

7SG15 MicroTAPP

Automatic Voltage Control

Document Release History

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Pre release

2010/02	Document reformat due to rebrand

Software Revision History

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1 Introduction

The comprehensive design of the MicroTAPP relay simplifies the design of a tap change control system allowing a large reduction in the external wiring normally required. Application of the relay for voltage control of the most complex networks is easily accomplished.

2 Voltage Standards

The allowable range of permissible voltage at each supply point determines to a large extent, the operational voltages that can be applied at each voltage level on the network. Using typical voltage ranges it will be useful here to examine the maximum typical design voltage drops that can occur across a distribution system at extreme loading conditions.

For this example the network voltage levels are 33kV, 11kV and LV.

Table 1 lists voltage drops starting at the in-feed point, this example being only one of many, but used here for the purpose of explanation. The tables use figures for fixed tap distribution transformers based on a nominal output equivalent to the statutory voltage and off load adjustment in $\pm 2.5\%$ and $\pm 5\%$ steps. In practice the nominal voltage of fixed tap transformers is higher than the statutory voltage, giving a fixed boost over the levels used in this example.

% Voltage Difference (from nominal)	At Source		Remote End	
	No Load	Full Load	No Load	Full Load
33/11kV Transformer (Basic 100% used to offset higher voltage system drop)	0	0	0	0
MV System	0	0	0	-8
LV System	0	-1	0	-7
Total	0	-1	0	-15
No load/Full load variation	1		15	

Table 1

Under the conditions shown in Table 1 where a basic control of voltage is used to give a constant voltage at the 11kV busbar, a customer connected close to the 33/11kV source can receive a supply that varies by only 1%, while a customer connected at a remote point on that network can receive a supply having a variation of some 15%.

Improved system utilisation can only be achieved and adequate voltage levels maintained if compensation for the full load drop can be successfully applied to the voltage control system such that the no-load/full-load variation is optimised.

2.1 Increasing the Network Capability

A method of Automatic Voltage Control (AVC) with Line Drop Compensation (LDC) has been used to offset the effects of line drops due to the load current effect upon the line R/X characteristic in order to achieve a constant voltage at the far end of a transmission line. This method is not practical for the distribution system where customers are connected along the length of multiple feeders radiating from a single substation with each feeder having a different load characteristic and length. The theoretical calculation of usable settings is, therefore, difficult for a distribution network.

If use of LDC is considered as **LOAD Drop Compensation** it can be employed in a practical way to increase the network utilisation. Using the data from Table 1 as an example, a modified **basic level** setting of -4% and an **LDC** setting of 8% is applied to the AVC. The effect on the voltage levels at the extremes of substation loading is seen by reference to Table 2.

% Voltage Difference (from nominal)	At Source		Remote End	
	No Load	Full Load	No Load	Full Load
33/11kV Transformer (Basic 96%)	-4	-4	-4	-4
33/11kV Transformer (LDC 8%)	0	+8	0	+8
MV System	0	0	0	-8
LV System	0	-1	0	-7
Total	-4	+3	-4	-11
No load/Full load variation	7		7	

Table 2

The maximum variation across the network is now reduced from 15% to 7% through the change to the BASIC and LDC controls, resulting in an improved overall supply to the connected customers or, if the original deviation was acceptable, allowing the feeder lengths to be extended and the maximum variation indicated in Table 1 still achieved.

Theoretically the use of LDC will improve the situation to the ideal point where the absolute voltage variation is the same at both the source and remote ends of all feeders.

While abnormal network running and disparate feeder load profiles may cause the use of LDC to be reduced from the ideal, advantage can still be gained by the use of restricted settings, including those networks where voltage drops occur only on the LV system.

3 Wiring Diagrams

The MicroTAPP has been designed as a complete system. The external wiring requirement necessary for connection to other equipment is minimal. Examples of typical arrangements for control of a tap changing transformer are attached at the end of this section.

4 Application of TAP change control

Reference to the Description of Operation section of this document explains that the use of the MPPC communication between MicroTAPP relays for **summation of load current** purposes. The minimisation of circulating current is carried out by each relay using that transformer's own current. When transformers are grouped consideration must be given to the Load Drop Compensation (LDC) requirements and effects of different running arrangements.

MicroTAPP is easily applied to double bus-bar substations allowing flexibility in the system running arrangements. The transformers do not have to be identical and can be supplied from different sources.

There are three main methods of application for MicroTAPP, as described in the description of operation section of this manual, each with particular advantages, giving the customer a wide choice depending on the particular application.

For maximum operational advantage the TAPP system is recommended.

4.1 TAPP Method – System Power Factor Setting

The TAPP method uses the “System Power Factor” setting applied to the relay with which to calculate the circulating current compensation. This setting is also used to normalise the line drop compensation applied, so that it is not affected by any circulating current and only relates to the load power factor.

Each MicroTAPP relay can monitor the state of the KANBUS link. The “Circulating current” and “line drop compensation” features both rely upon its operation to function correctly. An alarm can be given if a station in the group is lost when the MPPC Failure Detection set to “Enabled”.

In addition the MicroTAPP has a logic feature that will automatically switch all relays running as a group in circulating current mode to the TAPP method, if the loss of one of the relay stations on the MPPC KANBUS link between the relays is detected.

Therefore it is imperative that the setting applied to the relay accurately reflects the load power factor, irrespective of whether TAPP or circulating current is being used.

Ideally the power factor should be set identically on all transformers that normally supply a particular busbar load. The relay default power factor is 0.97 lagging and can be used initially, before the setting is refined to its operational value.

To find the setting to use, the relays should be switched into AUTO voltage control mode and left to tap to the NORMAL steady state. Once the relay(s) have reached the deadband the power factors can be read from the relay Instruments display. The deadband is reached when the only the NORMAL green coloured LED is illuminated.

When using the TAPP method it is important that the System Power Factor is set accurately to reflect the true load power factor. If there is a large error between these two parameters then the system voltage will also have an error.

Setting Example

Two transformers running in parallel at a single substation supply a common group load. The relays, tap changer and scheme are now fully commissioned and all relay Instruments are at expected values. The relays are switched to AUTO and left to settle into their voltage deadbands. The Power Factor Instrument is now selected using the fascia keypad. The relay Power Factor and Group Load in MVA are recorded from both relays over a period of time. The results are examined to find where the peak load occurred. The “System Power Factor” setting applied should reflect the power factor when the load is near or at its steady peak level. The substation load will vary during the normal daily load cycle so these values may need to be recorded for some time before the point is reached where the load is at its maximum value.

In this example, one relay displays a power factor of 0.92 lagging and the other displays 0.94 lagging, at the point at which the load is near its recorded peak. The average of these two values is 0.93 lagging. Both relays should now be set with a System Power Factor of 0.93 lagging.

For loads normally supplied from two parallel substations the power factors from all transformers paralleled should be averaged when the peak load occurs. All relays should then be set to this average value. The system circulating current will then be minimised. Minimising the circulating current allows MVar demand to be minimised and hence power system losses reduced.

NOTE: It is important to set the System Power Factor setting when the substation load is high, as this is when the compensation for circulating current and Line Drop Compensation (LDC) have maximum effect. In TAPP mode, if a significant difference exists between the true load power factor and the MicroTAPP “System Power Factor” setting, a system voltage error will occur. Therefore it is important to find the true System Power Factor and set the relay accordingly when the system is heavily loaded.

4.2 Independent Single Transformers

At a single transformer site a MicroTAPP relay is arranged as shown in Figure 1. Connections are made to the VT for voltage measurement and to the CT for LDC and control of circulating current when the transformer is operated in parallel with other transformers at remote sites. The TAPP method should be selected if it is possible to parallel substations together, albeit as a temporary measure. If a single transformer substation is purely radial with no possibility of parallel operation with another substation then circulating current can be selected.

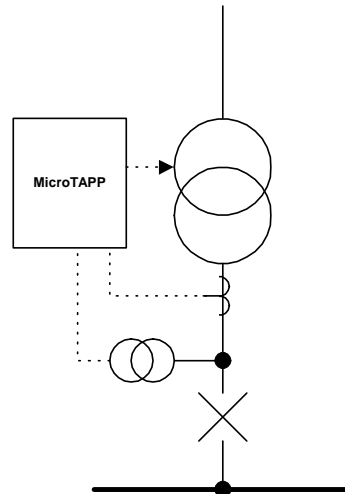


Figure 1

4.3 Parallel Transformers

When transformers are operated in parallel at a site use of the MPPC link between each voltage control relay enables accurate LDC at all times. Figure 2 shows the general MPPC arrangement for a multiple transformer site. If a MicroTAPP is de-energised, communication between other relays connected to the twisted pair cable is not affected.

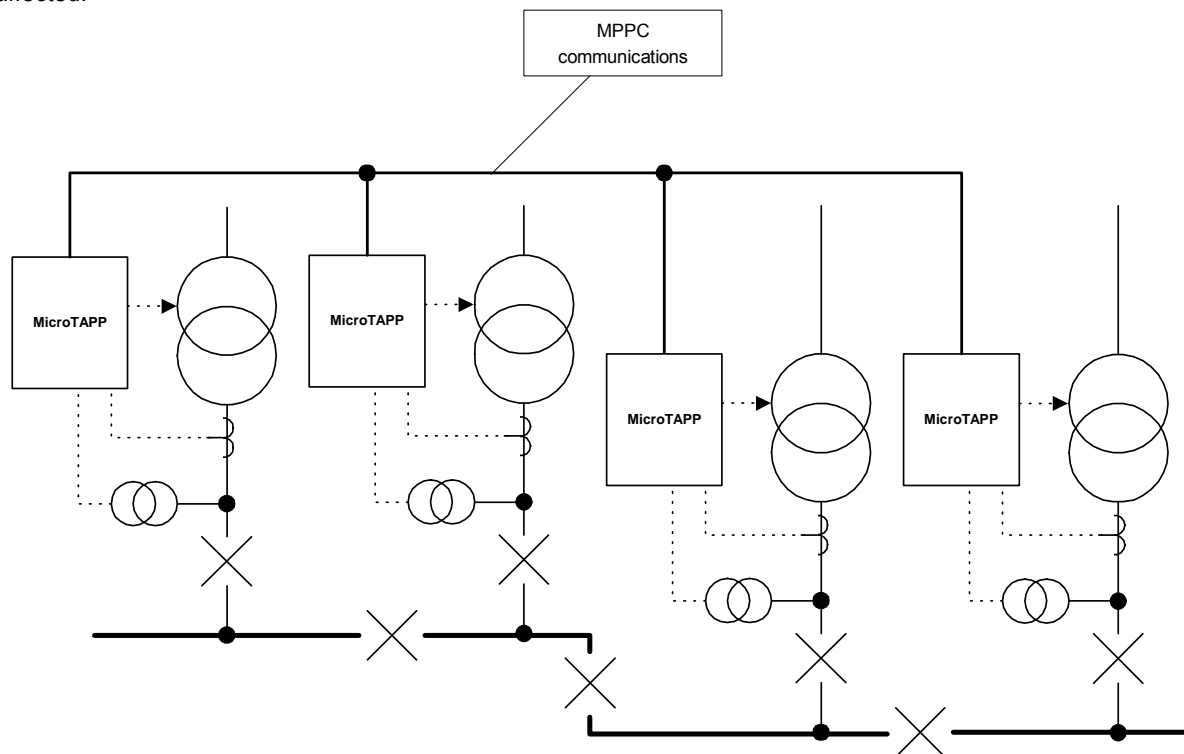


Figure 2

In more complex sites transformers may operate in groups with the busbar split, making two effective load groupings. Regardless of the transformer grouping the MPPC should always be connected to each relay. Where operational requirements necessitate changes to the busbar configuration and LDC is used, consideration must be given to the MicroTAPP relay settings.

Take an example of four transformers normally operating in two groups, i.e. two on each bus-bar as shown in Figure 2. The site can be operated as a single busbar with four transformers in parallel or as a two busbar site with each busbar supplied from two transformers.

The actual level of LDC for each of the two bus-bar groups will be proportional to the load on each of the respective bus-bars and these levels will be maintained (by virtue of the MPPC) at the correct level even if one transformer is taken out of service in either of the groups.

If the two groups are now interconnected either by closing the bus-coupler or operating the transformers in different system groups then the resulting levels of basic voltage and LDC will be a compromise based on the average settings and loading of each transformer in the new group.

If a single setting is not found to be satisfactory for all busbar configurations, alternate setting groups for different set-point levels and LDC etc. can be implemented from bus coupling CB auxiliary switch operation or from a SCADA signal.

4.4 Parallel networks

The MicroTAPP system uses a modified negative reactance design for the detection of circulating current. When selected for TAPP operation (modified negative reactance circulating current mode), the relay operates to minimise circulating current between transformers at the same site and also when transformers are operated in parallel across networks.

For optimum performance, an accurate normal network power factor must be entered as the "System Power Factor" setting. Switching to alternative Setting Groups can be used to match step changes system power factor due to the reactive compensation switching in or out of service. There are eight setting groups so it is possible to adjust the "System Power Factor" to eight distinct values.

4.5 Embedded Generation

When generation is embedded in a network, where tap changing transformers are used, consideration must be given to the method of voltage control employed. The choice of voltage control is influenced by the type of generator, the generator rating and the relative capacity of the local network. Figure 3 shows a typical arrangement.

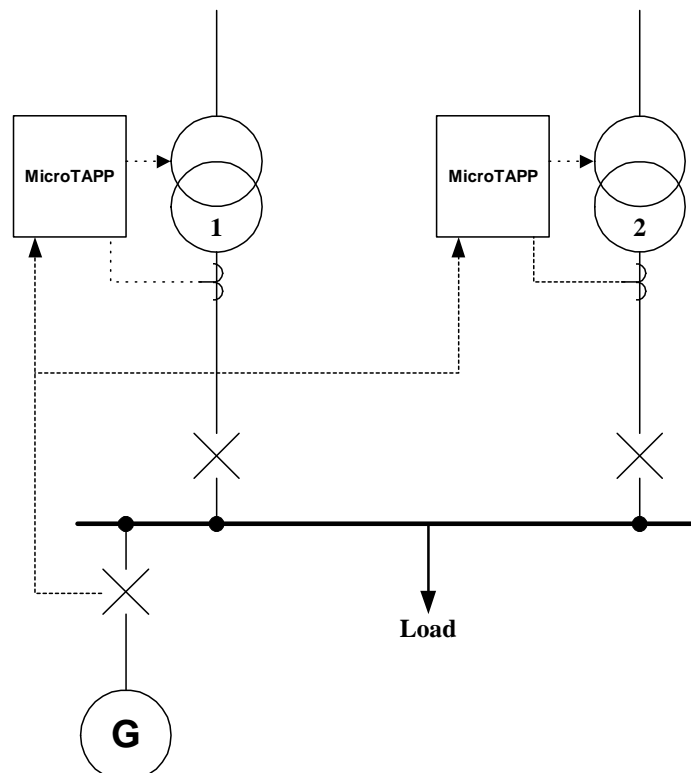


Figure 3

4.5.1 Generator Types

4.5.1.1 Synchronous

Synchronous generator control systems can control the generator terminal voltage and the power factor of load. The generator control can be set to run in power factor or voltage control mode. In either case the excitation is adjusted to hold either of these parameters within limits. Larger generators used for network control will run in power factor mode. This allows the MicroTAPP relay applied to GSU transformers to be set to TAPP method. In voltage control mode the power factor will tend to vary more and circulating current may be more suitable.

4.5.1.2 Asynchronous (Induction Generators)

Induction generators draw reactive magnetising current from the power system and export unity power factor load current. As the MicroTAPP relay is based on the negative reactance principle for tap change control, a significant variation in load power factor may affect relay performance. If the power factor range is large the MicroTAPP relay can be set to operate in 'True Circulating Current' mode. A disadvantage, as detailed in the 'Description' section of this manual is that networks cannot be operated in parallel.

4.6 Application of MicroTAPP

Generally, MicroTAPP can be applied as indicated in Tables 3 and 4. A 'small generator' will have an output which is significantly less than the load demand on the busbar, a 'large generator' will be capable of supplying significant proportion of the load. In practice the running arrangements for a particular site will determine the method of voltage control and the optimum settings that will be used, Tables 3 and 4 are included as a guide only.

Synchronous Generators		
Type of Generator	Small Generator in parallel with Transformers	Large Generator in parallel with Transformers
Power Factor control	Transformer voltage controlled by MicroTAPP. LDC may be used	Transformer voltage controlled by MicroTAPP. If a large LDC setting is used the effect will be reduced when the generator is running. A different setting group can be switched in to maintain the LDC at the correct level
Voltage control	Providing the generator and MicroTAPP voltage levels are similar, correct voltage will be maintained on the busbar. If a large LDC setting is used a circulating current will flow at higher load levels	

Table 3

Asynchronous Generators	
Small Generator	Large Generator
If operation of the generator does not cause a significant change in power factor the MicroTAPP can be used in TAPP mode. LDC settings will not change significantly	If operation of the generator causes a significant change in power factor the MicroTAPP can be used in circulating current mode. It will not be possible to run networks in parallel. A different setting group can be switched in to maintain the LDC at the correct level

Table 4

5 MT1-102 Advanced Relay - Application Guide

The advanced MicroTAPP relay (MT1-102) is available for applications where MW and MVar power flow is more dynamic, for instance when applied to Generator step up Transformers or at embedded generation sites. It has features that allow widely fluctuating loads to be accommodated on industrial supplies. Such loads are blast furnaces, rolling mills and smelter plants. The voltage control point can be switched between HV and LV depending upon the running arrangement of the plant. This is done by switching relay setting groups from the plant status fed to the relay via hardwired inputs or via the communication.

This relay can be fed from a AVC VT and CT on the HV or LV side of the transformer. It can also be used for single or three phase power transformers and allow reactive current compensation to be reduced to allow reactive current to flow through the system. It is therefore suitable for transmission applications and can be manually tapped to control MVar flow.

In all circumstances at a site where transformers are operated in parallel using the reactive circulating current control scheme, all relays must be set to operate from a voltage source on one side of the transformers only. With the MT1-102 relay this may be the directly measured voltage where the AVC VT is located, i.e. 'normal' or at the other side where the voltage is calculated, i.e. a 'virtual' VT. The relays can then have their control point switched, as demonstrated by the example below.

Application of the advanced settings is dependent upon particular operational situations. As an example consider a network where a local generation scheme supplies local load network which is also supplied by a long line from a remote source, Figures 4 and 5.

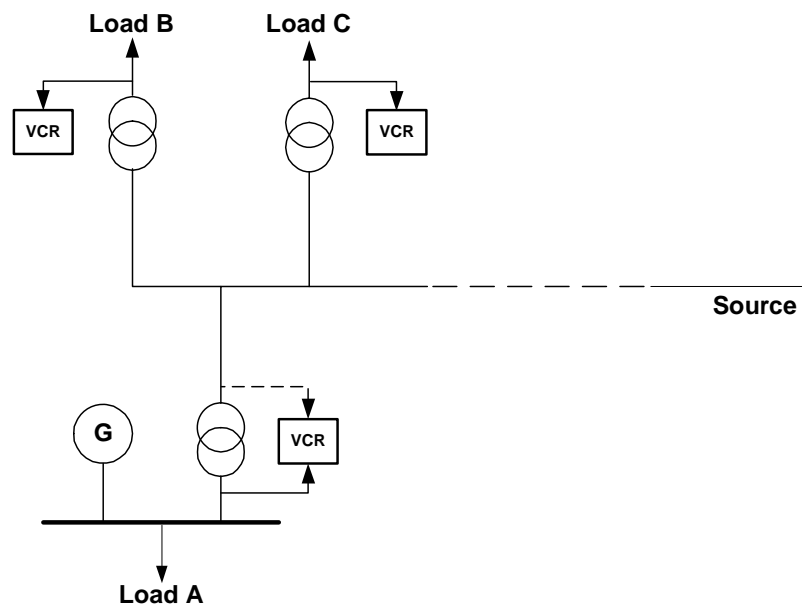


Figure 4

If the generation is active and the network is heavily loaded, voltage control is switched over to take control of the incoming voltage at load site A (see Figure 4) while the generation is configured to maintain the voltage on the local busbar. The incoming voltage at load sites B and C are supported by load site A and offset the line voltage drop from the source. Under light loading or during generation down time the VCR at load site A would be switched to take control of the voltage level at the local busbar.

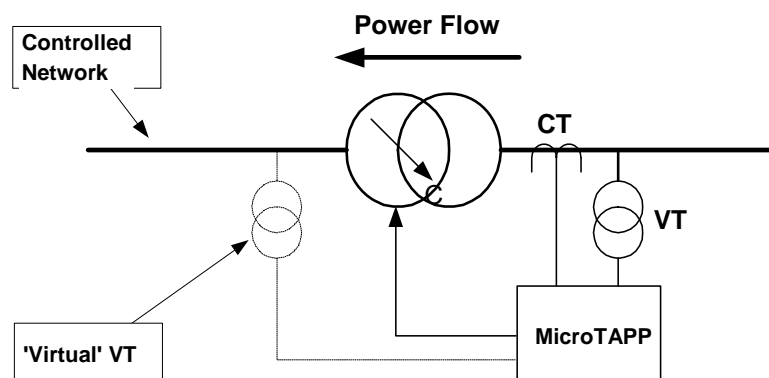
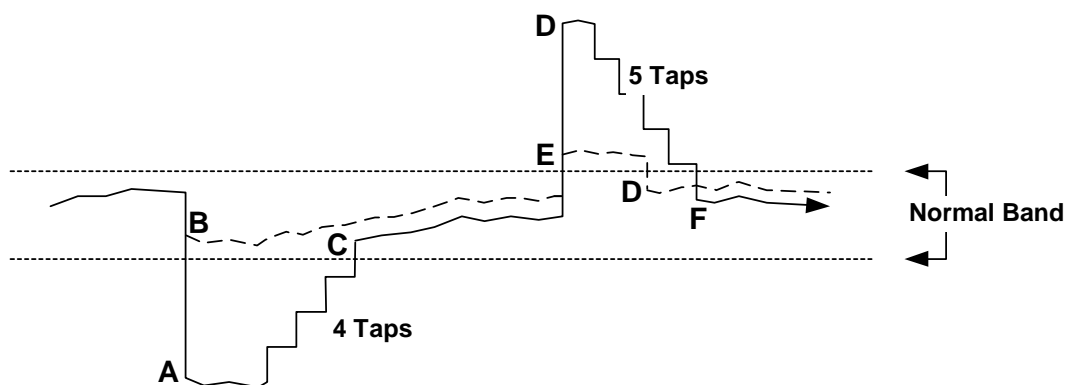


Figure 5

In a situation where a load fluctuates wildly, such as when running large motors or furnaces intermittently, automatic voltage control can result in an excessive number of tap change operations caused by the impedance drop through the transformer. In this instance the menu selection 'transformer voltage drop compensation' can be disabled. The disabling of this compensation allows a normal dead-band sensitivity to be applied while at the same time reducing the number of corrective tap-change operations to a practical number.

Figure 6 shows a situation where a heavy load causes a real voltage drop from A to B. After an initial time delay four tap-change operations will bring the voltage to the normal level at C. As the load is removed the busbar-voltage increases to a point D, where it may be excessive, and after a short delay if fast tap down is enabled, 5 tap-change operations are required to return the voltage to normal.

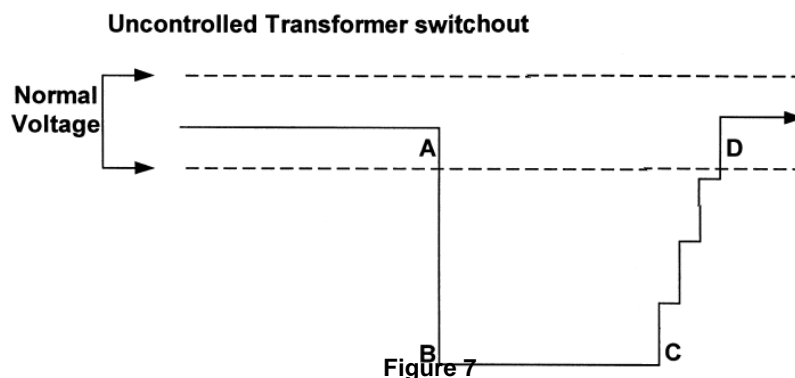
With the 'transformer voltage drop compensation' set to Disabled, the 'measured' voltage reduces to B when the load is applied and no corrective tap-change operations are required. As the load is removed the 'measured' voltage increases to E where, in this example, a single corrective tap change operation takes place after a normal time delay. This will reduce the number of tap changes and hence wear, but at the expense of some variation in the busbar voltage. To allow the transformer voltage drop to be ignored the VT must be located at the opposite side of the transformer from the load.

**Figure 6**

6 Network Control

6.1 Switching Out

When a transformer, as a member of a group, is switched out of service, an increase in load on the remaining units will cause a drop in the supplied power system voltage. If the transformers are high impedance this voltage drop can be very significant. Figure 7 shows the effect on the busbar voltage when a transformer is switched out. At switch-out the voltage falls from A to B and an initial time delay will take place before the first corrective tap-change operation at C which is then followed by further tap-change operations (determined by the inter-tap delay) until the voltage is returned to normal at D.



The MicroTAPP relay has functionality that enables automatic corrective tap changing to take place prior to switch-out. On receipt of a 'switch-out' signal the MicroTAPP relays operate the tap-changers such that, when the transformer is switched out, minimal change in voltage will be seen. The initiation instruction can be sent as serial

data over a communication system or as a latched signal applied to a status input. On completion of the operation a signal (ready for switch-out) is returned either over the communication system or by operation of an output relay. The preparation sequence is shown in Figure 8. On receipt of a switch-out signal (A), the nominated MicroTAPP will immediately tap down until its measured power factor is unity and send a warning signal to other relays in the same group. The transformers that are to remain in service react to maintain the busbar voltage at the correct level as shown by the tap change operations A-B. On switch-out at C there may be relatively small resistive voltage drop that may or may not require a corrective tap-change (D).

6.2 Switching In

When a transformer, as a member of a group, is switched in, a reduction in load on the transformers already in service will result in a voltage increase. When energised but before being put on load, the relay will adjust its open circuit terminal voltage such that no change in voltage will occur when the transformer is closed onto the busbar. The energised but unloaded transformer should be allowed to complete tap changes until the dead band is reached. It can then be loaded by closing the LV CB. At this point some circulating current will flow and the relays will tap to minimise it, but will hold the system voltage at the normal level.

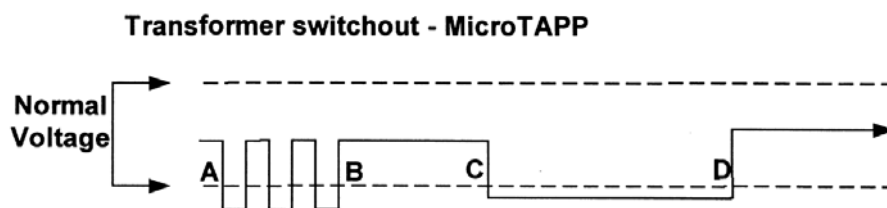


Figure 8

6.3 Falling Frequency

When available generation cannot meet demand the power system frequency will fall. When the frequency falls to a pre-defined value, circuit breakers are opened to shed load and thus return the frequency to normal.

Where loads are resistive a controlled voltage reduction can facilitate a load reduction before the operation of circuit breakers, a general standard for the reduction being two stages, each of 3%.

The MicroTAPP can be set to automatically effect a voltage reduction if the power system frequency falls below a set value, which would be higher than the trip out value, thereby reducing the possibility of loss of supply.

6.4 Tap Stagger

When in parallel with other transformers a MicroTAPP can be made to control voltage and at the same time import or export a fixed reactive current. The initiation instruction can be sent as serial data over a communication system or a signal applied to a status input.

6.5 Reactive Compensators

When power factor correction reactors are used to reduce power system losses the position of the reactive compensator can affect the operating point of the relay. Consider Figure 9 that shows a reactive compensator teed from the secondary connections from transformer 2 with the CT used for load current measurement located in the incoming side of the transformer circuit breaker.

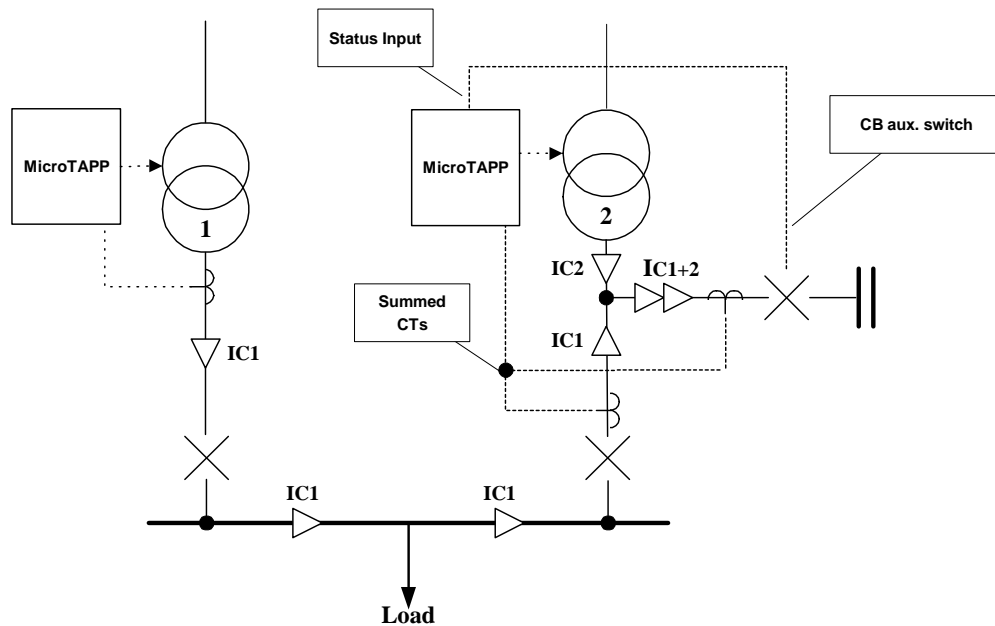


Figure 9

When the compensator is switched in, reactive current will flow through the LDC CT in the ‘wrong direction’ causing the apparent power factor to change. If reactive circulating current control is used for control of parallel transformers, the change in power factor will tend to make T2 operate at a higher voltage. A solution is to arrange for a group setting change with a new load power factor setting to be initiated automatically by closure of the compensator bank switch as shown in Figure 9. Obviously the original settings will be automatically re-applied when the switch is opened.

7 Voltage Transformers

7.1 Operational Considerations

The preferred location of the VT is at the transformer secondary connections.

In the case of a busbar connected VT it is important to disable MicroTAPP whenever the transformer secondary circuit breaker is open. If this precaution is not taken the regulating relay will be allowed to control a tap-changer without being able to measure its output voltage. Thus if the voltage is out of band (or drifts out of band) an unstable situation will arise caused by ineffective raise or lower instructions being issued by the relay to its tap-changer. The tap-changer will soon arrive at either its upper or lower limit producing an abnormal voltage.

Disabling is achieved by means of an auxiliary switch in the transformer’s lower voltage circuit breaker which is arranged to disconnect the MicroTAPP ‘enable’ input or by applying a signal to implement a ‘Tap change block’ command to the relay.

For more complex substations further auxiliary switches may be considered to be necessary in the bus-section and/or bus coupler circuit breakers in order to ensure that all possible operating conditions are catered for.

In common with most other voltage control schemes the MicroTAPP system can operate with either bus-bar or transformer connected VTs but the operational restrictions imposed by bus-bar VTs still apply and the ability of MicroTAPP to automatically match secondary voltages before putting transformers back on load (thus avoiding sudden step changes) cannot be utilised.

One significant advantage of the MicroTAPP system is that if an idle transformer is inadvertently restored to service on an unsuitable tap position then the inherent coupling features of MicroTAPP relays together with their “fast tap down” feature will quickly restore all transformers at the site to the optimum tap-positions. This applies to both types of VT connection but in particular to bus-bar VT schemes.

The VT used for measurement of voltage need not be related exactly to the transformer nominal output. The actual value is entered in the 'system settings/transformer' menu together with the transformer details, from which the control algorithms determine the actual voltage value.

Errors in the controlled voltage will be directly related to errors in the measured voltage and so these should be minimised by using the most accurate VTs available. As a guide the measuring accuracy of the VTs should be matched to the tap step resolution as a minimum requirement.

8 Current Transformers

As for a VT, the CT used for measurement of load current need not be related exactly to the transformer full load rating. The actual value is entered in the 'system settings/transformer' menu together with the power transformer details, from which the control algorithms determine the actual current value.

If the CT is mounted at the circuit breaker the CT current direction will be reversed, the setting menu allows the current direction to be reversed.

The accuracy of the measuring CTs is not as critical as it is with the measuring VTs. However, metering class CTs should be used if possible to minimise measuring errors.

9 Wiring Configurations

Diagrams located at the end of this section show typical arrangements for tap change control schemes. Inputs to the relay and outputs for indications and control are user programmable. Tables 5, 6 and 7 give examples of the I/O allocation for a complete control system as shown in the example scheme with the inclusion of other features not shown on the diagrams. 11 inputs are used with 5 outputs. Other combinations of I/O are available, see description of operation.

INPUTS	
Terminal	Default Allocation
Status 1	MicroTAPP enabled (to allow for control at tap changer)
Status 2	Lower signal to tap changer
Status 3	Raise signal to tap changer
Status 4	3% voltage reduction from SCADA **
Status 5	6% voltage reduction from SCADA **
Status 6	Prepare for Switch-Out from SCADA **
Status 7	Tap in Progress switch is closed
Status 8	Auto selection from SCADA **
Status 9	Manual selection from SCADA **
Status 10	Raise signal from SCADA **
Status 11	Lower signal from SCADA **

Table 5

Controls can also be carried out by use of the serial communication connections into the relay making use of the inputs marked ** unnecessary.

OUTPUTS	
Terminal	Default Allocation
Relay 1	Prepare for Switch-Out complete
Relay 2	Use N/C for Tap Changer motor supply contactor reset
Relay 2	Use N/O for Tap Changer motor supply latched contactor trip
Relay 3	Voltage control fault alarm
Relay 4	MicroTAPP initiated Lower signal
Relay 5	MicroTAPP initiated Raise signal

Table 6

OTHER INPUTS	
B9,11,13,15,17,19 (B23 is common)	Digital TPI
B23,25,27	Resistor TPI

Table 7

9.1 Voltage Transformers

Either a 3 phase or single phase voltage transformers can be used for voltage measurement. A 3 phase VT is preferable so that the level and voltage quality of all phases can be monitored. Figure 10 shows the relay connections for a 3 phase VT.

Where a single phase VT is used it can be connected between phases or from phase to earth, in either case the MicroTAPP set-up menu for the transformer allows the particular connection to be specified. Figure 11 shows the connections for a single phase VT.

9.2 Current Transformers

Figures 10 and 11 also show the relay connections for a current transformer. The input allows for any CT nominal secondary current up to 5 amps to be used. The MicroTAPP setup menu for the transformer allows the particular ratio to be specified.

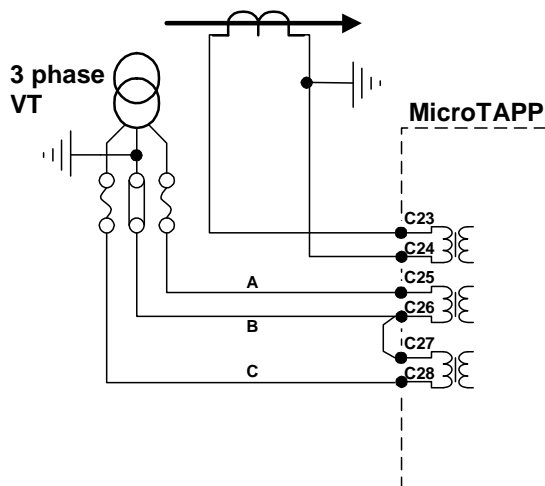


Figure 10

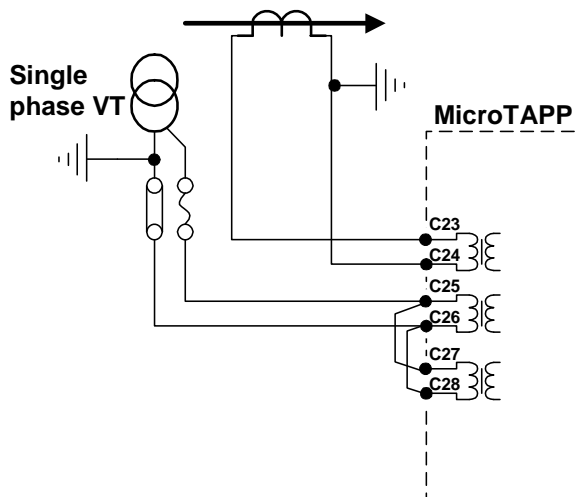


Figure 11

9.3 Inputs

The standard status inputs to the relay are rated for AC or DC voltages and have a range of 18V to 110V. When used at higher voltages up to 250V AC or DC, a series dropper resistor must be used as shown in the application diagrams at the end of this section. Alternately the relay can be specified with alternate voltage ratings, see performance specification section and order catalogue.

The inputs can be mapped to the required status configuration using the appropriate relay menu. A typical control scheme is shown at the end of this section.

9.4 Outputs

The standard outputs are relay contacts rated for 250V, AC or DC voltages, and have a current rating of 10A.

The outputs can be mapped to the required function using the relay system configuration menu, a typical control schemes are shown at the end of this section.

9.5 Tap Position

Connections are made to the MicroTAPP relay depending on the type of tap position sender unit provided with the tap changer as shown in Figures 12 and 13. Connections for all TPI sender unit types are provided.

The MicroTAPP monitors the integrity of the tap position. If a resistor type sender unit is used for the signalling of tap position an extra resistor having a value equal to 1 tap interval resistor must be inserted at the bottom of the resistor chain as shown in Figure 12. Where resistors are used for determination of tap position sender unit, a worn or poorly maintained moving contact may become open circuit and the indicator will read tap position '0', indicating a faulty sender unit.

The total resistance of the resistor chain should be greater than 250Ω and less than 100kΩ. If the total resistance is less than 250Ω, the short-fall can be made good by increasing the size of the Additional resistor. The value of this resistor should then be entered in terms of tap steps in the setting "Additional resistor equiv. to". However, this setting added to the number of tap positions must be less than 40. Resistors should be rated to 1W and to 1% accuracy.

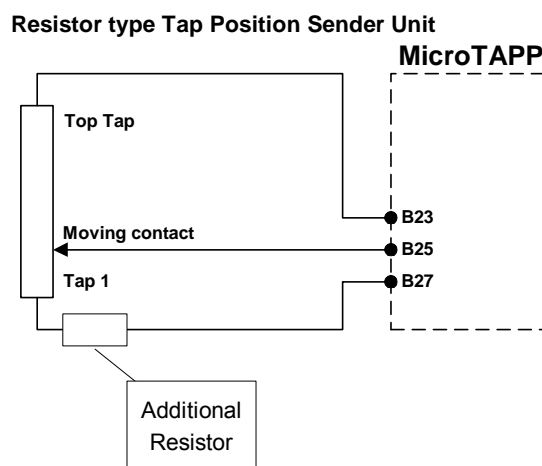


Figure 12

Where tap position is signalled from a switch, Figure 13 shows the connections, which are used for True binary, BCD and Gray code configurations. As with the Resistor type, a reading of tap position '0' will indicate a faulty sender unit.

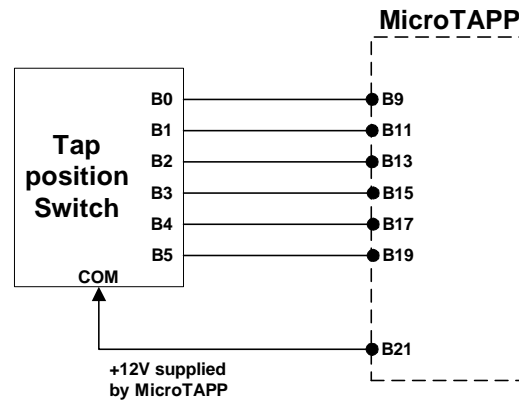


Figure 13

9.6 Transfer Tap Positions

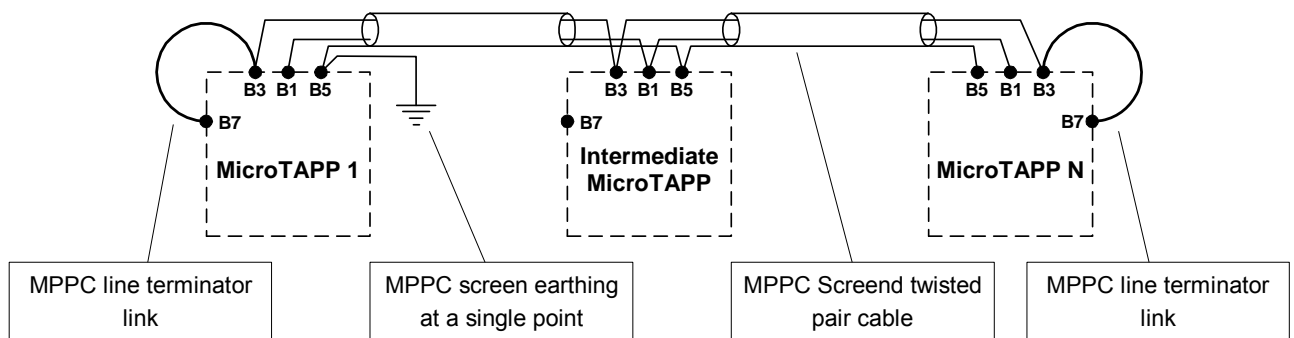
As described in the first section of this manual some tap changers have special positions which operate to rearrange the winding configuration but do not alter the voltage. When at these positions a single tap change control will result in more than one tap change operation which must be recognised for correct operation of the runaway prevention system. These positions may be indicated as the same position and labelled with suffix letters, i.e. 8A, 8B, 8C.

A system that allows for customisation of the tap position as indicated on the tap change mechanism is integrated into the TPI set-up menu, accessed by use of a 'tap customisation sub-menu from the '/settings/tap-changer' menu. If a tap position is maintained as the same position through the 'transfer' cycle, the positions can be re-numbered as the same position. For example, 7, 8, 8, 8, 9. To indicate that these tap positions are special, they must also be marked as 'T' to indicate a transfer position, in this case 7, 8T, 8, 8T, 9. It is important that the tap positions above the transfer point are also re-numbered.

The commissioning section of this manual gives details of the tap changer set-up procedure and correct determination of the number of 'physical' tap positions.

9.7 MicroTAPP Peer to Peer Communications (MPPC)

At a site, load and status information is passed between MicroTAPP relays by the MPPC system which is a screened twisted pair cable. The cable used should be a 22-swg shielded twisted pair cable with drain wire. The maximum cable length is of the order of several hundred meters



MPPC Inter-MicroTAPP connections

Figure 14

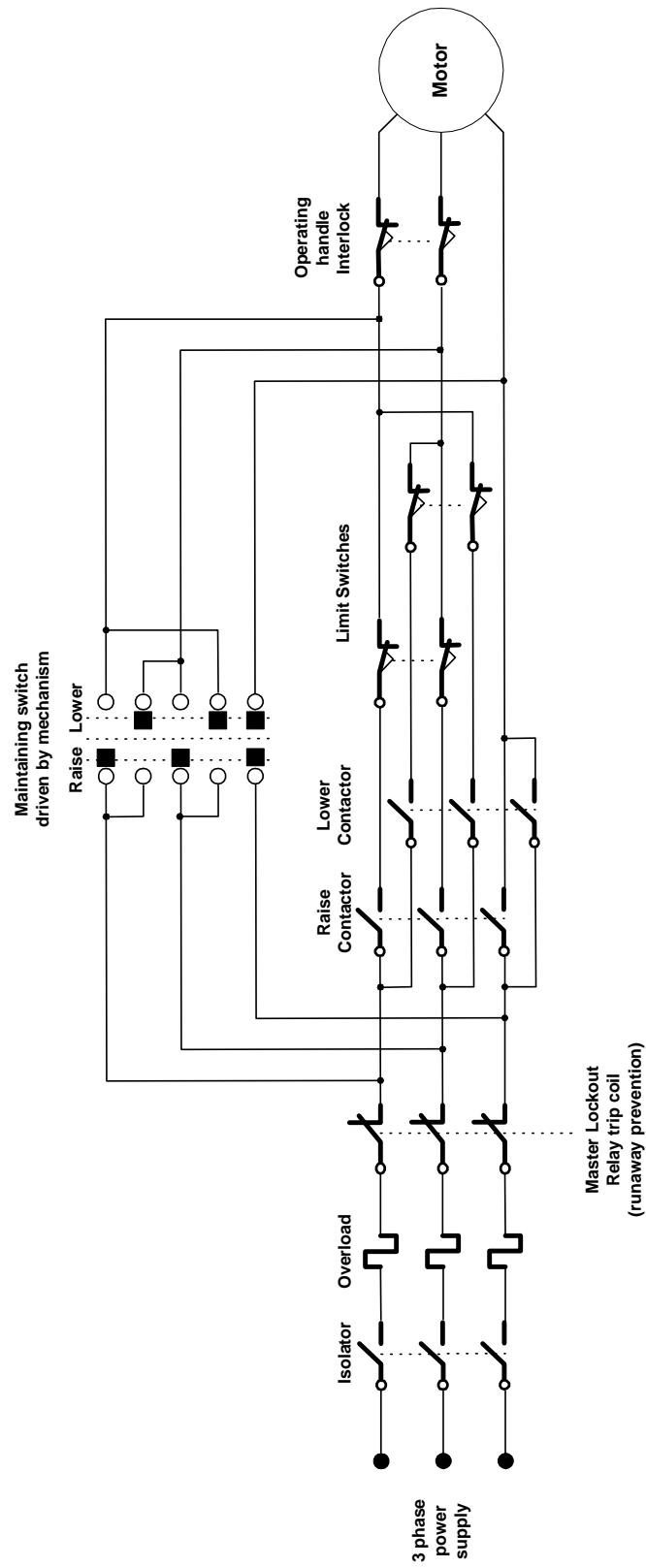
Each end of the MPPC cable must be connected to a line terminating resistor which is included within the MicroTAPP at terminal B7, the connections to which are made by linking from B3 to B7 on the first and last relay of the cable route as shown by Figure 14. The MPPC cable screen must be connected to earth at a SINGLE point only, again shown in Figure 14.

If an MPPC failure is detected when the relay is in circulating current mode (the "MPPC Failure Detection" setting in the "System Config" Menu must be set to "Enabled" for this to occur), the relay will automatically switch to TAPP mode.

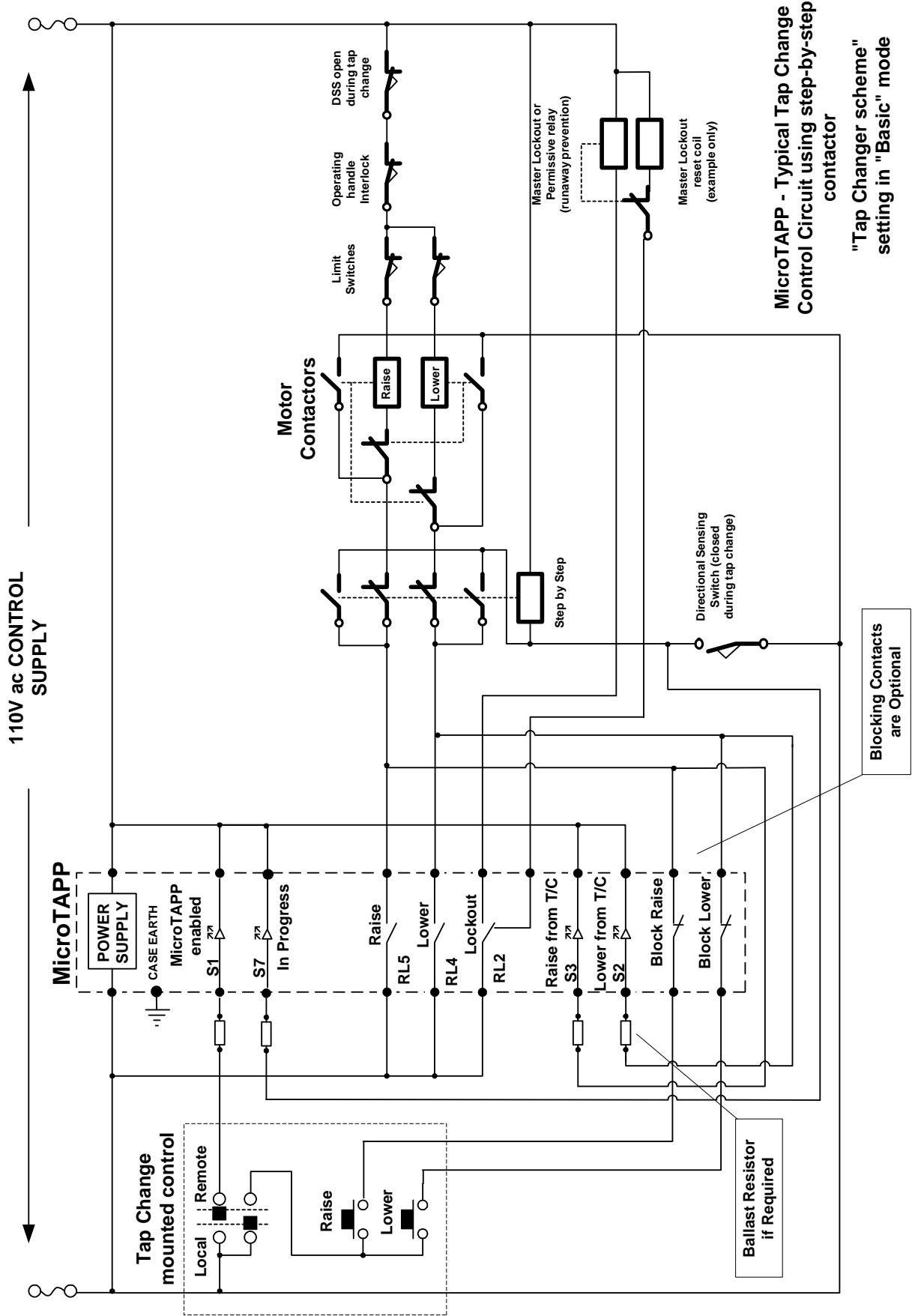
Only those relays set to the same Transformer Group will share load and circulating current information

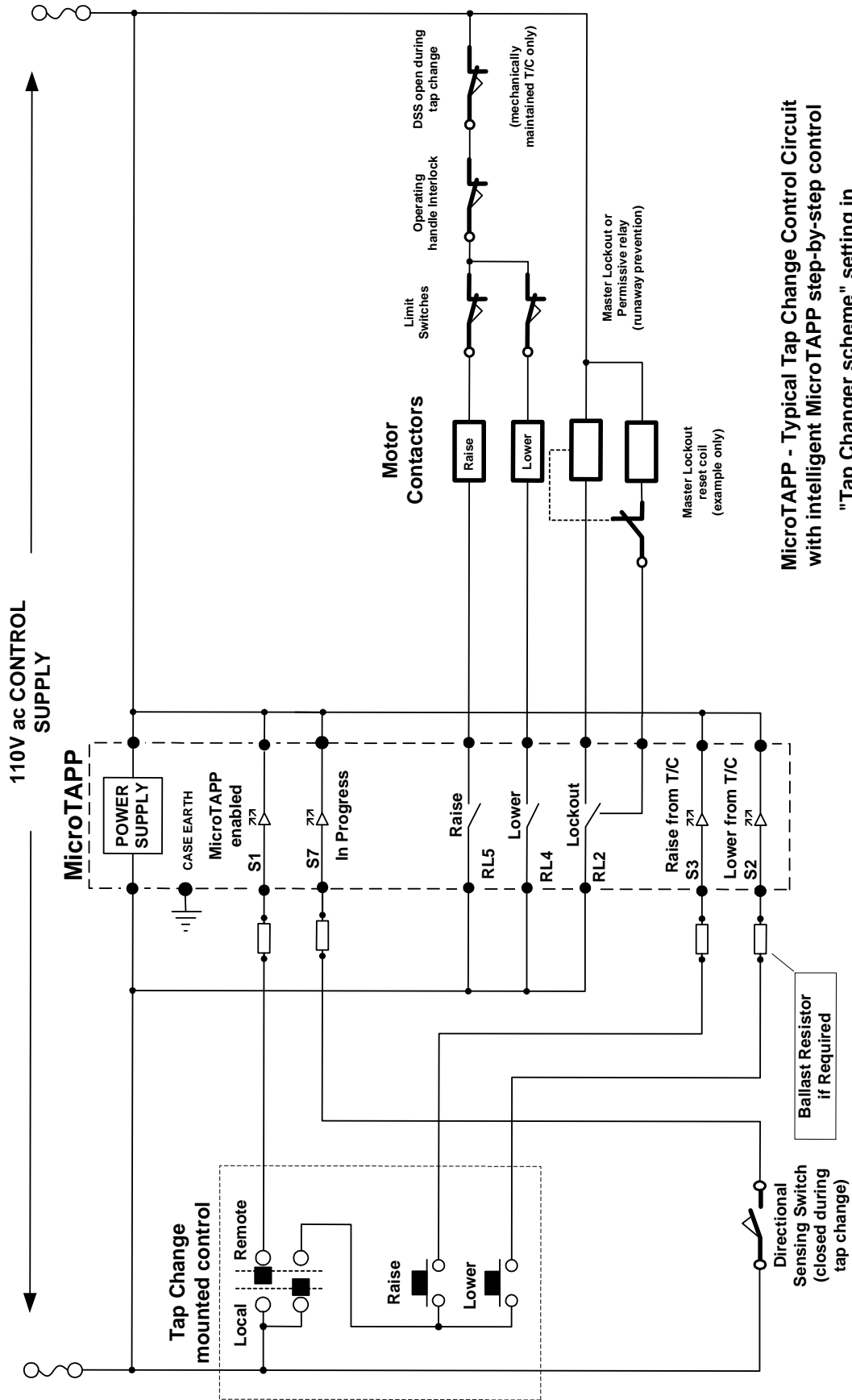
9.8 Alarms

A wide range of abnormal states are detected by the MicroTAPP which are available from the Fault Data option in the relay menu and remotely via serial communication.



Typical Tap Changer Motor Circuit





MicroTAPP - Typical Tap Change Control Circuit with intelligent MicroTAPP step-by-step control "Tap Changer scheme" setting in "Step-by-Step" mode