Sensonics Technical Note – DS1211

Overspeed Protection System for Turbines & MBFPT's

Overspeed protection is a key requirement in the power generation industry where failure of the speed control loop can lead to damaging consequences. Independent monitoring and shutdown is essential to remove this risk. Sensonics have been providing high integrity overspeed protection systems for many years with proven field reliability. The architecture of the system and facilities offered has been developed in conjunction with our customers in both the conventional and nuclear power industry.

Key elements of the Sensonics Overspeed Protection System:

- Voted arrangements - 2 of 3 and 2 of 4 as standard
- On line test trip and signal injection facilities
- Key lock inhibit
- High visibility displays and lamps
- Maximum speed capture function following shutdown
- Approval to IEC 61508
- Dual redundant or module independent power supply options

Sentry MO8608 Speed Monitor

This API670 compliant module accepts either a proximity probe or switch input measured from a key / slot or toothed wheel (TTL also accepted) up to a frequency of 10 kHz.

Measured speed is displayed on the front panel in either RPM or Hz to an accuracy of <0.01%. Four independent speed level alarms, A1+, A1-, A2+ and A2- are available. When the speed level exceeds or drops below the + or - alarm level for a specified period, the associated lamp will be illuminated on the display and the state of the appropriate relay changed.

A channel integrity alarm, A3, monitors the transducer/PSU and microprocessor, and a common A3 relay is provided. A green A3 TXD and A3 PSU "OK" LED illuminates on the front panel. If the TXD or PSU are faulty (green LED unlit) then the associated A3 relay will change its state.

An A4 alarm monitors the channel input and when tripped, indicates that a "zero speed" condition has occurred. An A4 alarm relay is available in addition to the front panel A4 indication LED.

The module can be operated in Over Speed Monitor Mode, selectable either from the front panel or automatically. This will cause the module to record the maximum speed and trip speed levels during an overspeed event or during testing.

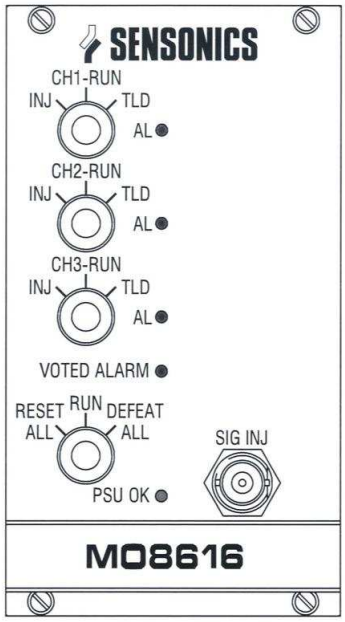
An external trip level divide input permits the configured alarm levels to be modified according to the S/W set up, to permit on-line trip testing.

The module when configured for overspeed mode can respond rapidly to shutdown plant exceeding alarm levels. The processing circuit exhibits a delay of approximately 0.7ms before initiating an alarm, additional delay is dependant on the number and teeth and rotational speed of the machine as well as the trip relay. For 3000RPM machines a delay of less than 20ms can be reasonably achieved

The RS485 interface available at the rear of the MO8608 unit can also be used to provide a remote speed display facility.

Voting & Diagnostics Module

The MO8616 provides 2 of 3 channel voting functionality as well as diagnostic facilities. Robust relay logic is utilised to perform the logic function, providing a high integrity voting system when used in combination with the 86xx series of Sentry measurement channels.



The unit accepts voltage free contacts through the rack backplane and provides a set of change over contacts representing the voted alarm state. This is configurable to a latching or non-latching alarm mode.

The front panel provides visual indication of each channel alarm status as well as the voted trip status. A reset key switch is available for clearing down any alarms.

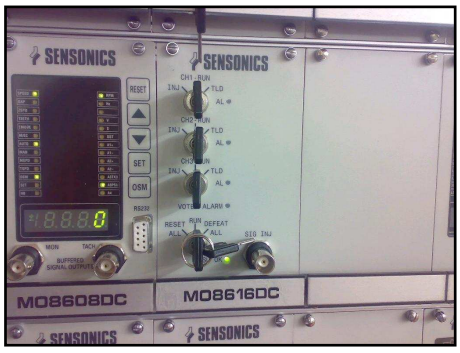
Diagnostics are included within this unit accessible through individual key switches located on the front panel. Each channel switch has three options, 'Run', 'Test' and 'Inject'.

The Run position is the normal mode of operation (key can only be removed in this position). The 'Test' position operates the Trip Level Divide function, which permits individual channels to be tested online by modifying the trip level. The 'Inject' position provides the facility to drive an external speed signal (derived from a signal source) to individual speed modules to verify accuracy and trip points.

Reliability Data

SIL calculations of the MO8608 module in single channel and 2 of 3 voted arrangement according to IEC61508 analysis requirements have been completed and the results detailed below.

The MO8608 module has a significant installation base in the UK and analysis of returns due to faults demonstrated an MTBF of 34 years. As can be seen the calculated theoretical MTBF is lower (worse) than that measured which adds substance to the SIL analysis and calculations.



To summarise:

	MTBF	SFF	PFD	SIL
MO8608	**19yrs**	**96%**	**1.01E-03**	**2**
MO8608 voted 2 of 3	**540yrs**	**96%**	**4.86E-05**	**3**

Mechanical Configuration

The rack layout and is illustrated below. This diagram includes a further module option in addition to the speed and voting to provide a dual redundant power supply. Each module provides a +24Vdc supply to the rack backplane and regulates from 110/240 Vac.

Overspeed Trip Rack layout with dual redundant power supply fitted

Software User Interface

The MO8608 module offers a 32-bit Windows interface for configuration of the unit. The two screen shots below illustrate the general settings and alarm settings available through this interface.