9410 Selection and Application Guide

Power quality and analysis metering

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Compact power, energy and power quality meters

The Siemens 9410 series power meter combines accurate, 3-phase energy and power measurement with data logging, power quality analysis, e-mail, alarming, Modbus Mastering, Waveform capture and extensive I/O capabilities not typically available in a compact meter.

Typical power and energy management applications using the 9410 Meter

- Financial management including accounting and billing
- Facility and energy management
- Supports operations management planning and procedures
- Power generation transmission and distribution
- Service entrances and onsite generation
- Power mitigation and main power distribution equipment
- PDUs and RPPs
- Tenants, departments or subcontractors
- Processes, lines, machines or equipment

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The 9410 series meters are ideally suited to local and remote monitoring of low or high voltage electrical installations in industrial facilities, commercial buildings, utility networks or critical power environments. Facility and operations personnel will benefit in energy-related costs while avoiding power quality conditions that can reduce equipment life and productivity.

The 9410 series meter is easy to install and use, offering integrated or remote high-visibility displays. A range of expansion modules help match features to the application and support field-upgrading of meters as required. Serial and Ethernet communication enable the meter to be used within a WinPM.Net power management system or with third-party management systems.

Benefits
- Maximize profits by providing high output with the least amount of risk to availability.
- Improve availability and reliability of electrical systems and equipment.
- Monitor power quality (PQ) for compliance and to prevent problems.
- Meters fully supported by WinPM.Net.
- Down to one millisecond digital Input event logging.

Typical applications
Industrial, commercial, and critical power
- Energy savings
  - Measure efficiency, reveal opportunities and verify savings
  - Sub-bill tenants for energy costs
  - Allocate energy costs to departments or processes
  - Reduce peak demand surcharges
  - Reduce power factor penalties
  - Leverage existing infrastructure capacity and avoid over-building
  - Support proactive maintenance to prolong asset life
- Energy availability and reliability
  - Validate that power quality complies with the energy contract
  - Verify the reliable operation of equipment
  - Improve response to power quality-related problems

For electrical infrastructure
- Energy availability and reliability
  - Improve transmission and distribution network reliability
  - Enhance substation metering to reduce field service time
  - Maximize the use of existing infrastructure
- Power quality
  - Verify compliance with new power quality standards
  - Analyze and isolate the source of power quality problems
9410 Meter

Features and benefits

Cost-effective, modular design
Standard features include a range of 3-phase power and energy measurements, total harmonic distortion (THD) metering, one RS-485 Modbus communication port, Dual-port Ethernet port, three digital inputs, one KY-type digital output, and alarming on critical conditions. The 9410 meter has custom logging and power quality analysis capabilities, while expansion modules offer additional I/O.

Easy installation
Mounts into panel cutouts using two clips with no tools required. Directly connects to circuits up to 600V AC, eliminating the need for voltage (potential) transformers.

High-Visibility COLOR display
Integrated or remote LCD offers multi-phase measurements, summary screens, bar charts, intuitive navigation and selectable languages.

High accuracy measurements
IEC 62053-22 class 0.2S and ANSI C12.20 0.2S real energy accuracy for sub-billing and cost allocation. For reactive energy Class 0.5S (IEC62053-24)

Power quality analysis
Reveal and understand power quality conditions with the 9410 meter capabilities:
- Dip and Swell detection
- Waveform capture - 256 samples per cycle (Pre and Post)
- Disturbance direction and detection
- Trending and forecasting
- Compliant PQ standards
  - IEC61000-4-30 Class 5
  - IEC 62586
  - EN50160

Extensive data logging, trending and forecasting
Non-volatile on-board logging of min/max values, energy and demand, maintenance data, alarms, and any measured parameters. Trending and short-term forecasting of energy and demand.

Custom alarming with time stamping
Triggers alarms on over 50 definable power or I/O conditions. Use boolean logic to combine up to four alarms.

Expandable I/O
A wide choice of standard or optional digital and analog inputs and outputs for pulse counting, demand metering for other utilities (pulse inputs from water, air, gas electricity or steam meters), equipment status/position monitoring, demand synchronization, triggering conditional energy metering, equipment control or interfacing.

Serial and Ethernet Communications
Up to two simultaneous Modbus communications ports. Use the RS-485 port on the base meter unit or the Dual-Port Ethernet for daisy-chaining via Ethernet. The Ethernet port will allow up to 8 supervisory systems to link to the meter at the same time and provide email-alarms and Modbus master functionality.
Measurements

PQ compliance reporting and basic PQ analysis
- Monitors and logs parameters in support of international PQ standards,
  - IEC 61000-4-30 Class S
  - IEC 62586 PQI-S
  - EN 50160
- Generates onboard PQ compliance reports accessible via onboard web pages:
  - Basic event summary and pass/fail reports, such as EN 50160 for power frequency, supply voltage magnitude, supply voltage dips, short and long interruptions, temporary over voltages, voltage unbalance and harmonic voltage.
  - ITIC (CBEMA) and SEMI curves, with alarm categorization to support further analyses.
  - NEMA Motor Derating curve.
- Basic meter provides EN 50160 but can be configured to provide IEEE 519.
- Harmonic analysis:
  - THD on voltage and current, per phase, min/max, custom alarming.
  - Individual harmonic magnitudes and angles on voltage and current, up to the 63rd harmonic.
- Built-In web-enabled waveform viewer
- High resolution waveform capture: triggered manually or by alarm, captured waveforms available directly from the meter via FTP in a COMTRADE format.
- Disturbance detection and capture: sag/swell on any current and voltage channel, alarm on disturbance event, waveform capture with per-event information.
- Patented disturbance direction detection: provides indication of the captured disturbance occurring upstream or downstream of the meter; time stamped results provided in the event log, with degree of certainty of disturbance direction.

Used with WinPM.Net, provides detailed PQ reporting across entire network:
- EN 50160 report.
- IEC 61000-4-30 report.
- PQ compliance summary.
- ISO 50001.
- Display of waveforms and PQ data from all connected meters.
- Onboard data and event logging.
- 512MB of standard non-volatile memory, 350 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms.
9410 Meter

Front panel display showing function selection buttons and 3-phase voltage, current and power summary display

Front panel display
The unique, anti-glare backlit white LCD can be easily read in extreme lighting conditions or viewing angles. An intuitive navigation with self-guided menus make the meter easy to use. Multilingual operation can be user-configured for English, Spanish, French, Italian, German, Portuguese, Chinese, and Russian.

The large 6-line display offers summary screens that simultaneously presents up to 4 concurrent values, including power and energy values, I/O conditions or alarm status. For example, all three voltage or current phases plus neutral can be quickly reviewed at one time. Bar chart displays graphically represent system loading and I/O conditions. Historical and active alarms are displayed with time stamping. Active alarms can be Color coded for quick indication of alarm severity.

The 9410 displays can also be customized to show any metering point or imported data point from Modbus RTU/TCP connected devices, making this a unique central display for critical information.
Installation

Installation – Mounting options
A meter with integrated display, or a remote display module, can be panel mounted through a square cutout (92 x 92 mm) or remote display retrofitted through an existing round meter hole using an adapter. A small panel footprint and shallow depth make the meters suitable for low voltage switchboards, shallow cable compartments or on standalone machines. The meter unit (without display) is DIN rail compatible.

Meters with the optional integrated display can be door panel mounted when voltage connections are within the local regulation limits. When voltage exceeds regulation limits, the meter unit can be mounted inside the electrical cabinet with an optional remote display connecting via a display adapter and cable. A single remote display can be transferred between any meter units.

Circuit and control power connections
Compatible with low and high voltage 4-wire wye and 3-wire delta systems. Direct connect inputs up to 690 V AC line-to-line or use voltage (potential) transformers for higher voltage systems. All models offer a universal AC or DC power supply.

Electrical Characteristics

<table>
<thead>
<tr>
<th>Type of measurement</th>
<th>True rms to 256 samples per cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement accuracy</td>
<td></td>
</tr>
<tr>
<td>Current and voltage</td>
<td>Class 0.2 as per IEC 61557-12</td>
</tr>
<tr>
<td>Active power</td>
<td>Class 0.2 as per IEC 61557-12</td>
</tr>
<tr>
<td>Power factor</td>
<td>Class 0.5 as per IEC 61557-12</td>
</tr>
<tr>
<td>Frequency</td>
<td>Class 0.2 as per IEC 61557-12</td>
</tr>
<tr>
<td>Active energy</td>
<td>Class 0.25 IEC 62053-22 (In=5A)</td>
</tr>
<tr>
<td>Reactive energy</td>
<td>Class 0.2 IEC 61557-12, ANSI C12.20 Class 0.2</td>
</tr>
</tbody>
</table>

Data update rate
1/2 cycle or 1 second

Input-voltage characteristics
- Specified accuracy voltage: 57 VLN/100 VLL TO 400 VLN/690 VLL
- Impedance: 5MΩ per phase
- Specified accuracy frequency: 42 to 69Hz (50/60Hz nominal)
- Limit range of operation -frequency: 20 to 450Hz

Input-current characteristics
- Rated nominal current: 1A (0.55), 5A (0.25), 10A (0.2ANSI)
- Specified accuracy current range: Starting Current: 5mA, Accuracy Range: 50mA-10A
- Permissible overload: 200A rms for 0.5s, non-recurring
- Impedance: 0.0003Ω per phase
- Burden: 0.024 VA at 10A

Power supply
- AC: 90-415V AC ±10% (50/60Hz ± 10%)
- DC: 120-300V DC ±10%
- Ride-through time: 100 ms (6 cycles at 60Hz) min., any condition
- 200 ms (12 cycles at 60Hz) typ., 120V AC
- 500 ms (30 cycles at 60Hz) typ., 415V AC
- Meter Only: 18 VA max at 415V AC, 6W at 300V DC
- Fully optioned meter: 36 VA max at 415V AC, 17W at 300V DC

Input/outputs
- Meter Base Only: 3 form A digital inputs (30V AC/60V DC) + 2 analog outputs (4-20mA, 0-10V DC)
- Optional: Digital - 6 form A digital inputs (30V AC/60V DC)
- Analog - 4 analog inputs (4-20mA, 0-30V DC)

Mechanical Characteristics

| Weight | Integrated display module 9.58 kg
|        | DIN rail mounted Model 0.528 kg
|        | IO modules 0.140 kg
|        | Remote display 0.300 kg

IP degree of protection
- IP 54, UL type 12: Panel mount and Remote display, front. IP 30: Panel mount rear, DIN rail mount, IO modules.

Dimensions
- Panel mount model: 96 x 96 x 77.5 mm
- DIN model: 96.6 x 90.5 x 90.8 mm
- IO modules: 90.5 x 90.5 x 22 mm

Environmental conditions
- Operating temperature: -25°C to +70°C
- Remote Display Unit: -25°C to +60°C
- Storage temperature: -40°C to +85°C
- Humidity rating: 5% to 95% non-condensing
- Installation category: III
- Operating altitude (maximum): 3000m above sea level
9410 Meter

Functions

Alarm and control functions
Over 50 definable alarm conditions with 1 second response time can be used to log critical events or to perform control functions. Trigger on over or under conditions on any measured parameters, phase unbalance, digital input changes and more.

Multiple alarms can be defined, with each alarm individually configured with pickup setpoint, dropout setpoint and delay. Each alarm can be assigned one of four priority classes. Assign multiple alarms to a single quantity to create alarm levels. Assign different actions based on the severity level of the alarm. Use alarms to trigger waveform recording, data logging or to control digital outputs.

Customizable Programmable logic with the 9410 meter increases flexibility by allowing the combination of up to four other alarms using NAND, AND, OR, NOR and XOR functions.

Communications
Multiple simultaneously operating communication ports allow the meters to be used as part of a power and energy management system and interface with other automation systems. Captured waveforms, alarms, billing data, and more can be uploaded to WinPM.Net 6.0 or later for viewing and analysis. Option modules offer a choice of communications standards.

- Standard RS-485 port (on meter unit): 2-wire connection, up to 38.4 kbaud, Modbus (ASCII and RTU) or JBUS protocol.
- Support of IPv6
- Dynamic Host Configuration Protocol (DHCP) IPv4 & IPv6 - DHCP is a network protocol that enables a server to automatically provide an IP address and other related information for a device.
- A dual port 10/100 Base-T UTP port supporting Modbus TCP/IP, DNP3 and IEC 61850 communications. Full-function embedded web server provides standard web browser access to meter data, and the ability to email on an alarm from the host meter. RS-485/232 port, 2- or 4-wire, Modbus (ASCII and RTU) master port providing Ethernet-to-serial line gateway or Modbus master functionality.

Software integration
Integration with the WinPM.Net system software allows for automatic retrieval of the meters real-time and on-board data logs. Modbus compatibility and register-based logged data supports integration and data access by building automation, SCADA and other third-party systems.

Special features
Hour counter: load running time in days, hours and minutes.

Upgradeable Firmware – Your meters can be upgraded with the latest firmware. Contact your local Siemens representative for details.
9410 Built-In Web Pages

The 9410 comes with many standard HTML web pages showing the meters data, but additional custom web pages can be designed to display other Modbus serial or Modbus TCP connected devices like power meters, trip units, flow meter information, and more!

Example screen from WinPM.Net software showing electrical system diagram with multiple real-time metering points.

Built-In web-enabled Waveform viewer
9410 Meter

Applications and benefits

- Maximize profits by providing high output with the least amount of risk to availability.
- Improve availability and reliability of electrical systems and equipment.
- Monitor power quality (PQ) for compliance and to prevent problems.
- Meters fully supported by WinPM.Net Power Monitoring Software.

Main characteristics

- Precision metering:
  - IEC 61557-12 PMD 5xK70 3000m 0.2 (performance measuring and monitoring functions).
  - Class 0.2S accuracy IEC 62053-22, ANSI C12.20 Class 0.2 (active energy).
  - Industry leading Class 0.5S* accuracy for reactive energy (IEC 62053-24).
  - Cycle-by-cycle RMS measurements updated every ½ cycle.
  - Full ‘multi-utility’ WAGES metering support.
  - Net metering.
  - Anti-tamper protection seals.
  - PQ compliance reporting and basic PQ analysis.
  - Monitors and logs parameters in support of international PQ standards
    - IEC 61000-4-30 Class S
    - IEC 62586 PQI-S

Digital and analog inputs and outputs

The 9410 meter provides a three digital status/counter input and digital (KY type) output. A wide range of optional field-installable expansion modules will add more digital and analog I/O as required. Up to four expansion modules can be installed per meter (including logging or communication modules).

Digital output relays can act in response to internal alarms, external digital input status changes, or commands over communications. Digital inputs can be used to trigger alarms, trigger logging, and synchronize to a demand pulse or control conditional energy accumulation. Both models offer five channels for metering of water, air, gas, electricity or steam utilities through the digital input pulse counting and consumption/demand calculation capabilities of the meter. Pulses from multiple inputs can be summed through a single channel communications. Up to 27 total digital inputs can be logged in the 9410 with millisecond time stamping for critical information like detailed sequence of event recording.

<table>
<thead>
<tr>
<th>Type</th>
<th>Input/ Output</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (Meter Unit)</td>
<td>1 digital KY</td>
<td>6 to 220V AC ±10 % or 3 to 250V DC ±10% 100 mA maximum at 25 °C, 1350 V rms isolation</td>
</tr>
<tr>
<td>3 digital input</td>
<td></td>
<td>20 to 150V AC/DC ±10 %, &lt;5 mA maximum burden</td>
</tr>
<tr>
<td>9410 (US2:948M2D06DI)</td>
<td>2 digital relay outputs</td>
<td>6 to 240V AC or 6 to 30V DC, 2 A rms, 5 A maximum for 10 second/hour</td>
</tr>
<tr>
<td></td>
<td>6 digital inputs</td>
<td>20 to 150V AC/DC, 2 mA max., 24V internal supply; 20 to 34V DC, 10 mA maximum (feeds 6 inputs)</td>
</tr>
<tr>
<td>9410 US2:948M2AO4AI</td>
<td>Analog I/O module (4 analog inputs &amp; 2 analog outputs)</td>
<td>4 analog inputs (4-20mA; 0-30 V), 2 analog outputs (4-20mA; 0-10 V) for interfacing with building management sensors and systems.</td>
</tr>
</tbody>
</table>

Attachment of logging, I/O, or Ethernet expansion modules to meter unit

Bottom view of 9410 meter unit, showing dual Ethernet port and RS-485 communication port connectors, configuration switches and 4x expansion I/O modules.
Ordering information

Please contact your local sales representative for ordering information.

Visit www.usa.siemens.com/pds for more information on other PDS products, applications and system solutions.

<table>
<thead>
<tr>
<th>Catalog Numbers</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>US2:9410DC</td>
<td>DIN96 Panel mount meter (Integrated color display, 1 DO, 3 DI, dual port Ethernet)</td>
</tr>
<tr>
<td>US2:9410TC</td>
<td>DIN rail mount meter without display (1 DO, 3 DI, dual port Ethernet)</td>
</tr>
<tr>
<td>US2:9410RC</td>
<td>DIN rail mount meter packaged with remote display (Includes 3 meter cable)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>US2:948DISP96</td>
<td>Remote display, 3 meter cable, mounting hardware for 30mm hole (nut and centering pin), mounting hardware for DIN96 cutout (92x92mm) adapter plate</td>
</tr>
<tr>
<td>US2:948M2DO6DI</td>
<td>Digital I/O Module (2 relay outputs &amp; 6 digital inputs - wetted)</td>
</tr>
<tr>
<td>US2:948M2AO4AI</td>
<td>Digital I/O Module (2 analog outputs (4 - 20 mA, 0-10V DC) and 4 analog inputs (4 - 20 mA, 0-30V DC)</td>
</tr>
<tr>
<td>US2:948DCAB10</td>
<td>Remote display cable, 10 meters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electromagnetic compatibility</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product standards</td>
<td>IEC 62052-11 and IEC 61326-1</td>
</tr>
<tr>
<td>Immunity to electrostatic discharge</td>
<td>IEC 61000-4-2</td>
</tr>
<tr>
<td>Immunity to radiated fields</td>
<td>IEC 61000-4-3</td>
</tr>
<tr>
<td>Immunity to fast transients</td>
<td>IEC 61000-4-4</td>
</tr>
<tr>
<td>Immunity to surges</td>
<td>IEC 61000-4-5</td>
</tr>
<tr>
<td>Immunity to conducted disturbances</td>
<td>IEC 61000-4-6</td>
</tr>
<tr>
<td>Immunity to power frequency magnetic fields</td>
<td>IEC 61000-4-8</td>
</tr>
<tr>
<td>Immunity to conducted disturbances, 2-150kHz</td>
<td>CLC/TR 50579</td>
</tr>
<tr>
<td>Immunity to voltage dips and interruptions</td>
<td>IEC 61000-411</td>
</tr>
<tr>
<td>Immunity to ring waves</td>
<td>IEC 61000-412</td>
</tr>
<tr>
<td>Conducted and radiated emissions</td>
<td>EN 55022, EN 55011, FCC part 15, IEC-003</td>
</tr>
<tr>
<td>Surge withstand Capability (SWC)</td>
<td>IEEE C37.90.1</td>
</tr>
</tbody>
</table>

Safety


Communication

Ethernet to serial line gateway: Communicates directly with up to 32 unit load ION slave devices.

Web server: Customisable pages, new page creation capabilities, HTML/XML compatible.

Serial port RS485: Baud rates of 2400 to 115200, pluggable screw terminal connector.

Ethernet port(s): 2x 10/100Base-TX, RJ45 connector (UTP). Up to 8 concurrent connections over Ethernet.

Protocol: Modbus, ION, DNP3, IEC 61850, HTTP, FTP, SNMP, SMTP, DPWS, RSTP, NTP, Sntp, GPS protocols

Cyber Security: Many industrial and utility customers are demanding a higher level of cyber security and encryption method hardening for their power monitoring systems. Meets NERC/CIP and IEC 62443 Standards.

Firmware Characteristics

High-speed data recording: Down to 1/2 cycle interval burst recording, stores detailed characteristics of disturbances or outages. Trigger recording by a user-defined setpoint, or from external equipment.

Harmonic distortion: Up to 63rd harmonic (127th via StruxureWare software) for all voltage and current inputs.

Sag/swell detection: Analyze severity/potential impact of sags and swells: magnitude and duration data suitable for plotting on voltage tolerance curves per phase triggers for waveform recording, control.

Disturbance direction detection: Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Analysis results are captured in the event log, along with a timestamp and confidence level indicating level of certainty.

Instantaneous: High accuracy of standard speed (1s) and high-speed (1/2 cycle) measurements, including true rms per phase and total for: voltage, current, active power (kW), reactive power (kvar), apparent power (kVA), power factor, frequency, voltage and current unbalance, phase reversal.

Load profiling: Channel assignments (800 channels via 50 data recorders) configurable for any measurable parameter, including historical trend recording of energy, demand, voltage, current, power quality, or any measured parameter. Trigger recorders based on time interval, calendar schedule, alarm/event condition, or manually.

Trend curves: Historical trends and future forecasts to better manage demand, circuit loading, and other parameters. Provides average, min, max and standard deviation every hour for last 24 hours, every day for last month, every week for last 8 weeks and every month for last 12 months.

Waveform captures: Simultaneous capture of all voltage and current channels sub-cycle disturbance capture, maximum cycles is 100,000 (16 samples/cycle x 96 cycles, 10MBBytes memory), max 256 samples/cycle.

Alarms: Threshold alarms: adjustable pickup and dropout setpoints and time delays, numerous activation levels possible for a given type of alarm, user-defined or automatic alarm threshold settings, user-defined priority levels (optional automatic alarm setting).
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