



Reyrolle  
Protection  
Devices

## 7SR224 Argus

Recloser Controller

Energy Management

**SIEMENS**

# 7SR224 Argus

Recloser Controller



## Description

The 7SR224 Recloser Controller is one of a range of new generation devices providing comprehensive directional and non-directional overcurrent protection integrated with associated protection elements and Autoreclose scheme logic. It builds on the years of in-service experience gained from the Argus family of products. The Controller provides independent Phase Fault, Earth Fault and Sensitive Earth Fault autoreclose sequences. Each sequence can be user set to any mix of Instantaneous (fast time current characteristic (TCC)) or Delayed TCC protection and independent Reclose (Dead) times. The Controller also provides a separate Autoreclose sequence for external protection.

Functions included are: -

Control, monitoring, instruments, Voltage - Sag & Swell, together with integrated input and output logic, data logging & fault report functions.

Controllers are housed in 4U high, size E10 or E12 cases.

## Function Overview

### Standard Functionality

21FL	Fault Location
27/59	Under/Overvoltage
27Sag/59Swell	SARFix Power Quality Counters
37	Undercurrent
46BC	Broken Conductor / Load Unbalance
46NPS	Negative Phase Sequence Overcurrent
47NPS	Negative Phase Sequence Overvoltage
49	Thermal Overload –Pole Segregated
50BF	Circuit Breaker Fail
51c	Cold Load Pickup
51V	Voltage Controlled Overcurrent
59N	Neutral Voltage Displacement
60CTS	CT Supervision
60VTS	VT Supervision
64H	High Impedance Restricted Earth Fault (EF)
67/50	Directional Instantaneous Phase Fault O/C
67/50G	Directional Instantaneous Earth Fault O/C
67/51	Directional Time Delayed Phase Fault O/C
67/51G	Directional Time Delayed Earth Fault O/C
67/50SEF	Directional Instantaneous Sensitive EF
67/51SEF	Directional Time Delayed Sensitive EF
74TCS	Trip Circuit Supervision H4/5/6/7 schemes
79	Autoreclose
81	Under/Over Frequency
81HBL2	Inrush Restraint
86	Lockout
	User Programmable Logic Equations, via HMI
	Graphical Programmable Logic, via pc application
	8 Settings Groups - Password access - 2 levels
	Self Monitoring

### Optional Functionality

25	Synchronising
	Loop Automation by Loss of Voltage
	Single /Triple Pole Autoreclose for Three Single Pole Circuit Breakers

## User Interface

- 20 character x 4 line backlit LCD
- Menu navigation keys
- 3 fixed function LEDs
- 8 or 16 Programmable Tri-colour LEDs
- 12 Programmable Function Keys with Tri-colour LEDs

## Monitoring Functions

Fault Data Mode – displays Date & Time, Type of fault and currents & voltages for each of last 10 faults.  
Favourite (Default) meters – User selectable from:-  
Currents - Primary, Secondary, xIn, Earth/SEF, Sequence Components and 2nd Harmonic,  
Voltages – 3 phase Primary, Secondary & xVn, Ph-Ph and Ph-n, Sequence Components, Calculated Earth Voltage. Voltage (Vx) from a 4<sup>th</sup> voltage input, Primary, Secondary & xVn. Synchronising phase, magnitude & frequency difference.  
Optional 3 phase from the source side providing Primary, Secondary & xVn, Ph-Ph and Ph-n, Sequence Components, Calculated Earth Voltage.  
Frequency  
Power – MW, MVar, MVA, Power Factor  
Energy – Export & Import - MWh, MVarh,  
Direction – Load Flow Indication  
Thermal capacity – %  
Autoreclose – status and shot number  
CB Maintenance:  
    2 Independent Trip Counters,  
    Frequent Operations Counter  
    Lockout handle operations counter  
    I<sup>2</sup>t summation for contact wear  
General alarms  
Battery Condition monitoring and automatic cyclical test.  
Power quality – 27 Sag and 59 Swell (Per pole Counters for SIARFix, SMARFix, STARFix and Interruption Events,)  
Binary Input status indication  
Binary Output status indication  
Virtual internal status indication  
Communications Meters  
Miscellaneous Meters, Date, Time, Waveform, Fault, Event & Data Log records-counters.  
Demand Monitoring

## Data Storage & Communications

### Standard Communications Ports

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Communication access to relay functionality is via a front USB port for local PC connection or rear electrical RS485 port for remote connection

### Optional Communications Ports

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2 Rear ST fibre optic serial ports (2 x Tx/Rx) + IRIG-B port  
1 additional Rear RS485 port + IRIG-B port  
1 additional Rear RS232 port + IRIG-B port  
2 Electrical Ethernet ports using RJ45 connectors  
2 Optical Ethernet using duplex LC connectors

### Protocols

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IEC60870-5-103, Modbus RTU and DNP 3.0 or IEC60870-5-101 serial protocols – User selectable with programmable data points  
IEC61850 Ethernet – optional  
Ethernet Redundancy: RSTP, HSR & PRP - standard on ethernet equipped models

### Data

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Event records  
Fault records  
Waveform records  
Measurands  
Commands  
Time synchronism  
Viewing and changing settings

## Description of Functionality

With reference to figure 8: 'Function Diagram'.

### 25 Synchronising

Synchronising is used with three pole Manual Closing and Autoreclose operations to ensure that voltages are within safe limits before allowing the close operation to proceed. The 7SR224 provides settings for voltages, phase and frequency difference for Check Synchronising as well as System Synchronising and Close on Zero phase difference for automatic selection following detection of a split system. Automatic Synchronising bypass is also available to allow closure to energise a dead feeder or busbar.

### 27/59 Under/over Voltage

4 elements which can be set independently as Under or overvoltage. Each element has settings for pickup level and Definite Time Lag (DTL) delays, operates if voltage 'exceeds' setting for duration of delay, Typically applied in load shedding schemes.

### 37 Undercurrent

2 element with settings for pickup level and Definite Time Lag (DTL) delays. Each operates if current falls below its setting for duration of its delay.

### 46BC Broken Conductor

Each element has settings for pickup level and DTL delay. With the circuit breaker closed, if the NPS / PPS current ratio is above setting this could be due to a broken conductor.

### 46NPS Negative Phase Sequence Overcurrent

Two elements, one DTL and one IDMT, with user settings for pickup levels and delays. NPS Current elements can be used to detect unbalances on the system. The negative sequence phase component of current is derived from the three phase currents. It is a measure of the quantity of unbalanced current on the system.

### 47NPS Negative Phase Sequence OverVoltage

Two DTL elements with independent user settings for NPS overvoltage pickup level and delays. NPS Voltage elements can be used to detect unbalances on the system. The negative sequence phase component of voltage is derived from the three phase voltages. It is a measure of the quantity of unbalanced voltage on the system.

### 49 Thermal Overload

The thermal algorithm calculates the thermal state of each pole from the measured currents and can be applied to lines, cables and transformers; operates if the user set thermal overload is exceeded. Capacity Alarm operates if a user set percentage of overload is reached.

### 50BF Circuit Breaker Fail

The circuit breaker fail function may be triggered from an internal trip signal or from a binary input. All measured currents can be 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 provided to enable another stage to be utilized if required.

### 59N Neutral Overvoltage

Two elements, one DTL and one IDMTL, have user settings for pickup level and delays. These will operate if the Neutral voltage exceeds the setting for duration of delay. Neutral overvoltage can be used to detect earth faults in high impedance earthed or isolated systems.

### 67/50 Phase Fault Elements

Provide Directional Instantaneous or Definite Time (DTL) Overcurrent protection, with independent settings for pickup current and time-delay. Four elements are provided. Elements can be Inrush-inhibited

### 67/51 Phase Fault Elements

Provide Directional - Inverse Definite Time Overcurrent protection, TCC/DTL with independent settings for pickup current, TCC and minimum/follower time-delay. Four elements are provided. User can select the TCC from standard IEC/ANSI or Legacy Characteristics e.g. 101 (A) etc. Reset TCC can be user set to either DTL or shaped, to integrate grading with electromechanical or other protection devices.

### Earth Fault/Sensitive Earth Fault

The Earth Fault current is measured directly via a dedicated current analogue input. This input is used for both Earth Fault and Sensitive Earth Fault elements.

### 67/50G Earth Fault

Provide Directional Instantaneous or Definite Time (DTL) earth fault protection, with independent settings for pickup current and time-delay. Four elements are provided. Elements can be Inrush-inhibited.

### 67/51G Earth Fault

Provide Directional - Inverse Definite Time earth fault protection, TCC/DTL with independent settings for pickup current, TCC and minimum/follower time-delay. Four elements are provided. User can select the TCC from standard IEC/ANSI or Legacy Characteristics e.g. 101 (A) etc. Reset TCC can be user set to either DTL or shaped, to integrate grading with electromechanical or other protection devices.

### 67/50SEF Sensitive Earth Fault

Provide Directional Instantaneous or Definite Time (DTL) earth fault protection, with independent settings for pickup current and time-delay. Four elements are provided. Elements can be Inrush-inhibited

### 67/51SEF Sensitive Earth Fault

Provide Directional Instantaneous or Definite Time (DTL) earth fault protection, with independent settings for pickup current and time-delay.

Four elements are provided.

Elements can be Inrush-inhibited

User can select the TCC from standard IEC/ANSI or Legacy Characteristics e.g. 101 (A) etc. Reset TCC can be user set to either DTL or shaped, to integrate grading with electromechanical or other protection devices.

### 67 Directional Control

Phase Fault, Earth Fault and Sensitive Earth Fault elements can be directionalised. Each element can be user set to Forward, Reverse, or Non-directional.

Where multiple elements are provided two could be set for Forward and two for Reverse, thus providing Bi-Directional Tri-state protection is a single device.

Phase Fault elements are polarised from the calculated quadrature voltage i.e.  $I_a \sim V_{bc}$ ,  $I_b \sim V_{ca}$  &  $I_c \sim V_{ab}$ .

Earth Fault/SEF elements are polarized from internally calculated Zero sequence Voltage, i.e.  $I_0 \sim V_0$ .

### 51c Cold Load

When a circuit breaker is closed onto a 'cold' load, i.e. one that has not been powered for a prolonged period, this can impose a higher than normal load-current demand on the system which could exceed 'Normal settings'. These conditions can exist for an extended period and must not be interpreted as a fault. To allow optimum setting levels to be applied for normal operation, Cold Load causes the 67/51 elements to change to 67/51c settings i.e. Setting/TCC/Time Multiplier /Follower delay times, for a limited period. Cold Load resets and returns to 'Normal settings' when either the circuit breaker has been closed for a User set period, or if the current has fallen to below a set level for a set time and it is safe to return.

### 51V Voltage Controlled OverCurrent

Element has settings for UnderVoltage pickup level and operates if voltage falls below setting. On Pick-up this element applies the set 51v Multiplier to the pickup setting of the 67/51 phase fault elements.

### 60CTS CT Supervision

The CT Supervision considers the presence of negative phase sequence current, without an equivalent level of negative phase sequence voltage, for a user set time as a CT failure. Element has user operate and delay settings.

### 60VTS VT Supervision

The VT Supervision uses a combination of negative phase sequence voltage and negative phase sequence current to detect a VT fuse failure. This condition may be alarmed or used to inhibit voltage dependent functions. Element has user operate and delay settings.

### 64H Restricted Earth Fault - scheme

The measured earth fault input may be used in a 64H high-impedance, restricted earth fault scheme. The required external series stabilising resistor and shunt non-linear Varistor can be supplied.

### 74TC Trip Circuit Supervision

Up to three trip circuits can be monitored using binary inputs connected in H4/H5/H6 or H7 schemes. Trip circuit failure raises an HMI alarm and output(s).

### 79 Auto Reclose

The controller provides independent Phase Fault, Earth Fault and Sensitive Earth Fault sequences. They can be set for up to 4 Shots i.e. 5 Trips + 4 Reclose attempts to Lockout. These sequences can be user set to any configuration of Instantaneous (fast TCC) or Delayed TCC protection, with independent Reclose (Dead) times.

As the user defines which elements are Instantaneous, the combination of TCC1 plus 50 High set elements & TCC2 plus 50 High Set elements, provides the user with full flexibility. It enables the optimisation of the protection characteristics, which will be applied at each point in the protection sequence. Limits can be set by the user on the number of Delayed Trips to Lockout or High set trips to Lockout. The External Protection Auto Reclose sequence allows AutoReclose to be provided for a separate high speed Protection device with options for Blocking External Trips to allow Overcurrent grading to take place.

### Single/Triple Auto Reclose

Additional optional functionality is available to provide tripping, auto reclose and control of three single pole Reclosers located together and controlled by a single 7SR224 device. The facility to operate each of the three phases independently for systems where single phase loads are connected is common in some countries. The 7SR224 provides flexible schemes which are used to provide single and three pole trip and reclose operations depending on the fault type detected.

### Dead/Live indication

Detection of live voltage is provided for each phase on both sides of the Recloser. This can be set to provide indication and alarms.

### Loss of Voltage LOV Automation

Additional optional functionality is available to provide control of Normally Open Points (NOP) and other Reclosers in the distribution network to provide an automation sequence of load restoration following a persistent fault. The sequence is started by the loss of voltage detection, for an extended period of time, following a complete but unsuccessful auto reclose sequence, which has caused Lockout of a Recloser at any point in the network.

### 81 Under/Over Frequency

Each of the 4 elements has settings for pickup level, drop-off level and Definite Time Lag (DTL) delays. This function operates if frequency 'exceeds' setting for duration of delay. Typically applied in load shedding schemes.

### 81HBL2 Second Harmonic Block

Where second harmonic current is detected i.e. during transformer energisation the user selected elements can be blocked

### 27/59 Voltage Sag/Swell

Power System Utilities use SARFI indices of Voltage Sag and Swell, which express the magnitude and duration of Sag and Swell variations occurring on their systems. These indices are based on the 'ride-through' capability of the customer's plant and are usually expressed in terms of the number of a specific class (index) of r.m.s. variation per customer per specified period.

These elements provide the raw data in the form of counters that display the total count of each type of index value. Sags have a greater impact on plant performance than Swells. Disturbances are classified according to their magnitude and duration, the limits can be User set for SIARFI, SMARFI & STARFI. Breaks above 60s duration are Interruptions. Counters for each are provided per pole.

### Programmable User Logic

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

User can freely map any protection element output to any Binary Output(s); and any Binary Input(s) to any Function Inhibit(s), Binary Output, LED's and/or internal Virtual signal points. User can also enter up to 16 Equations via the HMI or from a pc, defining User scheme-logic using standard Boolean Logic e.g. ( )/AND/OR/NOT/XOR, to combine BI, other Equations, Function Keys, LEDs, BO, and internal Virtual signal points. Each equation has PU/DO Time Delays and a Target Counter. Each Equation appears in the Output matrix and can be freely mapped to LEDs/BO.

In addition, the Reydisp Manager pc application provides graphical programming of user logic within the device.

### Circuit Breaker Maintenance

Four circuit breaker trip counters are provided:- Total Trip Count increments upon each trip command issued to give data for maintenance.

Delta Trip Count is an additional counter which can be reset independently of the Total Trip Counter and counts the number of operations since the last reset.

Frequent Operations Counter monitors the number of trip operations in a rolling window period of one hour and operates to stop cyclical sequences if the set number is exceeded.

An I<sup>2</sup>t summation Counter provides a means monitoring 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.

### Function LED's

Eight (E10 case) or sixteen (E12) user programmable tri-colour LED's are provided eliminating the need for expensive panel mounted pilot lights and associated wiring. Each LED can be user set to red, green or yellow allowing for clear indication of the associated function's state. A slip-in label pocket along-side enables the user to insert his own notation. A printer compatible template is available.

### Function Keys

Twelve user programmable function keys are available for implementing User logic and scheme control functionality, eliminating the need for expensive panel mounted control switches and associated wiring. Each function key has an associated user programmable tri-colour LED (red, green, yellow) allowing for clear indication of the associated function's state. A slip-in label pocket along-side enables the user to insert his own notation for the Function Key LED Identification.

Each Function Key can be mapped directly to any of the built-in Controller/Circuit Breaker Command functions or to the User Logic equations.



Fig 1. Tri-colour LED's and function keys

## Data Acquisition - Via Communication Interface

### 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 relay fascia and the last 100 are available through the communication interface using Reydisp Evolution. These records contain the time and date of trip, measured quantities and type of fault.

### Waveform recorder

The waveform recorder stores analogue data for all poles and the states of protection functions, binary inputs, LEDs and binary outputs with user settable 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.

### Demand Monitoring

A record of demand is available. The demand minimum, maximum and average values for currents, voltages, frequency and real, reactive and apparent power, over a user selectable period of time, is displayed and available via data communications. Typically this is set as a rolling value for the last 24 hours.

### Data Log

The average values of voltages, current and real and reactive power are recorded at a user selectable interval and stored to provide data in the form of a Data Log which can be downloaded for further analysis. A typical application is to record 15 minute intervals over the last 7 days.

### Real Time Clock

The time and date can be set and are maintained while the relay is de-energised by a back up storage capacitor. The time can be synchronized from a binary input pulse or the data communication channel.

## Reydisp Evolution

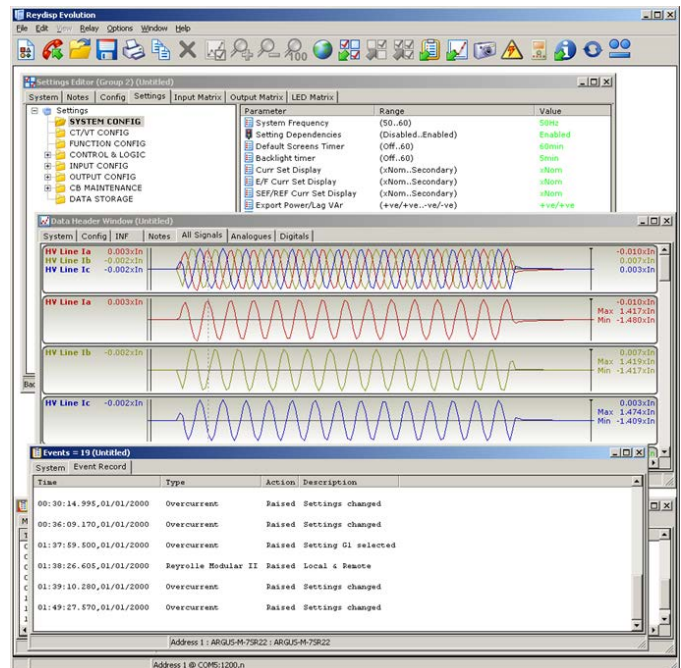


Fig 2. Typical Reydisp Evolution screenshot

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 relays.

Reydisp Evolution installation includes the Communications Editor to allow configuration of the serial protocol data points and options, the Curve Editor to allow programming of user defined TCC characteristics and the Language Editor to allow relay display text to be edited. This can be used to provide non-English language support using the European character set.

# Reydisp Manager

Reydisp Manager provides the functionality of Reydisp Evolution and also provides project management of multiple devices to allow engineering of IEC61850 projects. It also provides access to user logic within the devices via an easy to use graphical interface.

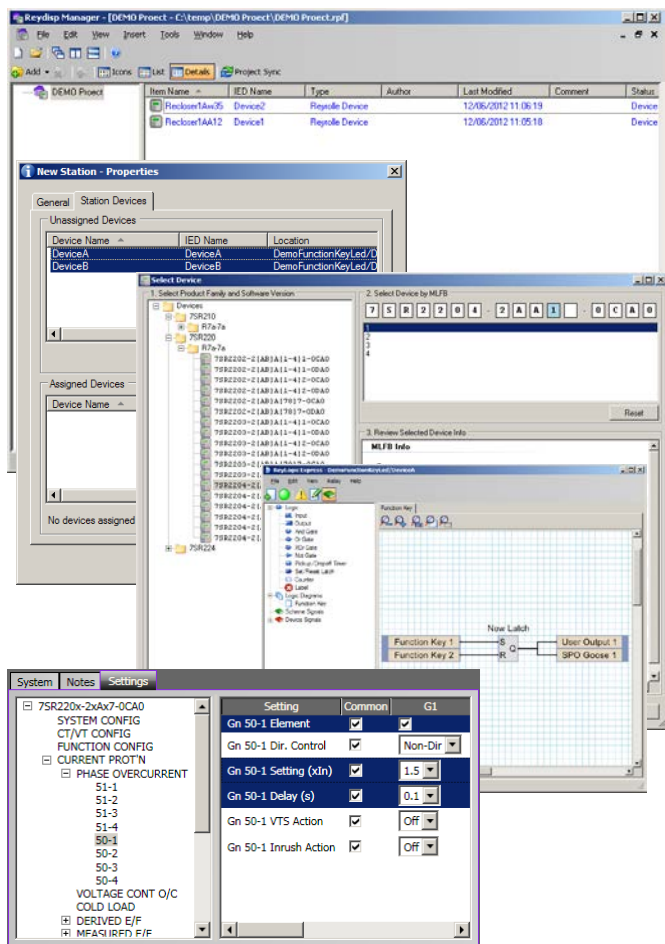


Fig 3. Typical Reydisp Manager screenshots



## Technical Data

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

## Inputs and Outputs

### Current Inputs

Quantity	3 x Phase & 1 x Earth or Sensitive Earth
Rated Current In	1/5 A
Measuring Range	80 x In
Instrumentation $\geq 0.1 \times I_n$	$\pm 1\% I_n$
Frequency	50/60 Hz
Thermal Withstand:	
Continuous	3.0 x In
10 Minutes	3.5 x In
5 Minutes	4.0 x In
3 Minutes	5.0 x In
2 Minutes	6.0 x In
3 Seconds	57.7 A (1 A) 202 A (5 A)
2 Seconds	70.7 A (1 A) 247 A (5 A)
1 Second	100 A (1 A) 350 A (5 A)
1 Cycle	700 A (1 A) 2500 A (5 A)
Burden @ In	$\leq 0.1$ VA (1 A ph. & Earth ) $\leq 0.3$ VA (5 A ph. & Earth )

### Voltage Inputs

Quantity	4 or 6
Nominal Voltage	40...160 V RMS a.c. Range
Instrumentation $\geq 0.8 \times V_n$	$\pm 1\% V_n$
Operating Range	4x VT models: 0-270 V RMS 6x VT models: 0-270 V RMS V1,V2,V3. 0-132 V RMS for V4,V5,V6
Thermal Withstand:	
Continuous	300 V RMS
1 Second	
Burden @ 110V	$\leq 0.1$ VA

### Binary Outputs

Operating Voltage	Voltage Free
Operating Mode	User selectable - Self or Hand Reset
Contact Operate / Release Time.	7 ms / 3 ms
Making Capacity: Carry continuously Make and carry (L/R $\leq 40$ ms and V $\leq 300$ V)	5 A ac or dc 20 A ac or dc for 0.5 s 30 A ac or dc for 0.2 s
Breaking Capacity ( $\leq 5$ A and $\leq 300$ V): AC Resistive AC Inductive DC Resistive DC Inductive	1250 VA 250 VA at p.f. $\leq 0.4$ 75 W 30 W at L/R $\leq 40$ ms 50 W at L/R $\leq 10$ ms

### Binary Inputs

Operating Voltage	19 V dc: Range 17 to 290 V dc 88 V: Range 74 to 290 V dc
Maximum dc current for operation	1.5 mA

### Auxiliary supply

Rated DC Voltage	24-250V DC Operating Range 19.2 to 275V	
Allowable superimposed ac component	12% of DC voltage	
Rated AC Voltage	100-230 VAC 50/60Hz Range 80 to 253 V rms AC 50/60Hz $\pm 5\%$	
Power Consumption:	Quiescent State (DC)	24V: 8W 110V: 7W 250V: 7W
	Maximum Load (DC)	24V: 12W 110V: 11W 250V: 11W
	Quiescent State(AC)	100V: 16VA 230V: 22VA
	Maximum Load (AC)	100V: 23VA 230V: 32VA
Allowable breaks/dips in supply (collapse to zero)	DC	50ms
	AC	2.5/3 cycles @50/60Hz

## Mechanical Tests

### Vibration (Sinusoidal)

IEC 60255-21-1 Class I

Type	Level	Variation
Vibration response	0.5 gn	$\leq 5\%$
Vibration endurance	1.0 gn	$\leq 5\%$

### Shock and Bump

IEC 60255-21-2 Class I

Type	Level	Variation
Shock response	5 gn, 11 ms	$\leq 5\%$
Shock withstand	15 gn, 11 ms	$\leq 5\%$
Bump test	10 gn, 16 ms	$\leq 5\%$

### Seismic

IEC 60255-21-3 Class I

Type	Level	Variation
Seismic response	1 gn	$\leq 5\%$

### Mechanical Classification

Durability	$>10^6$ operations
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## Electrical Tests

### 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

### High Frequency Disturbance

IEC 60255-22-1 Class III

Type	Level	Variation
Common (longitudinal)	2.5 kV	≤ 10 %
Series (transverse) mode	1.0 kV	≤ 10 %
RS485 standard rear port	1.0 kV	No data loss

### Electrostatic Discharge

IEC 60255-22-2 Class IV

Type	Level	Variation
Contact discharge	8.0 kV	≤ 5 %

### Fast Transient Immunity

IEC 60255-22-4 Class A (2002)

Type	Level	Variation
5/50 ns 2.5 kHz repetitive	4 kV	≤ 10 %
RS485 standard rear port	2 kV	No data loss

### Surge Immunity

IEC 60255-22-5; IEC 61000-4-5

Type	Level	Variation
Analog Inputs. Line to Earth	4.0 kV	≤ 10 %
Case, Aux Power & I/O. Line to Earth	2.0 kV	≤ 10 %
RS485 Comms port Line to Earth	1.0 kV	No Data Loss
Analog Inputs. Line to Line	1.0 kV	≤ 10 %
Case, Aux Power & I/O. Line to Line	1.0 kV*	≤ 10 %

\*Note 45ms DTL pick up delay applied to binary inputs

### Conducted Radio Frequency Interference Immunity

IEC 60255-22-6

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

### Radiated Radio Frequency Emissions

IEC 60255-25

Type	Limits at 10 m, Open Area test site, Quasi-peak
30 to 230 MHz	40 dB(μV/m)
230 to 10000 MHz	47 dB(μV/m)

### Conducted Radio Frequency Emissions

IEC 60255-25

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)

### Radiated Immunity

IEC 60255-22-3 Class III

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

## Climatic Tests

### Temperature

IEC 60068-2-1/2

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

### Humidity

IEC 60068-2-78

Operational test	56 days at 40 °C and 93 % relative humidity
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### IP Ratings

IEC 60529

Type	Level
Installed with cover	IP 51 from front
Installed with cover removed	IP 20 from front

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

## Performance

### 27/59 Under/Over Voltage

Number of Elements	4 Under or Over
Operate	Any phase or All phases
Voltage Guard	1,1.5...200 V
Setting Range Vs	5,5.5...200 V
Hysteresis Setting	0.0.1...80 %
Vs Operate Level	100 % Vs, ±1 % or ±0.25 V
Reset Level:	
Undervoltage	$= (100\% + \text{hyst}) \times V_{op}$ , ±1% or 0.25 V
Overvoltage	$= (100\% - \text{hyst}) \times V_{op}$ , ±1% or 0.25 V
Delay Setting td	0.00,0.01...20,20.5...100,101...1000,1010...10000,10100...14400 s
Basic Operate Time :	
0 to 1.1xVs	73 ms ±10 ms
0 to 2.0xVs	63 ms ±10 ms
1.1 to 0.5xVs	58 ms ±10 ms
Operate time following delay.	Tbasic +td , ±1% or ±10ms
Inhibited by	Binary or Virtual Input VT Supervision Voltage Guard

### Vx 27/59 Under/Over Voltage

Number of Elements	1 Under or Over for 4xVT variants
Operate	Any phase or All phases
Voltage Guard	1,1.5...200 V for 4xVT variants 1,1.5...120 V for 6xVT variants
Setting Range Vs	5,5.5...200 V for 4xVT variants 5,5.5...120 V for 6xVT variants
Hysteresis Setting	0.0.1...80%
Vs Operate Level	100 % Vs, ±1 % or ±0.25 V
Reset Level:	
Undervoltage	$= (100\% + \text{hyst}) \times V_{op}$ , ±1 % or 0.25 V
Overvoltage	$= (100\% - \text{hyst}) \times V_{op}$ , ±1 % or 0.25 V
Delay Setting td	0.00,0.01...20,20.5...100,101...1000,1010...10000,10100...14400 s
Basic Operate Time :	
0 to 1.1xVs	73 ms ±10 ms
0 to 2.0xVs	63 ms ±10 ms
1.1 to 0.5xVs	58 ms ±10 ms
Operate time following delay.	Tbasic +td , ±1 % or ±10 ms
Inhibited by	Binary or Virtual Input VT Supervision Voltage Guard

### 37 Undercurrent

Number of Elements	2
Setting Range Is	0.05,0.10...5.0 x In
Operate Level	100% Is, ±5% or ±1%xIn
Delay Setting td	0.00,0.01...20,20.5...100,101...1000,1010...10000,10100...14400s
Basic Operate Time:	
1.1 to 0.5 x Is	35 ms ±10 ms
Operate time following delay.	Tbasic +td , ±1% or ±10 ms
Overshoot Time	< 40 ms
Inhibited by	Binary or Virtual Input

### 46 Negative Phase Sequence Overcurrent

Number of Elements	DT & IT
DT Setting Range Is	0.05,0.10...5.0 x In
DT Operate Level	100 % Is, ±5 % or ±1 %xIn
DT Delay Setting td	0.00,0.01...20,20.5...100,101...1000,1010...10000,10100...14400 s
DT Basic Operate Time:	
0 to 2 x Is	40 ms ±10 ms
0 to 5 x Is	30 ms ±10 ms
DT Operate time following delay.	Tbasic +td , ±1% or ±10ms
IT Char Setting	IEC NI,VI,EI,LTI ANSI MI,VI,EI & DTL
IT Setting Range	0.05..2.5
Tm Time Multiplier	0.025,0.03...1.6,1.7... 5,6... 100
Char Operate Level	105 % Is, ±4 % or ±1 %In
Overshoot Time	< 40 ms
Inhibited by	Binary or Virtual Input

### 47 Negative Phase Sequence

Number of Elements	2
Setting Range Vs	1,1.5...90 V
Hysteresis Setting	0,0.1...80 %
Operate Level	100 % Vs, ±2 % or ±0.5 V
Delay Setting td	0.00,0.01...20,20.5...100,101...1000,1010...10000,10100...14400 s
Basic Operate Time	
0V to 1.5xVs	80 ms ±20 ms
0V to 10xVs	55 ms ±20 ms
Operate time following delay.	Tbasic +td , ±2 % or ±20 ms
Overshoot Time	< 40 ms
Inhibited by	Binary or Virtual Input

### 49 Thermal Overload

Operate levels	Operate and Alarm
Setting Range Is	0.10,0.11...3.0 x In
Operate Level	100% Is, ±5% or ±1%xIn
Time Constant Setting	1,1.5...1000min
Operate time	$t = \tau \times In \left\{ \frac{I^2 - I_p^2}{I^2 - (k \times I_B)^2} \right\}$ ±5 % absolute or ±100 ms where Ip = prior current (Is 0.3xIn to 3x In)
Alarm Level	Disabled, 50,51...100 %
Inhibited by	Binary or Virtual Input

### 50 (67) Instantaneous & DTL OC&EF (Directional)

Operation	Non directional, Forward or reverse
Elements	Phase and Measured Earth
Number of Elements	4 x OC 4 x Measured EF 'G' where fitted 4 x SEF where fitted
Setting Range Is	0.05,0.06...50 x In SEF 0.005...5 x In
Time Delay	0.00...14400s
Operate Level I <sub>op</sub>	100% Is, ±5% or ±1% x In
Reset Level	≥ 95 % I <sub>op</sub>
Operate time: 50	0 to 2xIs – 35ms, ±10ms, 0 to 5xIs – 25ms, ±10ms
Operate time following delay	T <sub>basic</sub> + t <sub>d</sub> , ±1% or ±10ms
Inhibited by	Binary or Virtual Input Inrush detector VT Supervision

### 51(67) Time Delayed OC&EF (Directional)

Elements	Phase, Measured Earth & SEF
Number of Elements	4 x OC 4 x Measured EF 'G' 4 x SEF
Operation	Non directional, Forward or reverse
Characteristic	IEC NI,VI,EI, LTI ANSI MI,VI,EI & DTL & Legacy (101 etc.)
Setting Range Is	0.05,0.1...2.5 x In SEF 0.005...1 x In
Time Multiplier	0.025,0.03...1.6,1.7... 5,6... 100
Time Delay	0,0.01... 20s
Operate Level I <sub>op</sub>	105% Is, ±4% or ±1% x In
Reset Level	≥ 95 % I <sub>op</sub>
Minimum Operate time IEC	$t_{op} = \frac{K}{\left[\frac{I}{I_s}\right]^n - 1} \times T_m$
ANSI	$t_{op} = \left[ \frac{A}{\left[\frac{I}{I_s}\right]^n - 1} + B \right] \times T_m$ ± 5 % absolute or ± 30 ms
Follower Delay	0 - 20s
Reset	ANSI decaying, 0 – 60s
Inhibited by	Binary or Virtual Input Inrush detector VT Supervision

### 51V Voltage Controlled Overcurrent

Setting Range	5,5.5...200V
Operate Level	100% Vs, ±5% or ±1% x Vn
Multiplier	0.25.0.3...1 x Is(51)
Inhibited by	VT Supervision

### 50BF Circuit Breaker Fail

Operation	Current check - Phase and Measured Earth with independent settings Mechanical Trip CB Faulty Monitor
Setting Range Is	0.05,0.055...2.0 x In
2 Stage Time Delays	Timer 1 20...60000ms Timer 2 20...60000ms
Operate Level	100% Is, ±5% or ±1% x In
Basic Operate time	< 20ms
Operate time following delay	T <sub>delay</sub> ±1% or ±10ms
Triggered by	Any function mapped as trip contact.
Inhibited by	Binary/Virtual Input
Timer By pass	Yes, 50BF CB Faulty Input

### 59N Neutral Voltage Displacement

Number of Elements	1xDT & 1xIT
DT Setting Range Is	1...100V
DT Operate Level	100% Vs, ±5% or ±1% x Vn
DT Delay Setting t <sub>d</sub>	0 ... 14400s
DT Basic Operate Time 0V to 1.5xVs	76ms ±20ms
DT Operate time following delay.	T <sub>basic</sub> + t <sub>d</sub> , ±1% or ±20ms
IT Setting Range	1...100V
TM Time Multiplier(IDMT)	0.1...140
Delay (DTL)	0...20s
Reset	0 ... 60s, ANSI decaying
Char Operate Level	105% Vs, ±2% or ±0.5V
Inhibited by	Binary or Virtual Input

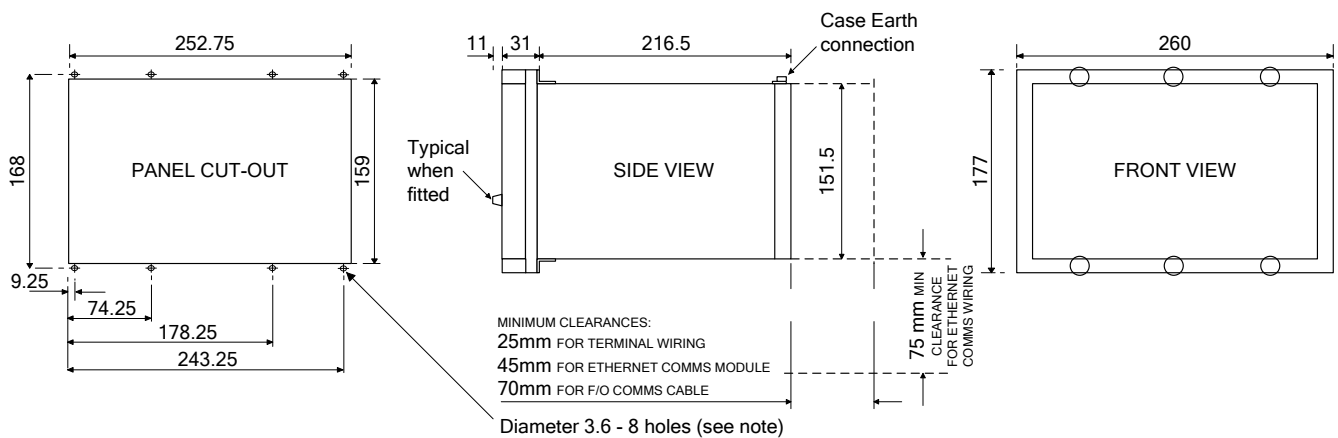
### 60 Supervision

CT	Vnps & Inps
VT	nps/zps

### 64H Restricted Earth Fault

Setting Range	0.005...0.95xIn
Operate Level	100% Is, ±5% or ±1% x In
Time Delay	0.00... 14400s
Basic Operate Time	0 to 2 xIs 45ms ±10ms 0 to 5 xIs 35ms ±10ms
Inhibited by	Binary or Virtual Input

## Case Dimensions

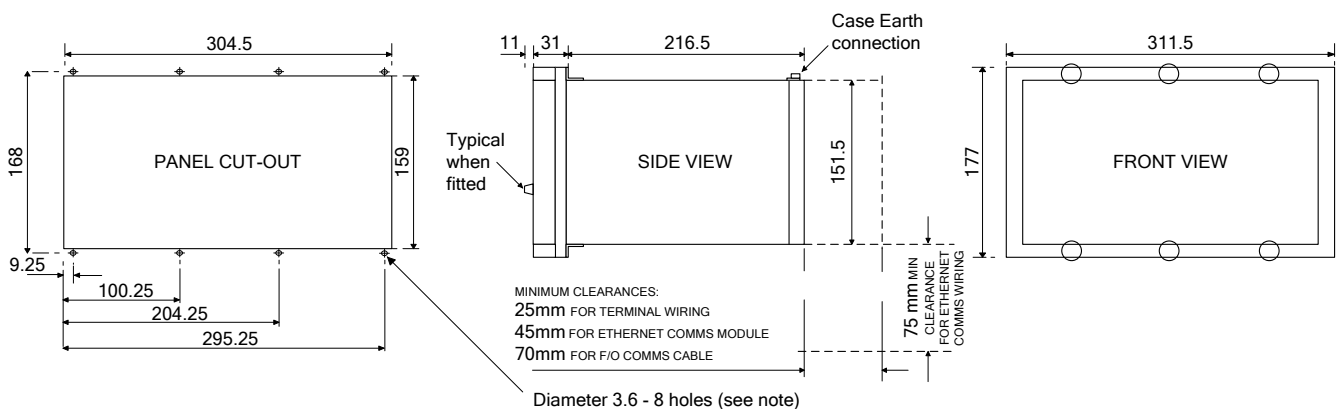


**NOTE:**

THE 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 4.5 DIAMETER) AND RELAYS MOUNTED USING M4 MACHINE SCREWS, NUTS AND LOCKWASHERS (SUPPLIED IN PANEL FIXING KIT).

THE RETAINING SCREW AT THE REAR OF THE CASE FOR THE ETHERNET VARIANT MUST BE FITTED FOR THE DEVICE TO COMPLY WITH PERFORMANCE CLAIMS.

Fig 4. E10 Case



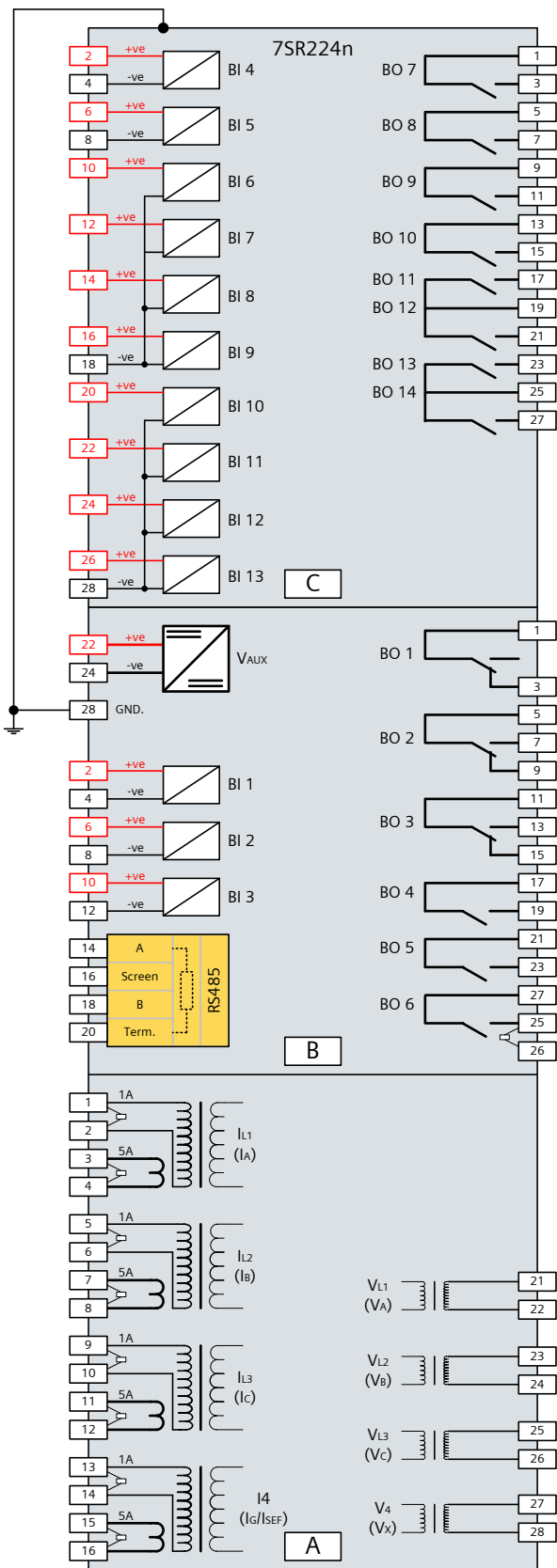
**NOTE:**

THE 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 4.5 DIAMETER) AND RELAYS MOUNTED USING M4 MACHINE SCREWS, NUTS AND LOCKWASHERS (SUPPLIED IN PANEL FIXING KIT).

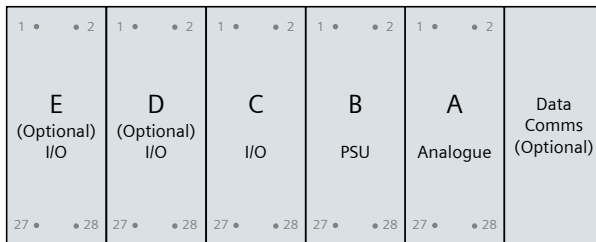
THE RETAINING SCREW AT THE REAR OF THE CASE FOR THE ETHERNET VARIANT MUST BE FITTED FOR THE DEVICE TO COMPLY WITH PERFORMANCE CLAIMS.

Fig 5. E12 Case

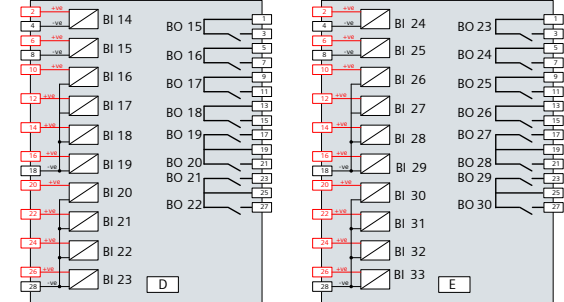
# 7SR224 Connection Diagram



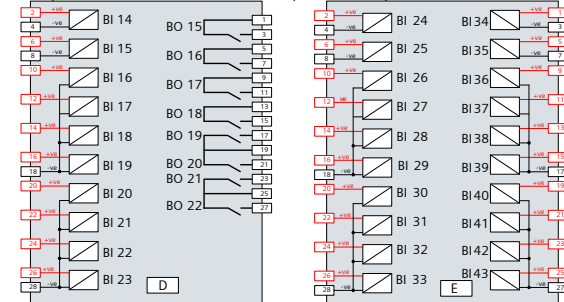
Rear View: Arrangement of terminals and modules



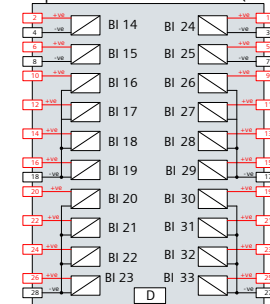
Optional Additional I/O for (23 Inputs 22 Outputs) and (33 Inputs 30 Outputs) Models



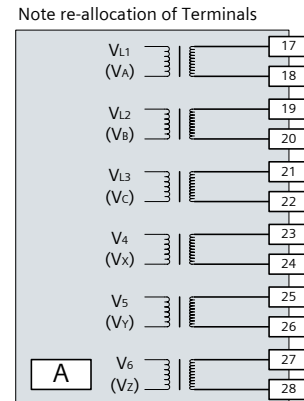
Optional Additional I/O for (43 Inputs 22 Outputs) Models



Optional Additional I/O for (33 Inputs 14 Outputs) Models



Alternative Voltage Input Connections for 6VT Models. Note re-allocation of Terminals



### NOTES

- BI = Binary Input
- BO = Binary Output
- Shows contacts internal to relay case assembly. Contacts close when the relay chassis is withdrawn from case

Fig 6. 7SR224 Wiring Diagram

# 7SR224 Interface Diagram

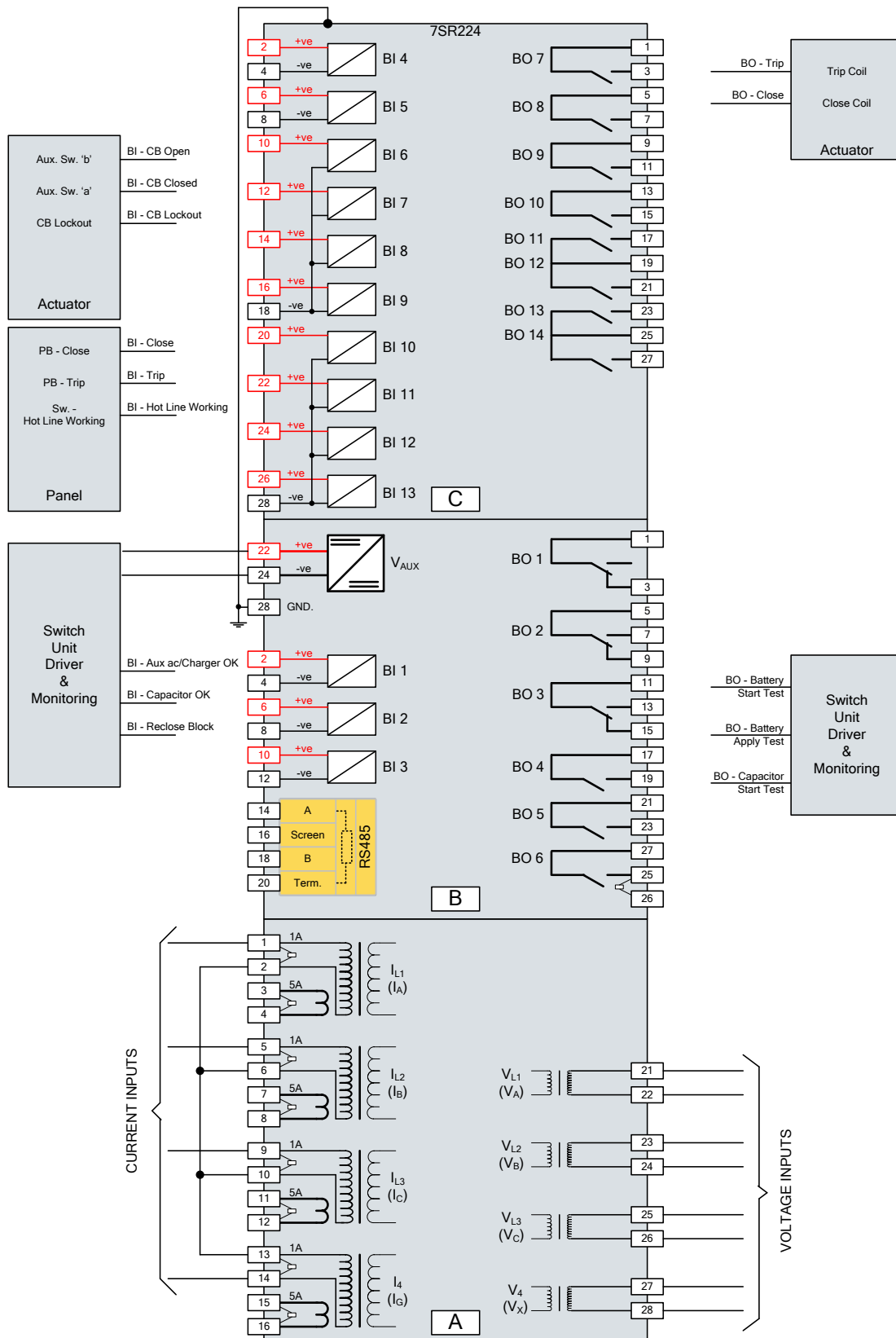


Fig 7. 7SR224 Interface Diagram

# Function Diagram for 7SR224 Recloser Controller

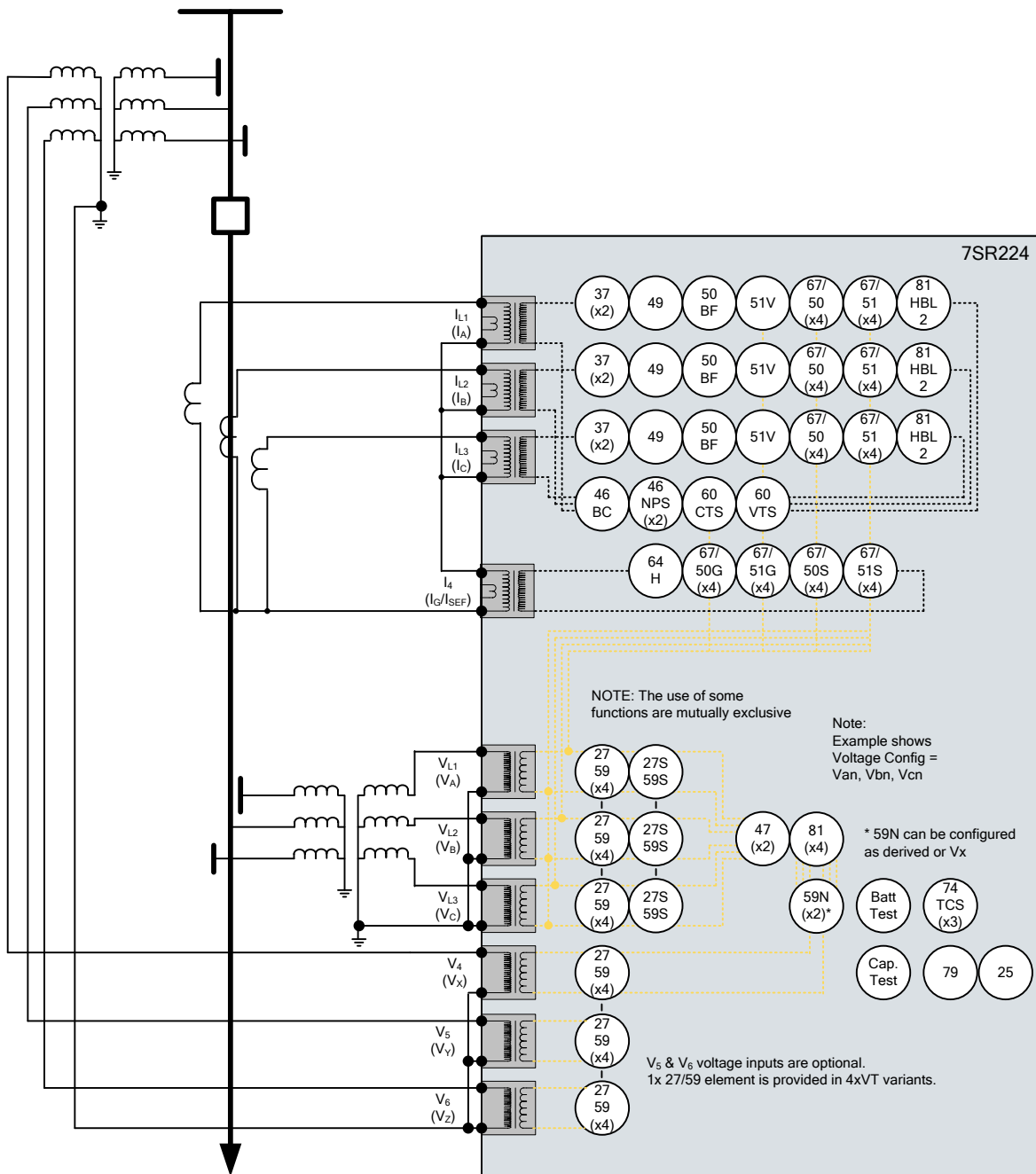


Fig 8. 7SR224 Function Diagram



# Ordering Information – 7SR224 Argus Recloser Controller

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<b>ORDER-No.:</b>	7	S	R	2	2	4							0			0
<b>Protection Product Family</b>					5											
Overcurrent - Directional					2											
<b>Relay Type</b>						6										
Recloser						4										
<b>Case, I/O and Fascia <sup>1)</sup></b>							7									
E10 case, 13 Binary Inputs / 14 Binary Outputs, 8 LEDs + 12 keys						2		3						C		
E10 case, 23 Binary Inputs / 22 Binary Outputs, 8 LEDs + 12 keys						3		3		1-4	2-3			C		
E10 case, 33 Binary Inputs / 14 Binary Outputs, 8 LEDs + 12 keys						4		3						C		
E12 case, 33 Binary Inputs / 14 Binary Outputs, 16 LEDs + 12 keys						6								C		
E12 case, 33 Binary Inputs / 30 Binary Outputs, 16 LEDs + 12 keys						7				1-4	2-3			C		
E12 case, 43 Binary Inputs / 22 Binary Outputs, 16 LEDs + 12 keys						8				1-4	2-3			C		
<b>Measuring Input</b>								8								
4xCT 1/5 A, 4xVT 63.5/110V								2						C/E		
4xCT 1/5 A, 6xVT 63.5/110V								3								
<b>Auxiliary Nominal Voltage</b>									9							
PSU Rated: 24-250V DC / 100-230V AC. Binary Input threshold 19V DC (Rated: 24-250V DC)										M						
PSU Rated: 24-250V DC / 100-230V AC. Binary Input threshold 88V DC (Rated: 110-250V DC)										N						
<b>Region Specific Functions</b>											10					
Region World, 50/60Hz, language English, (language changeable) Reyrolle fascia											A					
Region World, 50/60Hz, language English, (language changeable) Siemens fascia											B					
Region USA, 60/50Hz, language English-US (ANSI), (language changeable), Siemens fascia											C					
<b>Communication Interface</b>												11				
Standard version - included in all models, USB front port, RS485 rear port												1	2-3			
Standard version - plus additional rear F/O ST connectors (x2) and IRIG-B												2	2-3			
Standard version - plus additional rear RS485 and IRIG-B												3	2-3			
Standard version - plus additional rear RS232 and IRIG-B												4	2-3			
Standard version - plus additional rear Electrical Ethernet RJ45 (x2)												7	8			
Standard version - plus additional rear Optical Ethernet Duplex (x2)												8	8			
<b>Protocol</b>													12			
IEC 60870-5-103 and Modbus RTU and DNP 3.0 (user selectable setting)												1-4	2			
IEC 60870-5-103 and IEC60870-5-101 and Modbus RTU (user selectable setting)												1-4	3			
IEC 60870-5-103 and IEC60870-5-101 and Modbus RTU and DNP 3.0 (user selectable setting) and IEC61850												7-8	8			
<b>Spare</b>																13
																0

(continued on following page)

# Ordering Information – 7SR224 Argus Recloser Controller

ORDER-No.: 

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
7	S	R	2	2	4							0			0

## Protection Function Packages

Standard version - included in all models														14			
21FL	Fault Locator													C			
27/59	Under/overvoltage																
27/59	Under/overvoltage, Sag/swell																
37	Undercurrent																
46BC	Broken conductor/load unbalance																
46NPS	Negative phase sequence overcurrent																
47NPS	Negative phase sequence overvoltage																
49	Thermal overload																
50BF	Circuit breaker fail																
51V	Voltage dependent overcurrent																
59N	Neutral voltage displacement																
60CTS	CT supervision																
60VTS	VT supervision																
67/50	Directional instantaneous phase fault overcurrent																
67/50G	Directional instantaneous earth fault																
67/51	Directional time delayed phase fault overcurrent																
67/51G	Directional time delayed earth fault																
67/50HIZ	Directional instantaneous sensitive earth fault																
67/51HIZ	Directional time delayed sensitive earth fault																
74TC	Trip circuit supervision																
74BF	Circuit breaker close fail																
79	Autoreclose																
81	Under/overfrequency																
81HBL2	Inrush restraint																
86	Lockout																
	Battery and capacitor test																
	Cold load pickup																
	Programmable logic																
Standard version - plus														2-4	3	D	A
27/59	Under/overvoltage																
60VTS	VT supervision																
	Loop automation by loss of voltage																
Standard version - plus														6-8		E	A
	Single/triple pole autoreclose																
<b>Additional Functionality</b>														15			
No additional functionality															A		
25	Synchronising, synchronising check													C	D		
<b>Settings File</b>														16			
Standard settings and standard labels for Siemens Recloser															0		



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EMEA-C10031-00-76GB

December 2017

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