



# PCS-987R

## Torsional Stress Relay

Sub-synchronous oscillations (SSO) can occur when the turbine-generators are connected to the power grid with some electrical cases include: transmission line series capacitors, HVDC converters, large-scale wind power generation, etc. Under the action of SSO, the shaft system of turbine-generator will be in a state of torsional vibration, resulting in fatigue loss. In some severe cases, it may lead to the shaft cracks, bolt cut or coupling twist.

PCS-987R is a digital protective relay of torsional stress relay (TSR) which provides monitoring and protection of the torsional vibration for large-scale thermal power, nuclear power and other power generation units.

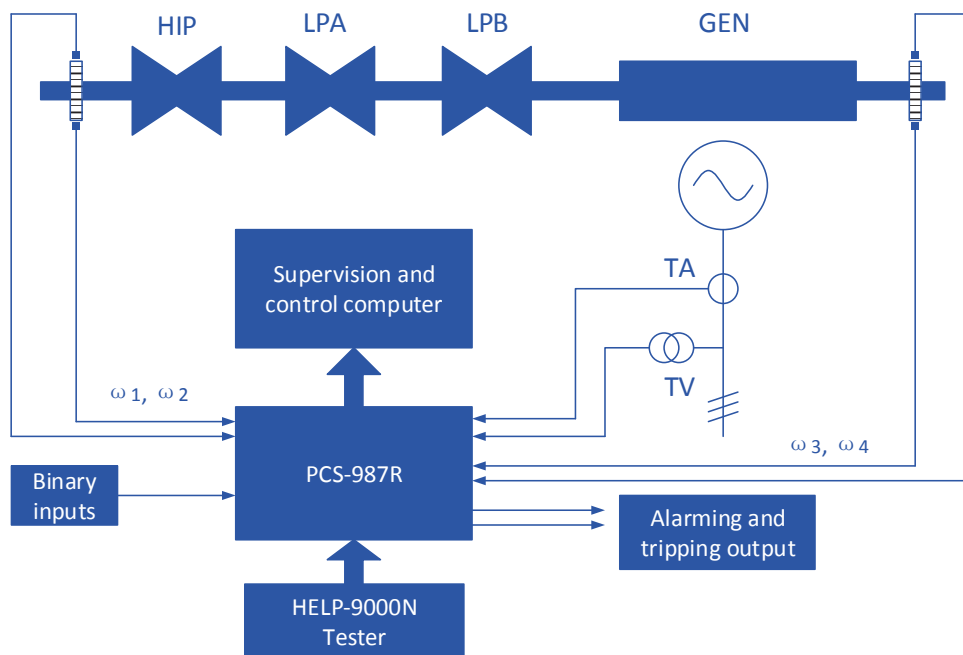


Figure 1 Typical application of PCS-985R

## Functions

- Protective Functions
  - Torsional vibration modal divergence protection
  - Shaft cross section accumulative fatigue protection for alarming or tripping
  - Shaft section total fatigue alarm function
- Miscellaneous functions
  - Current transformer supervision function (CTS)
  - Voltage transformer supervision function (VTS)
  - Rotational speed signal supervision function (four rotational speed signal sensors, installed at turbine end and exciter end)
  - Optical fiber communication supervision

## Features

- High-resolution, redundant, fault tolerant rotational speed measurement  
Accurate measurement of rotational speed signal is the basis of torsional stress protection. PCS-987R supports dual channels or 4 channels of speed signals, using high resolution measurement, and the theoretical accuracy of torsion angle measurement is less than 0.003deg. Fault tolerance algorithm is taken to eliminate the influence of transverse vibration and loss of rotational speed signal pulse and it can accurately recognized from abnormal speed signal.
- Self-adaptive band digital filters  
According to the natural mode frequency of shaft, the method of bilinear transformation is adopted, and the filter parameters are calculated by self-adaptive algorithm. The process of band filtering can effectively reduce the mutual interference between the similar modals, which can be used to accurately separate the components of each sub synchronous modal of the rotational speed.
- Multi-modal calculation of torque vector synthesis  
The primary thing of fatigue calculation is to calculate the torsional torque of each section. PCS-987R adopts the multi modal vector synthesis technology according to the shaft modal, and composes the torsion angle of each modal on the mass block, combined with the basic torque synthesis of the total torque, accurately responses to stress on the cross section.
- Dual-parameter calculation of section fatigue  
The calculation of cross section fatigue is nonlinear, and the fatigue of each modal can not be calculated separately. According to the prescribed load spectrum cycle counting method -- the double parameter method to calculate the section fatigue, fully consider the influence of the basic stress on the material life. These calculation methods can be used to calculate the stress and strain of the material, and it contains a number of different sizes of hysteresis loops. It

is the most reliable theory and application method for material fatigue analysis in the engineering field.

- Multiple protection criteria  
The modal divergence protection is used to prevent the instability of the sub synchronous oscillation, and accumulative fatigue protection can prevent the long time fatigue accumulation damage under the stable oscillation condition. The total fatigue alarm function is used to protect the fatigue of multiple torsional vibration, the total fatigue value is not lost, but also can be stored by the latch mode, and the device can not modify the fatigue accumulation value under the condition of the maintenance and debugging.
- Parallel calculation of double DSP system  
The hardware of the device comprises a 32-bit microprocessor and two 32-bit digital signal processors (DSP). Those processors can operate in parallel accompanied by fast A/D converter. The 32-bit microprocessor performs logic calculation and the DSP performs the protection calculation. High performance hardware ensures real time calculation of all protection relays within a sampling interval.
- Strong electromagnetic compatibility  
Integral panel, fully enclosed chassis, strong and weak electricity strictly separate, cancel the traditional back wiring mode, while in the software design also take corresponding anti-interference measures, the ability of anti interference device is greatly improved, external electromagnetic radiation also meet the relevant standards.
- Complete event recording function  
Complete event recording function is provided: 512 latest protection operation reports, 1024 latest supervision records, 1024 latest control operation records, 1024 latest user operation records and 1024 latest records of time tagged sequence of event (SOE) can be recorded.  
  
Record wave format is compatible with COMTRADE. Large recording capacity is supported; each default recording time is 1min. If the sub synchronous oscillation duration is more than 1min, the device will automatically record the data as multiple waveform storage, so as to ensure that the waveform data is not lost. The device also has the function of manual recording.
- Flexible communication  
This device can communicate with a SAS or RTU via different communication intermediates: Ethernet network, RS-485 serial ports. The communication protocol of this device is optional: IEC61850, IEC60870-5-103 or ModBus.
- Friendly human machine interface  
The human machine interface (HMI) with a small control module (a 320x240-dot LCD, 13 keys and 20 LED indicators) on the front panel is very friendly and convenient to the user.
- Powerful PC tool software  
Powerful PC tool software (PCS-Explorer) can fulfill protection function configuration, modify setting and waveform analysis.