



GE VERNOVA

KVTR

102

Scheme Description

Single or Multi-Shot, Three Phase Autoreclose

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This scheme description should be read in conjunction with Service Manuals R8505 and R8501, which give a general description of relay hardware, and instructions for installation, commissioning, maintenance and setting procedures, for all K-range autoreclose and check synchronism relays and overcurrent relays respectively.

The following description refers to the KCGG140 and KVTR102, ladder logic, inputs and outputs, which can be masked to opto inputs and output relays as required for a specific application. Please refer to Service Manual R8505, Sections 2.1, 2.2, 3.2, 3.4, 5.1.12, 5.1.13, 5.2.7, 5.2.8, 6.1.1 and 6.2.1 and R8501, Sections 3.2.12, 3.2.13, 3.4.1.4, 3.4.5, 3.6.3, 3.6.5, 5.3 and 5.4 for full details of relay inputs and outputs. The following scheme description also includes an explanation of the control switches used in a common application.

SECTION 1. APPLICATION, AND BASIC OPERATING SEQUENCE

The KCGG140/KVTR102 integrated protection and autoreclose relay scheme provides three phase overcurrent and earth fault protection with multi-shot three phase autoreclose control for distribution and transmission systems. It can be adjusted to perform a single shot, two shot, three shot or four shot cycle. Dead times for all shots (reclose attempts) are independently adjustable.

The scheme has four different operating modes, auto, non auto, live line and telecontrol, selectable by local control inputs to the KVTR relay from a four position rotary switch. Remote selection of auto and non auto can be done either via K-Bus or from the control inputs on the KVTR via a SCADA system, see Figures 1, 2 and 3 for typical circuit diagrams and rack arrangement.

1.1 Operating sequence

An autoreclose cycle is initiated by operation of the KCGG protective relay, provided the KVTR is in the auto operating mode and the circuit breaker is closed until the instant of protection operation. Dead time (TMR Dead Time 1, 2, 3 or 4) starts when the circuit breaker has tripped and the protection has reset. At the end of the dead time, a CB close signal is given (output RLY CB Close Sig), provided input signals are present indicating that system conditions are suitable (INP Safe toClose), and the circuit breaker closing spring or other energy source is fully charged (INP Spring Charg). The safe to close signal is taken from a contact on a separate voltage monitor or synchronism check relay, and the spring charged signal is taken from an auxiliary switch contact on the circuit breaker. The CB close signal is cut off when the circuit breaker closes.

When the circuit breaker closes, the reclaim time starts (TMR Reclaim Time). If the circuit breaker does not trip again, the relay resets at the end of the reclaim time. If the protection operates again and the circuit breaker trips once more before the reclaim time has elapsed, the relay either advances to the next shot in the programmed auto reclose cycle, or, if all programmed reclose attempts have been made, goes to lockout.

1.2 Operation modes

The KCGG140/KVTR102 integrated protection and autoreclose relay scheme has the following modes of operation:

1. auto
2. non auto
3. live line
4. telecontrol

The auto/non auto/live line operating modes can be made selectable locally from opto inputs to the KVTR relay from a four position rotary switch. The remote selection of auto and non auto modes can only be made when the local control switch is set to the telecontrol position energising the INP TeleControl. The selection of auto/non auto modes can be made from user commands USR Tel Auto and USR Tel Non Auto from a remote master station via K-Bus or locally at the relay. For situations where Protection Access Software is not installed, remote operating mode selection can be made from the SCADA system via interposing relays or opto couplers. The modes can be selected via a latched or pulsed signal from the SCADA system to the KVTR opto input INP Auto. Choice of remote selection of auto and non auto modes with the user commands or a latched or pulsed signal to an opto input can be made using the TELCOMM and PULSET function links, 2/2, 2/3, see Section 2.24.

When switched from a locally selected mode to telecontrol, the relay remains in the last locally selected mode until a new mode is selected remotely. The live line position is opposite the telecontrol position on the 4 position selector switch. This ensures that the last local mode of operation is either auto or non auto. The remote operating modes of auto and non auto are memorised, so that the relay will revert to the last selected mode following an auxiliary power supply interruption. Note, make before break contacts should be used on the selector switch for the relay to remain in last locally selected mode when the telecontrol position is selected if the pulsed signal option is used to toggle the remote operating mode.

Three KVTR opto inputs INP Auto, INP Live Line and INP TeleControl are assigned and used for local operating mode selection, via the selector switch. INP Auto selects autoreclose in service; INP Live Line selects live line working (autoreclose off and instantaneous protection in service); INP TeleControl enables telecontrol of auto/non auto modes. If all three inputs are off the relay adopts the non auto mode (autoreclose off and instantaneous protection blocked). The blocking of instantaneous elements for local non auto mode is done directly from the selector switch and also via the KVTR RLY Block InstPr. Thus, if the KVTR relay is removed from it's case there will still be blocking of the instantaneous protection. Therefore, when removing the KVTR from its case the local non auto position should be chosen to ensure discriminative tripping. If blocking of instantaneous elements is not wanted when in non auto mode then this can be disabled by setting software function link, 2/6, NONAUTO BLOCKINS to 0, see Section 8.2.

SECTION 2. MAIN OPERATING FEATURES

2.1. Instantaneous trips selector

A “block instantaneous trips” output can be arranged to block the trip function of non-discriminating protection, such as low set instantaneous overcurrent or earth fault protection, or distance protection operating with zone 1 extension. This can be set to operate after one, two, three or four trips (CNS Block Inst), and will then remain operated until the end of the auto reclose cycle, to ensure that the final trip to lockout for a persistent fault is made by discriminating protection, such as IDMT, or plain distance with conventional zone 1 reach. If this feature is not required, it can be effectively disabled by setting the target to five trips, so that it never operates.

The normal arrangement for this feature is for the output relay to be normally reset, and to operate (contact closes) to block non-discriminating protection (relay masked to output RLY Block InstPr). This is suitable for most modern protective relays such as Optimho and KCGG. For applications which require a normally closed contact which opens to inhibit tripping, the output relay can be arranged to be normally operated (contact closed), and to reset (contact opens) to block the protection trip output (relay masked to output RLY Enable Inst).

A second, independently adjustable, instantaneous trips selector is available (relay masked to output RLY Blk SEF Inst or RLY SEF Inst OK), for applications where sensitive earth fault protection is required to initiate auto reclosing, with short time SEF protection tripping being blocked after one, two, three or four trips (CNS Block InsSEF). Separate logic inputs are available for long time SEF and short time (nominally instantaneous) SEF protection (INP Inst SEF, INP Sensitive EF).

The operating logic allows for operation of the reclaim timer to be suspended by an input from low set instantaneous protection after CB reclosure, if the “block instantaneous trips” or “block short time SEF trips” output is operated. The low set instantaneous protection is usually the RLY I>/I< start contact on the KCGG connected to the INP Inst Protn or Inst SEF of the KVTR. This ensures that the reclaim time cannot time out and reset the relay and unblock the instantaneous protection before the time delayed protection trip has operated, and so allows reclaim time settings shorter than the time delayed protection operating time. Short reclaim time settings can help to prevent unnecessary lockout for a succession of transient faults in a short period, for example during a thunderstorm. If a long reclaim time setting is chosen (ie. longer than the maximum possible operating time of time delayed protection), this feature may be disabled by setting scheme function link 1/E, RC TIM RUN ON, to 1, to avoid unwanted extension of the effective reclaim time due to a fault cleared by time delayed protection on a downstream circuit breaker.

For applications with downstream pole mounted reclosers, when using sequence co-ordination (see Section 2.23), it may be desirable to re-enable instantaneous protection when the recloser has locked out. When the downstream recloser has locked out there is no need for discrimination and in the KVTR102 there are counter targets (CNS Unblock Inst and CNS Unblk InsSEF) whereby instantaneous protection can be unblocked after a number of shots. This allows the user to have instantaneous then IDMT and then instantaneous trips again during an autoreclose cycle. If this feature is not required, it can be effectively disabled by setting the target to five trips, so that it never operates.

2.2 Maintenance alarm

The relay maintenance alarm output, RLY Maint Alarm, operates and triggers a scheme alarm after a pre-selected number of fault trips (CNS Maint Alarm). This feature is purely for indication and does not initiate a lockout. The fault trips counter (maintenance counter) is incremented when the CB trips as a result of any protection operation. A logic input INP Non AR Protn is provided so that the counter can be incremented from protection not used to initiate autoreclose, for example by sensitive earth fault protection, busbar protection, or breaker fail protection from another CB on the busbar. The maintenance counter register can be reset to zero either through ladder logic input INP Reset M Cntr, if mask selected to an opto input, or via the 'Reset Counters - RST Maint Countr' menu of the user interface. The maintenance alarm is enabled when software function link, 2/D, MAINT ALARM, is set to 1, see Section 8.2.

2.3 Maintenance lockout

This is enabled by software function link selection. When enabled, this feature locks out autoreclosing, operates output RLY MaintLockout for indication purposes, and triggers a scheme alarm, after a pre-selected number of fault trips (CNS MaintLockout). Please refer to Section 12 - Scheme Alarms - Compound Alarms. The maintenance lockout target is adjustable independently of the maintenance alarm target.

The relay can be made to go to maintenance lockout immediately when the target count has been reached or at the end of the autoreclose cycle when autoreclose in progress has reset. This logic is selected with software function link, 1/C, M LCK IMM, see Section 8.1.

There is also logic in the relay to obtain an IDMT trip as the last trip before lockout for maintenance lockout. The relay will block instantaneous protection at the target counter setting, N, and at N+1 the relay will lockout. This logic is enabled when software function link, 2/8, ML EFF BLOCKINST, is set to 1, see Section 8.2.

To reset from maintenance lockout first the maintenance counter register has to be reset to zero as described in Section 2.2. Once the condition which caused the lockout is no longer active, the relay can be reset by any of the methods described in Section 2.8. Note, the 'maintenance lockout' alarm message on the LCD display can then be reset by pressing the [0] reset key on the front of the relay for 1s when lockout has been reset. Note, after resetting from lockout the red led starts to flash indicating to the operator that the alarm message can be reset. The reset of alarm messages can also be done over K-Bus from selecting Reset Alarms in the ALARMS menu.

2.4 Autoreclose initiation inhibit for a pre-selected time TMR Mancl AR Inh, following manual CB closing

The KVTR102 will inhibit autoreclose initiation for the manual close inhibit time following the manual closing of a CB. The autoreclose inhibit can be independently enabled or disabled by software function link, 1/7, MC AR INH, see Section 8.1. Relay logic can be enabled to send the relay to lockout following a switch onto a fault condition and for the trip to be IDMT by blocking the instantaneous protection for a switch onto fault condition. These options are selectable using software function links, 2/9 and 2/7, ARINH LOCK and ARINH BLOCKINST, see Section 8.2. The protection relay needs a small time delay to

recognise a block instantaneous protection signal from the KVTR. Thus, to avoid delaying the instantaneous protection, for a switch onto fault, the output RLY Block Inst will be on when the CB is open when function link 2/7 ARINH BLOCKINST is set to 1.

2.5 Lockout

There is an option to be able to pulse certain outputs, mainly concerning lockout, in the KVTR102 using the timer TMR Lockout. The output masks which can be pulsed are RLY MaintLockout, RLY Maint Alarm, RLY Exc Flt Frq, RLY CB Failclose, and RLY A/R Lockout. The software function link, 1/6 PULSED LOCKOUT, when set to 1 is used to select a pulsed output, see Section 8.1. Note, the alarm messages and control outputs are not pulsed for these functions and can be reset in the normal way.

There is also logic in the relay so that any protection initiating autoreclose via the KVTR INP Main Protn or INP Sensitive EF when in non auto and live line modes will cause the relay to go to lockout. This feature is enabled when software function link, 2/A, PROT LOCK, is set to 1, see Section 8.2.

When the reclose is prevented by the springs not being charged or no check synchronising the KVTR will go to lockout giving a 'Lockout' message plus a 'Low Gas/Springs Not Charged' or 'No Check Synchronising' alarm message.

2.6 Excessive fault frequency lockout

This is enabled by software function link selection. When enabled, this feature locks out auto reclosing and operates output RLY Exc Flt Frq for indication purposes, if a pre-selected number of fault trips (CNS Exc Flt Frq) occurs during a short period (TMR Exc Flt Frq), such as may happen during a severe lightning storm. Once the KVTR has locked out the excessive fault frequency counter resets to zero and can be reset from lockout by one of the methods described in Section 2.8.

There is also logic in the relay to obtain an IDMT trip as the last trip before lockout for excessive fault frequency. The relay will block instantaneous protection at the target counter setting, N, and at N+1 the relay will lockout. This logic is enabled when software function link 2/8, ML EFF BLOCKINST, is set to 1, see Section 8.2.

2.7 Delayed manual close

A delayed manual close facility is included in the relay, allowing an operator to press a button to initiate a CB close operation, then retire to a safe distance before the CB actually closes, in case it closes on to a pre-existing fault.

The KVTR logic is arranged so that if the INP Main Protn is energised when the CB is open then the KVTR will initiate a delayed CB close. In the scheme shown in Figure 1 the INP Main Protn is energised from the 'trip and autoreclose test' switch connected to the KCGG to perform this function. Note, the KVTR must be in the auto mode and the INP Inst Protn connected to the start contacts of the KCGG must not be energised to perform this function. A manual close via the relay front interface or remotely over K-Bus can also be done in parallel with the INP Main Protn initiation from a user control, USR ManCls.

The manual close time delay is set by the manual close timer (TMR Manual Close) on the KVTR relay. After initiating a manual close on the KVTR the output RLY Block

InstPr will be energised to block the instantaneous elements of the KCGG relay for the reclaim time delay.

The KVTR input INP Inst Protn should be masked to the low set protection of the KCGG, RLY I>/Io>, as it is used as a fault current indicator to the KVTR. If the INP Inst Protn is masked to high set protection on the KCGG or is not connected, it would be possible to trigger an unwanted reclosure of an open CB by unintentional activation of the KVTR INP Main Protn. To overcome this, scheme function link, 2/5, MANCLS, is used to enable/disable the INP Main Protn initiation of manual closing.

2.8 Reset from lockout

Once the condition which caused the lockout is no longer active, the relay can be reset by any of the following methods:-

- a) automatically after time TMR Mancl AR Inh after CB manual close, if software function link 1/9, AUTO RES LCK, is set to 1.
- b) automatically after time TMR Autoreset, irrespective of CB operation, if software function link 1/8, TIM RES LCK, is set to 1.
- c) user control USR ResetLockout.
- d) logic input INP ResetLockout, if mask selected to an opto input.
- e) selecting non auto mode, if software function link 2/B, NONAUTO RESETLCK, is set to 1.

2.9 Omit first shot of programmed cycle if selected protection operates

This feature is enabled by setting input masks such that logic input INP Omit 1st Sht is activated by the same opto input as the selected protection. This allows the relay to give a high speed auto reclose following, say, instantaneous protection operation, or a delayed auto reclose following time delayed protection operation.

2.10 Successful auto-reclose indication

This operates output RLY A/R Success and control output CTL A/R Success and triggers a scheme alarm if the circuit breaker is closed when the reclaim timer times out to reset the relay. The A/R Success indication resets at the next circuit breaker trip, or can be reset via logic input INP Reset Indicn (if mask selected), or user input USR Reset Indicn, or by resetting lockout without waiting for the circuit breaker to trip.

The output contact RLY A/R Success can be pulsed from TMR A/R Success, if software function link 2/C, PULSE A/R SUCCESS, is set to 1. The alarm message and control output are not pulsed and can be reset by resetting indications or lockout as described above.

2.11 CB failed to close alarm

This operates output RLY CB Failclose and control output CTL CB Failclose and triggers a scheme alarm and lockout, if the circuit breaker does not close within a period equal to TMR Close Pulse setting when the signal RLY CB Close Sig is given. Please refer to Section 12 - Scheme Alarms - Compound Alarms.

The alarm output resets when the circuit breaker is closed manually, or can be

reset via logic input INP Reset Indicn (if mask selected), or user input USR Reset Indicn, or by resetting lockout without closing the circuit breaker. The scheme lockout condition cannot be reset until the CB Failed alarm has been reset.

2.12 Input mode selection

Contacts on external equipment providing some of the input signals to the KVTR102 can be either normally open or normally closed; the logic being adjusted as required by software logic function link settings. The selectable inputs are listed below.

INP CB AuxSwitch, selected by Scheme Fn Link 1/0 = 1 or 0.

INP Spring Charg, selected by Scheme Fn Link 1/1 = 1 or 0.

INP Safe toClose, selected by Scheme Fn Link 1/2 = 1 or 0.

INP Block AR, selected by Scheme Fn Link 1/3 = 1 or 0.

Please refer to Section 8.1 for more information.

2.13 Auto reclose without protection operation

If Scheme Fn Link 1/4, INI CB TRIP, is set to 1, an auto reclose cycle can be initiated by any CB trip, without reference to protection, which may be useful during testing or commissioning.

2.14 Auto reclose initiation with CB initially open

If Scheme Fn Link 1/5, INI CB OPN, is set to 1, an auto reclose cycle can be initiated by protection operation even if the CB is initially open, which may be useful during testing or commissioning.

2.15 Dead time start without protection reset

If Scheme Fn Link 1/F, STDT CB TR, is set to 1, the dead time starts as soon as the CB trips, without waiting for the protection to reset. This option may be preferred if the protection does not have a fast consistent reset time.

2.16 First reclosure without system check

If Scheme Fn Link 2/0, HSAR NO SC, is set to 1, the first reclose attempt, after Dead Time 1, is made without checking for a "safe to close" signal. This may be preferred when high speed reclosing is applied (TMR Dead Time 1 < 1.00 s), to avoid the extra delay which may be inherent in an external synchronism check relay. Subsequent reclose attempts in a multi-shot autoreclose cycle will still require a "safe to close" signal.

2.17 Maintained close pulse

If Scheme Fn Link 1/D, FULL CL PLS, is set to 1, the CB close signal is not cut off when the CB closes, but is maintained for the set TMR Close Pulse time, which may be necessary for some types of CB closing mechanism. The scheme includes anti-pumping logic which will cut off the CB close signal if the protection re-operates or the CB re-trips before the set close pulse time has elapsed.

2.18 Setting changes in or out of service

Scheme Fn Link 2/1, NO SET IN SERV, allows the scheme to be set up so that settings can be changed either

- (i) only when the scheme is switched out of service, i.e. not in auto mode, or
- (ii) with the scheme either in or out of service.

2.19 Fault not cleared alarm

This alarm operates and scheme lockout is triggered if the protection input does not reset within a period equal to TMR Tripfail Time setting following auto reclose initiation. Please refer to Section 12 - Scheme Alarms - Compound Alarms.

The trip fail logic in the KVTR is not breaker fail logic, it is used to prevent the relay from remaining in 'A/R in Progress' for a fail to trip situation, taking the relay to lockout after a time delay 'TripFailTime'. It should be given a time delay longer than the maximum possible protection operation time which initiates autoreclose, usually IDMT protection. This would also include the SEF protection if it was decided to initiate autoreclose from SEF. The logic of the KVTR sends the relay to lockout if the protection inputs remain on longer than the trip fail time when autoreclose is in progress. The relay remains locked out for a trip fail until the breaker trips and the protection has reset or on reset of lockout if the protection has reset.

2.20 Sensitive earth fault

In the application described in this document the SEF protection is a definite time protection that trips the breaker but does not initiate autoreclose. The SEF protection (KCGG to>>) operating time is reduced to zero time during live line working using the to>> set to the required definite time in the Group 1 setting and Group 2 used for to>> = 0. The selector switch contacts are used to energise the KCGG INP Group 2 Settings when live line operating mode is selected. Output contacts on the KCGG relay are used to give an SEF trip and SEF alarm.

A local "SEF Enabled/Disabled" switch is used in the scheme to directly block the to>> sensitive earth fault element of the KCGG relay. The SEF Enabled/Disabled switch is used mainly in live line mode to disable SEF protection to prevent maltripping when maintenance is being done on conductors.

If SEF is required to initiate autoreclose then it can be done by feeding it to the INP Main Protn of the KVTR via the AR Initiate output contact of the KCGG. If a different number of shots and instantaneous trips are required for SEF protection then a second, independently adjustable, shots and instantaneous trips selection is available (CNS SEF Shots, CNS Block InsSEF, CNS Unblk InsSEF). Separate inputs are available to initiate SEF autoreclose (INP Inst SEF, INP Sensitive EF) and there is an output contact to block instantaneous SEF protection RLY Blk SEF Inst. For applications which require a normally closed contact which opens to inhibit tripping, the output relay can be arranged to be normally operated (contact closed), and to reset (contact opens) to block the SEF protection trip output (relay masked to output RLY SEF Inst OK).

2.21 Test trip and autoreclose

In the example scheme described in this document a "trip and autoreclose" test function is used which is initiated locally from a pushbutton. This feature is provided by using the pushbutton to energise the auxiliary 2 timer input on the KCGG relay, INP Aux 2. The timer is set to zero time with its output mask set to energise RL3 and RL4, the protection trip and autoreclose initiate output contacts. With the breaker closed a test trip and autoreclose is performed and with the breaker open a delayed manual close can be initiated, see Section 2.7. In the example scheme a remote test trip and autoreclose is initiated through the INP Aux 2 from the SCADA system. If K-Bus is being used then a remote test trip and autoreclose can be done by using the load shed feature to operate an output contact assigned in the RLY V Reduct 1 output mask which is fed into the INP Aux 2.

2.22 Circuit breaker control

The example scheme includes features for remote and local circuit breaker tripping and closing. If the KCGG relay is configured for remote control of the circuit breaker, then a trip or close can be carried out from the SYSTEM DATA column of the menu under SYS CB Control either remotely over K-BUS or locally via the relay front panel. Note, if the CB CONTROL on the master station software is to be used then the master station needs to know the position of the breaker. This indication is given by two auxiliary circuit breaker contacts connected to INP CB Open and INP CB Closed. If K-Bus is not being used a remote trip or close command can be initiated through INP LTripp and INP LClose from interposing relays from the SCADA system. A CB Control switch connected to INP LTripp and INP LClose can also be used in parallel with the remote trip and close inputs for local breaker control. These CB control operations are masked to the outputs RLY CB Tripp and RLY CB Close on the KCGG relay.

In the example scheme if a control trip command is issued at the same time as a protection operation initiates autoreclosing or during the dead time following a fault trip then the autoreclose cycle is blocked and the breaker is not allowed to close. This is done by energising the INP Block AR on the KVTR from a second output contact on the KCGG assigned for RLY CB Tripp.

A telecontrol in/out switch included in the example scheme is used in series with the RLY CB Tripp and RLY CB Close outputs of the KCGG, RL5 and RL6, to inhibit CB operation when the switch is in the 'out' position and enable CB operation when in the 'in' position.

2.23 Co-ordination with other devices

Scheme function link 2/4, SEQCOORD, when set to 1 enables the selection of sequence co-ordination with other protection devices. It allows the INP Inst Protn to advance the sequence count by one and start the dead time if the breaker is open or closed. When the dead time is complete and the INP Inst Protn is off the reclaim timer will be initiated. When function link 2/4 is set to 0 instantaneous protection must be allowed and the breaker has to be tripped to start the deadtime and advance the sequence count by one.

In the example scheme the RLY I>/Io> Start contact of the KCGG relay is used to indicate to the KVTR via the INP Inst Protn when fault current is present. The time delay setting, t>>>/to>>>, of the instantaneous element allows downstream

instantaneous protection to clear the fault. If the fault is not cleared then the KCGG instantaneous element will clear it after the $t_{>>>}/t_{o>>>}$ time delay. If the fault is cleared by downstream protection the KVTR will advance the count sequence by one, initiate the dead timer and initiate the reclaim timer when the dead time is complete and the INP Inst Protn is off.

The RLY $I_{>}/I_{o>}$ Start of the KCGG is used to advance the sequence count by one and initiate autoreclose for each incident that would have caused tripping but for the $t_{>>>}/t_{o>>>}$ time delay. Thus, the $I_{>>>}$ and $I_{o>>>}$ settings must be greater than or equal to the $I_{>}$ and $I_{o>}$ settings to get sequence co-ordination. Also, if SEF protection is required to initiate autoreclose and to have sequence co-ordination then the SEF current settings must also be equal to or greater than the $I_{>}$ and $I_{o>}$ settings which are used in the co-ordination logic as described above.

2.24 Remote Auto/Non Auto operation modes

Scheme function links 2/2 and 2/3, TELCOMM and PULSET, are used to select the method for remotely setting auto and non auto modes. These function links will only be effective when the mode selection switch is in the telecontrol position so that the INP TeleControl is energised. If K-Bus communications is being used then the most convenient way to change auto and non auto operation modes is with the user commands USR Tel Auto and USR Tel Non Auto. If K-Bus is not being used then a latched or pulsed signal from the SCADA system to the INP Auto could be used for remote selection of auto and non auto operation modes.

If function link $2/2 = 1$ and $2/3 = 0$, then the user commands USR Tel Auto and USR Tel Non Auto are enabled to select operation mode. These user commands are available remotely over K-Bus or locally at the relay front panel under the USER CONTROLS menu heading.

If function links $2/2$ and $2/3 = 0$, then only a latched signal to INP Auto of the KVTR can be used to select the operation mode.

If function link $2/2 = 0$ and $2/3 = 1$, then only a pulsed signal to INP Auto of the KVTR can be used to select the operation mode. A pulse signal to INP Auto will toggle the operation mode between auto and non auto.

If function links $2/2$ and $2/3 = 1$, then neither latched or pulsed signals will change the operating mode but the user commands are available. The logic was arranged in this way as a conscious decision has to be made to set the user controls by going into the user control menu selecting USR Tel Auto or USR Tel Non Auto and then pressing the [0] key to select the function. Therefore, only the selection of a pulsed or latched signal to INP Auto via the function links is of concern, and only one of these options can be enabled at a time.

2.25 Default Display

The KVTR102 has four default display options under LOGIC FUNCTIONS, LOG DefaultDsply - Ladder, Description, User ref and Counters. Choosing the Ladder option enables the operation modes to be shown as the default display. The default display will thus read as one of the following:

AUTO RECLOSE MODE

NON AUTO MODE

LIVE LINE MODE

When an alarm is initiated the default display is overwritten by the alarm message and returns when the alarm is reset.

SECTION 3. SCHEME INPUTS

The KVTR relay has eight opto-isolator input circuits, but the ladder logic has sixteen inputs. The actual inputs required for any specific application are selected by setting a mask to assign one or more of the opto inputs to each required ladder input. Although most selections are one-to-one, parallel mask settings are possible. A single opto input can activate more than one ladder input, and a single ladder input may be activated by more than one opto input.

The available logic inputs, and the "default" mask settings for the KVTR102 applied in the factory, are given below:-

Display name.	Default mask setting.	Associated opto-input.
INP CB AuxSwitch	0 0 0 0 0 0 0 1	Opto 0
INP Inst Protn	0 0 0 0 0 0 1 0	Opto 1
INP Main Protn	0 0 0 0 0 1 0 0	Opto 2
INP Spring Chrg	0 0 0 0 1 0 0 0	Opto 3
INP Safe toClose	0 0 0 0 0 0 0 0	None
INP Non AR Protn	0 0 0 0 0 0 0 0	None
INP Block AR	0 0 0 1 0 0 0 0	Opto 4
INP ResetLockout	0 0 0 0 0 0 0 0	None
INP Reset Indicn	0 0 0 0 0 0 0 0	None
INP Reset M Cntr	0 0 0 0 0 0 0 0	None
INP Omit 1st Sht	0 0 0 0 0 0 0 0	None
INP TeleControl	0 0 1 0 0 0 0 0	Opto 5
INP Auto	0 1 0 0 0 0 0 0	Opto 6
INP Live Line	1 0 0 0 0 0 0 0	Opto 7
INP Inst SEF	0 0 0 0 0 0 0 0	None
INP Sensitive EF	0 0 0 0 0 0 0 0	None

The available logic inputs, and the "default" mask settings for the KCGG140 applied in the factory, are given below:-

Display name.	Default mask setting.	Associated opto-input.
INP Block to>	0 0 0 0 0 0 0 0	None
INP Block to> >	0 0 0 0 0 0 1 0	Opto 1
INP Block to>>>	0 0 0 0 0 1 0 0	Opto 2
INP Block t>	0 0 0 0 0 0 0 0	None
INP Block t>>	0 0 0 0 0 0 0 0	None
INP Block t>>>	0 0 0 0 0 1 0 0	Opto 2

INP CB Open CLP	0 0 0 0 0 0 0 0	None
INP Aux1	0 0 0 0 0 0 0 0	None
INP Aux2	0 0 0 1 0 0 0 0	Opto 4
INP Aux3	0 0 0 0 0 0 0 0	None
INP Stg Grp2	0 0 0 0 0 0 0 1	Opto 0
INP CB Closed	0 1 0 0 0 0 0 0	Opto 6
INP CB Open	1 0 0 0 0 0 0 0	Opto 7
INP CB to Bus2	0 0 0 0 0 0 0 0	None
INP LTrip CB	0 0 1 0 0 0 0 0	Opto 5
INP LClose CB	0 0 0 0 1 0 0 0	Opto 3

SECTION 4. USER INPUTS

Up to sixteen user inputs are available through the user interface of the KVTR (relay keypad or remote control via K-bus). Please refer to Service Manual R8505D Sections 5.1.2 and 6.1.2 for details. The standard KVTR102 scheme includes four user inputs as follows:-

Display name.	Effect in scheme logic.
USR Tel Auto	Select Autoreclose operating mode.
USR Tel Non Auto	Select Non Autoreclose operating mode.
USR Manual Close	Manual close of the CB.
USR ResetLockout	Reset scheme lockout.
USR Reset Indicn	Reset "Successful AR" or "CB Failed to Close" alarm.

SECTION 5. SCHEME OUTPUTS

The KVTR and KCGG relays have eight output relays each with one normally open contact, plus a watchdog output with one normally open and one normally closed contact. The KVTR and KCGG application software has sixteen logic outputs. The actual outputs required for any specific application are selected by setting a mask to assign one or more of the output relays to each required logic output. Although most selections are one-to-one, parallel mask settings are possible. A single output relay may be activated by more than one logic output, and a single logic output can activate more than one output relay.

The available logic outputs, and the "default" mask settings for the KVTR applied in the factory, are given below:-

Display name	Default mask setting	Associated output relay
RLY A/R in Prog	0 0 0 0 0 0 0 1	RL 0
RLY CB Close Sig	0 0 0 0 0 0 1 0	RL 1
RLY AR Available	0 0 0 0 0 0 0 0	None
RLY Block InstPr	0 0 0 0 1 0 0 0	RL 3

RLY Maint Alarm	0 0 0 1 0 0 0 0	RL 4
RLY MaintLockout	0 0 1 0 0 0 0 0	RL 5
RLY Exc Flt Frq	0 0 1 0 0 0 0 0	RL 5
RLY CB Failclose	0 0 1 0 0 0 0 0	RL 5
RLY Live Line	0 0 0 0 0 0 0 0	None
RLY A/R Lockout	0 0 1 0 0 0 0 0	RL 5
RLY Auto Mode	1 1 0 0 0 0 0 0	RL 6, 7
RLY OutOfService	0 0 0 0 0 1 0 0	RL 2
RLY Enable Inst	0 0 0 0 0 0 0 0	None
RLY Blk SEF Inst	0 0 0 0 0 0 0 0	None
RLY SEF Inst OK	0 0 0 0 0 0 0 0	None
RLY A/R Success	0 0 0 0 0 0 0 0	None

The available logic outputs, and the default mask settings for the KCGG applied in the factory, are given below:-

Display name	Default mask setting	Associated output relay
RLY to>	0 0 0 1 1 0 0 0	RL 3,4
RLY to>>	1 0 0 0 1 0 0 0	RL 3,7
RLY to>>>	0 0 0 1 1 0 0 0	RL 3, 4
RLY l> Fwd	0 0 0 0 0 0 0 1	RL 0
RLY t>	0 0 0 1 1 0 0 0	RL 3, 4
RLY t>>	0 0 0 0 0 0 0 0	None
RLY t>>>	0 0 0 1 1 0 0 0	RL 3, 4
RLY Aux1	0 0 0 0 0 0 0 0	None
RLY Aux2	0 0 0 1 1 0 0 0	RL 3, 4
RLY Aux3	0 0 0 0 0 0 0 0	None
RLY V Reduct 1	0 0 0 0 0 1 0 0	RL2
RLY V Reduct 2	0 0 0 0 0 0 0 0	None
RLY V Reduct 3	0 0 0 0 0 0 0 0	None
RLY CB Close	0 1 0 0 0 0 0 0	RL 6
RLY CB Trip	0 0 1 0 0 0 1 0	RL 1, 5

SECTION 6. CONTROL OUTPUTS

Up to sixteen control outputs are available on the KVTR for relay status indications through the user interface. Please refer to Service Manual R8505D Sections 5.1.1 (System data, cell 000D - SYS control status), 5.1.3 and 6.2.2. The standard KVTR102 scheme provides sixteen control outputs, as follows:-

Display name	Scheme logic status
CTL DT In Prog	Dead time in progress
CTL Rcl In Prog	Reclaim time in progress
CTL A/R Lockout	Scheme lockout
CTL Maint Alarm	Maintenance alarm (Pre-lockout warning)
CTL MaintLockout	Maintenance lockout
CTL Block InstPr	Block non-discriminating protection (eg. low set inst OC or EF)
CTL Exc Flt Frq	Excessive fault frequency
CTL OutofService	AR switched out of service
CTL CB Failclose	CB failed to close
CTL Non Auto	Non auto operating mode
CTL ARinProgress	AR cycle in progress - initiation to reset or lockout
CTL ManCl AR Inh	AR initiation inhibit after manual CB close
CTL Blk SEF Inst	Block instantaneous SEF tripping
CTL A/R Success	Successful auto reclose
CTL Auto Reclose	Auto operating mode
CTL Live Line	Live Line operating mode

SECTION 7. PLANT STATUS OUTPUTS

Please refer to Service Manual R8505D, Sections 5.1.1 (system data, cell 000C - SYS plant status), and 6.2.3 and R8501E Section 5.1.1. The standard KCGG140 and KVTR102 scheme includes only one plant status output, CB1, showing the position of the circuit breaker.

SECTION 8. SOFTWARE LOGIC FUNCTIONS

Up to 32 logic functions can be included in K-series auto reclose relays. Please refer to Service Manual R8505D Sections 5.1.11 (cells 0A01 - Scheme Fn Links 1, & 0A02 - Scheme Fn Links 2), 5.2.4 and 6.5, for general information. Logic functions in KVTR102 application software are:-

8.1 Menu Cell 0A01 - Scheme Fn Links 1

Bit No.	Display	Effect in scheme logic
0	CBAUX = 52A	0 = INP CB AuxSwitch OFF = CB closed (52b contact) 1 = INP CB AuxSwitch ON = CB closed (52a contact)
1	IN3 ON = SPRCHG	0 = INP Spring Charg OFF = spring charged 1 = INP Spring Charg ON = spring charged
2	IN4 ON = SYN OK	0 = INP Safe toClose OFF = system OK to close 1 = INP Safe toClose ON = system OK to close
3	IN6 ON = LCKOUT	0 = INP Block AR OFF = drive to lockout 1 = INP Block AR ON = drive to lockout
4	INI CB TR	0 = protn op required to start A/R 1 = A/R start by CB trip (no ref to protn), for testing
5	INI CB OPN	0 = A/R init only if CB is initially closed 1 = A/R init by prot op with CB open or closed (for testing)
6	PULSED LOCKOUT	0 = continuous lockout output signal 1 = pulsed lockout output signal
7	MC AR INH	0 = A/R init enable immediately after CB manual close 1 = A/R init inhibit for TMR Mancl AR Inh after manual close
8	TIM RES LCK	0 = disable unconditional timed auto-reset from lockout 1 = enable unconditional timed auto-reset from lockout
9	AUTO RES LCK	0 = disable manual close timed auto-reset from lockout 1 = enable manual close timed auto-reset from lockout
A	EX FLT FRQ	0 = disable excessive fault frequency logic 1 = enable excessive fault frequency logic
B	M LCK	0 = disable maintenance lockout logic 1 = enable maintenance lockout logic
C	M LCK IMM	0 = maint lockout at end of A/R cycle after target reached 1 = maint lockout immediate when target is reached
D	FULL CL PLS	0 = CB close output cut off when CB closes 1 = CB close output held for set "TMR Close Pulse" time
E	RC TIM RUN ON	0 = reclaim time suspended if inst protection operates 1 = reclaim time continues if inst protection operates
F	STDT CB TR	0 = dead time start when CB tripped and protection reset 1 = dead time start when CB trips, regardless of protection

8.2 Menu Cell 0A02 - Scheme Fn Links 2:

Bit No.	Display	Effect in scheme logic
0	HSAR NO SC	0 = all reclosures require "system OK to close" signal 1 = 1st shot only (after D Time 1) without system check (subsequent shots require "system OK to close")
1	NO SET IN SERV	0 = settings can be changed with scheme in or out of service 1 = settings can be changed only with scheme out of service
2	TELCOMM	0 = disables user commands TelAuto and TelNonauto and allows latched INP Auto to select Auto and NonAuto modes remotely 1 = enables user commands TelAuto and TelNonauto
3	PULSET	0 = disables pulsed operation via INP Auto 1 = allows a pulsed INP Auto to toggle select Auto and NonAuto modes remotely
4	SEQCOORD	0 = disables sequence co-ordination with other protection 1 = enables sequence co-ordination with other protection
5	MANCLS	0 = disables a manual close via INP main protn 1 = enables a manual close via INP main protn
6	NONAUTO BLOCKINS	0 = disables the RLY Block InstPr when in NON AUTO mode 1 = enables the RLY Block InstPr when in NON AUTO mode
7	ARINH BLOCKINST	0 = no instantaneous protection block following a manual close 1 = blocks instantaneous protection following a manual close
8	ML EFF BLOCKINST	0 = no instantaneous protection block for maintenance lockout and excessive fault frequency 1 = blocks instantaneous protection for last trip of maintenance lockout and excessive fault frequency
9	ARINH LOCK	0 = no lockout for a manual close onto fault condition 1 = lockout for a manual close onto fault condition
A	PROT LOCK	0 = no lockout for a protection operation in non auto and live line 1 = INP Main Protn initiates a lockout in non auto and live line
B	NONAUTO RESETLCK	0 = Non auto mode does not reset lockout 1 = Non auto mode resets lockout
C	PULSE AR SUCCESS	0 = continuous output signal for A/R success 1 = pulsed output signal for A/R success
D	MAINT ALARM	0 = maintenance alarm is disabled 1 = maintenance alarm is enabled

The default factory settings for the scheme function links are:

Scheme Fn Lnks 1:	<u>0 0 0 0 1 1 1 0 1 1 0 0 1 0 1 1</u>
	F E D C B A 9 8 7 6 5 4 3 2 1 0
Scheme Fn Lnks 2:	<u>0 0 1 0 0 1 1 1 1 1 1 1 1 0 0 0</u>
	F E D C B A 9 8 7 6 5 4 3 2 1 0

SECTION 9. TIMER SETTING RANGES

Please refer to Service Manual R8505D, Sections 5.1.9 and 6.6 for general details. The timers used in the KVTR102 scheme are:

Display name	Description	Setting limits	
		Min	Max
TMR Dead Time 1	1st shot dead time	0.01s	300s
TMR Dead Time 2	2nd shot dead time	1.00s	300s
TMR Dead Time 3	3rd shot dead time	1.00s	9999s
TMR Dead Time 4	4th shot dead time	1.00s	9999s
TMR Close Pulse	Maximum duration of CB close signal	0.01s	10s
TMR Reclaim Time	Reclaim time	1.00s	600s
TMR SynCh Window	Maximum waiting time for safe to close signal at end of dead time. Lockout if not received	0.01s	600s
TMR SprCh Window	Maximum waiting time for spring charged signal at end of dead time. Lockout if not received.	0.01s	600s
TMR Mancl AR Inh	Auto reclose initiation inhibit period following CB manual close	0.01s	300s
TMR TripfailTime	Maximum waiting time for CB trip + protection reset following A/R initiation by protection operation	0.01s	300s
TMR Exc Flt Frq	Fault trip counting period for excess flt freq logic	1.00s	9999s
TMR Autoreset	Setting for time delayed auto-reset from lockout	1.00s	9999s
TMR Lockout	Pulsed output time for Lockout & Maintenance alarm (see Section 2.5)	0.01s	9999s
TMR Manual Close (see Section 2.7)	Manual Close Timer 0.01s	300s	
TMR A/R Success	Pulsed output time for A/R Success	0.01s	300s

Please refer to Service Manual R8501E, Sections 3.4 and 5.4 for general details. The timers used in the KCGG140 scheme are:

Display name	Description	Setting limits	
		Min	Max
TMR Aux 1	Auxiliary timer 1	0.00s	14.4ks
TMR Aux 2	Auxiliary timer 2	0.0s	14.4ks
TMR Aux 3	Auxiliary timer 3	0s	14.4ks
TMR iCLP	Cold load pick-up timer	0s	14.4ks
TMR iBF	Breaker fail timer	0.01s	10s
TMR iTRIP	Trip pulse timer	0.5s	2s
TMR iCLOSE	Close pulse timer	0.5s	2s
TMR iRESTORE	Restoration timer	0.00s	100s
TMR to>/t>	Timer for first current threshold	0.00s	100s
TMR to>>/t>>>	Timer for second current threshold	0.00s	100s
TMR to>>>/t>>>>	Timer for third current threshold	0.00s	10s
TMR iRESET	Reset timer	0.0s	60s
TMS	Time multiplier setting	0.025	1.20

SECTION 10. PROTECTION SETTING RANGES

Please refer to Service Manual R8501E, Sections 3.4.1.4 and 5.3 for general details. The overcurrent settings used in the KCGG140 scheme are:

Display name	Description	Setting limits	
		Min	Max
I>	First stage fault current threshold	0.08 In	3.2 In
Io>	First stage earth fault current threshold	0.02 In	0.8 In
I>>	Second stage fault current threshold	0.08 In	32 In
Io>>	Second stage earth fault current threshold	0.02 In	8.0 In
I>>>	Third stage fault current threshold	0.08 In	32 In
Io>>>	Third stage earth fault current threshold	0.02 In	8.0 In

SECTION 11. COUNTERS

Please refer to Service Manual R8505D, Section 6.7 for an overview.

11.1 Counter registers (coils/resets)

See Service Manual R8505D, Sections 5.1.14 and 6.12. KVTR102 logic includes four counters, as detailed below.

Display name	Description
Volatile: RST Sequence Cnt	A/R initiations counter, for sequence control
RST ExFltFrq Cnt	Fault trips counter for Excessive Fault Frequency logic
Non-volatile: RST Maint Countr	Fault trips counter for maintenance alarm and lockout
RST Total Reclos	Total reclose attempts counter

11.2 Counter settings (targets)

See Service Manual R8505D, Sections 5.1.10 and 6.7.1 KVTR102 logic includes counter settings as detailed below.

Display name	Description	Setting limits	
		Min	Max
CNS Shots	Maximum auto reclose attempts before lockout	1	4
CNS Block Inst	Permitted number of instantaneous trips	0	5
CNS Maint Alarm	Number of fault trips to maintenance alarm	1	9999
CNS MaintLockout	Number of fault trips to maintenance lockout	1	9999
CNS Exc Flt Freq	Fault trips target for Excessive Fault Freq logic	1	9999
CNS SEF Shots	Maximum A/R attempts for Sensitive EF initiation	0	4
CNS Block InsSEF	Permitted number of instantaneous SEF trips	0	5
CNS Unblock Inst	Number of trips before instantaneous protection is reinstated	0	5
CNS Unblk InsSEF	Number of trips before SEF instantaneous protection is reinstated	0	5

11. 3 Counter values (messages)

See Service Manual R8505D, Sections 5.1.6 and 6.10. Counter messages in the KVTR102 are given below.

Display name	Description
CNV Total Reclos	Total reclose attempts (RST Total Reclos - 0)
CNV ShotstoM.Lck (CNS MaintLockout - RST Maint Countr)	Fault trips remaining before maintenance lockout.

SECTION 12. SCHEME ALARMS

Please refer to Service Manual R8505D, Sections 2.4.1, 5.1.7 and 6.9, for an overview. Scheme alarms provided by the KVTR102 are described below.

Status 1 alarms - red LED continuous:

Auto reclose in progress, from initiation to reset or lockout.

Delayed manual cls in progress (operates from INP Main Protn or USR Mancls initiation to end of manual close time delay)

Excessive fault frequency

Auto reclose lockout

Compound alarms - red LED flashing:

Fault not cleared (protection failed to reset after A/R initiation by protection operation).

Maintenance lockout.

CB failed to close.

Status 2 alarms - amber LED continuous:

Maintenance Alarm

A/R Success

No check synchronising (lockout because TMR SynCh Window time exceeded)

Low gas/springs not charged (lockout because TMR SprCh Window time exceeded)

SECTION 13. EVENT RECORDS

Please refer to Service Manual R8505D, Sections 2.6.1, 5.1.4 and 6.10, for an overview. Event records in the KVTR102 are described below.

Records available over communications link:

Message	Associated data
SEQUENCE START TOTAL RECLOSURES	Time tag and counter RST Total Reclose value at start of last auto reclose cycle
SEQUENCE END TOTAL RECLOSURES	Time tag and counter RST Total Reclose value at end of last auto reclose cycle

Records available through local user interface:

Message Associated data

EVR SeqTm: Shots t : n	Total cycle time and number of reclose attempts in last auto reclose cycle
---------------------------	---

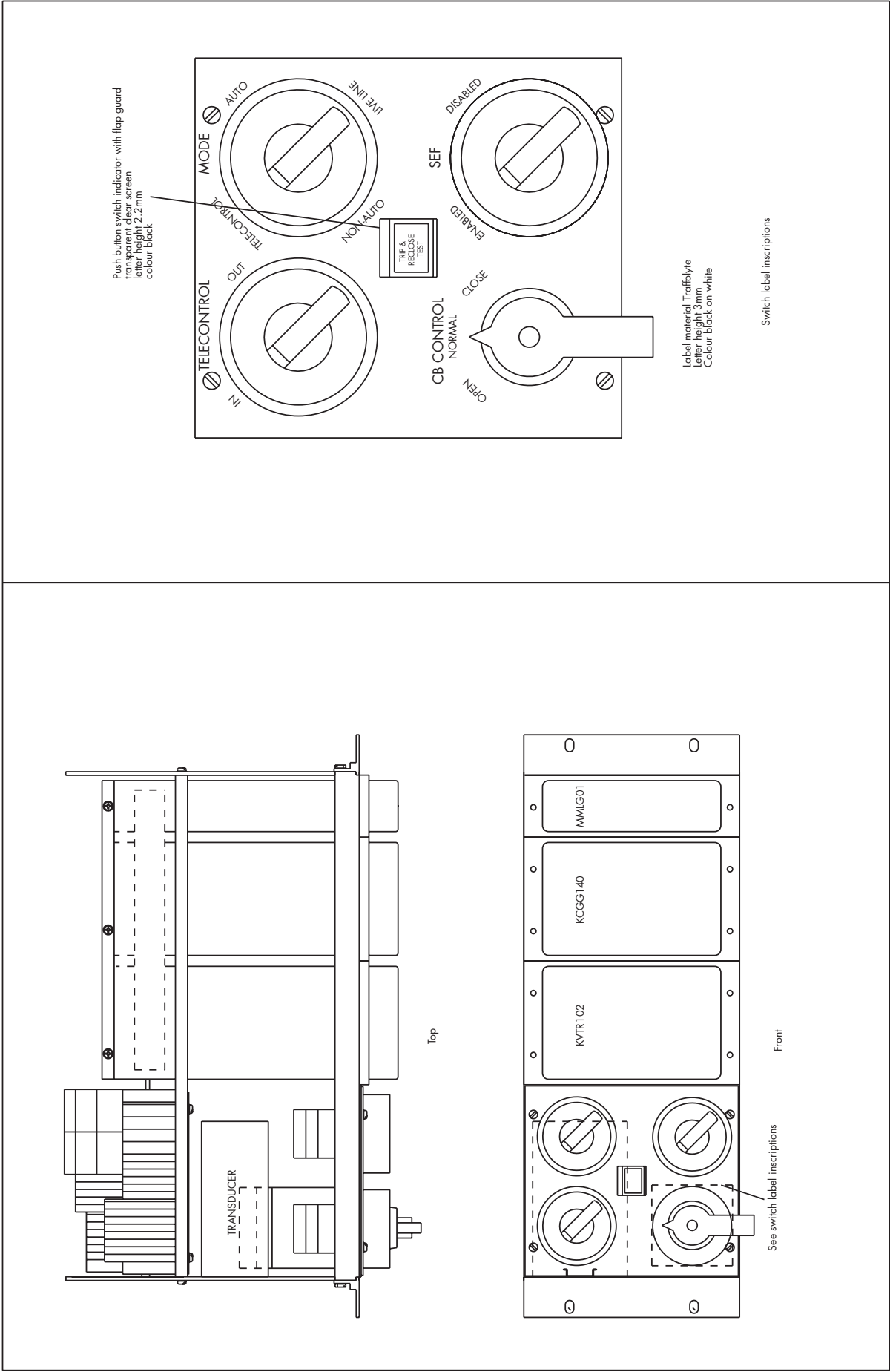


Figure 1. Rack arrangement autoreclose protection

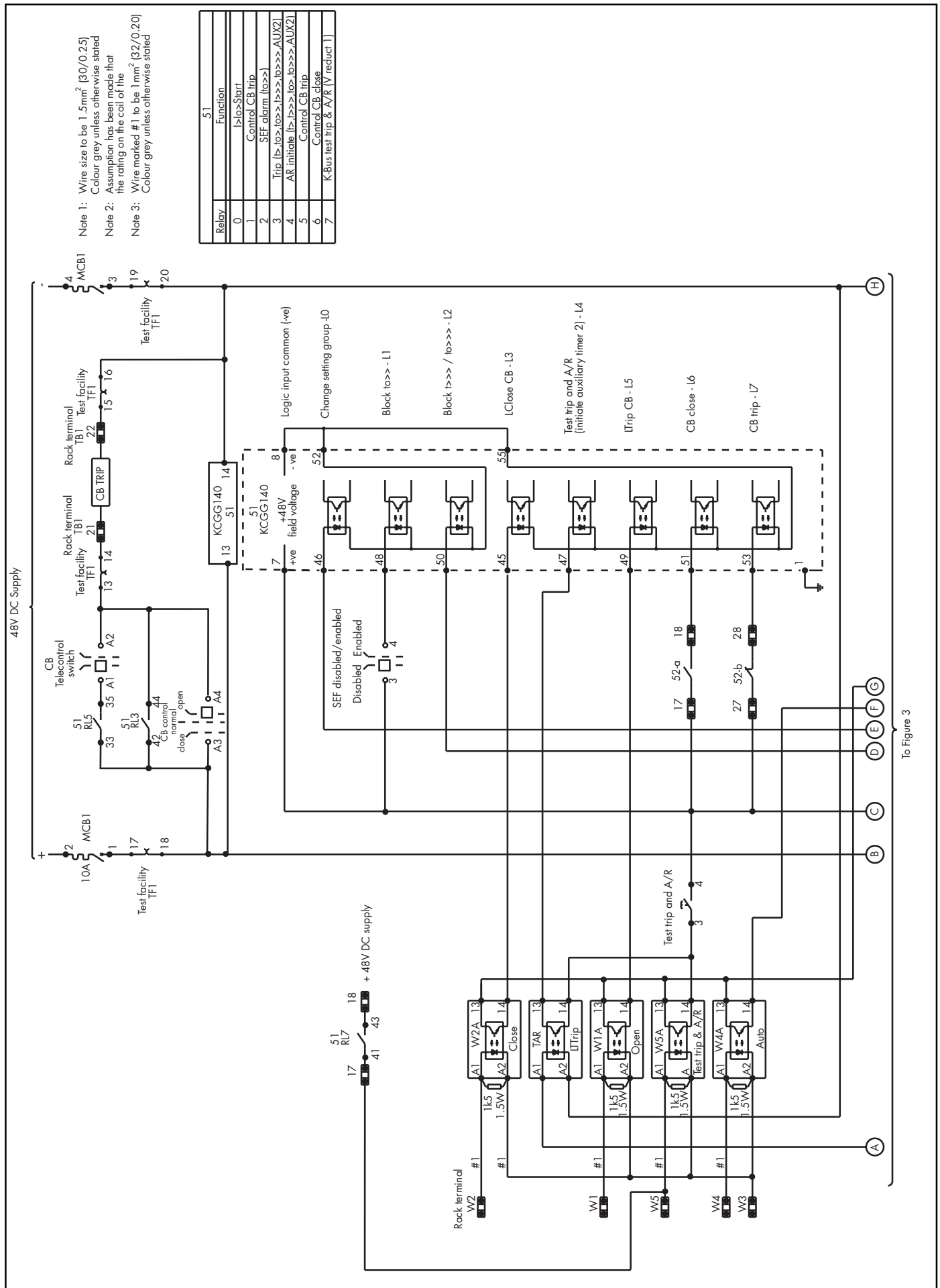


Figure 2. DC circuit diagram autoreclose protection

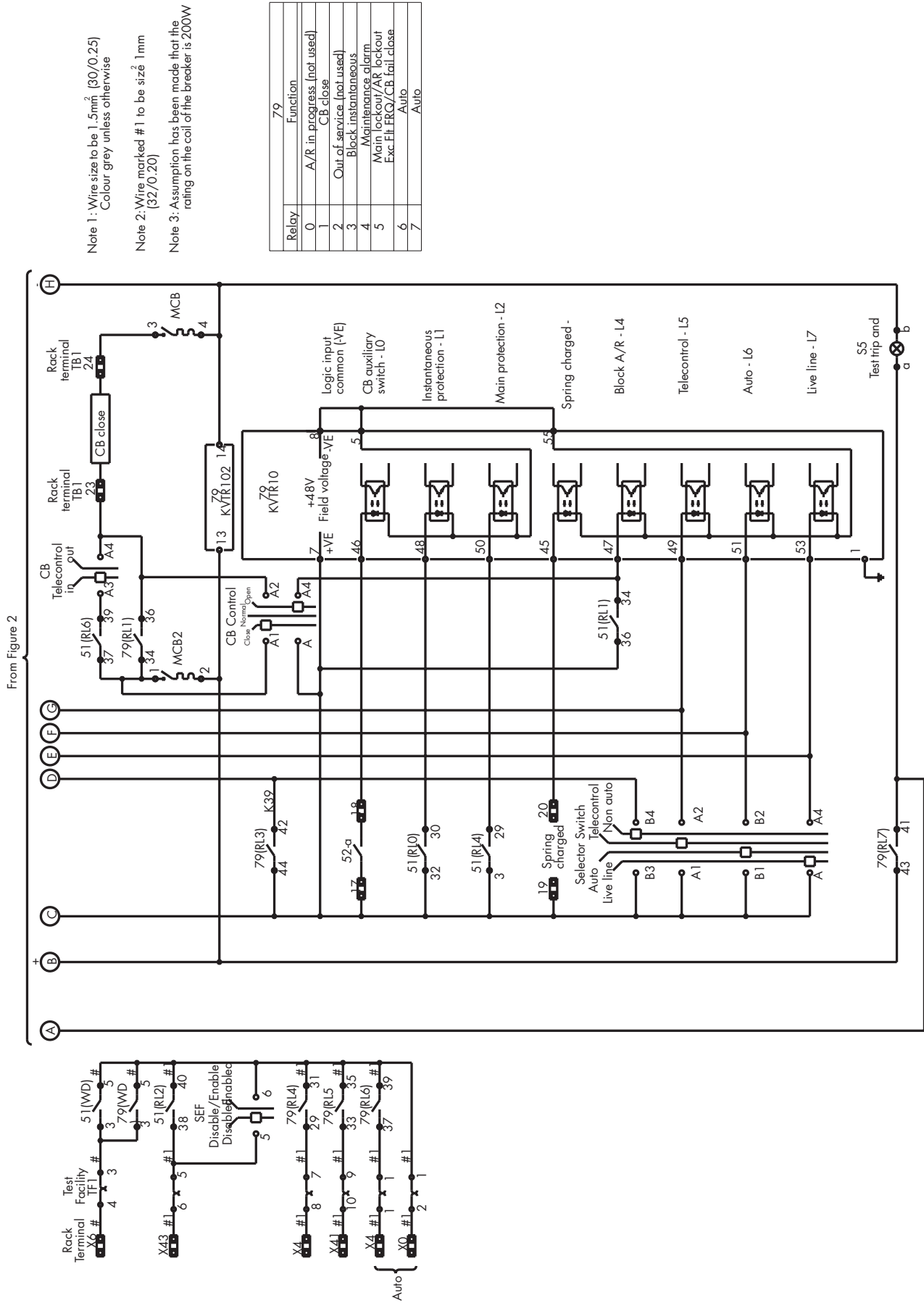


Figure 3. DC circuit diagram autoreclose protection



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