Miro-F Class A Transformer Monitor and Logger

The *Miro-F* Class A power quality recorder is a precision instrument designed specifically for transformer monitoring. It offers comprehensive and reliable LV side transformer monitoring and includes measurements of three phase voltages, four currents (three phases and neutral) and two temperatures. It is equipped with integrated remote cellular communications (3G/4G) and is therefore ideal for network asset management.

Large scale network monitoring solutions utilising multiple Miro-F instruments can be implemented (as shown in figure 2); providing network engineers with information for planning, operations, maintenance and network modelling. Features include calculation of transformer loss of life. Transformer life is affected by the transformer's operating temperatures, which are largely determined by loading trends, harmonics and ambient temperature. This feature can be used to maximise the useful life of transformers.

Automatic FTP uploads: Full PQ data including event captures pushed periodically to FTP server, to be viewed by proprietary Citrus software or converted to PQDIF format for use with third party analysis tools.
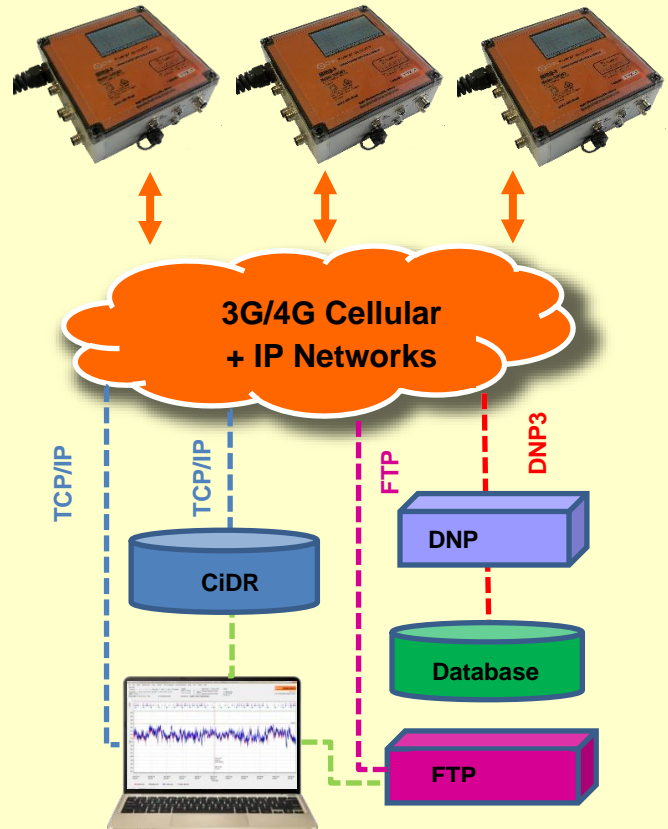

Figure 2: Miro-F - Scalable asset management systems. Remote connections to the Miro-F can be manual or automatic

Figure 1: Miro-F - Three phase transformer monitor and logger; Dimensions: (180 x 180 x 60) mm

The Miro-F (Figure 1) incorporates fixed voltage leads and removable current sensors. The current sensors (clamp on CTs or Rogowski coils) can be customised to match the transformer load. The Miro-F incorporates a back-plate and four magnetic feet for quick and easy installation on to the transformer. The weatherproof design (IP66) enables installation on pole-top transformers.

Scalable asset management systems
Automatic DNP3: Data points polled periodically by a DNP master, stored in third party database, viewed by third party viewer for interrogation and analysis.

CiDR (Citrus Data Retrieval): CiDR is a service for automatically collecting data from the Miro loggers. It allows users to schedule downloads of Miro files; Upgrade firmware; Synchronise the time; and automatically convert Miro data files into PQDIF format.

Manual TCP/IP: Connect using CITRUS TCP/IP connection, inserting a static IP address which provides a transparent connection and allows configuration, download of logged data and firmware updates.

The above systems can be deployed anywhere within cellular coverage and can support multiple Miro-F instruments. Secure communication can be established using SSH (Secure Shell) for TCP/IP and

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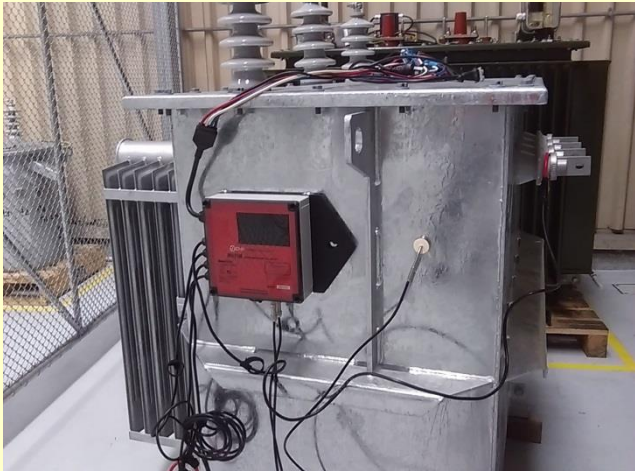FTPES (File Transfer Protocol Explicit Security) for FTP.

Figure 3: Miro-F - Installed on a distribution transformer

Key hardware features

- Certified to IEC61000-4-30, Class A
- Weatherproof enclosure – IP66
- AC voltage and current measurements.
- Surface and ambient temperature probes
- Expansion port (optional) allows for system expansion to include additional sensors, input/output controls and custom interfaces which broaden the Miro-F system platform. Example interfaces include DGA, Hydrogen and Bushing monitors.
- Powered from Phase A to Neutral of circuit being monitored, or external 12VDC supply.
- Starts logging on power up.
- Adjustable log interval.
- Gapless logging: User can download data, clear log memory and configure the device with no interruption to logging.
- Internal backup battery: 5-minute back up time as standard, with option to extend upon request.
- Optional GPS and external antenna.
- Cellular communications options (3G/4G) are integrated within the enclosure - no additional peripherals required other than an external antenna.
- Integrated WiFi for Android and iOS mobile applications
- Logged memory: 8GB
- Graphical colour display
  - Voltage and current waveforms
  - Phasor diagrams
  - Measurements
  - Status information
  - User defined screen

Key software (CITRUS) features

- The CITRUS platform is powerful, easy to use and intuitive application software that supports all CHKPQ products. It provides tools for: device management; data analysis; and reporting.
- Configurations
  - Pre-defined configurations for easy setup.
  - Create and store different configuration files for quick retrieval.
- Online monitor to view 'live' measurements.
- View multiple log file data on the same graph to compare PQ measurements with GPS synced time stamps.
- Event type filter to view only desired events.
- Analysis and Compliance reporting
  - Energy; Daily Min/Max; ITI (CBEMA) curve.
  - 24-hour scatter plot (Figure 4).
  - Voltage and Current histogram (Figure 5).
  - Transformer Loss of Life scenario calculations
  - Harmonic derating factor (i.e., K-Factor, Factor-K and Harmonic Loss Factor) scenario calculations
- Customised reports (available upon request).
- Views
  - Ability to edit an active view: Text and arrow annotation and title options available.
  - Generate a PDF, CSV file, or table.
  - Save and Print view.
  - Split or combine voltage and current graphs.
  - Multiple measurements on a single graph.
  - Horizontal and vertical cursors for accurate measurements.
  - Horizontal and vertical axes zooming functions.
- PQDIF export - 'PQView' compatible.
- Automatic FTP uploads
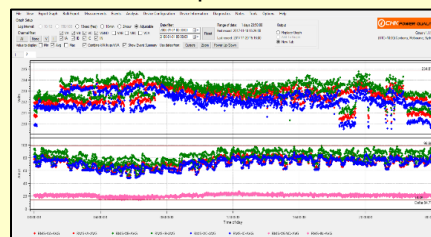
Figure 4 - 24-hour scatter diagram

Figure 5 - Voltage histogram with cumulative frequency

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Hardware specifications

PARAMETER	DESCRIPTION
Power quality parameters	
Class A declared/nominal input	230V 50Hz/60Hz
Power frequency	IEC61000-4-30 (section 5.1).
Magnitude of the supply voltage	IEC61000-4-30 (section 5.2).
Supply voltage dips and swells	IEC61000-4-30 (section 5.4).
Voltage interruptions	IEC61000-4-30 (section 5.5).
Supply voltage unbalance	IEC61000-4-30 (section 5.7).
Voltage harmonics	IEC61000-4-30 (section 5.8).
Measurement	
A to D Conversion	16 bits.
Samples per cycle	384 @ 50 Hz; 320 @ 60 Hz.
Sampling Rate	Nominal: 19.2kHz synchronised to mains.
Anti-aliasing	High-frequency components attenuated by at least 50dB so as not to interfere with harmonic measurements.
Measurement metrics	
Frequency	Range: 50Hz nominal (42.5-57.5) Hz, 60Hz nominal (51.0-69.0) Hz; Full range: (40-70) Hz. Measurement: 10s; Accuracy: ±5mHz referenced to RTC, ±1mHz referenced to GPS (optional)
Magnitude of the supply voltage (true RMS)	Measurement: 10/12 cycle rms. Range: 10% to 150% of nominal value with accuracy of ±0.1% of nominal value under conditions specified in IEC61000-4-30 section 6.1.
Dips and swells	Measurement: 1-cycle rms updated every half cycle. Accuracy: ±0.2% of nominal value, ±1 cycle. Range (magnitude) 0 to 200%. Range (duration) minimum 0.5 cycles by definition. No upper limit.
Voltage interruptions	Measurement: 1-cycle rms updated every half cycle. Accuracy: ±1 cycle. Range (duration) minimum 0.5 cycles by definition. No upper limit.
Voltage and current unbalance	Applicable 3 phase systems and evaluated using the method of symmetrical components. Metrics: u_2 = (U2/U1) and U_0 = (U0/U1). U0, U1 and U2 are sequence components. Range: 0.5% to 5% of U_2 and U_0. Accuracy: ±0.15%.
Power meter	Power-kW, Power-kVA, Power-kVAR, True Power Factor (TPF), Displacement Power Factor (DPF).
Voltage harmonics	IEC61000-4-7, Class I (up to 50th harmonic). Range: 10% to 200% of Class 3 electromagnetic environment in IEC 61000-2-4. Metrics: voltage and current magnitude and angle
Total harmonic distortion (THD)	IEC61000-4-7, THDS (up to 40th harmonic)
Crest factor	Indicates peak-to-rms ratio of waveform. ±1%.
Temperature	Two temperature channels measured each second, recording at the adjustable interval. Measurement: -50°C to +150°C. Accuracy: ±1°C.
Harmonic Derating Factors	Metrics: UL1561/UL1562 K-Factor, EN50464-3 Factor-K and Factor-K derating, IEEE C57.110 Harmonic Loss Factor (F_{HL} and F_{HL-STR}) and F_{HL} derating
Transformer Loss of Life	Supports IEC 60076-7 and IEEE C57.91 version. Metrics: Absolute loss of life, Percentage loss of life, Hotspot temperature, Ageing rate, Top oil temperature and Ambient temperature

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	Hotspot temperature, Top oil temperature (calculated or measured). Supports transformers with thermally upgraded or non-thermally upgraded insulation paper. Supported transformer cooling types: ONAN, ONAF, OF, OD.
Communications	
Wired data (standard)	USB 2.0.
Wireless (options)	Cellular remote communications and WiFi integrated within the instrument.
Logging	
Logged data memory	8GB.
Logging intervals	One adjustable interval from 1s to 3600s.
Measurements	All measurements simultaneously.
General	
Circuit connections	Three phase Wye, single phase & optional three phase delta.
Data file	PQA format binary with CSV export.
Data display	Real time measurements of basic parameters via LCD, all parameters via Online Monitor.
Software tools	CITRUS.
Inputs	
Voltage channels (AC/DC)	Common Neutral.
Voltage range	600VACrms (850Vpk), any phase to neutral.
Voltage surge protection (differential)	4kV Fast transients, 6kV 1.2/50us impulse – no effect. Recalibration may be required after impulses significantly exceeding 6kV.
Current channels (AC)	4
Current range	Dependent upon current sensor.
Temperature channels	2 x PT100 RTD Class B, M8 connectors.
Expansion Module Port	UART / SPI interface for future system upgrade. Allows for additional sensors (e.g. current, voltage, temperature, DGA), analogue I/O (e.g. 4-20mA/0-5V/0-10V), digital I/O and relays.
Instrument type	IEC61000-4-30, Class A.
Current Sensors	Flexible current probes or clamp-on current probes with automatic detection.
Accuracy	
Reference conditions	22ºC.
Current (instrument)	±0.2% of full scale. System accuracy depends on sensor.
Voltage	±0.1% of nominal value as specified above.
Voltage temperature coefficient	Approx. 25ppm/C
Environment and safety	
Use	Indoor and outdoor.
Altitude	Up to 2000m.
Operating Temperature	-20°C to +60°C.
Relative Humidity	20% to 99% Relative Humidity.
Degree of Protection	IP66 (all weather housing).
Certifications / type testing	
EMC	EN55022:1998 _A1:2000 +A2:2003 CLASS A.
Salt Spray (Corrosion)	MIL STD 810 G.
Outdoor weathering (UV)	IEEE 495:2007 or equivalent.
Random Vibration	MIL STD 810 G.
Impact Test	IEEE 495:2007 or equivalent.
Safety Category	IEC 61010-1, Pollution degree 3; CAT III 600V
Power	
Power supply	External 12VDC power supply; 15VA typical or

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	Powered from Phase A of circuit being monitored (except TxM304), range: (60-600) VACrms; 15VA typical.
USB powered (Mini USB)	Configuration and download.
Backup power	Rechargeable battery - LiFePO$_4$.
Backup battery duration	5 minutes. Longer duration available on request.
Timing	
Real time clock (RTC) battery	Non-rechargeable Lithium backup battery. Functional life: > 10 years.
RTC	Typical ±3ppm from -15 to 60C. Drift <1 second per week.
GPS (Optional)	Time accuracy: <1ms. External antenna required.
Mechanical	
Display	Colour graphic LCD (4.3" 480x272 Graphic TFT LCD); Dimensions: (97 x 56) mm.
Enclosure dimensions	(180 x 180 x 60) mm.
Weight	1.05kg (instrument only).
Case material and colour	Polycarbonate, moulded in light grey.

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