwise specified in the data sheet.

If automatic re-transfer of load to the inverter is specified in the data sheet, then the re-transfer of load to the inverter will be inhibited following four automatic transfers of load to bypass within a period of 5 minutes.

All breakers/switchgears are adequately rated for continuous rating as well as breaking capacity as applicable.

. All electronic power devices including thyristors, transistors (IGBTs), diodes etc. are rated under operating conditions for approximately 150% of the maximum current carried by the device.

All other electrical components such as transformers, reactors, breakers, contactors, switches, bus bars etc. are rated for at least 125% of the maximum required rating. No electronic device is subjected to PIV greater than 50% of its rated value.

The power supply for the fans is tapped from the inverter output. The rating of the UPS as specified in the data sheet is the net output of UPS after deducting power consumption for fan set. Maximum noise level from UPS system at 1 meter distance ,under rated load is 65 dBA

4.4 BATTERY BANK

UPS system should be suitable for charging 384 V battery bank of VRLA Maintenance free cells as per IRS:S93/96(A).Battery bank is part of this specification and the same shall be supplied and commissioned along with UPS. Manufacturers shall give an

Undertaking regarding use of battery grade acid as per IS 266:1993 and de-mineralized/distilled water as per IS1069:1993 for initial charging.

OEM shall also provide 5% of total numbers of 2V VRLA Cells as spare.

4.5 AC-DC CONVERTER

The AC-DC converter covered under this specification shall work satisfactorily meeting all the prescribed parameters as long as the ACDB is giving output 230 / 415 ± 1% AC.

AC-DC converters shall be connected in the following order:

i) Relay Internal
ii) Relay External
iii) Axle Counter
iv) Block Local UP
v) Block Local DN
vi) Panel Indication
vii) Block Line UP
viii) Block Line DN
ix) Block Tele UP
x) Block Tele DN
xi) Point M/c
xii) Electronic Interlocking

All components dissipating 3W or more power shall be mounted so that the body is not in contact with the board unless a clamp, heat sink or other means are used for proper heat dissipation.

Each converter shall be provided with a proper plug-in arrangement for AC input & DC output. A toggle switch/ pushbutton switch shall be provided for switching ON/OFF the unit.

The converter shall be provided with means for protection and visual indication on front panel for the following:

Description	Nomenclature	Indication
I) Input Power ON Indication	INPUT	Amber
ii) AC-DC Converter output OK	OUTPUT	Green
iii) AC-DC Converter fail	FAIL	Red

All modules except block Tele shall work on active load sharing basis without master/slave operation, Failure of any module shall not cause malfunction in other modules. The current sharing shall remain within±10% for 50% to100 % load.

The unit shall be provided with over-load protection, over-voltage protection and output

short circuit protection with fold back characteristics. The over-load protection shall be effective at 105% and output short circuit protection shall be effective at 110% of the rated current.

The DC over voltage protection shall be auto tracking type. Over voltage trip shall be set at approximately 110% of the setout put voltage. For example, in a 24V-32VAC-DC Converter module if output is set at 25V,over voltage shall be set at 25x1.1=27.2 approximately and soon.

The output voltage settability of the converter shall be within the -2% of the minimum rated voltage and +2% of the maximum rated voltage of the converter.

The output shall be free from overshoot because of "Turn on/Turn off" or power failure or when the battery charger is switched ON/OFF.

In case of failure of AC-DC converter the output voltage shall not exceed beyond pre-set value. Manufacturer shall submit fail-safety validation report in this regard by an approved assessor at the time of initial approval/any design change.

The no load input current shall not be more than 10% of the rated input current at maximum full load for all setting of output voltage and input voltage at 230/415± 1% AC nominal input voltage for AC-DC Converters of 50VA and above.

Each AC-DC converters shall be of modular type which shall be fitted in main rack. The input and output connections shall be made using irreversible plug-in connectors of appropriate rating.

The AC-DC converter of 12-40V,1A for block line circuit has been catered in this specification, which will be suitable for double line block instrument. Purchaser may select the voltage range for other type of block instruments from any of the following ranges:

a) 40-60V
b) 60-100V
c) 100-150V

The AC-DC converter for relay internal and relay external is catered for 24V, 5A operated metal to carbon relays. For 60V operated metal to metal relay system, DC-DC converter shall be used in n+ 2 configurations for relay internal. Where 'n' is the number of converters required to cater actual current requirement. Railway shall specify the rating of AC-DC converter as under:

Relay internal	60-66V,5A(n+2)
Relay external	60-66V,5A (n+1)
Relay external	24-32V,5A(n+1)

Whenever block proving by axle counter is used, the AC-DC converter of 24V-40V/5Aor10Ashall be used in place of block line DC-DC converters.

Each converter shall be designed for an input voltage of at 230 ± 1% AC. The out-

put regulation shall be ±1% of set value from 10% load to full load for the entire input range. AC-DC converter for block tele shall work at input voltage range of at 230 ± 1% AC..The regulation however shall be tested for at 230 ± 1% AC input variation.

Each AC-DC Converter shall be provided with voltage testing sockets on the front panel for the purpose of output voltage measurement in the common volt meter using patch cords & jacks.

Each converter shall be provided with a precision type10-turn potentiometer for adjusting the output voltage. This potentiometer shall be placed inside the AC-DC Converter. The output must be isolated from input.

Each AC-DC converter shall have blocking diodes at the output. The test points shall be provided before the blocking diode.

AC-DC converter for internal circuits shall be in n+ 2 configurations & for other circuits in n+1 configuration.

4.6 Spare module:- One Module of AC-DC converter should be kept as spare for each relay internal, relay external & Block line module or as required by the purchaser.

4.7 Radio Frequency Interference Suppression:

The AC-DC Converter shall be designed to minimize the level of Electromagnetic interference (EMI/RFI), both conducted & radiated in the vicinity of AC-DC Converter. The radiated & conducted noise shall be within the limits specified in applicable international/national standards. The firm shall submit certificate to this effect from accredited national/international test house at the time of type test.

The converter shall have self-resetting type protection from over load/short circuit of DC output.

The output ripple (peak to peak) of the converter shall not be more than 10mV at full load.

The sophomoric noise for block line and block tele shall not be more than 4 mV.

4.8 STEP DOWN TRANSFORMER:

Terminals & associated screws shall be of nickel-plated brass, and shall be of screw pillar type, securely fixed. The transformer shall be of double wound type and shall be designed for an input voltage of 230V±1% 50Hz. The capacity of the transformer maybe 1-3 KVA as per the requirement of the purchaser

The transformer shall have separate input and output windings. The primary of the transformer is 230V. The secondary winding shall have tapings at 0,100,110,120 &130volts at no load. The gauge of winding wires shall be such that current density does not exceed 2 A/mm sq. A rotary switch of 10 A or above shall be provided for switching ON/OFF

the transformer. The size of the core shall be as small as possible commensurate with the electrical characteristics required by this specification.

The core of the transformer shall be such that its Electro-magnetic property will not be affected due to ageing. The body of the core is required to be earthed and one earth terminal shall be provided for this purpose. Suitable marking shall be made near the earth terminal. The efficiency of the transformer at rated load with nominal input shall not be less than 90%.

The appropriate voltage shall be legibly & indelibly engraved near the input and output ter minals. An HRC fuse of appropriate rating shall be provided at the input of transformer.

The following LED indications shall be provided on the front panel:

Description	Nomenclature	Indication
a)Input ON	INPUT	Amber
b)Output ON	OUTPUT	Green
c)Tx. Fail	FAIL	Red

230VAC at 50Hz shall be applied on primary side between terminals '0' and' 230V 'and the voltages across different tapings on the secondary side shall be measured, which shall be within ±1.5%of the nominal value.

The open circuit secondary voltage and the primary no load current of the transformer shall be measured with the primary winding connected to 230V,50 Hz supply and the secondary winding open circuited. The open circuit secondary voltage at different tapings of the secondary windings shall be within ±1.5%of the nominal values. The primary no load current shall no texceed10% of the rated full load primary current for all transformers.

The percentage voltage regulation shall not be more than 5%.

OEM shall also provide two numbers of 230/110 V step down transformer along with all type of fuses used in system/sub-systems as spare.

4.9 STATUS MONITORING PANEL

Status monitoring panel shall be installed in the room of ASM on duty. The panel shall have following LED indications and alarms with resetting switch:

	Instruction	Condition	LED Ind.	Remark
A	Run Gen set	50% DOD	RED	Audio/visual alarm. Alarm can be acknowledged for audio cut off.

B	Emergency start generator	60% DOD	RED	-do-
C	System shut-down	70% DOD	RED	Signal feed cut off and all AC-DC converters to work. Audio alarm will continue till Generator is started.
D	Call S&T staff	Equipment fault	RED	Failure of any module or in case battery gets disconnected from circuit will give The alarm in panel. Alarm can be acknowledged for audio cut-off.
E	Stop Gen Set	UPS change over to float mode	GREEN	Audio/Visual alarm

Audio alarm in case of A,B & C shall be of one type of tone and there shall be different tone for the case of D & E cases.

In A, B & C conditions, the visual LED indication will remain lit until fault is cleared or the DG set is started and battery is charged up to 384V i.e.,2V/cell as the case may be until reset push button is pressed. In case of D condition, if fault is not cleared, the LED will continue to glow, even if reset push button is pressed.

5.0 COMMON REQUIREMENTS OF UPS PANEL

The following 3½ D digital meters with LED/ LCD display having 12mm numerical display shall be provided on top of the charger panel. The selector switch for meter shall not be at a height of more than 1800 mm from the ground.

a)	AC Voltmeter	0-500V	For AC input voltage
b)	AC Ammeter	0-600A	For AC input current
c)	DC Voltmeter	0-500V	For charger output voltage
d)	DC Ammeter	0-600A	For charger output current/charge/ Discharge current.

A selector switch shall be provided for reading Total/Charge/Discharge current. The DC meters shall work even when the AC supply is not available. All the above indications/measurements may be derived on a microprocessor based control and supervisory unit and may be displayed on an LED/LCD type alpha numeric display.

6.0 UPS IN PARALLEL CONNECTION:

Parallel Redundant UPS with bypass (With 2x50% batteries).
In UPS system having this configuration, two sets of rectifiers and inverters are provided. Under normal conditions, when AC mains power is available, both the rectifiers operate in parallel and supply DC power for float/ Boost charging the 2 x 50%

batteries and simultaneously to inverters. In case of failure in one rectifier, the other rectifier will feed the complete load and the battery without any interruption.

In case of incoming supply failure or failure of both rectifiers the 2 x 50% batteries feed the inverters without any interruption up to 4 Hours. Each rectifier is designed for simultaneously feeding complete inverter load and float/Boost charging of the 2 x 50% batteries to its rated capacity. Each rectifier is equipped with 'On Line' automatic as well as manual charging facility.

Normally both inverters will be synchronized with each other and with bypass supply. Both inverters will operate in parallel and share the load equally.

The load sharing controls do not have any common mode failure and any failure of the load sharing controls will not result in the loss of vital power.

When a disturbance/fault occurs in any one of the inverters, the faulty unit will automatically get disconnected and the entire load will be fed from the other inverter. In case both the inverters develop a fault, the complete load will be transferred to bypass supply through the static switches and retransfer of load from bypass supply to the inverter is possible in auto as well as in manual mode.

Rectifier /charger, inverter and static switch sections are suitably housed in sheet steel panels complete with all interconnections. The panels are free standing, fitted with suitable louvers for ventilation and cooling fans as required. The enclosure will provide IP-42 degree of protection.

All control wiring is neatly bunched together. Semiconductor and other components used in the equipment are of industrial grade with operating temperature range 0°C to + 85°C.

7.0 PROTECTION, METERING, INDICATIONS, ALARMS AND CONTROL REQUIREMENTS-

(a) Protections

i. Overload
ii. Short circuit at output of UPS
iii. Over and under voltage at battery terminals
iv. Over temperature
v. Input surge protection

(b) Metering on LCD (Scrolling)

i) Input voltage
ii) Input frequency
iii) Output voltage
iv) Output current
v) Output real power

vi) Bypass frequency
vii) Inverter frequency
viii) Bypass voltage (line-neutral)
ix) DC voltage (Battery Voltage)
x) Battery current (Charge/Discharge)
xi) Output apparent power
xii) Temperature
xiii) %Battery Charge

(c) LEDs are provided for following-

SN	Indication	Condition	Status
1	Input On	Mains Absent	Off
		Mains Available	Green
2	Bypass input	Absent/out of range	Off
		Within range	Green
3	By pass SSW	Bypass SSW off	Off
		Bypass SSW on	Red
4	Mains/Rectifier operation	Rectifier soft start	Blinking green
		Rectifier trip	Blinking red
		Rectifier healthy	Green
		Mains absent/out of range	Red
5	Inverter operation	Off	Red
		Trip	Blinking red
		Soft-start	Blinking green
		Healthy	Green
6	Inverter SSW	Inverter SSW off	Off

		Inverter SSW on	Green
7	Battery operation	Charging-float mode	Green
		Charging-boost mode	Blinking green
		Discharging	Red
8	Alarms	No alarms	Off
		Alarms present	Blinking red
		Alarms latched	Red

(d) Audio Visual Alarm

xiv) Mains fail
xv) Input OV
xvi) Input UV
xvii) Rectifier DC high
xviii) Low Battery
xix) Low battery trip
xx) Inverter over temperature
xxi) Inverter low
xxii) Inverter high
xxiii) Load on bypass
xxiv) UPS overload
xxv) UPS OL trip
xxvi) Alt low and Alt high

UPS is provided with provision to hook up all indication and audio visual alarm, with owner's system through RS485 / MODBUS. Dry contacts provided for Low Battery and Load on Inverter. The system will be provided with a front-panel alpha numeric LED/LCD display indicating various failures and having capability to download the log from remote place.

8.0 CONTROLS:

a) All the switches for starting, shut down and testing sequence.
b) Switchgears for feeding chargers, bypass line and dc bus from battery including backup protection.

c) Inverter ON/OFF switch (to initiate inverter operation)
d) Static switch transfer test through keypad

9.0 LIGHTING & SURGE PROTECTION:

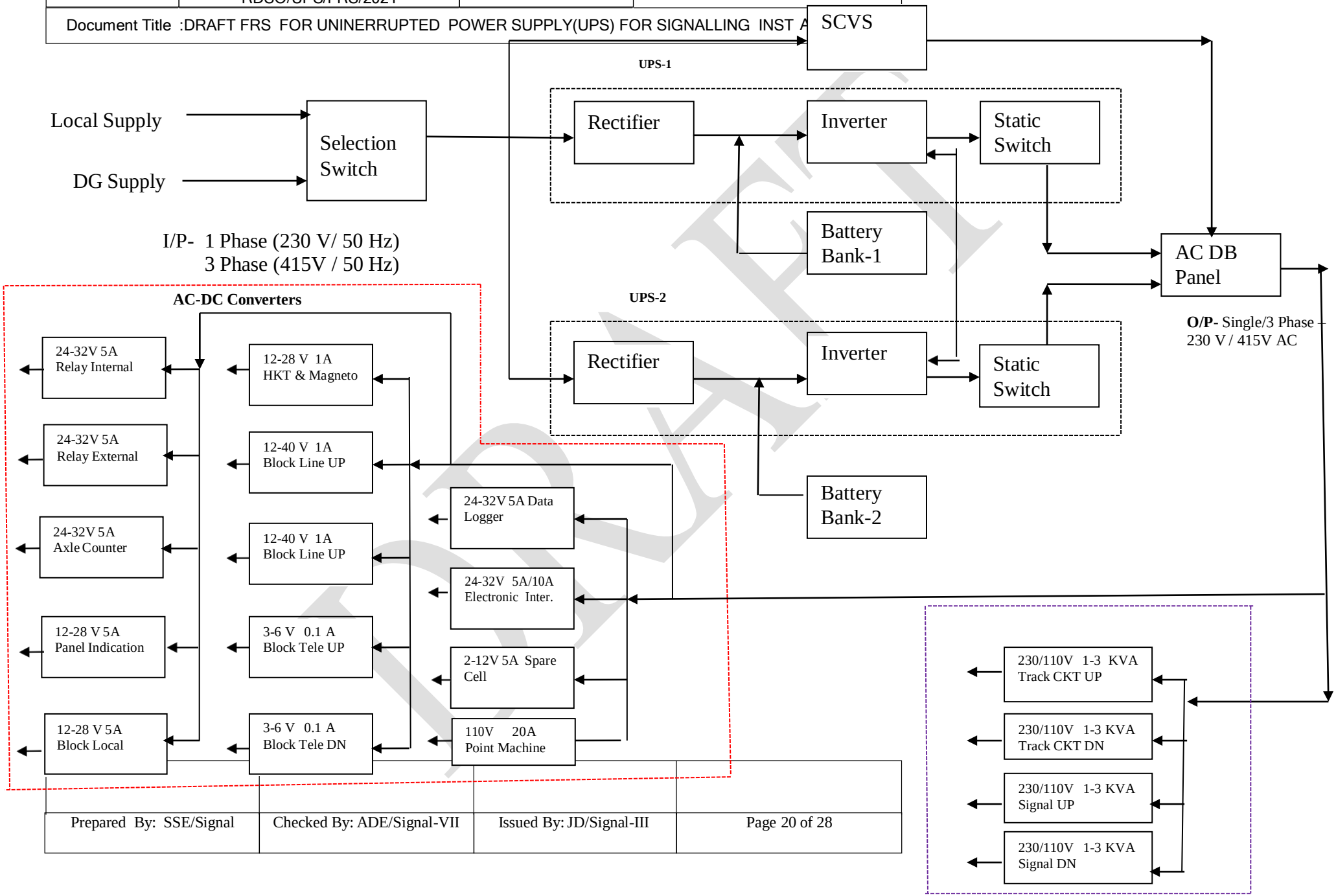
Details & specification for lighting & surge protection will be as per RDSO/SPN/165/2012 Version 3.0.

10.0 MODULE REPLACEMENT TIME AND MTBF:

i) The mean time to replace a faulty module of UPS shall be less than 20 minutes.

ii) The designed MTBF of UPS, Inverter, AC-DC Converter, Supervisory control unit & ASM Panel shall not be less than125000 hours.

11.0 SYSTEM ARCHITECTURE:


SCVS
UPS-1
Local Supply
DG Supply
Selection Switch
Rectifier
Inverter
Static Switch
Battery Bank-1
I/P- 1 Phase (230 V/ 50 Hz)
3 Phase (415V / 50 Hz)
AC DB Panel
O/P- Single/3 Phase 230 V / 415V AC
AC-DC Converters
UPS-2
Rectifier
Inverter
Static Switch
Battery Bank-2
24-32V 5A Relay Internal
24-32V 5A Relay External
24-32V 5A Axle Counter
12-28 V 5A Panel Indication
12-28 V 5A Block Local
12-28 V 1A HKT & Magneto
12-40 V 1A Block Line UP
12-40 V 1A Block Line UP
3-6 V 0.1 A Block Tele UP
3-6 V 0.1 A Block Tele DN
24-32V 5A Data Logger
24-32V 5A/10A Electronic Inter.
2-12V 5A Spare Cell
110V 20A Point Machine
230/110V 1-3 KVA Track CKT UP
230/110V 1-3 KVA Track CKT DN
230/110V 1-3 KVA Signal UP
230/110V 1-3 KVA Signal DN

12.0 TECHNICAL DATA SHEET:

Power (KVA)	**5 KVA**	**10 KVA**	**15 KVA**	**20 KVA**
INPUT - RECTIFIER				
Input Voltage	230VAC ; 1 Phase, 2 Wire , L & N	230VAC ; 1 Phase, 2 Wire , L & N	230VAC;1 Phase, 2 Wire L & N or 380 / 400 / 415 VAC ; 3 Phase, 4Wire , 3 L & N	230VAC;1 Phase, 2 Wire L & N or 380 / 400 / 415 VAC ; 3 Phase, 4Wire , 3 L & N
Input Voltage Range	150-275 VAC	150-275 VAC	150-275 VAC/ 340-460 VAC	150-275 VAC/ 340-460 VAC
Input Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Input Frequency Range	± 6%	± 6%	± 6%	± 6%
Input Power Factor	> 0.9	> 0.9	> 0.9	> 0.9
OUTPUT- INVERTER & BY-PASS				
Output Power Factor	>0.8	>0.8	>0.8	>0.8
Output Voltage	220VAC ; 1 Phase, 2 Wire , L & N	220VAC ; 1 Phase, 2 Wire , L & N	230VAC; 1 Phase, 2 Wire, L & N or 380 / 400 / 415 VAC ; 3 Phase, N	230VAC; 1 Phase, 2 Wire, L & N or 380 / 400 / 415 VAC ; 3 Phase, N
Output Voltage Regulation	± 1% (Static) ; ± 5% (Dynamic)	± 1% (Static) ; ± 5% (Dynamic)	± 1% (Static) ; ± 5% (Dynamic)	± 1% (Static) ; ± 5% (Dynamic)
Output Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Frequency Stability	± 0,1% (operation by battery) ; ± 1% (main synchron)	± 0,1% (operation by battery) ; ± 1% (main synchron)	± 0,1% (operation by battery) ; ± 1% (main synchron)	± 0,1% (operation by battery) ; ± 1% (main synchron)

Voltage Wave	Sinusoidal	Sinusoidal	Sinusoidal	Sinusoidal
Total Harmonic Distortion	< 3% (linear load) ; < 5% (non-linear load	< 3% (linear load) ; < 5% (non-linear load	< 3% (linear load) ; < 5% (-linear load	< 3% (linear load) ; < 5% linear load
Cold Start	No	No	No	No
Total Efficiency	> 90%	> 90%	> 90%	> 90%
Crest Factor	3 : 1	3 : 1	3 : 1	3 : 1
Transfer Time	0 msec.	0 msec.	0 msec.	0 msec.
BATTERY				
Battery Type	VRLA	VRLA	VRLA	VRLA
Battery Unit	192 no. 2V each	192 no. 2V each	192 no. 2V each	192 no. 2V each
Charge Voltage	405 VDC	405 VDC	405 VDC	405 VDC
Deep Discharge Voltage	300 VDC	300 VDC	300 VDC	300 VDC
Battery Test	Automatic and manual battery test system	Automatic and manual battery test system	Automatic and manual battery test system	Automatic and manual battery test system
Battery Charge Time	8 hours to 90% capacity after deep discharge	8 hours to 90% capacity after deep discharge	8 hours to 90% capacity after deep discharge	8 hours to 90% capacity after deep discharge
MIMIC & CONTROL PANEL& CONTROL				
Type	LCD Alphanumerical mini panel	LCD Alphanumerical mini panel	LCD Alphanumerical mini panel	LCD Alphanumerical mini panel
LCD Display	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery Charge Level, UPS Power, Load Percent, Synchron Case, Com-	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery Charge Level, UPS Power, Load Percent, Synchron Case, Com-	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery Charge Level, UPS Power, Load Percent, Synchron Case,	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery Charge Level, UPS Power, Load Percent, Synchron

	munication systems fault info.	munication systems fault info.	Communication systems fault info.	Case, Communication systems fault info.
LED Display	Load on Bypass, Load on UPS, Alarms and operation by battery leds.	Load on Bypass, Load on UPS, Alarms and operation by battery leds.	Load on Bypass, Load on UPS, Alarms and operation by battery leds.	Load on Bypass, Load on UPS, Alarms and operation by battery leds.
PROTECTION				
Over Load Capacity	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass
Short Circuit	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown
Over Heat	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.
Battery Low Level	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second
ALARMS				
Visual and Auditory	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low, over temperature, battery voltage high/low, short circuit, fault	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low, over temperature, battery voltage high/low, short circuit, fault in-	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low, over temperature, battery voltage high/low, short circuit, fault	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low, over temperature, battery voltage high/low, short

	inverter, battery test (Buzzer can be Off.)	verter, battery test (Buzzer can be Off.)	inverter, battery test (Buzzer can be Off.)	circuit, fault inverter, battery test (Buzzer can be Off.)
COMPUTER INTERFACE				
Management	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)
Dry Contact Information	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button
GENERAL				
Noise Level	< 65 dB (1 Meter)	< 65 dB (1 Meter)	< 65 dB (1 Meter)	< 65 dB (1 Meter)
Technologic	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver
Operation Temperature / Humidity	-10 °C to +70 °C(Min/Max) /90%	-10 °C to +70 °C (Min/Max)/90%	-10 °C to +70 °C (Min/Max)/90%	-10 °C to +70 °C (Min/Max)/90%
Cooling	Fan	Fan	Fan	Fan

TECHNICAL DATA FOR HEIGHER RATING UPS

Power (KVA)	**30 KVA**	**60 KVA**	**100 KVA**	**120 - 200 KVA**
INPUT - RECTIFIER				
Input Voltage	380 / 400 / 415 VAC ; 3 Phase, 4Wire , 3 L &N	380 / 400 / 415 VAC ; 3 Phase 4Wire , 3 L & N	380 / 400 / 415 VAC ; 3 Phase, 4Wire , 3 L & N	380 / 400 / 415 VAC ; 3 Phase, 4Wire , 3 L & N
Input Voltage Range	340-460 VAC	340-460 VAC	340-460 VAC	340-460 VAC
Input Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Input Frequency Range	± 6%	± 6%	± 6%	± 6%
Input Power Factor	> 0.9	> 0.9	> 0.9	> 0.9
OUTPUT- INVERTER & BY-PASS				
Output Power Factor	>0.8	>0.8	>0.8	>0.8
Output Voltage	380 / 400 / 415 VAC ; 3 Phase 4 Wire,3L&N	380 / 400 / 415 VAC ; 3 Phase, 4Wire 3L&N	380 / 400 / 415 VAC ; 3 Phase, 4Wire 3L&N	380 / 400 / 415 VAC ; 3 Phase, 4Wire 3L&N
Output Voltage Regulation	± 1% (Static) ; ± 5% (Dynamic)	± 1% (Static) ; ± 5% (Dynamic)	± 1% (Static) ; ± 5% (Dynamic)	± 1% (Static) ; ± 5% (Dynamic)
Output Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Frequency Stabil-	± 0,1% (operation by battery) ;	± 0,1% (operation by battery) ;	± 0,1% (operation by battery) ;	± 0,1% (operation by battery)

ity	± 1% (main synchron)	± 1% (main synchron)	± 1% (main synchron)	; ± 1% (main synchron)
Voltage Wave	Sinusoidal	Sinusoidal	Sinusoidal	Sinusoidal
Total Harmonic Distortion	< 3% (linear load) ; < 5% (non-linear load)	< 3% (linear load) ; < 5% (non-linear load)	< 3% (linear load) ; < 5% (non-linear load)	< 3% (linear load) ; < 5% (non-linear load)
Cold Start	No	No	No	No
Total Efficiency	> 90%	> 90%	> 90%	> 90%
Crest Factor	3 : 1	3 : 1	3 : 1	3 : 1
Transfer Time	0 msec.	0 msec.	0 msec.	0 msec.
BATTERY				
Battery Type	VRLA	VRLA	VRLA	VRLA
Battery Unit	192 no. 2V each	192 no. 2V each	192 no. 2V each	192 no. 2V each
Charge Voltage	405 VDC	405 VDC	405 VDC	405 VDC
Deep Discharge Voltage	300 VDC	300 VDC	300 VDC	300 VDC
Battery Test	Automatic and manual battery test system	Automatic and manual battery test system	Automatic and manual battery test system	Automatic and manual battery test system
Battery Charge Time	8 hours to 90% capacity after deep discharge	8 hours to 90% capacity after deep discharge	8 hours to 90% capacity after deep discharge	8 hours to 90% capacity after deep discharge
MIMIC & CONTROL PANEL& CONTROL				
Type	LCD Alphanumerical mini panel	LCD Alphanumerical mini panel	LCD Alphanumerical mini panel	LCD Alphanumerical mini panel
LCD Display	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Battery	Input Voltage , Output Voltage , Battery Voltage, Battery Current, Output Frequency, Bat-

	Charge Level, UPS Power, Load Percent, Synchron Case, Communication systems fault info.	Charge Level, UPS Power, Load Percent, Synchron Case, Communication systems fault info.	Charge Level, UPS Power, Load Percent, Synchron Case, Communication systems fault info.	tery Charge Level, UPS Power, Load Percent, Synchron Case, Communication systems fault info.
LED Display	Load on Bypass, Load on UPS, Alarms and operation by battery leds.	Load on Bypass, Load on UPS, Alarms and operation by battery leds.	Load on Bypass, Load on UPS, Alarms and operation by battery leds.	Load on Bypass, Load on UPS, Alarms and operation by battery leds.
PROTECTION				
Over Load Capacity	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass	100% ~ 125% load 10 minutes ; 125% ~ 150% load 1 minute ; > 150% load on the bypass
Short Circuit	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown	a) Inverter mod: UPS is shut-down itself b) Bypass mod : AC protection fuse is blown
Over Heat	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.	a) If main normal : UPS is cross to by-pass mode b) If main voltage is not normal : UPS is cut output, Alarm on the LCD Display.
Battery Low Level	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second	Battery low alarm occurs on the LCD. Sound alarm is given after 15 second
ALARMS				
Visual and Auditory	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low,	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low,	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage high / low,	Bypass alarm, mains fault, load on bypass, overload, mains failure, output voltage

	over temperature, battery voltage high/low, short circuit, fault inverter, battery test (Buzzer can be Off.)	over temperature, battery voltage high/low, short circuit, fault inverter, battery test (Buzzer can be Off.)	over temperature, battery voltage high/low, short circuit, fault inverter, battery test (Buzzer can be Off.)	high / low, over temperature, battery voltage high/low, short circuit, fault inverter, battery test (Buzzer can be Off.)
COMPUTER INTERFACE				
Management	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)	Dry contact info, RS232 Serial Port, TMON Software, remote control panel (option), SNMP and Megatec protocol (option)
Dry Contact Information	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button	Load on inverter / Bypass, Operation battery / mains, Battery low / normal, emergency button
GENERAL				
Noise Level	< 65 dB (1 Meter)	< 65 dB (1 Meter)	< 65 dB (1 Meter)	< 65 dB (1 Meter)
Technologic	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver	High frequency IGBT technology, PWM, True Online System, 2 Micro Pro. and high protection by driver
Operation Temperature / Humidity	-10 °C to +70 °C(Min/Max) /90%	-10 °C to +70 °C (Min/Max)/90%	-10 °C to +70 °C (Min/Max)/90%	-10 °C to +70 °C (Min/Max)/90%
Cooling	Fan	Fan	Fan	Fan