Reyrolle
Protection
Devices

7SG15 – MicroTAPP

Automatic Voltage Control

Answers for energy

7SG15 - MicroTAPP

Automatic Voltage Control

Fig 1. MicroTAPP AVC Relay

Description

The MicroTAPP range of Automatic Voltage Control (AVC) relays combines the power and flexibility of microprocessor technology with the renowned operating philosophy and effectiveness of the established Transformer Automatic Paralleling Package (TAPP) method.

The relay provides three function areas:

The efficient control of power system voltage levels through operation of an on-load tap changer

The monitoring and protection of the power system and tap-changer.

The collection of system data for analysis.

MicroTAPP represents a complete AVC system, eliminating complex control schemes and reducing inter-transformer-panel wiring to a single twisted-pair cable.

High integrity and confidence is maintained through the use of watchdog self-monitoring and supervision, while independent algorithms are provided for the voltage control and monitoring functions.

Communications using the IEC 60870 standard allows remote update of settings, and provides access to the relay's instrumentation, waveform storage and data collection facilities

Function Overview

MicroTAPP 101

Circulating Current voltage control.
Enhanced TAPP principle for voltage control.
User-specified system Power Factor eliminates errors associated with other circulating current schemes.
Load Drop Compensation counteracts network related voltage drop.
Circulating current is minimised to reduce system losses.
Tap-stagger allows circulating current to be introduced for network operation purposes.
Voltage offsets can be applied either through status inputs or the IEC60870 communications for Load Reduction and network operation.
Low system frequencies are detected and this can inhibit attempts to increase the voltage in, for example, a load shedding situation.
Homing minimises system disruption due to the switching in or out of transformers.
Tap position indication accepts inputs from either analogue or digital sender units.

Runaway detection locks out the tap-changer to prevent unwanted tap changes due to electrical or mechanical failure.

VT Fuse Monitor. Negative-phase sequence (NPS) voltage element detects blown VT fuses to prevent incorrect voltage control.
Data Storage is provided through Events, 24-hour Waveforms and Fault Records.
IEC 60870-5-103 Communications for in-station monitoring and control.
Hardware and software watchdogs provide comprehensive self-monitoring.

MicroTAPP 102

As for the MicroTAPP 101, plus:
Pseudo-VT™ allows control of voltage on remote side of transformer.

User Interface

40 character x 8 line backlit LCD
Menu navigation keys

5 fixed 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).

Primary and secondary currents
Primary and secondary voltages
Frequency
Power Factor
Phase Angles
Transformer & Group Load
PPS and NPS voltage
Tap Position
Status inputs
Output contacts
Tap counters
MPPC status

Description of Functionality

Voltage Control

The user specifies target voltage, voltage dead band, initial delay and inter-tap delay.

When a voltage excursion outside the dead band occurs the MicroTAPP acts to restore correct system voltage. When deciding on voltage excursion the measured voltage is compensated for:

> Load drop compensation (LDC) – compensates for voltage drop in the network.
>
> Corrective coupling voltage (CCV) – acts to eliminate current circulating between parallel transformers due to mis-matches in voltage.
>
> In service adjustments to the target voltage – applied either via status inputs or IEC60870 communications.

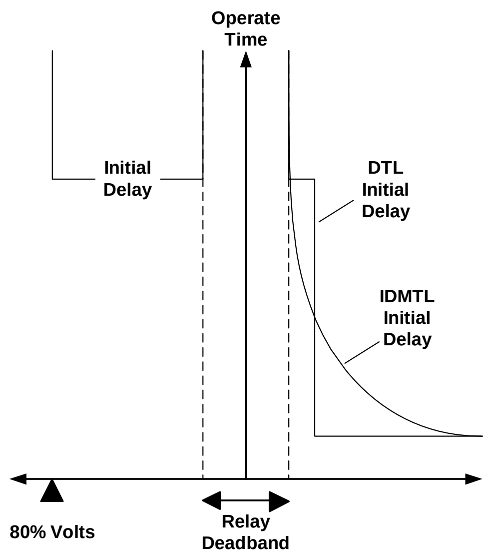


Fig 2. Tap Change control with Deadband

After an initial delay, implemented to allow short-term voltage fluctuations, a tap-change command is issued. The delay is a definite time for low voltages. For high voltages a definite time delay (DTL) or an inverse time delay (IDMTL) can be specified. If a DTL is specified a fast-tap down can be enabled to provide accelerated operation for very high system voltages. This provides a fixed high-set of top of Deadband + 2% with a 2 second delay.

The inter-tap delay sets a minimum period between successive tap instructions to allow time for the tap-changer to operate.

Advanced Control Functionality

Through its Pseudo-VT™ algorithm the MicroTAPP can calculate and hence control the voltage on the remote side of the transformer to that on which the VT and CT are located. It makes use of the tap position, which it ensures is correct through an intelligent operation monitor, to calculate the actual transformer ratio and compensate for voltage drops across the transformer.

Voltage Monitoring

Independent algorithms monitor the system voltage and provide a comprehensive set of blocking elements to prevent incorrect tap changes.

For added integrity, when a 3-phase VT is used a different voltage is used for monitoring than for voltage control. The blocking matrix intelligently blocks raise and lower operations depending on system conditions.

Excessive voltage unbalance can be caused by VT fuse failures. If 3-phase VTs are used this condition can be detected and voltage raise operations blocked.

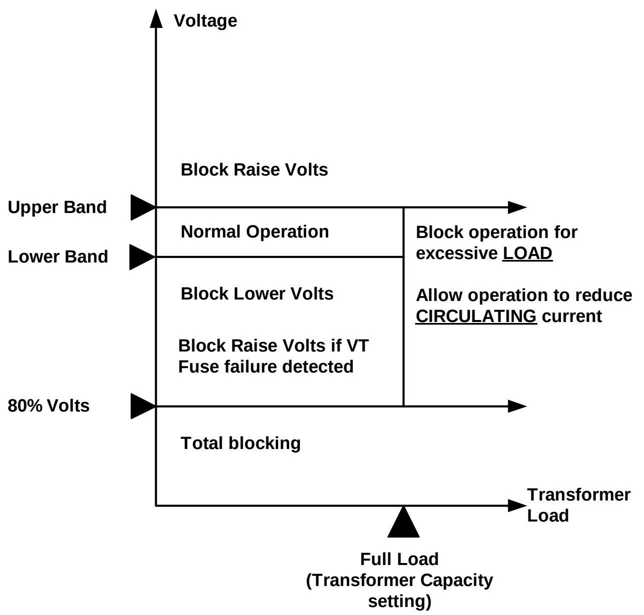


Fig 3. Voltage monitoring blocking matrix

If an excessive current flows at normal system power factors the relay inhibits all tap-changing operations. High currents when the power factor is abnormal may be as a result of circulating currents. In this situation the relay should act to reduce them rather than applying over-current blocking.

A system voltage below 80% will be due either to the Transformer being powered down or a system fault condition and so all tap-changing is inhibited.

Upper and Lower Alarm levels are provided to indicate abnormal voltages. An Alarm will also be issued if the voltage remains outside the Deadband for an abnormal time.

Tap-changer Monitoring

An intelligent tap-position indicator and runaway prevention algorithm monitors the entire tap-change operation. A Tap-changer runaway is quickly detected and the resulting alarm can be used to lock-out the tap-changer to prevent damage to the system. Incomplete tap-changes are also detected and indicated.

If the voltage requires a tap-change beyond the limits of the tap-changer this is inhibited and a target not achievable alarm is generated.

Tap Changer Maintenance

A tap-changer operations count and a "sum of I^2" count is provided. Alarm levels can be set which, when reached, can be routed to a condition-based maintenance system.

Data Storage and Communication

Sequence of event records

Up to 200 events are stored and time tagged to 1ms resolution. These are available via the communications.

Fault records

The last 10 tap-changer fault records are available from the fascia with time, date and type of failure.

Graphical records

Recordings of all operational data, voltage level, transformer load, summed load etc. are available for up to 24 hours.

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 supports the IEC 60870-5-103 communications standard.

Reydisp Evolution

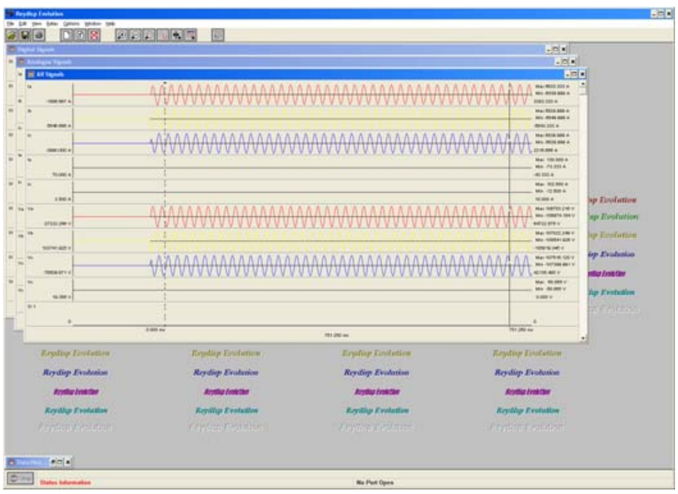


Fig 2. Typical ReyDisp Evolution screenshot

This support software is common to the entire range of Reyrolle numeric products. It provides the means for the user to apply settings to the Delta as well as to retrieve settings, instruments, events, waveforms and 24 hour data.

Technical Information

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

Inputs and Outputs

Characteristic Energising Quantity

AC Current	1, 5 A, 50/60 Hz
AC Voltage	63.5 V line-neutral, 110 V line-line, 50/60 Hz

Thermal Withstand	
AC Current Inputs	
continuous	3.0 xIn
10 minutes	3.5 xIn
5 minutes	4.0 xIn
2 minutes	6.0 xIn
1 second	250 A
1 cycle	625 A peak
AC Voltage Inputs	
continuous	300 V

Burden	
AC Current Inputs	
1 A	≤ 0.1 VA
5 A	≤ 0.3 VA
AC Voltage Inputs	
	≤ 0.01 VA

DC Auxiliary Supply

Nominal Voltage	Operating Range
30 VDC	24 to 37.5 VDC
48, 110 VDC	37.5 to 137.5 VDC
220 VDC	178 to 280 VDC
110 VAC	82.5 to 137.5 VAC RMS

Operate State	Burden
Quiescent (Typical)	17 W
Maximum	20 W

Burdens are measured at nominal rating.

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

Status Inputs

Nominal Voltage	Operating Range
30, 34 VAC/DC	24 to 37.5 VAC/DC
48, 54 VAC/DC	37.5 to 60 VAC/DC
110, 125 VAC/DC	87.5 to 137.5 VAC/DC
220, 250 VAC/DC	175 to 280 VAC/DC

Note that the status 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

Parameter	Value
Minimum DC current for operation (30 V and 48 V inputs only)	10 mA
Reset/Operate Voltage Ratio	90 %
Recommended minimum pulse duration	500 ms

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 W limits 10mA or 5V

Mechanical

Vibration(Sinusoidal)IEC 60255-21-1 Class 1

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

Shock and Bump IEC 60255-21-2 Class 1

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

Seismic IEC 60255-21-3 Class 1

1 gn, Seismic Response	≤ 5% variation

Mechanical Classification

Durability	In excess of 10^6 operations

Recommended load

Minimum recommended load	0.5 W, limits 10 mA or 5 V

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	≤3% variation
1.0kV, Transverse mode	

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 95% RH

Protection Elements

General Accuracy

Reference Conditions	
Parameter	Reference or Value
General	IEC 60255-3
Current Settings	100% of In
Time Multiplier	1.0
Current input (IDMTL)	2x to 20x Is
Current input (DTL)	5x Is
Auxiliary supply	Nominal
Frequency	50 Hz
Ambient temperature	20 °C

General Settings	
Parameter	Value
Transient Overreach of Highset/Lowset (X/R = 100)	≤ 5%
Disengaging Time (1)	< 42 ms
Overshoot Time	< 40 ms

Output contacts have a minimum dwell time of 100ms, after which the disengage time is as above.

Indication

Relay Healthy	
Method	Green LED
Relay Failure	Flashing or extinguished
High, Low Voltage	
Method	Red LEDs
Voltage Alarm	Flashing
Normal Voltage	
Method	Green LED
Tap In Progress	
Method	Amber LED
Lockout	Flashing

Settings and Instrumentation	
Method	graphical backlit LCD

Sub-station communications

Protocol	IEC 60870-5-103
RS-232 interface	
Location	Fascia
Form	25-pin female D-type connector
Fibre interface	
Location	Rear
Quantity	2 x Rx, 2 x Tx
Form	BFOC/2.5 (ST®) bayonet connector
COM1	
Baud rate	75-115200 baud
Interface	Fibre-optic port
COM2	
Baud rate	75-115200 baud
Interface	Auto-switches between Fibre-optic and RS-232

General Accuracy

Reference conditions

Parameter	Reference or Value
Auxiliary Supply	Nominal
Frequency	50/60 Hz
Ambient Temperature	20 °C

Accuracy Influencing Factors
Temperature

Ambient range	Variation
-10 °C to +55 °C	≤ 5%

Frequency

Range	Variation
47 Hz to 52 Hz	Level: ≤ 5%
57 Hz to 62 Hz	Operate Time: ≤ 5%

Harmonic content

Range	Variation
Frequencies to 550Hz	Setting: ≤ 5%

Control Elements

Voltage Control Method	TAPP, Circulating Current
Voltage Control	
Target	85 to 115% Vn
Dead band	±0.1 to ±5.0% Vn
Accuracy	±0.1% Vn
Repeatability	±1%
Initial Delay	
Characteristics	DTL or IDMTL (voltage high only)
Setting	2 to 180 s
Accuracy	±0.25 s
Repeatability	±0.25 s
General	
No of transformers	1 to 16
No of taps	1 to 39
Sender Unit	Resistor chain, binary, BCD, gray code
Inter-Tap delay	
Setting	Continuous, 1 to 120 s
Accuracy	1s
Repeatability	1s

Environmental

Temperature IEC 68-2-1/2

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

Humidity IEC 68-2-3

Operational test	56 days at 40 °C and 95% RH

Transient Overvoltage IEC 60255-5

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

Insulation IEC 60255-5

Test	Level (rms for 1 min)
Between all terminals and earth	2.0 kV
Between independent circuits	2.0 kV
Across normally open contacts	1.0 kV

Immunity
Auxiliary DC Supply IEC 60255-11

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

High Frequency Disturbance IEC 60255-22-1 Class III

Type	Level	Variation
Common (Longitudinal) Mode	2.5 kV	≤ 3%
Series (Transverse) Mode	1.0 kV	

Electrostatic Discharge IEC 60255-22-2 Class III

Type	Level	Variation
Contact discharge	8 kV	≤ 5%

Radio Frequency Interference IEC 60255-22-3

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

Fast Transient IEC 60255-22-4 Class IV

Type	Level	Variation
5/50ns, 2.5 kHz, repetitive	4kV	≤ 3%

Conducted RFI IEC 60255-22-6

Frequency Range	Level	Variation
0.15 to 80 MHz	10 V	≤ 5%

Emissions

Conducted limits IEC 60255-25

Frequency Range	Limits dB(ΔV)	
	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(ΔV/m)
30 to 230 MHz	40
230 to 10000 MHz	47

Mechanical

Vibration Sinusoidal IEC 60255-21-1 Class 1

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

Shock and Bump IEC 60255-21-2 Class 1

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

Seismic IEC 60255-21-3 Class 1

Type	Level	Variation
Seismic Response	1 gn	≤ 5%

Mechanical Classification

Durability	In excess of 10^6 operations

Sample Specification

Voltage Control

The following standard system conditions should be catered for with minimal or no adjustment to the Automatic Voltage Control System (AVC):

Where a transformer operates in parallel with other transformers, either within a site or across a network, the AVC should operate in order to (a) maintain the system voltage at the correct level and (b) operate at a tap position where minimal reactive circulating current flows from or into any system transformer which is a part of the network.

In the event of a failure of communications either between grouped transformers or from a remote control centre, the AVC should be able to operate in a standalone mode and achieve a satisfactory overall system voltage.

If a transformer in a group is switched IN, no significant change in voltage will occur.

If a transformer in a group is switched OUT, no significant change in voltage will occur.

The Load Drop Compensation (LDC) method, if used, must remain at the correct level regardless of the number of transformers connected to a common busbar.

Settings applicable to different network running arrangements should be applied to the AVC and be capable of implementation by a single instruction (either from a remote source or locally) or plant status change.

The AVC must be provided with the capability of independently protecting against incorrect operation which would allow abnormal voltages to be applied to the network.

The AVC shall be capable of controlling at least 16 transformers operating in parallel as a group.

The operating characteristics of the voltage regulating relay is to be such that a raise or lower command will only be issued after an initial time delay as set on the voltage regulating relay. A definite time characteristic and an inversely related initial time characteristic shall be selectable. When a definite time delay is selected a fast tapping feature which bypasses the initial time delay in the event of substantial voltage excursions above the set band is preferred. Any subsequent corrective signals for the same voltage deviation will be delayed by a separate inter-tap time delay.

The voltage regulating relay shall include a 'Load Drop Compensation' facility. LDC shall be used where the busbar voltage is increased in proportion to the total substation load current. The LDC effect shall be proportional to the total connected busbar load. This method will provide the correct voltage boost given by the chosen LDC setting, irrespective of the number of transformers in service. Full LDC functionality shall be retained when parallel control based on the minimum circulating current method is used.

Voltage Monitoring

Monitoring of the voltage level shall be via separate connections to those used for voltage control.

If the measured system voltage is less than a pre-set under-voltage limit or greater than a pre-set over-voltage limit, the system shall inhibit the appropriate tap control outputs to the relevant transformer but allow tap change operations that will correct the abnormal voltage. An alarm will be generated if the abnormal voltage persists.

Where a 3 phase VT is used the system shall monitor all voltages in order to ensure the integrity of the VT secondary output. Any abnormalities detected will inhibit the voltage raise outputs from the system and initiate an alarm.

If the load current is greater than a pre-set limit, the system shall inhibit all tap control outputs to the relevant transformer(s) and generate an alarm, unless the situation is caused by circulating current flowing between transformers. In this case tap changing will be allowed to reduce the circulating current.

Tap-changer Monitoring

The tap changer operation monitor circuits shall be provided for tap changer runaway protection in the event of a mechanism, wiring or relay fault. The following shall be considered minimum requirements for such protection:

Protection is required that will detect incorrect tap change operation at the earliest opportunity. An incorrect tap change operation is defined as "a tap change operation that is not initiated by a 'true' control signal". As an example, a slow to clear 'raise' contactor may allow a motor drive to continue driving the mechanism at the end of a tap change cycle such that the tap change maintaining switch recloses and thus allows the tap change to 'run away'.

The preferred scheme should not rely on timing systems for determination of this situation, but intelligently monitor the relationship between the control signals, the tap change in progress inputs and the tap position.

If a lockout is required the AVC will initiate contacts both for lockout and alarms. The lockout contacts shall provide for the tripping of a mechanically latched contactor or the permissive operation normally open contactor to remove the tap change motor power supply.

Inputs from plant

To avoid drain on substation batteries, the tap changer control supply will provide the supply for all AVC equipment and have a nominal AC voltage of 110V (+10% to –25%).

Measuring voltage inputs shall be provided which are capable of operating with VTs with secondary rating between 63.5 and 250V. Adjustment shall be provided to eliminate any VT ratio errors.

A measuring current input shall be provided capable of operating with CTs of 1 or 5A secondary rating. The relay shall be configurable to allow non-standard CT ratios to be used. The relay shall be capable of using the CT regardless of the phase to which it may be connected.

The relay shall be capable of measuring up to 39 tap positions, including special tap positions (e.g. 8A, 8B, 8C) from resistor chain, BCD, binary and gray code sender units.

A tap-change in progress (TCIP) signal shall be detected by the relay from a contact provided in the tap changer. The TCIP contact will close as the tap change starts and open at the end of the tap change sequence.

Outputs to plant

The tap raise/lower outputs shall be via normally open clean contacts with a minimum pulse time of 1.5s rated for 5A AC.

The AVC system will be required to prevent operation of the tap changer motor drive in the event of unwanted operations. Two methods may be used:

Tripping of a mechanically latched contactor connected into the supply for the motor
Permissive operation of a normally de-energised contactor connected into the motor supply during the tap changing sequence

To enable either option, change-over clean output contacts rated for at least 5A AC shall be provided.

Operator Controls

The AVC system shall provide the means to:

Switch control points between local (at the AVC) and remote (network control centre).

Switch between local and automatic control.

Raise and lower the tap-changer manually.

When set to local it shall not be possible for a remote point to operate the tap-changer or switch the AVC between manual and automatic modes.

If a Master/Follower tap change control scheme is proposed, additional control switches will be required. A Master/Follower design is NOT the preferred scheme for submission as a solution.

Indication and instrumentation

The following indications shall be provided:

Circuit identifier
AVC healthy LED
Voltage normal/high/low LEDs
Tap in progress LED
Voltmeter showing system voltage
Tap position indication, allowing for unusual tap arrangements (e.g. 8A, 8B, 8C)
Indication of transformer load, transformer load power factor and total load of all paralleled transformers

Remote Access

Remote access shall be provided through both hard-wired inputs and outputs, and using a non-proprietary communications protocol, e.g. IEC 60870-5-103. The following features shall be available using both access methods:
When the AVC system is set to remote, it will be possible to switch the AVC between automatic and manual. When in manual, it will be possible to operate the tap-changer from a remote point.

It will be possible to select between a minimum of 3 preset voltage targets.

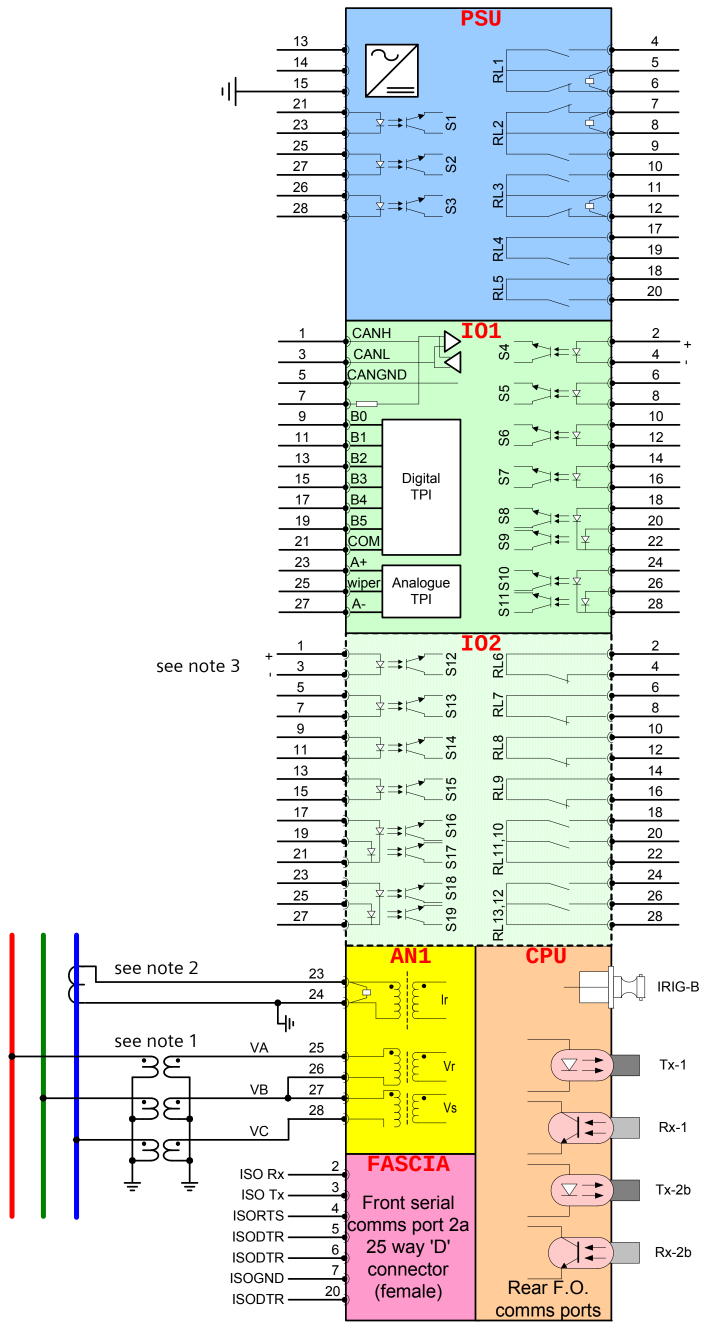
Alarms will be provided for AVC failure, VT fuse failure, voltage out of limits, tap-changer runaway, tap-change incomplete, target not achievable.

The following data shall be made available using the communications protocol:

Metering values of voltage, load, power factor and tap position.

Traces of voltage, current, tap position, frequency and a measure of power quality for a minimum period of 24 hours.

Typical Connection Diagrams



Notes

1. Analogue connections show use with a star-connected VT, other arangements can be used.
2. CT connection is shown on blue phase, any connection can used.
3. IO2 is provided on MT1-xxx xJ variants only

Fig. 4 shows two options for AC measuring connections, one using a 3-phase VT the other for when only a single-phase VT is available. Any phase may be chosen for the CT.

Fig. 6 and 7 show typical control circuit connections. Fig. 6 is the traditional connection for use with a step-by-step contactor (relay in 'Basic' mode). In Fig. 7 the step-by-step control is provided by the MICROTAPP software (relay in 'step-by-step' mode).

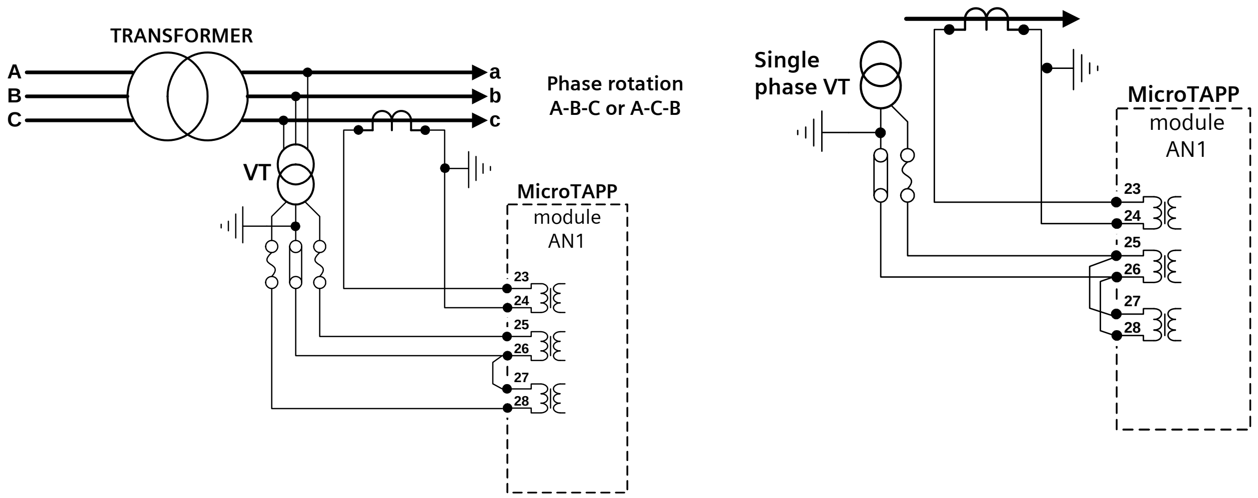


Fig 4. Typical voltage and current measurement inputs

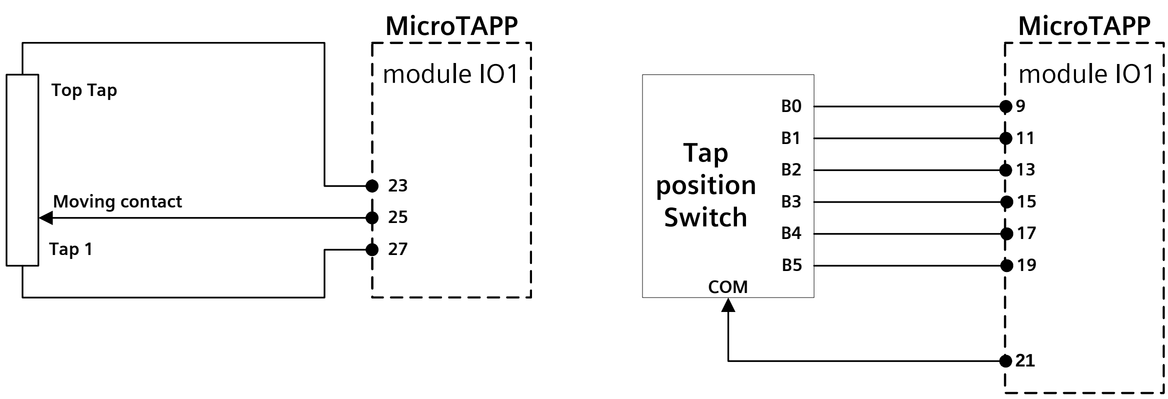


Fig5. Tap position input connections for Resistor Chain and BCD/Binary sender units

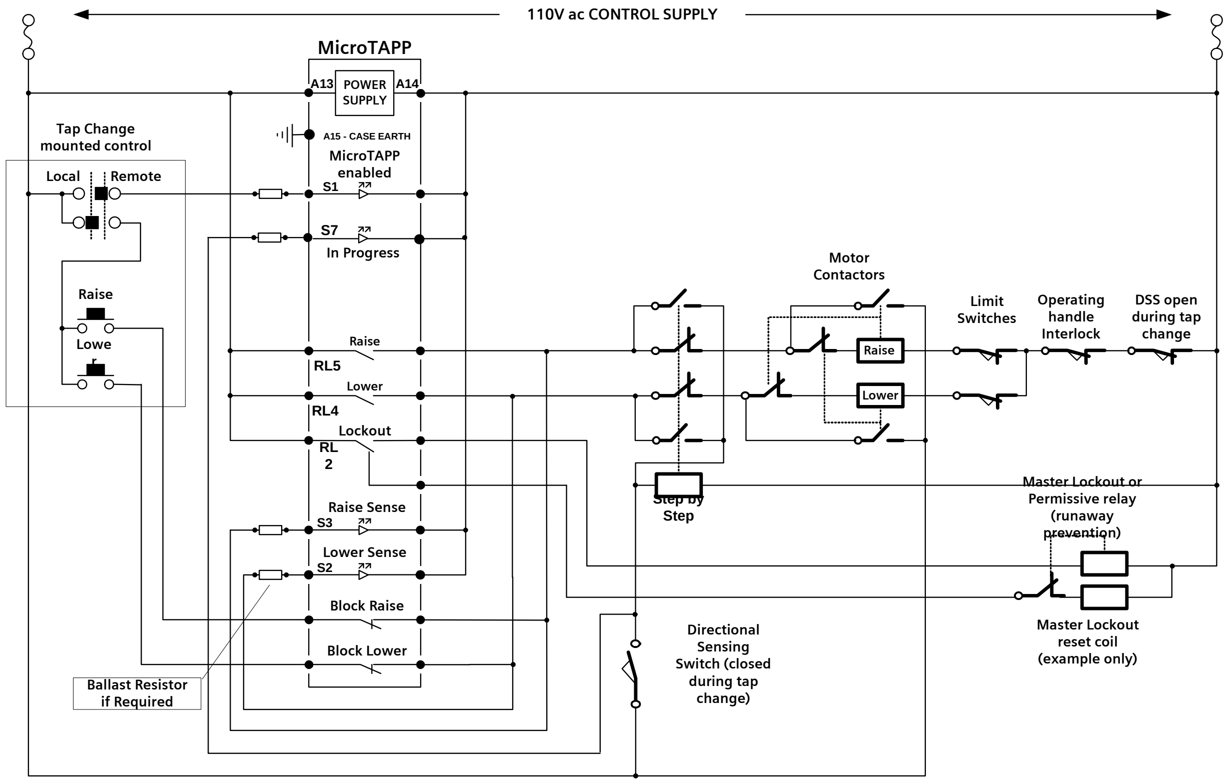


Fig 6. Typical tap-change control circuit with traditional step-by-step contactor

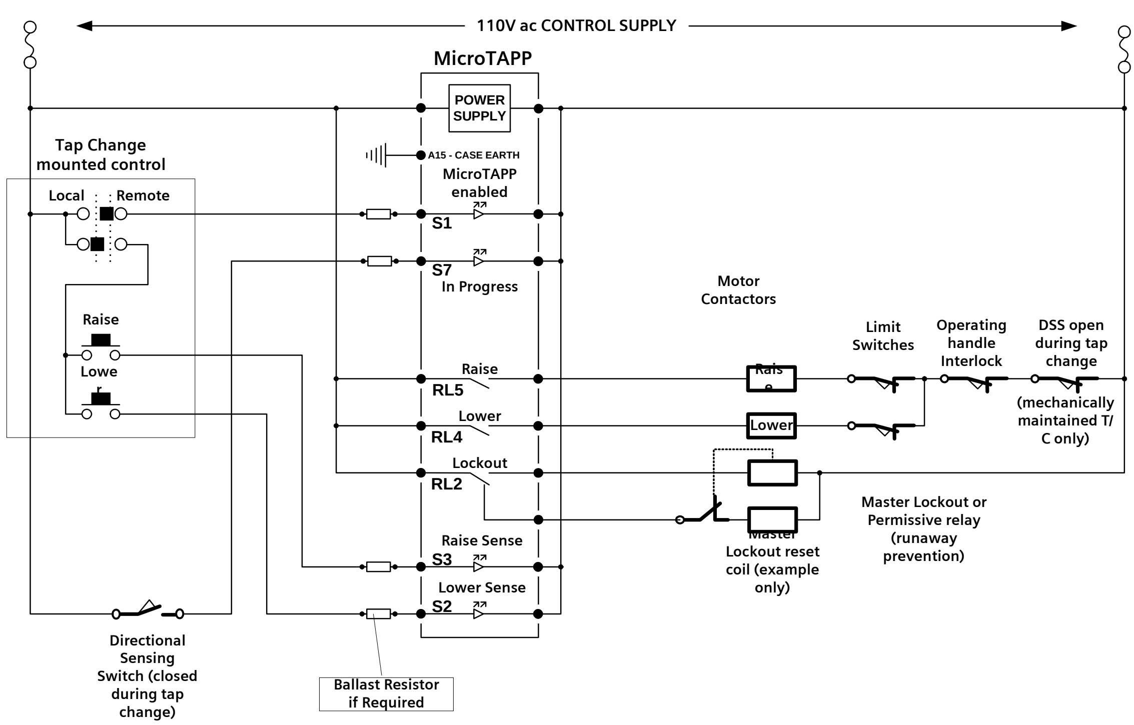


Fig 7. Typical tap-change control circuit with step-by-step control internal to the MICROTAPP

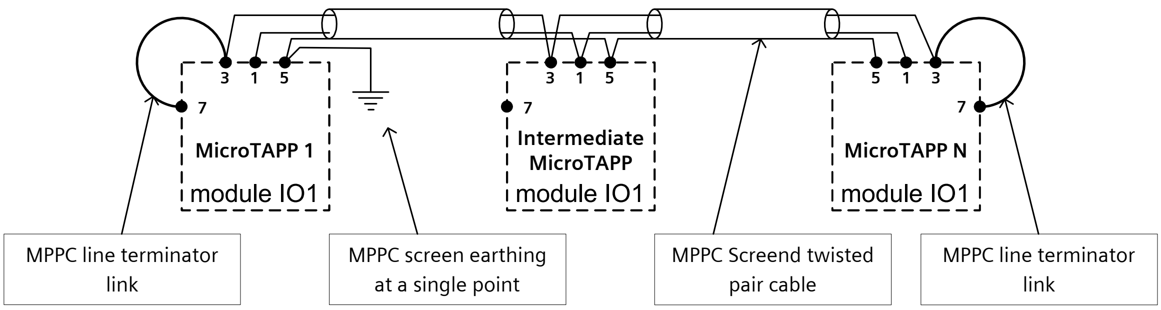


Fig 8. Connections for MicroTAPP peer-peer communications (MPPC)

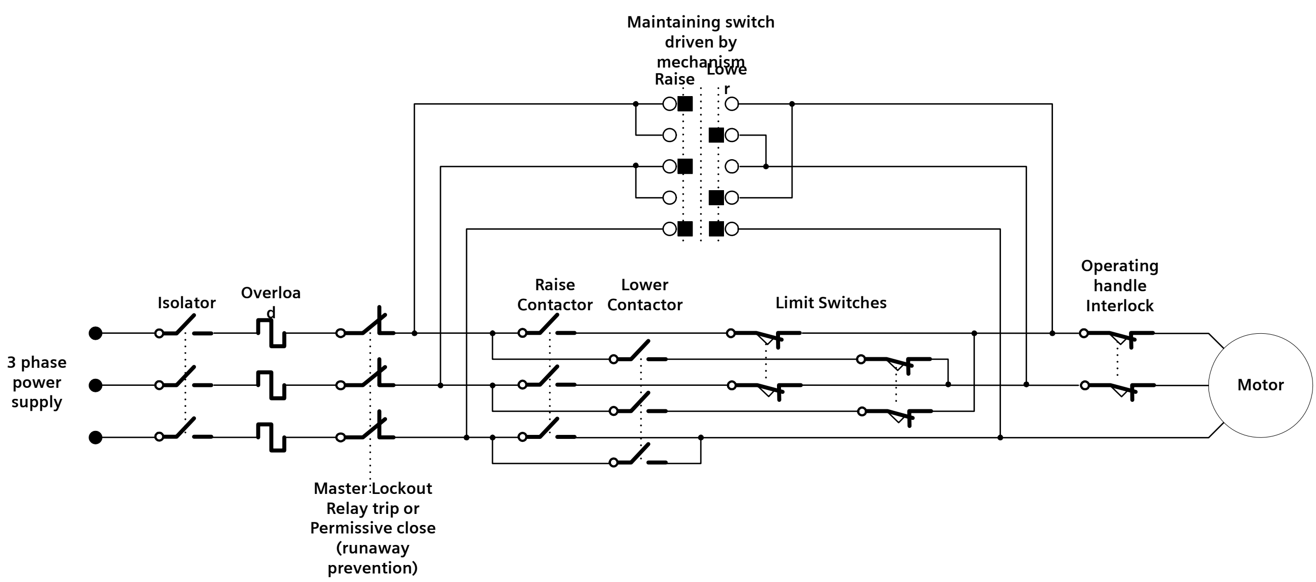


Fig 9. Typical tap-change motor circuit

Case Drawing

The MicroTAPP is supplied in either a size 8 or size 12 case, depending on the status input and output relay requirement, see the table below.

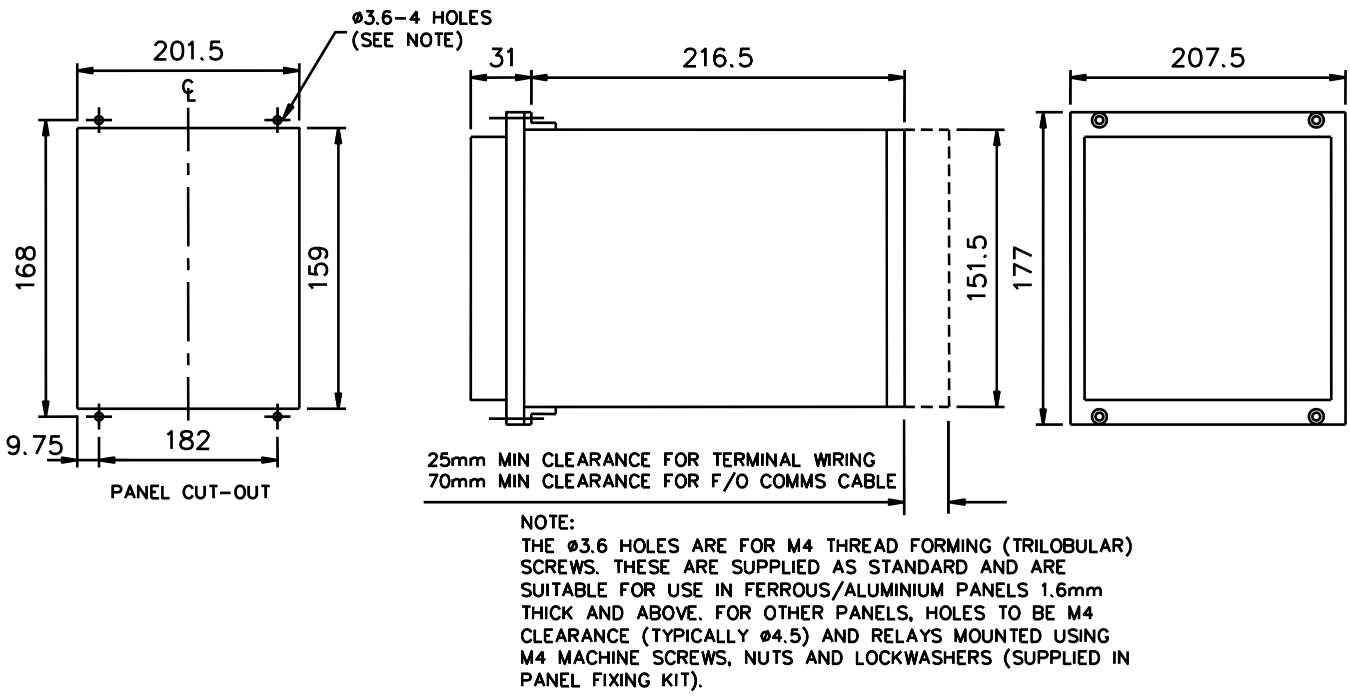


Fig 10. Overall Dimensions and panel drilling for Epsilon E8 case

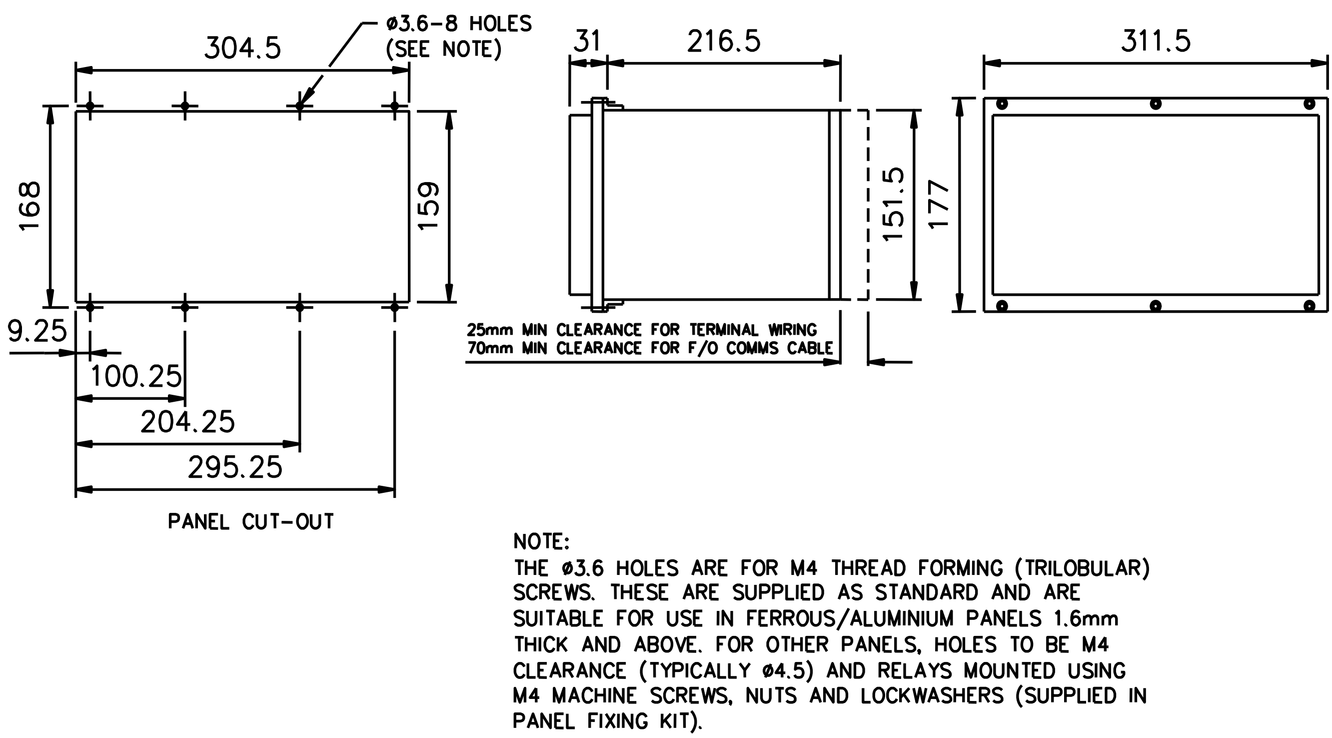


Fig 11. Overall Dimensions and panel drilling for Epsilon E12 case

Ordering Information - MICROTAPP 7SG151

Product description	Variants	Order No.
MICROTAPP		7 S G 1 5 □ 0 - □ □ □ □ □ - 0 □ □ 0
Transformer tap change control and monitoring.		
	<u>Relay type</u>	
	Automatic voltage control (AVC)	1
	<u>Protection options</u>	
	Basic - Microprocessor based automatic voltage control (AVC) system operating on the well proven TAPP philosophy	1
	Advanced - As basic model only particularly suitable for embedded generation and traction system applications as this model is capable of controlling the HV or LV voltage	2 G
	<u>Auxiliary supply /binary input voltage</u>	
	30 V DC auxiliary, 30 V DC/AC binary input	A
	30 V DC auxiliary, 48 V DC/AC binary input	B
	48/110 V DC auxiliary, 30 V DC/AC binary input	C
	48/110 V DC auxiliary, 48 V DC/AC binary input 1)	D
	48/110 V DC auxiliary, 110 V DC/AC low burden binary input	E
	220 V DC auxiliary, 110 V DC/AC low burden binary input	F
	220 V DC auxiliary, 220 V DC/AC low burden binary input	G
	110 V AC auxiliary, 110 V DC/AC binary input	H
	110 V AC auxiliary, 48 V DC/AC binary input	X
	110 V AC auxiliary, 220 V DC/AC binary input	J
	110 V AC auxiliary, 30 V DC/AC binary input	K
	<u>I/O range</u>	
	11 Binary Inputs / 5 Binary Outputs (incl. 3 changeover)	E E
	19 Binary Inputs / 13 Binary Outputs (incl. 3 changeover and 4 normally closed contacts)	J G
	19 Binary Inputs / 13 Binary Outputs (incl. 3 changeover)	K G
	<u>Frequency</u>	
	50/60Hz	3
	<u>Nominal current</u>	
	1/ 5 A	0
	<u>Housing size</u>	
	Case size E8 (4U high)	E
	Case size E12 (4U high)	G
	<u>Communication interface</u>	
	Fibre optic (ST-connector) / IEC 60870-5-103	A

1) High burden 110/125V & 220/250V 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) For use with resistor sender units, order mounting bracket assembly with 19 off 220ohm resistors – VCE:2512H10072

3) Milliamp transducer FTPT, order 7XG2300-1AA00-0AA0
Averaging VT FAVT, order 7XG2300-2AA00-0AA0
Tap position indication module FTIM, order 7XG2300-3AA00-0AA0

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