DC Measuring Instruments
DC Measuring Instruments

- DC Current Transducer
  - Hybrid-Optical Measuring Device
  - Zero Flux CT
- DC Voltage Divider
DC Current Measuring Device

- Measurement on DC side for control, monitoring and Protection
- AC CTs cannot be used on DC side – saturation
- DC current measuring devices –
  - DC shunt – low value resistor
  - mV drop from the shunt taken for determining the current
  - To solve insulation problems – electrical signals are converted to optical at the shunt and at control system converted to electrical
  - Supply for the conversion process is obtained from the control panels in the form of optical power
DC Current Measuring Device

DC Current Measuring Device (OPTODYN) Lay out at HVDC Kolar

Current Measuring Devices
11 Nos (4 HV+7 LV)

Voltage Dividers
04 Nos (2 HV+2 LV)
DC Current Measuring Device
Hybrid-Optical Measuring Device
Functional Concept

- Shunt
- Sensor Head at high voltage level
- Signal fibre
- Power fibre
- Control/Protection system at ground level
- Power supply
- Fibre optical cable

- Analog/Digital
- Digital/Optical
- Electrical Energy
- Optical Energy

- Optical
- Digital
- Power supply

- Digital control/protection system SIMADYN D

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Redundancy Concept

- Complete redundancy from sensor head via FO cable to control/protection equipment
- Only one Analog/Digital conversion per signal path
- Direct digital signal processing
Sensor Head Box with Sensors
Assembly of Shunt
Sensor OPTODYN™

Analog Input
Signal from Shunt

Optical Data
Link

Optical Power
Supply Link
Zero-flux current transformer

The Zero-flux current transformer is a contact-free d.c. current measuring system consisting of a core and coil assembly and an electronics module.

The core and coil assembly constitutes the measuring head which is placed around a current-carrying conductor.

The measurement is based on a perfect ampere-turns balance in the measuring head.

The accuracy is determined only by the burden resistor and the output amplifier, both located in the electronics module.
DCCT Principle

- Flux created from excitation, Primary DC current and cancellation add up

- Nonlinearity of BH curve creates distortion of sense current

- Second Harmonic is zero when no DC offset, i.e. cancellation equals Primary DC current
DCCT Basic Diagram

Ferrite

Excitation

F=40kHz

Harmonic Detector

2*f detector

Cancellation

Feedback
The measuring head comprises three cores, each having an auxiliary winding, N1, N2 and N3. A compensating winding, N4, is wound around all three cores.

Any voltage induced in tertiary winding N3 as a result of a change of flux due to a primary-current variation is immediately compensated for by the power amplifier.

The core equipped with the auxiliary winding N1 is used as a detector of the magneto motive-force balance. By continuously sensing the ampere-turns balance, the drift of the power amplifier is cancelled out.

The burden resistor converts the secondary current into a reference voltage.
DC Measuring Devices

- DC voltage divider
  - Capacitive & resistor divider circuit
  - Drop across the resistor scaled for determining the voltage
  - Optical conversion process is same as the current measuring device
DC Voltage Measurement
DC Voltage Measurement

1. HV-Terminal

2. DC-Divider

3. Secondary Box

4. Converter Box

ground connection
THANK YOU