sigPOD

sciemetric

PROCESS SIGNATURE VERIFICATION FOR PRODUCTION MONITORING

BENEFITS

- Quickly develop and deploy new applications in minutes, without the need for programming
- Eliminate the need for developing costly custom test setups to handle requirements not addressed by conventional purpose-built, off-the-shelf testers
- Comprehensive line-up of hardware models provides an unmatched array of data acquisition options that can be configured to monitor anything from the simplest single channel application to very complex, multi-channel, multi-phase tests
- Catch defects missed by conventional testers by introducing the advanced data collection, analysis, and reporting capabilities that make the sigPOD the best defect detection system on the market
- Optimize test algorithms or isolate root cause right on the test stand based on thousands of complete stored test records, or manage your test data from your desktop by connecting your sigPODs to Sciemetric's QualityWorX data management software
- Reduce training costs, minimize operator error, and slash sparing and maintenance costs by standardizing on a common test and monitoring platform

FEATURES

- **Compact, industrial packaging** offers a range of mounting options; NEMA 12 (IP 52) models also available.
- **Unmatched data collection with up to 24 synchronous analog channels,** 16 bit A/D, and up to 1 MHz sampling rate, and as many as 4 encoder input channels on a single unit, with an additional 64 encoder channels available via expansion modules.
- **Fast and flexible test setup:** configure up to 100 model types, each with their own unique configuration and calibration.
- **Intuitive operator interface,** with fully configurable password lock-out of higher level functions.
- **Quickly drill down into detailed historical results** to identify failure trends or review process signature details right on the test stand.
- **Powerful processing and extensive library** of 26 processes includes filters, derivatives, waveform math and more.
- **Accurate pass/fail determination** derived from as many as 10 scalar features for each waveform – choose from 31 analysis feature types, including statistically generated envelopes.
- **Detailed data management and reporting** featuring the industry's greatest storage capacity and built-in SPC.
- **Superior connectivity:** communicate with station controller via discrete I/O; optional fieldbus support for industry standard hardware (RS232, RS485, 10/100 BaseT) and protocols (EtherNet/IP, Modbus TCP, PROFINET).

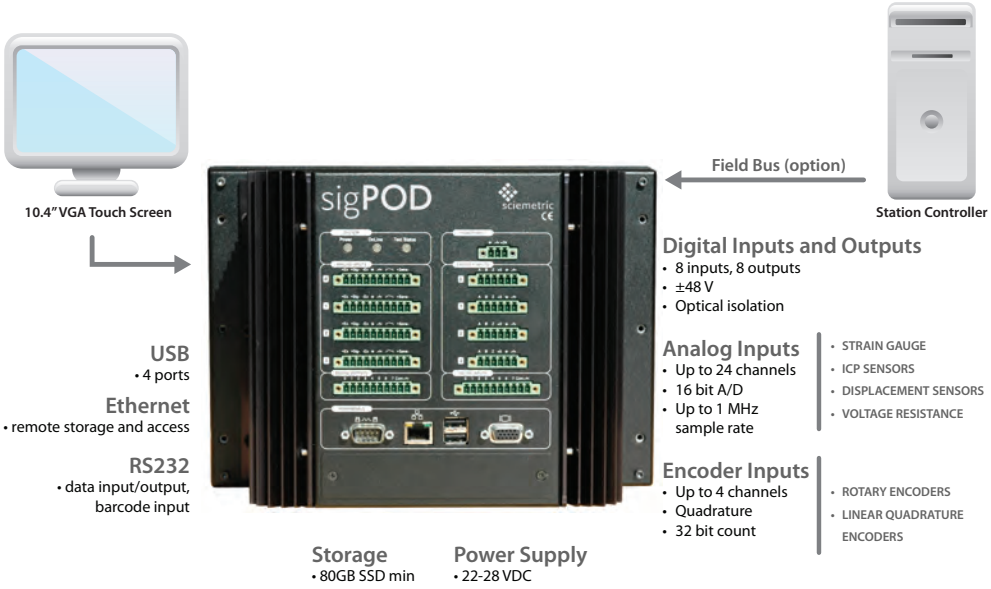
APPLICATIONS

- **Press-fit Monitoring**
- **Torque-to-Turn**
- **Resistance Weld**
- **Noise, Vibration, Harshness (NVH)**
- **Thermal Package Sealing**
- **Fluid Dispense**
- **Functional Test**
- **Leak Test**
- And many more!

OVERVIEW

Sciemetric's sigPOD is the industry's most versatile and powerful test and monitoring platform. With five different models offering a wide array of measurement capabilities, sigPOD can handle just about any application from simple press monitoring to complex, multi-stage functional tests. This unique versatility allows you to deploy the sigPOD across your entire manufacturing line, reducing training, support, and maintenance costs, while eliminating the need for developing expensive custom monitoring solutions in situations where traditional purpose-built testers do not satisfy requirements.

Central to the sigPOD's unmatched flexibility is the powerful, fully configurable PSV (Process Signature Verification) application software that comes pre-loaded on every unit. Using an intuitive menu-driven, point-and-click approach, new test applications can be developed and deployed in minutes, without the need for any programming. Or simply upload a pre-configured template and instantly change the personality of the sigPOD to match your immediate requirements. And with every application incorporating the most advanced defect detection technology available today, sigPOD PSV generates near instant ROI through improved product quality and yield.



CONFIGURING AND RUNNING A TEST

One of the biggest challenges with deploying a test or monitoring solution is developing a test setup that matches the specific requirements. In many cases, purpose-built, off-the-shelf solutions do not offer the required flexibility or functionality and you are faced with the daunting task of creating a complete hardware and software setup from scratch. sigPOD PSV allows you to quickly create a solution perfectly tailored to your application by providing you with a comprehensive lineup of data acquisition hardware paired with flexible and powerful application software.

A simple test can be created in just five steps, enabling you to be up and running in minutes.

Step 1: Connect and calibrate your sensors.

Step 2: Set up your data collection – create your models, operations and waveforms.

Step 3: Set up your data processing and analysis – configure waveform processing, signature analysis and feature limits.

Step 4: Configure your communications – establish communication with PLCs or other supervisory systems.

Step 5: Start your test.

Your complete test configuration can be quickly saved, along with calibration data, test data and other system settings, allowing you to easily back-up your work, or instantly duplicate your test on another sigPOD. Sample configurations are available for download on www.support.sciemetric.com to get you started even more quickly. The table below lists examples of some typical applications, including the types of defects that can be detected.

	MANUFACTURING EXAMPLES	DEFECTS DETECTED
Press	Bearing assembly insertion, alternator diode insertion, cylinder liner, fuel injector press	• Tapered hole • Bowed hole • Debris
Torque-to-Turn	Electric motor testing, engine cold test, transmission testing, axles, gas cap	• Poor lubrication • Poorly fitting sub-components • Debris/contamination
Resistance Weld	Pacemaker lead attach, vehicle assembly, battery cell assembly	• Expulsions • Electrode force • Electrode wear
Fluid Dispense	Valve cover, oil pan cover (engine assembly), dialysis filter seal	• Bubble formation • Partial hardening • Incorrect pressure
Thermal Package Sealing	Medical device packaging, pharmaceutical packaging	• Voids • Incomplete seal • Subjective noise
Noise-Vibration-Harshness Testing	Wheelchair motor testing, engine cold test, axle test, power steering vane pump, fuel pumps, bearing test, transmission	• Debris • Nicked gears • Concentricity
Leak	Engine chambers, cup plug test, valve seat test, oil cavity, fuel rail helium, oil gallery plug test, seal testing of medical components and devices	• Loose/damaged plugs • Blow holes • Casting porosity

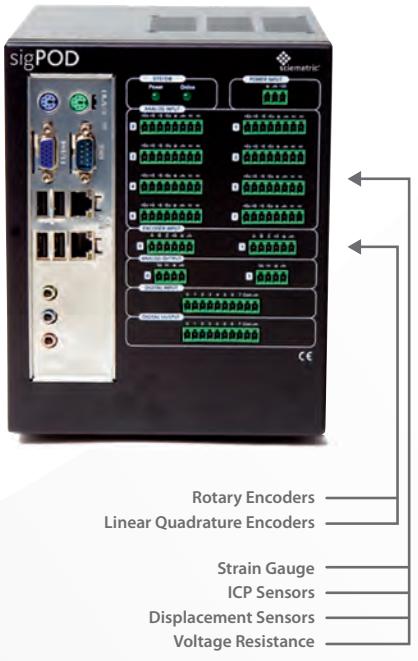
STEP 1: CONNECT AND CALIBRATE YOUR SENSORS

At the heart of sigPOD PSV is a powerful data collection engine that can sample as many as 8 analog inputs on a single sigPOD. With the addition of two 1608 USB Expansion Modules, this can be expanded to a total of 24 channels. Each input provides a flexible, high resolution analog measurement with the following characteristics:

- **A/D resolution: 16 bit A/D**
- **Sampling rates: up to 1MHz (depending on model)**
- **Differential inputs**
- **Per channel, independent measurement ranges, settable from 33 mV to 10 V full scale (depending on model)**

A built-in calibration utility makes sensor calibration a breeze, offering manual, one point and N point calibration options.

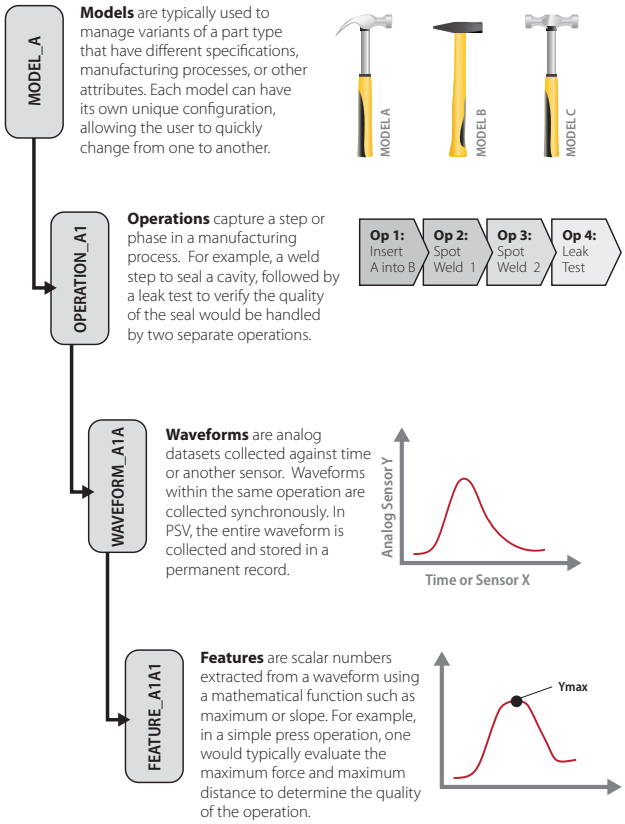
Each sigPOD unit comes with 1 to 4 encoder inputs, depending on the model. These can be used to measure the rotary position of such things as a crankshaft or torque spindle, or for linear displacement data such as with a SONY DL probe. Encoder inputs can be configured to monitor a single phase pulse (counter mode), or a two phase A-B pulse to track direction (quadrature mode).



STEP 2: SET UP YOUR DATA COLLECTION

The sigPOD's PSV software offers a number of features that provide the flexibility necessary to accommodate the complexities of your manufacturing process. For instance, in many cases, multiple model types can be assembled or tested at the same station, where each model may have a different test configuration. sigPOD PSV can store independent configurations for up to 100 different model types, each of which can be easily selected from the main screen, via digital I/O or fieldbus[2]. Each model type can have a custom description to identify it from the others, and has a unique set of data collection and analysis parameters. This could include everything from the sensor calibrations, to the processing and analysis applied to the waveforms, to the limits applied to the features.

Within each model, sigPOD PSV offers the option to define multiple *operations*. Operations allow the user to define up to 15 sequential tests or process steps, each of which can have its own set of waveforms, processing, analysis and pass/fail results. Using operations, a single sigPOD can be used to monitor multiple phases within a manufacturing process. For example, an assembly process where two parts are first pressed together, then spot welded in place, could be monitored by a single sigPOD, where the pressing step and welding step are captured by two separate operations. In this way, a single sigPOD can replace multiple dedicated monitoring or test devices, thereby lowering capital costs, simplifying the test setup, and consolidating the storage and analysis of the test data. See the figure to the right for an illustration of how *Models, Operations, Waveforms* and *Features* are organized within the Sciemetric data structures.



STEP 3: SET UP DATA PROCESSING AND ANALYSIS

Advanced data analysis is one of the keys to the sigPOD's superior defect detection capabilities. By allowing the test engineer to choose from a comprehensive library of signal processing and feature analysis algorithms, the sigPOD is able to isolate and identify more defects than any other tester — of any type — on the market today.

Powerful Processing

The first step in the data analysis is the application of signal processing to the measured data to enhance any features that are related to the presence of defects. First, the raw sensor data is plotted vs. time, a position sensor or any other sensor that was part of the same data collection, to create what is referred to as a "waveform". PSV can then apply one or more signal processing steps to any waveform to improve signal to noise ratios, exploit a specific feature or anomaly within the sensor data or convert the data from the time to frequency domain. In all, there are 26 processes available within PSV.

26 AVAILABLE PROCESSES

Absolute Value	Min track
FFT	Max track
Running RMS	Notch filter
Clipper	Pop noise filter
Derivative	Remove DC filter
Extract waveform	Waveform math
High Pass filter	Remove reversed data
Low Pass filter	Remove idle data
Bandpass filter	Knock detect
Integral	Smoother
Linear	Swap X & Y inputs
Synch average	Merge X & Y inputs
Make line	Store Y to temp waveform

2 Model selection via digital I/O and fieldbus restricted to first 16 models only.

Up to 15 processes can be cascaded and applied to each waveform. For example, you could perform waveform math to multiply two waveforms together, apply a low pass filter to remove measurement noise, and then run an FFT to convert to the frequency domain for analysis.

Thorough Analysis

Once the raw data has been processed, the sigPOD must apply unambiguous criteria to evaluate whether the part meets requirements, and is free of defects. Typically this is done by extracting one or more "features" from the processed waveforms, such as a peak, an average, or a slope, and comparing it against limits that differentiate between good and bad parts. For example, we might want to evaluate the maximum displacement in a force vs. distance curve to identify if the press traveled far enough to ensure proper seating. Or, if the difference between good and bad parts cannot be easily determined by a simple feature check, PSV also offers the ability to apply a statistically derived envelope to the entire waveform, allowing the software to automatically check the "shape" of the waveform for compliance.

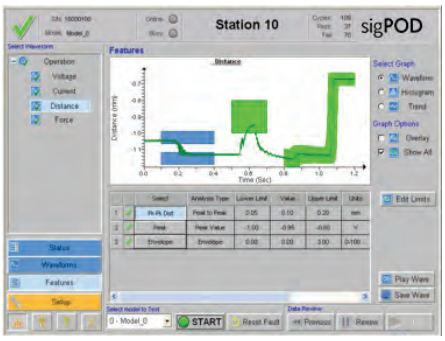
PSV offers 31 powerful feature checks to evaluate the waveform data. Up to 15 feature checks can be applied to the same waveform, all within the same test.

Feature values can be stored to temporary registers where they can then be used as input parameters for extracting other features, or in custom calculations using the built-in calculator.

This waveform processing and analysis can also be applied to previously saved data, allowing the user to quickly review the results of any processing and feature changes. This streamlines the setup process and eliminates the need to re-test production parts to evaluate the outcome of process or limit changes.

31 POWERFUL FEATURE CHECKS

Area	Waveform length
Knee value	Power sum
Knee Location	Get Y at X
Envelope	Slope
Number of points	Minimum value
Mean	Location of minimum value
Rise/Fall time	Peak RMS
True area	Peak value
Median	Peak location
Standard deviation	Total Harmonic Distortion
Peak to peak	Cusp value/location
Threshold count	Area below/above x-axis
Threshold crossing	Fit window
Custom Math	



Features view with multiple features displayed

STEP 4: CONFIGURE COMMUNICATION OPTIONS

The sigPOD can act alone to monitor the manufacturing process, or can be interfaced with a station controller for fully automatic operation. To support the automated mode, all sigPODs offer numerous connectivity options for communicating with 3rd party hardware such as PLCs or machine controllers. All models offer 8 digital inputs and 8 digital outputs, which are typically used for external triggering, model selection, and resetting the system. PSV also supports one of the widest arrays of fieldbuses in the industry, including EtherNet/IP, PROFINET, Modbus TCP.

Communication hardware options include RS232 serial and 10/100 Base T Ethernet, depending on the model. Serial numbers can be received over these interfaces to provide traceability to the test results. Numeric test results can also be transmitted via fieldbus or serial output in simple ASCII format, allowing data integration with most MES or ERP systems.

Digital I/O Settings Page

STEP 5: START YOUR TEST

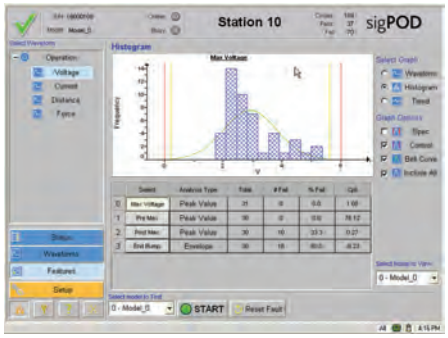
In execution or *run-time mode*, sigPOD PSV provides simple, intuitive operator screens specifically designed for a production manufacturing environment, with one button menu choices to allow the user to navigate and view test information. High level status screens allow operators to quickly assess the status of the manufacturing process, while more detailed results and graphs are available to 'drill down' right at the test station. Graphs can be made full screen, panned and zoomed for more thorough analysis of the results. A simple backup and restore interface also allows users to quickly create system or data backups. To avoid accidental changes to the configuration, access to the setup screens can be restricted to only certain users, based on their user ID and password.

Status View – Main

DATA MANAGEMENT AND REPORTING

Three Ways to View and Analyze sigPOD Data

1. Maximize the value of the sigPOD by putting the data collected to work to help reduce downtime, quickly diagnose station issues and improve both manufacturing quality and yield. Use the sigPOD's comprehensive SPC reporting to track test results right on the test stand even while the system is monitoring production. Local data storage for thousands of production cycles provides traceability for recent production.

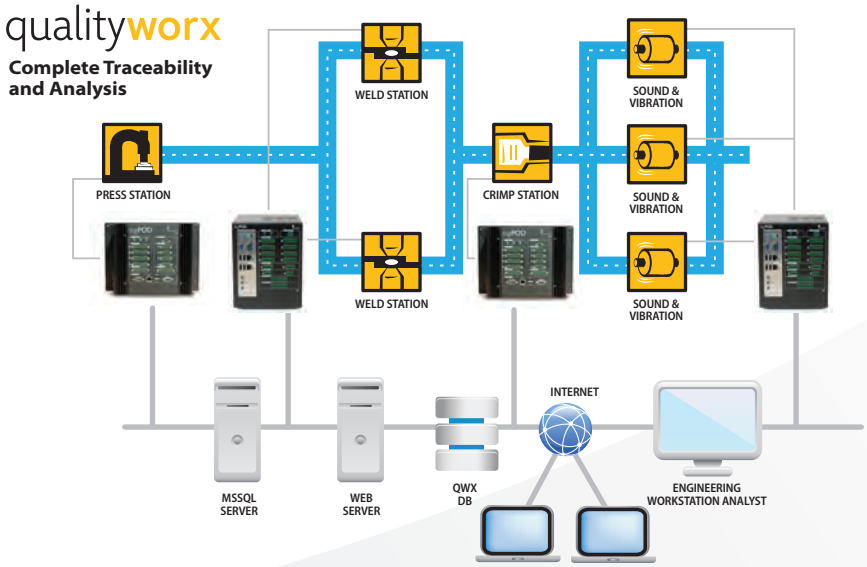


Features view – SPC Histogram

2. Use Sciemetric Studio software on your desktop to analyze part data and waveforms. Find trends, simultaneously view data from multiple test records and from multiple test stations and more. Drag and drop records to be analyzed into a project or use the optional Remote Store to push data from a sigPOD to the location of your choice for easy access.

Sciemetric Studio LT

3. For long-term traceability, real-time reporting and analytics, connect all of the sigPODs and other systems on the production line to a QualityWorX database. Track production KPIs using dashboards, create reports that provide deep drill-downs to the part level and conduct in-depth, what-if analysis to determine the root causes of issues affecting quality and productivity.



TECHNICAL SPECIFICATIONS

Power

- **Supply Voltage:** 24 VDC (22 to 28 VDC)
- **Power Consumption:** 75 W maximum, 40 W typical

Processor

- **System Memory:** System Memory: 2-4 GB RM (Depending on the Model)
- **Data Memory:** 80 GB SSD minimum
- **Ethernet:** 1 (Model 12xx) or 2 (Model 1508) ports
- **USB:** 2 or 4 (V 2.0)
- **RS232:** 1
- **Monitor:** SVGA Connector
- **Keyboard/Mouse:** PS2

General

- **Operating Temperature:** 5 to 45 ˚C
- **Environment:** IP52 (NEMA 12) Model 12xx or panel mounted 1302 with integrated display only
- **Paint Finish:** Black backed powder

Digital Inputs

- **Number of Channels:** 8 with common return line
- **Polarity:** Bidirectional
- **Isolation Voltage:** ±120 V (Optically isolated)
- **Input current:** Less than 2.3 mA
- **Input for low state:** 8 VDC maximum
- **Input for high state:** 16 VDC minimum
- **Maximum input Voltage:** ±48 V
- **Switching speed:** 2 msec

Digital Outputs

- **Number of Channels:** 8 with common return line
- **Polarity:** Bidirectional
- **Isolation Voltage:** 120 V (optically isolated)
- **Switching Capability:** ±1 A @ ±48 VDC or VAC peak
- **Contact Resistance:**
  > 100 M ohms off
  <0.5 ohms on
- **Power on State:** All off
- **Switching Speed:** 8 msec

Analog Excitation

- **Excitation Voltage:** +10 VDC
- **Maximum Current:**100 mA per channel
- **Accuracy:** ±0.1 %
- **Maximum Noise:** 100 µV
- **Short Circuit Protection:**
  Continuous

Encoder Input

- **Number of Channels:** See model chart
- **Sensors:** Rotary encoders and linear scales
- **Input Voltage:** 5 V TTL or OC (Open Collector)
- **Signal Type:** Quadrature or single phase
- **Max Input Frequency:**
  10 MHz TTL, 50 kHz Open Collector
- **Counter:** 32 bit (±2 x 10^9 counts)
- **Input Protection:** +24 V or -18 V without damage
- **Sensor Power:** +5 VDC @ 150 mA, current limited

Analog Input

- **Number of Channels:** 2, 4 and 8 (16 and 24 channels available with 1608 expansion module)
- **Input Ranges:**
  ±10V, ±5V, ±1V, ±200 mV (Model 1508, 16xx)
  ±10V, ±2V, ±1V, ±100 mV, ±33 mV (Model 12xx)
- **Input Accuracy:**
  ±0.02% for ±1 V range and greater;
  ±0.05% for ranges less than 1 V
- **Resolution:** 16 bit A/D, ±32,768 counts
- **Maximum Sample Rate:** 250 kHz (1 MHz Model 1508)
- **Input Impedance:** 10 Gohms in parallel with 100 pF (820 ohms no power)
- **Small Signal Bandwidth:**
  1.7 MHz (Model 1508)
  20 kHz (Model 12xx)
- **Cross Talk:** 75 dB adjacent channels, 90 dB non-adjacent channels
- **CMRR:** (DC to 60 Hz)
  75 dB (Model 12xx)
  100 dB (Model 1508)
- **Overload Protection:** ±25 V for up to 2 channels powered and ±15 V when off.

Test

- **Models / Recipes:** 100
- **Operations per model:** up to 15
- **Waveforms per operation:** up to 20
- **Features per waveform:** up to 15
- **Typical analysis time:** <400ms (dependant on complexity of analysis)
- **Response to trigger :** < 50ms

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	1202/1204	1508	1608 Expander
Software			
Configurable Application Software	✔	✔	-
Customer Application Software	✔	✔	-
Analog I/OS			
Number of Analog Channels	2/4	8	8
Expandable with 1608	✔	✔	-
High Speed Sampling (250 kHz)	✔	-	✔
Ultra-High Speed Sampling (1 MHz)	-	✔	-
Analog Output Channels (2)	-	✔	✔
Encoder Inputs			
Encoder Channels	2/4	2	2
Digital I/OS			
Digital In/Digital Out Channels	8/8	8/8	8/8
Display Options			
Integrated Touch-screen Display	10.4"	-	-
Optional 10.4" External Touch-screen	✔	✔	-
Environmental Rating			
NEMA 12 Rated Enclosure (IP 52)	✔	-	-
Mounting			
Machine Mount	✔	-	-
Panel Mount	✔	-	-
Wall Mount	Non TFT only	✔	✔
DIN Rail	✔	✔	✔

ABOUT SCIEMETRIC

Since 1981, Sciemetric technology and products have enabled the automotive, medical, industrial and manufacturing sectors to gain full visibility and control over their manufacturing processes. Sciemetric's process signature verification technology enables understanding of the physical behavior of machines and assembly systems; thereby, detecting defects previously thought to be undetectable. Sciemetric solutions help companies reduce costs, improve quality, maximize yield and increase traceability.

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