



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
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Date of Issue	2016-06-16
Page 1 of 29	

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ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16
Page 2 of 29	

TABLE OF CONTENTS

0.1 Circulation List

0.2 Amendment Record

FOREWORD

INTRODUCTION

- 1. SCOPE**
- 2. NORMATIVE REFERENCES**
- 3. TERMS AND DEFINITIONS**
- 4. REQUIREMENTS**
- 5. INFORMATION AND WARRANTY**
- 6. ANNEXES**

ANNEX A: TECHNICAL PARTICULARS

ANNEX B: GUARANTEED TECHNICAL PARTICULARS



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

Using PLC as medium of
communication between MCU
and UIU

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 3 of 29

0.1 Circulation List

Copy No.	Copy Holder
1	GM, SUPPLY CHAIN
2	MANAGER, STANDARDS DEVELOPMENT

Electronic copy (pdf) on KPLC Server currently: <http://172.16.1.40/dms/browse.php?fFolderId=23>

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
1	2015-04-25	Amendments on clauses- 4.2.1.4, 4.2.1.6, 4.2.1.9, 4.2.2.1.2, 4.2.2.1.10, 4.2.2.2.11, 4.3.2, 4.3.3, 4.5.2 (d), 4.5.9, 5.10, 5.4 (a), 5.7 & 5.8	M.K. Juma	R. Odun Bena
2	2016-04-18	Amendment on Clauses 4.2.2.1.12	M.K. Juma	R. Odun Bena
3	2016-06-17	Amendment on Clauses 4.2.1.4, 4.2.1.20, 4.2.1.21, 4.2.2.1.7, 4.3.1, 4.3.2, 4.3.3, 4.5.11; Inclusion: clauses 4.2.1.2.10, 4.2.2.2.20	M.K. Juma	R. Odun Bena
4	2016-07-25	Amendment on Clauses 4.1.1, 4.1.2, 4.2.1.5, 4.2.1.6, 4.2.1.11, 4.2.1.19, 4.2.1.27, 4.5.2 Inclusion 4.2.1.4, 4.2.1.25 4.2.1.26	M.K. Juma	R. Odun Bena
5	2016-08-15	Inclusion of 4.2.1.23, 4.2.1.24, 4.5.9 and 4.5.10	M.K. Juma	R. Odun Bena

10



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 4 of 29

FOREWORD

This specification lays down requirements for single-phase DIN rail mounting split prepayment meters for active energy, where the communication between MCU and UIU is by means of PLC. The specification is intended for procurement of equipment and does not include provision of contract.

The specification was prepared to establish and promote uniform requirements for single-phase split prepayment meters for active energy to be used at Kenya Power and Lighting Company Ltd. The specification lays down the minimum requirements for equipment acceptable for use in the KPLC system.

21



SINGLE-PHASE SPLIT PREPAYMENT DIN RAIL MOUNTING STATIC WATT - HOUR METERS FOR ACTIVE ENERGY

Using PLC as medium of
communication between MCU
and UIU

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 5 of 29

1. SCOPE

This specification applies to newly manufactured, single-phase Din rail mounting static watt-hour prepayment meters for direct connection, for measurement of alternating current electrical energy consumption at a nominal frequency of 50 Hz.

The method of credit transfer shall be through encrypted numeric tokens complying with the 20-digit STS encryption algorithms. The meters shall include a load switch for the purpose of interruption or restoration of the electricity supply to the load in accordance with the current value of the available credit maintained in the prepayment meter.

The Measurement and Control Unit (MCU) shall be separated from the User Interface Unit (UIU) and method of communication between them shall be over Power Line Carrier for a distance not less than one hundred (100) metres.

2. NORMATIVE REFERENCES

The following documents were referred to during the preparation of this specification; in case of conflict, the requirements of this specification take precedence.

- [1] IEC 60529: Degrees of protection provided by Enclosures (IP Code)
- [2] IEC 62052-11:2003, Electricity Metering equipment (a.c) – General Requirements, Tests and Test Conditions- PART 11: Metering equipment.
- [3] IEC 62053-21:2003, Electricity metering equipment (a.c) – Particular Requirements - Part 21: Static meters for active energy (Class 1.0).
- [4] IEC 62055-31:2005 Electricity metering – Payment systems – Part 31: Particular requirements – Static payment meters for active energy (classes 1 and 2).
- [5] IEEE1901.2 Standard for Low Frequency (less than 500kHz) Narrow Band Power Line Carrier for Smart Grid Applications
- [6] SANS1524-1:2004 Electricity prepayment Systems, Part 1: Prepayment meters.

3. TERMS AND DEFINITIONS

The definitions given in 2 shall apply.

KPLC: Kenya Power & Lighting Company Limited

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**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 6 of 29

MCU: Measurement and Control Unit

OFDM: Orthogonal Frequency Division Multiplex

PLC: Power Line Carrier

UIU: User Interface Unit

SRE: Significant Reverse Energy

4. REQUIREMENTS

Prepayment meters shall comply with the requirements of 2.1 and 2.3 for outdoor meters. The prepayment meters shall be mounted as for normal service.

4.1 Operating conditions requirements

4.1.1 The meters shall be suitable for operation in tropical climate where temperatures may vary from -1 to +60° Celsius.

4.1.2 Average Annual Relative humidity up to 90% and altitude of up to 2,600m.

4.1.3 The meters shall be used for measurement of active energy for domestic loads under tropical climate conditions.

4.2 Design and construction requirements

4.2.1 General

4.2.1.1 The requirements given in 2.1 shall apply.

4.2.1.2 The Measurement and Control Unit (MCU) shall be of DIN rail mounting with locking clip, to fit to a 35 mm Din rail.

4.2.1.3 The MCU and UIU shall communicate via PLC for a distance of not less than one hundred (100) meters.

4.2.1.4 The meters shall be constructed as 1 phase 2-wire meters.

4.2.1.5 The meters shall have terminals as follows: The Connection to the meter shall be Bottom-In, Bottom-Out with Live in and Neutral in terminals at the base level to allow



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
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Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 7 of 29

racking of the meter on a test bench. The meter terminals shall have a protection cover against ingress of water.

- 4.2.1.6 The MCU dimensions shall not exceed: Height = 170 mm; Width = 60 mm; and Depth = 95 mm; and meter base shall be on the width side where the Din rail is mounted.
- 4.2.1.7 The MCU body shall be ultrasonically sealed for life and there should be no screws on the MCU body except for the termination of cables.
- 4.2.1.8 The meter shall have terminal cover open detection. Once the terminal cover is opened, the load shall be disconnected.
- (a) The MCU shall be supplied with loading switch in open mode and installer can open terminal cover when MCU is not activated by commissioning code (token).
- (b) After installation of MCU, the installer will input a commission code (token) to close the loading switch and activate terminal cover open detection function.
- 4.2.1.9 After commissioning token is put into the MCU and loading switch closes, opening of the terminal cover will lead to tamper. When MCU has power and terminal cover is opened, MCU will disconnect immediately. When MCU has no power and terminal cover is opened, MCU will detect and record the event and disconnect immediately power resumes.
- 4.2.1.10 The MCU shall be sealed and its printed circuit boards conformal coated in a manner so as not to allow malfunction due to ingress of moisture, vermin, dust, chemicals and temperature extremes.
- 4.2.1.11 The meters terminal holes and screws shall be of Moving-cage type made of brass or nickel-plated brass for high conductivity and corrosion resistance.
- 4.2.1.12 Terminal holes shall be of at least 10mm diameter and 15mm in depth. The dimension from the terminal holes to meter base shall not exceed 20mm.
- 4.2.1.13 The meter's terminal screw inserts shall be sealable with utility wire seals.
- 4.2.1.14 The meters protection class shall be class II (Double insulated).
- 4.2.1.15 The meters shall have a non-volatile memory capable of data storage and with long-term data retention period of not less than 10 years or for the certified life of the meter or whichever is greater without an electrical supply being supplied to the meter.
- 4.2.1.16 The meters shall have register codes to indicate information like instantaneous power, current credit register, power fail counter, last credit token number, value of last credit token, etc. The values shall be available on the UIU display.

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**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 8 of 29

- 4.2.1.17 The principal unit for the measured values shall be the kilowatt-hour (kWh).
- 4.2.1.18 The meter shall have a means of reading the credit register to within a resolution of at least 0.01 kWh for testing purposes.
- 4.2.1.19 The meters shall detect significant reverse energy (SRE) when the line and load wires are swapped.
- 4.2.1.20 The meters shall continue to operate correctly and decrement credit during SRE detection.
- 4.2.1.21 The meters shall have LED indicators for testing and indication of kWh consumption.
- 4.2.1.22 The meters shall have an optical communication port, compliant to IEC 62056-21 for accessing information stored inside the meter through a hand held unit.
- 4.2.1.23 The meters shall use PLC communication module for communication to data concentrators and Meter data management System (MDMS) to a minimum distance of 1,000 meters with success rate of at least 97% using real time, bidirectional communication of maximum of 5 seconds.
- 4.2.1.24 The PLC shall comply with IEEE1901.2 using OFDM modulation at frequency band up to 500 KHz (G3/PRIME).
- 4.2.1.25 The meter shall be compliant to DLMS/ COSEM protocol.
- 4.2.1.26 The meters shall work under postpaid mode or prepaid mode. The switch of mode shall be done via meter specific token or optical communication.
- 4.2.1.27 The meters shall be supplied together with three copies of software for interrogating the meter data; and it shall not be possible to reprogram the meters using this software.
- 4.2.1.28 The MCU shall conform to the degree of protection IP 54 as given in IEC 60529. The terminals shall be so designed so as to ensure protection from ingress of water and dust.

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**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 9 of 29

4.2.2 Functionality

4.2.2.1 Measurement and Control Unit (MCU)

- 4.2.2.1.1 The MCU shall have a load switch to automatically interrupt the load circuit on the expiry of credit balance.
- 4.2.2.1.2 The load switch shall automatically restore the load circuit after top up.
- 4.2.2.1.3 The meter load switch shall comply with the requirements given in 2.1.
- 4.2.2.1.4 The meters shall be able to indicate absence or presence of continuous power.
- 4.2.2.1.5 The meters shall disconnect the load if power failure is detected and connect the load after normalization.
- 4.2.2.1.6 The meters shall have a programmable power limit setting that shall disconnect the load once exceeded and reconnect once the load falls below the set limit.
- 4.2.2.1.7 The MCU shall support two elements double circuit measurement. The MCU shall be equipped with 100A relay (loading switch) both in Live and Neutral circuits. These relays shall operate simultaneously. In case there is an imbalance between the Live circuit and the Neutral circuit, the MCU will take it as a tamper event and record it. The MCU will measure on the higher current without disconnecting the loading switch.
- 4.2.2.1.8 The MCU shall have a diagnostic LED to indicate the presence of communication between the MCU and the UIU.
- 4.2.2.1.9 The MCU shall continue metering and decrement credit, regardless of the state of the communications interface of the UIU.
- 4.2.2.1.10 The Live and Neutral of the MCU shall be DC immune
- 4.2.2.1.11 The MCU shall come fitted with an SCSSCAAA9 (MC171) compliant data port for programming and interrogating the meter. Two (2) sets of data interrogating and programming probes and software (1 each for optical and SCSSCAAA9 ports) shall be provided with the meter sample for evaluation. For the winning bidders,

ju



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PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

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communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 10 of 29

each delivery of 100,000 meters shall have 100 sets of probes and software for use with the optical and the SCSSCAA9 ports.

4.2.2.1.12 The MCU shall be supplied together with a plastic card of dimension 85mm x 54 (length X height) mm and material similar to that of a credit card indicating the meter number. The meter serial number shall be engraved on the card together with its bar code version and also stored in a magnetic medium with capability of being read out when the card is swiped.

4.2.2.1.13 The MCU shall be with pre-loaded 3 (three) kWh.

4.2.2.2 User Interface Unit (UIU)

4.2.2.2.1 The UIU shall comply with 20-digit (STS) encryption algorithms. All correctly entered tokens shall be registered to eliminate fraud.

4.2.2.2.2 The UIU's keypad shall be user friendly with a LCD display for numeric credit display and language independent pictograms to identified operational features. The height of the display characters for the numeric values shall not be less than 4.5 mm.

4.2.2.2.3 The UIU display shall have at least seven 7-numerical characters comprising of five integers and two decimals.

4.2.2.2.4 The UIU shall conform to the degree of protection IP 51 as given in IEC 60529.

4.2.2.2.5 The UIU shall communicate with MCU through (PLC) communication link for distance not less than one hundred (100) meters.

4.2.2.2.6 The UIU shall be an interchangeable unit and it shall be possible to view the mated MCU on the UIU.

4.2.2.2.7 The UIU shall enable loading the meter with a number of pre-purchased units of credit, without loss of any existing credit balance.

4.2.2.2.8 The UIU shall, upon acceptance of a valid token credit the exact amount contained on the token to the appropriate register in the meter and shall increment the register by this amount.

4.2.2.2.9 The UIU shall transfer the credit in kWh.



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 11 of 29

- 4.2.2.2.10 The UIU shall display the cumulative kilowatt-hour register.
- 4.2.2.2.11 The UIU shall have a means to remove digits from a partially entered number sequence-backspace key.
- 4.2.2.2.12 The UIU shall have the ability to recall the last five successful credit tokens entered and the associated dates and time.
- 4.2.2.2.13 The UIU shall be able to indicate the meter software.
- 4.2.2.2.14 The UIU shall indicate the status of the incoming supply.
- 4.2.2.2.15 The UIU shall indicate the credit status.
- 4.2.2.2.16 The UIU shall indicate token acceptance or rejection.
- 4.2.2.2.17 The UIU shall give low credit warning by means of a flag on UIU display and audio alarm. The UIU shall have option of muting the low credit warning sound by entering a code on the UIU.
- 4.2.2.2.18 The UIU keypad shall have backlight to enable keying of tokens in the dark.
- 4.2.2.2.19 The UIU shall be wall mountable
- 4.2.2.2.20 The UIU shall able to communicate with MCU when power off via 2xAA battery".

Handwritten mark



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 12 of 29

4.3 Electrical requirements

- 4.3.1** The meters shall be operated from mains with reference values of 230V, 50 Hz, with a load switching voltage range from 0.4Un to 1.3Un.
- 4.3.2** The load switch shall interrupt the supply when the voltage is below 0.4 Un and above 1.3Un.
- 4.3.3** The load switch shall automatically restore supply within a minute when the voltage falls within 0.4 – 1.3 Un.
- 4.3.4** The meters shall be connectable for 2-wire systems, drawing of which shall be printed on the meter body.
- 4.3.5** The meter shall have reference standard currents of:-
 $I_b = 5 \text{ A}$, $I_{max} \geq 80 \text{ A}$
- 4.3.6** Power consumption:
The requirement of 2.3 applies.
- 4.3.7** Influence of short-time over-currents:
The requirement of 2.3 applies..
- 4.3.8** Influence of self-heating
The requirement of 2.3 applies.
- 4.3.9** Over-voltage
The requirement of 2.3 applies.
- 4.3.10** Insulation test
The requirement of 2.3 applies.
- 4.3.11** EMC test
The requirement of 2.3 applies.

Requirements 4.3.6 to 4.3.11 shall form part of the type test approval to be issued by an international or the national (of the country of manufacture) meter certifying body.

4.4 Accuracy requirements

Tests and test conditions given in 2.2 shall apply.

- 4.4.1** The meter's accuracy shall be of class 1 for active energy.
- 4.4.2** Limits of errors due to variation of the current:
The requirement of 2.3 applies.



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 13 of 29

4.4.3 Limits of error due to influence quantities

The requirement of 2.3 applies.

4.4.4 Test of starting and no-load condition

The requirement of 2.3 applies.

4.4.5 Meter constant

The requirement of 2.3 applies.

4.4.6 Accuracy test conditions

The requirement of 2.3 applies.

Requirements of Clause 4.4 shall form part of the type test approval to be issued by an international or the national (of country of manufacture) meter certifying body.

4.5 Instructions and Marking

4.5.1 General

The requirements given in 2.1 shall apply. The information shall be in legible English, indelibly marked on the meter and of at least 4mm figure height.

4.5.2 Specific marking requirements

The following information shall be marked on each meter.

- (a) The standard transfer specification (STS) compliant serial number, in the preferred format known as a national meter number,
- (b) The STS compliance logo,
- (c) The inscription "Property of K.P. & L. Co Ltd.",
- (d) Name or trade mark of the manufacturer;
- (e) Country of origin;
- (f) Type/model;
- (g) Meter number;
- (h) Barcode comprising of meter serial no without blank spaces;
- (i) Standard(s) to which the meter complies;

11



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No. KP1/10A.2B/3/3/01

ISSUE NO. 2

REVISION NO. 4

Date of Issue 2016-06-16

Page 14 of 29

(j) Year of manufacture.

4.5.3 The following drawings and information shall be required with the tender:

- (a) Meter drawing giving all the relevant dimensions;
- (b) Wiring diagrams;
- (c) Description leaflet of the meter being offered;
- (d) Users and operational manuals.

4.5.4 A sample of the meter offered shall be submitted together with test tokens for; different Power Limit Settings and resets for the same, Credit and Clear Credit Tokens to aid in the testing of the meters. The manufacturer might be required to provide more tokens at no extra cost.

4.5.5 Copies of type approval certificate (s) with test and calibration results of the meter being offered obtained from an international or the national meter certification body shall be provided. If type approval certificate (s) is (are) from accredited meter certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation, under ISO/IEC 17025 from the national or an international certification body.

4.5.6 The bidder shall complete clearly, all the clauses in both columns of the Schedule in Appendix B. This shall form the basis of evaluation of the submitted tender. Failure to complete this Appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.

4.5.7 The supplier shall submit a Quality Assurance Plan (QAP) that will be used to ensure that the meters design, materials, workmanship, test, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations.

4.5.8 The supplier declaration on conformity to applicable standards like ISO 9001:2008 shall be supported with copies of valid certificates. The supplier shall submit with the tender, the calibration certificates for their test equipment issued by a third party testing laboratory that is accredited to ISO/IEC 17025".



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Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 15 of 29

- 4.5.9** The manufacturer shall provide a list and contact details of at least four previous utilities to which the meter being offered has been supplied.
- 4.5.10** The manufacturer should have supplied a minimum of 250,000 pieces of the meter type offered to similar utilities. Evidence of this shall be submitted with this tender.
- 4.5.11** Copies of DLMS/COSEM certificates shall be submitted with this tender
- 4.5.12** The manufacturer shall produce meters that fully meet the requirements of the IEC standard, IEC 62055-51:2007 - Electricity metering - Payment systems Part 51: Standard transfer specifications and hence :
- (a) Facilitates interoperability amongst hardware, software and meters supplied by other manufacturers
 - (b) Does not lock KPLC to only the bidder or any one supplier or manufacturer in its future procurement of prepayment meters, software or hardware.
 - (c) The meters shall be interoperable with the existing Smart metering Management System. The bidder shall demonstrated this before award.

5 INFORMATION AND WARRANTY (IN CASE OF TENDER AWARD)

- 5.1** Drawings and technical details shall be submitted to KPLC for approval before manufacture of the meters commences. KPLC undertakes to submit their comments or approval for the drawings within three weeks of receiving the draft copies.
- 5.2** The meter shall have a warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of eighteen months from the date of delivery. All defective meters shall be replaced at the supplier's cost.
- 5.3** KPLC shall meet the full costs of two engineers, for meter inspection and acceptance testing at the manufacturer's facility.
- 5.4 Samples**
- 5.4.1** The tenderer shall submit one MCU and two (2) UIU samples together with the tender documents. The submitted meter samples shall be subjected to accuracy tests at KPLC's Meter Central Laboratory to verify the requirements of IEC 62053-21:2003



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 15 of 29

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- 5.4 Samples**
- 5.4.1** The tenderer shall submit one MCU and two (2) UIU samples together with the tender documents. The submitted meter samples shall be subjected to accuracy tests at KPLC's Meter Central Laboratory to verify the requirements of IEC 62053-21:2003



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 16 of 29

Clause 8.1 and to verify responsiveness to other requirements of this specification. Samples shall not be returned to the tenderers.

- 5.4.2** Bidders are advised that the Laws of Kenya require that the Kenya Bureau of Standards must approve any new meter being introduced in the country. To this end, Bidders shall furnish the Bureau with 4 (four) samples of each meter type to be supplied. Bids submitted without the meter type approval from the Bureau will NOT be considered non-responsive. However the winning Bidder must submit this approval before the signing of the supply contract.

Bidders may communicate directly with the Kenya Bureau of Standards on this matter through the following address:

The Managing Director
Kenya Bureau of Standards,
P.O. Box 54974, 00200,
Nairobi, Kenya.

Tel: (+254 020) 605490, 602350

Fax: (+254 020) 604031

Email: info@kebs.org

Web: <http://www.kebs.org>

- 5.5** The meters shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.
- 5.6** The meters shall be packed in suitable groups and / or batches with consecutive serial numbers. Packaging shall be done only after KPLC approval
- 5.7** The meters shall be packaged in multiples of ten unless where the number of meters in a group/batch does not make a multiple of ten.
- 5.8** The number of meters packaged in a group and/or batch for handling/lifting/carrying by an operator manually shall be such that their weight does not exceed 15 kg.
- 5.9** The supplier shall indicate the delivery time versus quantities of each type of meter and his production capacity.
- 5.10** Where test and / or calibration certificates/ reports are issued by a laboratory other than the International / National Standards and Testing Authority, a copy of accreditation



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 17 of 29

certificate, under ISO/IEC 17025 from the International/ National meter certification body shall be attached together with the tender documents.

- 5.11** The manufacturer shall provide current e-mail addresses, fax and telephone numbers of the national / international testing / calibration laboratories and meter certification bodies. The test certificates shall bear the product serial number of meter on offer.

M



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 18 of 29

6 ANNEXES

Annex A: Summary of Technical Data

Measurement and Control Unit - General information	
Type	Single phase, 2-wire, direct connected prepayment meter
Compatible networks	Single phase, 2-wire, earthed neutral
Electrical ratings	
Accuracy	kWh Class 1 (IEC 62053-21)
Voltage measurement (U_n)	230V; 50Hz
Load switching voltage range	0.5 U_n to 1.3 U_n
Voltage circuit burden	2W and 10 VA
Current circuit burden	4VA @ Base reference current I_b
Current measurement	$I_b = 5 A$; $I_{max} = 80 A$.
Protective class	Class II double insulated
MCU Enclosure	
Mounting	Rail mounting, with locking clip compatible with 35 mm DIN standard rail
Rating	IP54, suitable for installation in a pole-top or outdoor kiosk housing
Material	UV stable polycarbonate/ABS blend with flame retardant
Resistance to heat and fire	As per IEC 60695-2-1 (glow-wire)
Resistance to spread of fire	UL94-VO rated @ 1.5mm
Terminals	
Type	Moving-cage terminal
Material	Mild steel/nickel/brass
Maximum Cable Size	10 mm ²
Operating environment	
Area of application	Indoor meter
Operating temperature range	-1 °C to 60 °C
Storage temperature range	-10 °C to 60 °C
Relative humidity	Maximum 90%, annual mean 75%
Operation	
General	Credit store with decrement-on-use
Credit entry mechanism	Keypad; encrypted numeric tokens
Credit encryption method	20-digit STS
Metrological performance	
Measurement direction	Forward and reverse detection and metering



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 19 of 29

Consumption indicator	Visible LED
Status indication	Visible LED
Liquid Crystal Display (LCD)	8 digits + icons; icon information, numeric information
Accurate metering range	0.05 I _b to 1.2 I _{max}
Starting current	0.4% I _b
Short circuit current	30 I _{max}
Disconnection Device	
Type	Single pole latching contactor, 100 A.
Insulation; Over voltage and Surge Protection	
Insulation system classification	Protective class II
Insulation level	4 kV rms for 1 minute
Over voltage withstand	400 VAC for 48 hours
Surge immunity	
Voltage impulse withstand	□□□□□n excess of 6 kV, 1.2/50□s (IEC 62052-11)
Current impulse withstand	5kA/20 □s
Electromagnetic compatibility	
Electrostatic discharge	15 kV air discharge
Immunity to HF fields	80 MHz to 2 GHz @ 10V/m with load 80 MHz to 2 GHz @ 30V/m no load
Immunity to FTB	4 kV
Radio interference	Complies with requirements for CISPR 22
Specification Compliance	IEC 61000-4-2; IEC 61000-4-3; IEC 61000-4-4; IEC 61000-4-6 CISPR 22
Communication Circuitry	
Type	PLC
Rated Impulse Voltage	Peak Voltage 6 kV (1,2/50□s) waveform (According to IEC 62052-11 protective class II)
Insulation properties	4 kVrms (1 Minute) (According to IEC 62052-11 protective class II)
Communication Distance	□□□□□ metres
User Interface Unit	
Type	PLC
Operating Range (Com)	□100 metres
Operating Environment	



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 20 of 29

Operating Temperature	-10 °C to 60 °C
Storage Temperature Range	
Relative Humidity	75 %
UIU Enclosure	
Type	Wall mounted
Rating	IP 51
Material	UV stable polycarbonate/ABS blend with flame retardant
Sealing	
Enclosure	Factory sealed, no user serviceable parts
Type	Language-independent
Components	Pictographic/Numeric LCD display, keypad, LED rate of consumption indicator, audio feedback
Liquid Crystal Display (LCD) Size	At least 7 digits + 11 icons; icon information; numeric information display of various meter information such as credit levels, token entry, etc
Keypad	12-key, international standard layout including "information" and "backspace" keys
Buzzer	Feedback on key press, Token Accept and Reject melodies, low-credit alarms as a factory-programmable option
Light emitting Diode (LED)	Rate of consumption indicator (pulse rate proportional to current rate of consumption)

ANNEX B: Specifications Matrix for Split Prepayment Static Meters for active Energy - Guaranteed Technical Particulars (GTP)

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.1	Operating conditions requirements		
4.1.1	The meters shall be suitable for operation in tropical climate where temperatures may vary from -1 to + 60 degrees Celsius		
4.1.2	Average Annual Relative humidity up to 90% and altitude of up to 3,200m.		
4.1.3	The meters shall be used for measurement of active energy for domestic loads under tropical climate conditions		
4.2	Design and construction requirements		
4.2.1	General		
4.2.1.1	The requirements given in 2.1 shall apply.		



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 21 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.2.1.2	The Measurement and Control Unit (MCU) shall be of DIN rail mounting with locking clip, to fit to a 35 mm Din rail.		
4.2.1.3	The MCU and UIU shall communicate via PLC for a distance of not less than one hundred (100) meters.		
4.2.1.4	The meters shall be constructed as 1 phase 2-wire meters.		
4.2.1.5	The meters shall have terminals as follows: The Connection to the meter shall be Bottom-In, Bottom-Out with Line in and Neutral in terminals at the base level to allow racking of the meter on a test bench. The meter terminals shall have a protection cover against ingress of water.		
4.2.1.6	The MCU dimensions shall not exceed: Height = 170 mm; Width = 60 mm; and Depth = 95 mm; and meter base shall be on the width side where the Din rail mount shall be located.		
4.2.1.7	The MCU body shall be ultrasonically sealed for life and there should be no screws on the MCU body except for the termination of cables.		
4.2.1.8	The meter shall have terminal cover open detection. Once the terminal cover is opened, the load shall be disconnected.		
(a)	The MCU shall be supplied with loading switch in open mode and installer can open terminal cover when MCU is not activated by commissioning code (token).		
(b)	After installation of MCU, the installer will input a commission code (token) to close the loading switch and activate terminal cover open detection function.		
(c)	After commissioning token in put into the MCU and loading switch closes, opening of the terminal cover will lead to tamper. When MCU has power and terminal cover is opened, MCU will disconnect immediately. When MCU has no power and terminal cover is opened, MCU will detect and record the event and disconnect immediately power resumes.		
4.2.1.9	The MCU shall be sealed and its printed circuit boards conformal coated in a manner so as not to allow malfunction due to ingress of moisture, vermin, dust, chemicals and temperature extremes.		
4.2.1.10	The meters terminal holes and screws shall be of Moving-cage type made of brass or nickel-plated brass for high conductivity and corrosion resistance.		
4.2.1.11	Terminal holes shall be of at least 10-mm diameter and 15mm in depth. The dimension from the terminal holes to meter base shall not exceed 20mm.		

11



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 22 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.2.1.12	The meter's terminal screw inserts shall be sealable with utility wire seals.		
4.2.1.13	The meters protection class shall be class II (Double insulated).		
4.2.1.14	The meters shall have a non-volatile memory capable of data storage and with long-term data retention period of not less than 10 years or for the certified life of the meter or whichever is greater without an electrical supply being supplied to the meter.		
4.2.1.15	The meters shall have register codes to indicate information like instantaneous power, current credit register, power fail counter, last credit token number, value of last credit token, etc. The values shall be available on the UIU display.		
4.2.1.16	The principal unit for the measured values shall be the kilowatt-hour (kWh).		
4.2.1.17	The meter shall have a means of reading the credit register to within a resolution of at least 0.01 kWh for testing purposes.		
4.2.1.18	The meters shall detect significant reverse energy (SRE) when the line and load wires are swapped.		
4.2.1.19	The meters shall continue to operate correctly and decrement credit during SRE detection.		
4.2.1.20	The meters shall have LED indicators for testing and indication of kWh consumption.		
4.2.1.21	The meters shall have an optical communication port, compliant to IEC62056-21 for accessing information stored inside the meter through a hand held unit.		
4.2.1.22	The meters shall use PLC communication module for communication to data concentrators and Meter data management System (MDMS) to a minimum distance of 1,000 meters with success rate of at least 97% using real time, bidirectional communication of maximum of 5 seconds.		
4.2.1.23	The PLC shall comply with IEEE1901.2 using OFDM modulation at frequency band up to 500 KHz (G3/PRIME).		
4.2.1.24	The meter shall be compliant to DLMS/ COSEM protocol		
4.2.1.25	The meters shall work under postpaid mode or prepaid mode. The switch of mode shall be done via meter specific token or optical communication.		
4.2.1.26	The meters shall be supplied together with three copies of software for interrogating the meter data; and it shall not be possible to reprogram the meters using this software.		

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**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 23 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.2.1.27	The MCU shall conform to the degree of protection IP 54 as given in IEC 529. The terminals shall be so designed so as to ensure protection from ingress of water and dust.		
4.2.2	Functionality		
4.2.2.1	Measurement and Control Unit (MCU)		
4.2.2.1.1	The MCU shall have a load switch to automatically interrupt the load circuit on the expiry of credit balance.		
4.2.2.1.2	The load switch shall automatically restore the load circuit after top up.		
4.2.2.1.3	The meter load switch shall comply with the requirements given in 2.1.		
4.2.2.1.4	The meters shall be able to indicate absence or presence of continuous power.		
4.2.2.1.5	The meters shall disconnect the load if power failure is detected and connect the load after normalization.		
4.2.2.1.6	The meters shall have a programmable power limit setting that shall disconnect the load once exceeded and reconnect once the load falls below the set limit.		
4.2.2.1.7	The MCU shall support two elements double circuit measurement. The MCU shall be equipped with 100A relay (loading switch) both in Live and Neutral circuits. These relays shall operate simultaneously. In case there is an imbalance between the Live circuit and the Neutral circuit, the MCU will take it as a tamper event and record it. The MCU will measure on the higher current without disconnecting the loading switch.		
4.2.2.1.8	The MCU shall have a diagnostic LED to indicate the presence of communication between the MCU and the UIU.		
4.2.2.1.9	The MCU shall continue metering and decrement credit, regardless of the state of the communications interface or the UIU.		
4.2.2.1.10	The Live and Neutral of the MCU shall be immune to DC		
4.2.2.1.11	The MCU shall come fitted with an SCSSCAA9 (MC171) compliant data port for programming and interrogating the meter. Two (2) sets of data interrogating and programming probes and software (1 each for optical and SCSSCAA9 ports) shall be provided with the meter sample for evaluation. For the winning bidders, each delivery of 100,000 meters shall have 100 sets of probes and software for use with the optical and the SCSSCAA9 ports.		



SINGLE-PHASE SPLIT PREPAYMENT DIN RAIL MOUNTING STATIC WATT - HOUR METERS FOR ACTIVE ENERGY

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 24 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.2.2.1.12	The MCU shall be supplied together with a plastic card of dimension 85mm x 54 (length X height) mm and material similar to that of a credit card indicating the meter number. The meter serial number shall be engraved on the card together with its bar code version and also stored in a magnetic medium with capability of being read out when the card is swiped.		
4.2.2.1.13	The MCU shall be with pre-loaded 3 (three) kWh.		
4.2.2.2	User Interface Unit (UIU)		
4.2.2.2.1	The UIU shall comply with 20-digit (STS) encryption algorithms. All correctly entered tokens shall be registered to eliminate fraud.		
4.2.2.2.2	The UIU's keypad shall be user friendly with a LCD display for numeric credit display and language independent pictograms to identified operational features. The height of the display characters for the numeric values shall not be less than 4.5 mm.		
4.2.2.2.3	The UIU display shall have at least seven 7-numerical characters comprising of five integers and two decimals.		
4.2.2.2.4	The UIU shall conform to the degree of protection IP 51 as given in IEC 60529.		
4.2.2.2.5	The UIU shall communicate with MCU through (PLC) communication link for distance not less than one hundred (100) meters.		
4.2.2.2.6	The UIU shall be an interchangeable unit and it shall be possible to view the mated MCU on the UIU.		
4.2.2.2.7	The UIU shall enable loading the meter with a number of pre-purchased units of credit, without loss of any existing credit balance.		
4.2.2.2.8	The UIU shall, upon acceptance of a valid token credit the exact amount contained on the token to the appropriate register in the meter and shall increment the register by this amount.		
4.2.2.2.9	The UIU shall transfer the credit in kWh.		
4.2.2.2.10	The UIU shall display the cumulative kilowatt-hour register.		
4.2.2.2.11	The UIU shall have a means to remove digits from a partially entered number sequence-backspace key.		
4.2.2.2.12	The UIU shall have the ability to recall the last five successful credit tokens entered and the associated dates and time.		
4.2.2.2.13	The UIU shall be able to indicate the meter software.		
4.2.2.2.14	The UIU shall indicate the status of the incoming supply.		

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**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 25 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.2.2.2.15	The UIU shall indicate the credit status.		
4.2.2.2.16	The UIU shall indicate token acceptance or rejection.		
4.2.2.2.17	The UIU shall give low credit warning by means of a flag on UIU display and audio alarm. The UIU shall have option of muting the low credit warning sound by entering a code on the UIU.		
4.2.2.2.18	The UIU keypad shall have backlight to enable keying of tokens in the dark.		
4.2.2.2.19	The UIU shall be wall mountable		
4.2.2.2.20	The UIU shall be able to communicate with MCU when power off via 2xAA battery".		
4.3	Electrical requirements		
4.3.1	The meters shall be operated from mains with reference values of 230V, 50 Hz, with a load switching voltage range from 0.5Un to 1.3Un.		
4.3.2	The load switch shall interrupt the supply when the voltage is below 0.4 Un and above 1.3Un.		
4.3.3	The load switch shall automatically restore supply within a minute when the voltage falls within 0.4 – 1.3 Un.		
4.3.4	The meters shall be connectable for 2-wire systems, drawing of which shall be printed on the meter body.		
4.3.5	The meter shall have reference standard currents of:- Ib = 5 A, I _{max} ≥ 80 A		
4.3.6	Power consumption: The requirement of 2.3 applies		
4.3.7	Influence of short-time over-currents: The requirement of 2.3 applies.		
4.3.8	Influence of self-heating The requirement of 2.3 applies.		
4.3.9	Over-voltage The requirement of 2.3 applies.		
4.3.10	Insulation test The requirement of 2.3 applies.		
4.3.11	EMC test The requirement of 2.3 applies.		
4.4	Accuracy requirements		
	Tests and test conditions given in 2.2 shall apply.		
4.4.1	The meter's accuracy shall be of class 1 for active energy		

11



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 26 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.4.2	Limits of errors due to variation of the current: The requirement of 2.3 applies.		
4.4.3	Limits of error due to influence quantities The requirement of 2.3 applies.		
4.4.4	Test of starting and no-load condition The requirement of 2.3 applies.		
4.4.5	Meter constant: The requirement of 2.3 applies.		
4.4.6	Accuracy test conditions: The requirement of 2.3 applies.		
4.5	Instructions and Marking		
4.5.1	General The requirements given in 2.1 shall apply. The information shall be in legible English, indelibly marked on the meter and of at least 4mm figure height.		
4.5.2	Specific marking requirements The following information shall be marked on each meter.		
	(a) The standard transfer specification (STS) compliant serial number, in the preferred format known as a national meter number,		
	(b) The STS compliance logo,		
	(c) The inscription "Property of K.P. & L. Co Ltd.",		
	(d) Name or trade mark of the manufacturer;		
	(e) Country of origin;		
	(f) Type/model;		
	(g) Meter number;		
	(h) Barcode comprising of meter serial no without blank spaces;		
	(i) Standard(s) to which the meter complies;		
	(j) Year of manufacture.		
4.5.3	The following drawings and information shall be required with the tender:		
	(a) Meter drawing giving all the relevant dimensions;		
	(b) Wiring diagrams;		
	(c) Description leaflet of the meter being offered;		
	(d) Users and operational manuals.		
4.5.4	A sample of the meter offered shall be submitted together with test tokens for; different Power Limit Settings and resets for the same, Credit and Clear Credit Tokens to aid in the testing of the meters. The manufacturer might be required to provide more tokens at no extra cost.		



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16

Page 27 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
4.5.5	Copies of type approval certificate (s) with test and calibration results of the meter being offered obtained from an international or the national meter certification body shall be provided. If type approval certificate (s) is (are) from accredited meter certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation, under ISO/IEC 17025 from the national or an international certification body.		
4.5.6	The bidder shall complete clearly, all the clauses in both columns of the Schedule in Appendix B. This shall form the basis of evaluation of the submitted tender. Failure to complete this Appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.		
4.5.7	The bidder shall provide a quality assurance plan		
4.5.8	The manufacturer shall provide proof of conformance to ISO 9001(2008) standards by attaching valid copy certificates.		
4.5.9	The manufacturer shall provide a list and contact details of at least four previous utilities to which the meter being offered has been supplied.		
4.5.10	The manufacturer should have supplied a minimum of 250,000 pieces of the meter type offered to similar utilities in the past two years.		
4.5.11	Copies of DLMS/COSEM certificates shall be submitted with this tender		
4.5.12	The manufacturer shall produce meters that fully meet the requirements of the IEC standard, IEC 62055-51:2007 - Electricity metering - Payment systems Part 51: Standard transfer specifications and hence :		
5	INFORMATION AND WARRANTY (IN CASE OF TENDER AWARD)		
5.1	Drawings and technical details shall be submitted to KPLC for approval before manufacture of the meters commences. KPLC undertakes to submit their comments or approval for the drawings within three weeks of receiving the draft copies.		



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

Doc. No.	KP1/10A.2B/3/3/01
ISSUE NO.	2
REVISION NO.	4
Date of Issue	2016-06-16
Page 28 of 29	

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
5.2	The meter shall have a warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of eighteen months from the date of delivery. All defective meters shall be replaced at the supplier's cost.		
5.3	KPLC shall meet the full costs of two engineers, for meter inspection and acceptance testing at the manufacturer's facility.		
5.4	Samples		
5.4.1	The tenderer shall submit one MCU and two (2) UIU samples together with the tender documents. The submitted meter samples shall be subjected to accuracy tests at KPLC's Meter Central Laboratory to verify the requirements of IEC 62053-21:2003 Clause 8.1 and to verify responsiveness to other requirements of this specification. Samples shall not be returned to the tenderers.		
5.4.2	Bidders may communicate directly with the Kenya Bureau of Standards on this matter through the following address: The Managing Director Kenya Bureau of Standards, P.O. Box 54974, 00200, Nairobi, Kenya. Tel: (+254 020) 605490, 602350 Fax: (+254 020) 604031 Email: info@kebs.org Web:http://www.kebs.org		
5.5	The meters shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.		
5.6	The meters shall be packed in suitable groups and / or batches with consecutive serial numbers. Packaging shall be done only after KPLC approval		
5.7	The meters shall be packaged in multiples of ten unless where the number of meters in a group/batch does not make a multiple of ten.		
5.8	The number of meters packaged in a group and/or batch for handling/lifting/carrying by an operator manually shall be such that their weight does not exceed 15 kg.		
5.9	The supplier shall indicate the delivery time versus quantities of each type of meter and his production capacity.		

11



**SINGLE-PHASE SPLIT
PREPAYMENT DIN RAIL
MOUNTING STATIC WATT -
HOUR METERS FOR
ACTIVE ENERGY**

**Using PLC as medium of
communication between MCU
and UIU**

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Page 29 of 29

CLAUSE	KPLC REQUIREMENT	MANUFACTURER'S COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
5.10	Where test and / or calibration certificates/ reports are issued by a laboratory other than the International / National Standards and Testing Authority, a copy of accreditation certificate, under ISO/IEC 17025 from the International/ National meter certification body shall be attached together with the tender documents.		
5.11	The manufacturer shall provide current e-mail addresses, fax and telephone numbers of the national / international testing / calibration laboratories and meter certification bodies. The test certificates shall bear the product serial number of meter on offer.		

Manufacturer's Declaration: I on behalf of declare that the above specifications matrix conforms to a typical tender meter, type being offered for this tender.

Signature & Stamp