

DUOBIAS-M

7SR242 - Multi-Functional Integrated Transformer Protection Relay

Description

Based on the REYROLLE Multi-Function platform our new generation of integrated transformer protection relays are designated the 7SR24 series. The relay is the latest development of transformer protection relays and utilizes years of numeric relay protection experience with the 'DUOBIAS' family of products.

Housed in 4U high, size E8 or E10 cases, these relays provide protection, control, monitoring, instrumentation and metering with integrated input and output logic, data logging & fault reports. Communication access to relay functionality is via a front USB port for local PC connection or rear electrical RS485 port for remote connection. Additional rear port options are available.



Standard Functionality

| | |
|--------|-------------------------------------|
| 50BF | Circuit Breaker Fail |
| 64H | High Impedance REF |
| 74TC | Trip Circuit Supervision |
| 81HBL2 | 2nd Harmonic Block/Inrush Restraint |
| 81HBL5 | 5th Harmonic Block |
| 87T | Biased Differential (2Windings) |
| 87HS | High-Set Differential |
| 8 | Settings Groups |
| | Password Protection – 2 levels |
| | User Programmable Logic |
| | Self Monitoring |

Optional Functionality

| | |
|-------|--|
| 24 | Over-Fluxing |
| 27/59 | Under/Over Voltage |
| 37 | Undercurrent |
| 46NPS | Negative Phase Sequence Overcurrent |
| 49 | Thermal Overload |
| 50 | Instantaneous Overcurrent |
| 50G/N | Instantaneous Earth Fault |
| 51 | Time Delayed Overcurrent |
| 51G/N | Time Delayed Measured Earth Fault /SEF |
| 59N | Neutral Voltage Displacement |
| 81 | Under/Over Frequency |

Data Communications

Front USB port
Rear RS485 port

User Interface

20 character x 4 line backlit LCD
Menu navigation keys
3 fixed LEDs
16 or 24 Programmable Tri-colour LEDs (Option)

Data Communication Options

2 Rear fibre optic + IRIG-B ports

Protocols

IEC60870-5-103 or Modbus RTU protocols – User selectable

Standard Monitoring Functions

Primary current phases and earth
Secondary current phases and earth
Earth differential
Restraint relay currents
Positive Phase Sequence (PPS) Current
Negative Phase Sequence (NPS) Current
Zero Phase Sequence (ZPS) Current
Single phase voltage*
Secondary single phase voltage*
Apparent power and power factor*
Real and reactive power*
WWhr forward and reverse*
VArHr forward and reverse*
Historical demand record
Frequency
Binary Input/Output status
Trip circuit healthy/failure
Time and date
Starters
Fault records
Event records
Waveform records
Circuit breaker trip counters
 I^2t summation for contact wear

* Optional voltage measurements from single phase VT input – indication for balanced voltage conditions

Function Diagram showing example of external connections

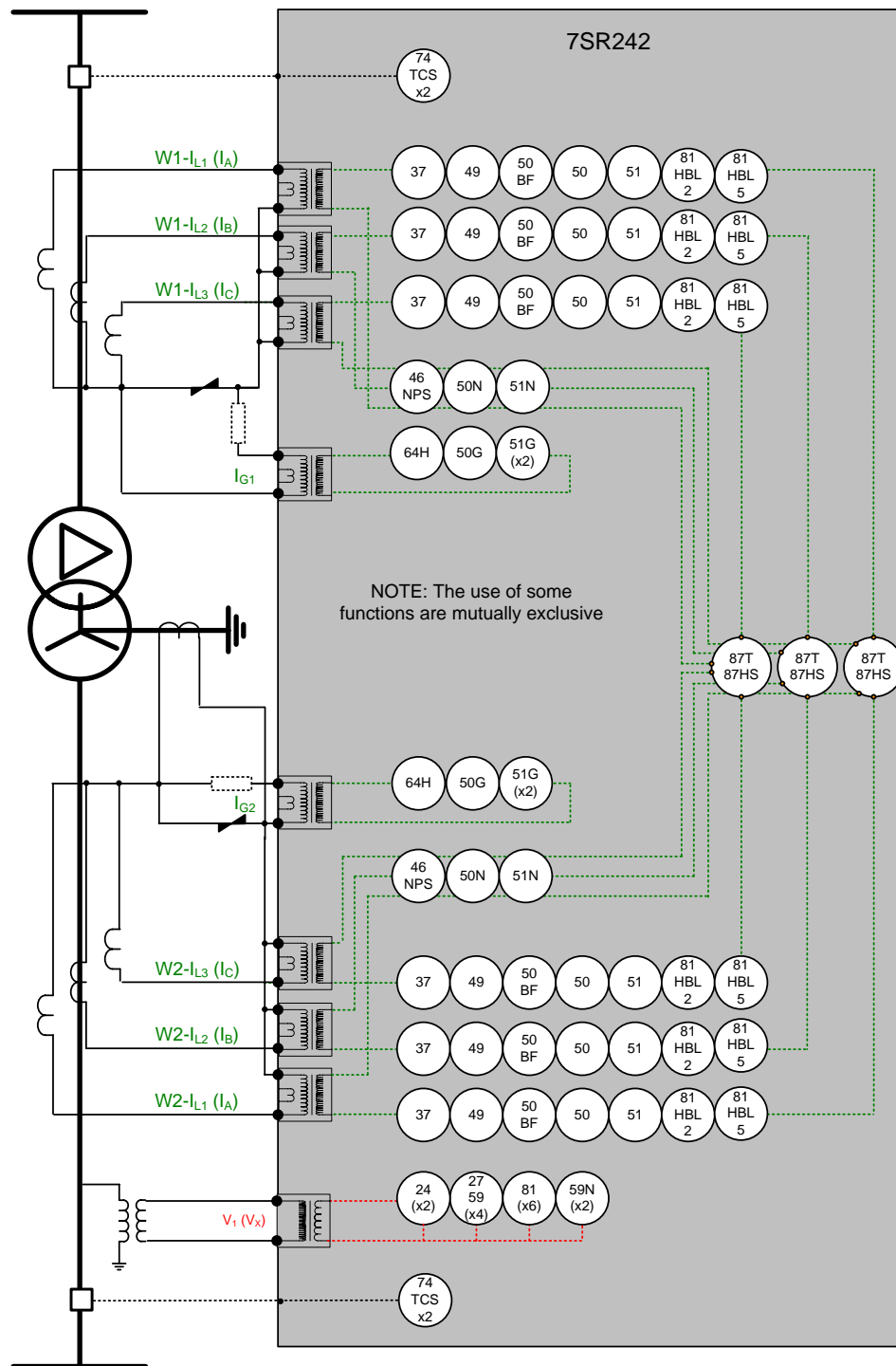


Fig. 1. Transformer Protection Relay DUOBIAS-M 7SR242

Standard Functionality

24 Over-Fluxing

Each element has settings for pickup level and Definite Time Lag (DTL) delays. Operates if Volts/Hertz ratio is above setting for duration of delay.

27/59 Under/Over Voltage

Each element has settings for pickup level, drop-off level and Definite Time Lag (DTL) delays. Operates if voltage 'exceeds' setting for duration of delay. Can be applied in load shedding schemes.

37 Undercurrent

Each element has settings for pickup level and Definite Time Lag (DTL) delays. Operates if current falls below setting for duration of delay.

46NPS Negative Phase Sequence Overcurrent

Each element has user settings for pickup level and IDMTL or DTL delay, operates if NPS Current exceeds setting and delay. NPS Current elements can be used to detect unbalances on the system or remote earth faults when a delta-star transformer is in circuit.

49 Thermal Overload

The thermal algorithm calculates the thermal states from the measured line currents. Outputs are available for thermal overload and thermal capacity.

50/51 Phase Fault

50 INST/DTL and 51 IDMTL/DTL elements provide overcurrent protection, each with independent settings for pickup current, time-multiplier (51) and time-delays. User can select IEC or ANSI Time Current Characteristics. The IDMT stage has a user programmable reset characteristic, either DTL or shaped current/time reset characteristic, to improve grading with electromechanical protection.

50G/51G/50N/51N Earth Fault/Sensitive Earth Fault

Two earth fault measurement modes are available. One mode directly measures the earth current from an independent CT, or the residual connection of the 3 line CTs. This input can be set to either earth fault or sensitive earth fault (50G/51G). The second mode derives the earth current internally from the 3 phase CTs (50N/51N). 50 INST/DTL and 51 IDMTL/DTL elements provide overcurrent protection, each with independent settings for pickup current, time-multiplier (51) and time-delays. User can select IEC or ANSI Time Current Characteristics. The IDMT stage has a user programmable reset characteristic either DTL or shaped current/time reset characteristic to improve grading with electromechanical protection

50BF Circuit Breaker Fail

The circuit breaker fail function may be triggered from an internal trip signal or from a binary input. Line currents are monitored following a trip signal and an output is issued if any current is still detected after a specified time interval. This can be used to re-trip the CB or to back-trip an upstream CB. A second back-trip time delay is available to enable another stage to be utilized if required.

59N Neutral Overvoltage

Each element has settings for pickup level and Definite Time Lag (DTL) delays. Operates if Neutral voltage exceeds setting for duration of delay.

Neutral overvoltage can be used to detect earth faults in high impedance earthed or isolated systems.

64H Restricted Earth Fault - scheme

The measured earth fault input may be used in a high impedance restricted earth fault scheme. Required external series stabilising resistor and non-linear voltage limiting shunt resistor can be supplied.

74TC Trip Circuit Supervision

The trip circuit(s) can be monitored via binary inputs. Trip circuit failure raises an HMI alarm and output(s).

81 Under/Overfrequency

Each element has settings for pickup level, drop-off level and Definite Time Lag (DTL) delays. Each element operates if frequency exceeds setting for duration of delay. Typically applied in load shedding schemes.

81HBL2 Second Harmonic Block/Inrush Restraint

Where second harmonic current is detected (i.e. during transformer energisation) user selectable elements can be blocked.

81HBL5 Fifth Harmonic Block

Fifth Harmonic Detectors can be user selected to block the Biased Differential Elements.

87HS High-Set Differential

High speed unrestrained differential elements to provide protection against high levels of internal fault current.

87T Biased Differential

The differential characteristic incorporates two bias stages – the first stage for steady state errors i.e. tap position and CT ratios the second stage for transient errors i.e. CT saturation.

Programmable Logic

The user can map Binary Inputs and Protection operated outputs to Function Inhibits, Logic Inputs, LEDs and/or Binary Outputs.

The user can also enter up to 16 equations defining scheme logic using standard functions e.g. Timers, Latches, AND/OR gates, Inverters and Counters.

Each Protection element output can be used for Alarm & Indication and/or tripping.

Circuit Breaker Maintenance

For each winding two circuit breaker operations counters are provided. The Maintenance Counter records the overall number of operations and the Delta Counter the number of operations since the last reset.

I²t summation Counters provide a measure of the contact wear indicating the total energy interrupted by the circuit breaker contacts.

Each counter has a user set target operations count which, when reached, can be mapped to raise Alarms/ Binary Outputs.

These counters assist with maintenance scheduling.

Data Records - accessible via Data Comms ports

Sequence of event records

Up to 5000 events are stored and time tagged to 1ms resolution.

Fault Records

The last 10 fault records are displayed on the HMI, with time and date of trip, measured quantities and type of fault.

Disturbance recorder

The waveform recorder stores analogue data for all phases, the states of protection functions, Binary Inputs, LEDs and Binary Outputs with pre & post trigger data. A record can be triggered from Protection function, Binary input or via data communications. 10 records of 1 second duration are stored and the user can set the ratio of pre-trigger % i.e. pre-fault recording time.

Load profile recording

The demand is averaged over a user-selectable period of time. A rolling record of such demand averages is stored and provides the demand history. A typical application is to record 15min-averages for the last 7 days.

Reydisp Evolution



Fig. 3. Typical ReyDisp Evolution screenshot

ReyDisp Evolution is common to the entire range of Reyrolle numeric products. It provides the means for the user to apply settings, interrogate settings and retrieve events and disturbance waveforms from the DUOBIAS-M multi-functional relays.



Fig. 4. Tri-colour LED's

Tri-colour LED's

16 or 24 user programmable LED's are available eliminating the need for expensive panel mounted pilot lights and associated wiring. Each LED is tri-color (red, green, yellow) allowing for clear indication of the associated function's state.

Service Conditions and Performance Data

Temperature

IEC 60068-2-1/2

| Type | Level |
|-----------------|------------------|
| Operating Range | -10 °C to +55 °C |
| Storage range | -25 °C to +70 °C |

Humidity

IEC 60068-2-3

| Type | Level |
|------------------|---|
| Operational test | 56 days at 40 °C and 95 % relative humidity |

Insulation

IEC 60255-5

| Type | Level |
|--------------------------------|-------------------------|
| Between any terminal and earth | 2.0 kV AC RMS for 1 min |
| Between independent circuits | 2.0 kV AC RMS for 1 min |
| Across normally open contacts | 1.0 kV AC RMS for 1 min |
| Impulse Voltage Type test | 5 kV (peak) 1.2 / 50 µs |

IP Ratings

| Type | Level |
|------------------------------|-------|
| Installed with cover | IP 51 |
| Installed with cover removed | IP 30 |

Auxiliary DC Supply Variation

| Type | Level |
|--|-------------------|
| Allowable superimposed ac component | 12% of DC voltage |
| Allowable breaks/dips in supply (collapse to zero) | 20ms |

High Frequency Disturbance

IEC 60255-22-1 Class III

| Type | Level | Variation |
|--------------------------|--------|-----------|
| Common (longitudinal) | 2.5 kV | ≤ 5 % |
| Series (transverse) mode | 1.0 kV | ≤ 5 % |

Electrostatic Discharge

IEC 60255-22-2 Class IV

| Type | Level | Variation |
|-------------------|--------|-----------|
| Contact discharge | 8.0 kV | ≤ 5 % |

Radiated Immunity

IEC 60255-22-3 Class III

| Type | Level | Variation |
|--------------------|--------|-----------|
| 80 MHz to 1000 MHz | 10 V/m | ≤ 5 % |

Fast Transients

IEC 60255-22-4 Class IV

| Type | Level | Variation |
|----------------------------|-------|-----------|
| 5/50 ns 2.5 kHz repetitive | 4kV | ≤ 5 % |

Surge Immunity

IEC 60255-22-5

| Type | Level | Variation |
|--|------------------------------|-----------|
| Between all terminals and earth, or between any two independent circuits | 4.0 kV, 1.2/50 µs or 8/20 µs | ≤ 10 % |

Conducted Radio Frequency Interference

IEC 60255-22-6

| Type | Level | Variation |
|----------------|-------|-----------|
| 0.15 to 80 MHz | 10 V | ≤ 5 % |

Emissions

IEC 60255-25

Radiated Radio Frequency

| Type | Limits at 10 m, Quasi-peak |
|------------------|----------------------------|
| 30 to 230 MHz | 40 dB(µV) |
| 230 to 10000 MHz | 47 dB(µV) |

Conducted Radio Frequency

| Type | Limits | |
|-----------------|------------|-----------|
| | Quasi-peak | Average |
| 0.15 to 0.5 MHz | 79 dB(µV) | 66 dB(µV) |
| 0.5 to 30 MHz | 73 dB(µV) | 60 dB(µV) |

Mechanical

Vibration (Sinusoidal)

IEC 60255-21-1 Class I

| Type | Level | Variation |
|---------------------|--------|-----------|
| Vibration response | 0.5 gn | ≤ 5 % |
| Vibration endurance | 1.0 gn | ≤ 5 % |

Shock and Bump

IEC 60255-21-2 Class I

| Type | Level | Variation |
|-----------------|--------------|-----------|
| Shock response | 5 gn, 11 ms | ≤ 5 % |
| Shock withstand | 15 gn, 11 ms | ≤ 5 % |
| Bump test | 10 gn, 16 ms | ≤ 5 % |

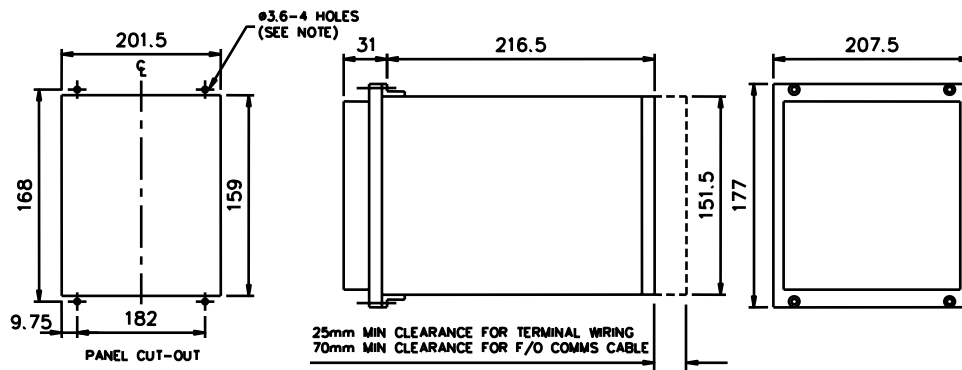
Seismic

IEC 60255-21-3 Class I

Mechanical Classification

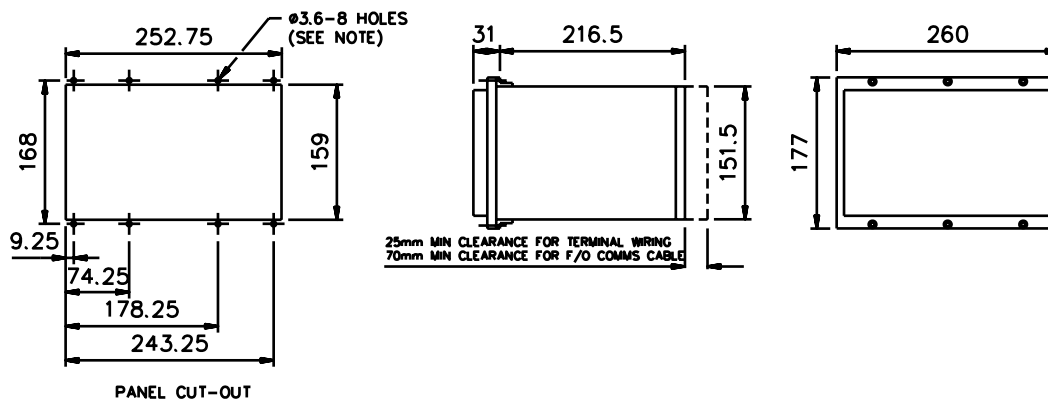
| Type | Level |
|------------|------------------------------|
| Durability | > 10 ⁶ operations |

E8 Case Dimensions



NOTE:
 THE $\phi 3.6$ HOLES ARE FOR M4 THREAD FORMING (TRILOBULAR) SCREWS. THESE ARE SUPPLIED AS STANDARD AND ARE SUITABLE FOR USE IN FERROUS/ALUMINIUM PANELS 1.6mm THICK AND ABOVE. FOR OTHER PANELS, HOLES TO BE M4 CLEARANCE (TYPICALLY $\phi 4.5$) AND RELAYS MOUNTED USING M4 MACHINE SCREWS, NUTS AND LOCKWASHERS (SUPPLIED IN PANEL FIXING KIT).

E10 Case Dimensions



NOTE:
 THE $\phi 3.6$ HOLES ARE FOR M4 THREAD FORMING (TRILOBULAR) SCREWS. THESE ARE SUPPLIED AS STANDARD AND ARE SUITABLE FOR USE IN FERROUS/ALUMINIUM PANELS 1.6mm THICK AND ABOVE. FOR OTHER PANELS, HOLES TO BE M4 CLEARANCE (TYPICALLY $\phi 4.5$) AND RELAYS MOUNTED USING M4 MACHINE SCREWS, NUTS AND LOCKWASHERS (SUPPLIED IN PANEL FIXING KIT).

Ordering Information – DUOBIAS-M 7SR242 – 2 winding transformer protection

| Product description | Variants | Order No. |
|---|---|---|
| Duobias M | | 7 S R 2 4 2 □ - 2 □ A □ 1 - 0 □ A 0 |
| Multifunction 2 winding Transformer differential protection | <p><u>Protection Product</u> Transformer</p> <p><u>Relay Type</u> Differential (2 winding)</p> <p><u>Case I/O and Fascia ¹⁾</u> E8 case, 6 CT, 2 EF/REF CT, 1 VT, 9 Binary Inputs / 6 Binary Outputs, 16 LEDs E10 case, 6 CT, 2 EF/REF CT, 1 VT, 19 Binary Inputs / 14 Binary Outputs, 24 LEDs</p> <p><u>Measuring Input</u> 1/5 A, 63.5/110V, 50/60Hz</p> <p><u>Auxiliary voltage</u> 30 to 220V DC, binary input threshold 19V DC 30 to 220V DC, binary input threshold 88V DC</p> <p><u>Communication Interface</u> Standard version – included in all models, USB front port, RS485 rear port Standard version – plus additional rear F/O ST connectors (x2) and IRIG-B</p> <p><u>Protocol</u> IEC 60870-5-103 and Modbus RTU (user selectable setting)</p> <p><u>Protection Function Packages</u> Standard version – Included in all models 81HBL2 2nd harmonic block/inrush restraint 81HBL5 5th harmonic block 87T Biased current differential 87HS Current differential highest Programmable logic For each winding/circuit breaker 50BF Circuit breaker fail 64H High impedance REF 74TC Trip circuit supervision</p> <p>Standard version – plus For each winding/circuit breaker 37 Undercurrent 46NPS Negative phase sequence overcurrent 49 Thermal overload 50 Instantaneous phase fault overcurrent 50G/50N Instantaneous earth fault 51 Time delayed phase fault overcurrent 51G/51N Time delayed earth fault</p> <p>As above – plus 24 Overfluxing 27/59 Under/overvoltage 59N Neutral voltage displacement 81 Under/overfrequency For each winding/circuit breaker 37 Undercurrent 46NPS Negative phase sequence overcurrent 49 Thermal overload 50 Instantaneous phase fault overcurrent 50G/50N Instantaneous earth fault 51 Time delayed phase fault overcurrent 51G/51N Time delayed earth fault</p> <p><u>Additional Functionality</u> No Additional Functionality</p> | <p>↑ 4</p> <p>↑ 2</p> <p>↑ 2</p> <p>↑ 3</p> <p>↑ 2</p> <p>↑ A</p> <p>↑ B</p> <p>↑ 1</p> <p>↑ 2</p> <p>↑ 1</p> <p>↑ A</p> <p>↑ B</p> <p>↑ C</p> <p>↑ A</p> |

¹⁾ Each EF/SEF CT is configured as 51G/50G or 64H (user selectable setting).

Qualifications

Siemens Protection Devices Limited operates a quality system accredited to ISO9001.
CE Compliant to relevant EU Directives.

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