Reyrolle
Protection
Devices

7SG14 Duobias M

Transformer Protection

Answers for energy

SIEMENS

7SG14 Duobias M

Transformer Protection

Description

The 7SG14 Duobias-M has an established history as a transformer protection relay going back to the fundamental development of biased differential transformer protection. It is capable of providing all necessary protection and alarm functions for protecting a 2 or 3 winding transformer.

The main protection function is current differential with load bias and second harmonic restraining characteristic. This is supplemented with a number of additional functions to provide a comprehensive transformer protection management package.

Function Overview

Standard Functionality

Biased differential current protection with even harmonic restraint (87).
Instantaneous differential highset (87HS).
Integral current amplitude and vector group compensation.
Variants for 2 or 3 sets of current transformers.
E8, E12 or E16 case.
Trip circuit supervision.
LEDs for alarm functions removes the need for flag repeat relays, Buchholz etc
Compatible with communications software Reydisp Evolution.
Metering of external and internal signals for both magnitude and phase angle aids commissioning
Settings stored in EEPROM, logic schemes in FLASH memory
Flash upgradeable firmware
Expandable I/O of up to 27 binary inputs and 29 output contacts that can be programmed from the relay front fascia
Continuous self monitoring

Optional Functionality

High Impedance Restricted Earth Fault per winding (87REF)
Circuit Breaker Fail per winding (50BF)
Instantaneous / definite time overcurrent phase fault and derived earth fault per winding (50 and 50N)
Inverse definite minimum time phase fault and derived earth fault per winding (51 and 51N)
Instantaneous/definite time measured earth fault per winding (50G)
Inverse definite minimum time measured earth fault per winding (51G)
Overexcitation protection Volts/frequency (2 x DTL + 1 x IDMTL) (24)
Transformer thermal overload (49)
4-stage under/overvoltage(27/59)
4-stage under/overfrequency (81)
2-stage NPS overcurrent (46)

User Interface

20 character x 2 line backlit LCD
Menu navigation keys
1 fixed LED.
16 or 32 programmable LEDs.

Monitoring Functions

Analogue values can be displayed on the LCD screen. In addition most values can be obtained via the data communications channel(s).

Line currents for each winding
Relay currents for each winding (after ratio and vector group compensation)
Operate and restrain currents
Binary inputs
Output contacts

Data Communications

Communication access to relay functionality is via a front RS232 port for local PC connection.
Two rear ST fibre optic ports (2 x Tx/Rx) and an IRIG-B are also provided.

Protocols

Serial data comms conform to IEC60870-5-103 and Modbus RTU standards.

Description of Functionality

The 7SG14 provides all the protection functions required for power transformers.

Vector group compensation and ratio correction

The relay can compensate for all standard transformer winding vector connections and for differing CT ratios across the transformer, without the need for secondary interposing CTs.

Biased differential (87)

A biased differential characteristic is provided which gives sensitivity for internal faults and stability for through faults and load current.

Two bias slopes are provided, the first allows for measuring inaccuracies and transformer ratio variation due to tap-changing, the second ensures stability for CT saturation on through faults.

The biased differential element restrains for second harmonic inrush currents, with a setting for restraint level. This provides stability under inrush conditions, while allowing the protection to be set more sensitively for normal operation.

The relay M is stable for fifth harmonic currents, generated as a result of transformers operating close to, or above their knee point.

Differential highset (87HS)

A differential highset is also provided, this is not subject to inrush restraint.

Optional Functionality

Restricted Earth Fault (87REF)

Faults in the tap-changer windings of a transformer are common. Restricted earth-fault protection gives improved sensitivity for faults at the lower end of the transformer windings.

Under/overvoltage (27/59)

4 Stage under/overvoltage elements can be provided and the undervoltage elements may be guarded via an additional undervoltage setting to prevent operation during transformer switch on.

Under/overfrequency (81)

4 Stage under/overfrequency elements can be provided and these may be inhibited with the undervoltage inhibited setting defined as above, to prevent any unwanted operation.

Backup overcurrent & earth fault

The following backup overcurrent elements can be provided:

- Instantaneous/definite time phase fault (50)
- Inverse time/definite time phase fault (51)
- Instantaneous/definite time derived earth fault (50N)
- Inverse time / definite time derived earth fault (51N)

These elements provide backup protection for the transformer and guard against a fault outside the transformer CT zone. They can also be used to protect the transformer against damage due to uncleared external faults while grading with other time-delayed protections.

Measured earth fault

The following earth-fault overcurrent elements are available for each transformer winding:

- Instantaneous/definite time measured earth fault (50G)
- Inverse time/definite time measured earth fault (51G)

These elements are incompatible with the use of the high impedance restricted earth-fault elements.

Over-excitation (24)

Over-excitation of a transformer can lead to damaging currents flowing in the transformer. This can be detected from fifth harmonic content; however this is subject to uncertainty. The 7SG14 can offer a Volts/frequency (V/f) element, which provides direct measurement of excitation. The setting level of this type of element is more easily related to the transformer data. Both DTL and user defined IDMTL characteristics are available. Over fluxing protection is recommended for all generator step up transformers

Thermal Overload (49)

The algorithm calculates the thermal state of the transformer from the measured currents.

Negative Phase Sequence Overcurrent (46)

One inverse and one definite time lag element are provided. These may be used as back-up protection or for detection of tap changer faults.

Circuit breaker fail (50BF)

The circuit breaker fail function operates by monitoring the current following a trip signal and issues an output if the current does not cease within a specified time interval. This output contact can be used to backtrip an upstream circuit breaker. The circuit breaker fail function has a fast reset feature.

Application

Transformer configurations

The Duobias M can provide up to 3 sets of analogue inputs (where a single set consists of 3 phase current inputs and an earth current input) which can be used on a variety of 2 and 3 winding transformer configurations.

The most common configurations of transformer are 2 and 3 winding transformers connected to single lines/busbars, as in Figure 2. For a 2 winding transformer 2 analogue input sets are required, while for a 3 winding transformer 3 analogue input sets are needed. Input currents may be summed into a protection element such as overcurrent.

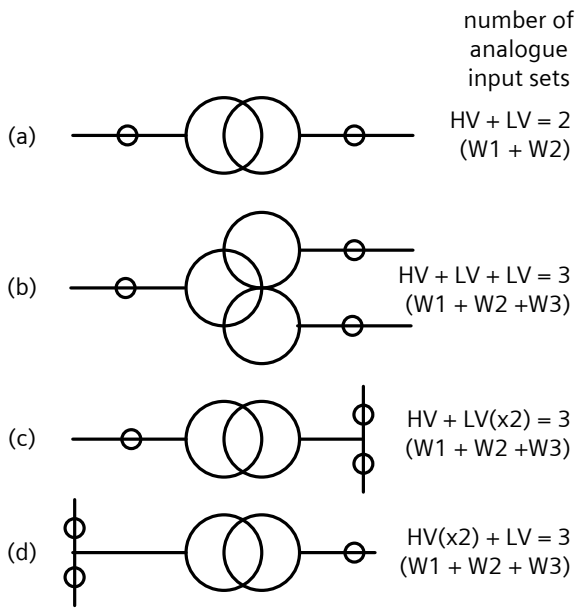


Fig 1. Transformer Configurations

Figure 2 shows the flow of fault current for an out-of-zone fault on system, with busbar connected CTs. It is important that the transformer protection is correctly biased to ensure stability for CT saturation. This cannot be done correctly if the CTs are paralleled – individual inputs to the transformer protection must be provided for correct biasing.

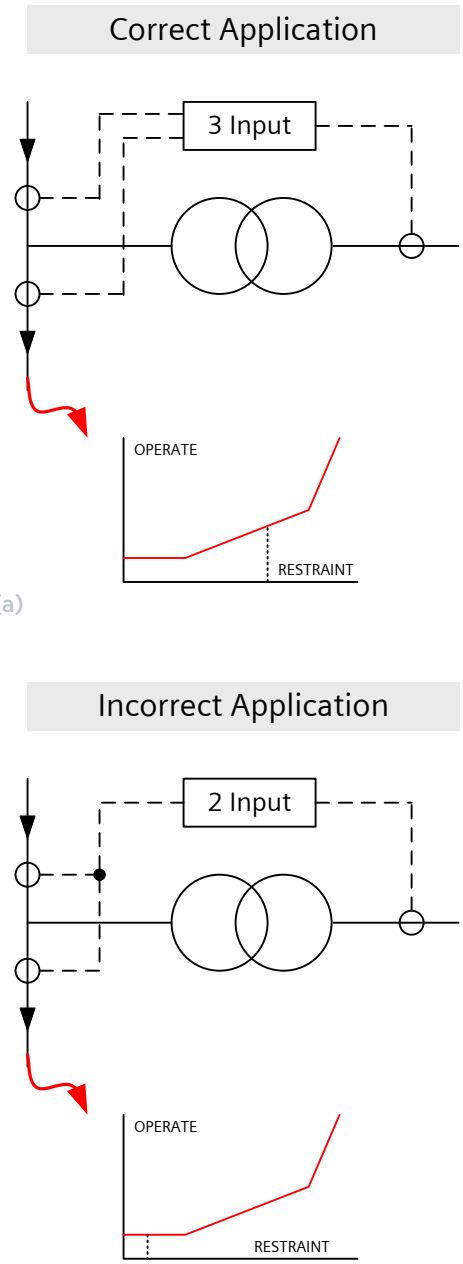


Fig 2. Out of Zone Fault and its Effect on Protection Biasing – use one relay input set per set of CTs

Data Storage and Communication

Sequence of event records

Up to 500 events are stored and time tagged to 1ms resolution. These are available via the communications.

Fault records

The last 10 fault records are available from the fascia with time and date of trip, measured quantities and type of fault.

Disturbance recorder

5 seconds of waveform storage is available and is user-configurable as 5 x 1s or 1 x 5s records. Within the record the amount of pre-fault storage is also configurable. The recorder is triggered from a protection operation, or binary input. (e.g. Buchholz flag indication).

The records contain the analogue waveforms of the line currents and the digital input and output signals.

The relay settings must be appropriately programmed in order for a wave form to be triggered from an external protection device.

Communications

Two fibre-optic communications ports are provided on the rear of the relay. They are optimised for 62.5/125µm glass-fibre, with BFOC/2.5 (ST®) bayonet style connectors.

In addition users may interrogate the relay locally with a laptop PC and the RS232 port on the front of the relay.

The relay can be user selectable to either IEC 60870-5-103 or Modbus RTU as its communications standard.

Reydisp evolution

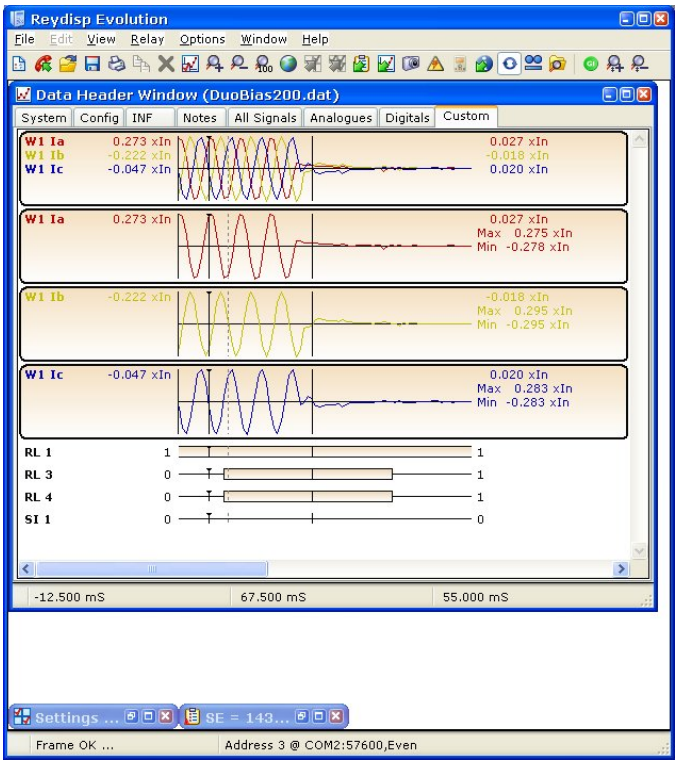


Fig 3. Disturbance Records in Reydisp Evolution

Reydisp Evolution is common to the entire range of Reyrolle numeric products. It provides a means for the user to apply settings to the relay, interrogate settings and retrieve disturbance waveforms.

Reydisp evolution utilises IEC 60870-5-103 protocol.

Technical Data

For full technical data refer to the Performance Specification of the Technical Manual.

Inputs and Outputs

Characteristic energising quantity

AC Current/Voltage	Frequency
1A / 5A	50 / 60Hz
40 – 160V	

Current Inputs

Current	Withstand Time
3.0 x In	Continuous
3.5 x In	10 minutes
4.0 x In	5 minutes
5.0 x In	3 minutes
6.0 x In	2 minutes
250A	1 Second
625A peak	I Cycle

Input	Burden
5A	≤ 0.3 VA
1A	≤ 0.1 VA

Note: Burdens and impedances are measured at nominal current rating.

DC Auxiliary Supply

Nominal Voltage	Operating Range V dc
30V	24 to 37.5V
48/110V	37.5 to 137.5V
220 V	178.0 to 280.0V
110/220V	88 to 275V

Operate State	Burden
Quiescent (Typical)	15 W
Maximum	27 W

Allowable superimposed ac component	≤12% of dc voltage
Allowable breaks/dips in supply (collapse to zero from nominal voltage)	≤20 ms

Binary inputs

Nominal Voltage	Operating Range V dc
30V	18 to 37.5V
48V	37.5 to 60V
110 V	87.5 to 137.5V
220V	175 to 280V

The binary input voltage need not be the same as the main energising voltage.

The 30V and 48V inputs meet the requirements of ESI48-4 ESI 1. However, the 110V and 220V inputs will operate with a DC current of less than 10mA. Where 110V or 220V inputs compliant with ESI48-4 ESI 1 are required, a relay with 48V binary inputs can be supplied with external series resistors as follows:

Nominal Voltage	Resistor Value	Wattage
110V	2k7 ± 5%	2.5 W
220 V	8k2 ± 5%	6.0 W

Binary input performance

Parameter	Value
Minimum DC current for operation (30V and 48V inputs only)	10 mA
Reset/Operate Voltage Ratio	≥ 90 %
Typical response time	< 5 ms
Typical response time when used to energise an output relay contact	< 15 ms
Minimum pulse duration	40 ms

Each binary input has an associated timer that can be programmed to give time delayed pick-up and time delayed drop-off. When set to a minimum of 20ms the binary inputs will provide immunity to an AC input signal and will not respond to the following:
250V RMS 50/60 Hz applied for two seconds through a 0.1µF capacitor.
500 V RMS 50/60 Hz applied between each terminal and earth. Discharge of a 10µF capacitor charged to maximum DC auxiliary supply voltage.

Output Relays

Carry continuously	5A ac or dc
Make and carry (L/R ≤ 40 ms and V ≤ 300V)	20A ac or dc for 0.5s 30A ac or dc for 0.2s
Breaking Capacity (≤ 5 A and ≤ 300 V): AC Resistive AC Inductive DC Resistive DC Inductive	 1250 VA 250 VA at p.f. ≤ 0.4 75 W 30 W at L/R ≤ 40ms 50 W at L/R ≤ 10ms
Minimum number of operations	1000 at maximum load
Minimum recommended load	0.5 Watt limits 10mA or 5V

Mechanical

Vibration (Sinusoidal)

IEC 60255-21-1 Class 1

0.5 gn, Vibration response 1.0 gn, Vibration endurance	≤ 5% variation

Shock Bump

IEC 60255-21-2 Class 1

5 gn, Shock response, 11ms 15 gn, Shock withstand, 11ms 10 gn, Bump test, 16ms	≤ 5% variation

Seismic

IEC 60255-21-3 Class 1

1 gn, Seismic response	≤ 5% variation

Mechanical Classification

Durability	In excess of 10^6 operations

Electrical Tests

Insulation IEC 60255-5

RMS levels for 1 minute

Between all terminals and earth	2.0 kV
Between independent circuits	2.0 kV
Across normally open contacts	1.0 kV

Transient Overvoltage

IEC 60255-5

Between all terminals and earth or between any two independent circuits without damage or flashover	5 kV 1.2/50 µs 0.5 J

High Frequency Disturbance

IEC 60255-22-1 Class III

2.5kV, Longitudinal mode 1.0kV, Transverse mode	≤3% variation

Electrostatic Discharge

IEC 60255-22-2 Class III

8kV, Contact discharge	≤5% variation

Fast Transient

IEC 60255-22-4 Class IV

4kV, 5/50ns, 2.5 kHz, repetitive	≤3% variation

Radio Frequency Interference

IEC 60255-22-3

10 V/m, 80 to 1000 MHz	≤5% variation

Conducted RFI

IEC 60255-22-6

10 V, 0.15 to 80 MHz	≤5% variation

Conduct limits

IEC 60255-25

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

Radiated limits

IEC 60255-25

Frequency Range	Limits at 10 m Quasi-peak, dB(µV/m)
30 to 230 MHz	40
230 to 10000 MHz	47

Environmental

Temperature

IEC 68-2-1/2

Operating	-10 °C to +55 °C
Storage	-25 °C to +70 °C

Humidity

IEC 68-2-3

Operational test	56 days at 40 °C and 93% RH

Protection Elements

General Accuracy

Reference Conditions	
General	IEC60255 Parts 6, 6A & 13
Auxiliary	Nominal
Frequency	50/60Hz
Ambient Temperature	20°C
Initial Setting	Any setting
Bias Slope	Any setting
High set	Any setting
Restricted earth fault	Any setting
Magnetizing Inrush	Any setting
Current amplitude correction	1.00
Vector group compensation	Yy0,0°

Accuracy influencing factors

Temperature	
10 °C to +55 °C	≤ 5% variation
Frequency	
47 Hz to 52 Hz	Setting: ≤5% variation
57 Hz to 62 Hz	Operate Time: ≤ 5% variation

Vector group compensation

Interposing CT	
No. of elements	Per Winding
CT Connection	Yy0 0°, Yd1 -30°, Yy2 -60°, Yd3 -90°, Yy4 -120°, Yd5 -150°, Yy6 180°, Yd7 150°, Yy8 120°, Yd9 90°, Yy10 60°, Yd11 30°, Ydy0 0°
CT Multiplier	0.25 to 3.00 step 0.01

Biased differential (87)

No. of elements	1
Level	
Initial setting	0.1 to 2.0In step 0.05In
Bias slope	0 to 0.7 step 0.05
Bias slope limit	1 to 20 xIn step 1In
Delay	0 to 1 sec
Accuracy	Operate:100% of setting ± 5% or ± 10mA
	Reset: ≥ 90% of operate current
Repeatability	±1%
Through-fault stability	50 xIn
Operate Time	
Typically	1.5 Cycles

Inrush Inhibit	
Settings	Off, 15% to 25% step 1%
Accuracy	± 5% or ± 30 ms
Repeatability	± 1%
Bias	Phase, Cross, Sum

Differential highset (87HS)

No. of elements	1
Level	
Initial setting	1 to 30x In step 1x In
Accuracy	Operate:100% of setting ± 5% or ± 10mA
	Reset: ≥95% of operate current
Repeatability	±1%
Operate Time	
Typically	1 Cycle

Restricted earth-fault (87REF)

No. of elements	Up to 1 per winding
Level	
Settings	0.02 to 0.96 In step 0.005In
Accuracy	Operate: 100% of setting ± 5% or ± 10mA
	≥ 95% of operate current
Repeatability	±1%

Operate Time	
Typically	< 1.5 Cycles

Delay	
Setting (td)	0 to 864000s

Phase-fault overcurrent protection (50)

Characteristic	Instantaneous/DTL
No. of elements	Up to 2 per winding
Level	
Settings	0.05 to 25In step 0.05In
Accuracy	Operate: 100% of setting ± 5% or ± 10mA
	Reset: ≥95% of operate current
Repeatability	±1%
Delay	
Settings	0.0 to 864000s
Accuracy	± 5 ms
Repeatability	± 1%

Phase fault overcurrent (51)

Characteristic	IDMTL
IEC	Normal Inverse (NI), Very Inverse (VI), Extremely Inverse (EI), Long Time Inverse (LTI)
IEEE	Moderately Inverse (MI), Very Inverse (VI), Extremely Inverse (EI),
	DTL
No. of elements	Up to 1 per winding
Level	
Settings	0.05 to 2.5 In step 0.05In
Accuracy	Operate: 105% of setting ± 5% or ± 10mA
	Reset: ≥ 95% of operate current
Repeatability	±1%
IDMTL Time Multiplier	
Settings	0.025x to 1.600x step 0.025
Accuracy	± 5% or ± 30 ms
Repeatability	± 1%

Negative Sequence Overcurrent (46)

Characteristic	Instantaneous (46DT)
No. of elements	Up to 1 per winding
Level	
Settings	0.02 to 4x In
Accuracy	Operate: 100% Is ± 5% or ± 10mA
	Reset: 95% Iop
Repeatability	±1%
Delay	
Setting (td)	0 to 864000s
Accuracy	89ms + td
Repeatability	± 1% or ± 20ms

Characteristics	IDMTL (46IT)
No. of elements	Up to 1 per winding
Level	
Setting	0.02 to 2.5In
Accuracy	Operate 105% Is ± 4% or I 10mA
	Reset > 95% Ipo
Repeatability	± 1%
IDMTL Time Multiplier	
Characteristics	IDMTL
IEC	Normal Inverse (NI) Very Inverse (VI) Extremely Inverse (EI) Long Time Inverse (LTI)
IEEE	Moderately Inverse (MI) Very Inverse (VI) Extremely Inverse (EI)
	DTL
Settings	0.025 to 1.6x step 0.025
Accuracy	IDMT ± 5% or ± 50ms DTL ± 1% or ± 40ms
Repeatability	± 1% or ± 20ms

Earth-fault overcurrent protection

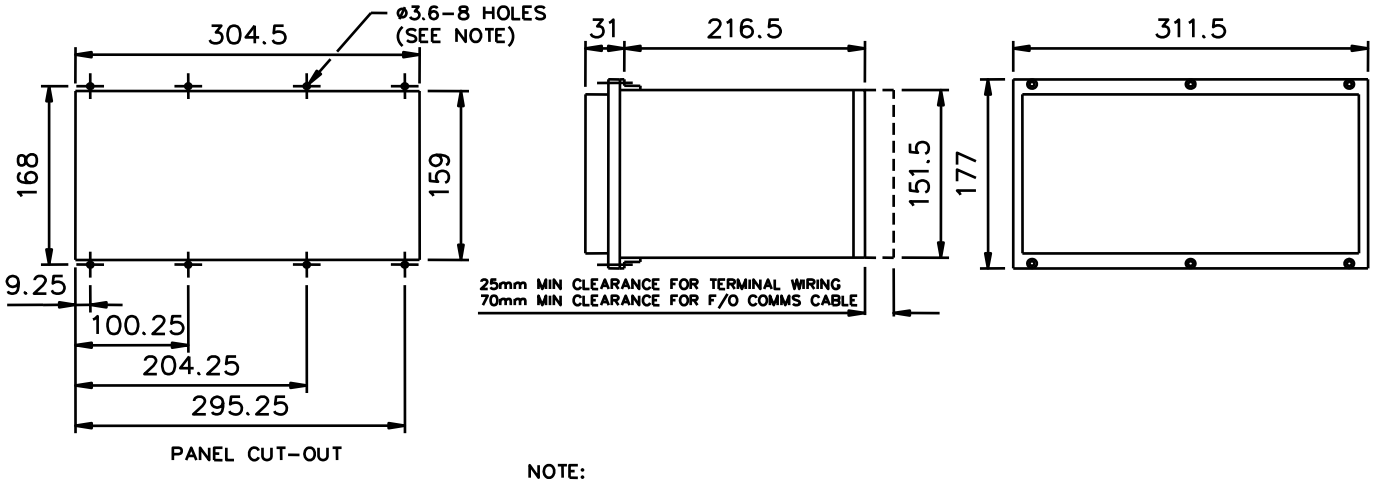
Characteristic	DTL
No. of elements	Up to 2 per winding
Level	
Settings	0.01 to 25 x In
Accuracy	Operate: 100% of setting ± 5% or ± 10mA
	Reset: ≥ 95% of operate current
Repeatability	±1%
Delay	
Settings	0.00 to 864000s
Accuracy	± 5 ms
Repeatability	± 1%

Characteristic	
IDMTL (IEC)	Normal Inverse (NI), Very Inverse (VI), Extremely Inverse (EI), Long Time Inverse (LTI)
IDMTL (IEEE)	Moderately Inverse (MI), Very Inverse (VI), Extremely Inverse (EI), DTL
No. of elements	Up to 1 per winding
Level	
Setting	0.1 to 2.5xIn step 0.05 In
Accuracy	Operate: 105% of setting ± 5% or ± 10mA
	Reset: ≥ 95% of operate current
Repeatability	±1%
IDMTL Delay	
Settings	0.025x to 1.600x
Accuracy	± 5% or ± 30 ms

Circuit breaker failure

Characteristic		DTL
No. of elements		2
Level		
Settings		0.05 to 2In
Accuracy		Operate: 100%Is ± 5% or ± 10mA
		Reset: <100%Iop ± 5% or ± 10mA
Repeatability		±1%
Delay		
Settings	Re-trip	0.02 to 60sec
	Back-trip	0.02 to 60sec
Accuracy		± 5 ms
Repeatability		± 1%

Case Dimensions



NOTE:
THE ø3.6 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 ø4.5) AND RELAYS MOUNTED USING M4 MACHINE SCREWS, NUTS AND LOCKWASHERS (SUPPLIED IN PANEL FIXING KIT).

Fig 4. E12 Case Dimensions

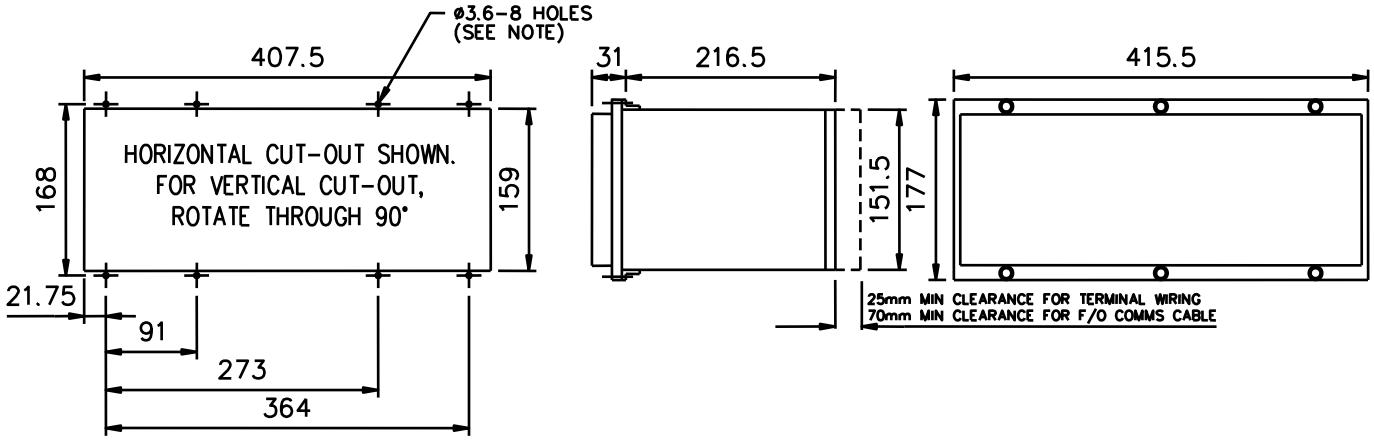


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Fig 5. E16 Case Dimensions

Connection Diagram 7SG14 Duobias M

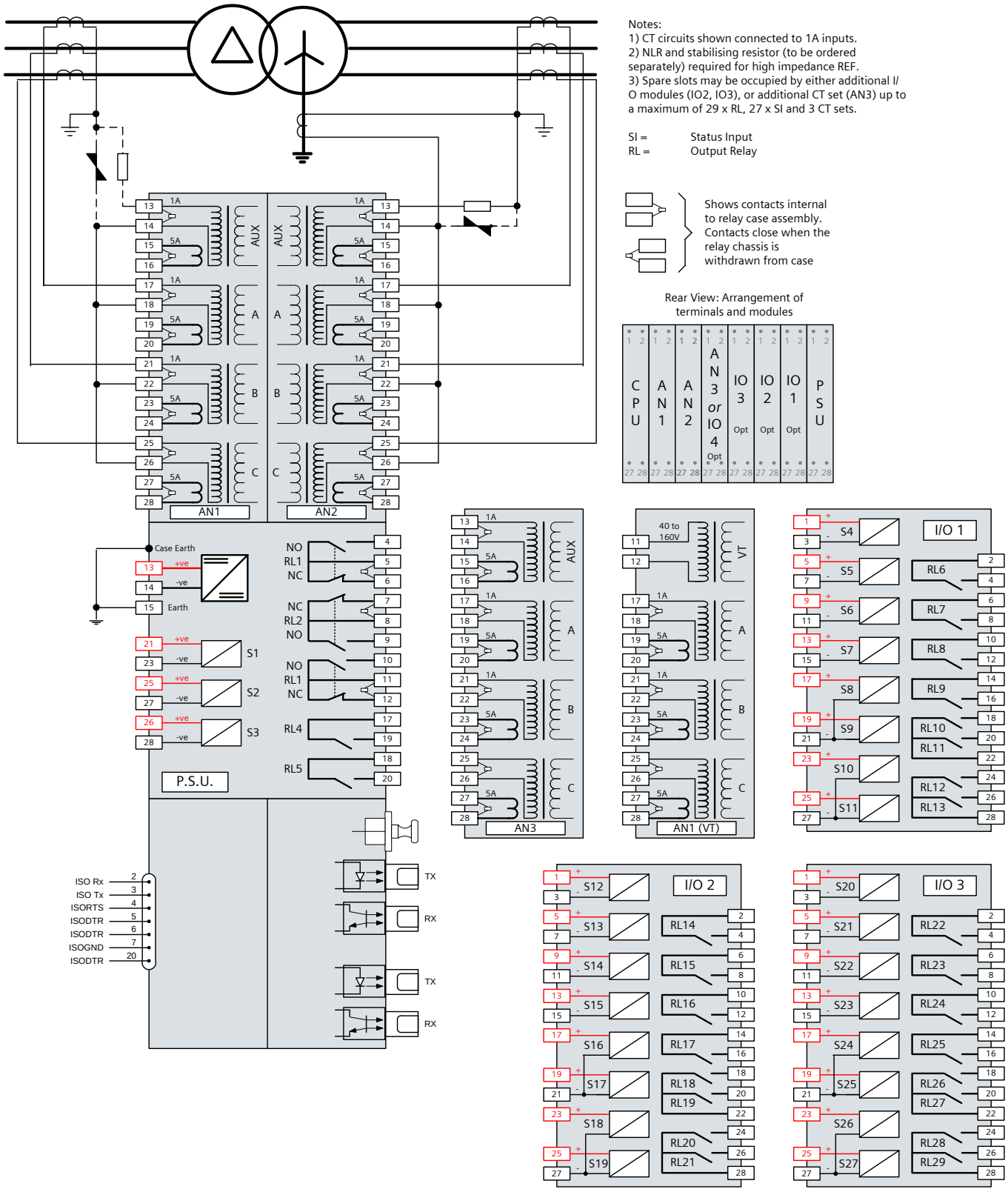


Fig 6. 7SG14 Connection Diagram

Module Location

Module location when viewed from relay front with the fascia door open.

E16 case 2 or 3W

A	B	C	D	E	F	G	H
PSU	I/O 1	(I/O2)	(I/O3)	(AN3) Or (I/O4)	AN2	AN1	CPU

E12 case 2 or 3W

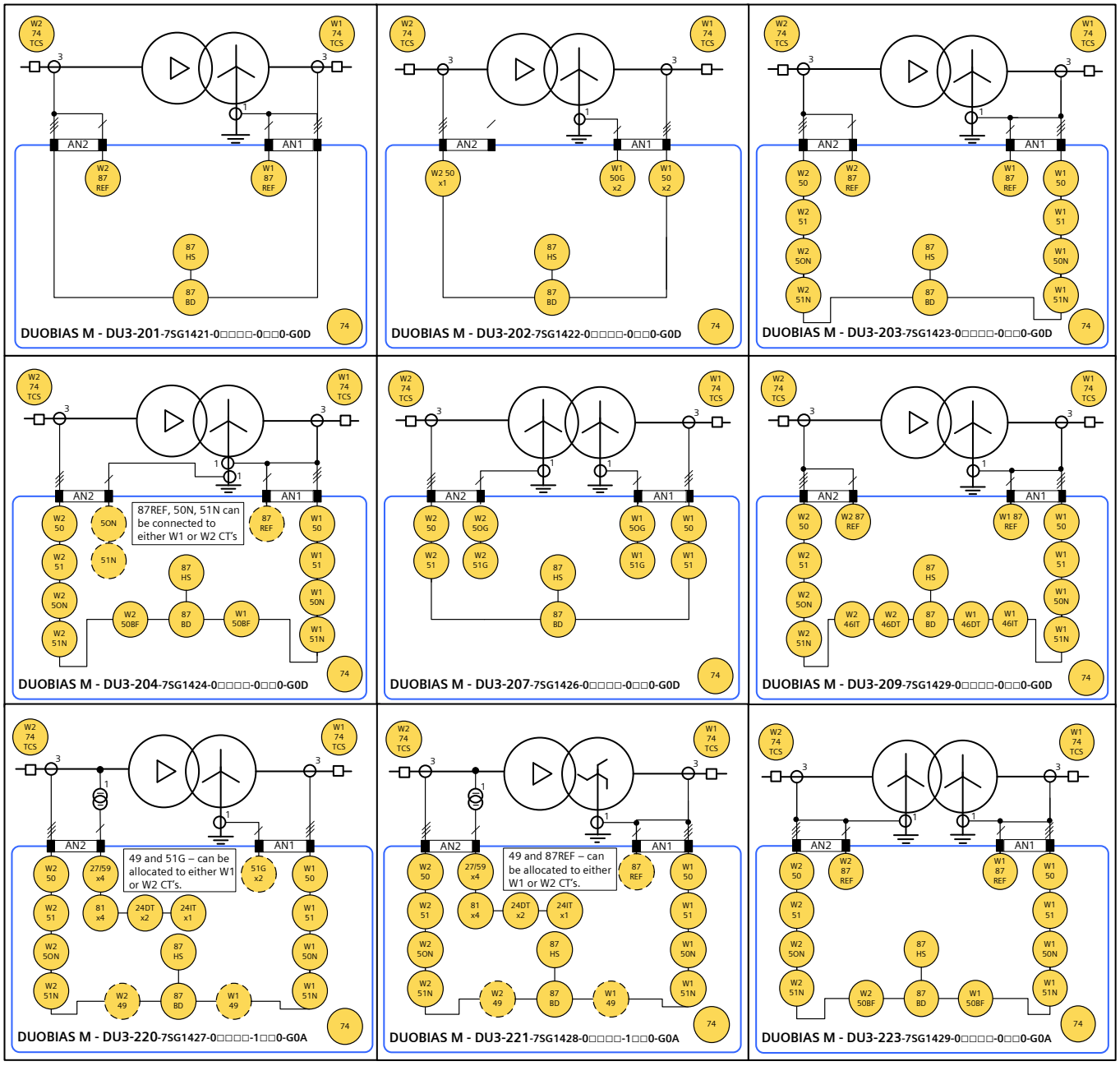
A	B	C	D	E	F
PSU	I/O1	(AN3) OR (I/O2)	AN2	AN1	CPU

E8 case 2 or 3W

A	B	C	D
PSU	AN1	AN2	CPU

The following ANSI Function Diagrams illustrate the use of the various models. All transformer vector groups can be accommodated by selection of appropriate relays settings. The "?" symbol in the MLFB code, shown on these diagrams, denotes a user selection for rating, I/O count and case size.

ANSI Diagrams Two Winding Models – 7SG142 Duobias M

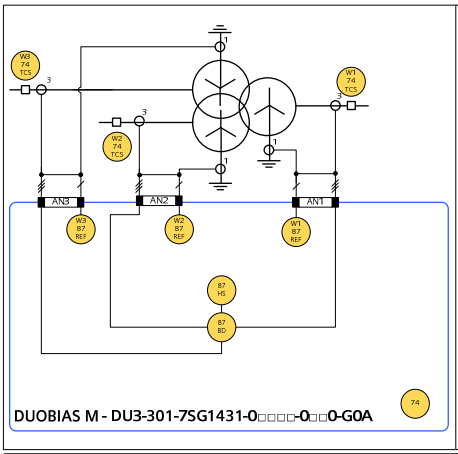


ANSI CONNECTION DIAGRAMS
DUOBIAS M TWO WINDING TRANSFORMER DIFFERENTIAL RELAYS - 7SG142*

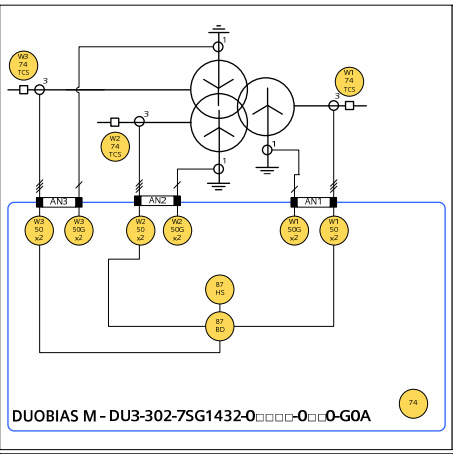
FUNCTION NUMBER - IEEE Std C37.2-1996

24DT	OVER FLUXING – DTL V/f	50BF	TWO STAGE CIRCUIT BREAKER FAIL	74	ALARM/TRIP LED INDICATION (BUCHHOLZ etc)
24IT	OVER FLUXING – User Definable Inverse V/f	51	IDMTL/DTL OVER CURRENT	74TCS	TRIP CIRCUIT SUPERVISION/FAIL
27	DTL UNDER VOLTAGE - Single Phase	50G	MEASURED INST/DTL EARTH (GROUND) FAULT	87BD	BIASED DIFFERENTIAL
46DT	DTL NEGATIVE PH. SEQUENCE OVERCURRENT	51G	MEASURED IDMTL/DTL EARTH(GROUND)FAULT	87HS	DIFFERENTIAL HIGHSET
46IT	IDMTL NEGATIVE PH. SEQ. OVERCURRENT	50N	DERIVED INST/DTL EARTH (GROUND) FAULT	87REF	HIGH IMPEDANCE RESTRICTED (GROUND) EARTH
49	THERMAL OVERLOAD	51N	DERIVED IDMTL/DTL EARTH (GROUND) FAULT	FAULT	(External series setting resistor and non linear
50	INST/DTL OVER CURRENT	59	DTL OVER VOLTAGE - Single Phase		resistor required – not shown)

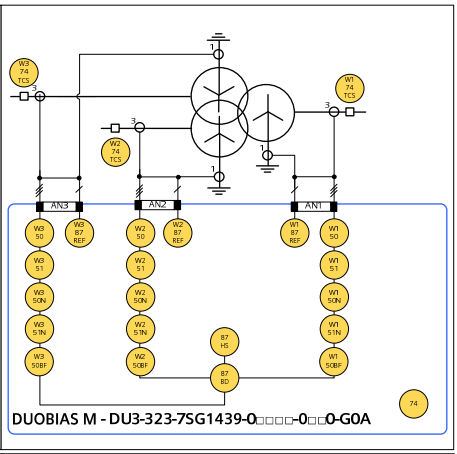
ANSI Diagrams Three Winding Models – 7SG143 Duobias M



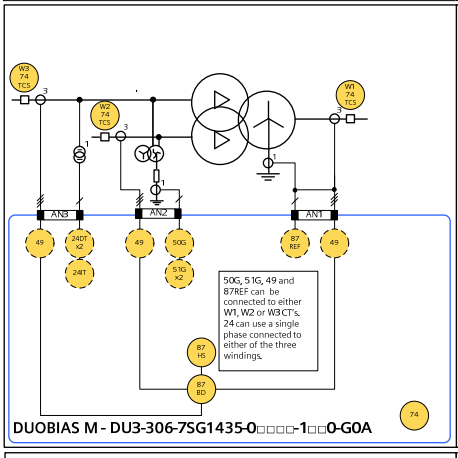
DUOBIAS M - DU3-301-7SG1431-0□□□□-0□□0-G0A



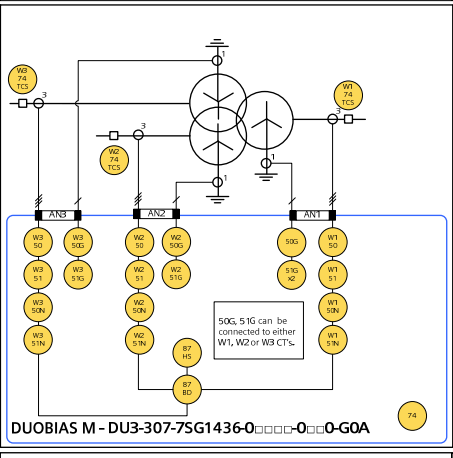
DUOBIAS M - DU3-302-7SG1432-0□□□□-0□□0-G0A



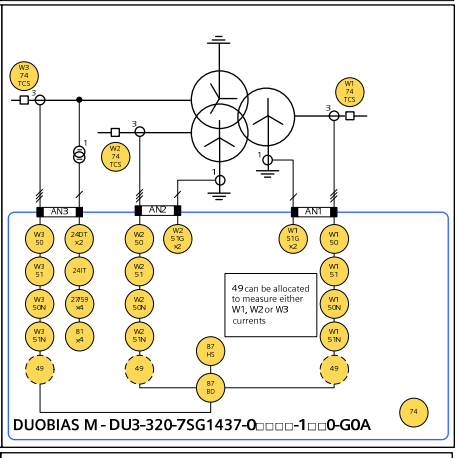
DUOBIAS M - DU3-323-7SG1439-0□□□□-0□□0-G0A



DUOBIAS M - DU3-306-7SG1435-0□□□□-1□□0-G0A



DUOBIAS M - DU3-307-7SG1436-0□□□□-0□□0-G0A



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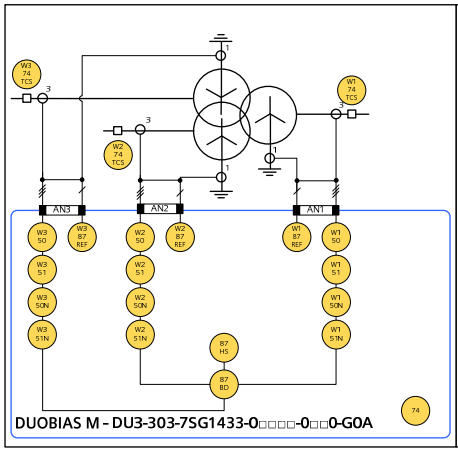

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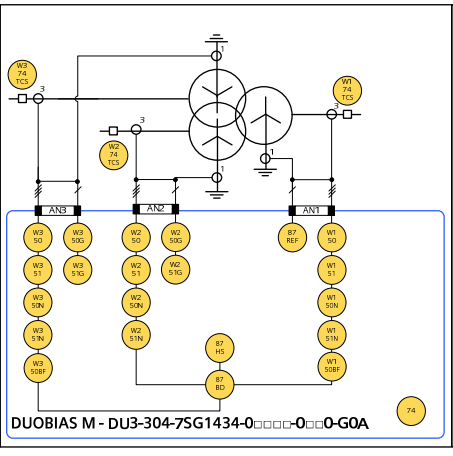

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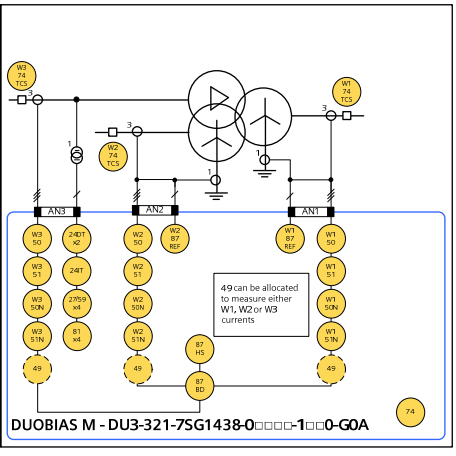

DUOBIAS M - DU3-321-7SG1438-0□□□□-1□□0-G0A

ANSI CONNECTION DIAGRAMS
THREE WINDING DUOBIAS M TRANSFORMER DIFFERENTIAL RELAYS - 7SG143*

FUNCTION NUMBER - IEEE Std C37.2-1996

24DT	OVER FLUXING - DTL V/f	50BF	TWO STAGE CIRCUIT BREAKER FAIL	74	ALARM/TRIP LED INDICATION (BUCHHOLZ etc)
24IT	OVER FLUXING - User Definable Inverse V/f	51	IDMTL/DTL OVER CURRENT	74TCS	TRIP CIRCUIT SUPERVISION/FAIL
27	DTL UNDER VOLTAGE - Single Phase	50G	MEASURED INST/DTL EARTH (GROUND) FAULT	87BD	BIASED DIFFERENTIAL
46DT	DTL NEGATIVE PH. SEQUENCE OVERCURRENT	51G	MEASURED IDMTL/DTL EARTH(GROUND)FAULT	87HS	DIFFERENTIAL HIGHSET
46IT	IDMTL NEGATIVE PH. SEQ. OVERCURRENT	50N	DERIVED INST/DTL EARTH (GROUND) FAULT	87REF	HIGH IMPEDANCE RESTRICTED (GROUND)
49	THERMAL OVERLOAD	51N	DERIVED IDMTL/DTL EARTH (GROUND) FAULT		EARTH FAULT (External Series Setting Resistor
50	INST/DTL OVER CURRENT	59	DTL OVER VOLTAGE - Single Phase		and Non-linear Resistor Required - not shown)

Ordering Information 7SG142 Duobias M

Product description	Variants	Order No.
Duobias-M (200 series)		**7 S G 1 4 □ □ - 0 □ □ □ □ - □ □ □ 0 - □ □ □**
Two winding transformer differential protection.		
	Relay type	
	200 series – Transformer Protection (2 analogue input sets, 2 winding)	**2**
	Basic protection functionality - included in all models - Vector group compensation and ratio correction - Biased differential protection (87BD) - Differential high-set (87HS) - Internal protections indication (Buchholz, temperature etc.) (74) - Trip circuit supervision (74TC)	
	Protection options [4])	
	Option 01 - Restricted earth-fault (87REF)	**1** **0**
	Option 02 - 2 stage DTL overcurrent (50) - 2 stage DTL measured earth-fault (50G)	**2** **0**
	Option 03 - Restricted earth-fault (87REF) - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N)	**3** **0**
	Option 04 - Restricted earth-fault (one winding) (87REF) - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N) - DTL measured earth-fault (one winding) (50G) - IDMTL measured earth-fault (one winding) (51G) - Circuit breaker fail (50BF)	**4** **0**
	Option 07 - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL measured earth-fault (50G) - IDMTL measured earth-fault (51G)	**6** **0**
	Option 09 - Restricted earth-fault (87REF) - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N) - DTL NPS DTL overcurrent (46DT) - IDMTL NPS overcurrent (46IT)	**9** **0** **G 0 D**
	Option 20 - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N) - 2 stage IDMTL measured earth-fault (one winding) (51G) - 4 stage under/overvoltage (27/59) - 4 stage under/overfrequency (81) - Overexcitation (24) - Thermal overload (one winding) (49)	**7** **1**

(continued on following page)

Product description	Variants	Order No.
Duobias-M (200 series)		**7 S G 1 4 □ □ - 0 □ □ □ □ - □ □ □ 0 - □ □ □**
(continued from previous page)		
	Protection options [4])	
	Option 21	**8** **1**
	- Restricted earth-fault (one winding) (87REF)	
	- DTL overcurrent (50)	
	- IDMTL overcurrent (51)	
	- DTL derived earth-fault (50N)	
	- IDMTL derived earth-fault (51N)	
	- 4 stage under/overvoltage (27/59)	
	- 4 stage under/overfrequency (81)	
	- Overexcitation (24)	
	- Thermal overload (one winding) (49)	
	Option 23	**9** **0** **G 0 A**
	- Restricted earth-fault (87REF)	
	- DTL overcurrent (50)	
	- IDMTL overcurrent (51)	
	- DTL derived earth-fault (50N)	
	- IDMTL derived earth-fault (51N)	
	- Circuit breaker fail (50BF)	
	Auxiliary supply /binary input voltage	
	30 V DC auxiliary, 30 V DC binary input	**A**
	30 V DC auxiliary, 48 V DC binary input	**B**
	48/110 V DC auxiliary, 30 V DC binary input	**C**
	48/110 V DC auxiliary, 48 V DC binary input [1])	**D**
	48/110 V DC auxiliary, 110 V DC low burden binary input	**E**
	220 V DC auxiliary, 110 V DC low burden binary input	**F**
	220 V DC auxiliary, 220 V DC low burden binary input	**G**
	I/O range	
	3 Binary Inputs / 5 Binary Outputs (incl. 3 changeover)	**A** **E**
	11 Binary Inputs / 13 Binary Outputs (incl. 3 changeover) [2])	**B**
	19 Binary Inputs / 21 Binary Outputs (incl. 3 changeover) [2])	**C**
	27 Binary Inputs / 29 Binary Outputs (incl. 3 changeover) [3])	**D**
	Frequency	
	50Hz	**1**
	60Hz	**2**
	Nominal current	
	1/ 5 A	**0**
	Voltage inputs	
	Not available	**0**
	63.5/110 V AC	**1**
	Housing size	
	Case size E8 (4U high)	**E**
	Case size E12 (4U high)	**G**
	Case size E12 (4U wide, vertical)	**H**
	Case size E16 (4U high)	**J**
	Case size E16 (4U wide, vertical)	**K**
	Communication interface	
	Fibre optic (ST-connector) / IEC 60870-5-103 or Modbus RTU	**B**

1)High burden 110V & 220V binary inputs compliant with ESI48-4 ESI 1 available via external dropper resistors with 48V binary input version, 110/125 V application, order combination of the following resistor boxes to suit number of binary inputs, VCE:2512H10064 (9 inputs, 110V), VCE:2512H10065 (5 inputs, 110V), VCE:2512H10066 (1 inputs, 110V), 220/250 V application, order resistor box 2512H10066 in addition, VCE:2512H10067 (5 inputs, 220V), VCE:2512H10068 (1 inputs, 220V), Refer to website for application note about ESI48-4 compliance

2) Case size E12, Case size E16

3) Functions are per winding unless stated otherwise, REF models require external resistors and Metrosil (NLR) at additional cost.

Ordering Information 7SG143n Duobias M

Product description	Variants	Order No.
Duobias-M (300 series)		**7 S G 1 4 □ □ - 0 □ □ □ □ - □ □ □ 0 - □ □ □**
Three winding transformer differential protection.		
	Relay type	
	300 series - Transformer Protection (3 analogue input sets, 3 winding)	**3**
	Basic protection functionality - included in all models - Vector group compensation and ratio correction - Biased differential protection (87BD) - Differential high-set (87HS) - Internal protections indication (Buchholz, temperature etc.) (74) - Trip circuit supervision (74TC)	
	Protection options [4])	
	Option 01 - Restricted earth-fault (87REF)	**1** **0**
	Option 02 - 2 stage DTL overcurrent (50) - 2 stage DTL measured earth-fault (50G)	**2** **0**
	Option 03 - Restricted earth-fault (87REF) - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N)	**3** **0**
	Option 04 - Restricted earth-fault (one winding) (87REF) - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N) - DTL measured earth-fault (two winding) (50G) - IDMTL measured earth-fault (two winding) (51G) - Circuit breaker fail (50BF)	**4** **0**
	Option 06 - Restricted earth-fault (one winding) (87REF) - Overexcitation (24) - DTL measured earth-fault (two winding) (50G) - IDMTL measured earth-fault (two winding) (51G)	**5** **1**
	Option 07 - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N) - DTL measured earth-fault (50G) - IDMTL measured earth-fault (51G)	**6** **0**
	Option 20 - DTL overcurrent (50) - IDMTL overcurrent (51) - DTL derived earth-fault (50N) - IDMTL derived earth-fault (51N) - 2 stage IDMTL measured earth-fault (two winding) (51G) - 4 stage under/overvoltage (27/59) - 4 stage under/overfrequency (81) - Overexcitation (24) - Thermal overload (one winding) (49)	**7** **1**

(continued on following page)

Product description	Variants	Order No.
Duobias-M (300 series)		**7 S G 1 4 □ □ - 0 □ □ □ □ - □ □ □ 0 - □ □ □**
(continued from previous page)		
	Protection options [4])	
	Option 21	**8** **1**
	- Restricted earth-fault (two winding) (87REF)	
	- DTL overcurrent (50)	
	- IDMTL overcurrent (51)	
	- DTL derived earth-fault (50N)	
	- IDMTL derived earth-fault (51N)	
	- 4 stage under/overvoltage (27/59)	
	- 4 stage under/overfrequency (81)	
	- Overexcitation (24)	
	- Thermal overload (one winding) (49)	
	Option 23	**9** **0** **G 0 A**
	- Restricted earth-fault (87REF)	
	- DTL overcurrent (50)	
	- IDMTL overcurrent (51)	
	- DTL derived earth-fault (50N)	
	- IDMTL derived earth-fault (51N)	
	- Circuit breaker fail (50BF)	
	Auxiliary supply /binary input voltage	
	30 V DC auxiliary, 30 V DC binary input	**A**
	30 V DC auxiliary, 48 V DC binary input	**B**
	48/110 V DC auxiliary, 30 V DC binary input	**C**
	48/110 V DC auxiliary, 48 V DC binary input [1])	**D**
	48/110 V DC auxiliary, 110 V DC low burden binary input	**E**
	220 V DC auxiliary, 110 V DC low burden binary input	**F**
	220 V DC auxiliary, 220 V DC low burden binary input	**G**
	I/O range	
	3 Binary Inputs / 5 Binary Outputs (incl. 3 changeover) 2)	**A**
	11 Binary Inputs / 13 Binary Outputs (incl. 3 changeover) [2])	**B**
	19 Binary Inputs / 21 Binary Outputs (incl. 3 changeover) [3])	**C**
	27 Binary Inputs / 29 Binary Outputs (incl. 3 changeover) [3])	**D**
	Frequency	
	50Hz	**1**
	60Hz	**2**
	Nominal current	
	1/ 5 A	**0**
	Voltage inputs	
	Not available	**0**
	63.5/110 V AC	**1**
	Housing size	
	Case size E12 (4U high)	**G**
	Case size E12 (4U wide, vertical)	**H**
	Case size E16 (4U high)	**J**
	Case size E16 (4U wide, vertical)	**K**
	Communication interface	
	Fibre optic (ST-connector) / IEC 60870-5-103 or Modbus RTU	**B**

1) High burden 110V & 220V binary inputs compliant with ESI48-4 ESI 1 available via external dropper resistors with 48V binary input version, 110/125 V application, order combination of the following resistor boxes to suit number of binary inputs, VCE:2512H10064 (9 inputs, 110V), VCE:2512H10065 (5 inputs, 110V), VCE:2512H10066 (1 inputs, 110V), 220/250 V application, order resistor box 2512H10066 in addition, VCE:2512H10067 (5 inputs, 220V), VCE:2512H10068 (1 inputs, 220V), Refer to website for application note about ESI48-4 compliance

2) Case size E12

3) Case size E16

4) Functions are per winding unless stated otherwise, REF requires external resistors and Metrosil (NLR) at additional extra cost.

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