a world class African city

		REFERENCE	REV
TITLE:	SPECIFICATION FOR PHASOR MEASUREMENT UNITS DATA LOGGERS	CP_TSSPEC_422	0
		DATE: JULY 2025	
		PAGE: 1 OF 30	

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FOREWORD

This specification was prepared by the following Work Group members:

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The Work Group was appointed by Study Committee, which, at the time of approval, comprised of the following members:

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2016

INTRODUCTION

As part of City Power's ongoing commitment to enhancing grid reliability, operational efficiency, and real-time monitoring capabilities, the deployment of Phasor Measurement Units (PMUs) has become a strategic priority. PMUs are critical components in modern power systems, providing high-resolution, time-synchronized measurements of electrical quantities such as voltage, current, frequency, and phase angle.

This specification document outlines the technical and functional requirements for PMU data loggers to be integrated within City Power's transmission and distribution network. The data loggers will serve as essential tools for capturing, storing, and transmitting synchrophasor data, enabling advanced analytics, fault detection, and system stability assessments.

The specifications herein are designed to ensure compatibility with existing infrastructure, adherence to industry standards (such as IEEE C37.118), and support for future scalability. This document serves as a guideline for vendors, engineers, and stakeholders involved in the procurement, installation, and maintenance of PMU data logging systems.

1. SCOPE

The document covers the technical and operational requirements for the PMU data loggers used within City Power's substation for grid monitoring, stability analysis, and compliance.

This specification must be read in conjunction with CP_TSSPEC_003, Specification for quality of supply statistics and check metering instruments with billing capabilities.

2. NORMATIVE AND INFORMATIVE REFERENCES

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

2.1. CP_TSSPEC_003: Specification for Quality of supply statistics and check metering instrument with billing capabilities

2.2. IEEE C37.118.2: Standard for synchrophasor data transfer for power systems

2.3. IEEE C37.118.1: Standard for synchrophasor measurements for power systems

2.4. IEC 60255-118-1: Measuring relays and protection equipment – part 118-1: Synchrophasor for power systems – Measurements.

2.5. IEEE 1588: Standard for a precision clock synchronization protocol for networked measurement and control systems

2.6. IEC 61850-90-5: Communication networks and systems for power utility automation according to IEEE C37.118.

2.7. NIST special publication 1500-101, The smart grid: An introduction

2.8. SANS 61000(all parts): Electromagnetic Compatibility (EMC)

3. DEFINITIONS AND ABBREVIATIONS

The definitions and abbreviations in relevant standards mentioned above shall apply to this specification.

4. REQUIREMENTS

4.1 General

4.1.1. The phasor measurement units data loggers shall be lightweight, field deployable, portable for temporary grid monitoring, fault analysis, system diagnostics at intake substation or distribution substation.

4.1.2 The phasor measurement unit data loggers shall automatically capture and log voltage, current, power, harmonics, and associated power quality values.

4.1.3 The phasor measurement unit data loggers shall capture dips, swells, and inrush currents with event waveform snapshots and high-resolution RMS profiles.

4.1.4 The phasor measurement unit data loggers shall view data locally on the instruments, via mobile app and desktop software or through WIFI infrastructure.

4.1.5 The phasor measurement unit data loggers shall have a minimum of 4 flexible current probes to measure all three phases and neutral.

4.1.6 The phasor measurement unit shall have a bright colour touch screen for in-field analysis and data checks.

4.1.7 Communication and data streaming shall be interface with phasor data concentrator and support remote configuration and firmware.

4.1.8 The phasor measurement unit shall have user role (admin, operator and viewer) security and access control.

4.1.9 The phasor measurement unit shall have a password protection and two-factor authentication.

4.1.10 The PMU data logger shall have 2 wired connection auxillary inputs, with input range of 0 V dc to +-10 V dc

4.1.11 The PMU data logger shall 2 input wireless connection that requires WIFI

4.1.12 The phasor measurement unit software shall be fully integrate with other device already installed at City Power both locally and remotely.

4.1.13 Type test and Routine test shall compliance with SANS 61000.

4.2 Functional Requirements

The phasor measurement unit shall be able to measure parameters such as:

4.2.1 Voltage and current phasors

4.2.2 Frequency and ROCOF

4.2.3 Phase angle difference

4.3 Sampling rate

The phase measurement unit data logger shall have a minimum sampling rate of 30 samples/sec (50 HZ) and 60 -120 samples/sec for dynamic grid events.

4.4 Time synchronization

4.4.1 PMU data logger shall have a time synchronization accuracy of 1µs.

4.4.2 PMU data logger shall use IRIG-B for precise time synchronization

4.5 Data logging and storage

4.5.1 The PMU data logger shall use the IEEE C37.118.2 format, comtrade, CSV for data logging and storage of data.

4.5.2 PMU data logger shall have a retention capacity of:

4.5.2.1 local: minimum of 30 days.

4.5.2.2 central archive: minimum of 1 year

4.5.3 The PMU data logger shall have SSD or industrial – grade flash media storage media.

4.5.4 The PMU data logger shall have CRC check, encryption data integrity.

4.6 Communication interfaces

4.6.1 Communication protocols shall be in compliance with IEEE C37.118.2, IEC 61850 and DNP3.

4.6.2 Physical interface shall be Ethernet, (RJ45 to USB), RS-232/RS-485, RJ45 to HDMI.

4.6.3 PMU data loggers shall have protection features for cybersecurity, role-based access control, TLS/SSL encryption and audit logging.

4.6.4 The phasor measurement unit data logger shall an IP address and port configuration.

4.6.5 The PMU shall have a wireless radio with adapter, with the following parameters

- Frequency range 2412 MHz to 2462 MHz
- Output power < 100mW

4.7 Environmental and mechanical requirements

4.7.1 The design and construction of the phasor measurement unit data logger shall be suitable for the following conditions:

Operating temperature	-20 ºC to 70ºC
Humidity	5% to 95%, non-condensing
Altitude above sea level	1800 m
Atmospheric pressure	80 kPa to 106 kPa
Lighting	Severe
Dust	Severe

4.7.2 The phasor measurement unit data logger shall the following mechanical characteristics:

Ingress protection rating	IEC 60529;IP65
Mounting	DIN rail or 19-inch rack

4.8 USER INTERFACE AND CONFIGURATION

4.8.1 Local interface:

4.8.1.1 The phasor measurement unit data logger shall have a LCD or touchscreen (minimum of 4.5 inch for portable units)

4.8.1.2 The display screen shall indicate the following indicators:

- Power status
- GPS lock
- Data logging activity
- Communication status

4.8.1.3 The phasor measurement unit shall navigate the following at local interface:

- Menu-driven interface
- Soft keys or touch controls

4.8.1.4 The following basic function shall be available at local interface:

- Start/Stop logging
- View real-time phasor data
- System diagnostics

4.8.2 Remote interface

4.8.2.1 Communication link for the PMU shall be:

4.8.2.1.1 Wired (Ethernet, Serial)

4.8.2.1.2 Wireless (Wi-Fi, Cellular, satellite)

4.8.2.2 PMU protocols shall comply with standard formats TCP/IP, MODBUS, DNP3 and IEEE C37.118.

4.8.2.3 The PMU shall be able to retrieve real time and historical data remotely.

4.8.2.4 The PMU shall be able to configure settings remotely and also apply diagnostic functions.

4.8.3 Mobile App

4.8.3.1 The phase measurement unit data logger shall have a mobile app with:

4.8.3.1.1 Bluetooth or Wi-Fi connectivity,

4.8.3.1.2 Quick setup and diagnostics,

4.8.3.1.3 GPS or location logging

4.8.9 Configuration options

4.8.9.1 The phasor measurement unit data logger shall be able to map voltage and current inputs.

4.8.9.2 The phasor measurement unit shall be able to configure CT/VT ratios settings.

4.9 Electrical Requirement

4.9.1 The PMU shall meet the following requirement:

4.9.1.1 Power supply shall meet the following parameters

Voltage range	220V to 550 V
Mains power	100 V to 240 V, compliance with IEC 60320 input
Power consumption	Max 50 VA (max. 15 VA when powered using IEC 60320 input)
Standby power	<0.3
Efficiency	≥70%
Mains frequency	50 HZ
Battery power	Li-ion 3.7V, 9.25 Wh, replaceable

On-battery runtime	5 hours
Charging time	<6 hours

1.9.2 Voltage inputs for the PMU data logger

Number of inputs	4 (3 phase and neutral)
Maximum input voltage	1000 Vrms/1700 Vpeak (phase to neutral)
Input impedence	>1 MΩ
Bandwidth	42 Hz to 3 kHz
Scaling	1:1 variable

1.9.3 Current inputs for the PMU data logger

Number of inputs	4, mode selected automatically attached sensor
Current sensor output voltage Clamp	500 mVrms/ 50 mVrms
Current sensor output voltage Rogowski Coil	150 mVrms/15 mVrms at 50 Hz
Range	Supplier will specify
Bandwidth	42 Hz to 3 kHz
Scaling	1;1, variable

5. TRAINING

5.1 The suppliers shall provide comprehensive training courses on the configuration, installation, operation and maintenance of the phasor measurement unit data logger.

5.2 The suppliers shall provide technical support on operations and equipment queries for

the duration of the contract

5.3 User, Functional & System Support Training

5.3.1 Technical system support training for City Power employees

5.3.2 Training on operations/monitoring/control for the managers/supervisors/data stewards/engineers

5.3.3 The service provider shall provide a copy of the training materials and user documentation to the City Power in an electronic readable and printable format.

6. QUALITY MANAGEMENT

A quality management system shall be set up in order to assure the quality during manufacture, installation, removal, transportation and disposal of phasor measurement unit data loggers. Guidance on the requirements for a quality management system may be found in the following standards: ISO 9001:2015. The details shall be subject to agreement between the purchaser and supplier.

7. HEALTH AND SAFETY

A health and safety plan shall be set up in order to ensure proper management and compliance during manufacture, installation, removal, transportation and disposal of phasor measurement unit data loggers. Guidance on the requirements of a health and safety plan shall be found in ISO 45001:2018 standards. The details shall be subject to the agreement between City Power and the Supplier.

8. ENVIRONMENTAL MANAGEMENT

An environmental management plan shall be set up in order to ensure the proper environmental management and compliance is adhered to during manufacture, installation, removal, transportation and disposal of phasor measurement data loggers. Guidance on the requirements for an environmental management system shall be found in ISO 14001:2015 standards. The details shall be subject to agreement between City Power and the Supplier. This is to ensure that the asset created conforms to environmental standards and City Power SHERQ Policy.

ANNEXURE A - Technical schedules A and B

Item No.1 – Portable PMU data loggers-Sap No.5124

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
1		Manufacturer Country Supplier	XXX XXX XXX	
2	4.1.1	Lightweight, field deployable, portable	Required	
3	4.1.2	Automatic capture and log voltage, current, harmonics and associated power quality	Required	
4	4.1.4	View data locally, on instruments, mobile app, desktop software and through Wi-Fi	Required	
5	4.1.5	Four (4) flexible current probes	Required	
6		Four (4) Voltage probes	Required	
7	4.1.12	Fully integrate with other City Power QoS instruments and Software	Required	
8	4.1.8	User role security and access control	Required	
9	4.1.9	Password protection and two (2) factor authentication	Required	
10	4.1.10	2 wired connection auxiliary inputs	Required	
11	4.1.10	Auxiliary inputs range	0V dc to +- 10 V dc	
12	**4.2**	**Functional requirements**		
13	4.3	Sampling rate at 50 HZ	Required	
14	4.3	Minimum sample rate	30/sec	
15	4.3	Dynamic grid events	60 -120/sec	
16	**4.4**	**Time synchronization**		
17	4.4.1	Time synchronization accuracy	1µ	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.
Note: Please note that the tenderer shall provide proof of compliance to the requirements.

Tender Number: _____

Tenderer's Authorized Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

ANNEXURE A - Technical schedules A and B
Item No.1 – Portable PMU Sap No.5124
Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
18	4.4.2	Precise time synchronization	IRIG or GPS	
19	**4.5**	**Data logging and storage**		
20	4.5.1	Compliance with IEEE C37.118.2 format, Comtrade, CSV for data logging and storage of data	Required	
21	4.5.2	Retention capacity (local: 30 days and central archive: 1 year)	Require	
22	4.5.4	CRC check, encryption data integration	Required	
23	4.5.3	SSD or industrial grade flash media storage	120 GB	
24	**4.6**	**Communication interfaces**		
25	4.6.1	Communication protocols comply with requirements of IEEE C37.118.2, IEC 61850, DPN 3	Required	
26	4.6.2	Physical interface	Required	
27	4.6.3	Cybersecurity, role-based access control, TLS/SSL encryption and audit logging	Required	
28	4.6.4	IP address and port configuration	Required	
29	4.6.5	Wireless radio with adapter		
30	4.6.5	Frequency range	2412 MHz - 2462 MHz	
31	4.6.5	Output power	< 100mW	
32	**4.7**	**Environmental and Mechanical requirements**		
33		Operating temperature minimum	-20ºC	
		Operating temperature maximum	70ºC	
34		Humidity (non-condensing)	5% to 95%	
35		Altitude	1800 m	
36		Atmospheric pressure minimum	80 kPa	
37		Atmospheric pressure maximum	106 kPa	
38		Lighting	Severe	
39		Dust	Severe	
40	4.7.2	Ingress Protection	IP 65	

41	4.7.2	Mounting	Required	

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

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ANNEXURE A - Technical schedules A and B
Item No.1 – Portable PMU-Sap No.5124
Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
42	**4.8**	**User interface and configuration**		
43	4.8.1.1	LCD touch screen	Required	
44	4.8.1.1	Size of the screen	4.5 inch (min)	
45	4.8.1.2	Display screen indication	Required	
46	4.8.2	Remote interface,	Required	
47	4.8.3	Mobile app	Required	
48	**4.9**	**Electric requirement**		
49	4.9.1	Power system requirement		
50		Voltage range	220V – 550V	
51		Main power, compliance with IEC 60320	100V-240V	
52		Power consumption, compliance with IEC 60320	Max 50 VA	
53		Standby power	< 0.3	
54		Efficiency	≥ 70%	
55		Mains frequency	50 Hz	
56		Battery power (replaceable)	Li-ion 3.7V, 9.25 Wh	
57		On-battery runtime	5 hours	
58		Charging time	< 6 hours	

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ANNEXURE A - Technical schedules A and B
Item No.1 – Portable PMU-Sap No.5124
Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
59	**4.9.2**	**Voltage inputs**		
60		Number of inputs	4	
61		Maximum input voltage	Required	
62		Input impedance	>1MΩ	
63		Bandwidth	Required	
64		Scaling	Required	
65	**4.9.3**	**Current inputs**		
66		Number of inputs	Required	
67		Current sensor output voltage clamp	Required	
68		Current sensor output voltage Rogowski coil	Required	
69		Range	Specify	
70		Bandwidth	42 Hz – 3 Hz	
71		Scaling	1;1, variable	
72		**Marking and packaging**		
73		Marking and labelling for PMU data logger	Required	
74		**Documentation**		
75		Documentation for PMU data logger		
76		Support service for the PMU data logger, monitoring system		
77		**Monitoring**		
78		Compatible with City Power SCADA requirements	Required	
79		compatible with City Power IOT requirements	Required	
80				
81	4.1.12	The PMU software shall be fully integrate with other PQ device already installed at City Power	Required	

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ANNEXURE A - Technical schedules A and B
Item No.1 – Portable PMU-Sap No.5124

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered
Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Item No.1 – Portable PMU-Sap No.5124

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub-clause of CP_TSSPEC_422**	**Proposed deviation**

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

ANNEXURE B - Technical schedules A and B

Item No.2 – Wired PMU data loggers-Sap No.5127

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
1		Manufacturer	XXX	
		Country	XXX	
		Supplier	XXX	
2	4.1.1	Lightweight, field deployable, portable	Required	
3	4.1.2	Automatic capture and log voltage, current, harmonics and associated power quality	Required	
4	4.1.4	View data locally, on instruments, mobile app, desktop software and through Wi-Fi	Required	
5	4.1.5	Four (4) flexible current probes	Required	
6		Four (4) Voltage probes	Required	
7	4.1.12	Fully integrate with other City Power QoS instruments and Software	Required	
8	4.1.8	User role security and access control	Required	
9	4.1.9	Password protection and two (2) factor authentication	Required	
10	4.1.10	2 wired connection auxiliary inputs	Required	
11	4.1.10	Auxiliary inputs range	0V dc to +- 10 V dc	
12	**4.2**	**Functional requirements**		
13	4.3	Sampling rate at 50 HZ	Required	
14	4.3	Minimum sample rate	30/sec	
15	4.3	Dynamic grid events	60 -120/sec	
16	**4.4**	**Time synchronization**		
17	4.4.1	Time synchronization accuracy	1µ	

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ANNEXURE B - Technical schedules A and B
Item No.2 – Portable PMU Sap No.5127
Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
18	4.4.2	Precise time synchronization	IRIG or GPS	
19	**4.5**	**Data logging and storage**		
20	4.5.1	Compliance with IEEE C37.118.2 format, Comtrade, CSV for data logging and storage of data	Required	
21	4.5.2	Retention capacity (local: 30 days and central archive: 1 year)	Require	
22	4.5.4	CRC check, encryption data integration	Required	
23	4.5.3	SSD or industrial grade flash media storage	120 GB	
24	**4.6**	**Communication interfaces**		
25	4.6.1	Communication protocols comply with requirements of IEEE C37.118.2, IEC 61850, DPN 3	Required	
26	4.6.2	Physical interface	Required	
27	4.6.3	Cybersecurity, role-based access control, TLS/SSL encryption and audit logging	Required	
28	4.6.4	IP address and port configuration	Required	
29	4.6.5	Wireless radio with adapter		
30	4.6.5	Frequency range	2412 MHz - 2462 MHz	
31	4.6.5	Output power	< 100mW	
32	**4.7**	**Environmental and Mechanical requirements**		
33		Operating temperature minimum	-20ºC	
		Operating temperature maximum	70ºC	
34		Humidity (non-condensing)	5% to 95%	
35		Altitude	1800 m	
36		Atmospheric pressure minimum	80 kPa	
37		Atmospheric pressure maximum	106 kPa	
38		Lighting	Severe	
39		Dust	Severe	
40	4.7.2	Ingress Protection	IP 65	

41	4.7.2	Mounting	Required	

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ANNEXURE B - Technical schedules A and B
Item No.2 – Wired PMU-Sap No.5127
Schedule A: Purchaser's specific requirements
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Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
42	**4.8**	**User interface and configuration**		
43	4.8.1.1	LCD touch screen	Required	
44	4.8.1.1	Size of the screen	4.5 inch (min)	
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47	4.8.3	Mobile app	Required	
48	**4.9**	**Electric requirement**		
49	4.9.1	Power system requirement		
50		Voltage range	220V – 550V	
51		Main power, compliance with IEC 60320	100V-240V	
52		Power consumption, compliance with IEC 60320	Max 50 VA	
53		Standby power	< 0.3	
54		Efficiency	≥ 70%	
55		Mains frequency	50 Hz	
56		Battery power (replaceable)	Li-ion 3.7V, 9.25 Wh	
57		On-battery runtime	5 hours	
58		Charging time	< 6 hours	

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ANNEXURE B - Technical schedules A and B
Item No.2 – Wired PMU-Sap No.5127
Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub-clause of CP_TSSPEC_422	Description	Schedule A	Schedule B
59	**4.9.2**	**Voltage inputs**		
60		Number of inputs	4	
61		Maximum input voltage	Required	
62		Input impedance	>1MΩ	
63		Bandwidth	Required	
64		Scaling	Required	
65	**4.9.3**	**Current inputs**		
66		Number of inputs	Required	
67		Current sensor output voltage clamp	Required	
68		Current sensor output voltage Rogowski coil	Required	
69		Range	Specify	
70		Bandwidth	42 Hz – 3 Hz	
71		Scaling	1;1, variable	
72		**Marking and packaging**		
73		Marking and labelling for PMU data logger	Required	
74		**Documentation**		
75		Documentation for PMU data logger		
76		Support service for the PMU data logger, monitoring system		
77		**Monitoring**		
78		Compatible with City Power SCADA requirements	Required	
79		compatible with City Power IOT requirements	Required	
80				
81	4.1.12	The PMU software shall be fully integrate with other PQ device already installed at City Power	Required	

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ANNEXURE B - Technical schedules A and B
Item No.2 – Wired PMU-Sap No.5127

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Note: Ticks [√, X], Asterisk [*], Word [Noted] or TBA ["to be advice"] will not be accepted.

Item No.1 – Wired PMU-Sap No.5124

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub-clause of CP_TSSPEC_422**	**Proposed deviation**

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

ANNEXURE C – Bibliography

NONE

ANNEXURE D – REVISION INFORMATION

DATE	REV. NO.	NOTES
JULY 2025	0	First issue

ANNEXURE E – STOCK ITEMS
Material Group: PMU DATA LOGGER

Item	SAP No.	SAP Short Description	SAP Long Description
1	5124	PMU PORTABLE DATA LOGGER	PORTABLE PMU DATA LOGGER. 3 PHASE PMU FOR SUBSTATION AND DISTRIBUTION NETWORK. ITEM SPECIFICATION NO. CP_TSSPEC_422.
2	5127	PMU WIRED DATA LOGGER	WIRED PMU DATA LOGGER. 3 PHASE PMU FOR SUBSTATION AND DISTRIBUTION NETWORK. ITEM SPECIFICATION NO. CP_TSSPEC_422. ITEM SPECIFICATION NO. CP_TSSPEC_422.