Type KAVR 100

Multi-Shot Auto-Reclose and Check Synchronism Relay

Service Manual

R8507D

HANDLING OF ELECTRONIC EQUIPMENT

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of AREVA T&D products are immune to the relevant levels of electrostatic discharge when housed in their cases. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the following precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are a same electrostatic potential as the equipment by touching the case.

2. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.

3. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.

4. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.

5. Store or transport the module in a conductive bag.

More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 60147-0F.

If you are making measurements on the internal electronic circuitry of an equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap.

Wrist straps should have a resistance to ground between 500k – 10M ohms. If a wrist strap is not available you should maintain regular contact with the case to prevent the build up of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

AREVA T&D strongly recommends that detailed investigations on the electronic circuitry, or modification work, should be carried out in a Special Handling Area such as described in BS5783 or IEC 60147-0F.

CONTENT

1. SAFETY SECTION

This Safety Section should be read before commencing any work on the equipment.

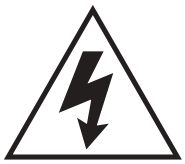
1.1 Health and safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

1.2 Explanation of symbols and labels

The meaning of symbols and labels may be used on the equipment or in the product documentation, is given below.

Caution: refer to product documentation



Caution: risk of electric shock

Protective/safety *earth terminal

Functional *earth terminal

Note: This symbol may also be used for a protective/safety earth terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.

*NOTE: THE TERM EARTH USED THROUGHOUT THE PRODUCT DOCUMENTATION IS THE DIRECT EQUIVALENT OF THE NORTH AMERICAN TERM GROUND.

2. INSTALLING, COMMISSIONING AND SERVICING

Equipment connections

Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electrical shock or energy hazards.

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

Before energising the equipment it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment earth may cause a safety hazard.

The recommended minimum earth wire size is $2.5mm^{2,}$ unless otherwise stated in the technical data section of the product documentation.

Before energising the equipment, the following should be checked:

- Voltage rating and polarity;
- CT circuit rating and integrity of connections;
- Protective fuse rating;
- Integrity of earth connection (where applicable)
- Remove front plate plastic film protection
- Remove insulating strip from battery compartment

3. EQUIPMENT OPERATING CONDITIONS

The equipment should be operated within the specified electrical and environmental limits.

3.1 Current transformer circuits

Do not open the secondary circuit of a live CT since the high level voltage produced may be lethal to personnel and could damage insulation.

3.2 External resistors

Where external resistors are fitted to relays, these may present a risk of electric shock or burns, if touched.

3.3 Battery replacement

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity, to avoid possible damage to the equipment.

3.4 Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

3.5 Insertion of modules and pcb cards

These must not be inserted into or withdrawn from equipment whist it is energised since this may result in damage.

3.6 Fibre optic communication

Where fibre optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

4. OLDER PRODUCTS

Electrical adjustments

Equipments which require direct physical adjustments to their operating mechanism to change current or voltage settings, should have the electrical power removed before making the change, to avoid any risk of electrical shock.

Mechanical adjustments

The electrical power to the relay contacts should be removed before checking any mechanical settings, to avoid any risk of electric shock.

Draw out case relays

Removal of the cover on equipment incorporating electromechanical operating elements, may expose hazardous live parts such as relay contacts.

Insertion and withdrawal of extender cards

When using an extender card, this should not be inserted or withdrawn from the equipment whilst it is energised. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

Insertion and withdrawal of heavy current test plugs

When using a heavy current test plug, CT shorting links must be in place before insertion or removal, to avoid potentially lethal voltages.

5. DECOMMISSIONING AND DISPOSAL

Decommissioning: The auxiliary supply circuit in the relay may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the relay (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

Disposal: It is recommended that incineration and disposal to water courses is avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of lithium batteries.

6. TECHNICAL SPECIFICATIONS

Protective fuse rating

The recommended maximum rating of the external protective fuse for this equipment is 16A, Red Spot type or equivalent, unless otherwise stated in the technical data section of the product documentation.

Insulation class:	IEC 601010-1 : 1990/A2 : 2001 Class I EN 61010-1: 2001 Class I	This equipment requires a protective (safety) earth connection to ensure user safety.
Insulation Category (Overvoltage):	IEC 601010-1 : 1990/A2 : 1995 Category III EN 61010-1: 2001 Category III	Distribution level, fixed insulation. Equipment in this category is qualification tested at 5kV peak, 1.2/50µs, 500Ω, 0.5J, between all supply circuits and earth and also between independent circuits.
Environment:	IEC 601010-1 : 1990/A2 : 1995 Pollution degree 2 EN 61010-1: 2001 Pollution degree 2	Compliance is demonstrated by reference to generic safety standards.
Product Safety:	72/23/EEC	Compliance with the European Commission Low Voltage Directive.
CE	EN 61010-1: 2001 EN 60950-1: 2002	Compliance is demonstrated by reference to generic safety standards.

PURPOSE OF THIS MANUAL

This manual is intended as a guide to the setting procedures for the KAVR 100 multi-shot auto-reclose and check synchronism relay. It explains the optional features of this relay and how they may be selected.

Some of the options involve the use of the serial communication channel but only the setting up of the relay for these functions is covered in this document, together with some notes on the operation of these functions within the relay. The external connection to the serial port is discussed fully in the service manual for communications.

The remainder of the manual deals with installation, commissioning and mainetance of the relay.

RELAYS COVERED BY THIS MANUAL

KAVR 100 Combined autoreclose and check synchronism relay.

Standard model KAVR 100 01 and variant KAVR 100 02.

CONTENT

1. HANDLING AND INSTALLATION

1.1 General considerations

1.1.1 Receipt of relays

Protective and control relays, although generally of robust construction, require careful treatment prior to installation on site. Upon receipt, relays should be examined immediately, to ensure no damage has been sustained in transit. If damage has been sustained during transit, a claim should be made to the transport contractor, and an AREVA T&D representative should be promptly notified. Relays that are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags.

1.1.2 Electrostatic discharge (ESD)

The relays use components that are sensitive to electrostatic discharges. The electronic circuits are well protected by the metal case and the internal module should not be withdrawn unnecessarily. When handling the module outside its case, care should be taken to avoid contact with components and electrical connections. If removed from the case for storage, the module should be placed in an electrically conducting anti static bag.

There are no setting adjustments within the module and it is advised that it is not unnecessarily disassembled. Although the printed circuit boards are plugged together, the connectors are a manufacturing aid and not intended for frequent dismantling; in fact considerable effort may be required to separate them. Touching the printed circuit board should be avoided, since complementary metal oxide semiconductors (CMOS) are used, which can be damaged by static electricity discharged from the body.

1.2 Handling of electronic equipment

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits are completely safe from electrostatic discharge when housed in the case. Do not expose them to risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.

2. Handle the module by its front plate, frame or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.

3. Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.

4. Place the module on an anti static surface, or on a conducting surface which is at the same potential as yourself.

5. Store or transport the module in a conductive bag.

   If you are making measurements on the internal electronic circuitry of an equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap. Wrist straps should have a resistance to ground between 500k – 10M. If a wrist strap is not available, you should maintain regular contact with the case to prevent a build-up of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

   More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 60147-OF. It is strongly recommended that detailed investigations on electronic circuitry, or modification work, should be carried out in a Special Handling Area such as described in the afore-mentioned BS and IEC documents.

1.3 Relay mounting

Relays are dispatched, either individually, or as part of a panel/rack assembly. If loose relays are to be assembled into a scheme, then construction details can be found in publication R7012. If an MMLG test block is to be included it should be positioned at the right hand side of the assembly (viewed from the front). Modules should remain protected by their metal case during assembly into a panel or rack. The design of the relay is such that the fixing holes are accessible without removal of the cover. For individually mounted relays, an outline diagram is normally supplied showing the panel cut-outs and hole centres. These dimensions will also be found in publication R6003.

1.4 Unpacking

Care must be taken when unpacking and installing the relays so that none of the parts is damaged, or the settings altered and they must at all times be handled by skilled persons only. The installation should be clean, dry and reasonably free from dust and excessive vibration. The site should be well lit to facilitate inspection. Relays that have been removed from their cases should not be left in situations where they are exposed to dust or damp. This particularly applies to installations which are being carried out at the same time as construction work.

1.5 Storage

If relays are not to be installed immediately upon receipt they should be stored in a place free from dust and moisture in their original cartons. Where de-humidifier bags have been included in the packing they should be retained. The action of the de-humidifier crystals will be impaired if the bag has been exposed to ambient conditions and may be restored by gently heating the bag for about an hour, prior to replacing it in the carton.

Dust which collects on a carton may, on subsequent unpacking, find its way into the relay; in damp conditions the carton and packing may become impregnated with moisture and the de-humidifier will lose its efficiency.

Storage temperature –25°C to +70°C.

2. DESCRIPTION

2.1 Application and basic operating sequence

The KAVR100 auto-reclose relay provides multi-shot three phase auto-reclose control with integral synchronism check and voltage monitor, 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.

An auto-reclose cycle is initiated by operation of a protective relay, provided the circuit breaker is closed up to the instant of protection operation, and the dead time (TMR Dead Time 1, 2, 3 or 4) starts when the circuit breaker has tripped and the protection reset.

At the end of the dead time, a CB Close signal is given (output RLY CB Close Sig), provided selected system conditions are satisfied and the circuit breaker is "healthy". (Input INP Spring Charg is a composite signal from the CB, indicating that it is in a fit state to operate, e.g. closing spring charged, gas or oil pressure OK, etc.). 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 retrip, the relay resets at the end of the reclaim time. If the protection re-operates and retrips the circuit breaker before the reclaim time has elapsed, the relay either advances to the next shot in the programmed cycle, or, if all programmed shots have been made, goes to lockout.

2.2 Main operating features

2.2.1 Selection in and out of service

The scheme can be switched in or out of service (Auto-reclosing On and Off), either by activating input masks INP RemSw Inserv and INP RemSw Outsrv, if assigned to opto inputs, or by user controls USR Switch inSrv or USR Sw outofServ, via relay user interface or K-Bus.

2.2.2 Selectable options via software function links

The scheme logic includes 32 scheme function links, described in section 2.8 below. Each function link is a "software switch" with two setting positions, 0 and 1. The scheme function links allow scheme logic to be configured to suit the specific requirements of each application, by enabling those features which are required and disabling those features which are not required.

2.2.3 Settings changes in or out of service

If Scheme Fn Links 2 bit 1 is set to 1, the scheme has to be switched out of service (Auto-reclose Off), to enable settings changes to be made.

If Scheme Fn Links 2 bit 1 is set to 0, settings changes can be made with the scheme in or out of service.

2.2.4 Input mode selection

The relay logic for the following input masks can be suitably configured for either normally open or normally closed external contacts by software function link settings (see section 2.8 below):-

– INP CB AuxSwitch;

- INP Spring Charg;
- INP Block AR.

2.2.5 Line and bus voltage check before closing

A wide range of system checks (synchronism check, dead line / live bus, etc.), selected by function link settings, can be applied to auto-reclosing, and to manual circuit breaker closing if requested by input mask INP Manual CB Cl. Please refer to sections 2.8 and 2.13 below.

2.2.6 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 OC or EF protection, or distance protection operating with Zone 1 extension, before the final reclosure, to ensure that the final trip to lockout for a persistent fault is made by discriminating protection such as IDMT OC or EF or plain distance with conventional 80% Zone 1 reach. This output can be set to operate after 1, 2, 3 or 4 trips (CNS Inst Trips setting), and will then remain operated until the relay resets or locks out at the end of the auto-reclose cycle.

The usual arrangement for this feature is for the output relay to be normally reset, and operate (contact closes) to block non-discriminating protection (Relay Mask RLY Block InstPr assigned to an output relay). This is suitable for most modern protective relays. For protective relays which require a normally closed contact which opens to inhibit non-discriminating trip functions, Relay Mask RLY Enable Inst can be assigned instead.

A second independently adjustable instantaneous trips selector is available (Relay Mask RLY Blk SEF Inst or RLY SEF Inst OK assigned to an output relay), for applications where sensitive earth fault (SEF) protection is required to initiate auto-reclosing, with short time SEF protection tripping being blocked after 1, 2, 3 or 4 trips (CNS SEF InsTrips setting). Separate logic input masks are available for inputs from short time and long time SEF protection.

The operating logic can be configured such that operation of the reclaim timer is suspended by an input from non-discriminating protection if the Block Instantaneous Trips or Block Short Time SEF Trips output is set. This input is now treated as a "fault present but not yet tripped" indication, and ensures that the reclaim time cannot time out and reset the relay before the time delayed discriminating protection operates. This arrangement allows reclaim time settings shorter than the maximum protection operating time to be applied, which can help to prevent unnecessary lockout for a succession of transient faults at short intervals, for example in a lightning storm.

2.2.7 Maintenance Alarm and Lockout

A "fault trips" counter (RST Maint Countr) is incremented whenever the CB trips as a result of any protection operation. A special input mask [INP Non AR Protn] is provided to allow the counter to be incremented without initiating an AR cycle, for a trip initiated by any protection for which AR is not required. The counter can be reset to zero:-

- via the RESET COUNTERS menu column in the user interface, locally or via K-Bus;
- by energising an opto input assigned to input mask [INP Reset M Cntr];
- if FNCT 20 = 1, by activating user control cell [USR Res MaintCnt] via K-Bus;

– if FNCT 20 = 1 and the ML/O output is set, by pressing the [0] key when prompted.

Output mask [RLY Maint Alarm] and control status flag [CTL Maint Alarm] are set when the fault trips counter reaches the [CNS Maint Alarm] target setting, and remain set until the counter value becomes less than the target (i.e. usually until the counter is reset). The output mask can also be reset, even if the counter has not been reset, by activating user control cell [USR Reset MAlarm]. This output is purely for indication, and does not initiate a lockout.

When Maintenance Lockout (MLO) is enabled, by setting FNCT 11 = 1, output mask [RLY MaintLockout] and control status flag [CTL MaintLockout] operate when the fault trips counter reaches the [CNS MaintLockout] target setting. The MLO output remains set until the counter is reset - see above, and forces a scheme lockout.

2.2.8 Temporary inhibit after manual CB close

The relay logic can be configured by software function link settings such that auto-reclose initiation is inhibited for a short period (timer setting TMR ManCl AR Inh) following manual closure of the circuit breaker and/or following initial energisation of a previously dead line. This is to prevent auto-reclosure in the event of manual CB closure onto a pre-existing fault (switch on to fault). Line dead or live status is derived from voltage comparator elements in the synchronism check / voltage monitor logic.

2.2.9 Cold load pick-up

When enabled, by software function link selection, this feature operates output mask RLY C.Ld Pickup, which may be assigned to an output relay if required, to block selected protection for a period equal to TMR C.Ld Pickup setting, following manual CB closing.

2.2.10 Excessive fault frequency lockout

When enabled, by software function link selection, this feature locks out auto-reclosing and operates output mask RLY Exc Flt Frq for indication purposes, if a pre-selected number of fault trips (CNS Exc Flt Frq setting) occurs during a defined period (TMR Exc Flt Frq setting), for example in a lightning storm.

2.2.11 Line voltage interlock

When enabled, by software function link selection, this feature inserts additional checks in the auto-reclose initiation and dead time start logic, such that an auto-reclose cycle cannot be initiated unless the line was live until immediately before the protective relay operation, and the dead time cannot start until the line has gone dead. An adjustable line voltage memory timer is included in case the line voltage drops due to the fault before the protective relay operates.

2.2.12 Reset from lockout

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

– automatically after time setting TMR Mancl AR Inh, following successful manual CB closure (optional – select by software function link setting);

– automatically after time setting TMR Autoreset, irrespective of CB operation (optional – select by software function link setting);

– user input (via K-Bus) - see 2.4 below;

– opto input assigned to input mask INP ResetLockout - see 2.3 below;

– pressing [0] when "Reset Alarms = [0]" is displayed - see 2.11, Scheme Alarms.

2.2.13 Omit first shot

This is enabled by setting input masks such that mask INP Omit 1st Sht is activated by the same opto input as the selected protection (e.g. INP Main Protn). Then when the selected protection operates, the auto-reclose cycle omits the first shot of the programmed cycle and immediately executes the programmed second shot instead. This feature allows, for example, the relay to execute a two shot auto-reclose cycle (high speed AR then delayed AR) when initiated by input INP Inst Protn, or a single shot delayed AR cycle when initiated by input INP Main Protn.

2.2.14 Successful auto-reclose indication

Output mask RLY A/R Success and control output CTL A/R Success operate if the circuit breaker has auto-reclosed during the cycle and has remained closed up to the end of the reclaim time. Output mask RLY A/R Success resets after two seconds fixed pulse time. Control output CTL A/R Success resets at the next circuit breaker trip.

2.2.15 CB failed to close alarm

Output mask RLY CB Failclose and control output CTL CB Failclose operate, scheme lockout is initiated, and a local alarm is generated, if the circuit breaker does not close within a period equal to TMR Close Pulse setting when the CB Close signal is given. Output mask RLY CB Failclose resets after two seconds fixed pulse time. Control output CTL CB Failclose, and the local alarm indication, both reset when the circuit breaker is closed, or the relay is reset from lockout by any of the methods described above.

2.2.16 Fault not cleared alarm

Scheme lockout is initiated and a local alarm is generated, if the circuit breaker does not trip or the protection does not reset within a period equal to TMR TripfailTime setting following auto-reclose initiation. The alarm resets when the circuit breaker finally trips and protection resets, or when the relay is reset from lockout by any of the methods described above.

2.2.17 Auto-reclose without protection

If Scheme Fn Links 1 bit 4 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. See 2.8 below.

2.2.18 AR initiation with CB open

If Scheme Fn Links 1 bit 5 is set to 1, an auto-reclose cycle can be initiated by protection operation even if the circuit breaker is initially open, which may be useful during testing or commissioning. See 2.8 below.

2.2.19 Maintained close pulse

If Scheme Fn Links 1 bit D is set to 1, the CB Close signal is not cut off when the circuit breaker closes, but is maintained for the set TMR Close Pulse time. This option may be preferred for some types of circuit breaker closing mechanism. Anti-pumping logic is included to cut off the CB Close signal if the protection re-operates or the circuit breaker re-trips before the set close pulse time has elapsed.

2.3 Opto isolated Inputs

KAVR relays have eight opto isolated inputs, with software filtering to prevent maloperation due to induced a.c. signals in the external wiring. KAVR100 scheme logic has fifteen functional logic inputs. The inputs required for any specific application are selected by setting INPUT MASKS to assign one or more opto inputs to each required logic input. Although most selections are one to one, parallel mask settings are possible. A single opto input can activate more than one logic input, and a single logic input may be activated by more than one opto input.

The available functional logic inputs are described below. The default mask settings are listed in scheme logic diagram, drg. no. 08 KAVR100 01.

Display Name	**Effect in Scheme Logic**
INP CB AuxSwitch	CB status indication, open/closed
INP Inst Protn	(i) Initiate AR (provided "Block Instantaneous Trips" not operated: see Main Operating Features - Instantaneous trips selector). (ii) Prevent reclaim timer from timing when a fault is present (waiting for time delayed trip).
INP Main Protn	Initiate AR ("trip repeat" contact from protection).
INP Spring Charg	CB stored energy (e.g. closing spring and/or gas pressure) indication - charged / not charged
INP Manual CB Cl	Initiate CB closure with selected system check conditions for manual CB close. See section 2.8, FNCT 27 to 31, and 2.13
INP Non AR Protn	Increments fault trips counter for maintenance alarm/lockout, without initiating AR
INP Block AR	Cancel AR (drive to lockout).
INP ResetLockout	Reset scheme from lockout.
INP Reset Indication	(Not used in latest KAVR ladder logic)
INP Reset M Cntr	Reset maintenance alarm/lockout fault trips counter.
INP Omit 1st Sht	Omit first shot of selected program, i.e. first reclose with dead time 2.
INP RemSw Inserv	Switch AR scheme logic in service.
INP RemSw Outsrv	Switch AR scheme logic out of service.
INP Inst. SEF	(i) Initiate AR SEF program (provided "Block SEF Instantaneous Trips" not operated: see Main Operating Features - Instantaneous trips selector). (ii) Prevent reclaim timer from timing when a fault is present (waiting for time delayed trip).
INP Sensitive EF	Initiate AR SEF program ("trip repeat" contact from protection).

2.4 User Inputs

KAVR100 relay scheme logic includes seven inputs which are operated over K-Bus or via the front plate user interface. They are accessible in the USER CONTROLS menu column, and are detailed below.

Display Name	Effect in Scheme Logic
USR Switch inSrv	Switch AR scheme logic in service.
USR Sw outofServ	Switch AR scheme logic out of service.
USR ResetLockout	Reset scheme from lockout.
USR Reset MAlarm	Resets output mask RLY Maint Alarm, even if maint counter is not reset.
USR Dec MaintCnt	Decrements RST Maint Countr by 1 (See Counters)
USR Inc MaintCnt	Increments RST Maint Countr by 1 (See Counters)
USR Res MaintCnt	Resets RST Maint Countr, provided FNCT 22 = 1.

2.5 Output Relays

KAVR relays have eight output relays, each with one normally open contact, plus a watchdog output with one normally open and one normally closed contact. KAVR100 scheme logic has sixteen functional logic outputs. The outputs required for any specific application are selected by setting RELAY MASKS to assign one or more output relays to each required logic output. Although most selections are one to one, parallel 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 are described below. The default mask settings are listed in scheme logic diagram, drg. no. 08 KVTR100 01.

Display Name	Operating Logic
RLY A/R In Prog	Auto reclose cycle in progress.
RLY CB Close Sig	CB close signal.
RLY AR Available	AR logic in service and not locked out.
RLY Block InstPr	Operates to inhibit non-discriminating protection trip function after set number of trips.
RLY Maint Alarm	Fault trips counter >= maintenance alarm target.
RLY MaintLockout	Fault trips counter >= maintenance lockout target.
RLY Exc Flt Frq	“Excessive fault frequency” lockout.
RLY CB Failclose	CB failed to close when signal was applied.
RLY C.Ld Pickup	Operates for set Cold Load Pickup time following manual CB close on to previously dead circuit.
RLY A/R Lockout	AR scheme locked out.
RLY ManCl AR Inh	AR initiation temporarily inhibited following manual CB close.
RLY OutOfService	AR logic selected out of service.
RLY Enable Inst	Normally operated: resets to inhibit non-discriminating protection trip function after set number of trips. (Inverse of RLY Block InstPr for use where N/C (normally closed) contact is required).

Display Name	Operating Logic
RLY Blk SEF Inst	Operates to inhibit fast SEF protection trip function after set number of trips.
RLY SEF Inst OK	Normally operated: resets to inhibit fast SEF protection trip function after set number of trips. (Inverse of RLY Blk SEF Inst for use where N/C (normally closed) contact is required).
RLY A/R Success	CB remained closed to end of reclaim time.

2.6 Control Outputs

Fourteen "control outputs" (see Sections 5.1.1 - cell 000D, and 5.1.3) are available for relay status indications through the user interface, as described below.

Display Name	Operating Logic
CTL DT in Prog	Dead time in progress.
CTL Rcl in Prog	Reclaim time in progress.
CTL A/R Lockout	Scheme locked out.
CTL Maint Alarm	Maintenance alarm (pre-lockout warning).
CTL MaintLockout	Maintenance lockout.
CTL Block InstPr	Non-discriminating protection trip function inhibited.
CTL Exc Flt Frq	Excessive fault frequency lockout.
CTL OutofService	AR scheme selected out of service.
CTL CB Failclose	CB failed to close when signal was applied.
CTL CldLd Pickup	"Cold load pickup" period following manual CB close.
CTL ArinProgress	AR cycle in progress, from initiation to reset or lockout.
CTL ManCl AR Inh	AR initiation temporarily inhibited following manual CB close.
CTL Blk SEF Inst	Fast SEF trip function inhibited.
CTL A/R Success	CB remained closed to end of reclaim time.

2.7 Plant Status Output

"Plant status" output C.B.1 controls bits 0 and 1 of the SYS Plant Status word in cell 000C in the SYSTEM DATA menu column, and indicates the position of the associated circuit breaker, as determined from input mask INP CB AuxSwitch.

When the CB is closed, SYS Plant Status bits 0 & 1 are 0 & 1 respectively.

When the CB is open, SYS Plant Status bits 0 & 1 are 1 & 0 respectively.

No other plant status outputs are used in KAVR100 logic, and SYS Plant Status bits 2 to F are always 0.

2.8 Software Logic Functions

KAVR100 scheme logic can be user-configured to enable/disable selected features, as required for specific applications, by setting scheme function links to 0 or 1. Links are identified by:-

1. decimal numbering from FNCT 0 to FNCT 31 in ladder logic diagrams, and

2. hexadecimal numbering in two sixteen-bit words in LOGIC FUNCTIONS menu cells 0A01 and 0A02.

Cell 0A01 [Scheme Fn. Links 1] bits 0 to F correspond to FNCT 0 to 15.

Cell 0A02 [Scheme Fn. Links 2] bits 0 to F correspond to FNCT 16 to 31.

In the following lists, the default settings applied in the factory are identified by (D).

Logic FNCT number	Scheme Fn. Links 1 bit no.	Display Name	Effect in scheme logic
0	0	CBAUX = 52a	0 = logic correct for N/C (normally closed) 52b CB aux contact; 1 = logic set for N/O (normally open) 52a CB aux contact (D).
1	1	IN3 ON = SPRCHG	0 = logic correct for CB spring charge contact open when spring charged/gas OK; 1 = logic correct for CB spring charge contact closed when spring charged/gas OK (D).
2	2	SYNCH TEST	0 = logic correct for normal service (D); 1 = special setting for factory testing synch check logic.
3	3	IN6 ON = LCKOUT	0 = logic correct for N/C (normally closed) external contact which opens to drive AR to lockout; 1 = logic correct for N/O (normally open) external contact which closes to drive AR to lockout (D).
4	4	INI CB TR	0 = AR initiation by protection operation (D) 1 = AR initiation by any CB trip, without reference to protection.
5	5	INI CB OPN	0 = AR initiation only if CB is closed up to instant of protection operation (D); 1 = AR initiation by protection operation without reference to CB position.
6	6	C LD P/U	0 = cold load pickup logic disabled (D); 1 = cold load pickup logic enabled
7	7	MC AR INH	0 = AR initiation enabled immediately after CB manual close; 1 = AR initiation inhibited for TMR Mancl AR Inh time after manual CB close (D).
8	8	TIM RES LCK	0 = disable unconditional timed auto-reset from lockout (D); 1 = enable unconditional timed auto-reset from lockout.

Logic FNCT number	Scheme Fn. Links 1 bit no.	Display Name	Effect in scheme logic
9	9	AUTO RES LCK	0 = disable timed auto-reset from lockout following manual CB close; 1 = enable timed auto-reset from lockout following manual CB close (D).
10	A	EX FLT FRQ	0 = excessive fault freq. logic disabled (D); 1 = excessive fault frequency logic enabled.
11	B	M LCK	0 = maintenance lockout logic disabled (D); 1 = maintenance lockout logic enabled.
12	C	ML EFF BLOCKINST	0 = when ML/O &/or EFF enabled, gives Block Inst output when target is reached, then lockout at next trip (i.e. target + 1). (D); 1 = maintenance lockout or EFF lockout (when enabled) immediate when target is reached.
13	D	FULL CL PLS	0 = CB close output off when CB closes (D); 1 = CB close output maintained for set TMR Close Pulse time.
14	E	RC TIM RUN ON	0 = reclaim time suspended when INP Inst Protn is on (D); 1 = reclaim time runs even if INP Inst Protn is on.
15	F	STDT CB TR	0 = dead time start when CB tripped AND protection reset (D); 1 = dead time starts when CB trips, without reference to protection.

Logic FNCT number	Scheme Fn Links 2 bit no.	Display Name	Effect in scheme logic
16	0	HSAR NO SC	0 = all reclosures require “system safe to close” check (D); 1 = 1st shot after D.Time 1 without system check: subsequent reclosures require “system safe to close” check.
17	1	NO SET IN SERV	0 = settings can be changed with scheme in or out of service (D); 1 = settings can be changed only if scheme logic is selected out of service.
18	2	MCL-CS	0 = logic correct for normal service (D); 1 = special setting for factory testing synch check logic.

Logic FNCT number	Scheme Fn Links 2 bit no.	Display Name	Effect in scheme logic
19	3	LLINIT DLTIME	0 = AR initiation & dead time start without reference to line voltage monitor input (D); 1 = AR initiation only if line was live up to instant of protection operation, and dead time start only if line goes dead.
20	4	RESET MAINT CNT	0 = disable Maint Counter reset by user control or Global Reset (D); 1 = enable Maint Counter reset by user control or Global Reset
21	5	DLC AR INH	0 = AR initiation enabled immediately after line energisation (D); 1 = AR initiation inhibited for TMR Mancl AR Inh time after line energisation.
22	6	ARC-CS	0 = disable AR with synch check; 1 = enable AR with Phase Angle check (D).
23	7	ARC-DLLB	0 = disable AR with dead line / live bus; 1 = enable AR with dead line / live bus (D).
24	8	ARC-LLDB	0 = disable AR with live line / dead bus; 1 = enable AR with live line / dead bus (D).
25	9	ARC-DLDB	0 = disable AR with dead line / dead bus (D); 1 = enable AR with dead line / dead bus.
26	A	ARC-ANY	0 = disable AR without system check (D); 1 = enable AR without system check.
27	B	MCL-SS	0 = disable ManCl with synch check; 1 = enable ManCl with Sys. Angle check (D).
28	C	MCL-DLLB	0 = disable ManCl with dead line / live bus; 1 = enable MCl with dead line / live bus (D).
29	D	MCL-LLDB	0 = disable ManCl with live line / dead bus; 1 = enable MCl with live line / dead bus (D).
30	E	MCL-DLDB	0 = disable MCl with dead line / dead bus (D); 1 = enable MCl with dead line / dead bus.
31	F	MCL-ANY	0 = disable ManCl without system check (D); 1 = enable ManCl without system check.

2.9 Timer Setting Ranges

Menu column headed TIMER SETTINGS includes fourteen user-adjustable timer settings, as described below.

Display Name	Description	Setting Range (sec)
TMR Dead Time 1	First shot dead time.	0.01 - 300
TMR Dead Time 2	Second shot dead time.	1.0 - 300
TMR Dead Time 3	Third shot dead time.	1.0 - 9999
TMR Dead Time 4	Fourth shot dead time	1.0 - 9999
TMR Close Pulse	Maximum waiting time for CB to close when signal is given.	0.01 - 10.0
TMR Reclaim Time	Reclaim time.	1.0 - 600
TMR SynCh Window	Maximum waiting time for “system safe to close” signal at end of dead time. Lockout if not satisfied.	0.01 - 9999
TMR SprCh Window	Max. waiting time for "spring charged" signal at end of dead time. Lockout if not received.	0.01 - 600
TMR Mancl AR Inh	AR initiation inhibit period after manual CB close.	0.01 - 300
TMR Tripfail Tim	Maximum waiting time for CB trip and protection reset after AR initiation by protection operation.	0.01 - 300
TMR Exc Flt Frq	Fault trip counting period for excessive fault frequency logic	0.01 - 9999
TMR Autoreset	Auto-reset time from lockout, if FNCT 8 = 1.	1.0 - 9999
TMR C Ld Pickup	Cold load pickup time	1.00 - 9999
TMR LineV Memory	Line volt memory timer (see Main Operating Features - Line voltage interlock)	0.01 - 100

2.10 Counters

Counter-related logic functions involve “counter registers” and “settings” (see below). Scheme logic compares counter register contents with reference values as required, and updates “counter values” for display via the user interface.

2.10.1 Counter registers (“coils” or resets)

Counter registers are incremented and reset by specific logic events, and can also be reset to zero via the menu column headed RESET COUNTERS.

Display Name	Description
RST Sequence Cnt	AR initiations counter, for sequence control: auto reset at end of AR cycle (volatile).
RST ExFltFrq Cnt	Fault trips counter for excessive fault frequency logic: auto-reset at lockout or excessive fault frequency timeout (volatile).

Display Name	Description
RST Maint Countr	Fault trips counter for maintenance alarm and lockout.
RST Total Reclos	Total reclose attempts counter.

2.10.2 Counter targets (Settings).

These user-adjustable values appear under menu column heading COUNTER SETTINGS. They can be used in scheme logic as reference values for counter comparisons and counter value messages.

Display Name	Description	Setting Range
CNS Shots	Maximum number of reclose attempts before lockout for a persistent fault.	1 - 4
CNS Inst Trips	Permitted number of trips by non-discriminating protection.	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 frequency logic	1 - 9999
CNS SEF Shots	Maximum number of reclose attempts initiated by SEF protection before lockout.	0 - 4
CNS SEF InsTrips	Permitted number of trips by fast SEF protection	0 - 5

2.10.3 Counter values (messages)

These messages appear under menu column heading COUNTER VALUES. Each "value" is the difference between two specific quantities - counter registers, targets or fixed values

Display Name	Description
CNV Total Reclos	Total reclose attempts (RST Total Reclos - 0)
CNV ShotstoM.Lock	Remaining fault trips before maintenance lockout (CNS MaintLockout - RST Maint Countr)

2.11 Alarms

2.11.1 Scheme Alarms

Scheme alarms are generated by various events in scheme logic. Each alarm comprises one of the Alarm LEDs being lit, and an LCD message. When any scheme alarm is active, bit 6 of the SYS Alarms word in the SYSTEM DATA column is set to 1. Messages associated with currently active alarms overwrite the selected relay default LCD display, and are also displayed under menu column heading SCHEME ALARMS. When more than one alarm, or any latching alarm (see below), is active, the messages can be scrolled by short presses of the [F] key. The relay can be arranged to automatically scroll to the next message every five seconds: see under MENU SYSTEM - Menu contents - Logic functions - 0A06 LOG Rotation.

Scheme alarms are in two groups, **Status** and **Latching**, with different reset modes.

Status alarms (red or amber LED) are active while the initiating scheme logic conditions are active, and **reset when the initiating conditions become inactive.**

Status alarms on the KAVR100 are:

LCD message & LED (Amber (A) or Red (R))	Activating scheme logic condition
AUTO RECLOSE IN PROGRESS (A)	Auto-reclose in progress, from initiation until reset or lockout.
AUTO RECLOSE INHIBIT (A)	A/R initiation temporarily inhibited following manual CB closing. See under Main Operating Features.
AUTO RECLOSE OUT OF SERVICE (A)	Auto-reclose selected out of service.
MAINTENANCE LOCKOUT (R)	RST Maint Countr >= CNS MaintLockout.

Latching alarms (red LED) are initiated by specific scheme logic conditions, and **remain active even after the initiating conditions have reset.** If any latching alarm is active, when all active alarm messages have been displayed, the next message displayed is [Reset Alarms = [0]]. Once the initiating conditions have reset, the associated alarm can be reset by a long press of the [0] key when the [Reset Alarms = [0]] message is displayed.

Latching alarms on the KVAR100 are:

LCD message	Initiating scheme logic condition
AUTO RECLOSE LOCKOUT	Auto-reclosing locked out.
FAULT NOT CLEARED	CB failed to trip, or protection failed to reset, within TMR TripfailTime after AR initiation.
EXCESS FLT FREQ LOCKOUT	RST ExFltFrq Cnt >= CNS Exc Flt Freq.
CIRCUIT BREAKER FAILED TO CLOSE	CB not closed by end of TMR Close Pulse time when CB Close command is given.

As an alternative to pressing the [0] key when the [Reset Alarms = [0]] message is displayed, the above alarms can also be reset as follows:-

AR LOCKOUT: energise opto input assigned to input mask [INP ResetLockout];

activate user control [USR ResetLockout] (can be done via K-Bus);

successful manual CB closure: if FNCT 9 = 1, scheme resets automatically.

FLT NOT CLEARED: automatic reset when CB opened and protection reset.

CB FAIL TO CLOSE: automatic reset by successful manual CB closure

2.12 Scheme Event Records

The relay scheme logic allows specified events to be time tagged and saved into memory, with a copy of the current contents of a specific counter register. These scheme logic events are saved into memory arrays indexed by the event record number, overwriting any previous data, and an event flag is set to indicate which event has occurred. The event bit in the communications status word is also set - see under **Serial communication** - Time tagged event records.

The scheme event records can be interrogated from two sources:

1. Over K-Bus, when descriptive text, time tag and counter value are transmitted on request, for each event. The relay software scans the event flags to determine which events have occurred, transmits the appropriate data, and finally resets the event flag when the master station sends an ACCEPT EVENT signal. When all event flags have been cleared, the event bit in the communications status byte is also cleared.

2. Via the local user interface in the EVENT RECORDS menu column, where descriptive text and the elapsed time and counter value change between two events is displayed. Reading this event record does not affect the event flag or the event bit in the communications status byte.

Scheme event records in the KAVR100 relay are:

2.12.1 K-Bus messages to master station:

Message text	**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 finish of last auto-reclose cycle.

2.12.2 Local EVENT RECORDS:

Display	Associated data
[EVR SeqTm: Shots] [t : n]	t = total cycle time, and n = number of reclosures, in last AR cycle.

2.13 Synchronism Check / Voltage Monitor

The KAVR relay incorporates two voltage transformers for measuring line and busbar voltages (see under **Measurement** below). The scheme logic includes software comparator modules to make various comparisons between line and bus voltages, as described below.

Phase angle comparison (synchronism check): applied when selected by scheme function link FNCT 22, to supervise auto-reclosing.

System angle comparison (synchronism check): applied when selected by scheme function link FNCT 27, to supervise manual CB closing.

Dead line / live bus comparison: applied when selected by scheme function link FNCT 23, to auto-reclosing; or when selected by scheme function link FNCT 28, to manual CB closing.

Live line / dead bus comparison: applied when selected by scheme function link FNCT 24, to auto-reclosing; or when selected by scheme function link FNCT 29, to manual CB closing.

Dead line / dead bus comparison: applied when selected by scheme function link FNCT 25, to auto-reclosing; or when selected by scheme function link FNCT 30, to manual CB closing.

Synchronism check and voltage monitor settings are accessed in the menu column headed CHECK SYNCH STGS, as described in Section 5 - MENU SYSTEM. Setting ranges are detailed in Section 7 - TECHNICAL DATA.

The Phase Angle and System Angle comparators are identical in operation, but can have different settings, for example to permit auto-reclosing with phase angle up to setting θ1, or manual CB closing with phase angle up to setting θ2. Each of these comparators will give an output to the scheme logic provided:-

1. it is enabled by setting the relevant CSS Fn. Links bit to 1 (bit 0 to enable phase angle check, or bit 5 to enable system angle check);

AND

2. the ladder logic input to the element is on;

AND

3. the measured magnitude of BOTH incoming voltages is greater than 5 volts;

AND

4. (a) if the slip time (delayed operation) feature is enabled by setting the relevant CSS Fn. Links bit to 1 (bit 2 for phase angle check, or bit 7 for system angle check) - the measured phase angle between incoming line and bus voltages is less than the set angle (CSS Phase angle, or CSS System angle, as relevant), for a time greater than the set delay time (CSS Synch timer for phase angle check, or CSS System timer for system angle check);

   or

   (b) if the slip time (delayed operation) feature is disabled by setting the relevant CSS Fn. Links bit to 0 (bit 2 for phase angle check, or bit 7 for system angle check) - the measured phase angle between incoming line and bus voltages is less than the set angle (CSS Phase angle, or CSS System angle, as relevant);

AND

5. if slip frequency blocking is enabled by setting the relevant CSS Fn. Links bit to 1 (bit 1 for phase angle check, or bit 6 for system angle check) - the measured rate of change of phase angle between incoming line and bus voltages is less than the set slip frequency limit (CSS Slip Freq. for phase angle check, or CSS System Slip for system angle check);

AND

6. if undervoltage blocking is enabled by setting CSS Fn. Links bit B to 1 - the measured magnitude of BOTH incoming voltages is not less than the CSS Undervoltage setting;

AND

7. if differential voltage blocking is enabled by setting CSS Fn.Links bit D to 1 - the difference between the measured magnitudes of the incoming line and bus voltages is less than the CSS Diff Voltage setting.

The dead line / live bus comparator gives an output to the scheme logic, provided:-

1. it is enabled by setting CSS Fn. Links bit 8 to 1;

AND

2. the measured magnitude of the incoming line volts is less than the CSS V. B/L Dead setting;

AND

3. the measured magnitude of the incoming bus volts is greater than the CSS V. B/L Live setting.

The live line / dead bus comparator gives an output to the scheme logic, provided:-

1. it is enabled by setting CSS Fn. Links bit 9 to 1;

AND

2. the measured magnitude of the incoming bus volts is less than the CSS V. B/L Dead setting;

AND

3. the measured magnitude of the incoming line volts is greater than the CSS V. B/L Live setting.

The dead line / dead bus comparator gives an output to the scheme logic, provided:-

1. it is enabled by setting CSS Fn. Links bit A to 1;

AND

2. the measured magnitudes of BOTH the incoming line and bus volts are less than the CSS V. B/L Dead setting.

2.14 Measurement

Measurements are only available in relays including check synchronism features (KAVS and KAVR). These relays have two voltage transformers for measuring line and busbar voltages.

Measurement is based on the Fourier derived value of the power frequency component of current and harmonics up to and including the 6th are suppressed.

The 7th harmonic is the first predominant harmonic and this is attenuated by a factor of 3; also higher harmonics are further progressively attenuated by the anti-aliasing filter. This feature eliminates the need for third harmonic rejection filters in the circuits of sensitive earth fault relays. The frequency response is further enhanced by frequency tracking the measured signal over a range of 45Hz to 65Hz.

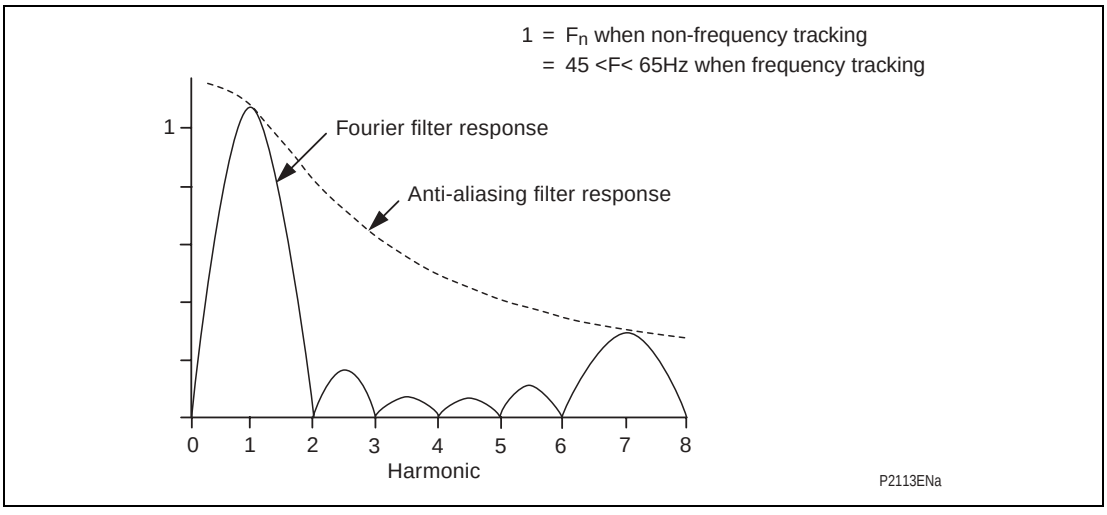


Figure 1. Response of Fourier filtering

With frequency tracking, the sampling rate of the A/D conversion is adjusted to match the frequency of the tracked signal. In the absence of a signal to track, the sampling rate settles to that determined from the set rated frequency (Fn). In the presence of a signal within the tracking range (45Hz to 65Hz) the relay will lock-on and the '1' on the horizontal scale in Figure 1 will correspond to the current value of the power system frequency. The resulting output for the second, third, fourth, fifth and sixth harmonics will be zero. Frequencies in between the harmonics, of any significant amplitude, do not generally exist on the power system. Hence the first higher frequency to give an output is the seventh, as already mentioned. Phase signals contain a predominant power frequency component and are given preference for frequency tracking. Then the frequency response will be represented by Figure 1.

Figure 2 shows the response when tracking a signal with little or no fundamental power frequency component. When the signal is outside the frequency tracking range, of 45 to 65Hz, the relay will try to lock on to a sub-harmonic of the signal frequency and give the response shown.

When a transformer is energised an almost pure second harmonic current can appear in the neutral circuit. Multiple relays with a combined earth/ground fault element are best suited to such applications because the frequency tracking will lock onto the phase signals which will be predominantly at the power frequency and the second harmonic response will be zero.

All measurement values can be displayed on the front of the relay. The display will be in primary system values if the voltage transformer ratios are entered under CHECK SYNCH STGS. The default setting for these ratios is 1:1; the displayed settings and measured values then being in terms of the secondary quantities from the primary transducers.

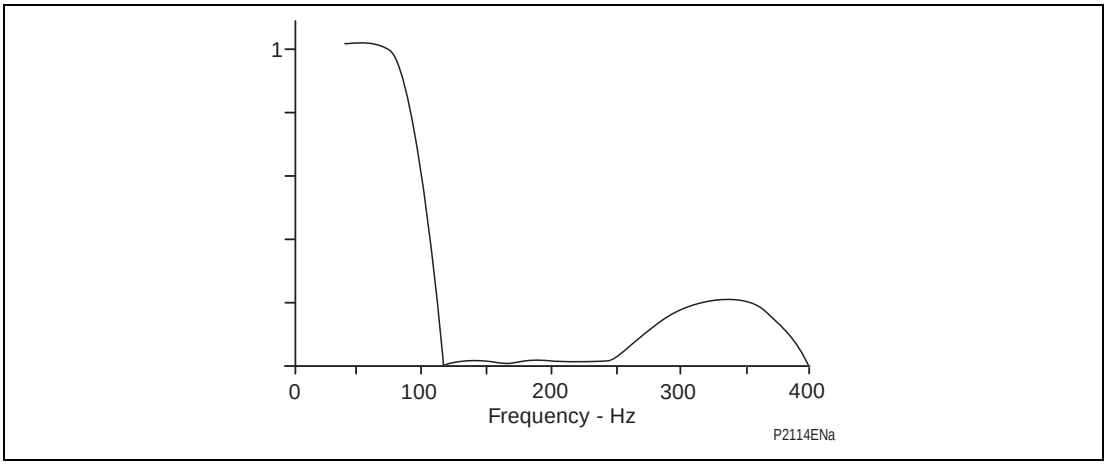


Figure 2. Frequency response for single voltage input

2.15 Alarms

2.15.1 Scheme alarms

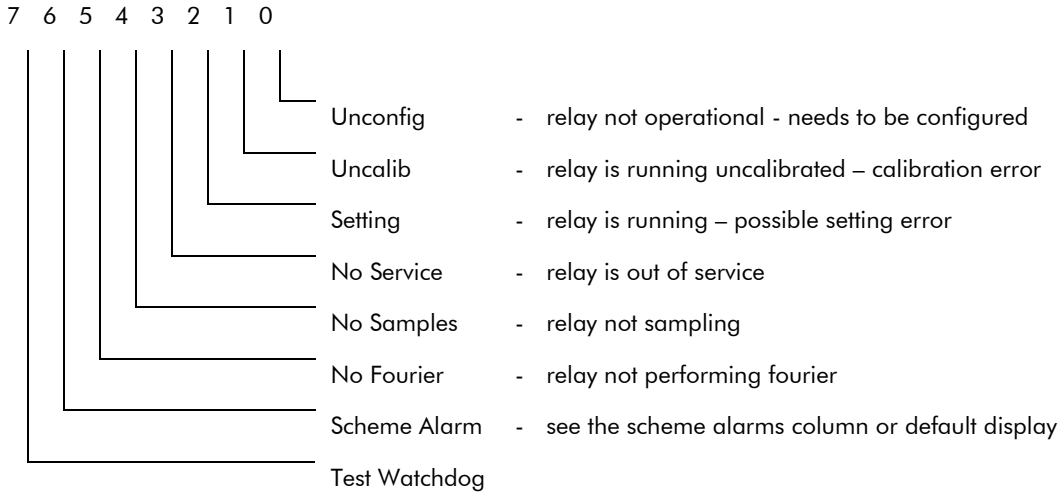
Scheme alarms are indicated by either the red or amber LED being on, steady or flashing. Conditions that cause an alarm to be given are determined in the ladder diagram. See Section 2.11 for a full description. The operation of any scheme alarm will cause the corresponding bit in the SYS Alarms cell to be set.

2.15.2 Self monitoring alarms

The monitoring circuits within the relay continually perform a self test routine. Any detected loss of operation in the first instance initiates a reset sequence to return the equipment to a serviceable state. Examples of this are the main processor, the communication processor and the display processor. The voltage rails are also supervised and the processors are reset if the voltage falls outside their working range. Should the main processor fail and not restart, the watchdog relay will operate to provide an alarm. This relay will also alarm loss of the auxiliary energising supply to the auxiliary powered relays.

In addition the memory of the relay is checked for possible corruption of data and any detected errors will result in an alarm being generated. An ALARM LED indicates several states which can be identified by viewing the alarm flags that are to be found in the SYSTEM DATA column of the menu and consist of seven characters that may be either "1" or "0" to indicate the set and reset states of the alarm. The flags offer the following indications:

Bit position



When any of the above alarms occurs an event is generated at the master station. If more than one alarm occurs at the same time, only the lowest bit position will be sent as the event.

For the above self monitoring alarms the AMBER ALARM LED will be continuously lit, the alarm bit will be set in the STATUS word as a remote alarm and the watchdog relay will operate. However, there is another form of alarm that causes the AMBER ALARM LED to flash and this indicates that the password has been entered to allow access to change protected settings within the relay and this is not generally available as a remote alarm.

The alarm state can be determined via the menu of the relay in the SYS Alarms cell.

Error (0) could result in incorrect operation, due to the configuration error, so the application software is stopped, the watchdog relay given an alarm and the menu locked with the default display showing "Unconfigured".

For error (1) the relay will continue to perform its intended function, but with some reduction in accuracy.

2.15.3 Watchdog test feature

The test watchdog bit can be set or cleared as a normal setting. When set to 1 the watchdog relay drops off, the amber LED lights up and the alarm bit in the communications status byte is set. When the bit is reset to zero all these features revert to normal.

2.16 Password protection

Password protection is only provided for the configuration settings of the relay. This includes VT ratios, system and check synchronism function link settings, opto-input and relay output allocation. Any accidental change to configuration could seriously affect the ability of the relay to perform its intended functions, whereas, a setting error may only cause a grading problem. Individual relay settings are protected from change when the relay cover is in place.

2.17 Serial communication

Serial communications are supported over K-Bus, a multidrop network that readily interfaces to IEC 60870-5 FT1.2 Standards. The language and protocol used for communication is Courier. It has been especially developed to enable Generic Master Station Programs to access many different types of relay without continual modification to the Master Station Program. The relays form a distributed data base for the Master Station and may be polled for any information required. This includes:

1. Measured values
2. Menu text
3. Settings and setting limits
4. Event records
5. Disturbance records
6. Plant status
7. Control status – a 16 bit word wherein the individual bits are assigned in the ladder diagram.
8. Status – an eight bit word that identifies the trip and alarm state, busy state, also the presence of event and disturbance records for collection.

2.17.1 Time tagged event records

An event may be a change of state of an opto input or an output relay; a setting that has been changed locally or it may be one of up to 16 changes, assigned in the ladder (see Section 2.12). A total of 50 events may be stored in a buffer, each with an associated time tag. The time tag is the value of a timer counter that is incremented every 1 millisecond.

The event records can be accessed via the serial communication port when the relay is connected to a suitable master station. When the relay is not connected to a master station the event records can still be extracted within certain limitations:

1. The event records can be read via the serial communication port and a K-Bus/ IEC 60870-5 interface unit will be required to enable the serial port to be connected to an IBM or compatible PC. Suitable software will be required to run on the PC so that the records can be extracted.

2. When the event buffer becomes full the oldest record is overwritten by the next event.

3. Records are deleted when the auxiliary supply to the relay is removed, to ensure that the buffer does not contain invalid data. Dual powered relays are most likely to be affected.

4. The time tag will be valid for 48 days assuming that the auxiliary supply has not been lost within that time. However, there may be an error of ±4.3 seconds in every 24 hour period due to the accuracy limits of the crystal. This is not a problem when a master station is on line as the relays will usually be polled once every second or so.

Events that are recorded include:

1. Change in state of opto inputs

2. Change in state of relay outputs

3. Change to settings made locally

4. Alarm messages

5. Local event records defined in the ladder diagram

Items 1 and 2 may be deleted from the events by setting SYS Fn Link 7 to 0 – see Section 5.1.1.

2.17.2 Disturbance records

The internal disturbance recorder has one channel allocated to each of the measured anologue quantities; one to record the eight control inputs; one to record the eight relay outputs. As with the event recorder, when the buffer is full the oldest record is overwritten and records are deleted if the auxiliary supply to the relay is removed. This ensures that when the buffer is read the contents will all be valid.

The disturbance recorder is stopped and the record frozen a set time after a selected trigger has been activated. For example a protection trip command could be the selected trigger and the delay would then set the duration of the trace after the fault.

Each sample has a time tag attached to it so that when the wave form is reconstituted it can be plotted at the correct point against the time scale, thus ensuring that the time base is correct and independent of the frequency. The K-Series relays measure eight samples per cycle but the method of recording allows the analysis program to perform with records that may have a different sample rate.

The disturbance records can only be accessed via the serial communication port.

2.17.3 Remote control functions

Control functions that affect the relay and that can be performed over the serial link include the change of individual relay settings and functions in the scheme logic that are defined in the ladder diagram.

2.17.4 Notes on serial port

Each relay in the K-Series has a serial communication port configured to K-Bus Standards.

K-Bus is a communication interface and protocol designed to meet the requirements of communication with protective relays and transducers within the power system substation environment. It has to be as reliable as the protective relays themselves

and must not result in their performance being degraded in any way. Hence error checking and noise rejection has been a major concern in its design.

The communication port is based on EIA(RS)485 voltage transmission and reception levels with galvanic isolation provided by a transformer. A polled protocol is used and no relay unit is allowed to transmit unless it receives a valid message, without any detected error, addressed to it. Transmission is synchronous, over a pair of screened wires, and the data is FM0 coded with the clock signal to remove any dc component to enable the signal to pass through the transformers. This method of encoding the data results in the polarity of the connection to the bus wiring being unimportant.

With the exception of the master units, each node in the network is passive and any failed unit on the system will not interfere with communication to the other units. The frame format is HDLC and the data rate is 64 kbits/second. Up to 32 units may be connected to any bus at any point over a maximum length of 1000 metres.

2.17.5 Notes on security of remote control via the serial port

Access to the memory of the relay is restricted to that addressed via the menu system of the relay. In addition all setting changes are reflexed back to the master station for verification before the EXECUTE command is issued. On reception of the execute command the new setting is checked against the limits stored in the relay before they are entered. Only then does the relay respond to the new setting.

All remote commands are reflexed back to the master station for verification before they are executed and any command left set is automatically rejected if not executed within the time-out period. No replies are permitted for global commands, as this would cause contention on the bus, instead a double send is used for verification purposes with this type of command.

Remote control is restricted to those functions that have been selected in the relay's menu table and the selection can not be changed without entering the password. CRC and message length checks are used on each message received. No response is given for received messages with a detected error. The master station can be set to retransmit a command a set number of times if it does not receive a reply or receives a reply with a detected error.

2.18 Model Variant KAVR100 02

Model variant KAVR10002 has slightly different functionality from the standard KAVR10001. The variant was developed to meet the special requirements of TNB Malaysia, but might be appropriate in some other situations. The deviations from the standard model are described below.

1. Logic Inputs

Input Mask SEFINST (INP Inst SEF) is replaced by a new mask INHCHSYN (INP CheckSyn).

Input mask SEF (INP Sensitive RF) is deleted.

2. Output Relays

Relay mask BLSEFINS (RLY Blk SEF Inst) is replaced by a new mask SYNCH (RLY CheckSyn OK).

Relay mask OKSEFINS (RLY SEF Inst OK) is replaced by a new mask NOSYNCH (RLY ChSyn Failed).

3. Functions

FNCT 18 is re-designated SYNCH-ANY

4. Alarms

New Status 1 alarm SYNCH CHECK FAILED, triggered by output relay mask NOSYNCH.

5. Counter Settings

SEFSHOTS (CNS SEF Shots) and SEFINSTR (CNS SEF InsTrips) are deleted.

6. Ladder Logic

The changes to the ladder logic are shown in section 6.

3. EXTERNAL CONNECTIONS

Standard connection table

Function	Terminal				Function
Earth Terminal	–	1	2	–	Not Used
Watchdog Relay (Break contact)	b	3 5	4 6	m	Watchdog Relay (Make contact)
48V Field Voltage	[+]	7	8	[–]	48V Field Voltage
Not Used		9	10		Not Used
Not Used		11	12		Not Used
Auxiliary Voltage Input	(+)	13	14	(–)	Auxiliary Voltage Input
Not Used		15	16		Not Used
Line Voltage	In	17	18	Out	Line Voltage
Busbar Voltage	In	19	20	Out	Busbar Voltage
Not Used		21	22		Not Used
Not Used		23	24		Not Used
Not Used		25	26		Not Used
Not Used		27	28		Not Used
Output Relay 4	–	29 31	30 32	–	Output Relay 0
Output Relay 5	–	33 35	34 36	–	Output Relay 1
Output Relay 6	–	37 39	38 40	–	Output Relay 2
Output Relay 7	–	41 43	42 44	–	Output Relay 3
Opto Control Input L3	(+)	45	46	(+)	Opto Control Input L0
Opto Control Input L4	(+)	47	48	(+)	Opto Control Input L1
Opto Control Input L5	(+)	49	50	(+)	Opto Control Input L2
Opto Control Input L6	(+)	51	52	(–)	Common L0/L1/L2
Opto Control Input L7	(+)	53	54	–	K-Bus Serial Port
Common L3/L4/L5/L6/L7	(–)	55	56	–	K-Bus Serial Port

Key to connection tables

[+] and [–] indicate the polarity of the dc output from these terminals.

(+) and (–) indicate the polarity for the applied dc supply.

In / Out the signal direction for the in phase condition.

Note: All relays have standard Midos terminal blocks to which connections can be made with either 4mm screws or 4.8mm pre-insulated snap-on connectors. Two connections can be made to each terminal.

3.1 Auxiliary supply

The auxiliary voltage may be ac or dc provided it is within the limiting voltages for the particular relay. The voltage range will be found on the front plate of the relay; it is marked (Vx = 24 – 125V) or (48 – 250V). An ideal supply to use for testing the relays will be 50V dc or 110V ac because these values fall within both of the auxiliary voltage ranges.

The supply should be connected to terminals 13 and 14 only. To avoid any confusion it is recommended that the polarity of any applied voltage is kept to the Midos standard:

For dc supplies the positive lead connected to terminal 13 and the negative to terminal 14.

For ac supplies the live lead is connected to terminal 13 and the neutral lead to terminal 14.

Note: To avoid damage to the relay do not connect any auxiliary supplies to terminals 7 and 8.

3.2 Opto-isolated control inputs

The opto-isolated control inputs are rated for 48V and energised from the isolated 48V field voltage provided on terminals 7 and 8 of the relay. Terminal 8(–) must be connected to terminals 52 and 55. The opto-isolated control inputs can then be energised by connecting a volt free contact between terminal 7(+) and the terminal associated with the required input L0 to L7 given in the above table.

The circuit for each opto-isolated input contains a blocking diode to protect it from any damage that may result from the application of voltage with incorrect polarity.

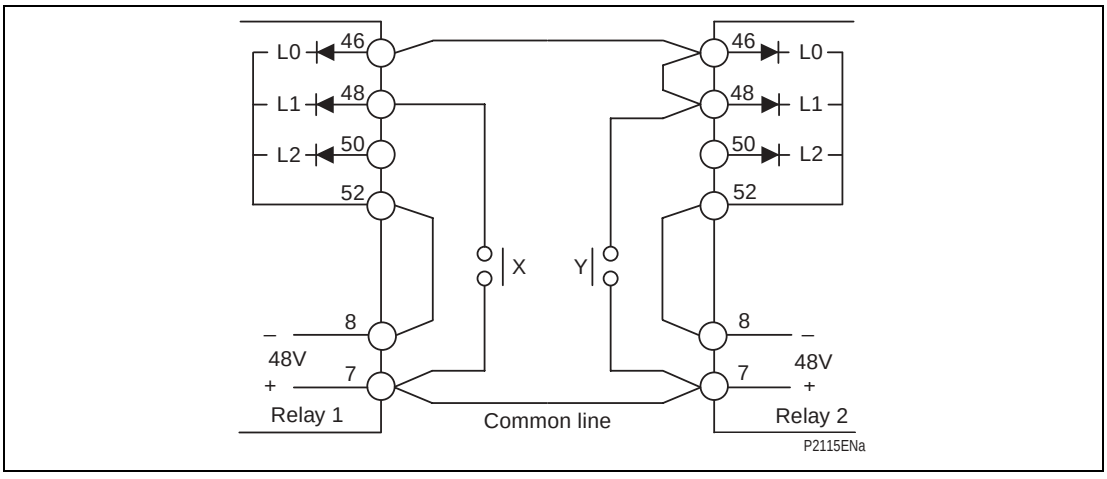


Figure 3. Connection to opto-isolated control inputs

Where the opto-isolated input of more than one relay is to be controlled by the same contact it will be necessary to connect terminal 7 of each relay together to form a common line. In the example, shown in Figure 1, contact X operates L1 of relay 1 and contact Y operates L0 of relay 1 as well as L0/L1 of relay 2. L2 is not used on either relay and has no connections made to it.

3.3 Analog inputs

KAVR relays have two analog inputs on the microprocessor board. Each is fed via an input transducer, a low pass filter and a three range scaling amplifier. The analog signals are sampled eight times per cycle on each channel as the sampling rate tracks the frequency of the input signal.

The wide setting range provided is sufficient to enable the relays to operate over the voltage range 5V to 132V. Thus the same relay can be connected phase to phase or phase to neutral.

3.4 Output relays

There are four programmable output relays on the microprocessor board and four on the auxiliary expansion board. These relays each have two make contacts connected in series to increase their rating. The functions to which these relays respond are selectable via the menu system of the relay.

In addition there is a watchdog relay which has one make and one break contact. Thus it can indicate both healthy and failed conditions. As these contacts are mainly used for alarm purposes single contacts are used and their rating is therefore not quite as high as that of the programmable outputs.

The terminal numbers for the output relay contacts are given in the table at the start of Section 3.

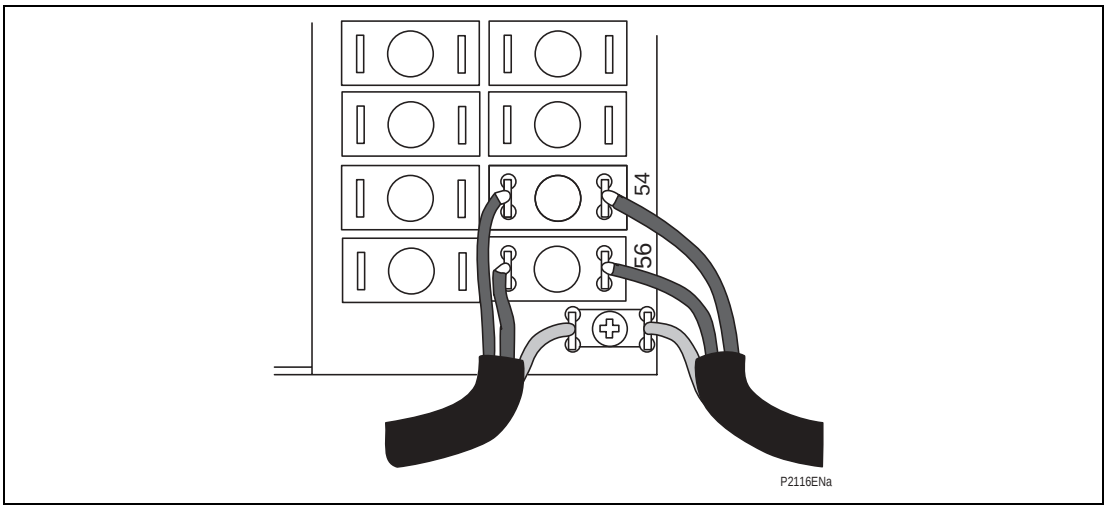


Figure 4. Terminal arrangement for communications

3.5 Serial communication port (K-Bus)

Connection to the K-Bus Port is by standard Midos 4mm screw terminals or snap-on connectors. A twisted pair of wires is all that is required; the polarity of connection is not important. It is recommended that an outer screen is used with an earth connected to the screen at the Master Station end only. Termination of the screen is effected with the "U" shaped terminal supplied and which has to be secured with a self tapping screw in the hole in the terminal block just below terminal 56. Operation has been tested up to 1,000 metres with cable to:

DEF Standard 16-2-2c

16/0.2mm dia

40mΩ/m per core

171pf/m core/core

288pf/m core/screen

The minimum requirement to communicate with the relay is a K-Bus/IEC 60870-5 converter box Type KITZ101 and suitable software to run on an IBM or compatible personal computer.

4. USER INTERFACE

The interface provides the user with a means of entering settings to the relay and of interrogating the relays to retrieve recorded data.

4.1 Front plate layout

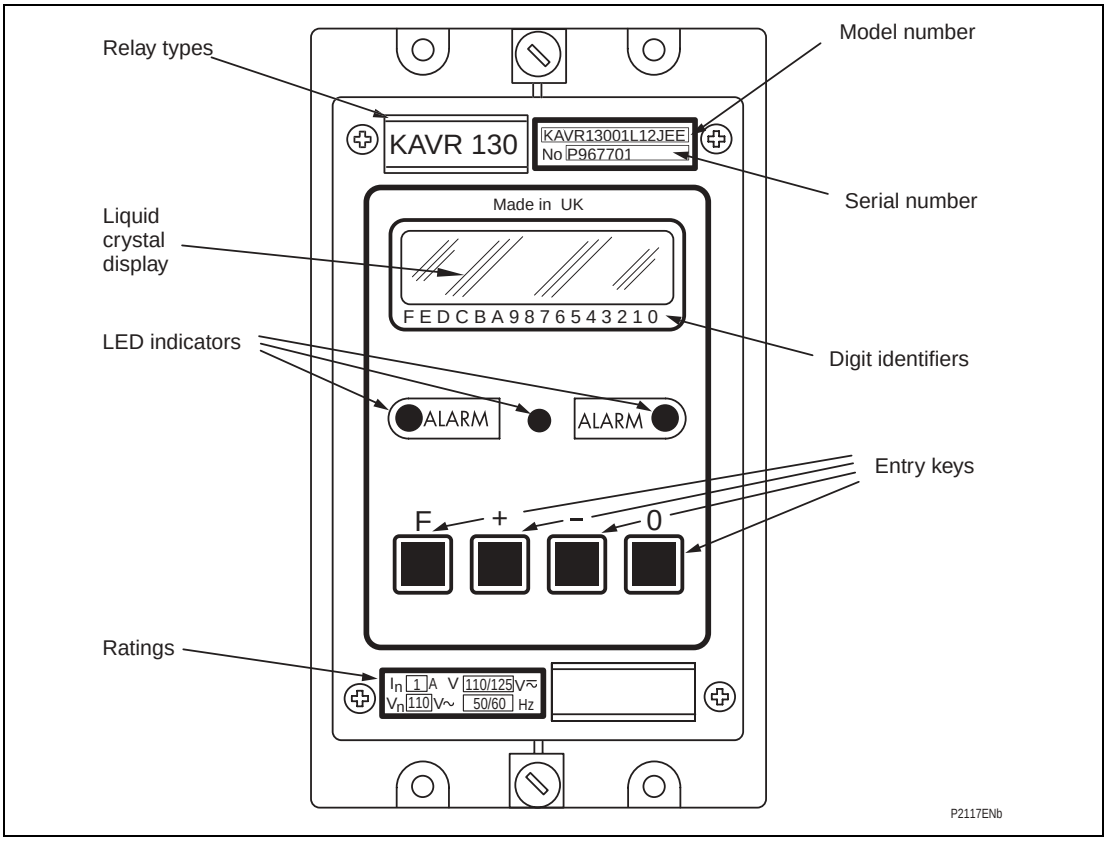


Figure 5. Front plate layout

The front plate of the relay carries an identification label at the top corner. This identifies the relay by both its model number and serial number. This information is required when making any enquiry to the factory about a particular relay because it uniquely specifies the product. In addition there is a rating label in the bottom corner which gives details of the auxiliary voltage rating.

Two handles, one at the top and one at the bottom of the front plate, will assist in removing the module from the case. Three light emitting diodes (LED's) provide status indication and in addition there may be a liquid crystal display and a four key pad for access to settings and other readable data.

4.2 LED indications

The three LED's provide the following functions:

GREEN LED Indicates the relay is powered up and running. In most cases it follows the watchdog relay.

YELLOW LED

1. Indicates alarm conditions that have been detected by the relay during its self checking routine.
2. Flashes when the password is entered (password inhibition temporarily overridden).
3. Indicates alarm condition(s) entered in the logic diagram have occurred.

RED LED — Indicates alarm condition(s) defined in the ladder diagram have occurred.

4.3 Keypad

Four keys on the front plate of the relay enable the user to select the data to be displayed and settings to be changed. The keys perform the following functions:

[F] – FUNCTION SELECT KEY

[+] – INCREMENT VALUE KEY

[–] – DECREMENT VALUE KEY

[0] – RESET/ESCAPE KEY

4.4 Liquid crystal display

The liquid crystal display (LCD) has two lines, each of sixteen characters, that are used to display settings, measured values and records which are extracted from the relays' data bank. A backlight is activated when any of the keys on the front plate of the relay is momentarily pressed. This enables the display to be read in all conditions of ambient lighting.

The numbers printed on the front plate just below the display identify the individual digits that are displayed for some of the settings, i.e. function links, relay masks etc.

5. MENU SYSTEM

Data within the relays is accessed via a MENU table. The table is divided into columns and rows to form cells, rather like a spreadsheet. Each cell may contain text, values, limits and functions. The first cell in a column contains a heading which identifies the data grouped on that column.

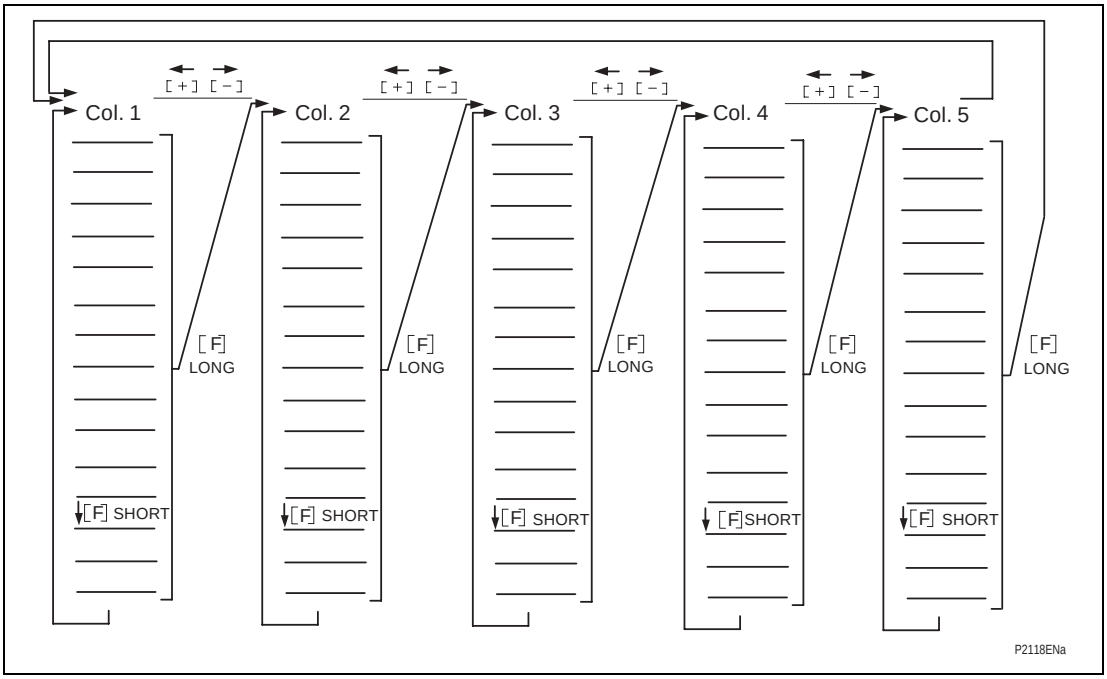


Figure 6. Menu system of relay

Four keys on the front plate of the relay allow the menu to be scanned and the contents displayed on a two line by sixteen character liquid crystal display (LCD). The act of depressing any key will result in the LCD backlight being switched on. The backlight will turn off again if a key is not pressed again within one minute.

The display will normally be the selected default setting and a momentary press of the function key [F] will change the display to the heading for the first column, SYSTEM DATA. Further momentary presses of the [F] key will step down the column, row by row, so that data may be read. If at any time the [F] key is pressed and held for one second the cursor will be moved to the top of the next column and the heading for that column will be displayed. Further momentary presses of the [F] key will then move down the new column, row by row. In this way the full menu of the relay may be scanned with just one key, the [F] key, and this key is accessible with the cover in place on the relay.

The other key that is accessible with the cover in place is the reset key [0]. A momentary press of this key will switch on the back light for the LCD without changing the display in any way.

To change any setting the cover has to be removed from the relay to gain access to the [+] and [–] keys, which are used to increment or decrement, a setting value, or reset a counter value to zero. When a column heading is displayed the [–] key will change the display to the next column and the [+] key will change the display to the previous column, giving a faster selection.

When a cell containing a relay setting is displayed the action of pressing either the [+] or [–] keys will indicate to the relay that a value is to be changed and a flashing cursor will appear on the display. To escape from the setting mode, without making

any change, the [0] key should be depressed for one second. For instruction on how to change the various types of settings refer to Section 5.2.

5.1 Menu contents

Related data and settings are grouped together in separate columns of the menu. Each column has a text heading that identifies the data contained in that column. Each cell may contain text, values, limits and/or a function. The cells are referenced by the column number/row number. For example 0201 is column 02, row 01.

The full menu is given in the following notes but not all the items will be available in a particular relay. Those cells that do not provide any useful purpose are not made available in the factory configuration to avoid the confusion that would occur in deciding what values to set them to. In a similar way certain settings will disappear from the menu when the user de-selects them

The menu cells that are read only are marked [READ].

Cells that can be set are marked [SET].

Cells that can be reset are marked [RESET].

Cells that are password protected are marked [PWP].

5.1.1 SYSTEM DATA

0002	SYS Password	Password [PWP]
0003	SYS Fn Links	Function Links [PWP]
	LINK 0 [SYS Rem ChgStg] LINK 7 [SYS En Log Evts]	1 = Enable remote setting changes 1 = Enable all event records to be stored
0004	SYS Description	Description or user scheme identifier [PWP]
0005	SYS Plant Ref.	User plant/location identifier [PWP]
0006	SYS Model No.	Model number [READ]
0007	SYS Firmware No.	Firmware Number [READ]
0008	SYS Serial No.	Serial number [READ]
0009	SYS Frequency	Frequency [SET]
000A	SYS Comms Level	Communication level [READ]
000B	SYS Rly Address	Communication address [SET]
000C	SYS Plant Status	Plant Status [READ]
000D	SYS Ctrl Status	Control Status [READ]
0011	SYS Software Ref	Reference number of the operating system software [READ]
0012	SYS Ladder Ref	Reference number of the ladder diagram software [READ]
0020	SYS Opto Status	Status of the opto inputs [READ]
0021	SYS Relay Status	Status of the relay outputs [READ]
0022	SYS Alarms	State of alarms, bits 0 to 6 [READ]; test watchdog, bit 7 [SET]

0002 SYS Password [PWP]

The selected configuration of the relay is locked under this password and cannot be changed until it has been entered. Provision has been made for the user to change the password, which may consists of four upper case letters in any combination. In the event of the password becoming lost a recovery password may be obtained on request, but the request must be accompanied by a note of the model and serial number of the relay. The recovery password will be unique to one relay and will not work on any other unless the user set password is the same.

0003 SYS Fn Links [PWP]

These function links enable selection to be made from the system options, for example what commands over the serial link will be acted upon.

LINK 0 [SYS Rem ChgStg]	Set to 0, settings can only be changed at the relay. Set to 1, settings can also be changed over the communications link.
LINK 7 [SYS En Log Evts]	Set to 0, changes to opto inputs and output relays do not register as events. Set to 1, changes to opto inputs and output relays register as events.

0004 SYS Description [PWP]

This is text that describes the relay type, for example “Auto-reclose”. It is password protected and can be changed by the user to a name which may describe the scheme configuration of the relay if the relay is changed from the factory configuration.

0005 SYS Plant Ref. [PWP]

The plant reference can be entered by the user, but it is limited to 16 characters. This reference is used to identify the primary plant that the relay is associated with.

0006 SYS Model No. [READ]

The model number that is entered during manufacture has encoded into it the mechanical assembly, ratings and configuration of the relay. It is the same as the model number printed on the front plate and this number should be quoted in any correspondence concerning the product.

0007 SYS Firmware Number [READ]

The version of software and memory components is coded into this number. It can not be changed.

0008 SYS Serial Number [READ]

The serial number is the relay identity and encodes also the year of manufacture. It can not be changed from the menu.

0009 SYS Frequency [SET]

The set frequency from which the relay starts tracking on power-up. It also controls the sampling frequency of the opto inputs, so should be set to the system frequency, even for a KVTR.

000A SYS Communication Level [READ]

This cell will contain the communication level that the relay will support. It is used by Master Station programs to decide what type of commands to send to the relay.

000B SYS Relay Address [SET]

An address between 1 and 254 that identifies the relay when interconnected by a communication bus. These addresses may be shared between several communication buses and therefore not all these addresses will necessarily be available on the bus to which the relay is connected. The address can be manually set. Address 0 is reserved for the automatic address allocation feature and 255 is reserved for global messages. The factory set address is 255.

000C SYS Plant Status [READ]

Plant status is a 16 bit word which is used to transport plant status information over the communication network. The various bit pairs are pre-allocated to specific items of plant.

000D SYS Control Status [READ]

The control status word acts like software contacts to transfer data from the relay to the master station controlling communications. In autoreclose relays the function of each bit is defined in the ladder diagram and a description of the function of the bit is entered. The description will be displayed in the CONTROL OUTPUTS menu column, along with its state (ON or OFF).

0011 SYS Software Ref [READ]

The version of operating system software is coded into this number. It can not be changed.

0012 SYS Ladder Ref [READ]

The version of ladder diagram software is coded into this number. It can not be changed.

0020 SYS Opto Status [READ]

Displays the status of the opto inputs. 1 means the input is on, 0 means it is off.

0021 SYS Relay Status [READ]

Displays the status of the output relays. 1 means the relay is on, 0 means it is off.

0022 SYS Alarms

Current state of alarm flags (see 2.11and 5.2.10).

5.1.2 USER CONTROLS [SET]

0101 to 0110

Up to 16 user controls may be entered in the ladder. They act as inputs in the ladder. User controls not entered will not be displayed. Any displayed user control can be operated by pressing the [0] key. A user control will remain on for a minimum of approximately 250ms, or until the [0] key is released.

5.1.3 CONTROL OUTPUTS [READ]

0201 to 0210

Up to 16 control status outputs may be entered in the ladder. Outputs not entered will not be displayed. Each displayed output consists of some text describing its function and its state (ON or OFF). These outputs correspond to the bits in the control status word.

5.1.4 EVENT RECORDS [READ]

0300 to 0310

This column will display "Scheme Events" data.

5.1.5 MEASUREMENTS [READ]

0401	MES Line Voltage	Line voltage
0402	MES Bus Voltage	Bus voltage
0403	MES Phase Angle	Angle between the line and bus voltages
0404	MES System Frq	Frequency of the line voltage
0405	MES Slip Frq	Difference in frequency between the input voltages

This column is only available if one or more check synchronism elements are entered in the ladder diagram.

The measurements display can be selected as the default display.

5.1.6 COUNTER VALUES [READ]

0500 to 0510

This column displays Counter Values (messages) – see Section 2.10.

5.1.7 ALARMS [READ]

0600 to 0610

This column displays all active Scheme – see Section 2.11.

If any alarms are enabled, the alarm text will overwrite the default display.

5.1.8 CHECK SYNCH STGS [SET]

(Check synchronism settings)

Note: This column is only visible if one or more check synchronism elements are entered in the ladder diagram.

0701	CSS Fn. Links	Check synchronism function links [PWP]	
	Link 0 [Synccheck]	1 =	enable check synchronism phase angle measurement
	Link 1 [Slipfreq]	1 =	enable slip frequency measurement (if link 0 = 1)
	Link 2 [Sliptime]	1 =	enable slip timer (if link 0 = 1)
	Link 3 [Splitdet]	1 =	enable system split detector
	Link 4 [Splittime]	1 =	enable split timer (if link 3 = 1)

	Link 5 [Syscheck]	1 =	enable system phase angle measurement
	Link 6 [Sysfreq]	1 =	enable system frequency measurement (if link 5 = 1)
	Link 7 [Systime]	1 =	enable slip timer (if link 5 = 1)
	Link 8 [DLLB]	1 =	enable dead line/live bus voltage detection
	Link 9 [LLDB]	1 =	enable live line/dead bus voltage detection
	Link A(10) [DLDB]	1 =	enable dead line/dead bus voltage detection
	Link B(11 [UV Block]	1 =	enable undervoltage monitor to block operation of the phase angle and system angle measurements
	Link C(12) [UVOP]	0 =	set undervoltage element output to be on for undervoltage condition
		1 =	set undervoltage element output to be off for undervoltage condition
	Link D(13) [DiffBLK]	1 =	enable differential voltage monitor to block operation of the phase angle and system angle measurements
	Link E(14) [DiffOP]	0 =	set differential voltage element output to be on for differential voltage condition
		1 =	set differential voltage element output to be off for differential voltage condition
0702	CSS VT Ratio	Ratio of both VTs[PWP]	
0703	CSS Phase angle	Angle must be less than setting for check synchronism to be allowed	
0704	CSS Slip Freq.	Rate of change of angle must be less than setting for check synchronism to be allowed	
0705	CSS Synch Timer	Angle must be less than phase angle setting for longer than this setting for check synchronism to be allowed	
0706	CSS Split Angle	Angle must be greater than setting to detect a system split condition	
0707	CSS Split Timer	Minimum time for which system split detector output will remain on	
0708	CSS System Angle	Angle must be less than setting for system synchronism to be allowed	
0709	CSS System Slip	Rate of change of angle must be less than setting for system synchronism to be allowed	
070A	CSS System Timer	Angle must be less than system angle setting for longer than this setting for system synchronism to be allowed	

070B	CSS V. B/L Live	Voltage above which the line and bus are considered live
070C	CSS V.B/L Dead	Voltage below which the line and bus are considered dead
070D	CSS Undervoltage	Voltage below which undervoltage detector operates
070E	CSS Diff Voltage	If the difference between the incoming voltages exceeds this setting the difference voltage detector operates

5.1.9 TIMER SETTINGS [SET]

0801 to 0810

Up to 16 user adjustable timer settings entered in the ladder. Settings not entered will not be displayed.

Up to 16 characters of text to describe the timer, and maximum and minimum limits to restrict the setting range of the timer can be entered. The default setting range is 0.01 seconds to 9999 seconds.

5.1.10 COUNTER SETTINGS [SET]

0901 to 0910

Up to 16 counter settings entered in the ladder. Settings not entered will not be displayed.

Up to 16 characters of text to describe the setting, and maximum and minimum limits to restrict the setting range of the setting can be entered. The default setting range is 1 to 9999.

5.1.11 LOGIC FUNCTIONS [SET]

0A01	Scheme Fn. Links 1	Function links entered in ladder, numbers 0 to 15
0A02	Scheme Fn. Links 2	Function links entered in ladder, numbers 16 to 31
0A03	LOG Input Status	State of inputs to the ladder diagram software (after masking) [READ]
0A04	LOG Output Status	State of the outputs of the ladder diagram software, before masking onto the output relays [READ]
0A05	LOG Default Dsply	Selects the default display [SET]

The selection can be:

1. The manufacturer's display (AREVA T&D K-SERIES MIDOS)
2. The ladder default display
3. Description (or user defined scheme reference)
4. Plant Reference (user defined)
5. V Line V Bus
6. The Counter Values

7. Measurements (See Section 5.1.5)

0A06	LOG Rotation	Selects if default display 5 or 6 and the alarm display will change every 5 seconds or only when the [F] key is pressed [SET]
0A07	LOG TEST RELAYS Select	Selects output relays which will change state when cell 0A08 is reset [PWP]
0A08	LOG TEST RELAYS = (0)	Selected relays will change state when [0] key is pressed [PWP]

5.1.12 INPUT MASKS [PWP]

0B01 to 0B10

An eight bit mask is allocated to each functional logic input in the scheme logic. Please refer to Section 2.3 - Opto isolated inputs. Each cell in the INPUT MASKS column displays on the top line the defined display name for the associated input function, and on the bottom line a series of "1"s and "0"s for the selected mask. The numbers printed on the front plate under the display indicate which opto input (L7 to L0) is associated with each bit. A "1" indicates that the particular opto input will activate the selected logic input, and a "0" indicates that it will not.

5.1.13 RELAY MASKS [PWP]

0C01 to 0C10

An eight bit mask is allocated to each functional logic output in the scheme logic. Please refer to Section 2.5 - Output relays. Each cell in the RELAY MASKS column displays on the top line the defined display name for the associated output function, and on the bottom line a series of "1"s and "0"s for the selected mask. The numbers printed on the front plate under the display indicate which output relay (RLY7 to RLY0) is associated with each bit. "1" indicates that the particular output relay will operate when the selected logic output operates, and a "0" indicates that it will not.

5.1.14 RESET COUNTERS [SET]

0D01 to 0D10

This column displays counter registers – see Section 2.10. Any displayed counter can be reset to zero.

5.1.15 RECORDER (see also Section 5.3)

0E01	REC control	RUNNING/TRIGGERED/STOPPED [SET]
0E02	REC Capture	SAMPLES/MAGNITUDE/PHASE [SET]
0E03	REC Post Trigger	Trace length after trigger [SET]
0E04	REC Trig ON	Select ladder recorder trigger to trigger when turned on [SET] **(Not available in KAVR100)**
0E05	REC Trig OFF	Select ladder recorder trigger to trigger when turned off [SET] **(Not available in KAVR100)**

5.2 Changing text and settings

To enter the setting mode

Settings and text in certain cells of the menu can be changed via the user interface. To do this the cover must be removed from the front of the relay to gain access to the **[+]** & **[–]** keys. Give the **[F]** key a long press to change from the selected default display and switch on the backlight; the heading SYSTEM DATA will be displayed. Use the **[+]** & **[–]** keys, or a long **[F]** key press, to select the column containing the setting or text cell that is to be changed. Then with the **[F]** key step down the column until the contents of the cell are displayed. Press the **[+]** or **[–]** key to put the relay into the setting mode, which will be indicated by a flashing cursor on the bottom line of the display. If the cell is a read-only cell then the cursor will not appear and the relay will not be in the setting mode.

To escape from the setting mode

To escape from the setting procedure without effecting any change, hold the [0] key depressed for one second. The original setting will be retained

To accept the new setting

Press the **[F]** key until the display reads:

Are You Sure?

+ = YES – = NO .

Press the **[0]** key if you decide not to make any change.

Press the **[–]** key if you want to further modify the data before entry.

Press the **[+]** to accept the change. This will terminate the setting mode.

5.2.1 Entering passwords (in SYSTEM DATA column, cell 0002)

The **[+]** & **[–]** keys can be used to select a character at the position of the cursor. When the desired character has been set the **[F]** key can be given a momentary press to move the cursor to the position for the next character. The process can then be repeated to enter all four characters that make up the password. When the fourth character is acknowledged by a momentary press of the **[F]** key the display will read:

Are You Sure?

+ = YES – = NO

Press the **[0]** key if you decide not to enter the password.

Press the **[–]** key if you want to modify the entry.

Press the **[+]** to enter the password. The display will then show four stars **** and if the password was accepted the yellow LED will flash. If the password is not accepted a further attempt can be made to enter it, or the **[0]** key used to escape. Password protection is reinstated when the alarm LED stops flashing, two minutes after the last key press, or by selecting the PASSWORD cell and pressing the **[0]** key for more than one second.

5.2.2 Changing passwords

After entering the current password and it is accepted, as indicated by the alarm LED flashing, the **[F]** key is pressed momentarily to move to the next menu cell. If instead, it is required to enter a new password, the **[+]** key must be pressed to select the setting mode. A new password can be entered with the same procedure described in Section 5.2.1. Only capital (upper case) letters may be used for the password.

Be sure to make a note of the password before entering it.

Access will be denied without the correct password.

5.2.3 Entering text

Enter the setting mode as described in Section 5.2 and move the cursor with the **[F]** key to where the text is to be entered or changed. Then using the **[+]** & **[–]** key select the character to be displayed. The **[F]** key may then be used to move the cursor to the position of the next character and so on. Follow the instructions in Section 5.2 to exit from the setting change.

5.2.4 Changing function links

Select the page heading required and step down to the FUNCTION LINKS cell required and press either the **[+]** or **[–]** to put the relay in a setting change mode. A cursor will flash on the bottom line at the extreme left position. This is link "F"; as indicated by the character printed on the front plate under the display.

Press the **[F]** key to step along the row of links, one link at a time, until some text appears on the top line that describes the function of a link. The **[+]** key will change the link to a "1" to set the function and the **[–]** key will change it to a "0" to clear it. Not all links can be set, some being factory selected and locked. The links that are locked in this way are usually those for functions that are not supported by a particular relay, when they will be set to "0". Merely moving the cursor past a link position does not change it in any way.

5.2.5 Changing setting values

Move through the menu until the cell that is to be edited is displayed. Press the **[+]** or **[–]** key to put the relay into the setting change mode. A cursor will flash in the extreme left hand position on the bottom line of the display to indicate that the relay is ready to have the setting changed. The value will be incremented in single steps by each momentary press of the **[+]** key, or if the **[+]** key is held down the value will be incremented with increasing rapidity until the key is released. Similarly, the **[–]** key can be used to decrement the value. Follow the instructions in Section 5.2 to exit from the setting change.

Note: When entering the VT ratio the overall ratio should be entered, i.e. 11000/110V VT has an overall ratio of 100:1. With rated voltage applied the relay will display 110V when VT ratio has the default value of 1:1 and when the VT ratio is set to 100:1 the displayed value will be 100 x 110 = 11000V.

5.2.6 Setting communication address

The communication address will normally be set to 255, the global address to all relays on the network, when the relay is first supplied. Reply messages are not issued from any relay for a global command, because they would all respond at the same time and result in contention on the bus. Setting the address to 255 will ensure that when first connected to the network they will not interfere with communications on existing installations. The communication address can be manually set by selecting

the appropriate cell for the SYSTEM DATA column, entering the setting mode as described in Section 5.2 and then decrementing or incrementing the address.

It is recommended that the user enters the plant reference in the appropriate cell and then sets the address manually to "0". The master station will then detect that a new relay has been added to the network and automatically allocate the next available address on the bus to which that relay is connected and communications will then be fully established.

5.2.7 Setting input masks and relay masks

To change a mask setting, it is necessary first to select the SYS Password cell and enter the correct password, as described in Section 5.2.1, then move to the required mask cell, and press either **[+]** or **[-]** to put the relay into a setting change mode. A cursor will then flash on the bottom line at bit position 7.

Press the [F] key to step along the row of bits, one at a time, changing bits as required. For each bit to be changed, press **[+]** to change it to "1" or **[-]** to change it to "0". Follow the instructions in Section 5.2 to exit from the setting change.

5.2.8 Resetting counter registers

Move to the required cell in the RESET COUNTERS column. The display shows on the top line the counter register display name, and on the bottom line the current contents of that register. Press either **[+]** or **[–]** to put the relay into a setting change mode. A cursor will then flash on the bottom line at bit position F.

Press **[+]**. The word RESET will appear on the bottom line, to the right of the current counter contents. Follow the instructions in Section 5.2 to exit from the reset procedure. If you confirm the reset by pressing **[+]** when the display shows:

Are You Sure?

+ = YES **–** = NO

the display bottom line will change to 0.

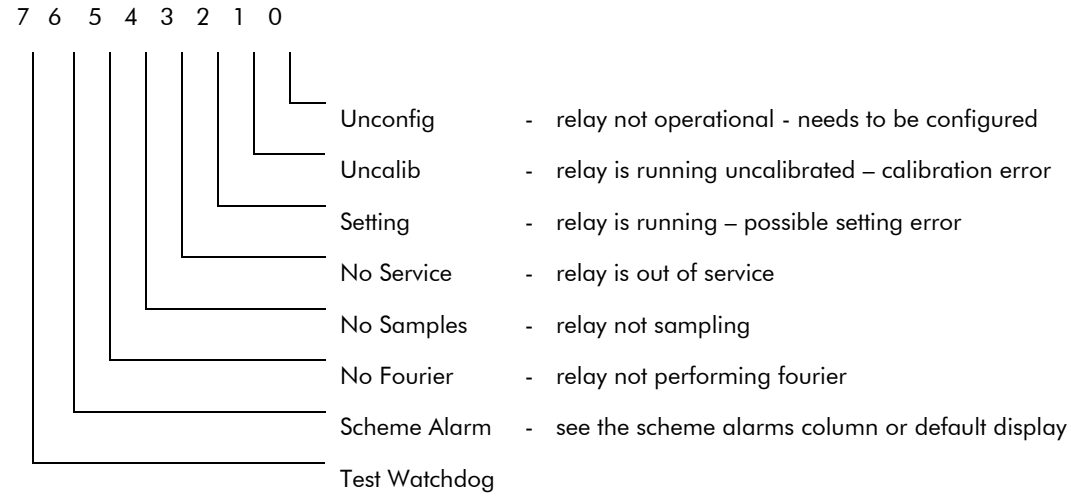
5.2.9 Resetting values and records

Some values and records can be reset to zero or some predefined value. To achieve this the menu cell must be displayed, then the [0] key must then be held depressed for at least one second to effect the reset.

5.2.10 Alarm records

The alarm flags are towards the end of the SYSTEM DATA column of the menu and consist of seven characters that may be either "1" or "0" to indicate the set and reset states of the alarm. The control keys perform for this menu cell in the same way as they do for Function Links and, if this cell is selected with the function key **[F],** the relay can then put in the setting mode by pressing the **[+]** key. The **[F]** can then be used to step the cursor to each bit in the alarm status word and text describing the alarm state indicated by the bit selected with the cursor will be displayed as the cursor passes over the individual bits. The numbers printed on the front plate of the relay under the display identify the individual bits in the alarm record.

Bit position



For the alarms listed above with the exception of the Scheme Alarm the amber alarm LED will be continuously lit. However, there is another form of alarm that causes the ALARM LED to flash and this indicates that the password has been entered to allow access to change protected settings within the relay. This is not generally available as a remote alarm and the alarm flags do not change. For LED indications for Scheme Alarms, please see Section 2.11.

No control will be possible via the key pad if the "Unconfigured" alarm is raised because the relay will be locked in a non operate-state.

5.2.11 Default display (LCD)

The LCD changes to a default display if no key presses are made for 15 minutes. The default display can be selected to any of the options listed in Section 5.1.11 LOGIC FUNCTIONS location 0A05 by following the setting procedure given in Section 5.2.5. The display can be returned to the default value, without waiting the 15 minute delay, by selecting any column heading and then holding the **[0]** reset key depressed for 1 second.

When a scheme alarm occurs, the display changes automatically to display the alarm text. All alarms must be cleared and, if necessary, the Reset Alarms cell reset, as described in Section 2.11, before the relay returns to the selected default display.

5.3 Disturbance recorders

The disturbance recorder may be triggered by several different methods dependent on the settings in this column of the menu. However, the records have to be read via the serial communication port and suitable additional software is required to reconstruct and display the wave forms. Only one complete record is stored and the recorder must be retriggered before another record can be captured.

5.3.1 Recorder control

This cell displays the state of the recorder:

RUNNING	–	recorder storing data (overwriting oldest data)
TRIGGERED	–	recorder stop delay triggered
STOPPED	–	recorder stopped and record ready for retrieval

When this cell is selected, manual control is possible and to achieve this the relay must be put into the setting mode by pressing the **[+]** key. A flashing cursor will then appear on the bottom line of the display at the left hand side. The **[+]** key will then select "RUNNING" and the **[–]** key will select triggered. When the appropriate function has been selected the **[F]** key is pressed to accept the selection and the selected function will take effect when the **[+]** key is pressed to confirm the selection. To abort the selection at any stage press the reset key **[0].**

5.3.2 Recorder capture

The recorder can capture:

SAMPLES	–	the individual calibrated samples
MAGNITUDES	–	the Fourier derived amplitudes
PHASES	–	the Fourier derived phase angles

The relay has no electro-mechanical adjustments, all calibration is effected in software and all three of the above options are used in the calibration process. For normal use as a fault recorder SAMPLES will be the most useful.

Relays without analog inputs cannot record magnitudes and phases as the Fourier software is not running. Only samples can be recorded and only the input and output digital channels will be obtained.

5.3.3 Recorder post trigger

The Post Trigger setting determines the length of the trace that occurs after the stop trigger is received. This may be set to any value between 1 and 512 samples. When recording samples the total trace duration is 512 ÷ 8 = 64 cycles because the interval between the samples is equivalent to one eighth of a cycle. However, the Fourier derived values are calculated once per cycle and so the total trace length when recording these calculated phase or amplitude values is 512 cycles.

5.3.4 Recorder logic triggers

Any or all of the disturbance recorder triggers detailed in section 2.12 can be selected as stop triggers, by setting 1 against the relevant bit or bits in cell REC Trig ON or REC Trig OFF. Any trigger which has its associated bit set to 0 will not trigger the disturbance record. The procedure for setting recorder triggers is the same as changing function links, described in section 5.2.4.

5.3.5 Notes on recorded times

The times recorded by triggering from the ladder recorder triggers are affected by the following factors:

The relay accepted the opto-isolated inputs as valid 12.5 ±2.5ms at 50Hz (10.4 ±2.1ms at 60Hz) after the opto-input was energised.

The recorder is triggered at the end of the execution of the ladder code during which the trigger swr is changed. Thus there could be up to 10ms delay between the event occurring in the ladder code and the recorded time.

The output relay coils are energised or de-energised at the end of the execution of the ladder code during which the coil memory is changed. The contacts will change approximately 5ms after the coil has been energised.

Otherwise time tags are generally to a resolution of 1ms for events and to a resolution of 1s for the samples in disturbance records.

6. SCHEME LOGIC

KAVR100 01 software scheme logic is documented in drawing number 08 KAVR100 01, sheets 1 to 11. Sheets 1 & 2 list all the scheme logic elements accessible via the user interface, sheets 3 to 9 document the logic in ladder diagram format, and sheets 10 & 11 list the factory default relay settings. Another version of the logic diagram, drawing number 08 KAVR100 00, sheets 1 to 11 is available on request, with spaces for users to fill in details of settings when changed from the default values. Drawing 08 KAVR100 00 sheets 1 to 9 are identical to 08 KAVR100 01 sheets 1 to 9: only sheets 10 & 11 are different.

KAVR100 02 software scheme logic is documented in drawing number 08 KAVR102 01, sheets 1 to 11. Sheets 1 & 2 list all the scheme logic elements accessible via the user interface, sheets 3 to 9 document the logic in ladder diagram format, and sheets 10 & 11 list the factory default relay settings. Another version of the logic diagram, drawing number 08 KAVR102 01, sheets 1 to 11 is available on request, with spaces for users to fill in details of settings when changed from the default values. Drawing 08 KAVR102 00 sheets 1 to 9 are identical to 08 KAVR102 01 sheets 1 to 9: only sheets 10 & 11 are different.

6.1 Ladder logic

The ladder logic shown in the above drawing is a graphical representation of the actual scheme logic. The ladder logic is arranged in a series of pages, each having six rows of seven elements. Each element position can be either blank or occupied by a graphical symbol representing a specific logic test (in columns 1 to 6 from the left hand side of the page) or logic flag (in column 7). A key to the ladder logic symbols is given in drawing number 08 KAXX 00 sheets 1 & 2.

The scheme logic is executed once every ten milliseconds, executing all pages sequentially, starting with page 1. On every page, the logic tests are executed column by column from left to right across the page, then the flags or actions in column 7 are set or reset according to the inputs resulting from the logic tests, before the next page logic is tested. The flags on each page then remain in the same state until that page is tested again during the next logic execution. It is important to remember that during the logic tests on any page, the status of any flag on that page is seen as it was at the end of the previous execution: the new flag state resulting from the current logic execution is not seen in logic tests on that page until the next execution.

It may be easier to interpret the scheme logic if the ladder logic is read as an electromagnetic schematic diagram, treating the left and right side uprights as positive and negative supply rails, flags in column 7 as relay coils, and logic test symbols in columns 1 to 6 as "make" or "break" relay contacts, time delayed contacts, etc. Using this approach, it is important to remember (i) the sequential page by page execution as described above, and (ii) all horizontal elements "conduct" left to right only, as if each incorporates a blocking diode.

6.2 Ladder logic: element identification

6.2.1 Inputs

Each ladder logic "contact" associated with a scheme logic input mask or user input is identified by a short ladder name, which is an abbreviated version of its full display name. Each element is further identified "input n" or "userin n", where "n" refers to the position of the input in the associated list in section 2.3 or 2.4. List numbering starts at 0. "Input n" numbers refer to the list positions of INPUT MASKS, not to any specific opto-inputs.

6.2.2 Outputs and software relays

Each ladder scheme logic output or control output element has a short ladder name, which is an abbreviated version of its full display name. Each “coil” symbol in column 7 is further identified “RL n” or “CS n”, where “n” refers to the position of the output in the associated list in section 2.5 or 2.6. List numbering starts at 0. “RL n” numbers refer to the list positions of output RELAY MASKS, not to any specific output relay contacts.

Each internal scheme logic flag, or “software relay”, has a short ladder name, but no other identification.

Each “contact” associated with a scheme logic output, control output or software relay, is identified by the same ladder name, with a reference underneath to the ladder page number and row number (Pn Rn) where the associated “coil” is located in the ladder logic. Software scheme function links

Each scheme function link “contact” is identified by the associated scheme function link number FNCT n.

6.2.3 Software scheme function links

Each scheme function link “contact” is identified by the associated scheme function link number FNCT n.

6.2.4 Other elements

Timer settings, counter registers and counter target settings used in the scheme logic are all identified by a short ladder name which is an abbreviation of the associated full display name, listed in section 2.9 or 2.10

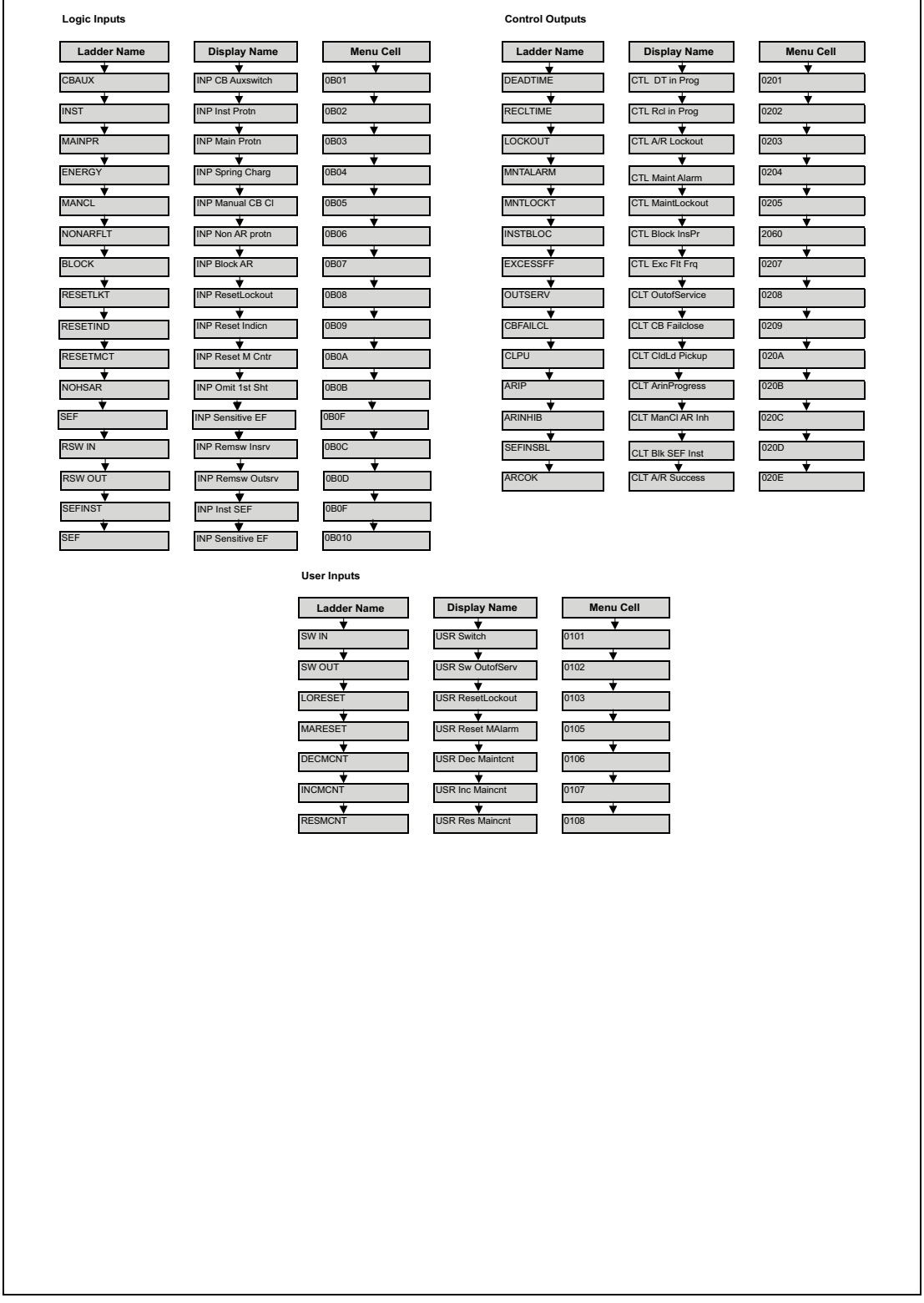


Figure 7. Scheme logic diagram: KAVR 100 (Drg No. 08 KAVR 100 01)

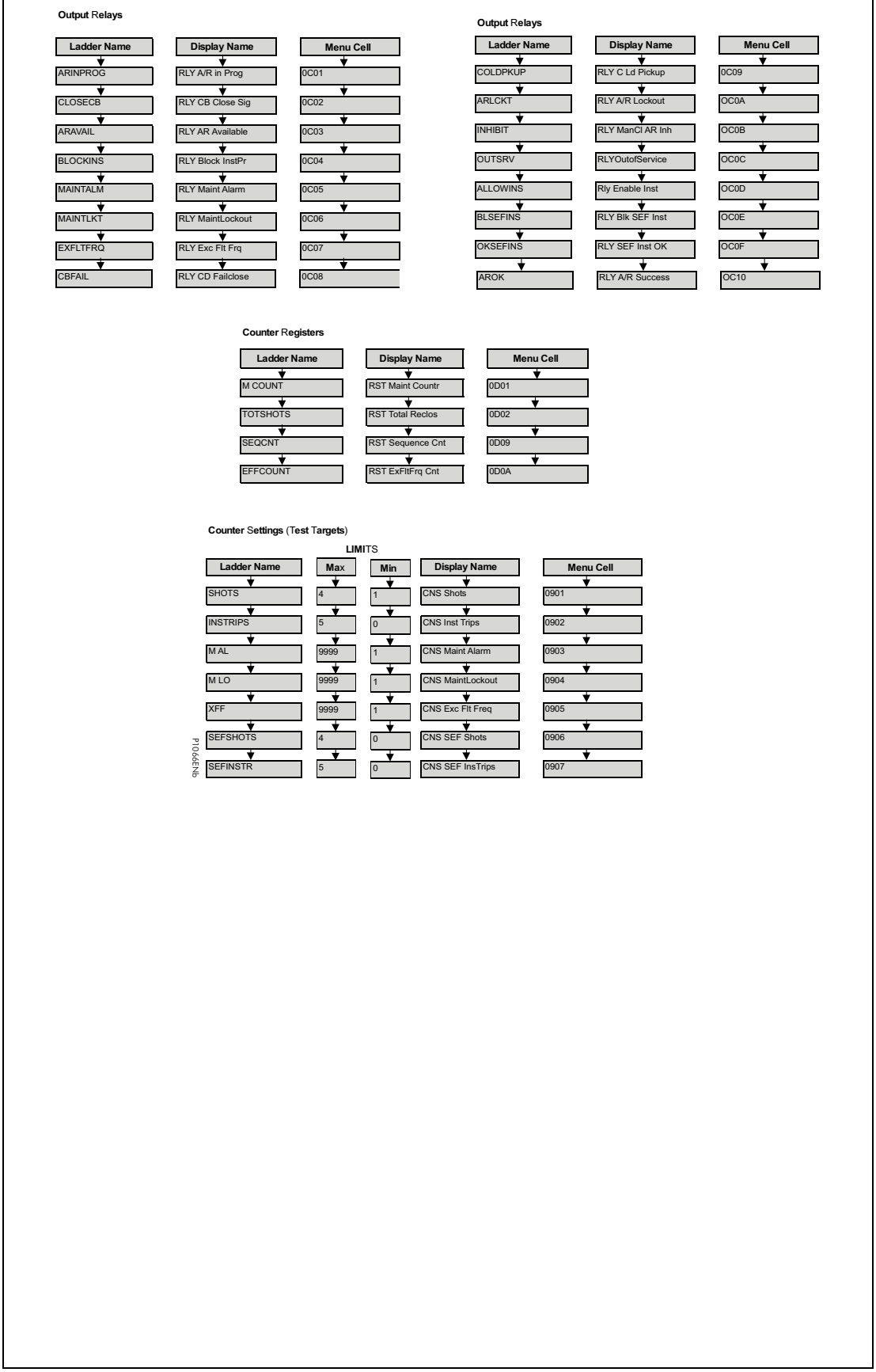


Figure 8. Scheme logic diagram: KAVR 100 (Drg No. 08 KAVR 100 01)

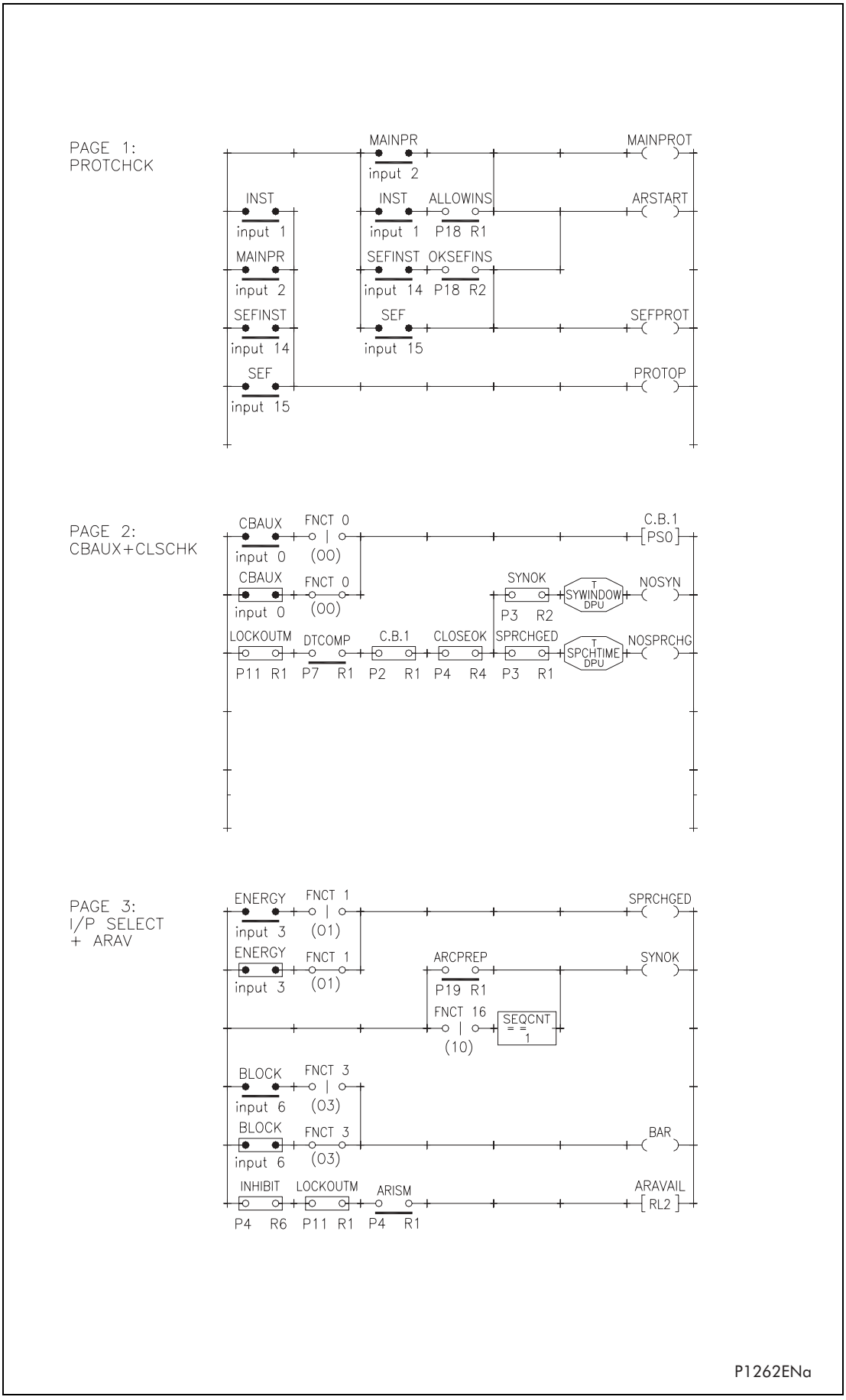


Figure 9. Scheme logic diagram: KAVR 100 (Drg No. 08 KAVR 100 01)

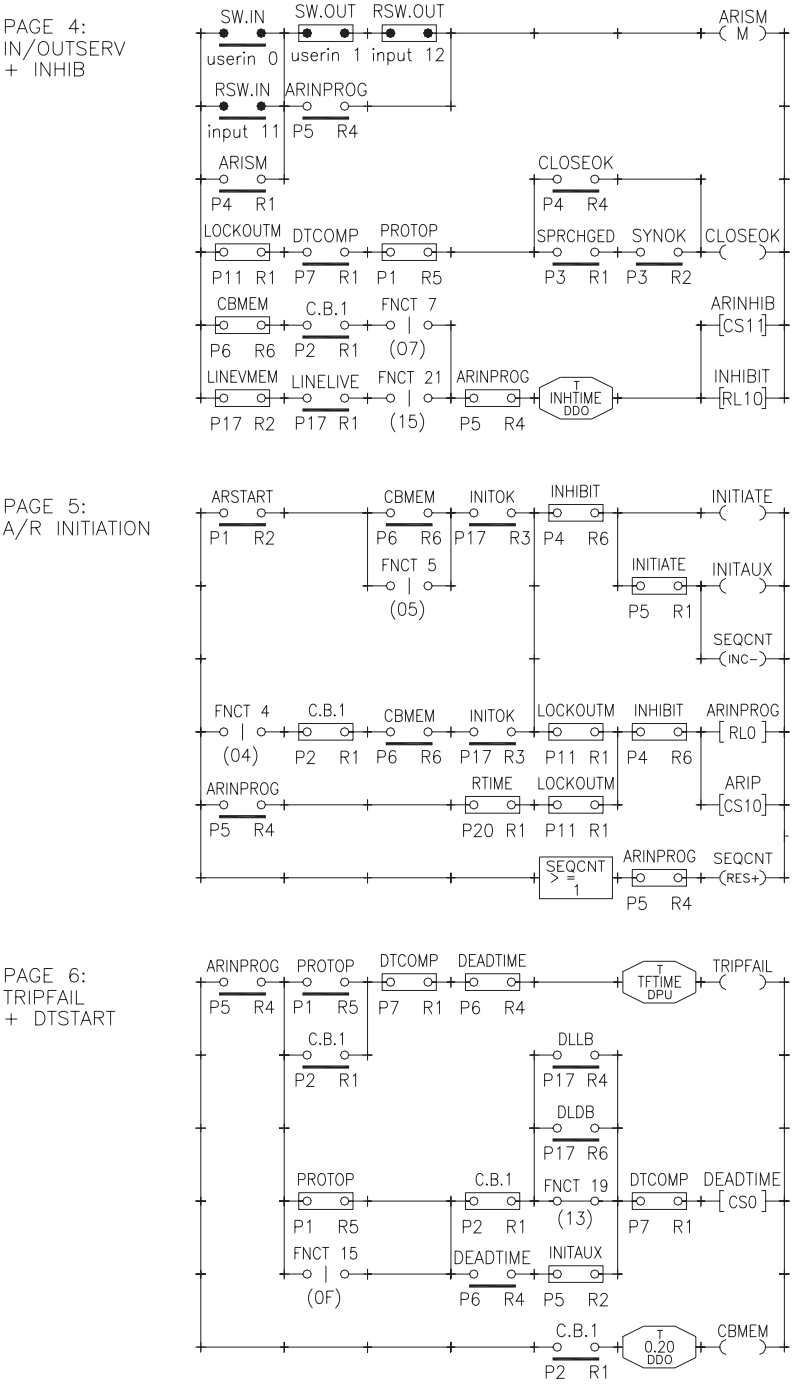


Figure 10. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

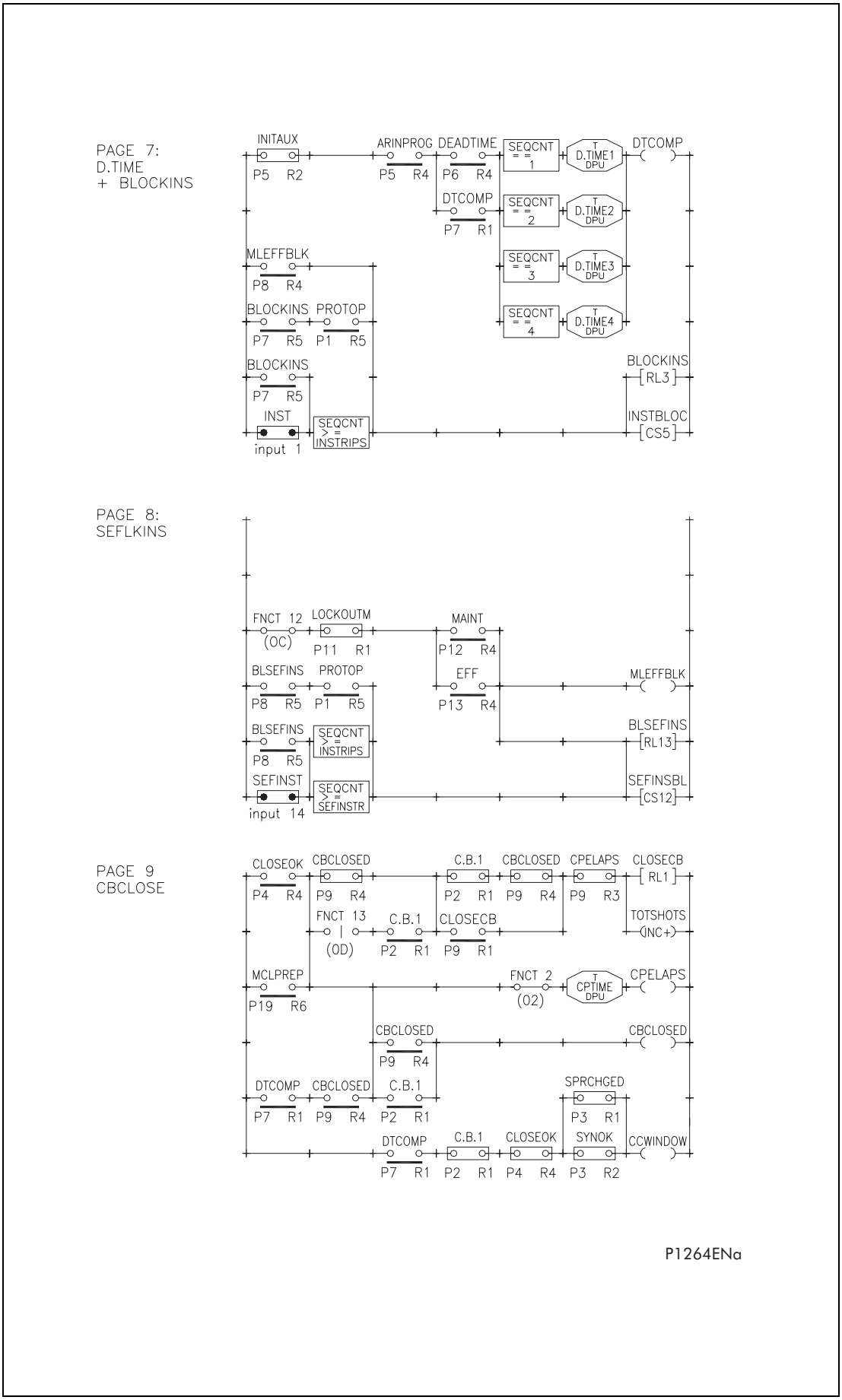


Figure 11. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

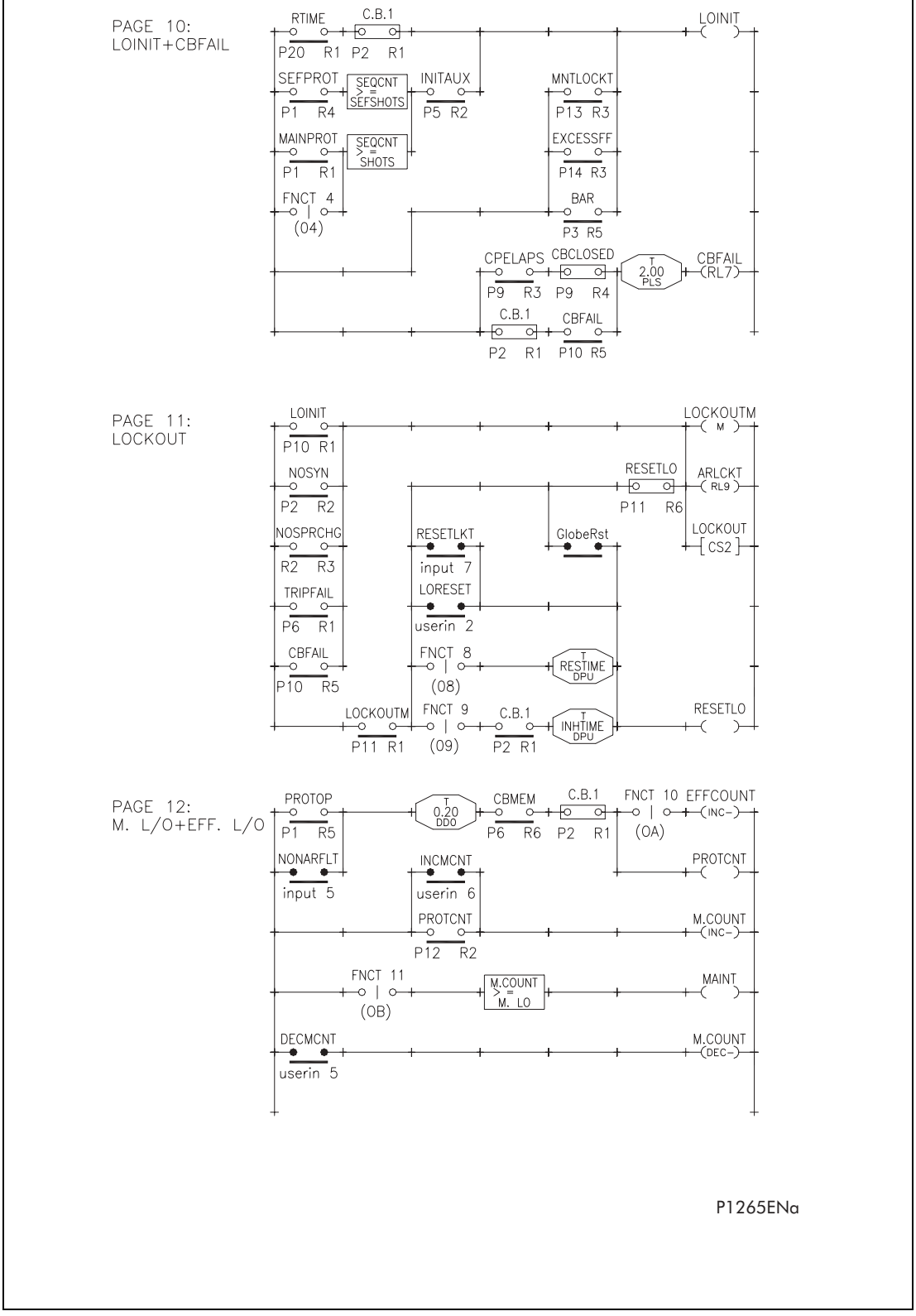


Figure 12. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

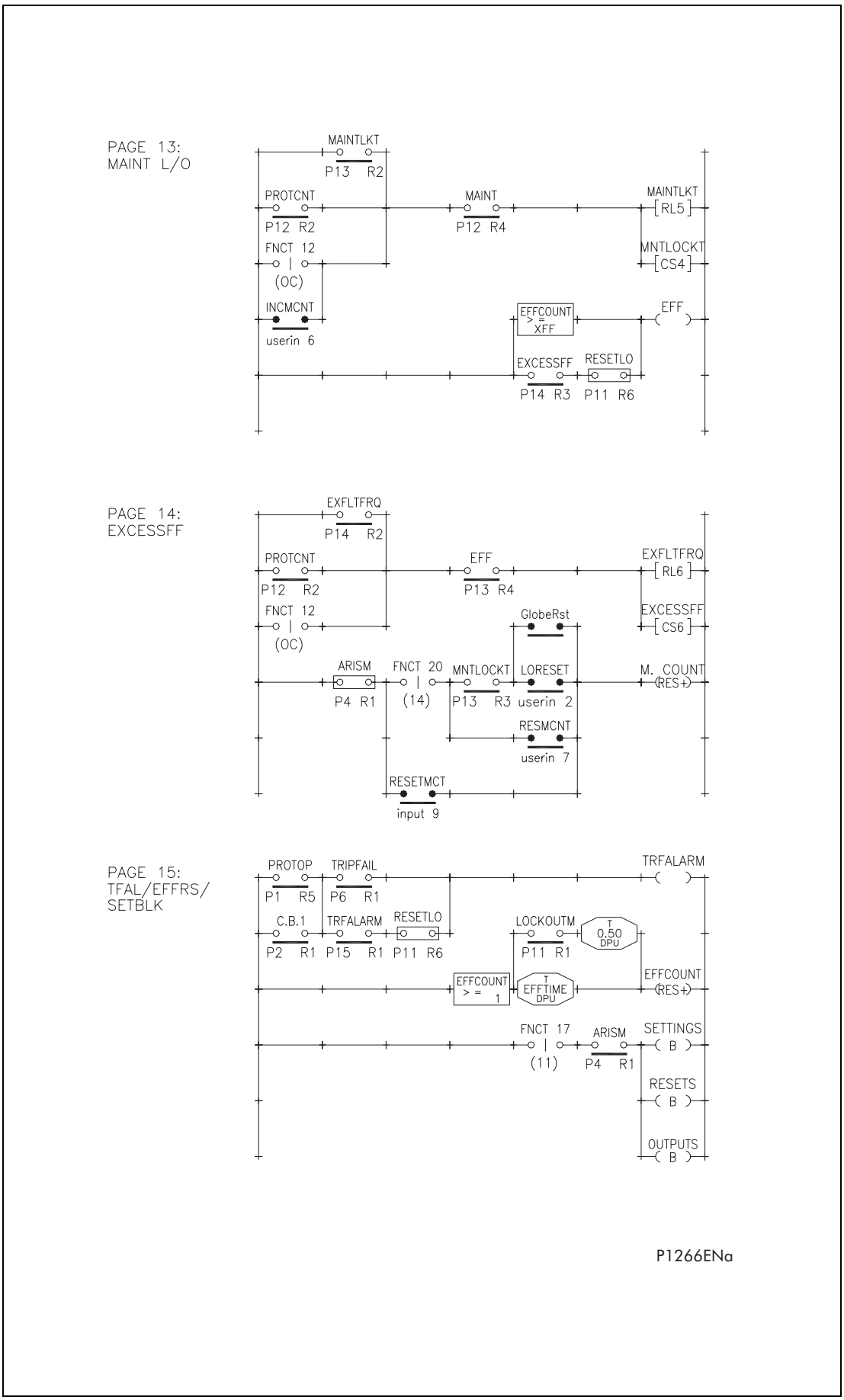


Figure 13. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

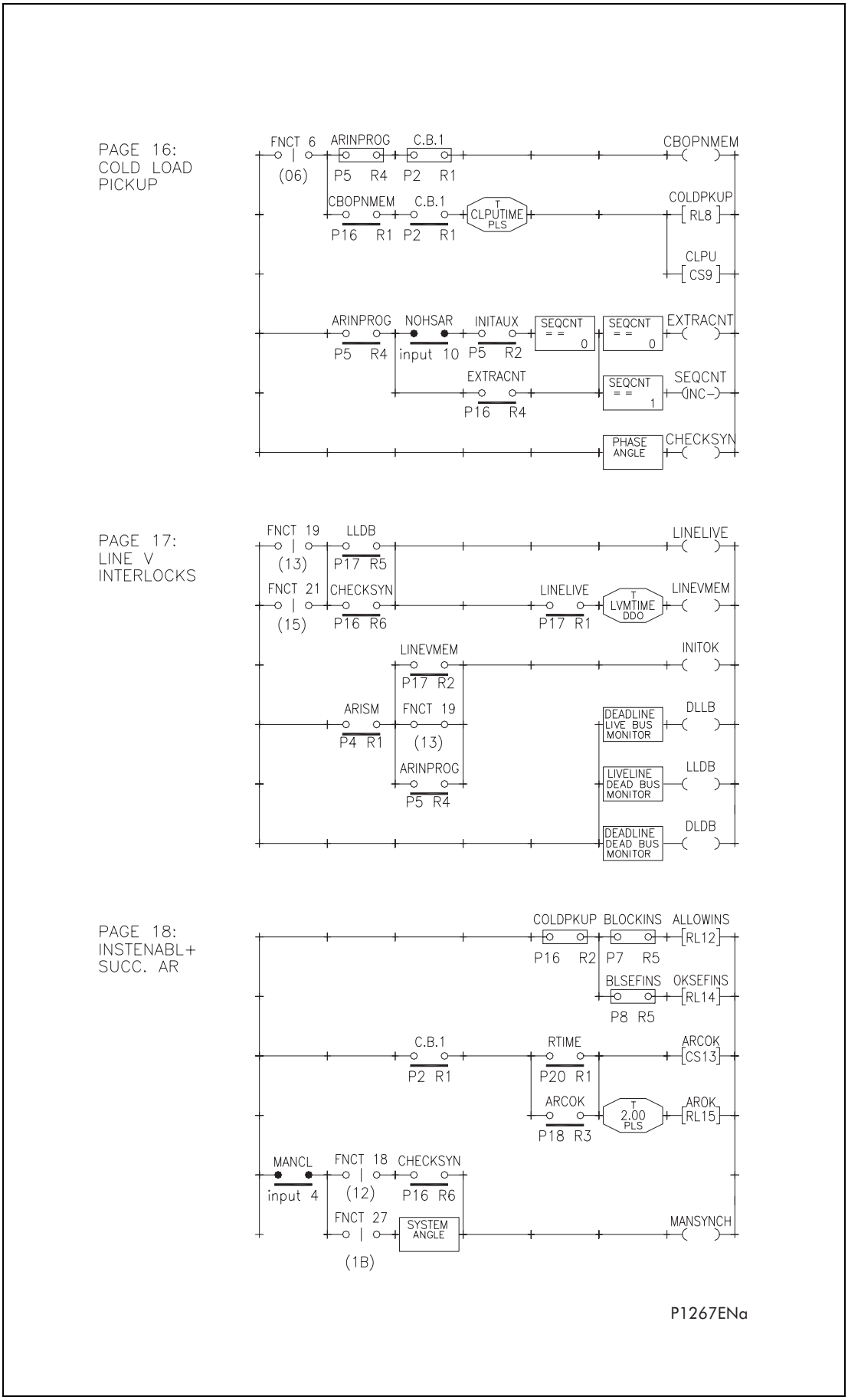


Figure 14. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

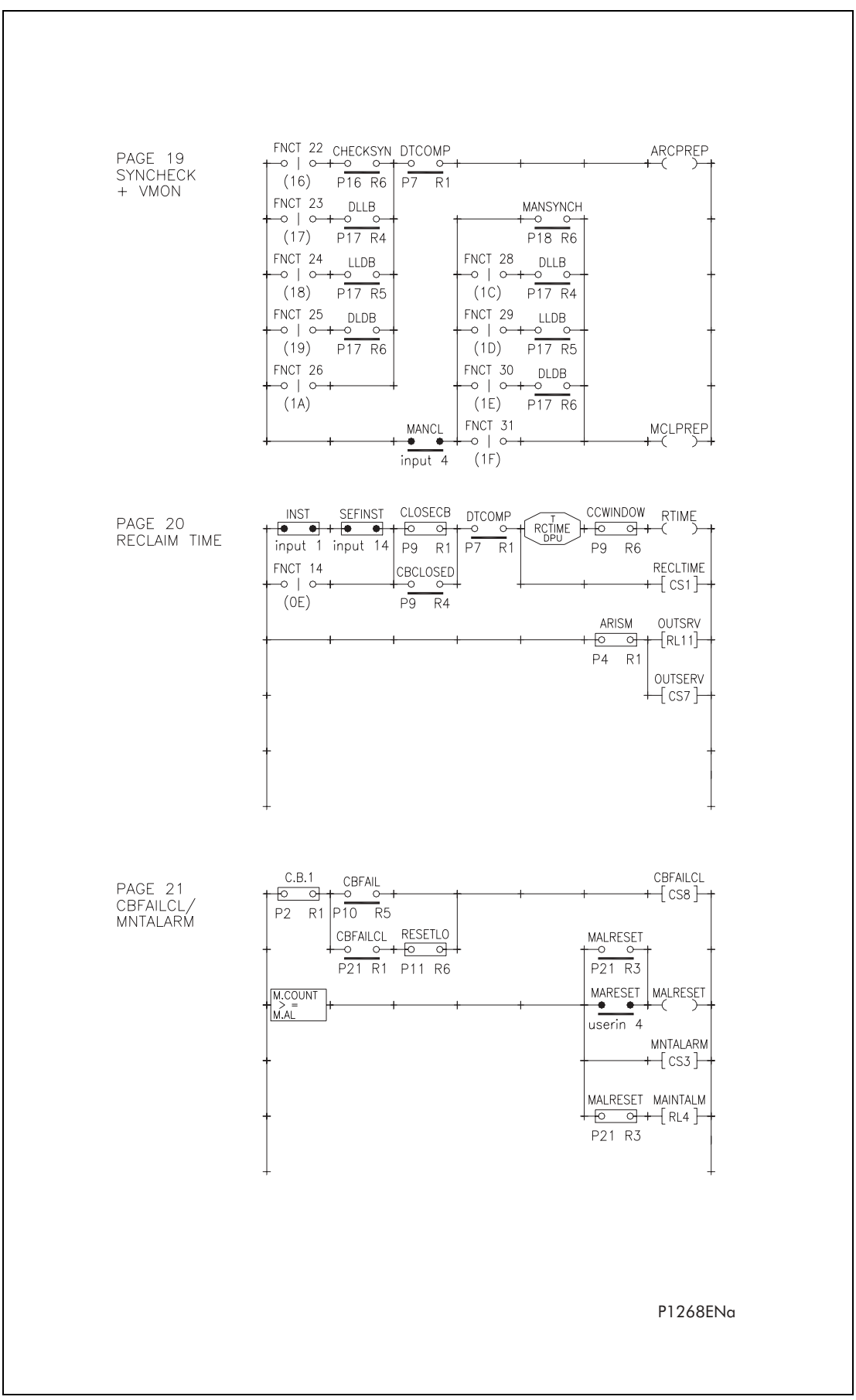


Figure 15. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

FUNCTION LINK SETTINGS

LINK NUMBER	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
SYS Fn. Links	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
CSS Fn. Links	0	0	1	0	1	1	1	1	1	1	1	0	0	1	1	1
Scheme Fn. Lnks 1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	1
Scheme Fn. Lnks 2	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0

TIMER SETTINGS

Dead Time 1	10 Seconds	SprCh Window	5 Seconds
Dead Time 2	60 Seconds	Mancl AR Inh	5 Seconds
Dead Time 3	180 Seconds	TripfailTime	1 Second
Dead Time 4	180 Seconds	Exc Flt Frq	1000 Seconds
Close Pulse	1 Second	Autoreset	300 Seconds
Reclaim Time	180 Seconds	C.Ld Pickup	600 Seconds
SynCh Window	5 Seconds	Linev Memory	2 Seconds

INPUT MASKS

OPTO NUMBER	7	6	5	4	3	2	1	0
INP CB AuxSwitch	0	0	0	0	0	0	0	1
INP Inst Protn	0	0	0	0	0	0	1	0
INP Main Protn	0	0	0	0	0	1	0	0
INP Spring Charg	0	0	0	0	1	0	0	0
INP Manual CB Cl	0	0	0	1	0	0	0	0
INP Non AR Protn	0	0	1	0	0	0	0	0
INP Block AR	0	1	0	0	0	0	0	0
INP ResetLockout	1	0	0	0	0	0	0	0
INP Reset Indicn	0	0	0	0	0	0	0	0
INP Reset M Cntr	0	0	0	0	0	0	0	0
INP Omit 1st Sht	0	0	0	0	0	0	0	0
INP RemSw Inserv	0	0	0	0	0	0	0	0
INP RemSw Outserv	0	0	0	0	0	0	0	0
INP Inst. SEF	0	0	0	0	0	0	0	0
INP Sensitive EF	0	0	0	0	0	0	0	0

RELAY MASKS

RELAY NUMBER	7	6	5	4	3	2	1	0
RLY A/R in Prog	0	0	0	0	0	0	0	1
RLY CB Close Sig	0	0	0	0	0	0	1	0
RLY AR Available	0	0	0	0	0	0	0	0
RLY Block InstPr	0	0	0	0	1	0	0	0
RLY Maint Alarm	0	0	0	1	0	0	0	0
RLY MaintLockout	0	0	1	0	0	0	0	0
RLY Exc Flt Frq	0	1	0	0	0	0	0	0
RLY CB Failclose	1	0	0	0	0	0	0	0
RLY C.Ld Pickup	0	0	0	0	1	0	0	0
RLY A/R Lockout	0	0	0	0	0	1	0	0
RLY ManCl AR Inh	0	0	0	0	0	0	0	0
RLY OutOfService	0	0	0	0	0	1	0	0
RLY Enable Inst	0	0	0	0	0	0	0	0
RLY Blk SEF Inst	0	0	0	0	0	0	0	0
RLY SEF Inst OK.	0	0	0	0	0	0	0	0
RLY A/R Success	0	0	0	0	0	0	0	0

CHECK SYNCH. SETTINGS

CSS V.T. Ratio	1:1
CSS Phase Angle	20°
CSS Slip Freq.	50mHz
CSS Synch. Timer	1 Second
CSS System Angle	20°
CSS System Slip	50mHz
CSS System Timer	1 Second
CSS V. B/L Live	32V
CSS V. B/L Dead	13V
CSS Undervoltage	54V
CSS Diff. Voltage	6.5V

P1260ENa

Figure 16. Relay settings: KAVR 100 (factory default settings) (Drg No 08 KAVR 10001)

COUNTER SETTINGS

CNS Shots	1
CNS Inst Trips	1
CNS Maint Alarm	19
CNS MaintLockout	20
CNS Exc Flt Freq	10
CNS SEF Shots	0
CNS SEF InsTrips	0

RESET COUNTERS

RST Maint Countr	0
RST Total Reclos	0
RST Sequence Cnt	0
RST ExFltFrq Cnt	0

LOGIC FUNCTIONS

DefaultDsply	Ladder
Rotation	Press [F] key
TEST RELAYS Select	00000000

RECORDER SETTINGS

REC Control	Triggered
REC Capture	Samples
REC Post Trigger	511 Samples

SYSTEM SETTINGS

SYS Password	AAAA
SYS Description	RECLOSE + CHKSYN
SYS Plant Ref.	RECLOSE + CHKSYN
SYS Frequency	50Hz
SYS Rly Address	255

P1261ENa

Figure 17. Relay settings: KAVR 100 (factory default settings) (Drg No. 08 KAVR 10001)

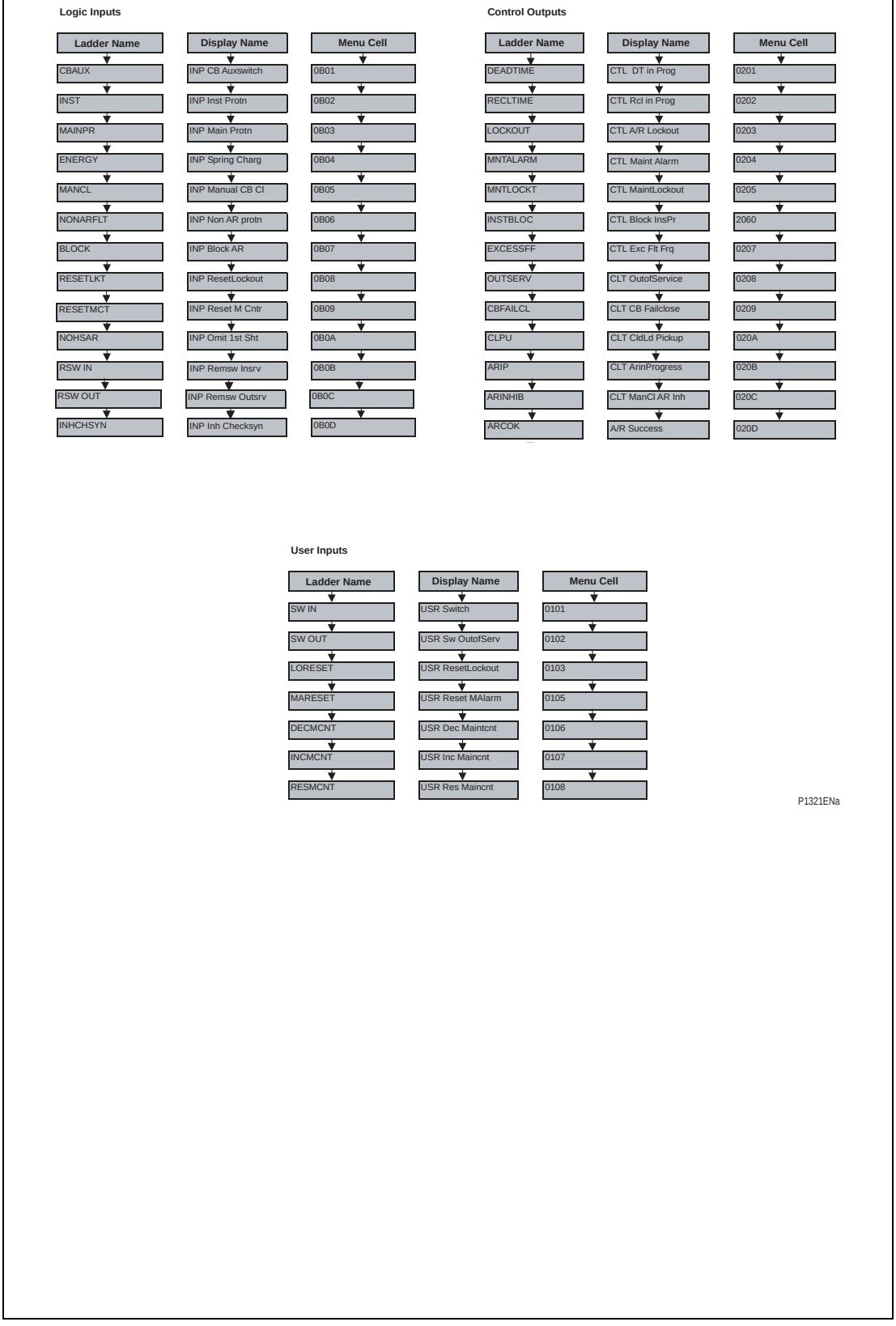


Figure 18. Scheme Logic Diagram: KAVR 102 (Drg No 08 KAVR102 01)

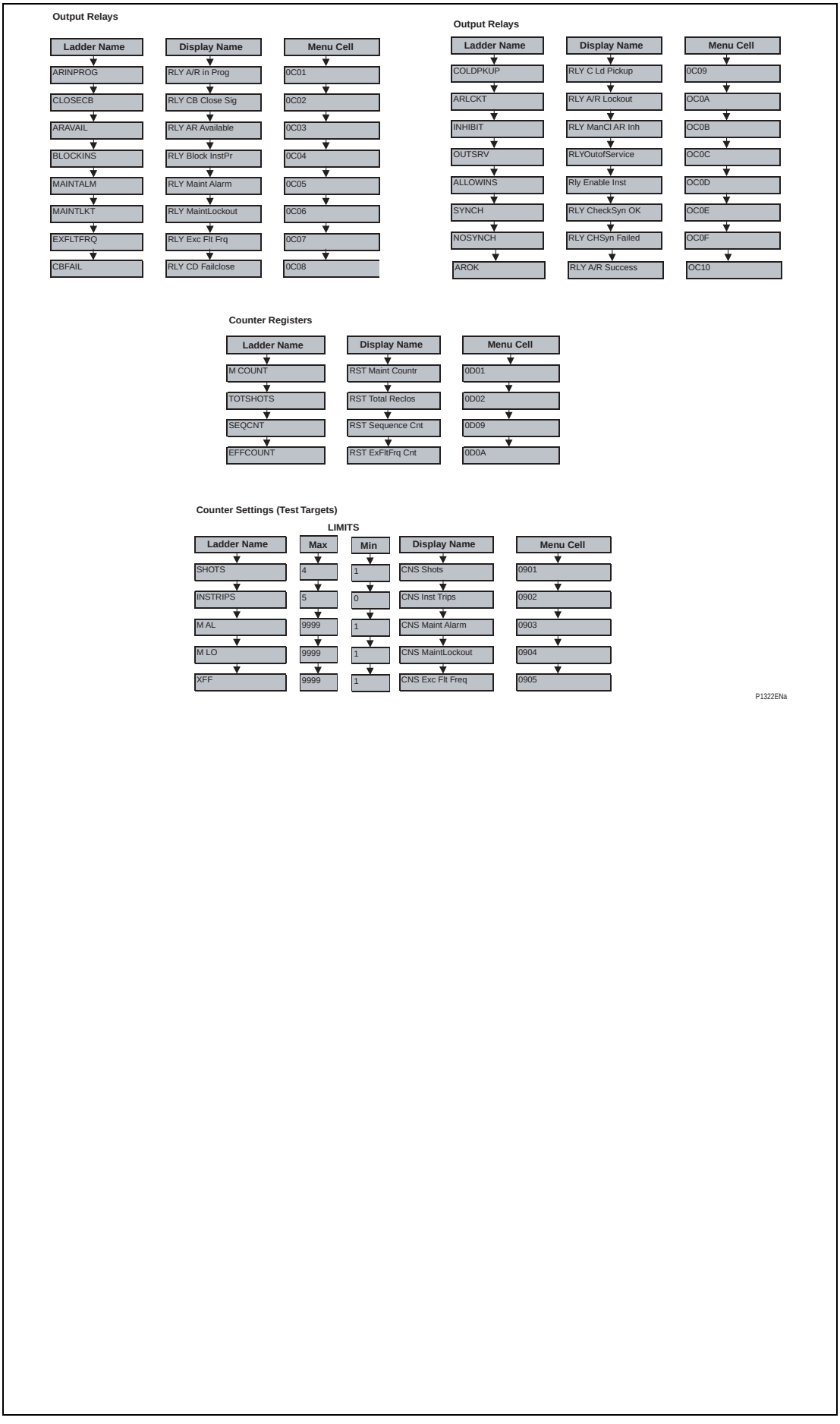


Figure 19. Scheme Logic Diagram: KAVR 102 (Drg No 08 KAVR102 01)

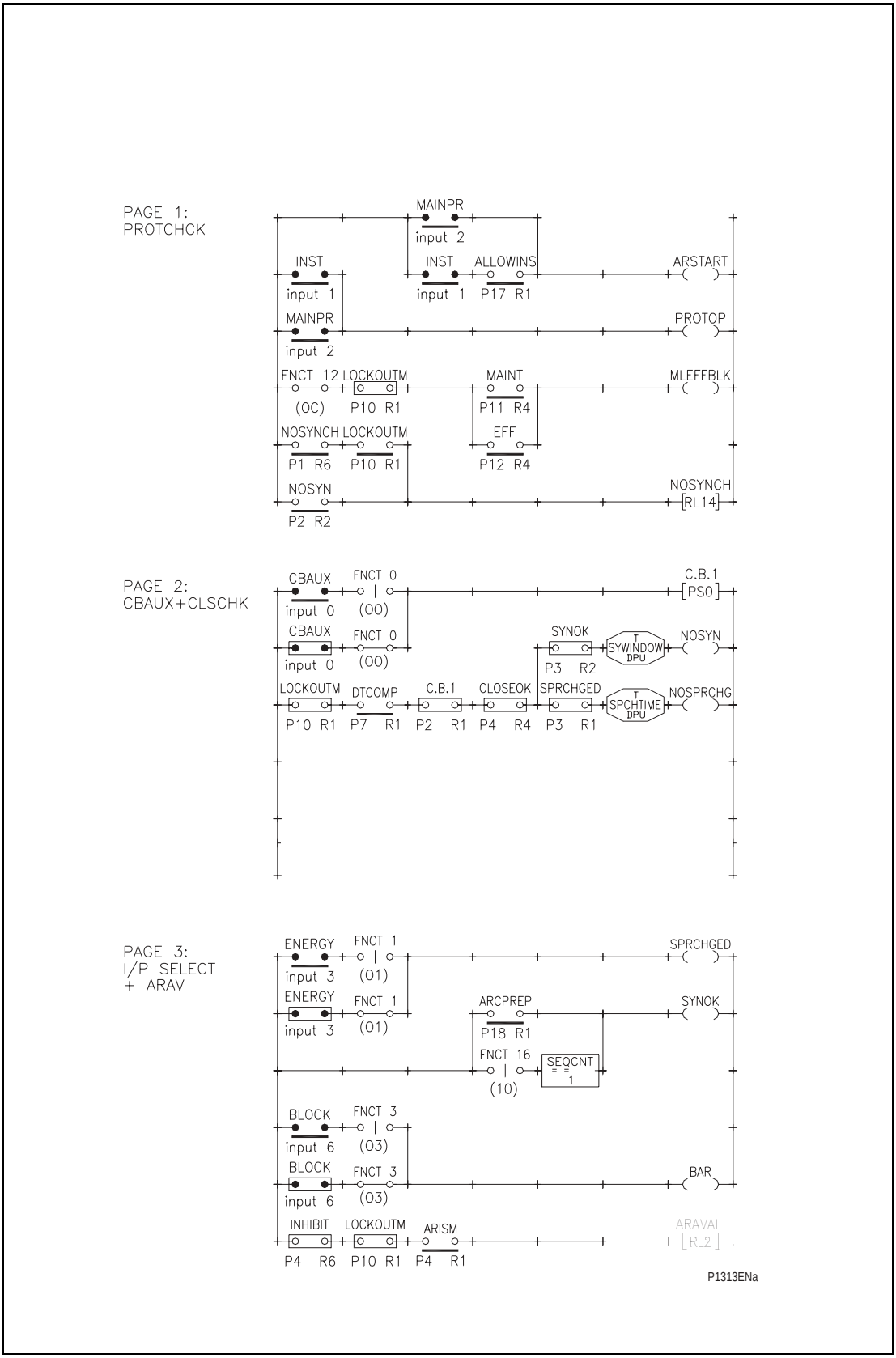


Figure 20. Scheme logic diagram : KAVR 102 (Drg No. 08 KAVR 102 01)

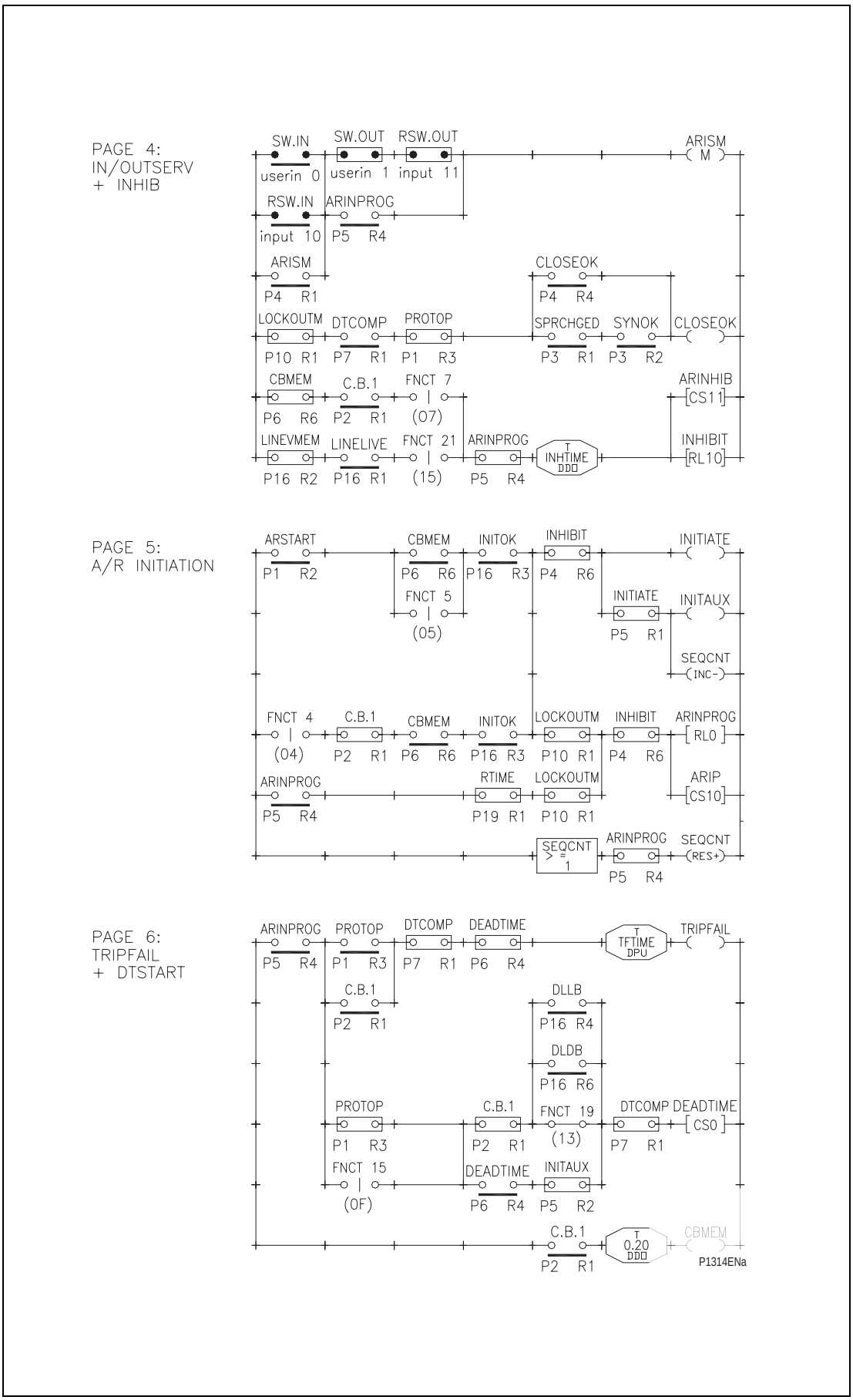


Figure 21. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

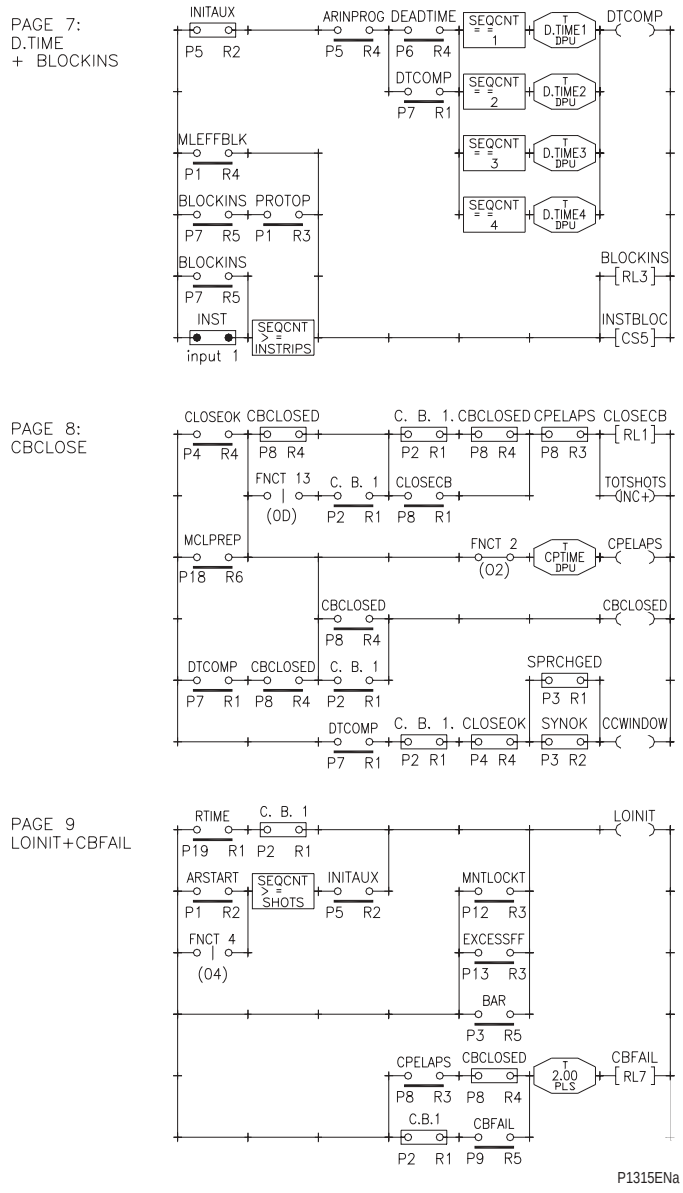


Figure 22. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

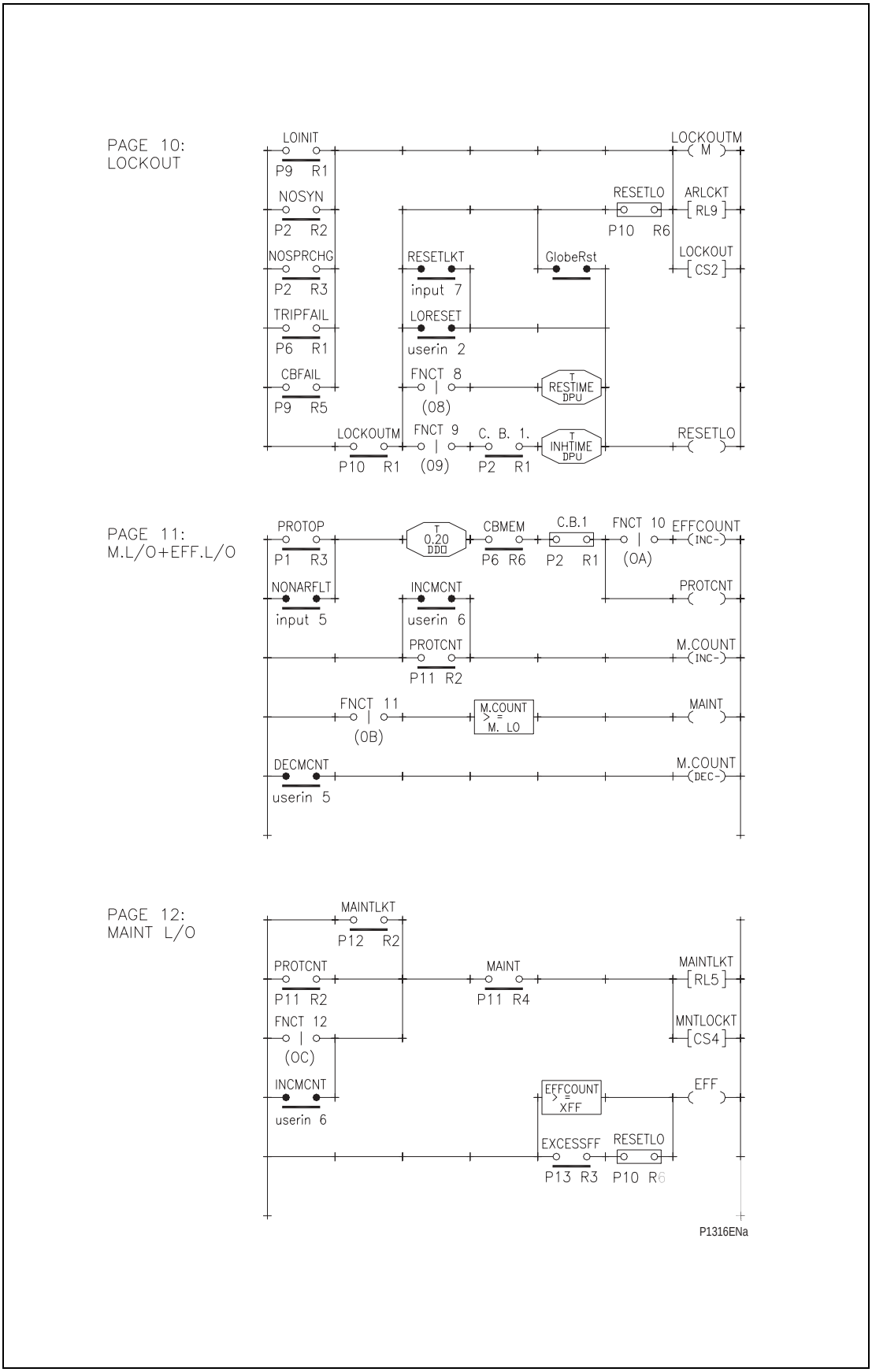


Figure 23. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

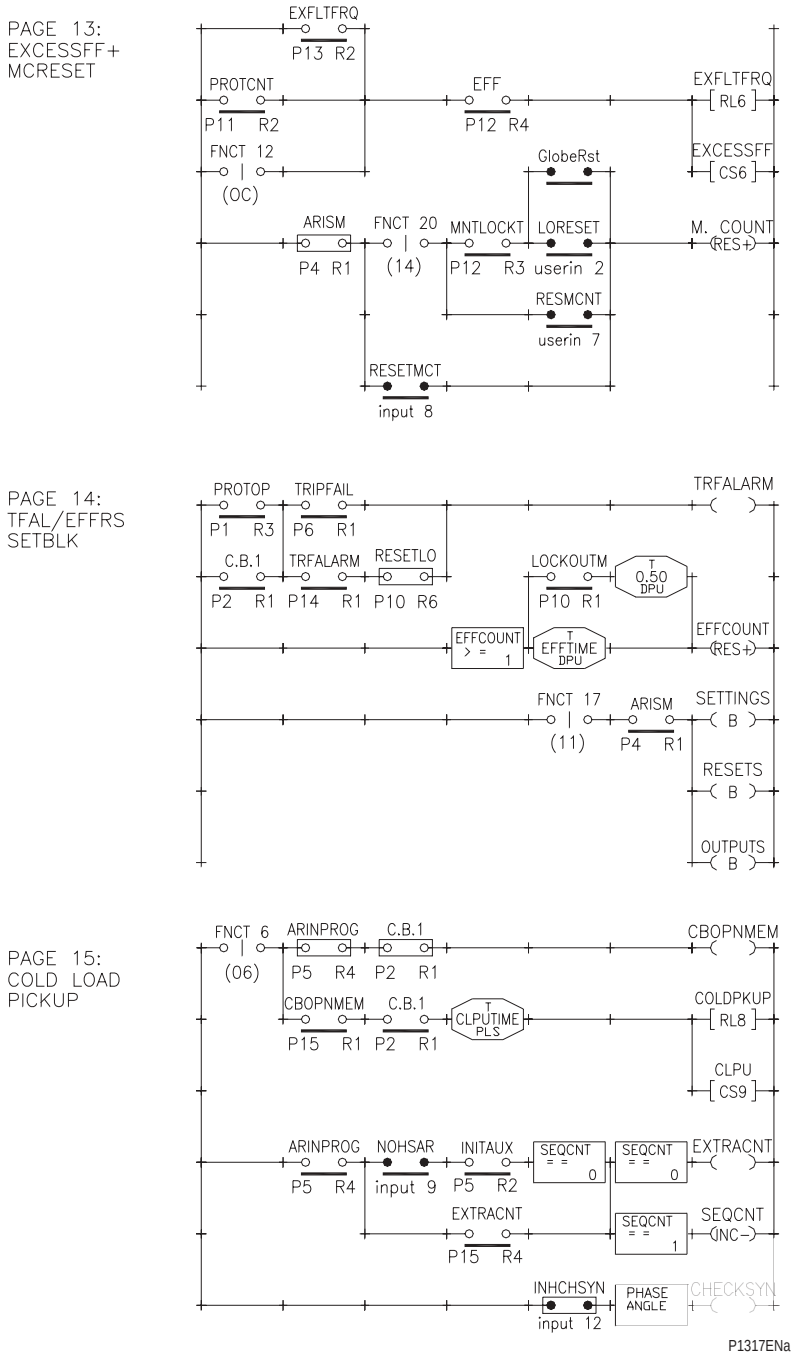


Figure 24. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

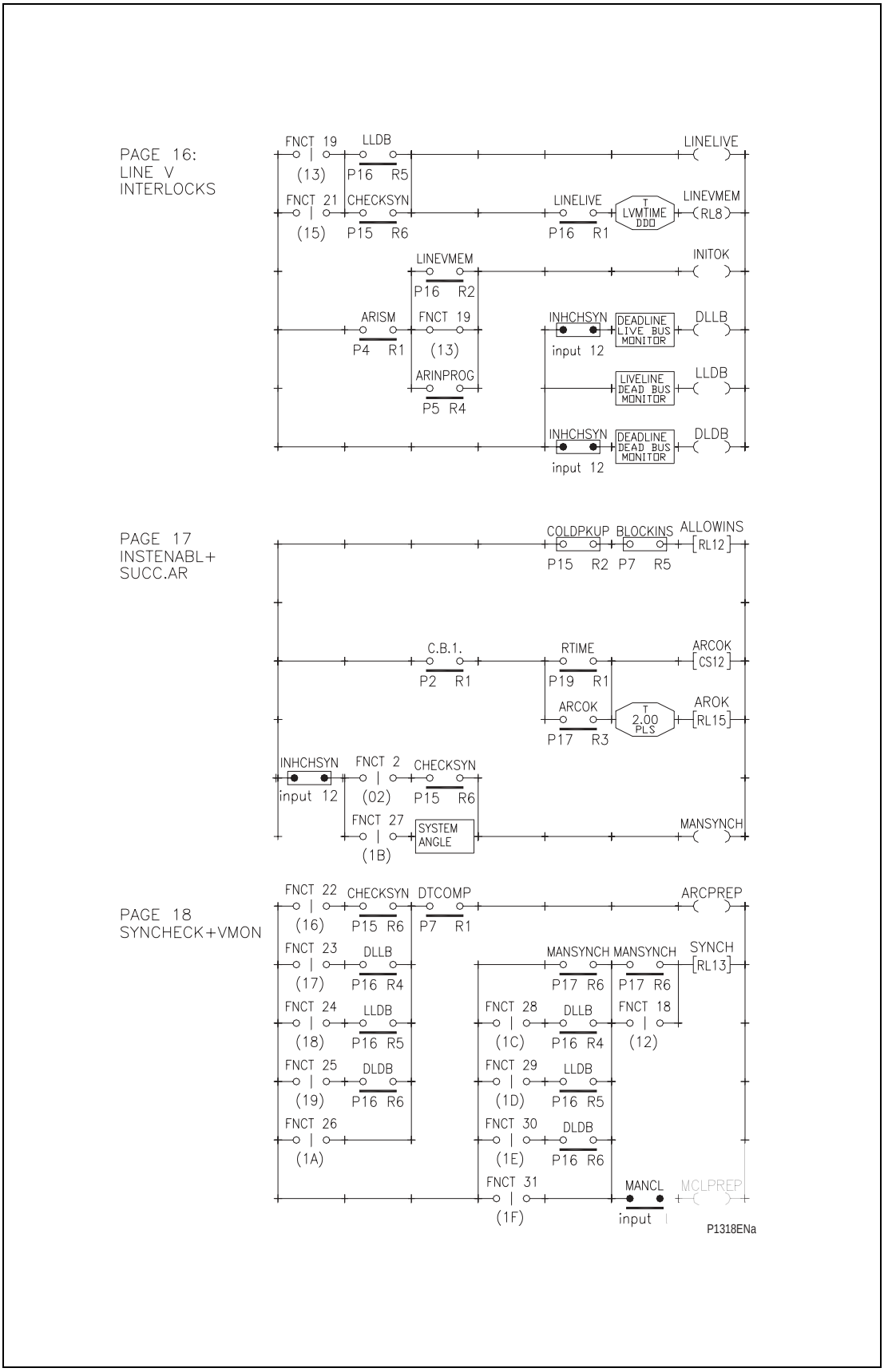


Figure 25. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

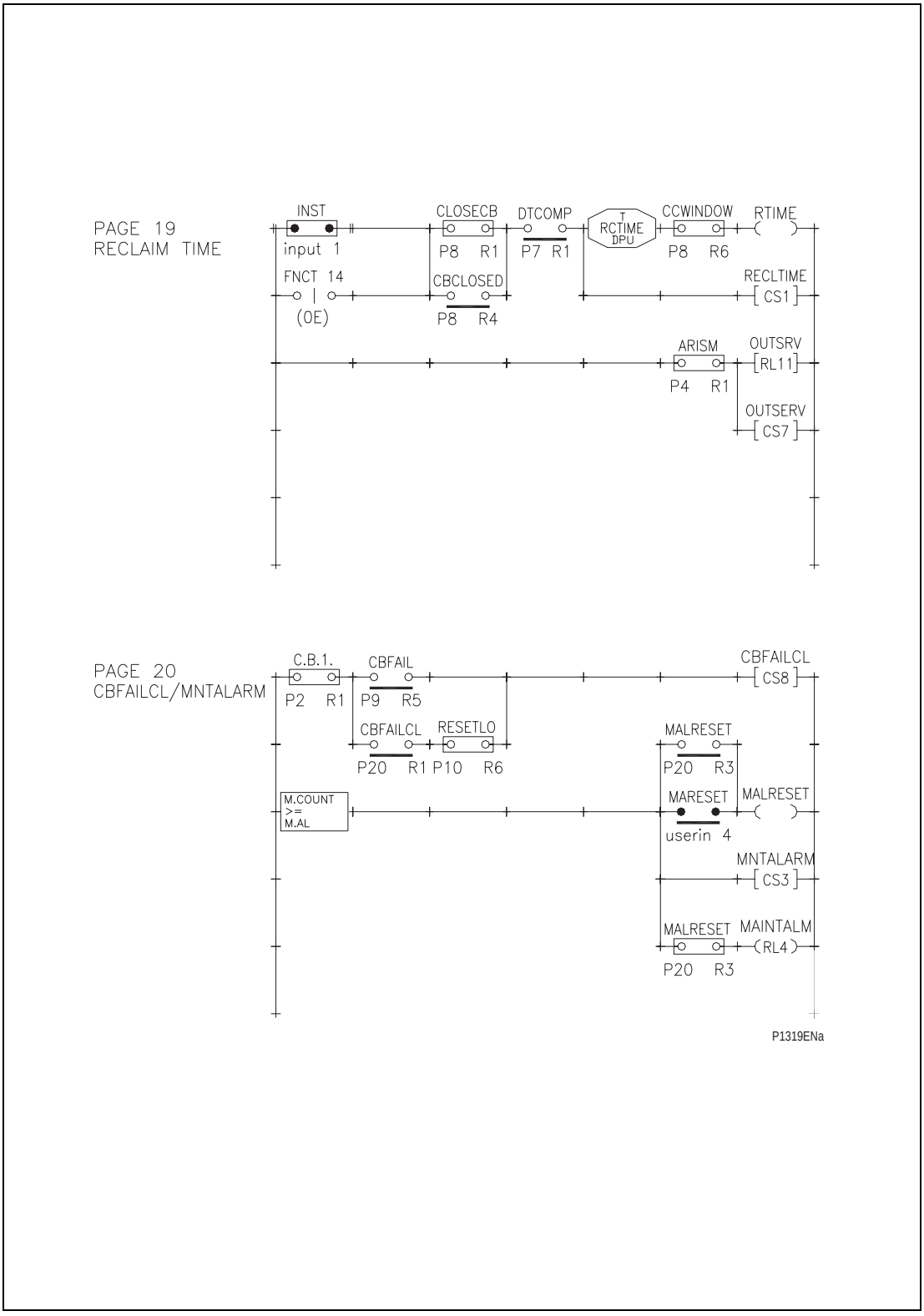


Figure 26. Scheme logic diagram : KAVR 100 (Drg No. 08 KAVR 100 01)

FUNCTION LINK SETTINGS

LINK NUMBER	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
SYS Fn. Links	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
CSS Fn. Links	0	0	1	0	1	1	1	1	1	1	1	0	0	1	1	1
Scheme Fn. Lnks 1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	1
Scheme Fn. Lnks 2	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0

TIMER SETTINGS

Dead Time 1	10 Seconds	SprCh Window	5 Seconds
Dead Time 2	60 Seconds	Mancl AR Inh	5 Seconds
Dead Time 3	180 Seconds	TripfailTime	1 Second
Dead Time 4	180 Seconds	Exc Flt Frq	1000 Seconds
Close Pulse	1 Second	Autoreset	300 Seconds
Reclaim Time	180 Seconds	C.Ld Pickup	600 Seconds
SynCh Window	5 Seconds	Linev Memory	2 Seconds

INPUT MASKS

OPTO NUMBER	7	6	5	4	3	2	1	0
INP CB AuxSwitch	0	0	0	0	0	0	0	1
INP Inst Protn	0	0	0	0	0	0	1	0
INP Main Protn	0	0	0	0	0	1	0	0
INP Spring Charg	0	0	0	0	1	0	0	0
INP Manual CB Cl	0	0	0	1	0	0	0	0
INP Non AR Protn	0	0	1	0	0	0	0	0
INP Block AR	0	1	0	0	0	0	0	0
INP ResetLockout	0	0	0	0	0	0	0	0
INP Reset M Cntr	0	0	0	0	0	0	0	0
INP Omit 1st Sht	0	0	0	0	0	0	0	0
INP RemSw Inserv	0	0	0	0	0	0	0	0
INP RemSw Outserv	0	0	0	0	0	0	0	0
INP Inh CheckSyn	1	0	0	0	0	0	0	0

RELAY MASKS

RELAY NUMBER	7	6	5	4	3	2	1	0
RLY A/R in Prog	0	0	0	0	0	0	0	1
RLY CB Close Sig	0	0	0	0	0	0	1	0
RLY AR Available	0	0	0	0	0	0	0	0
RLY Block InstPr	0	0	0	0	1	0	0	0
RLY Maint Alarm	0	0	0	0	0	0	0	0
RLY MaintLockout	0	0	0	0	0	0	0	0
RLY Exc Flt Frq	0	1	0	0	0	0	0	0
RLY CB Failclose	1	0	0	0	0	0	0	0
RLY C.Ld Pickup	0	0	0	0	1	0	0	0
RLY A/R Lockout	0	0	0	0	0	1	0	0
RLY ManCl AR Inh	0	0	0	0	0	0	0	0
RLY OutOfService	0	0	0	0	0	1	0	0
RLY Enable Inst	0	0	0	0	0	0	0	0
RLY CheckSyn OK	0	0	0	1	0	0	0	0
RLY ChSyn Failed	0	0	1	0	0	0	0	0
RLY A/R Success	0	0	0	0	0	0	0	0

CHECK SYNCH. SETTINGS

CSS V.T. Ratio	1:1
CSS Phase Angle	20°
CSS Slip Freq.	50mHz
CSS Synch. Timer	1 Second
CSS System Angle	20°
CSS System Slip	50mHz
CSS System Timer	1 Second
CSS V. B/L Live	32V
CSS V. B/L Dead	13V
CSS Undervoltage	54V
CSS Diff. Voltage	6.5V

P1311ENa

Figure 27. Relay settings: KAVR 102 (factory default settings) (Drg No 08 KAVR 102 01)

COUNTER SETTINGS

CNS Shots	1
CNS Inst Trips	1
CNS Maint Alarm	19
CNS MaintLockout	20
CNS Exc Flt Freq	10

RESET COUNTERS

RST Maint Countr	0
RST Total Reclos	0
RST Sequence Cnt	0
RST ExFltFrq Cnt	0

LOGIC FUNCTIONS

DefaultDsply	Ladder
Rotation	Press [F] key
TEST RELAYS Select	00000000

RECORDER SETTINGS

REC Control	Triggered
REC Capture	Samples
REC Post Trigger	511 Samples

SYSTEM SETTINGS

SYS Password	AAAA
SYS Description	RECLOSE + CHKSYN
SYS Plant Ref.	RECLOSE + CHKSYN
SYS Frequency	50Hz
SYS Rly Address	255

P1312ENa

Figure 28. Relay settings: KAVR 102 (factory default settings) (Drg No 08 KAVR 102 01)

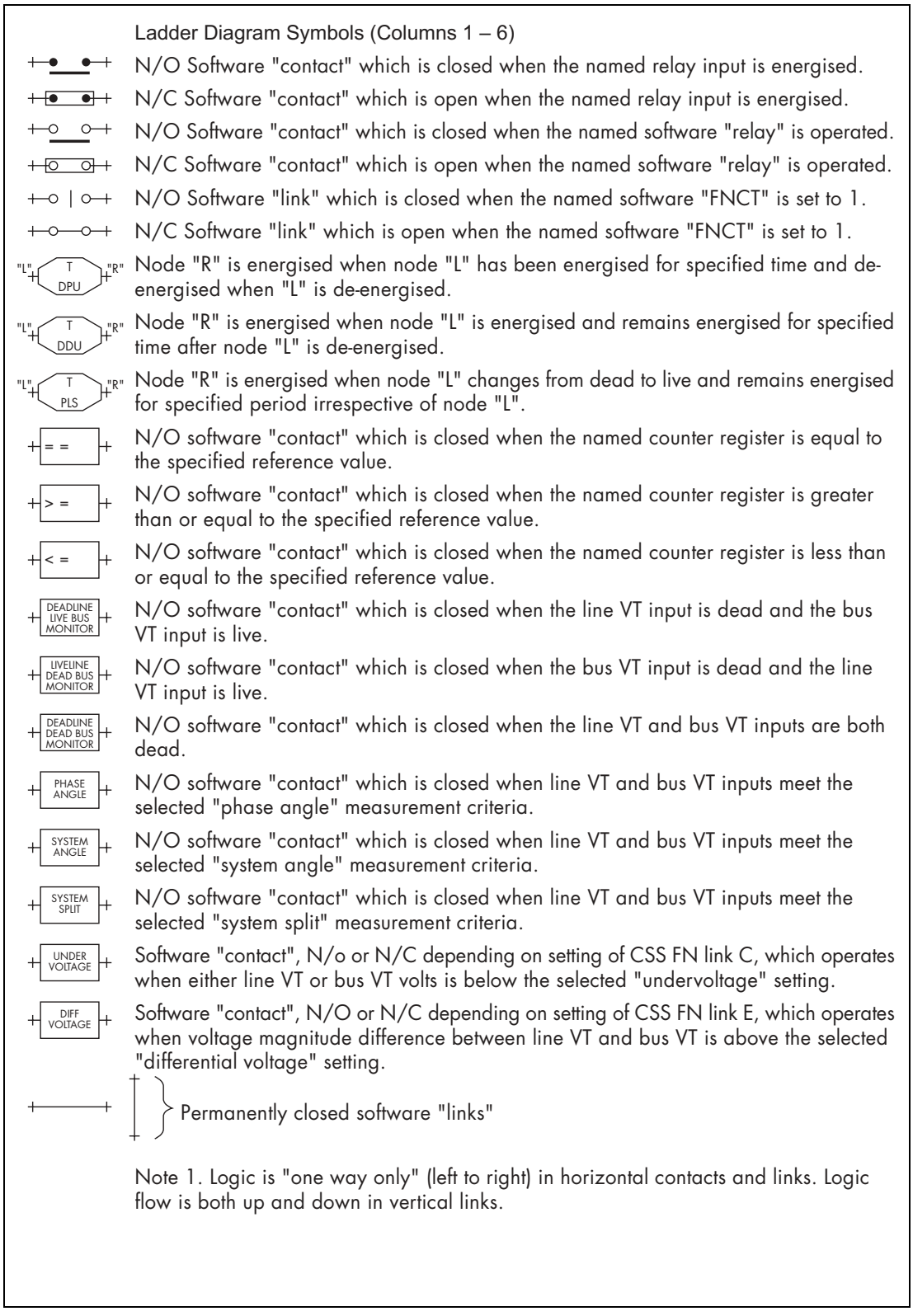


Figure 29. Ladder diagram symbols : (Drg No. 08 KAXX 00) sheet 1

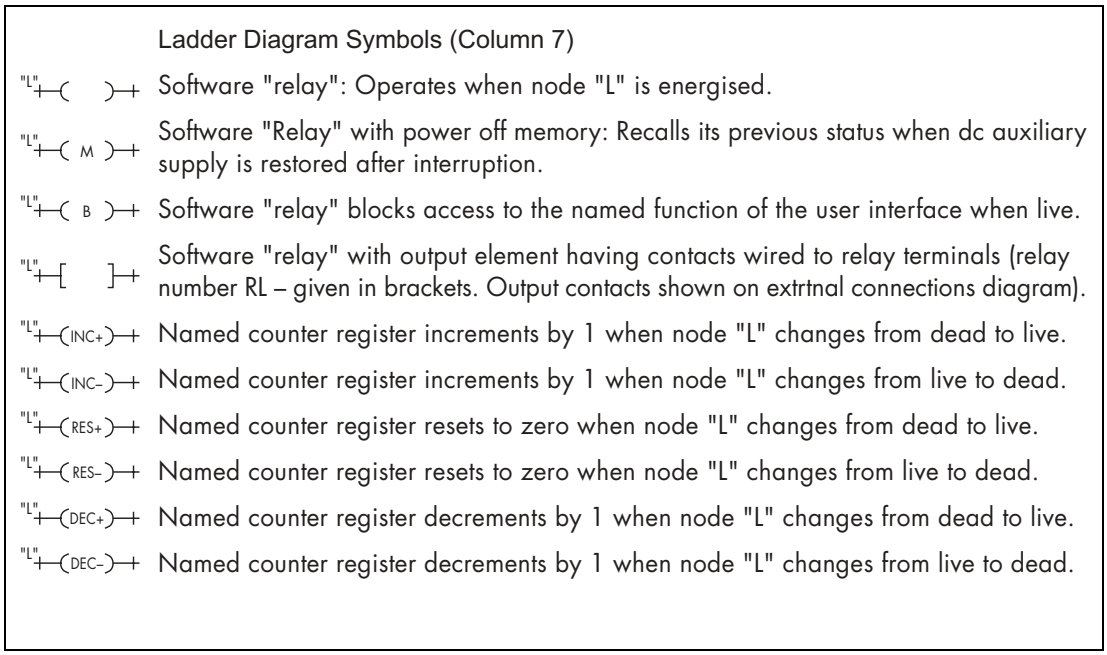


Figure 30. Ladder diagram symbols : (Drg No. 08 KAXX 00) sheet 1

7. TECHNICAL DATA

7.1 Ratings

7.1.1 Inputs

Input Voltage (Vn)	Nominal Rating	Operative Range	
	63.5/110V	5 – 440V	

Auxiliary Voltage (Vx)	Nominal Rating	Operative Range		Absolute
		dc supply	ac 50/60Hz	Maximum
	24 – 125V ac/dc	19 – 150V	50 – 133V	190V crest
	48 – 250V ac/dc	33 – 300V	87 – 265V	380V crest

Frequency (Fn)	Nominal Rating	Reference Range
Frequency tracking	50Hz or 60Hz	45 – 65Hz
Non tracking	Non tracking	47 – 51Hz or 57 – 61Hz

Opto-Isolated Inputs	Nominal Rating	Reference Range
Supply	50V dc only	25 – 60V dc only

7.1.2 Outputs

Field voltage 48V dc (current limited to 60mA)

7.2 Burdens

7.2.1 Voltage circuits

0.012VA at 110V

0.15VA at 327V

0.87VA at 440V

7.2.2 Auxiliary voltage

DC supply	2.75 – 3.0W	at Vx max. with no output relays or logic inputs energised
	4.0 – 4.5W	at Vx max. with 2 output relays and 2 logic inputs energised
	7.6 – 8.6W	at Vx max. with all output relays and logic inputs energised
AC supply	4.5 – 9.0VA	at Vx max. with no output relays or logic inputs energised
	6.0 – 12.0VA	at Vx max. with 2 output relays and 2 logic inputs energised
	7.5 – 20.0VA	at Vx max. with all output relays and logic inputs energised

7.2.3 Opto-isolated inputs

DC supply 0.25W per input (50V 10kÝ)

7.3 Setting ranges

7.3.1 Autoreclose settings

Timer setting range

The default setting range for all timers is 0.01 to 9999 seconds.

More restrictive limits may be applied to each timer. See the scheme documentation for details.

Counter setting range

The default setting range for all counter settings is 1 to 9999.

More restrictive limits may be applied to each counter. See the scheme documentation for details.

7.3.2 Check synchronism settings

Undervoltage detector	
Voltage setting range	22 to 132V rms
Voltage setting step	0.5V
Operate	±5% of the set value
Reset	<105% of operation
Differential voltage detector	
Voltage setting range	0.5 to 22V rms

Voltage setting step	0.5V
Operate	±5% of the set value
Reset	>97% of setting
Phase angle measurement	
Setting range	5° to 90°
Setting step	1°
Operates at	setting +0 –3°
Resets at	operate value –0 +3°
Slip frequency	
Setting range	0.005 to 2.000Hz
Setting step	0.001Hz
Blocks at	setting ±10mHz
Slip timer	
Setting range	0.1 to 99 seconds
Setting step	0.1 seconds
System split	
Setting range	90° to 175°
Setting step	1°
Operates at	setting +0 –3°
Resets at	operate value –0 +3°
Split timer	
Setting range	0.1 to 99 seconds
Setting step	0.1 seconds
System angle measurement	
Setting range	5° to 90°
Setting step	1°
Operates at	setting +0 –3°
Resets at	operate value –0 +3°
System slip frequency	
Setting range	0.005 to 2.000Hz
Setting step	0.001Hz
Blocks at	setting ±10mHz
System timer	
Setting range	0.1 to 99 seconds
Setting step	0.1 seconds
Live voltage	
Setting range	Dead voltage setting to 132V

Setting step	0.5V
Operates at	±5% of setting
Resets at	>98% of operate value
Dead voltage	
Setting range	5.5V to live voltage setting
Setting step	0.5V
Operates at	±5% of setting
Resets at	<104% of operate value

Note: The live voltage setting cannot be set to less than the dead voltage setting, and the dead voltage setting cannot be set to greater than the live voltage setting.

7.3.3 Measurement (displayed)

Voltage	Vin x VT ratio	for V Line and V Bus
Phase angle	±180°	Angle between V Line and V Bus
System frequency	45 – 65Hz	Frequency of V Line
Slip frequency	±32Hz	Difference in frequency between V Line and V Bus

7.3.4 Ratios

VT ratios	1:1 to 9999:1	Default = 1:1

7.4 Accuracy

7.4.1 General for reference conditions

Ambient temperature	20°C
Frequency	50Hz or 60Hz (whichever set)
Auxiliary voltage	24V to 125V (aux. powered)
	48V to 250V (aux. powered)

Auto reclose timers

±0.5%

The operating time for scheme logic functions is also affected by:

- The input sampling time (5/8 x system period)
- The number of executions of the ladder code needed to perform the function. An execution occurs every 10ms.
- The time for an output relay to close its contacts (typically 5ms)

Undervoltage detector

Operation	±5% of the set value
Reset	<105% of operation

Differential voltage detector

Operation	±5% of the set value

Reset	>97% of operation
Phase angle and system angle measurement	
Operation	setting –3 +0°
Resets	operate value –0 +3°
Slip frequency and system slip frequency	
Operation	setting ±0.010Hz
Reset	setting ±0.010Hz
Split angle measurement	
Operation	setting –3 +0°
Resets	operate value –3 +0°
Check synchronism timers	
All timers	±0.5% + 0 to 40ms
Live voltage monitor	
Operation	±5% of the set value
Reset	<98% of operation
Dead voltage monitor	
Operation	±5% of the set value
Reset	<104% of operation
Measurements	
Voltage	±5% of reading (±1% Vn typical)
Frequency (45 – 65Hz)	±5% of reading (±1% Fn typical)
Phase angle	±0.5° (typical)

7.4.2 Influencing quantities

Ambient temperature	Operative range –25°C to +55°C
Voltage settings	0.03% per °C
Operation times	1%
Angle measurement	2°
Frequency	Operative range 46 to 65Hz
Voltage settings	1%
Operation times	1%
Angle measurement	<1°

Auxiliary supply

Nominal	Operative range
24/125V	19 to 150V dc (aux. powered)
	50 to 133V ac (aux. powered)
48/250V	33 to 300V dc (aux. powered)
	87 to 265V ac (aux. powered)

Voltage settings	0.5%

Operation times	0.5%
Angle measurement	0.5°

7.5 Opto-isolated control inputs

Capture time	12.5 ±2.5ms at 50Hz
	10.4 ±2.1ms at 60Hz
Release time	12.5 ±2.5ms at 50Hz
	10.4 ±2.1ms at 60Hz
Maximum series lead resistence	5ký (2 optos in parallel)
Maximum ac induced loop voltage	>50V rms (thermal limit)
Maximum capacitance coupled ac voltage	>250V rms via 0.1μF

7.6 Contacts

Output relays 0 to 7		
Type	2 make contacts connected in series	
Rating		
Make and carry continuously	5A	
Make and carry for 0.2s	30A	
Break	ac	1250VA with maxima of 5A and 300V
	dc	50W resistive 25W inductive (L/R = 0.04s) with maxima of 5A and 300V)

Watchdog	1 make and 1 break	
Type		
Rating		
Make and carry continuously	5A	
Make and carry for 0.2s	10A	
Break	ac	1250VA with maxima of 5A and 300V
	dc	30W resistive 25W inductive (L/R = 0.04s) with maxima of 5A and 300V)

7.7 Operation indicator

3 light emitting diodes – internally powered.

16 character by 2 line liquid crystal display (with backlight).

7.8 Communication port

Language:	COURIER
Transmission:	Synchronous – EIA(RS)485 voltage levels
Frame format:	HDLC
Baud rate:	64kbit/s
K-Bus cable:	Screened twisted pair
K-Bus cable length:	1000m of cable
K-Bus loading:	32 units (multi-drop system)

7.9 High voltage withstand

7.9.1 Insulation

2kV rms for one minute between all terminals and case earth, except terminal 1.

2kV rms for one minute between terminals of independent circuits, including contact circuits.

1.5kV rms across open contacts of output relays 0 to 7.

1.0kV rms for 1 minute across open contacts of the watchdog relay.

7.9.2 Impulse IEC 60255-5

5 kV peak, 1.2/50μs, 0.5J between all terminals and all terminals to case earth.

7.9.3 High frequency disturbance IEC 60255-22-1/2

2.5kV peak between independent circuits and case.

7.9.4 Fast transient IEC 60255-22-4

Class 3 (2kV)	relay contact circuits
Class 4 (4kV)	relay contacts with external filter
Class 4 (4kV)	all other circuits

7.9.5 Static discharge test

Class 4 (15kV)	discharge in air with cover in place
Class 3 (6kV)	point contact discharge with cover removed

7.9.6 ANSI/IEEE standards C36.90

The relay also complies with the appropriate ANSI-IEEE standards for power-system protection relays

7.10 Environmental

7.10.1 Temperature IEC 60068-2-3

Storage and transit	–25°C to +70°C
Operating	–25°C to +55°C

7.10.2 Humidity IEC 60068-2-3

56 days at 93% relative humidity and 40°C

7.10.3 Enclosure protection IEC 60529

IP50 (Dust protected)

7.10.4 Vibration IEC 60255-21-1

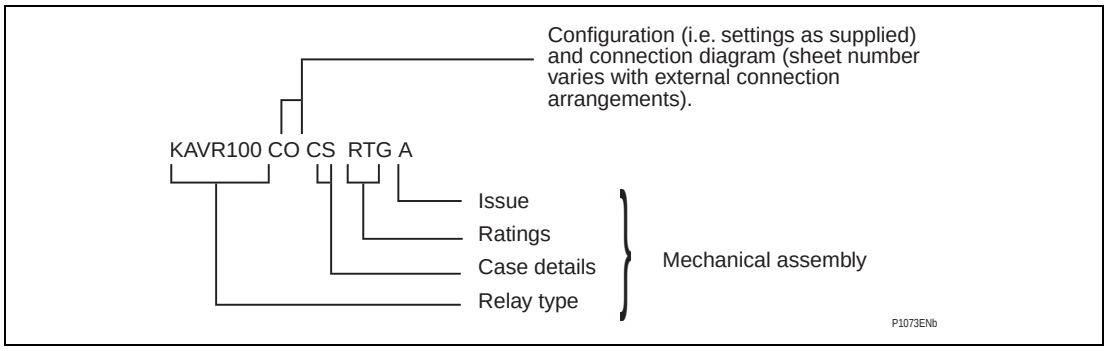
0.5g between 60Hz and 600Hz

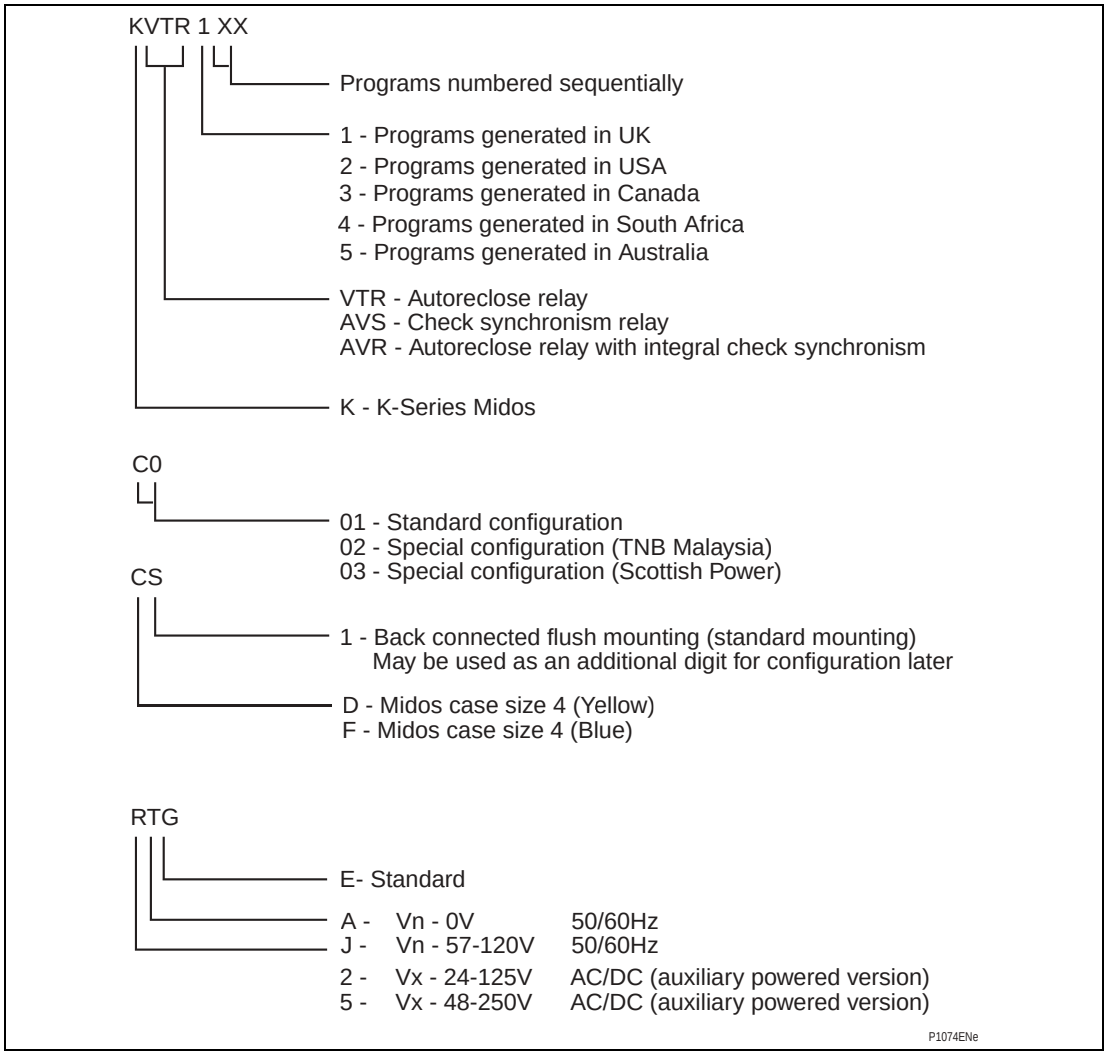
0.07 mm peak to peak between 10Hz and 60Hz.

7.10.5 Mechanical durability

10,000 operations, minimum.

7.11 Model numbers





Note: Initial production relays will have the voltage rating marked as Vn = 110V and later models this will be marked 57 – 120V. The voltage rating and operational range is the same for both marked ratings and the only difference is in the label affixed to the relay.

8. COMMISSIONING

8.1 Commissioning preliminaries

When commissioning a K-Series relay for the first time the engineers should allow an hour to get familiar with the menu. Please read Section 8.1.1.1 which provides simple instructions for negotiating the relay menu using push buttons **[F] [+] [–]** and **[0]** on the front of the relay. Individual cells can be viewed and the settable values can be changed by this method.

If a portable PC is available together with a K-Bus interface unit and the commissioning software, then the menu can be viewed a page at a time to display a full column of data and text. Settings are also more easily entered and the final settings can be saved to a file on a disk for future reference or printing a permanent record. The instructions are provided with the Courier Access software.

8.1.1 Quick guide to local menu control

With the cover in place only the **[F]** and **[0]** push buttons are accessible, so data can only be read or flag and counter functions reset. No settings can be changed. In the table **[F]** long indicates that the key is pressed for at least 1 second and **[F]** short for less than 0.5 second. This allows the same key to perform more than one function.

8.1.1.1 With the cover fitted to the case

Current Display	Key Press	Effect of Action
Default display or Scheme alarm(s)	**[F]** short	Display changes to next item in list, if any available
	[F] long	Display changes to first menu column heading "SYSTEM DATA"
	[0] short or **[0]** long	Backlight turns ON
Column Heading	**[0]** short	Backlight turns ON
	[0] long	Returns to the selected default display, or scheme alarms, without waiting for the 2 minute delay
Anywhere in menu	**[F]** short	Displays the next item of data in the column
	[F] long	Displays the heading for the next column
	[0] short	Backlight turns ON
	[0] long	If a resettable cell is displayed it will be reset

Table 8.1

8.1.1.2 With the cover removed from the case

Current Display	Key Press	Effect of Action
Column Heading	**[+]**	Move to next column heading
	[–]	Move to previous column heading
A settable cell	**[+]** or **[–]**	Puts the relay in the setting mode (flashing cursor on bottom line of display) if the cell is not password protected or blocked in the ladder diagram
Setting mode	**[+]**	Increments value
	[–]	Decrements value
	[F]	Changes to the confirmation display If function links, relay or input masks are displayed then the **[F]** key will step through them from left to right. A further key press will change to the confirmation display
	[0]	Escapes from the setting mode without setting being changed
Confirmation display	**[+]**	Confirms setting and enters new value
	[–]	Returns prospective value of setting for checking and further modification
	[0]	Escapes from the setting mode without the setting being changed

Table 8.2

8.1.2 Terminal allocation

Reference should be made to the diagram supplied with every relay. The diagram number will be found on the label fixed inside the case to the left hand side. Section 2.3 of the document provides useful notes on the connections to the relay

8.1.3 Electrostatic discharge (ESD)

See recommendations in Section 1 of this service manual before handling the module outside its case

8.1.4 Inspection

Carefully examine the module and case to see that no damage has occurred since installation and visually check the current transformer shorting switches in the case are wired into the correct circuit and are closed when the module is withdrawn. Check the serial number on the module, case and cover are identical and that the model number and rating information is correct.

Check that the external wiring is correct to the relevant relay diagram or scheme diagram. The relay diagram number appears inside the case on a label at the left hand side. The serial number of the relay also appears on this label, the inside of the cover and on the front plate of the relay module. The serial numbers marked on these three items should match; the only time that they may not match is when a failed relay module has been replaced for continuity of protection.

With the relay removed from its case, ensure that the shorting switches between terminals 21 and 22, 23 and 24, 25 and 26, 27 and 28 are closed by checking with a continuity tester.

8.1.5 Earthing

Ensure that the case earthing connection, above the rear terminal block, is used to connect the relay to a local earth bar and, where there is more than one relay, the copper earth bar is in place connecting the earth terminals of each case in the same tier together.

8.1.6 Main current transformers

DO NOT OPEN CIRCUIT THE SECONDARY CIRCUIT OF A LIVE CT SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL TO PERSONNEL AND COULD DAMAGE INSULATION.

8.1.7 Test block

If the MMLG test block is provided the connections should be checked to the scheme diagram, particularly that the supply connections are to the live side of the test block (coloured orange) and with the terminals allocated odd numbers (1, 3, 5, 7 etc.). The auxiliary supply is normally routed via terminals 13(+) and 15(–), but check against the schematic diagram for the installation.

8.1.8 Insulation

Insulation tests only need to be done when required.

Isolate all wiring from earth and test the insulation with an electronic or brushless insulation tester at a dc voltage not exceeding 1000V. Terminals of the same circuits should be temporarily strapped together.

The main groups on the relays are given below but they may be modified by external connection as can be determined from the scheme diagram.

- Voltage transformer circuits
- Auxiliary voltage supply
- Field voltage output and opto-isolated control inputs
- Relay contacts
- Communication port
- Case earth

Note: Do not apply an insulation test between the auxiliary supply and the capacitor discharge terminals because they are part of the same circuit and internally connected.

8.2 Commissioning test notes

8.2.1 Equipment required

A means of switching the field voltage onto each opto input

Time interval meter

Multifinger test plug type MMLB01 for use with test block type MMLG

Continuity tester

2 ac voltmeters 0 – 440V

2 suitable non-inductive potentiometers to adjust voltage level

A means of adjusting the phase relationship between the 2 voltages

Phase angle meter or transducer.

A portable PC, with suitable software and a KITZ101 K-Bus/IEC 60870/5 interface unit will be useful but in no way essential to commissioning.

8.3 Auxiliary supply tests

8.3.1 Auxiliary supply

The relay can be operated from either an ac or a dc auxiliary supply but the incoming voltage must be within the operating range specified in Table 8.3.

Relay Rating (V)	DC Operating Range (V)	AC Operating Range (V ac)	Maximum Crest Voltage (V)
24/125	19 – 150	50 – 133	190
48/250	33 – 300	87 – 265	380

Table 8.3

CAUTION
THE RELAY CAN WITHSTAND SOME AC RIPPLE ON A DC AUXILIARY SUPPLY. HOWEVER, IN ALL CASES THE PEAK VALUE OF THE AUXILIARY SUPPLY MUST NOT EXCEED THE MAXIMUM CREST VOLTAGE. DO NOT ENERGISE THE RELAY USING THE BATTERY CHARGER WITH THE BATTERY DISCONNECTED.

8.3.2 Energisation from auxiliary voltage supply

For secondary injection testing using the test block type MMLG, insert test plug type MMLB01 with CT shorting links fitted. It may be necessary to link across the front of the test plug to restore the auxiliary supply to the relay.

Isolate the relay trip contacts and insert the module. With the auxiliary disconnected from the relay use a continuity tester to monitor the state of the watchdog contacts as listed in Table 8.4 .

Connect the auxiliary supply to the relay. The relay should power up with the LCD showing the default display and the centre green LED being illuminated, this indicates the relay is healthy. The relay has a non-volatile memory which remembers the state (ON or OFF) of the power fail software relays when the relay was last powered. This may cause an alarm to be set when the scheme logic is run, causing one or both of the LED indicators to be illuminated. With a continuity checker monitor the state of watchdog contacts as listed in Table 8.4.

Terminals	With Relay De-energised	With Relay Energised
3 and 5	contact closed	contact open
4 and 6	contact open	contact closed

Table 8.4

8.3.3 Field voltage

The relay generates a field voltage that should be used to energise the opto-isolated inputs. With the relay energised, measure the field voltage across terminals 7 and 8. Terminal 7 should be positive with respect to terminal 8 and should be within the range specified in Table 8.5 when no load is connected.

Nominal dc Rating (V)	Range (V)
48	45 – 60

Table 8.5

8.4 Measurement checks

To test the relay measurement functions a known voltage should be injected into each ac input

With the VT Ratio settings of the CHECK SYNCH STGS heading set to the values of the VTs the displayed measured values and settings will be in the equivalent primary quantities.

All measured values have a tolerance of ±5%.

8.5 Opto-input checks

This test is to check that all the opto inputs are functioning correctly. The state of the opto-isolated input can be viewed from the [SYS Opto Status] display under the SYSTEM DATA heading.

If external equipment is connected to any of the opto input terminals, this test can be used to check both the external wiring and correct operation of the external contact when the relevant equipment is operated. For example, the CB can be tripped and closed to check operation of the CB auxiliary contact connected to energise the opto input assigned to input mask INP CB AuxSwitch (default mask setting to opto input L0).

If external equipment is not yet connected to all of the opto input terminals, the unconnected opto inputs may be tested by individually connecting relay terminal 7 to the relevant opto input terminal listed below.

Opto-Input Number	Terminal
L0	46
L1	48
L2	50
L3	45
L4	47
L5	49
L6	51
L7	53

The status of each opto-input can be viewed by displaying [SYS Opto Status] which will be found towards the end of the SYSTEM DATA column of the menu. When each opto is energised, one of the characters on the bottom line of the display will change to indicate the new state of the inputs. The number printed on the front plate under the display will identify which opto each character represents. A "1" indicates an energised state and a "0" indicates a de-energised state.

Note: The opto-isolated inputs may be energised from an external 50V battery in some installations. Check that this is not the case before connecting the field voltage otherwise damage to the relay may result.

8.6 Output relay checks

This test is to check that all the output relays are functioning correctly. The output relays to be tested can be set in the [LOG TEST RELAYS Select] cell under the LOGIC FUNCTIONS heading and tested in the next cell, [LOG TEST RELAYS = [0]].

The output relays can then be individually tested by monitoring the relay terminals listed below:

Output relay number	Terminals
0	30 – 32
1	34 – 36
2	38 – 40
3	42 – 44
4	29 – 31
5	33 – 35
6	37 – 39
7	41 – 43

The procedure for testing the output relays is:

1. Enter the relay password
2. Go to the [LOG TEST RELAYS Select] cell. Set the character on the bottom line of the display corresponding to each relay to be tested to "1", and all not to be tested to "0".
3. Go to the [LOG TEST RELAYS =[0]] cell. Press the [0] key and the selected relay(s) will change state for as long as the key remains pressed.

If these operations are performed using the master station the relays will change state for approximately 250ms.

8.7 Synchronism check elements

Under LOGIC FUNCTIONS, set Scheme Fn. Links 1 to 0000001010001111.

Under INPUT MASKS, set INP Manual CB Cl to 00010000.

Under RELAY MASKS, set RLY CB Close Sig to 00000010.

Connect terminal 7 to terminal 47.

Monitor output relay RL1 - terminals 34-36 - for all the following tests.

Note that the relay password must be entered for every change of CSS Fn. Links settings.

8.7.1 Phase angle check - instantaneous operation.

Under LOGIC FUNCTIONS, set Scheme Fn. Links 2 to 0000000000000100.

Under CHECK SYNCH STGS, set CSS Fn. Links to 0000000000000001.

Inject nominal voltage into V Line terminals 17-18 and V Bus terminals 19-20, starting with the phase angle between them less than (CSS Phase Angle setting - 3°). Output RL1 should operate.

Slowly increase the phase angle until RL1 resets and note the angle when this happens. This should be less than (CSS Phase Angle setting + 1°).

Slowly decrease the phase angle until RL1 re-operates and note the angle when this happens. This should be greater than (CSS Phase Angle setting - 3°).

8.7.2 Phase angle check - delay on operation.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0000000000000101.

Set the phase angle between V Line and V Bus inputs greater than CSS Phase Angle setting, so that output RL1 is reset. Switch the phase angle to zero and measure the time for output RL1 to operate. This should be not less than (CSS Synch Timer setting - 5% + 0.01s) and not greater than (CSS Synch Timer setting + 5% + 0.04s).

8.7.3 Phase angle check - undervoltage blocking.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0000100000000001.

Set both voltages to greater than CSS Undervoltage setting and phase angle to zero. Out put RL1 should be operated.

Slowly reduce V Line until RL1 resets and note the value when this happens. This should be within + or - 5% of CSS Undervoltage setting.

Slowly increase V Line until RL1 re-operates and note the value when this happens. This should be within - 0% and + 10% of the "reset" value.

Slowly reduce V Bus until RL1 resets and note the value when this happens. This should be within + or - 5% of CSS Undervoltage setting.

Slowly increase V Bus until RL1 re-operates and note the value when this happens. This should be within - 0% and + 10% of the "reset" value.

8.7.4 Phase angle check - differential voltage blocking.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0010000000000001.

Set both voltages to nominal and phase angle to zero. Out put RL1 should be operated.

Slowly reduce V Line until RL1 resets and note the (V Bus - V Line) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly increase V Line until RL1 re-operates and note the V Line value when this happens. This should be within -0% and + 10% of the V Line value when RL1 reset in the last test.

Continue slowly increasing V Line until RL1 resets and note the (V Line - V Bus) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly reduce V Line until RL1 re-operates and note the V Line value when this happens. This should be within -10% and + 0% of the V Line value when RL1 reset in the last test.

Slowly reduce V Bus until RL1 resets and note the (V Line - V Bus) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly increase V Bus until RL1 re-operates and note the V Bus value when this happens. This should be within -0% and + 10% of the V Bus value when RL1 reset in the last test.

Continue slowly increasing V Bus until RL1 resets and note the (V Bus - V Line) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly reduce V Bus until RL1 re-operates and note the V Bus value when this happens. This should be within -10% and + 0% of the V Bus value when RL1 reset in the last test.

8.7.5 System angle check - instantaneous operation.

Under LOGIC FUNCTIONS, set Scheme Fn. Links 2 to 0000100000000000.

Under CHECK SYNCH STGS, set CSS Fn. Links to 0000000000100000.

Inject nominal voltage into V Line terminals 17-18 and V Bus terminals 19-20, starting with the phase angle between them less than (CSS System Angle setting - 3°). Output RL1 should operate.

Slowly increase the phase angle until RL1 resets and note the angle when this happens. This should be less than (CSS System Angle setting + 1°).

Slowly decrease the phase angle until RL1 re-operates and note the angle when this happens. This should be greater than (CSS System Angle setting - 3°).

8.7.6 System angle check - delay on operation.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0000000010100000.

Set the phase angle between V Line and V Bus inputs greater than CSS System Angle setting, so that output RL1 is reset. Switch the phase angle to zero and measure the time for output RL1 to operate. This should be <u>not less than</u> (CSS System Timer setting - 5% + 0.01s) and <u>not greater than</u> (CSS System Timer setting + 5% + 0.04s).

8.7.7 System angle check - undervoltage blocking.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0000100000100000.

Set both voltages to greater than CSS Undervoltage setting and phase angle to zero. Out put RL1 should be operated.

Slowly reduce V Line until RL1 resets and note the value when this happens. This should be within + or - 5% of CSS Undervoltage setting.

Slowly increase V Line until RL1 re-operates and note the value when this happens. This should be within - 0% and + 10% of the “reset” value.

Slowly reduce V Bus until RL1 resets and note the value when this happens. This should be within + or - 5% of CSS Undervoltage setting.

Slowly increase V Bus until RL1 re-operates and note the value when this happens. This should be within - 0% and + 10% of the "reset" value.

8.7.8 System angle check - differential voltage blocking.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0010000000100000.

Set both voltages to nominal and phase angle to zero. Out put RL1 should be operated.

Slowly reduce V Line until RL1 resets and note the (V Bus - V Line) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly increase V Line until RL1 re-operates and note the V Line value when this happens. This should be within -0% and + 10% of the V Line value when RL1 reset in the last test.

Continue slowly increasing V Line until RL1 resets and note the (V Line - V Bus) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly reduce V Line until RL1 re-operates and note the V Line value when this happens. This should be within -10% and + 0% of the V Line value when RL1 reset in the last test.

Slowly reduce V Bus until RL1 resets and note the (V Line - V Bus) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly increase V Bus until RL1 re-operates and note the V Bus value when this happens. This should be within -0% and + 10% of the V Bus value when RL1 reset in the last test.

Continue slowly increasing V Bus until RL1 resets and note the (V Bus - V Line) value when this happens. This should be within -0V and +2V of CSS Diff Voltage setting.

Slowly reduce V Bus until RL1 re-operates and note the V Bus value when this happens. This should be within -10% and + 0% of the V Bus value when RL1 reset in the last test.

8.8 Voltage monitor elements.

8.8.1 Dead line / live bus monitor.

Under CHECK SYNCH STGS, change CSS Fn. Links to 0000011100000000.

Under LOGIC FUNCTIONS, change Scheme Fn. Links 2 to 0001000000000000.

Adjust V Line and V Bus values and check that output RL1 operates and resets in line with the following table:

V Line value	V Bus value	RL1 state
CSS V. B/L Dead - 2V	CSS V. L/B Live + 2V	Operated
CSS V. B/L Dead + 2V	CSS V. L/B Live + 2V	Reset
CSS V. B/L Dead - 2V	CSS V. L/B Live - 2V	Reset

8.8.2 Live line / dead bus monitor.

Under LOGIC FUNCTIONS, change Scheme Fn. Links 2 to 0010000000000000.

Adjust V Line and V Bus values and check that output RL1 operates and resets in line with the following table:

V Line value	V Bus value	RL1 state
CSS V. B/L Live + 2V	CSS V. L/B Dead - 2V	Operated
CSS V. B/L Live + 2V	CSS V. L/B Dead + 2V	Reset
CSS V. B/L Live - 2V	CSS V. L/B Dead - 2V	Reset

8.8.3 Dead line / dead bus monitor.

Under LOGIC FUNCTIONS, change Scheme Fn. Links 2 to 0100000000000000.

Adjust V Line and V Bus values and check that output RL1 operates and resets in line with the following table:

V Line value	V Bus value	RL1 state
CSS V. B/L Dead - 2V	CSS V. L/B Dead - 2V	Operated
CSS V. B/L Dead + 2V	CSS V. L/B Dead - 2V	Reset
CSS V. B/L Dead - 2V	CSS V. L/B Dead + 2V	Reset

8.9 Final settings and scheme test

When synchronism check and voltage monitor element checks have been completed, the final "in service" relay settings should be entered. KAVR relays are factory configured with a set of default settings before dispatch. The commissioning engineer should be supplied with a list of all required settings for each relay installation. Any required settings which are different from the default settings, and any settings which were changed for testing (see 8.7 and 8.8 above), may be adjusted either by following the procedures detailed in Section 5.2 (5.2.1 to 5.2.7) or using a PC with suitable access software and a KITZ interface.

It is particularly important that Scheme Fn. Links 1 bit 2 (SYNCH TEST) and Scheme Fn. Links 2 bit 2 (MCL-CS) are set to 0 for normal service. CSS Fn. Links bits A, 9, 8, 5 & 0 should all be set to 1 to enable all synchronism check and voltage monitor elements to operate: selection of the specific checks required for auto-reclosing and manual closing can then be made using Scheme Fn. Links 2 bits 0, & 3 to F (scheme function links FNCT 0, & 3 to F), as described under Software Logic Functions and Synchronism Check / Voltage Monitor.

User adjustable relay settings are found in menu columns SYSTEM DATA, CHECK SYNCH STGS, TIMER SETTINGS, COUNTER SETTINGS, LOGIC FUNCTIONS, INPUT MASKS and RELAY MASKS.

When the final relay settings have been entered, they should be noted on the commissioning test record sheet. If K-Bus communications are being used, the master station PC can download settings to the relay, record and save relay settings to disc, and download saved settings to other relays.

When all external connections have been checked and final relay settings entered, if system conditions permit, an **optional** scheme test may be executed, by manually operating the associated protection, e.g. by injection testing, and checking that the CB trips and auto-recloses correctly, subject to any required external checks, such as CB gas pressure OK and/or V Line and V Bus in synchronism. **This test should be by agreement with the end user.**

9. PROBLEM SOLVING

9.1 Password lost or not accepted

Relays are supplied with the password set to AAAA.

Only upper case letters are accepted.

Password can be changed by the user. See Section 5.2.

There is an additional unique recovery password associated with the relay which can be supplied by the factory, or service agent, if given details of its serial number. The serial number will be found in the system data column of the menu and should correspond to the number on the label at the top right hand corner of the frontplate of the relay. If they differ, quote the one in the system data column.

9.2 Check synchronism settings

9.2.1 Cells not visible

To make the check synchronism setting cells visible, the following links must be set to "1" in the CSS Fn. Links cell:

Cell Text	Function Link Text	Function Link Bit Pattern (*)
CSS Phase Angle	Synccheck	0000000000000001
CSS Slip Freq	Synccheck and Slipfreq	0000000000000011
CSS Synch Timer	Synccheck and Sliptime	0000000000000101
CSS System Angle	Syscheck	0000000000100000
CSS System Slip	Syscheck and Sysfreq	0000000001100000
CSS System Timer	Syscheck and Systime	0000000010100000
CSS V.B/L Live	LBDL or DBLL or DBDL	0000011100000000
CSS V.B/L Dead	LBDL or DBLL or DBDL	0000011100000000
CSS Undervoltage	UVBlock	0000100000000000
CSS Diff.Voltage	DiffBLK	0010000000000000

9.2.2 Undervoltage feature does not block

If the undervoltage feature does not block the phase angle or system angle output

Set CSS Fn Link UVBlock to "1" (0000100000000000)

9.2.3 Differential voltage feature does not block

If the differential voltage feature does not block the phase angle or system angle output

Set CSS Fn Link DiffBLK to "1" (0010000000000000)

9.2.4 Undervoltage feature output has incorrect sense

Set CSS Fn Link UVOP to "1" (0001000000000000)

9.2.5 Differential voltage feature output has incorrect sense

Set CSS Fn Link DiffOP to "1" (0100000000000000)

9.2.6 Function links cannot be changed

Enter the password as these menu cells are protected.

Links are not selectable if associated text is not displayed.

9.2.7 Timer and counter settings cannot be changed

Return the relay to an AREVA T&D agent.

9.2.8 Counters cannot be reset

Return the relay to an AREVA T&D agent.

9.3 Alarms

If the watchdog relay operates, first check that the relay is energised from the auxiliary supply. If so, then try to determine the cause of the problem by examining the alarm flags towards the bottom of the SYSTEM DATA column of the menu. This will not be possible if the display is not responding to key presses.

Having attempted to determine the cause of the alarm it may be possible to return the relay to an operational state by resetting it. To do this, remove the auxiliary power supply for about 10 seconds. Then re-establish the supplies and the relay should in most cases return to an operating state.

Recheck the alarm status if the alarm LED is still indicating an alarm state. The following notes will give further guidance.

9.3.1 Watchdog alarm

The watchdog relay will pick-up when the relay is operational to indicate a healthy state, with its make contact closed. When an alarm condition that requires some action to be taken is detected the watch-dog relay resets and its break contact will close to give an alarm.

Note: The green LED will usually follow the operation of the watchdog relay in either of the above two cases.

There is no shorting contact across the case terminals connected to the break contact of the watchdog relay. Therefore, the indication for a failed/healthy relay will be cancelled when the relay is removed from its case.

If the relay is still functioning, the actual problem causing the alarm can be found from the alarm records in the SYSTEM DATA column of the menu (see Section 2.4.2).

9.3.2 Unconfigured or uncalibrated alarm

For an UNCONFIGURED alarm the relay logic is stopped and no longer performing its intended function. For an UNCALIBRATED alarm the relay logic will still be operational but there may be an error in its calibration that may require attention. It may be left running.

To return the relay to a serviceable state the initial factory configuration will have to be reloaded and the relay recalibrated. It is recommended that the work be carried out at the factory, or entrusted to a recognised service centre.

9.3.3 Setting error alarm

A SETTING alarm indicates that the area of non-volatile memory where the selected relay settings are stored, has been corrupted. The current settings should be checked against those applied at the commissioning stage or any later changes that have been made.

If a personal computer (PC) is used during commissioning then it is recommended that the final settings applied to the relay are copied to a floppy disc with the serial number of the relay used as the file name. The setting can then be readily loaded back into the relay if necessary, or to a replacement relay.

9.3.4 "No Service" alarm

This alarm flag can only be observed when the relay is in the calibration or configuration mode when the protection program will be stopped.

9.4 Records

9.4.1 Problems with event records

The event records are erased if the auxiliary supply to the relay is lost for a period exceeding the hold-up time of the internal power supply.

Only limited event data can only be read on the LCD. To obtain full event data the event records must be read via the serial communications port.

The oldest event is overwritten by the next event to be stored when the buffer becomes full.

When a master station has successfully read a record it usually clears it automatically and when all records have been read the event bit in the status byte is set to "0" to indicate that there are no longer any records to be retrieved.

9.4.2 Problems with disturbance records

Only one record can be held in the buffer and the recorder must be reset before another record can be stored.

The disturbance records are erased if the auxiliary supply to the relay is lost for a period exceeding the hold-up time of the internal power supply.

Disturbance records can only be read via the serial communications port. It is not possible to display them on the LCD.

No trigger selected to initiate the storing of a disturbance record.

Post trigger set to maximum value and so missing the event.

When a master station has successfully read a record it will clear it automatically and the disturbance record bit in the status byte will then be set to "0" to indicate that there are no longer a record to be retrieved.

9.5 Communications

Address cannot be automatically allocated if the remote change of setting has been inhibited by function link SD0. This must be first set to "1", alternatively the address must be entered manually via the user interface on the relay.

Address cannot be allocated automatically unless the address is first manually set to 0. This can also be achieved by a global command including the serial number of the relay.

Relay address set to 255, the global address for which no replies are permitted.

9.5.1 Measured values do not change

Values in the MEASUREMENTS column are snap shots of the values at the time they were requested. To obtain a value that varies with the measured quantity it should be added to the poll list as described in the communication manual.

9.5.2 Relay no longer responding

Check if other relays that are further along the bus are responding and if so power down the relay for 10 seconds and then re-energise to reset the communication processor. This should not be necessary as the reset operation occurs automatically when the relay detects a loss of communication.

If relays further along the bus are not communicating, check to find out which are responding towards the master station. If some are responding then the position of the break in the bus can be determined by deduction. If none is responding then check for data on the bus or reset the communication port driving the bus with requests.

Check there are not two relays with the same address on the bus.

9.5.3 No response to remote control commands

Check that the relay is not inhibited from responding to remote commands by observing the system data function link settings. If so reset as necessary; a password will be required.

System data function links can not be set over the communication link if the remote change of settings has been inhibited by setting system data function link SD0 to 0. Reset SD0 to 1 manually via the user interface on the relay first.

10. MAINTENANCE

10.1 Testing

K-Series MIDOS relays are self-supervising and so require less maintenance than earlier designs of relay. Most problems will result in an alarm so that remedial action can be taken. However, some periodic tests could be done to ensure that the relay is functioning correctly.

If the relay can be communicated with from a remote point, via its serial port, then some testing can be carried out without actually visiting the site.

When testing locally the same tests may be carried out to check for correct functioning of the relay.

10.1.1 Alarms

The alarm status LED should first be checked to identify if any alarm conditions exist. The alarm records can then be read to identify the nature of any alarm that may exist.

10.1.2 Measurement accuracy

The values measured by the relay can be compared with known system values to check that they are in the approximate range that is expected. If they are, then the A/D conversion and calculations are being performed correctly.

10.1.3 Output relay test

The output relays can be made to change state, if the password has been entered using menu cells LOG TEST RELAYS Select (0A07) and LOG TEST RELAYS = [0] (0A08).

The LOG TEST RELAYS Select cell displays the relays to be tested. Setting any position to "1" will result in the state of the corresponding relay changing state when the [0] key is given a long press in cell LOG TEST RELAYS = [0]. The state will remain changed for 250 milliseconds or until the [0] key is released, whichever is longer.

10.2 Additional tests

Additional tests can be selected from the commissioning instructions, Section 8, as required.

10.3 Method of repair

Please read the handling instructions in Section 1 before proceeding with this work. This will ensure that no further damage is caused by incorrect handling of the electronic components.

10.3.1 Replacing a PCB

a) Replacement of user interface

Withdraw the module from its case.

Remove the four screws that are placed one at each corner of the frontplate.

Remove the frontplate.

Lever the top edge of the user interface board forwards to unclip it from its mounting.

Then pull the PCB upwards to unplug it from the connector at its lower edge.

Replace with a new interface board and assemble in the reverse order.

b) Replacement of main processor board

This is the PCB at the extreme left of the module, when viewed from the front. To replace this board:

First remove the screws holding the side screen in place. There are two screws through the top plate of the module and two more through the base plate.

Remove screen to expose the PCB.

Remove the two retaining screws, one at the top edge and the other directly below it on the lower edge of the PCB.

Separate the PCB from the sockets at the front edge of the board. Note that they are a tight fit and will require levering apart, taking care to ease the connectors apart gradually so as not to crack the front PCB card. The connectors are designed for ease of assembly in manufacture and not for continual disassembly of the unit.

Reassemble in the reverse of this sequence, making sure that the screen plate is replaced with all four screws securing it.

c) Replacement of auxiliary expansion board

This is the second board in from the left hand side of the module.

Remove the processor board as described above in b).

Remove the two securing screws that hold the auxiliary expansion board in place.

Unplug the PCB from the front bus as described for the processor board and withdraw.

Replace in the reverse of this sequence, making sure that the screen plate is replaced with all four screws securing it.

10.3.2 Replacing output relays and opto-isolators

PCBs are removed as described in 10.3.1 b and c. They are replaced in the reverse order. Calibration is not usually required when a PCB is replaced unless either of the two boards that plug directly on to the left hand terminal block is replaced, as these directly affect the calibration.

Note: This CB is a through hole plated board and care must be taken not to damage it when removing a relay for replacement, otherwise solder may not flow through the hole and make a good connection to the tracks on the component side of the PCB.

10.3.3 Replacing the power supply board

Remove the two screws securing the right hand terminal block to the top plate of the module.

Remove the two screws securing the right hand terminal block to the bottom plate of the module.

Unplug the back plane from the power supply PCB.

Remove the securing screw at the top and bottom of the power supply board.

Withdraw the power supply board from the rear, unplugging it from the front bus.

Reassemble in the reverse of this sequence.

10.3.4 Replacing the back plane (size 4 & 6 case)

Remove the two screws securing the right hand terminal block to the top plate of the module.

Remove the two screws securing the right hand terminal block to the bottom plate of the module.

Unplug the back plane from the power supply PCB.

Twist outwards and around to the side of the module.

Replace the PCB and terminal block assembly.

Reassemble in the reverse of this sequence.

10.4 Recalibration

Whilst recalibration is not usually necessary it is possible to carry it out on site, but it requires test equipment with suitable accuracy and a special calibration program to run on a PC. It is recommended that the work is carried out by an authorised agency.

After calibration it will be necessary to re-enter all the settings required for the application so it will be useful to have a copy of the settings available on a floppy disk. Although this is not essential it can reduce the down time of the system.

10.5 Return to factory

Should the need arise for the equipment to be returned to AREVA T&D for repair, then the Repair Form at the back of this manual should be completed and sent with the equipment. A copy of any commissioning test results should also be sent with the equipment.

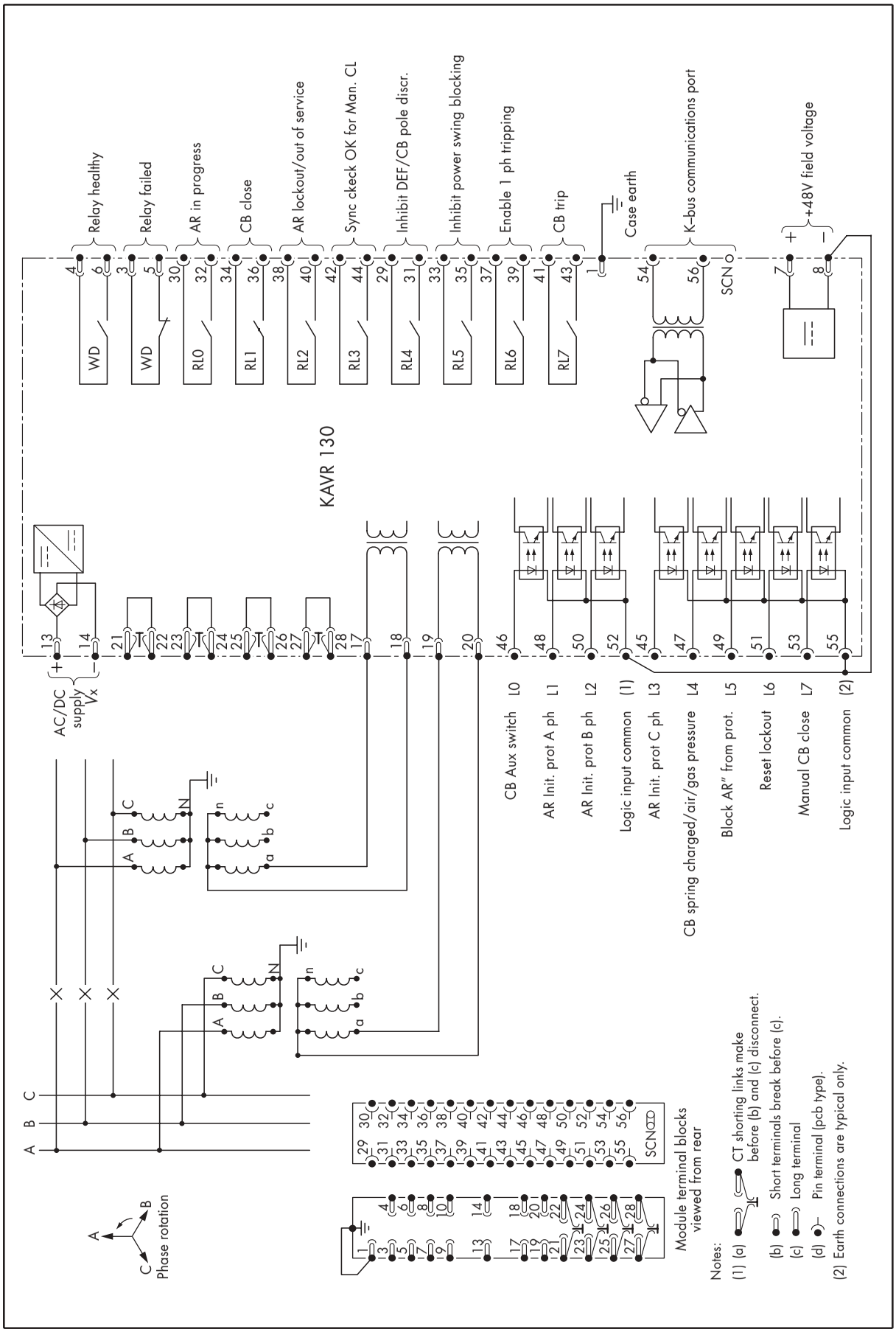


Figure 31. Typical application diagram: Midos auto-reclose and check synchronising relay type KAVR 100

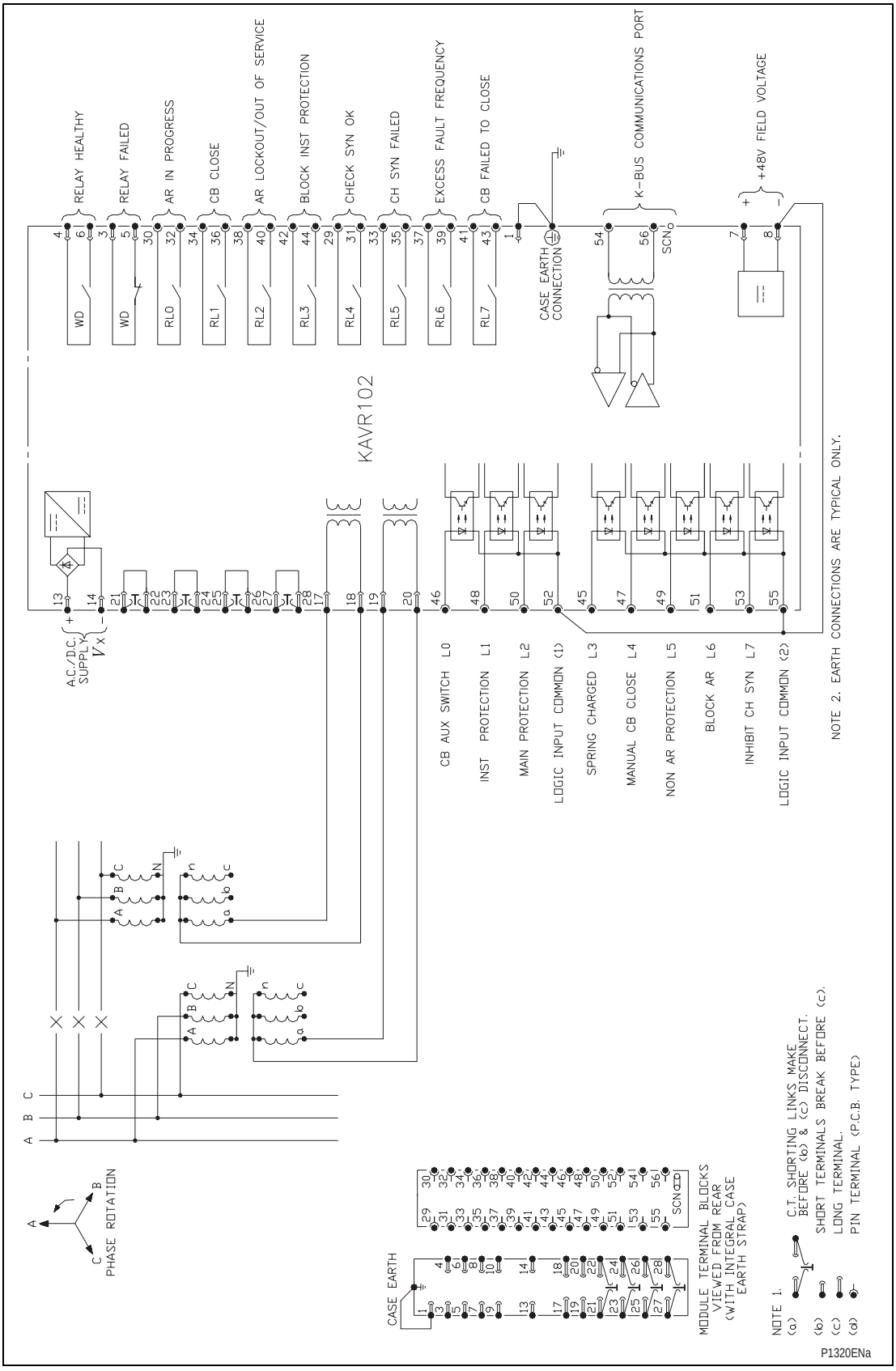


Figure 32. Typical application diagram: Midos auto-reclose and check synchronising relay type KAVR 102

11. COMMISSIONING TEST RECORD

Relay type		K	
Relay model number		Date	
Relay firmware number		Serial number	
Station		Circuit	

		(tick)
Rated voltage Vn	0	
	57/120V ac	
Auxiliary voltage	24/125V	
	48/250V	

8.1 Commissioning preliminaries

8.1.4	Serial number on case, module and cover checked	
	CT shorting switches in case checked	
	Terminals 21 and 22, 23 and 24, 25 and 26, 27 and 28 checked for continuity with module removed from case	
	External wiring checked to diagram (if available)	
8.1.5	Earth connection to case checked	
8.1.7	Test block connections checked	
8.1.8	Insulation checked	

8.3 Auxiliary supply checked

8.3.1	Auxiliary voltage at relay terminals			V ac/dc
8.3.2	Watchdog contacts checked			
	Supply off	Terminals 3 and 5		
		Terminals 4 and 6		
	Supply on	Terminals 3 and 5		
		Terminals 4 and 6		
8.3.3	Field voltage			V dc

8.4 Relay settings

Function link settings

Function link number	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
SYS Fn. Links (1)	0	0	0	0	0	0	0	0		0	0	0	0	0	0	
CSS Fn. Links (2)	0															
Scheme Fn. Lnks 1 (3)																
Scheme Fn. Lnks 2 (3)																

Notes: 1. System data column
Check synch settings column
Logic functions column

Input mask settings

Opto I nput number	7	6	5	4	3	2	1	0
INP CB AuxSwitch								
INP IProt A Phase								
INP Prot B Phase								
INP Prot C Phase								
INP Spring Charge								
INP Manual CB Cl								
INP Incr. M.Count								
INP Block AR								
INP Trip 2/3Ph								
INP Holdoff								
INP Select 1P AR								
INP Select 3P AR								
INP ResetLockout								
INP Reset M Cntr								
INP Inh CheckSyn(variant 02 only)								

Relay mask settings

Relay number	7	6	5	4	3	2	1	0
RLY A/R in Prog								
RLY CB Close Sig								
RLY PSB Inhibit								
RLY PSB Enable								

	RLY AR Lockout							
	RLY Inhibit Z1Ex							
	RLY Enable Z1Ex (10301 only)							
or	RLY ChCyn Failed (10302 only)							
	RLY 1PhAR InProg							
	RLY DEF+P1Dis OK							
	RLY Maint Alarm							
	RLY MaintLockout							
	RLY CB Trip 3Ph							
	RLY Allow 1PTrip							
	RLY MC SysCh OK							
	RLY 3Ph AR Only							
	RLY AR Off							

System data column settings

SYS Description _____

SYS Plant Ref _____

SYS Frequency _____ Hz

SYS Comms Level _____

SYS Rly Address _____

Check synchronism settings

CSS VT Ratio _____

CSS Phase Angle _____

CSS Slip Freq. _____

CSS Synch Timer _____

CSS System Angle _____

CSS System Slip _____

CSS System Timer _____

CSS V. B/L Live _____

CSS V B/L Dead _____

CSS UnderVoltage _____

CSS Diff.Voltage _____

Timer settings

TMR Dead Time 1 _____

TMR Dead Time 2 _____

TMR Dead Time 3 _____

TMR Dead Time 4 _____

TMR Close Pulse _____

TMR Reclaim Time _____

TMR SynCh Window _____

TMR SprCh Window _____

TMR Mancl AR Inh _____

TMR TripFailTim _____

TMR Exc Flt Frq _____

TMR Autoreset _____

TMR Cld Pickup _____

TMR LineV Memory _____

Counter settings

CNS Shots _____

CNS Inst Trips _____

CNS Maint Alarm _____

CNS MaintLockout _____

CNS Exc Flt Freq _____

CNS SEF Shots _____

CNS SEF InsTrips _____

8.4 Metering checks

	Actual Value Injected		Relay Metered Value	
Line Voltage	_____	V	_____	V
Bus Voltage	_____	V	_____	V

8.5 Opto input checks

Opto input number	(tick)
L0	
L1	
L2	
L3	
L4	
L5	
L6	
L7	

8.6 Output relay checks

Output relay number	(tick)
0	
1	
2	
3	
4	
5	
6	
7	

8.7.1/ 8.7.5 Phase angle element and system angle element

	Phase Angle		System Angle	
Drop Off	_____	°	_____	°
Pick Up	_____	°	_____	°

8.7.2/ 8.7.6 Synchronism timer (blocking the phase angle element) and system timer (blocking the system angle element)

	Phase Angle		System Angle	
Operating Time	_____	s	_____	s

8.7.3/ 8.7.7 Undervoltage element

	V Line		V Bus	
Pick Up	_____	V	_____	V
Drop Off	_____	V	_____	V

8.7.4/ 8.7.8 Differential voltage element

(a) Varying V Line

	V Line				V Bus	
	Low		High			
Pick Up	_____	V	_____	V	_____	V
Drop Off	_____	V	_____	V	_____	V

(b) Varying V Bus

	V Bus				V Line	
	Low		High			
Pick Up	_____	V	_____	V	_____	V
Drop Off	_____	V	_____	V	_____	V

8.8 Voltage monitors

8.8.1 Dead line/live bus monitor

V Line		V Bus		Dead Line/Live Bus Element (tick)
_____	V	_____	V	☐
_____	V	_____	V	☐
_____	V	_____	V	☐

8.8.2 Live line/dead bus monitor

V Line		V Bus		Live Line/Dead Bus Element (tick)
_____	V	_____	V	☐
_____	V	_____	V	☐
_____	V	_____	V	☐

8.8.3 Dead line/dead bus monitor

V Line		V Bus		Dead Line/Dead Bus Element (tick)
_____	V	_____	V	
_____	V	_____	V	
_____	V	_____	V	

Commissioning Engineer	Customer Witness
Date	Date

12. KAVR100 SOFTWARE HISTORY

KAVR10001x1xJEA -> xJEB (June 1993 to Feb 1994)

1. Original issue functional software.
2. Operating system upgrade to 1.04 - minor bug fix of op system software
3. Eliminate incorrect reclose following inst trip when blockins operates. Allow SpCh and SynchCh window to time out fully even if > reclaim time

Issue Date	SYS Software Ref	SYS Ladder Ref
June 1993	Op Sys 1.03	KAVR100EA C1.2
July 1993	Op Sys 1.04	KAVR100EB C1.2
October 1993	Op Sys 1.05	KAVR100EC C1.2

Settings file issue A

KAVR10001x1xJEB -> xJEC (Feb 1994 to August 1994)

1. Remove out of service (OOS) flag to avoid unwanted watchdog operation when switched out of service.
2. Operating system upgrade to 1.1 - Vline and Vbus option added to default display, En Log Evts function link added, set alarm condition added to generate an event when an alarm occurs

Issue Date	SYS Software Ref	SYS Ladder Ref
Jan 1994	Op Sys 1.05	KAVR100ED C1.2
March 1994	Op Sys 1.1	KAVR100EE C1.3

Settings file issue A for KAVR100ED C1.2 and B for KAVR100EE C1.2

KAVR10001x1xJEC -> xJED (Feb 1994 to Nov 1995)

1. Operating system upgrade to issue 1.12 - reset alarm condition added
2. Operating system upgrade to issue 1.21 - Reset Alarms cell made available in default display
3. Operating system upgrade to issue 1.3 - minor bug fix of op system software
4. Operating system upgrade to issue 1.31 - test watchdog feature added
5. Operating system upgrade to issue 1.34 - minor bug fix of op system software
6. Operating system upgrade to issue 1.40 - minor bug fix of op system software
7. Operating system upgrade to issue 1.41 - minor bug fix of op system software

Issue Date	SYS Software Ref	SYS Ladder Ref
August 1994	Op Sys 1.12	KAVR100EF C1.41
Dec 1994	Op Sys 1.21	KAVR100EG C1.43
March 1995	Op Sys 1.3	KAVR100EH C1.44
May 1995	Op Sys 1.31	KAVR100EI C1.45
Nov 1995	Op Sys 1.34	KAVR100EJ C1.46

Issue Date	SYS Software Ref	SYS Ladder Ref
Nov 1996	Op Sys 1.40	KAVR100EL C1.50
June 1997	Op Sys 1.41	KAVR100EM C1.51

Settings file issue C.

There were retrospective updates of opsys in Nov 1996 and June 1997 for KAVR10001D1xJEC

KAVR10001x1xJED -> xJEE (Nov 1995 to Dec 1996)

1. Operating system upgrade to issue 2.02 – Opsys for new 20Mhz processor, previously 16Mhz
2. Corrected alarm message spelling 'Circuit Beaker' to 'Circuit Breaker'

Issue Date	SYS Software Ref	SYS Ladder Ref
Nov 1995	Op Sys 2.02	KAVR100EJ C1.46
Dec 1995	Op Sys 2.02	KAVR100EK C1.46

Settings file issue C.

KAVR10001x1xJEE -> xJEF (Dec 1996 to March 1997)

1. Increase Synch Window max time to 9999s, Blockins seal in during protection operation, pulsed CB Fail and Success A/R operation (YE modifications)

Issue Date	SYS Software Ref	SYS Ladder Ref
Nov 1996	Op Sys 2.10	KAVR100EL C1.50

Settings file issue C.

KAVR10001x1xJEF -> xJEG (March 1997 to Nov 1997)

1. Operating system upgrade to issue 2.11 - minor bug fix of op system software

Issue Date	SYS Software Ref	SYS Ladder Ref
June 1997	Op Sys 2.11	KAVR100EM C1.51

Settings file issue C.

KAVR10001x1xJEG -> xJEH (Nov 1997 to July 1998)

1. Logic change for 'Global Reset' function operated by simple press of [0] key

Issue Date	SYS Software Ref	SYS Ladder Ref
Nov 1997	Op Sys 2.20	KAVR100EN C1.60

Settings file issue C.

KAVR10001x1xJEH -> (July 1998 to date)

1. Increment/decrement to maintenance count by user control, Enable correct flagging if final trip is IDMT+BAR

Issue Date	SYS Software Ref	SYS Ladder Ref
July 1998	Op Sys 2.22	KAVR100EO C1.62

Settings file issue C.

KAVR10002x1xJEA -> (May 1999 to date)

Model variant KAVR10002 has slightly different functionality from the standard KAVR10001. The variant was developed to meet the special requirements of TNB Malaysia, but might be appropriate in some other situations. The deviations from the standard model are described below.

1. Logic Inputs

Input Mask SEFINST (INP Inst SEF) is replaced by a new mask INHCHSYN (INP CheckSyn).

Input mask SEF (INP Sensitive RF) is deleted.

2. Output Relays

Relay mask BLSEFINS (RLY Blk SEF Inst) is replaced by a new mask SYNCH (RLY CheckSyn OK).

Relay mask OKSEFINS (RLY SEF Inst OK) is replaced by a new mask NOSYNCH (RLY ChSyn Failed).

3. Functions

FNCT 18 is re-designated SYNCH-ANY

4. Alarms

New Status 1 alarm SYNCH CHECK FAILED, triggered by output relay mask NOSYNCH.

5. Counter Settings

SEFSHOTS (CNS SEF Shots) and SEFINSTR (CNS SEF InsTrips) are deleted.

6. Ladder Logic

The changes to the ladder logic are shown in section 6.

REPAIR FORM

Please complete this form and return it to AREVA T&D with the equipment to be repaired. This form may also be used in the case of application queries.

AREVA T&D
St. Leonards Works
Stafford
ST17 4LX
England

For : After Sales Service Department

Customer Ref: _____ Model No: _____

AREVA Contract Ref: _____ Serial No: _____

Date: _____

1. What parameters were in use at the time the fault occurred?

   AC Volts _____ Main VT/Test set

   DC Volts _____ Battery/Power supply

   AC current _____ Main CT/Test set

   Frequency _____

2. Which type of test was being used? _____
3. Were all the external components fitted where required? Yes / No
   (Delete as appropriate)
4. List the relay settings being used

   _____

   _____

   _____

5. What did you expect to happen?

   _____

   _____

   _____

   _____

continued overleaf

6. What did happen?

_____

_____

_____

7. When did the fault occur?

Instant	Yes / No	Intermittent	Yes / No
Time delayed	Yes / No	(Delete as appropriate)	
By how long?	_____		

8. What indications if any did the relay show?

_____

_____

_____

_____

9. Was there any visual damage?

_____

_____

_____

10. Any other remarks which may be useful:

_____

_____

_____

_____	_____
Signature	Title
_____	_____
Name (in capitals)	Company name

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