



DIG SILENT

Monitoring Systems

PFM300 & PFM300-GCC

INTEGRATED, MULTIFUNCTIONAL DATA ACQUISITION SYSTEM /
 FAULT RECORDER / DYNAMIC SYSTEM MONITOR / PHASOR MEASUREMENT UNITS /
 POWER QUALITY / POWER PLANT MONITOR / GRID CODE COMPLIANCE MONITORING

Monitoring Systems

The DlgSILENT Monitoring Systems are integrated, multi-functional data acquisition systems which cover recording, monitoring and analysis of signals in all relevant timeframes. Flexible hardware and software components allow for the configuration of portable, standalone, multiple distributed and linked installations.

Our Power System Monitoring PFM300 product line features grid and plant supervision, fault recording, power quality and grid characteristics analysis.

The Grid Code Compliance Monitoring PFM300-GCC product is an extended version of the Power System Monitoring PFM300. It has additional features for continuous compliance auditing of power plants with respect to grid code requirements.



PRODUCT APPLICATION

New

PFM300

PFM300-GCC

	PFM300	PFM300-GCC
 Multifunctional Fault and Event Recorder	✓	✓
 Dynamic System & Network Performance Monitor (DSM)	✓	✓
 Power Plant Monitor	✓	✓
 Phasor Measurement Unit (PMU)	✓	✓
 Power Quality Monitor	✓	✓
 Grid Code Compliance (GCC)		+

Power System Monitoring PFM300

The Power System Monitoring PFM300 is a multifunctional Dynamic System Monitor which fully integrates with DlgSILENT PowerFactory software. PFM300 features grid and plant monitoring, fault recording, power quality and grid characteristics analysis.

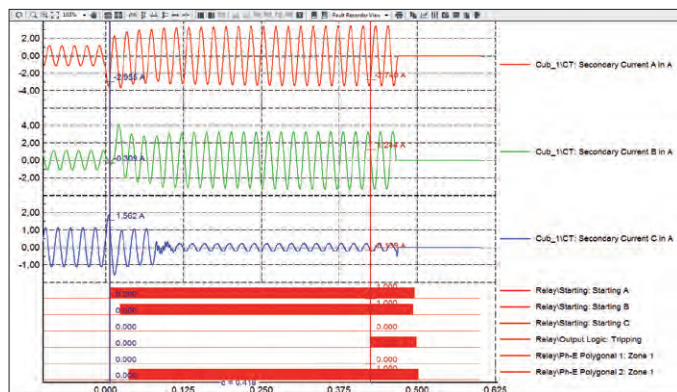
It provides easy access to recorded data and test results and allows the analysis of trends and the verification of system disturbance responses. PFM300 supports the latest standards and protocols.



MULTIFUNCTIONAL FAULT AND EVENT RECORDER

Transient fault recording facilitates the analysis of protection and circuit-breaker device operation.

- Digital Fault Recorder (DFR)
- Flexible channel configuration
- Up to 640 analogue and 2688 digital channels in one system
- Flexible trigger conditions on all inputs and conditions
- Integrated Sequence of Events Recorder (SOE)
- Protection relay function and status supervision
- Different recording rates; fully-configurable
- Centralised Master Station software for convenient data analysis of all field-deployed PFM300 systems
- IEC 61850 compliant



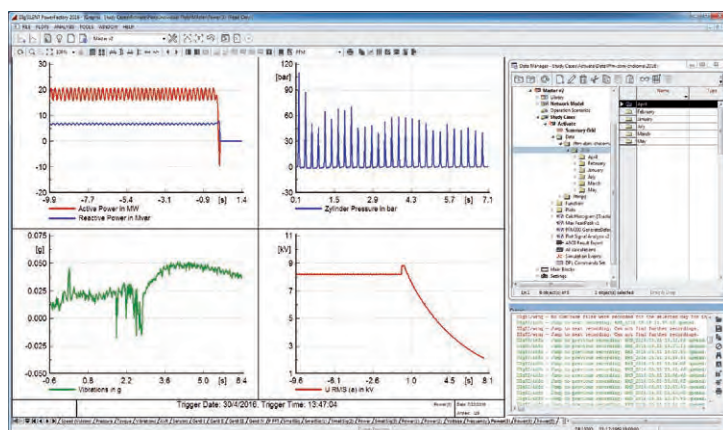
DIgSILENT | **PFM300** Product Application Power System Monitoring



DYNAMIC SYSTEM & NETWORK PERFORMANCE MONITOR (DSM)

DSM performs the important tasks of power system stability supervision and determination and analysis of key system parameters.

- Voltage stability monitoring and steady-state instability supervision
- Generation outage, load rejection and system frequency
- Response analysis
- Primary- and secondary response supervision
- Load-shedding tuning and optimisation
- Power System Stabiliser (PSS) effectiveness supervision
- Tie-line power exchange and network control characteristics
- Control performance supervision and identification
- Generator and load parameter identification
- Phase angle supervision



POWER PLANT MONITOR

Precise knowledge of grid response and plant characteristics is often required for solving stability problems, operating within stability margins and for the optimal tuning of grid and plant control systems.

- Generator, motor and general feeder load tests as well as parameter identification
- AVR/exciter performance supervision and identification
- Prime mover and associated controls supervision (boiler control, primary control, etc.)
- Optimal tuning of Power System Stabilisers (PSS)
- Observation of shaft oscillations

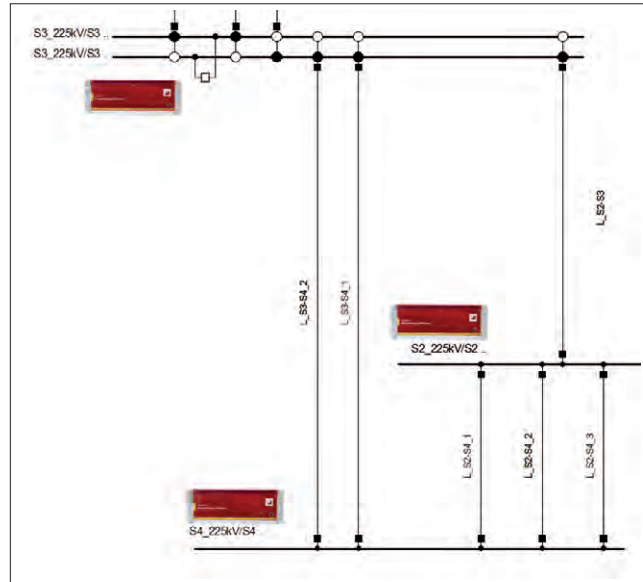




PHASOR MEASUREMENT UNIT (PMU)

Wide area measurement (WAM) in regional transmission grids and very wide area super grids via PMUs is considered to be one of the most important measurement techniques in power systems. PMUs allow the early detecting of faults, thereby preventing power outages and so increasing grid reliability.

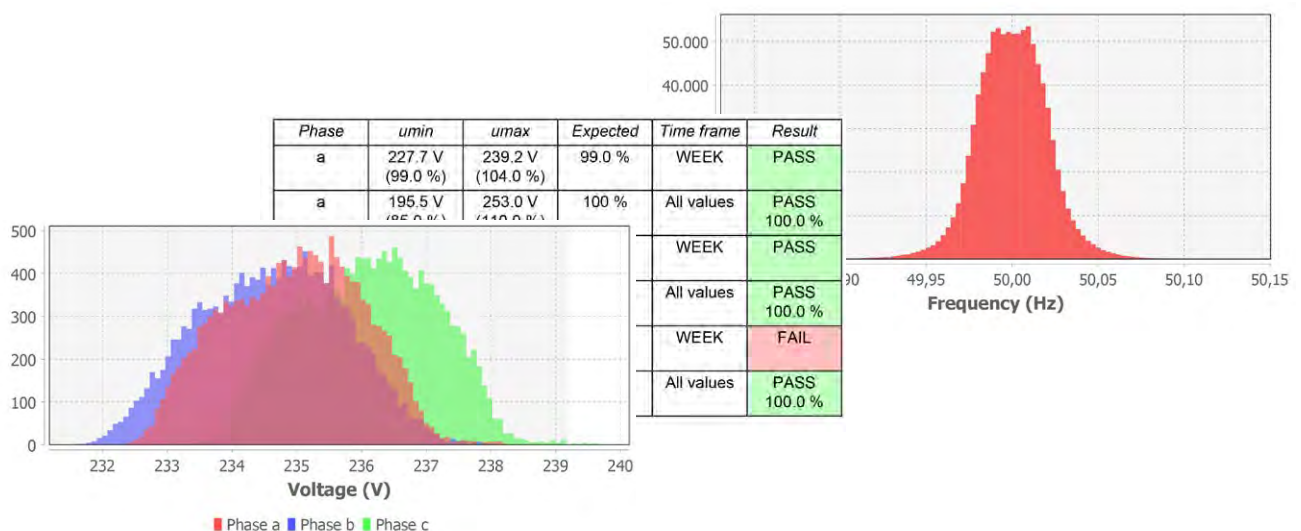
- Real-time synchro-phasor measurement technology with phase angle supervision
- IEEE C37.118 /2005 /2011 compliant
- Multiple C37.118 inputs / outputs
- Aggregation of C37.118 inputs with analogue signal inputs



POWER QUALITY MONITOR

Poor power quality is a problem for all consumers. It contributes to high energy costs and production disturbances. Following the IEC 61000-4-30 standard it is possible to verify the power quality of the power supply.

- True RMS voltage and current, frequency
- Harmonics and interharmonics up to the 50th order in accordance with IEC 61000-4-7
- Unbalance, voltage dips, swells and interruptions
- Short & Long-Term Flicker in accordance with IEC 61000-4-15
- Recording of all time frames from half-cycle stream up to 2 hours aggregated
- Statistical PDF reports in accordance with EN 50160





Grid Code Compliance Monitoring PFM300-GCC

An increasing number of independent power producers (IPPs), such as wind, pv or conventional power plants, are connecting to public transmission and distribution grids. Grid connection contracts with grid operators include obligations to comply with performance requirements set out in the relevant grid codes. These grid codes will typically specify the expected behaviour of the plant during network disturbances, requirements for support of the steady-state and dynamic stability of the grid, and obligations relating to ancillary services provision and power quality. Non-compliance with these grid code requirements can result in payment reductions or even disconnection from the grid as well as conflicts between the parties involved.

The new Grid Code Compliance Monitoring System PFM300-GCC has been designed to carry out online audits of the compliance of your power plant with the grid code, automatically report on any grid code relevant issues and provide transparency between parties through traceability of non-compliance events. In this innovative solution DlgSILENT has successfully combined its considerable expertise in both hardware systems for monitoring and power system simulation software development, to provide an online assessment of grid code compliance.

FEATURES

Flexible monitor functions

- Frequency range
- LVRT, HVRT
- Reactive current behaviour based on voltage during LVRT
- Reactive power behaviour based on voltage or active power
- Active power behaviour controlled by frequency / voltage response regulation
- Meet Ramp Rate Control requirements
- Parameter settings can be static or dynamic via signal inputs

Online compliance status

- Compliance status via Event Viewer and web interface
- Traceability of all interim calculated values
- Report on grid code compliant network disturbances
- Detailed plots and reproducible data basis

Comprehensive reports

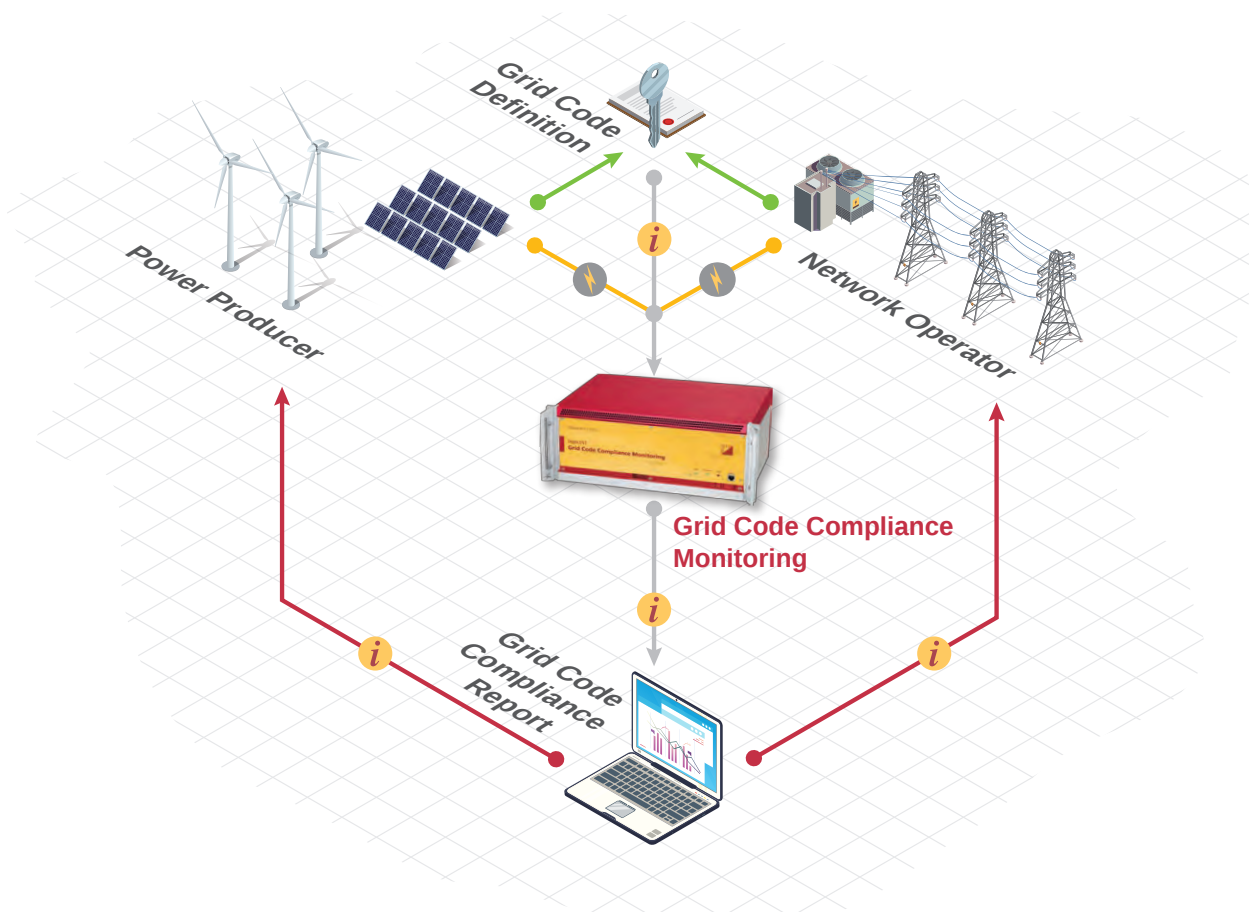
- Interactive report generator
- Statistical report showing all non-compliant events
- Report on grid code compliant network disturbances
- Power quality report in accordance with EN 50160
- Detailed plots and reproducible data basis

Easy configuration

- Configuration via web-interface
- Templates available for common grid codes
- Parameter settings can be static or dynamic via signal inputs from SCADA
- Configurable additional inputs for further internal analysis

Multiple connection concept

- Simultaneous data delivery to multiple independent parties
- Independent report generation and data analysis by all parties via individual Master Stations



KEY BENEFITS

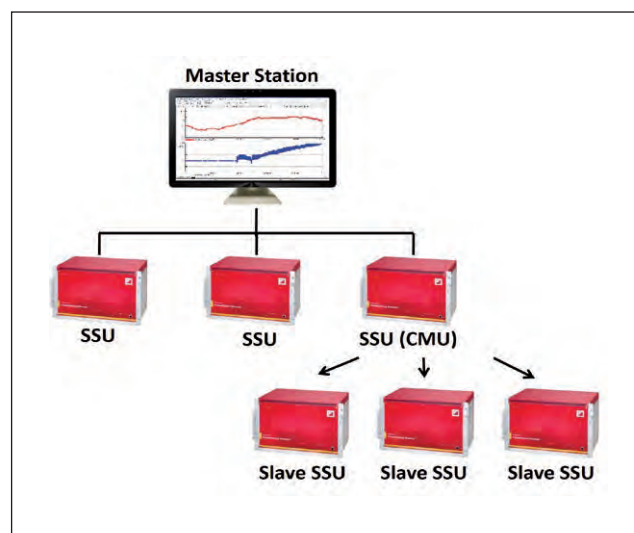
- Continuous online audit of grid code compliance and instant notification of non-compliant behaviour
- Traceability of grid code compliance triggered events via detailed reports
- Remote access to the online audit devices by all interested parties
- Reliable data basis for power plant performance optimisation (e.g. power plant controller analysis and tuning)
- Slot-based components for easy upgrade or adaptation to different applications
- Availability of portable and rackmount versions as well as fully-configured cabinet according to customer specification

DlgSILENT | PFM300 & PFM300-GCC

Functional Overview

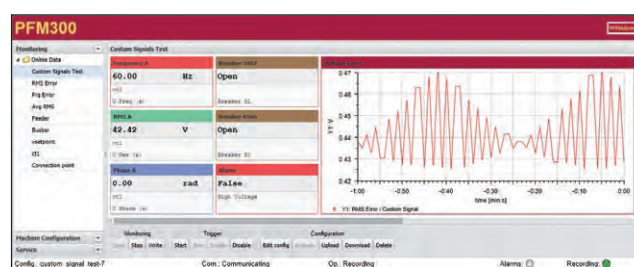
ARCHITECTURE

- The PFM300 Smart Signal Unit (SSU) is an integrated, multifunction data acquisition system. It houses all components such as power supply, CPU, data storage and signal inputs with flexible channel configuration including interfaces for channel extension devices like Signal Units (SU) and Digital Units (DU)
- Centralised Master Station software for convenient data analysis supervision of all SSUs in the field
- Network connection of multiple SSUs to a Master Station
- Scalability of multiple SSUs including their extension devices
- Management of multiple linked slave-SSUs by the integrated Control Monitoring Unit (CMU) from an SSU. Two topologies are possible managed by one SSU: high numbers of channels with up to 640 analogue and 2688 digital channels; or distributed installation locations
- Slot-based components for easy upgrade or adaptation to different applications
- Availability of portable and rackmount versions as well as fully-configured cabinet according to customer specification



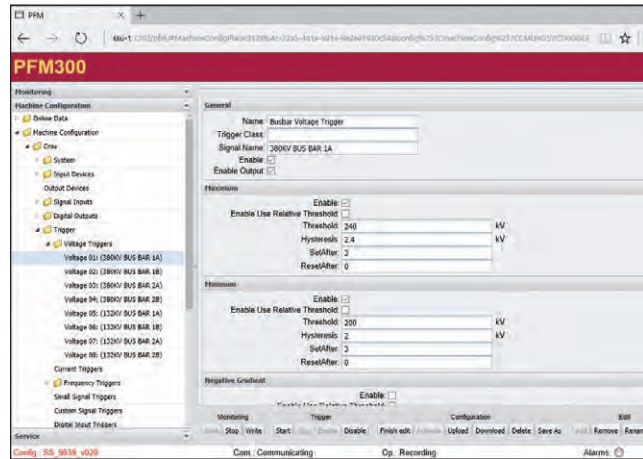
SSU WEB INTERFACE

- Accessible on each Smart Signal Unit
- Display of live values; supports various display types
- Measurement operation control including manual triggering
- Easy configuration of signal assignment, trigger settings and recording parameters
- Including archive with up- and download functionality
- User management with multiple user accounts/groups having different access rights
- Firmware update via web browser



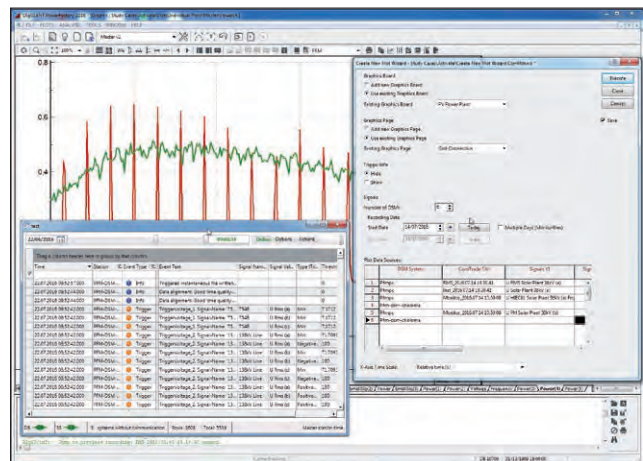
SSU TRIGGER SUPERVISION

- Triggering on all analogue and digital signal inputs as well as inputs via protocol
- Setup of triggers on all values such as RMS, frequency, power, PQ values, oscillations or user-defined signals
- Threshold settings on maximum, minimum or gradients of analogue values
- Triggering on falling or rising edge
- Hysteresis and time filter options on all trigger monitors
- Synthetically-created trigger conditions based on logical combination of different trigger monitors via user-defined equations
- Timer triggers
- Multiple trigger monitors can be set on same signal values with different settings or logical combinations thereof
- Automatic re-triggering extending the recording
- Automatic trigger deactivation in case of excessive continuous triggering
- Remote triggering of other PFM300 locations



MASTER STATION

- Centralised Master Station software for convenient data analysis of all field-deployed PFM300 systems
- Master Station released as a module of DigSILENT PowerFactory
- User-friendly interface with special toolbar, plot wizards and Master Station tool kit
- Data collection service to centralise recordings from all field SSUs to the Master Station via IEC 61850 or SMB Protocol via TCP/IP
- Database-based event viewer for PFM events such as triggers, warnings, alarms and SOE (sequence of events) with multiple screen arrangement, individual filter options and export functions
- Easy plot creation and data handling with various features including scaling, filtering, record scrolling, jumping, etc.
- Statistical functions such as maxima/minima, average and histograms
- Individual post-creation of signalling, based on multiple recorded signals
- Statistical PDF reports in accordance with EN 50160
- Recorded data can be exported to various file types such as ASCII, Excel, etc.
- Full integration of recordings into PowerFactory simulations
- Optional Scripting and Automation package for customised reporting or add-on functionality



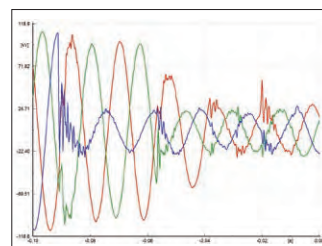
DlgSILENT | PFM300 & PFM300-GCC

Functional Overview

SSU MULTI-TIMEFRAME DATA STREAMS

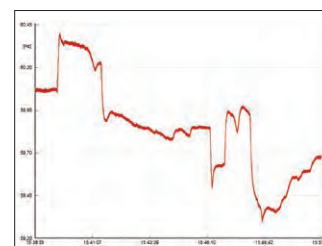
RAW DATA STREAM

Stream rate:	15,151kHz (303 samples/cycle @50Hz, 252 samples/ cycle @60Hz)
Stream values:	Instantaneous values from all signal inputs
COMTRADE output:	Recording based on trigger event ▪ Pre-fault time: user-selectable (typical: 1 - 60s) ▪ Post-fault time: user-selectable (typical: 1 - 120s) ▪ Re-trigger: supported; various options



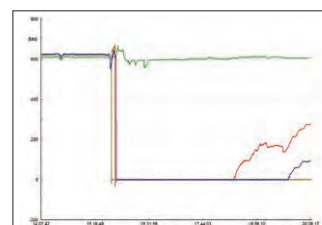
FAST DATA STREAM

Stream rate:	1 - 2 samples/cycle (50–100 samples/sec. @50Hz, 60 - 120 samples/sec. @60Hz)
Stream values:	Voltages and currents RMS/phasor, frequency, power, PQ values, DI, etc. based on all signal inputs, C37.118 input values, user-defined signal aggregation based on multiple input signals
Protocol output:	via IEEE C37.118 or IEC 60870-5-101/104
COMTRADE output:	Recording based on trigger event ▪ Pre-fault time: user-selectable (typical: 1 - 120s) ▪ Post-fault time: user-selectable (typical: 60 - 1200s) ▪ Re-trigger: supported; various options



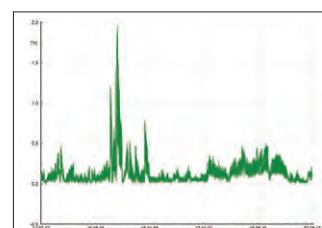
SLOW DATA STREAM

Stream rate:	Up to 10 samples/second
Stream values:	Same as for fast data stream
Protocol output:	via IEEE C37.118 or IEC 60870-5-101/104
COMTRADE output:	Continuous recording 24h; saved daily



POWER QUALITY DATA STREAMS

Stream rate:	Half-cycle stream, 10/12 cycle stream, 150/180 cycle aggregation stream, 10min aggregation stream, 2h aggregation stream according to IEC 61000-4-30
Stream values:	True RMS voltage and current, frequency, harmonics and interharmonics up to the 50th order in accordance with IEC 61000-4-7, unbalance, voltage dips, swells and interruptions, Flickermeter in accordance with IEC 61000-4-15
COMTRADE output:	Continuous recording, based on trigger event or timer-based



DlgSILENT | PFM300 & PFM300-GCC

Technical Specification

HARDWARE VERSIONS

There are two versions of the PFM300 Smart Signal Unit and three versions of the PFM300 Extension Unit. Each PFM300 unit can be configured according to customer needs via flexible cards. Grid Code Compliance Monitoring is available as an optional software module on all hardware versions. Refer to Pages 12 and 13.



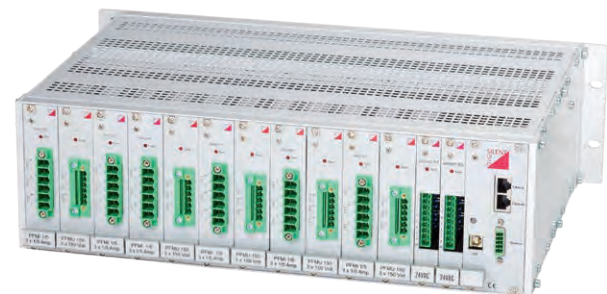
SMART SIGNAL UNIT SSU15

Specification

- 15 analogue input channels (as configured)
- 16 digital inputs channels (as configured)
- 7 digital output channels (as configured)
- 15.151kHz, 16-bit sampling
- Time synchronisation (as configured)
- Solid state storage 256 GB
- Width: 449 mm (19" standard), Height: 177 mm (4 HU), Depth: 316 mm

Variants

- 19" Rackmount (C)
- Portable (CP)



SMART SIGNAL UNIT SSU32

Specification

- 32 analogue input channels (as configured)
- 32 digital input channels (as configured)
- 7 digital output channels (as configured)
- 15.151kHz, 16-bit sampling
- Time synchronisation (as configured)
- Solid state storage 256 GB
- Width: 449 mm (19" standard), Height: 310 mm (7 HU), Depth: 316 mm

Variants

- 19" Rackmount (C)
- Portable (CP)
- Redundant power supply (CD)
- Extendable version (CE)

Extensions

- Extendable with up to 4 Signal Units (SU32) totalling to up to 160 analogue channels and 160 digital input channels
- Extendable with up to 2 further digital units (DU128/256), totalling to up to 672 digital input channels

SIGNAL UNIT SU32 (EXTENSION)

Specification

- 32 analogue input channels (as configured)
- 32 digital input channels (as configured)
- 15.151 kHz, 16-bit sampling
- Width: 449 mm (19" standard), Height: 133 mm (3 HU), Depth: 316 mm

DIGITAL UNIT DU128/256 (EXTENSION)

Specification

- 128/256 digital input channels (as configured)
- 1kHz sampling
- Width: 449 mm (19" standard), Height: 133/632 mm (3/6 HU), Depth: 316 mm

DIgSILENT | PFM300 & PFM300-GCC

Technical Specification

GENERAL CHARACTERISTICS

COMMUNICATION PORTS

- 1x front LAN Ethernet TCP/IP 10/100Mb/s
- 2x back LAN Ethernet TCP/IP 10/100/1000Mb/s
- Support of Redundant Network Interface PRP-1 and HSR according IEC 62439-3 incl. Port A, B failure supervision (optional)

PROTOCOLS

- IEEE C37.118 /2005 /2011 (PMU input/output)
- IEC 60870-5-101/104 (Output)
- IEC 61850 edition 2

RECORDING FORMAT

- COMTRADE IEEE C37.111 / IEC 60255-24 Ed.2
- Detailed trigger cause information using the COMTRADE .INF file

SUPPLY VOLTAGE

- 100 - 240 VAC, 50-60Hz
- 100 - 250 VDC
- $\pm 10\%$, CAT II
- Full redundancy (optional)

CERTIFICATION

- CB Certificate: IEC 61010-1(ed.3) and IEC 61010-2-030(ed.1)
- CB Certificate: IEC 61326-1(ed.2)
- IEC 61850- Edition-2 Certified

INDIVIDUAL CONFIGURATIONS

TIME SYNCHRONISATION

Card Type	
GPS Card	Including antenna, mounting accessories, 50m coaxial cable
IRIG-B Card	Supported protocol via BNC: – IRIG-B B122/B123
PTP/NTP Card	Supported protocols via RJ45: – IEEE 1588v2 Precision Time Protocol (PTP) – Network Time Protocol (NTP)

ADDITIONAL COMMUNICATION PORTS

Card Type	
Interface Card	Additional Ports: – 2x LAN Ethernet TCP/IP 10/100Mb/s – 4x COM RS-232 and RS-485

DIGITAL OUTPUT

Card Type	
Digital Output Card	7 dry contacts: – 1 live status change over – 6 programmable (nc/no) – Rating 125V, 0,2A

SOFTWARE MODULES

PFM300	Base functionality
PFM300-GCC	Grid Code Compliance Monitoring (GCC) Refer to page 6

PFM300 channel inputs can be configured via individual measurement cards. Each PFM300 unit can handle a specific number of cards and channels. Refer to page 11.

There are separate cards for analogue and digital signals. Each analogue Cards has 3 channels (phases). Digital input cards are available with 8 or 16 channels.

INPUT CHANNEL CONFIGURATIONS

Card Type	Channels (Phases)	Range	Overload	Input impedance	Typical Application
PFMU 120	3	210V AC	CAT IV 300V, CAT III 600V	> 2,5M Ohm	VT Star / Delta
PFMU 150	3	420V AC	CAT IV 300V, CAT III 600V	> 2,5M Ohm	VT Star / Delta
PFMU 800	3	848 V AC 1200 V DC	CAT IV 300V, CAT III 600V, CAT II 1000V	> 2,2M Ohm	Excitation Voltage
PFMI 1	3	3,35 A AC	CAT IV 300V, CAT III 600V, 50A 1s, 10A continuous	< 0,1 Ohm	CT 1A metering core
PFMI 5	3	13,5 A AC	CAT IV 300V, CAT III 600V, 150A 1s, 20A continuous	< 0,1 Ohm	CT 5A metering core 1A protection core
PFMI 10	3	31,5 A AC	CAT IV 300V, CAT III 600V, 150A 1s, 35A continuous	< 0,1 Ohm	CT 10A metering core 5A protection core
PFMI CLX incl. 3 clamps	3	7 A AC	CAT IV 300V, CAT III 600V	–	Current clamps
PFMSU 0.2	3	+/- 200mV		> 1M Ohm	Excitation Current via shunt
PFMSU 1	3	+/- 1V		> 1M Ohm	1V signal
PFMSU 10	3	+/- 10V		> 1M Ohm	10V signal
PFMSI 20	3	+/- 20mA		50 Ohm	4-20mA signal
PFM DI-8	8	DI 24V			Digital input
PFM DI-16	16	DI 24V			Digital input

All analogue and digital channels have galvanic isolation. Various additional signal input ranges are available, as are custom requests.



DlgSILENT is a consulting and software company providing engineering services in the field of electrical power systems for transmission, distribution, generation and industrial plants.

DlgSILENT was founded in 1985 and is a fully independent, privately owned company located in Gomaringen/Tübingen, Germany. DlgSILENT continued expansion by establishing offices in Australia, South Africa, Italy, Chile, Spain, France, the USA and Oman, thereby facilitating improved service following the world-wide increase in usage of its software products and services. DlgSILENT has established a strong partner network in many countries such as Mexico, Malaysia, UK, Switzerland, Colombia, Brazil, Peru, China and India. DlgSILENT services and software installations have been conducted in more than 150 countries.

DIGSILENT POWERFACTORY

DlgSILENT develops the leading integrated power system analysis software PowerFactory, which covers the full range of functionality from standard features to highly sophisticated and advanced applications including wind power, distributed generation, real-time simulation and performance monitoring for system testing and supervision. For wind power applications, PowerFactory has become the power industry's de-facto standard tool, due to PowerFactory models and algorithms providing unrivalled accuracy and performance.

DIGSILENT STATIONWARE

is a reliable central protection settings database and management system, based on the latest .NET technology. StationWare stores and records all settings in a central database, allows modelling of relevant workflow sequences, provides quick access to relay manuals, interfaces with manufacturer-specific relay settings and integrates with PowerFactory software, allowing powerful and easy-to-use settings coordination studies.

DIGSILENT MONITORING SYSTEMS

Our Power System Monitoring PFM300 product line features grid and plant supervision, fault recording, power quality and grid characteristics analysis. The Grid Code Compliance Monitoring PFM300-GCC product has been designed for continuous compliance auditing of power plants with respect to grid code requirements, thereby providing plant operators and utilities utmost transparency and non-compliance detection.

DIGSILENT CONSULTING

DIGSILENT GmbH is staffed with experts of various disciplines relevant for performing consulting services, research activities, user training, educational programs and software development. Highly specialised expertise is available in many fields of electrical engineering applicable to liberalised power markets and to the latest developments in power generation technologies such as wind power and distributed generation. DIGSILENT has provided expert consulting services to several prominent PV and wind grid integration studies.



DIGSILENT | Services

PRODUCT SUPPORT

- Up to 5 years hardware warranty
- Professional installation and product support via customer portal and hotline
- Detailed manuals and documentation
- PFM300 Firmware updates incl. new features
- PowerFactory Master Station service packs and new versions

SERVICES, CONSULTANCY AND TRAINING

- On-site commissioning services
- Training at DIGSILENT offices as well as at user's site
- Power plant testing, including associated equipment such as steam, gas and hydraulic turbines, combustion engines, wind turbines, PV panels and their associated control systems (AVR/Exciter systems, Power System Stabilisers (PSS), prime mover controllers, etc.)
- Development of simulation models for dynamic analysis and parameter identification based on measurements, including models for certification processes of new generating units
- Verification of grid code compliance of power plants and generating units
- Observation and evaluation of shaft oscillations due to torsional interaction with power system controllers and converters
- Testing and assessment of power quality performance of power plants and system consumers, incl. analysis of harmonic distortion, flicker, voltage dips and swells
- Performance testing of industrial systems, in particular those containing steam processes.

DlgSILENT Worldwide



DlgSILENT GmbH
Heinrich-Hertz-Straße 9
72810 Gomaringen
Germany

PHONE
+49 7072 9168-0 (Switchboard)
+49 7072 9168-23 (Sales)
+49 7072 9168-88 (Fax)

MAIL
mail@digsilent.de
www.digsilent.de



DlgSILENT GmbH is certified
to the ISO 9001:2015 standard.
More information is available at
www.tuv-sud.com/ms-cert.