



CONDITION  
MONITORING  
SOLUTIONS

SENSOMICS LTD

The Sentry G3 Machinery Protection Monitor is a high performance signal conditioning unit; providing a universal platform for the interfacing of various sensor types in compliance with the API 670 standard. Each of the four channels can be independently programmed to provide continuous monitoring and protection facilities across a broad spectrum of measurement regimes (including vibration, expansion, temperature, speed, etc). Utilising the latest DSP technology, once a channel is set up and running, the resulting alarm relay and analogue output facilities are independent from the remaining module functionality, resulting in a scalable high integrity configuration.

The module is provided with an intuitive colour LCD display and drive facility to provide immediate viewing and access to the machine parameters. Several modes of display are available including bar graph, FFT and an alarm historian.

The module provides the necessary power source for the selected transducer, providing for 2 (ICP type) or 3 – wire accelerometer variants,  $\pm$  24V proximity probe systems, LVDTs and a range of speed & temperature sensors.

Each transducer signal is buffered and available via the front panel analogue connection arrangement and a USB interface is provided for programming of the unit and storage of channel history and settings.

The unit is designed for mounting in a custom 19 inch rack assembly which also contains a dual redundant power supply option. The G3 system offers excellent channel density with up to 24 measurement channels in a 3U format.

Each channel can provide independent analogue outputs of current and voltage for DCS connection in addition to an alarm relay. Further alarm relay expansion is possible through connection to digital outputs at the rear of the module.



**Machine Measurement Modes**

- Absolute and Relative Vibration
- Displacement and Thrust Position
- Speed, Phase and Reverse Rotation
- Differential and Casing Expansion
- Rod Drop
- Temperature

**Turbine Specialist Measurement Modes**

- Shaft Eccentricity
- Differential Ramp Expansion
- Rotor / Stator Air Gap
- Overspeed



**Flexible Configuration**

- LPF, HPF, Tracking and Notch Filters
- Programmable Warning and Danger Alarms with Relay Logic
- Cross-Channel Voting
- Harmonic and Phase Analysis
- Programmable Transducer Supply
- Scaleable Module Hardware with plug in DSP card, up to four channels
- Dual Redundant Power Supply
- USB Programmable
- Dual Redundant Modbus RS485
- Park and Calibration modes

**Absolute Vibration**

*Selectable Measurement Modes*

AM1	Overall Level, Band limited (LPF & HPF)
AM2	Overall Level, Fixed HPF & Tracking LPF
AM3	Overall Level, Fixed HPF & Tracking Notch
AM4	Fund and Harm Magnitude & Phase

Configurable Warning and Danger, negative and positive going alarms per channel.

*Measurement Units*

Select from Acceleration (m/s<sup>2</sup> or g), Velocity (mm/s or ips) and Displacement (um or mil).

Select from average, rms, pk, pk to pk, pk / rms or dB referenced to 20Log<sub>10</sub>(1.0V).

*Filter Characteristics*

*Low Pass*

Programmable 3dB, 100Hz to 10kHz  
 Roll off >24dB / Octave  
 Setting resolution 1%  
 Tracking ratio of 0.1 to 10 of incoming Tacho  
 Tacho division (multi tooth wheel) 1 to 60

*High Pass*

Programmable 3dB, 0.1Hz to 100Hz  
 Roll off >24dB / Octave  
 Setting resolution 1%

*Notch Filter*

Programmable, 100Hz to 10kHz  
 Constant Q, 35dB rejection  
 Setting resolution 1%  
 Tracking ratio of 0.1 to 10 of incoming Tacho  
 Tacho division (multi tooth wheel) 1 to 60

*Measurement Range, Accuracy and Resolution*

*For AM1 & AM2 measurements*

Maximum range setting  
 Acceleration 0 – 100.0g, ±0.2% typ, ±1.0% max  
 Velocity 0 – 100mm/s, ±0.2% typ, ±1.0% max  
 Displacement 0 – 1000um, ±0.2% typ, ±1.0% max  
 Resolution of displayed readings better than 1%

*For AM3 measurements*

Maximum range setting  
 Acceleration 0 – 100.0g, ±1.0% typ, ±3.0% max  
 Velocity 0 – 100mm/s, ±1.0% typ, ±3.0% max  
 Displacement 0 – 1000um, ±1.0% typ, ±3.0% max  
 Resolution of displayed readings better than be 1% min

*For AM4 measurements*

Maximum range setting  
 Acceleration 0 – 100.0g, ±2.0% typ, ±5.0% max  
 Velocity 0 – 100mm/s, ±2.0% typ, ±5.0% max  
 Displacement 0 – 1000um, ±2.0% typ, ±5.0% max  
 Phase 0 - 360°, ±1.0° typ, ±5.0° max  
 Resolution of displayed readings better than 1%

*Noise Floor*

Acceleration	0.001g rms typ
Velocity	0.02mm/s rms typ
Displacement	0.05um pk typ

*Transducer Configurations*

Accelerometer	
Sensitivity Range	10.00mV/g to 10.00V/g
Standard ICP option	+24V or -24V
3/4 – wire option	+24V, -24V or +12V

Velocity Transducer	
Active or Passive option	
Sensitivity Range	1mV/mm/s to 50mV/mm/s
Standard ICP option	+24V
3/4 – wire option	+24V or +12V

Transducer Integrity	
Active device range	-19.0V to +19.0V
Passive device	O/C and S/C detection

**Relative Vibration**

*Selectable Measurement Modes*

AM1	Overall Level, Band limited (LPF)
AM2	Overall Level, Tracking LPF
AM3	Overall Level, Tracking Notch
AM4	Smax, Fund and Harm Magnitude & Phase
AM5	Absolute Shaft Vibration
AM6	Overall Level, dual mode eccentricity

Configurable Warning and Danger positive going alarms per channel.

*Measurement Units*

Displacement (um or mil), pk or pk to pk,

*Filter Characteristics*

*Low Pass*

Programmable 3dB, 100Hz to 10kHz  
 Roll off 24dB / Octave  
 Setting resolution 1%  
 Tracking ratio of 0.1 to 10 of incoming Tacho  
 Tacho division (multi tooth wheel) 1 to 60  
 Gap Filter Fixed 3dB at 0.5Hz, 16 sample average

*High Pass*

Fixed 3dB at 0.8Hz, AM1 to AM5  
 Fixed 3dB at 0.015Hz, AM6  
 Roll off >24dB / Octave

*Notch Filter*

Programmable, 100Hz to 10kHz  
 Constant Q, 35dB rejection  
 Setting resolution, 1%  
 Tracking ratio of 0.1 to 10 of incoming Tacho  
 Tacho division (multi tooth wheel) 1 to 60

*Measurement Range, Accuracy and Resolution*

*For AM1 & AM2 measurements*

Displacement 0–1000um max, ±0.2% typ, ±1.0% max  
 Resolution of displayed readings better than 1%

*For AM3 measurements*

Displacement 0–1000um max, ±1.0% typ, ±3.0% max  
 Resolution of displayed readings better than 1%

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### For AM4 measurements

Displacement 0–1000um max,  $\pm 2.0\%$  typ,  $\pm 5.0\%$  max  
Phase 0 - 360°,  $\pm 1.0^\circ$  typ,  $\pm 5.0^\circ$  max  
Resolution of displayed readings better than 1%  
Smax accuracy  $\pm 5.0\%$  max

### For AM5 measurements

Displacement 0–1000um max,  $\pm 2.0\%$  typ,  $\pm 5.0\%$  max  
Resolution of displayed readings better than 1%

### For AM6 measurements

Displacement 0–1000um max,  $\pm 2.0\%$  typ,  $\pm 5.0\%$  max  
Resolution of displayed readings better than 1%  
Low Speed mode measurement – true pk-pk  
High Speed mode measurement – rms calculated pk-pk  
LSM to HSM transition 0 – 50,000 rpm

### Noise Floor

Displacement 0.05um pk typ

### Transducer Configuration

Eddy Current / Proximity Probe  
Sensitivity Range 1.00mV/um to 10.00mV/um  
Fixed Options 3.94mV/um & 7.84mV/um  
4 – wire system -24V @ 40mA max  
Integrity window -19.0V to -1.0V  
Gap measurement -20.0V to -0.1V

## Thrust / Differential Expansion

### Measurement Modes

AM1 Relative Expansion,  $Y = mX + c$   
Y is the desired calibrated measurement  
X is the proximity probe measured value  
m is a scaling factor resulting from calibration  
c is an offset factor resulting from calibration

AM2 Complementary Expansion, switches between 2-channels around collar arrangement to enhance measurement range, each channel calibrated  $Y = mX + c$ .

AM3 Dual Ramp Expansion, utilises 2-channels on a ramp collar arrangement (Chan A – Chan B) / 2, each channel calibrated  $Y = mX + c$ . Optional LVDT Case Expansion Calculation (Chan C).

Dual level, configurable negative and positive going alarms per channel.

### Measurement Units

Displacement mm, um, mil or inch

### Filter Characteristics

#### Low Pass

Measurement Filter 400Hz, 128 sample average  
Gap Filter Fixed 3dB at 0.5Hz, 16 sample average

### Measurement Range, Accuracy and Resolution

Displacement 0–100mm max,  $\pm 0.2\%$  typ,  $\pm 1.0\%$  max  
Resolution of displayed readings better than 1%

### Transducer Configuration

Eddy Current / Proximity Probe  
Sensitivity Range 0.1mV/um to 10.00mV/um  
Fixed Options 3.94mV/um & 7.84mV/um  
4 – wire system -24V @ 40mA max  
Integrity window -19.0V to -1.0V  
Gap measurement -20.0V to -0.1V

## Speed

### Measurement Parameters

Frequency Range	0.02Hz to 20kHz
Accuracy	$< \pm 0.1\%$ of reading
Resolution	$< \pm 0.1\%$ of full scale
Dynamic range	100mV pk-pk – 20V pk-pk
Measurement Range	0 – 50,000 rpm 0 – 1000 Hz

### Input Settings

Teeth Setting Range	1 – 256
Threshold mode	Manual Level
Threshold detection	Transition
Manual detection setting	+19.0V to -19.0V

### Overspeed Mode

The Overspeed mode when set shall capture maximum machine speed event following a shutdown. This positive going alarm can be allocated to an appropriate relay.

Overspeed Mode	Auto / Manual
Overspeed Trigger	0 – 50,000rpm

### Zerospeed Alarm

The zerospeed alarm is raised when the shaft rotation drops below a set speed. This negative going alarm can be allocated to an appropriate relay.

Zerospeed detection period 1 – 60 seconds

### Over Acceleration Alarm

The acceleration alarm is raised if the rate of change of speed exceeds the set percentage. This positive going alarm can be allocated to an appropriate relay.

Acceleration Setting	1 – 1000%
Acceleration Start	100 – 50000 rpm

### Transducer Configuration

Eddy Current / Proximity Probe option  
Sensitivity 3.94mV/um & 7.84mV/um  
4 – wire system -24V @ 50mA max  
Integrity window -19.0V to -1.0V  
Gap measurement -20.0V to -0.1V  
Gap Filter Fixed 3dB at 0.5Hz, 16 sample average

Other Probe options  
Passive Magnetic Probe 2-wire 10kOhm  
Active Magnetic Probe 2-wire +12V 10kOhm  
Active Magnetic Probe 3-wire +12V 10kOhm

## Phase Reference (1/rev)

### Measurement Mode

When a DSP channel is configured in this mode a phase reference is generated for use by other channels configured in the absolute or relative vibration modes. Up to two channels per module can be configured as a phase reference. The phase reference is selectable from any other module channel connected to the rack system.

*Measurement Parameters*

Frequency Range	0.02Hz to 20kHz
Accuracy	< ±0.1% of reading
Resolution	<±0.1% of full scale
Dynamic range	100mV pk-pk – 20V pk-pk
Measurement Range	0 – 50,000 rpm 0 – 1000 Hz
Buffered Output	TTL

*Input Settings*

Threshold mode	Manual
Threshold detection	Positive Edge
Manual detection setting	+19.0V to -19.0V

*Transducer Configuration*

Eddy Current / Proximity Probe option	
Sensitivity	3.94mV/um or 7.84mV/um
4 – wire system	-24V @ 40mA max
Integrity window	-19.0V to -1.0V
Gap measurement	-20.0V to -0.1V

Gap Filter Fixed 3dB at 0.5Hz, 16 sample average

Other Probe options	
Passive Magnetic Probe	2-wire 10kOhm
Active Magnetic Probe	2-wire +12V 10kOhm
Active Magnetic Probe	3-wire +12V 10kOhm

**Casing Expansion / Valve Position (LVDT)**

*Measurement Mode*

Expansion or Position,  $Y = mX + c$   
 Y is the desired calibrated measurement  
 X is the LVDT measured value  
 m is a scaling factor resulting from calibration  
 c is an offset factor resulting from calibration

Dual level, configurable negative and positive going alarms per channel.

*Measurement Units*

Displacement mm, um, mil, inch or % of stroke

*Measurement Range, Accuracy and Resolution*

Displacement 0–1000mm max, ±0.2% typ, ±1.0% max  
 Resolution of displayed readings better than 1%

*Transducer Drive*

AC LVDT	
Amplitude Voltage	3.5Vrms typ
Frequency	3kHz ± 5%

*Integrity Alarms*

Invalid measurement alarm is raised if reading falls outside of calibrated stroke range. Transducer integrity alarm raised on loss of valid signal from secondary winding.

**Temperature**

*Measurement Mode*

Two channels of temperature measurement are available for each DSP channel. The DSP channel is fixed to a particular sensor type.

*Measurement Units*

Temperature °C or °F

*Measurement Range, Accuracy and Resolution*

RTD	-20 °C –150 °C, ±0.5% typ, ±1.0% max Sensitivity 10mV / °C
K-type	-20 °C – 1000 °C, ±0.5% typ, ±1.0% max Sensitivity 41uV / °C Junction compensated

Resolution of displayed readings better than 1%

*Integrity Alarm*

Transducer integrity alarm raised on loss of valid signal from transducer.

**Reverse Rotation**

*Measurement Mode*

When two DSP channels are configured in this mode a phase reference is generated by each channel for detection in the module of reverse rotation against a multi-toothed target. Consult Sensonics for details regarding the precise positioning requirement of the probes.

*Measurement Parameters*

Frequency Range	0.02Hz to 20kHz
Accuracy	< ±0.1% of reading
Resolution	<±0.1% of full scale
Dynamic range	100mV pk-pk – 20V pk-pk
Buffered Output	TTL

*Input Settings*

Threshold mode	Manual
Threshold detection	Transition
Manual detection setting	+19.0V to -19.0V

*Transducer Configuration*

Eddy Current / Proximity Probe option	
Sensitivity	3.94mV/um or 7.84mV/um
4 – wire system	-24V @ 40mA max
Integrity window	-19.0V to -1.0V
Gap measurement	-20.0V to -0.1V
Gap Filter Fixed 3dB at 0.5Hz, 16 sample average	

Other Probe options	
Passive Magnetic Probe	2-wire 10kOhm
Active Magnetic Probe	2-wire +12V 10kOhm
Active Magnetic Probe	3-wire +12V 10kOhm

Threshold mode	Auto / Manual
Threshold detection	Pulse / Gap
Manual detection setting	+19.0V to -19.0V

**Forward and Reverse Alarm**

Two alarms are available to provide the status of the rotating shaft. Each alarm can be allocated to an appropriate relay.

**Zerospeed Alarm**

The zerospeed alarm is raised when the shaft rotation drops below a set speed. This negative going alarm can be allocated to an appropriate relay.

Zerospeed detection period 1 – 60 seconds

**Rod Drop**

**Measurement Mode**

The Rod Drop measurement mode monitors the position of a piston rod synchronised to a once per revolution phase reference (configured in a separate channel). Alarm functions are available for relative change in rod position from calibration point and for rod vibration. These positive going alarms can be allocated to an appropriate relay.

**Measurement Units**

Displacement, mm, um, mil or inch

**Measurement Range, Accuracy and Resolution**

Displacement 0–4mm max, ±0.2% typ, ±1.0% max  
 Vibration 0–1000um max, ±0.2% typ, ±1.0% max

Resolution of displayed readings shall be < 1%

Average Rod Drop calculated when no sync pulse available.

**Transducer Configuration**

Eddy Current / Proximity Probe  
 Fixed Options 3.94mV/um & 7.84mV/um  
 4 – wire system -24V @ 40mA max  
 Integrity window -19.0V to -1.0V

**Rotor to Stator Air Gap**

**Measurement Mode**

The Rotor to Stator Air Gap mode monitors the stator wall gap to the rotor poles synchronised to a once per revolution phase reference (configured in a separate channel). Suitable for hydro turbine generator applications the system utilises readings from suitable capacitive displacement probes fixed at positions around the stator.

Dual level, configurable negative and positive going alarms per channel.

**Measurement Units**

Gap, mm or inch

**Measurement Range, Accuracy and Resolution**

Gap 2–32mm, ±1.0% typ, ±2.0% max  
 Resolution of displayed readings shall be < 1%

Gap measurement provided for average, maximum and minimum with pole number for max and min.

No. of Poles or samples per revolution, 2 to 128.

**Transducer Configuration**

Capacitive Proximity Probe  
 Sensitivity 333mV/mm  
 4 – wire system +24V @ 150mA max  
 Integrity window 0.1V to 9.9V

**Common Alarm Features**

**Parameter Alarms**

Two parameter alarms (A1 and A2) are available per channel, programmable within the set measurement range. Hysteresis, Latching mode and Delay are configurable.

Hysteresis 1 to 10%, resolution 1%  
 Delay 1 to 60s, resolution 0.1s  
 Mode Latching or Fleeting

For displacement measurements (e.g. thrust, differential expansion, air gap, etc.) each parameter alarm can be configured for both positive and negative going values for window alarming.

For speed measurements each parameter alarm can be configured for either positive or negative going.

**Integrity Alarms**

The A3 and A4 alarms are allocated to transducer integrity and channel / gap integrity respectively. Hysteresis, Latching mode and delay are configurable.

Hysteresis 1 to 10%, resolution 1%  
 Delay 1 to 60s, resolution 0.1s  
 Mode Latching or Fleeting

**Relay Alarms**

A single relay is available per channel; this can be allocated to an alarm or group of alarms as required and configured for energised or de-energised to alarm.

For further relay expansion eight channels of Alarm I/O are available at the rear terminals for allocation to available alarm parameters.

**Summary Alarms**

A single open collector line at the rear terminals is allocated to a 'First up' Alarm for identification of the primary channel alarm in the system rack.

**Channel Defeat**

Individual channels can be configured to defeat parameter alarms in the event of an integrity alarm. During defeat all other channel interfaces operate as normal.

**Alarm Historian**

All alarm events are stored and time stamped for later access through the front panel display and drive facility. Capacity to store 100 events with a download facility.

**Alarm Reset**

All latched alarm events or individual channel latched alarms can be reset through the front panel display and drive facility.

**Park Enable**

The Park function permits the analogue outputs to be forced to a preset value in the event of a transducer alarm (user software control only)

**Analogue Outputs**

*Current and Voltage Outputs*

Two analogue outputs are available per channel, configurable for either 4 – 20mA or 0 – 10V.

Accuracy	±0.5% of range
Amplitude Linearity	± 1% of range

The analogue output is set across the measurement range as standard.

**Buffered Outputs**

For each channel the raw transducer signal is buffered to both the front panel and rear terminals.

Frequency Range	DC to 10kHz
Accuracy	± 1%

For speed and timing measurement modes a TTL signal only is available at the rear terminals.

**Common Rack Features**

*Trip Level Multiply or Divide;* Module detection of this common rack facility will multiply or divide alarm levels when configured for vibration or speed channels respectively.

*Calibration;* Module detection of this common rack facility will force the analogue outputs to a preset value. Alarms can be defeated in this mode if required.

*Reset;* Module detection of this common rack facility will reset all active latched alarms.

*Set Up Disable;* detection of this common rack facility will disable changes via the front panel user interface and disable the USB interface.

*Tacho 1 & 2;* speed and phase marker channels can output tacho signal to backplane for use with other measurement channels

**Front Panel Facilities**

Colour LCD display	Size 43mm x 57mm Resolution 240 x 320 pixels Backlight Timeout Function
Display Modes	4 Channel Bargraph 4 Channel Traffic Light Measurement + Gap Alarm Matrix
Historian	Single Channel Trend 500,000 points per channel Downloadable to .csv format Alarm Log 500 entries
FFT	Single Channel FFT, 512pts
LED Indicators	OK Active Green ALM Active Red TxRx Active Green
Communications	USB Type B Interface Windows XP compatible
Navigation	Menu Button Drive Button
Buffered Outputs	SMB Jack 75 Ohm

**Communications**

USB interface for front panel user set up  
RS-485 Dual Redundant Modbus slave at rear terminals

**Power Supply**

Module Supply Voltage	+18V to +28V
Module Power Consumption	15W typ 20W max
Rack Supply Voltage	90 - 264Vac 50/60Hz
Rack Power Consumption (with 6 modules)	90W typ 120W max

**Mechanical**

Module Dimensions	3U x 12HP x 220mm
Module Mass	0.9kg

**Temperature**

Operating	-30 °C to +65 °C
Storage	-30 °C to +85 °C

**CE Marking**

EN55011 Heavy Industrial Standard conducted & radiated emissions

EN61000-3-2:1995  
EN61000-3-3:1995

EN55014 Heavy Industrial Standard Immunity

EN61000-4-2:1995,  
EN61000-4-3:1996,  
EN61000-4-4:1995,  
EN61000-4-5:1995,  
EN61000-4-6:1996,  
EN61000-4-8:1993,  
EN61000-4-11:1994

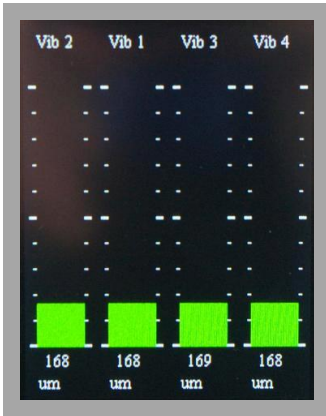
Low Voltage Directive  
EN60950:1992+A1+A2+A3+A4

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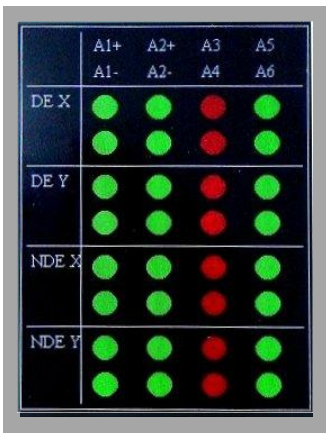
## Software Facilities

**Front panel** permits display of channels in various modes.

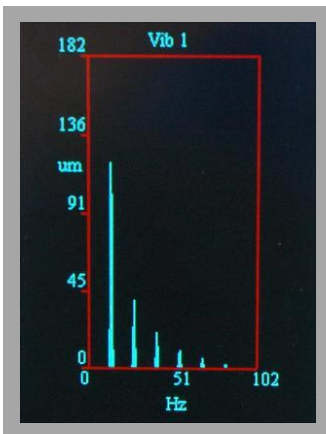
Bar Graph with colour coded alarm status



Alarm page with colour coded alarm status

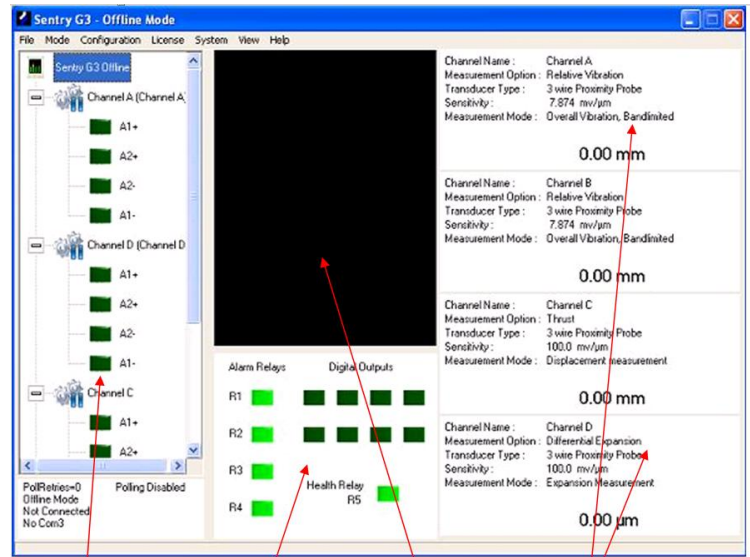


FFT for dynamic channels



The Sentry G3 **User interface** provides complete set up and control of all module channels. Uploading measurement algorithms to the DSP card, configuring for sensor input type, measurement mode, alarm levels and analogue outputs.

Overall user panel provides intuitive status of the module measured values and alarm status.



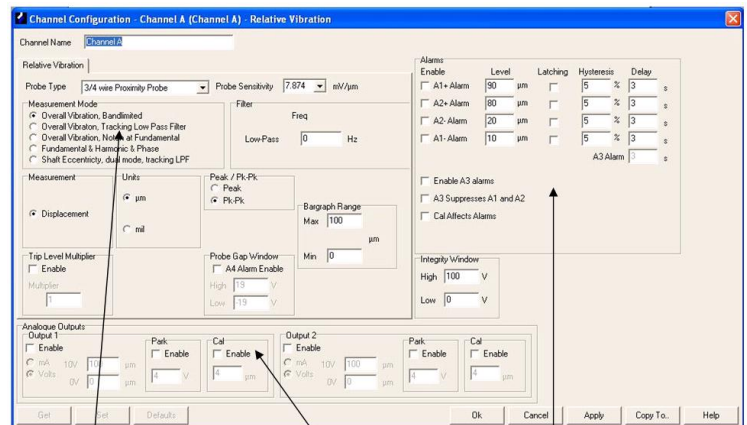
Module Status Window

Alarm Relay Status and Configuration

Module Display Facility

Channel Summary Windows

The channel measurement panel is the same format for all measurement algorithms, providing a common interface for the detailed configuration of the channel parameters.



Measurement mode configuration

Analogue Outputs Control

Alarm Panel Configuration

If you require assistance with any questions please contact your local Sensonics representative



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