**Guideform Specification - Phasor Measurement Unit:**

**MiCOM P40 Agile P847**

10th Jan, 2020

The phasor measurement unit shall be delivered as part of a single family which provides scalable monitoring and control for all voltage levels in transmission and distribution systems. The family shall cover single and double feeder inputs and support up to four sets of three-phase CT inputs. Comprehensive measurement and control shall be provided in one integrated package suitable for incorporation in an integrated substation control system.

**Mechanical Specifications**

**Design**

* The device shall be housed in a case width of 60TE (12 inches, 304.8mm) or 80TE (16 inches, 406.4mm) depending upon the engineered scheme requirements;
* The device shall be presented in a 4U case height format (177mm), for ease of integration/standardization in standard control and protection racks and panels.
* The case width must be a multiple of 10TE (2 inches) to ensure easy engineering in 19 inch rack panels.
* For applications requiring up to 16 inputs and 8 outputs the device shall be housed in a case width no greater than 60TE (8 inches, 206mm). Devices for applications with up to 24 inputs and 24 outputs should be mounted in a full width (80TE) case to allow housing directly in a single 19 inch rack tier

**Enclosure Protection**

The degree of protection offered shall be as per IEC 60529: 2002:

* IP 52 Protection (front panel) against dust and dripping water.
* IP 50 Protection for the rear and sides of the case against dust.
* IP 10 Product safety protection for the rear due to live connections on the terminal block.
* The device shall be housed in a metallic case wrapper.
* The device case shall not include any ventilation louvres or other deliberate holes – it shall be an enclosed unit.

**Weight**

* The weight of the device shall be 9kg – 12kg (depending on chosen options) for 60TE case and 13kg – 16kg (depending on chosen options) for 80TE case.

**General Input/Output Terminals**

All terminals shall be ring-lug screw type for security and robustness:

* The screw size shall be M4 to allow suitable torque tightness.
* Connection of up to two independent ring lugs per terminal shall be supported, to permit daisy-chaining of connections where required, without resorting to inserting two wires in a ferrule.

**Front Port Serial PC Interface**

A front panel USB communication port shall be provided for service access by relay technicians/engineers, communicating with the PC toolsuite software:

* Isolation shall be to ELV level.
* A cable length up to 5m shall be supported.

**Rear Ethernet Connections**

* The relay shall have two fibre optic ports as an ordering option, to support communication redundancy, for IEC61850-8-1 and C37.118.2-2011 communication. A choice of redundancy protocols shall be available, such as IEC 62439-3 PRP or HSR, RSTP based on IEEE 802.1w, Self-Healing Ring (SHR) and Dual Homing Star (DHS). PRP and HSR shall be provided in a single ordering option, switchable with a software configurator.
* The ports shall be a 100 Base FX interface in accordance with IEEE802.3 and IEC 61850, wavelength 1300nm, for multi-mode 50/125µm or 62.5/125µm fibre, connector style: IEC 874-10 BFOC 2.5 -(ST®)
* A single RJ45 or fibre optic Ethernet port shall also be available as an option for IEC61850 / C37.118.2-2011 communication
* Hot standby redundancy (Ethernet failover) shall also be available as an ordering option.
* A dual port option should also be available supporting a single fibre optic Ethernet port and a single RJ45 port where the model application requires.
* Each port should support TCP, UDP unicast, UDP multicast or UDP multicast spontaneous communication protocols.

**Rear Serial Communication interface for SCADA**

* The relay shall have a minimum of one rear EIA (RS-485 port) for SCADA communications.
* Protocol supported shall be: Courier

**Rear connector for external clock synchronization signal**

* The relay shall support a BNC connector to accept an IRIG-B format B00x demodulation synchronizing signal.

**Batteries**

* Batteries shall not be included to maintain the records such as event, fault and disturbance records or the real time clock when power is lost to the relay

**Ratings**

**AC Measurement Range**

* The device shall be suitable for power systems operating at 50 and 60Hz.
* The operating range for the network frequency shall be from 45 to 65Hz.
* The relay shall be suitable for current transformer secondary ratings of 1A or 5A and shall be an order option selection. The current transformer inputs shall have a continuous rating of 4 times the rated current and a short time thermal withstand capability of 100 times the rated current for 1 second.
* The static and dynamic ranges for the CT inputs shall meet the requirements of synchrophasor specification C37.118.1-2011/C37.118.1a-2014.
* The current inputs shall have automatic CT shorting when the analogue module is removed, to enhance the safe working environment of technicians and relay engineers.
* The voltage transformer inputs shall be rated for 100/120V ac and shall have a continuous rating of 2 times the rated voltage. The inputs shall have a short time thermal withstand capability of 2.6 times the rated voltage for 10 sec.

**Auxiliary Voltage (Vx)**

The device auxiliary power supply input shall accommodate at least two standard battery voltage ratings used by the utility, as an ordering option, such as to minimize or eliminate multiple ordering options and spares holdings. Typical ratings most common in the utility environment shall include:

* 48V to 125Vdc nominal range (covering both 48/54 V and 110/125 V battery supplies in a single ordering option).
* 110V to 250Vdc nominal range (covering both 110/125 V and 220/250 V battery supplies in a single ordering option).
* The device shall operate for a deviation from the nominal range of -20% lower nominal voltage, up to +20% of higher nominal voltage.
* Auxiliary power supply interruption ride-through according to IEC 60255-11: 2008, with all communications ports active, all binary I/O energized, and LCD backlight on: 20ms.
* With a tolerable ac ripple of up to <15% for a dc supply, as per IEC 60255-11: 2013.
* The quiescent burden of the energized device shall be less than 11 W.
* Additional burden of second communications port shall be 1.25 W
* Additional burden for each output relay shall be 0.13 W
* The initial current inrush at switch-on shall be limited to no more than 8 A

**Digital (“Opto”) Inputs & Output Contacts**

To accommodate a high number of switchgear elements, the relay shall offer flexibility in ordering options for up to 24 opto inputs and 24 output contacts.

**Opto Inputs**

* Opto inputs shall provide independent terminals for wiring. Grouped optos shall not be acceptable.
* The opto inputs shall be universal range, rated from 24V to 250Vdc nominal, with a withstand of up to 300Vdc.
* The opto inputs shall have a software-selectable pick-up setting, without needing an ordering option or any need to change jumpers.
* The pick-up setting shall be matched at approximately 80% of battery nominal, with reset hysteresis such that drop-off is at approximately 60% of battery nominal. Such operation shall ensure that spurious pickup is avoided for battery earth faults where half-voltage may be falsely experienced by capacitive coupling.
* Opto inputs shall be compliant to ESI 48-4 EB2, presenting a “high burden” to prevent spurious pickup for capacitive discharge, with intelligent switching to reduce the burden to a low quiescent value under genuine operated conditions.
* Opto inputs shall be immune to capacitor discharge and power frequency without the need for external suppression. External resistors shall not be permitted.
* It shall be possible to connect two in series, with voltage sharing across the pair, permitting deployment in trip circuit supervision schemes (if required). It shall be possible to implementation full trip circuit supervision scheme via the optos: the supervision shall be active for CB open as well as closed conditions (full H7 scheme).

**Output Contacts**

**Contacts ratings:**

The rating of the output contacts shall be as follows, in accordance with IEC 60255-1: 2009:

* Maximum continuous current capacity shall be 10A, or 8A as measured by the harsher UL-compliant method.
* The short term make and carry rating shall be 30A for 3s, 250A for 30ms.
* The DC break capacity shall be 50W resistive or 62.5W inductive (L/R = 50ms)
* It shall be possible to configure a software latching (lockout) function for output contacts, whose status is memorized for reapplication after a power supply interruption

**Watchdog Contacts:**

Watchdog contacts shall be provided, with relay healthy (normally open) and relay fail/de-energised (normally closed) connection outputs available. Watchdog contact shall be in addition to the standard contacts available in the relay. Any error detected by the device self-motoring shall cause an alarm to be raised, such that hardwiring of an alarm to adjacent devices is possible, if required. The contact ratings of watchdog contact shall be:

* DC breaking capacity 30W resistive, 15W inductive (L/R = 40ms)

**LED Indicators**

Up to eight/eighteen freely-programmable LED indicators shall be provided, in addition to fixed function LEDs for Alarm, Trip, Out of Service and Healthy indication.

* It shall be possible to configure a software latching function for the LEDs, whose status is memorized for reapplication after a power supply interruption
* In relays with function keys, it shall be possible to set all the programmable LED’s in three different colours - RED / YELLOW / GREEN as per the scheme requirement using the programmable logic scheme.

**HMI Display**

* A textual LCD display screen shall be provided on the product, capable to display power system measurements, fault and event records, interrogate alarms, implement password access control, initiate commissioning test modes, monitor I/O status, alter synchrophasor settings, and change communication parameters including the device IP address.
* The device menu shall incorporate dependency rules, such that menu cells which are rendered inapplicable as a result of a previous menu selection are removed/hidden. Any whose range of options or settings range is affected shall also be automatically adapted.
* Multi-language support shall be provided, the following being the minimum: English, French, German, Spanish and Russian. Whichever local language is applied, simple switching to English shall always be possible to allow factory support, 3rd party commissioning etc.

**Functional Specifications**

**Monitoring and Control**

Synchrophasor measurements shall be provided by a numerical microprocessor-based relay equipped with the following monitoring, control, automation, and reporting functions. The relay shall have self-supervision to monitor the integrity of the hardware and such functions.

Optimized model options shall be available adapted to the different applications of synchrophasor measurements:

* Single feeders with a single set of 3 phase current inputs and 3 phase voltage inputs
* Double feeders with two sets of 3 phase current inputs and 3 phase voltage inputs
* Applications requiring up to two sets of 3 phase voltages and up to 4 sets of three phase current inputs.
* Nominal voltage rating 110-120 Vac
* Nominal current rating 1 A or 5 A as an order option

Specific requirements are as follows:-

**Phasor Measurements specification compliance**

Phasors measurements shall meet the static and dynamic requirements of C37.118.1-2011 with C37.118.1a-2014 amendments.

Compliance to the specification C37.118.1-2011 with C37.118.1a-2014 amendments shall be certified by a third party accredited test house for operation with synchrophasor data transfer set at 25 Frames per second and above.

**Phasor Measurements**

* The device shall include capabilities for real-time synchrophasor measurements.
* Phasor measurements to include voltage and current magnitudes and angles
* Synchrophasors to be transmitted in accordance with protocol C37.118.2-2011.
* Synchrophasor accuracy to meet 1% TVE to the limits of C37.118.1-2011 with 2014 amendment for PMU settings
* 50 Hz Applications: Phasor measurements reference of 45-55 Hz shall support the following frame rates:-
  + Phasors shall support class M response at 25 and 50 frames per second
  + Phasors shall support class P response at 10, 25 or 50 frames per second
* 60 Hz Applications: Phasor measurements reference of 55-65 Hz shall support the following frame rates:-
  + Phasors shall support class M response at 30 and 60 frames per second
  + Phasors shall support class P response at 10, 12,15, 30 or 60 frames per second
* Each synchrophasor shall have a user configurable name of up to 16 characters
* Two synchrophasor data streams shall each have unique assigned 16 bit ID codes
* Two logical PMUs shall be available each with a 16 bit identifier for its ID code
* Two logical PMUs shall be available each with a 32 bit global PMU ID number.
* Each phasor in the PMU streams shall have a user configurable name of up to 16 ASCII text characters
* Phasors shall be settable to be sent in polar or rectangular notation.
* Data format of phasors, frequency or ROCOF shall be settable as either floating point or integer
* PMU service status shall be settable for each of the two available logical PMUs
* Each phasor shall have settings for individual magnitude and angular compensation.
* Vector groups of phasors shall allow vector shifts in steps of 30 degrees

**Disturbance Recording**

The device shall include on-board disturbance recording, suitable to record a minimum of 8 fault clearance events

* The disturbance records shall have 8 analogue, 32 digital and 1 time channel.
* All channels and the trigger source shall be user configurable.
* The disturbance records time length shall be configurable from 0.1 s to 10.5 s.
* It shall be possible to retrigger the recording in case a long duration record is required
* The disturbance records shall be able to be extracted from the relay via the remote communications and saved in the COMTRADE format.
* The resolution of the records shall be 24 samples per cycle or greater.
* The record storage shall be maintained even after the device has been powered-down.

**Event Recording**

* The device shall include on-board event recording, suitable to record a minimum of 512 time-tagged events:
* The time stamp resolution of the records shall be 1ms.
* The record storage shall be maintained even after the device has been powered-down.
* The menu and PC toolsuite shall provide shortcut access to at least the last 5 fault trip records.
* Any maintenance events captured by the IED self-monitoring shall be visible in the Event Log
* Filtering of events shall be possible at the relay configuration stage so the use of event buffer may be limited to relevant events only.

**Programmable Logic**

The device shall include a graphical programmable logic facility, to enable customizing of the device response to the utility’s exact requirements:

* Programmable logic shall be provided including OR, AND and majority gate functions, with the ability to invert the inputs and outputs, and provide feedback paths in the logic. A minimum of 100 logic gates shall be available.
* Timer elements shall be provided, including delay on pick-up (DPU), delay on drop-off (DDO), combined DPU/DDO, pulsed, and minimum dwell time functions. A minimum of 16 timers shall be provided (not counting the timer functions which are expected to be an inherent provision with each output contact and LED indicator function).
* The logic shall not take the form of logic equations, but must be formed with graphical drag and drop gates, with all logic processed concurrently. There shall be no need to observe sequential “rules” which constrain in what order gates are processed, and how they affect any declared result.
* The concurrent processing of the logic shall ensure that the full logic declares a stable result without any race effects due to calculation lag.
* The amount of logic programmed shall not in any way affect the deterministic behavior of the control and communication functions in the relay. Whether the logic is sparsely used, or used up to its maximum capacity, this shall not change the operating time of those functions.
* Vice-versa, the programmable logic shall remain deterministic regardless of the extent of other device functions enabled.
* A license-free graphical PC tool shall be provided, to configure the programmable logic.
* The IED shall be supplied with pre-loaded default PSL schemes that provide a typical application scheme, to save on engineering / implementation time in projects.

**Measurements**

* The device shall include capabilities for real-time AC measurements of current and voltages including positive, negative and zero sequence components, frequency and derived power quantities.

**Setting Groups**

The device shall offer four programmable setting groups, including independent logic schemes

**PC Toolsuite**

The device shall be supported by a license-free Windows®-based toolsuite, with support for operating systems up to Windows 10. The toolsuite shall support:-

* Creation of offline synchrophasor settings, downloading and uploading to the device
* Standard application template creation for synchrophasor settings, such that the utility can standardize on a number of global templates, where only local (feeder-specific) parameters change at each site.
* Settings file export and import in Excel format
* Graphical creation and editing of programmable logic
* Comparison of setting and programmable logic files to identify any differences between versions
* Creation of IEC 61850 configuration and reports
* Retrieval of fault, event and disturbance records, and cybersecurity logs
* Display of extracted records, including disturbance record waveform graphics
* Control and resetting commands
* Polling of measurement values

**Communications**

**Ethernet Station Bus – IEC 61850-8-1**

* The relay shall support up to 64 GOOSE Inputs and Outputs
* The relay shall support synchrophasor protocol C38.118.2-2011 over Ethernet

**Serial Communication based on EIA RS485**

* The relay shall have a serial communication port based on EIA RS485, that supports Courier communication protocol.

**Cybersecurity**

* The relay shall be provided with a NERC compliant display
* Relay menu/settings shall be in such a way that a minimum 4 levels of access shall be provided with different password controls.
* To comply with NERC requirements of passwords
  + It shall be possible to program the passwords using any alpha numeric or special characters, minimum up to six characters long
  + Shall be possible to limit the number attempts to enter the correct password, beyond which the password shall be blocked
  + It shall be possible to block the physical and logical communication interfaces.
  + Event records shall include events related security management.

**Time synchronization**

* The device shall support a 1 pulse per second accurate synchronization signal from a fiber optic source from a GPS receiver for synchronization of the phasor measurements.
* The device shall also support unmodulated IRIG-B 00x fiber optic input to time stamp synchrophasor readings and for relay synchronization

**Environmental Conditions**

The following norms and standards compliance shall be demonstrated. All shall be carried out at an ILAC accredited laboratory:

**Ambient Temperature Range**

Compliance as per IEC 60255-27: 2005

* Operating temperature range: -25°C to +55°C (or -13°F to +131°F).
* Storage and transit: -25°C to +70°C (or -13°F to +158°F)

Tested as per IEC 60068-2-1: 2007:

* -25°C storage (96 hours), -40°C operation (96 hours).

IEC 60068-2-2: 2007:

* +70°C storage (96 hours), +70°C operation (96 hours)

**Ambient Humidity Range**

* As per IEC 60068-2-78: 2001: 56 days at 93% relative humidity and +40°C
* As per IEC 60068-2-30: 2005: Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55°C

**Corrosive Environments**

The device shall provide harsh environmental coating of printed circuit boards as standard. The coating shall be applied after printed circuit boards have been subjected to a cleaning and drying process.

The environmental claims achieved shall be:

* As per IEC 60068-2-42: 2003, IED 60068-2-43: 2003, Part 2, Test Ke, Method (class) 3. Industrial corrosive environment/poor environmental control, mixed gas flow test. 21 days at 75% relative humidity and +25oC exposure to elevated concentrations of H2S, (100 ppb) NO2, (200 ppb) Cl2 (20 ppb).
* As per IEC 60068-2-52 Salt mist (7 days)
* As per IEC 60068-2-43 for H2S (21 days), 15 ppm
* As per IEC 60068-2-42 for SO2 (21 days), 25 ppm

**Type Tests**

The following norms and standards compliance shall be demonstrated:

**Insulation**

As per IEC 60255-27: 2005

* Insulation resistance > 100MΩ at 500Vdc (using only electronic/brushless insulation tester).

**Creepage Distances and Clearances**

As per IEC 60255-27: 2005

* Pollution degree 3,
* Overvoltage category III,
* Impulse test voltage (not RJ45) 5 kV.
* Impulse test voltage (RJ45) 1 kV.

**High Voltage (Dielectric) Withstand**

1. As per IEC 60255-27: 2005: 2 kV rms AC, 1 minute:

Between all case terminals connected together, and the case earth.

Also, between all terminals of independent circuits.

* 1 kV rms AC for 1 minute, across open watchdog contacts.
* 1 kV rms AC for 1 minute, across open contacts of changeover output relays.

1. As per ANSI/IEEE C37.90-2005:

* 1.5 kV rms AC for 1 minute, across open contacts of output relays and open watchdog contacts.
* 1.0 kV rms AC for 1 minute, across open contacts of changeover output relays.

**Impulse Voltage Withstand Test**

As per IEC 60255-27: 2005

* Front time: 1.2 µs, Time to half-value: 50 µs,
* Peak value: 5 kV, 0.5J
* Between all independent circuits, and all terminals and case earth.

**Electromagnetic Compatibility (EMC)**

The following norms and standards compliance shall be demonstrated. All shall be carried out at an ILAC accredited laboratory:

**1 MHz Burst High Frequency Disturbance Test**

As per IEC 60255-22-1: 2008, Class III, and IEC 60255-26: 2013

* Common-mode test voltage: 2.5 kV,
* Differential test voltage: 1.0 kV,
* Test duration: 2s, Source impedance: 200Ω

**Damped Oscillatory Test**

As per EN61000-4-18: 2011: Level 3, 100 kHz and 1 MHz. Level 4: 3 MHz, 10 MHz and 30 MHz, IEC 60255-26:2013:

* Common mode test voltage: 2.5kV and 4kV
* Differential mode test voltage: 1kV

**Immunity to Electrostatic Discharge**

As per IEC 60255-22-2: 2009 Class 3 and Class 4, IEC 60255-26:2013:

* 15kV discharge in air to user interface, display, and exposed metalwork.
* 8kV discharge in air to all communication ports.

**Electrical Fast Transient or Burst Requirements**

As per IEC 60255-22-4: 2008 and EN61000-4-4:2004. Test severity level lll and lV, IEC 60255-26:2013:

* Applied to communication inputs: Amplitude: 2 kV, burst frequency 5 kHz and 100 KHz (level 4)
* Applied to power supply and all other inputs except for communication inputs: Amplitude: 4 kV, burst frequency 5 kHz and 100 KHz (level 4)

**Surge Withstand Capability**

As per IEEE/ANSI C37.90.1:2002:

* 4kV fast transient and 2.5kV oscillatory applied common mode and differential mode to opto inputs (filtered), output relays, CTs, VTs and power supply.
* 4kV fast transient and 2.5kV oscillatory applied common mode to communications and IRIG-B.

**Surge Immunity Test**

As per IEC 61000-4-5: 2005 Level 4, IEC 60255-26:2013

* Time to half-value: 1.2/50 µs,
* Amplitude: 4kV between all groups and case earth,
* Amplitude: 2kV between terminals of each group (excluding communications ports where applicable)

**Immunity to Radiated Electromagnetic Energy**

As per IEC 60255-22-3: 2007, Class III, and IEC 60255-26:2013:

* Frequency band 80 MHz to 3.0 GHz
* Spot tests at 80, 160, 380, 450, 900, 1850, 2150 MHz
* Test field strength 10 V/m
* Test using AM 1 kHz @ 80%

As per IEEE/ANSI C37.90.2: 2004:

* 80MHz to 1000MHz, 1 kHz@ 80% am and pulse modulated.
* Field strength of 35 V/m.

**Radiated Immunity from Digital Communications**

As per IEC 61000-4-3: 2006, Level 4: and IEC 60255-26:2013:

* Test field strength, frequency band 800 to 960 MHz, and 1.4 to 2.0 GHz: 30 V/m,
* Test using AM: 1 kHz / 80%.

**Radiated Immunity from Digital Radio Telephones**

As per IEC 61000-4-3: 2006, and IEC 60255-26: 2013:

* 10 V/m, 900MHz and 1.89GHz.

**Immunity to Conducted Disturbances Induced by Radio Frequency Fields**

As per IEC 61000-4-6: 2008, Level 3,

* Disturbing test voltage: 10 V rms.

**Power Frequency Magnetic Field Immunity**

As per IEC 61000-4-8: 2009, Level 5,

* 100A/m applied continuously,
* 1000A/m applied for 3s.

As per IEC 61000-4-9: 2001, Level 5,

* 1000A/m applied in all planes.

As per IEC 61000-4-10: 2001, Level 5,

* 100A/m applied in all planes at 100kHz/1MHz with a burst duration of 2s.

**Conducted Emissions**

As per EN 55022: 2010: Class A:

* 0.15 - 0.5MHz, 79dBμV (quasi peak), 66dBμV (average)
* 0.5 - 30MHz, 73dBμV (quasi peak), 60dBμV (average).

**Radiated Emissions**

As per EN 55022: 2010: Class A:

* 30 - 230MHz, 40dBμV/m at 10m measurement distance
* 230 - 1GHz, 47dBμV/m at 10m measurement distance
* 1 – 2 GHz, 76 dBµV/m at 10 m measurement distance

**Power Frequency**

As per IEC 60255-22-7:2003, IEC 60255-26:2013:

Compliance to be achieved using filters on opto inputs.

* 300 V common-mode (Class A)
* 150 V differential mode (Class A)

**EU Directives**

A declaration of conformity shall evidence compliance with EU directives, and each device shall display a  mark.

**EMC Compliance**

As per 2004/108/EC: Compliance to the European Commission Directive on EMC shall be claimed. Product specific standard EN 60255-26: 2009 shall be used to establish conformity.

**Product Safety**

As per 2006/95/EC: Compliance to the European Commission Low Voltage Directive (LVD) shall be claimed. Product specific standards shall be used to establish conformity: EN 60255-27: 2005

**R&TTE Compliance**

Radio and Telecommunications Terminal Equipment (R&TTE) directive 99/5/EC.

* Compliance demonstrated by compliance to both the EMC directive and the Low voltage directive, down to zero volts. Applicable to rear communications ports.

**Other Approvals to be demonstrated:**

* Underwriters Laboratory (UL)
*  compliance shall be demonstrated
* (Complies with Canadian and US requirements)

**Mechanical Robustness**

The following norms and standards compliance shall be demonstrated:

**Vibration Test**

As per EN 60255-21-1: 1996

* Response Class 2
* Endurance Class 2

**Shock and Bump**

As per EN 60255-21-2: 1995

* Shock response Class 2
* Shock withstand Class 1
* Bump Class 1

**Seismic Test**

As per EN 60255-21-3: 1995

* Class 2

**Transit Packaging Performance**

The primary packaging carton shall comply with the international freight standard ISTA 1C specification, to minimize the risk of damage in transit:

* Vibration tests in 3 orientations, vibratory movement 7 Hz, amplitude 5.3 mm, acceleration 1.05g
* Drop tests - 10 drops from 61 cm height on multiple carton faces, edges and corners

**Quality**

* The company’s quality management system shall be accredited and independently audited to ISO 9001: 2015
* The company’s environmental management system shall be accredited and independently audited to ISO 14001: 2015
* The company’s occupational health and safety management system shall be accredited and independently audited to OHSAS 18001: 2007
* The company’s information security system shall be accredited and independently audited to ISO 27001: 2013
* Each device shall be subjected to a 24 hour heat-soak during the manufacturing process, in order to mimimise the risk of early-life failures.
* The vendor shall supply the actual measured Mean-Time Between Failures (MTBF) for the device upon request.
* The device shall include a ten-year warranty for material and workmanship defects.
* The vendor shall offer a nominal 5 day turn-around for warranty repairs
* The relay shall incorporate a rating label which is accessible and visible from the front of the relay, without needing to open any cubicle door to expose the terminal side (rear) of the relay. This label shall show the model number, serial number, month of manufacture and rating details of the device.