# Numerical Voltage/ Frequency Protection Relay

# ARGUS 8


EASUN REYROLLE

Operation & Maintenance Instruction Manual

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## REFERENCE MATERIAL

[1] - REYDISP EVOLUTION : is a PC based relay support package which allows local or remote access to relays for uploading settings, downloading event and disturbance records, reading real-time data and allowing control of plant. The package is available from Reyrolle Protection and is compatible with all Argus range relays.

[2] - INFORMATIVE COMMUNICATIONS INTERFACE : a report detailing all aspects of the communications protocol used in the Argus range of relays is available from Reyrolle Protection. The report reference is 434TM05B.

# 1 INTRODUCTION

The Argus 8 series of Voltage and Frequency relays are numerical, multi-function devices, which have been designed to be applied for the protection of generation, transmission, distribution and industrial systems.

- Argus 8 - 100 series provide under / over voltage, negative sequence overvoltage and neutral voltage displacement functions.
- Argus 8 - 200 series provide under / over frequency functions in addition to the functions included in the 100 series.
- Argus 8 - 300 series provide identical functionality to the 200 series but have a faster frequency element operate time. Suitable for 50Hz systems only.

The protection functions available in the range have many possible applications, some of which are mentioned below :

**Under / overvoltage elements :**

Four independent elements are supplied, each of which can be set to operate for under or overvoltage conditions and all having separate DTL time delay elements. These can be used to protect generators against overvoltages, motors against loss of supply or applied as backup protection in the event of defective system regulating equipment.

**Negative phase sequence (NPS) overvoltage elements :**

Two independent elements are supplied, each of which has a DTL time delay element. These can be used to monitor the quality of the supply and protect plant or feeders against system unbalance.

**Neutral voltage displacement (NVD) elements :**

Two independent elements are supplied, each of which has a DTL time delay element. These can be used to detect earth faults in high impedance earthed or isolated systems. For this feature, the residual voltage can be measured directly from an open delta tertiary winding or calculated internally from the three phase voltage inputs. The NVD elements include a third harmonic filter, which de-sensitises the elements to any superimposed third harmonic frequencies.

**Under / overfrequency elements :**

Four independent elements are supplied, each of which can be set to operate for under or over frequency and all having separate DTL time delay elements. These can be applied wherever frequency protection is required to maintain system stability e.g. in load shedding schemes. The accuracy and security of operation of the numeric algorithms enables the relay to be employed to detect any frequency abnormalities.

**Blocking operation :**

Each protection element can be blocked from operation by a user defined status input signal. In addition, the voltage, frequency, and NPS elements can be blocked by the Voltage Blocking Threshold, which has a variable setting range. Also, each frequency element can be blocked by any combination of the voltage elements starting.

Argus 8 series of Voltage and Frequency relays are part of the comprehensive range of Argus-platform based numeric relays. These relays have extensive control functions, which are supplemented by advanced metering, data storage and fibre optic communications. Supervisory and self-monitoring features give added confidence to the user as well as reduced maintenance and down time. A menu-based interface gives user-friendly access to relay settings, meters and operational data.

The relay conforms to the relevant IEC 60255 standards.

The following table details the functions available in the Argus 8 - two pole variants which are supplied in the Epsilon E4 case size. Note how the number and type of elements included depend upon the 'Connection Setting' parameter.

| Catalogue Number | Connection Setting | Protection Elements Available | | | | | I/O Available | |
|---|---|---|---|---|---|---|---|---|
| | | Voltage | Frequency | NPS | NVD Direct | NVD Calc. | Inputs | Outputs |
| AG8 101-103 | 2Ph-Ph | 4 | - | 2 | - | - | 4 | 7 |
| | Ph-N+NVD | 4 | - | - | 2 | - | | |
| | Ph-Ph+NVD | 4 | - | - | 2 | - | | |
| | 2 systems A/B | 4 | - | - | - | - | | |
| AG8 201-203 | 2Ph-Ph | 4 | 4 | 2 | - | - | 4 | 7 |
| | Ph-N+NVD | 4 | 4 | - | 2 | - | | |
| | Ph-Ph+NVD | 4 | 4 | - | 2 | - | | |
| | 2 systems A/B | 4 | - | - | - | - | | |
| AG8 301-303* | 2Ph-Ph | 4 | 4 | 2 | - | - | 4 | 7 |
| | Ph-N+NVD | 4 | 4 | - | 2 | - | | |
| | Ph-Ph+NVD | 4 | 4 | - | 2 | - | | |
| | 2 systems A/B | 4 | - | - | - | - | | |

* Argus 8 types 301-303 are suitable for 50Hz systems only.

**Table 1 - Argus 8 - 2 Pole Variants**

The following table details the functions available in the Argus 8 - three pole variants which are supplied in the Epsilon E6 case size. Note how the number and type of elements included depend upon the 'Connection Setting' parameter.

| Catalogue Number | Connection Setting | Protection Elements Available | | | | | I/O Available | |
|---|---|---|---|---|---|---|---|---|
| | | Voltage | Frequency | NPS | NVD Direct | NVD Calc. | Inputs | Outputs |
| AG8 104-106 | 3Ph-Ph | 4 | - | 2 | - | - | 1 | 7 |
| | 2Ph-Ph+NVD | 4 | - | - | 2 | - | | |
| | 3Ph-N+NVD | 4 | - | 2 | - | 2 | | |
| AG8 107-109 | All features as above | | | | | | 9 | 7 |
| AG8 110-112 | All features as above | | | | | | 5 | 11 |
| AG8 204-206 | 3Ph-Ph | 4 | 4 | 2 | - | - | 1 | 7 |
| | 2Ph-Ph+NVD | 4 | 4 | - | 2 | - | | |
| | 3Ph-N+NVD | 4 | 4 | 2 | - | 2 | | |
| AG8 207-209 | All features as above | | | | | | 9 | 7 |
| AG8 210-212 | All features as above | | | | | | 5 | 11 |
| AG8 304-306* | 3Ph-Ph | 4 | 4 | 2 | - | - | 1 | 7 |
| | 2Ph-Ph+NVD | 4 | 4 | - | 2 | - | | |
| | 3Ph-N+NVD | 4 | 4 | 2 | - | 2 | | |
| AG8 307-309 | All features as above | | | | | | 9 | 7 |
| AG8 310-312 | All features as above | | | | | | 5 | 11 |

* Argus 8 types 304-312 are suitable for 50Hz systems only.

**Table 2 - Argus 8 - 3 Pole Variants**

# 2 HARDWARE DESCRIPTION

## 2.1 General

All of the Argus range of relays share common hardware components and modules. The design for the mechanical arrangement of the relays has been carefully chosen to provide a high level of EMI screening using multi-layer PCB's with ground planes, RFI suppression components and earthed metal screens. The internal arrangement has been divided into noisy and quiet areas in order to improve noise immunity and reduce RFI emissions. The only direct connection from the quiet components to the external environment is via the optical serial communications interface, which is immune to radiated or conducted interference.

## 2.2 Analogue Inputs

The input stage of an Argus 8 relay measures either two or three voltage quantities depending upon the particular variant. Over the range of 5 Vrms to 200 Vrms it maintains accuracy within ±1% (or 0.25V) over the declared frequency performance range. The wide measuring range of the input stage allows for either phase-phase or phase-neutral connections e.g. 110Vrms or 63.5Vrms nominal voltages.

Note : on relay variants which have a 2Ph-Ph connection setting, the 3$^{rd}$ phase voltage can be calculated from the two known phases if the external connection is connected phase-phase.

In order to ensure high accuracy voltage, frequency and sequence component calculations the voltage signals are sampled at 32 samples per cycle for both 50Hz and 60Hz system frequencies. The high sampling rate provides high accuracy and quality waveform storage records, which are stored at a rate of 16 samples per cycle.

## 2.3 Output Relays

Argus 8 relays have a variety of output contact types available depending upon the case size and expansion card option. The full range is given in Table 3.

| Catalogue Number | Output Relays Available | | |
|---|---|---|---|
| | C/O Contact | N/O Contact | N/C Contact |
| AG8 101-103 | 1 | 5 | 1 |
| AG8 201-203 | 1 | 5 | 1 |
| AG8 301-303 | 1 | 5 | 1 |
| AG8 104-106 | 3 | 4 | - |
| AG8 204-206 | 3 | 4 | - |
| AG8 304-306 | 3 | 4 | - |
| AG8 107-109 | 3 | 4 | - |
| AG8 207-209 | 3 | 4 | - |
| AG8 307-309 | 3 | 4 | - |
| AG8 110-112 | 3 | 8 | - |
| AG8 210-212 | 3 | 8 | - |
| AG8 310-312 | 3 | 8 | - |

**Table 3 - Output Relay Types**

All output relays are fully user configurable and can be programmed to operate from any or all of the protection functions. In addition, a watchdog feature within the relay can be mapped to any of the output relays. A changeover or normally-closed contact is generally required for this.

All output relays are of the same design and therefore each is capable of handling direct circuit breaker-tripping duty.

Output relays can be set to remain energised for a minimum time of between 100-500msec. If required, however, outputs can be programmed to operate as latching relays. These latched outputs can be reset by either pressing the TEST/RESET button, by energising a status input or by sending an appropriate communications command.

A trip test feature is provided to exercise the output contacts.

For a list of terminal numbers and their usage see Tables 4 and 5 at the back of this section.

## 2.4 Status Inputs

On two pole Argus 8 variants there are a total of 4 status inputs available in the relay. Of these three have a common negative supply and one is electrically isolated from the rest.

Standard three pole Argus 8 relays have 1 status input. One type of expansion card includes an extra 4 status inputs giving a total of 5. Another type of expansion card includes an extra 8 status inputs giving a total of 9. Tables 1 and 2 show the number of status inputs available for each type of relay.

All status inputs are fully user programmable and each has a pick-up and drop-off timer. These timers allow software filtering to be applied, which provides security in the presence of any induced A.C. voltages in the external wiring. If high-speed operation is required then the pick-up delay should be set to zero.

Each of the status inputs can be programmed to perform one of the following functions :

- Inhibit operation of any one or more protection functions.
- Select an alternative settings group.
- Trigger storage of a waveform record.
- Synchronise the real-time clock.
- Reset latched output relays.
- Energise an output relay.
- Register a Trip by an external device.
- Raise an alarm annunciation.

Additionally, each status input can have its operating logic inverted with the Status Invert feature.

For a list of terminal numbers and their usage see Tables 4 and 5 at the back of this section.

## 2.5 Self Monitoring

The relay incorporates a number of self-monitoring features. Each of these features can initiate a controlled reset sequence, which can be used to generate an alarm output. In addition, the Protection Healthy LED will give visual indication.

A watchdog timer continuously monitors the microprocessor and the relay program memory is continuously checked for data corruption using a cyclic redundancy check (CRC) routine. The internal voltage supply rails are also continuously supervised and the microprocessor is reset if any of the rails are detected to be outside of their working ranges. Any failure is detected in sufficient time so that the microprocessor can be shut down in a safe and controlled manner.

## 2.6 Measuring Principles

The input phase voltages to the relay are passed through voltage transformers, which step down the phase voltages to levels which are suitable for the electronic input stage of the relay. The transformers also provide essential isolation between the power system and the relay. The output of the transformers are differential signals which are passed through lowpass filters and then from the voltage transformer board to the processor / analogue

board. Here the signals are fed to differential amplifiers which have excellent common-mode rejection. These will reject any high frequency noise which may have coupled to the differential pair signals.

The single-ended output from the differential amplifiers is then fed to gain switching amplifiers which maximise the signal gain to provide optimum measurement resolution. From here the signals are fed to the ADC where they are sampled at a rate of 32 samples per power system cycle. (The dynamic range of the analogue-to-digital converter (ADC) is increased with this gain switching method.)

The main signal processing algorithm in the relay is a discrete fourier transform (DFT) which is performed on each phase input. The DFT extracts the power system fundamental frequency component from the input voltages, effectively filtering out noise, D.C. and harmonics. The DFT is tuned for either 50 or 60Hz, depending upon the system frequency setting. Output from the DFT calculations are real and imaginary components for each voltage input.

The real and imaginary components are used to derive the magnitude quantity, which is then scaled to give a RMS value. Part of the DFT calculation includes extra filtering which smoothes the real and imaginary components, giving reduced ripple on the RMS calculation for off-system frequency conditions. In addition, a lookup table is used to compensate for magnitude variations from the output of the RMS calculation for 47-62Hz frequencies.

The real and imaginary components output from the DFT module are also used to derive the phase of the input signal. The frequency is derived from the rate-of-change of the phase angle calculation. In addition, negative phase sequence (NPS) and zero phase sequence (ZPS) quantities are also derived from the output of the DFT calculation. The DFT ensures that D.C. and harmonics are rejected and so guarantees accurate and stable sequence calculations. The ZPS calculation, which is used in the neutral voltage displacement (NVD) function also benefits from excellent inherent 3$^{rd}$ harmonic rejection.

All relays are fully calibrated during manufacture using accurate voltage source equipment. Calibration coefficients are stored in EEPROM and are used by the processor to compensate for any inaccuracies in the input stage, which have been introduced by the analogue circuits. Errors in magnitude and phase are eliminated using this method.

## 3 PROTECTION FUNCTIONS

### 3.1 Voltage Blocking Element

The voltage blocking element acts as a block to the Voltage, Frequency and NPS elements in the relay. If all phase voltages fall below the threshold level then the blocking operation will operate. This block does not apply to the NVD elements.

- For 3 pole relay variants: Voltage blocking is applied when all 3 phases fall below the threshold level. (If set to 2Ph-Ph+NVD, then when the two phases fall below).
- For 2 pole relay variants (set as 2Ph-Ph): Voltage blocking is applied when both phases fall below the threshold level.

The setting range for the voltage blocking threshold is OFF, 1V - 100V with a 1V step . This element is required mainly for undervoltage operation conditions. Under normal circumstances, if all phase voltages fall below the undervoltage setting, a trip output would be the expected response. However, in some applications e.g. auto-reclose schemes, having an undervoltage relay trip when the line is de-energised during the auto-reclose sequence is not usually desirable. Blocking the undervoltage operation in this situation can be achieved by using the Voltage Blocking Threshold, which should generally be set above the level of expected induced voltages on the line.

(See Applications Guide Section 2.2 for more information regarding this element).

### 3.2 Voltage Elements

Each version of the Argus 8 relay has 4 voltage elements as standard. These can be configured to be either undervoltage (U/V) or overvoltage (O/V) elements. If the input voltages exceed the pickup level, whether U/V or O/V, then each element operates through a gate, which selects operation from any one phase or all phases. At this point the element can still be inhibited from starting, using either a status input inhibit or if the input voltages are below the voltage blocking threshold level. Figure 1 shows the basic operation of each voltage element. The 'event' and 'instrument' labels in the diagram indicate where this type of information is generated.

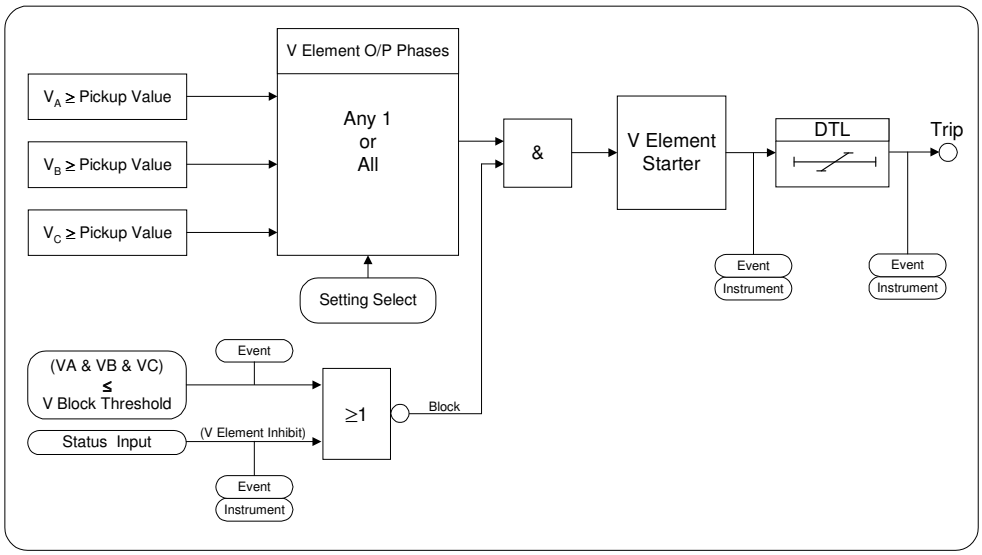



**Figure 1 - Voltage Element**

The voltage elements each have a variable hysteresis setting which allows the user to vary the pick-up - drop-off ratio for a particular element.

### 3.3 NPS Overvoltage Elements

Some Argus 8 variants have, depending upon their configuration, 2 NPS overvoltage elements. If the NPS (V2) input exceeds the setting value the starter will pickup unless any of the inhibits are enabled. Figure 2 shows the basic operation of each NPS overvoltage element. The 'event' and 'instrument' labels in the diagram indicate where this type of information is generated.

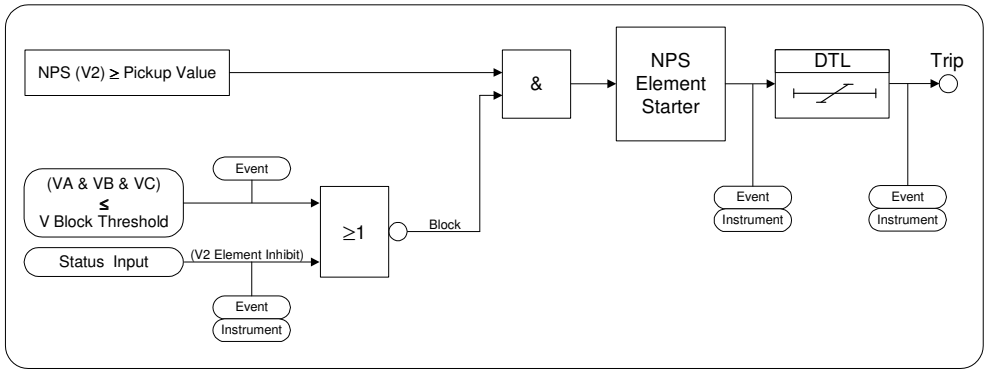



**Figure 2 - NPS Overvoltage Element**

### 3.4 NVD Overvoltage Elements

Some Argus 8 variants have, depending upon configuration, 2 neutral voltage displacement (NVD) overvoltage elements. The neutral or residual voltage can be measured directly from an open delta tertiary winding or calculated internally from the three phase voltage inputs.

If the relay is configured so that the residual voltage is measured directly, then this value is fed to the element starter directly. Also, a 3Vo V.T. ratio setting will be made available. If however, the residual is calculated from the 3 phase input voltages, then 3 x Vo is fed to the element starter. (Vo is the zero sequence voltage ).

If the NVD input exceeds the setting value the starter will pickup unless an inhibit is enabled. Figure 3 shows the basic operation of each NVD overvoltage element. The 'event' and 'instrument' labels in the diagram indicate where this type of information is generated.

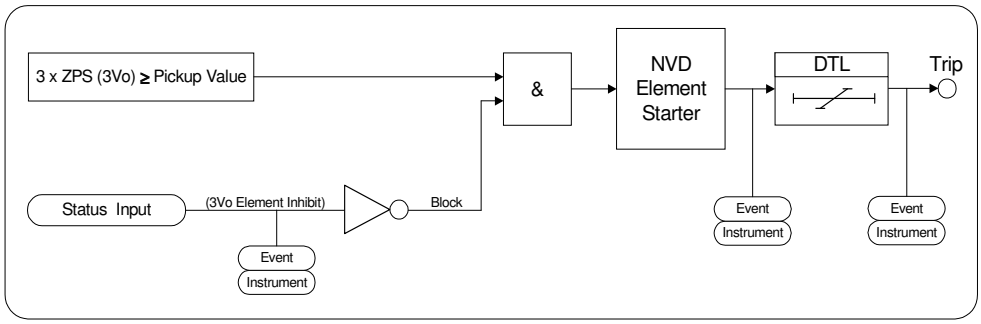



**Figure 3 - NVD Overvoltage Element**

### 3.5 Frequency Elements

Argus 8 - 200 series variants have 4 frequency elements as standard. These can be configured as either underfrequency (U/F) or overfrequency (O/F). Each element can be inhibited in four different ways :-

1. If all phase voltages fall below the voltage blocking threshold level.
2. Via a status input inhibit signal.
3. Via any combination of voltage elements starting.
4. If all of the phase voltages fall below 29V. This is independent of the voltage blocking threshold and is required to ensure that the frequency accuracy claims are within ±10mHz. (Below 29V the frequency accuracy deteriorates marginally).

Figure 4 shows the basic operation of the frequency elements. The 'event' and 'instrument' labels in the diagram indicate where this type of information is generated.

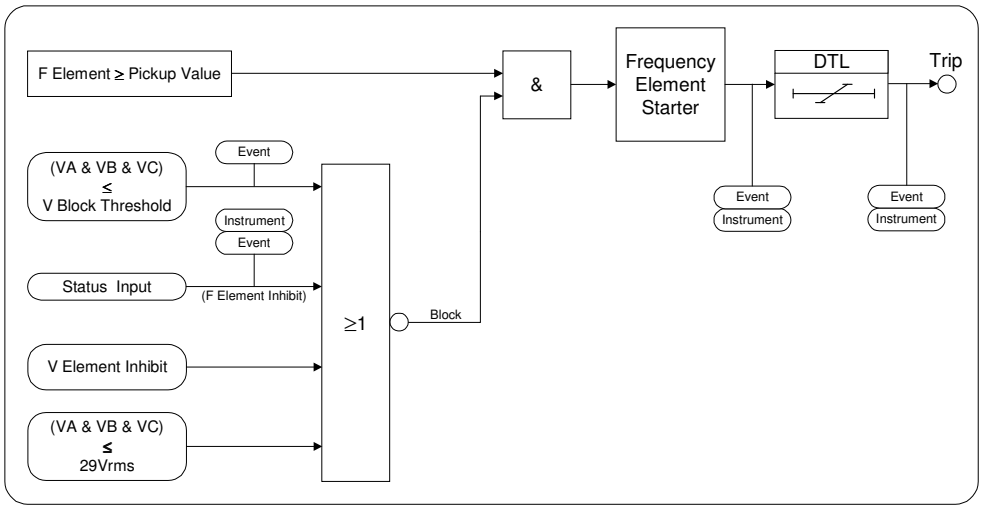



**Figure 4 - Frequency Element**

The frequency calculation is performed on data from one input phase only. If all phase voltages are above an internal threshold of 29V, then the frequency calculation will be derived from the phase A input. If however, phase A falls below 29V, then the calculation will automatically switch to phase B data. During the switchover process the last frequency value measured is held until phase B returns a valid frequency answer. This will take approximately 180ms. The switchover precedence is A-B-C and as each phase recovers its voltage then the frequency calculation is switched back to this phase. This method ensures that the frequency calculation is performed on a solid system voltage and not on low levels of input voltage where noise could cause incorrect calculation.

### 3.6 Two Systems Connection

Two pole Argus 8 variants have a '2 Systems A/B' connection setting. This setting re-configures the relay to become a 4 element voltage relay but with the ability to assign the voltage elements to two different systems. System A has voltage elements VE1 and VE2 assigned to it and System B has VE3 and VE4 assigned to it.

The System A input voltage is applied at the Va / Vab input terminals. System B is applied at the Vo / Vbc input terminals.

### 3.7 External Tripping

Any status input can be programmed to receive a trip signal from another device. The status input should firstly be mapped to the trip output contact in the Output Configuration Menu, so that energisation of the status input results in a trip signal being issued. If the same trip contact is specified in the 'Fault trigger' setting then the relay will switch to the fault data mode and indicate that an external trip has occurred.

## 4 OTHER FEATURES

### 4.1 Metering

The Argus metering feature provides real-time data available from the relay fascia in the 'Instruments Mode' or via the communications interface. The following displays are available :

- Primary RMS volts for VA, VB, VC and VO (alternatively VAB, VBC, VCA)
- Secondary RMS volts for Va, Vb, Vc, V1, V2 and Vo (alternatively Vab, Vbc, Vca)
- System frequency
- Output relay status

- Digital input status
- General alarm screen
- Trip counter
- Power on counter
- Number of waveforms recorded
- Number of events stored
- Date - displayed in DD/MM/YY format
- Time - displayed in HH:MM:SS format
- Starter information for Voltage, Frequency, NPS and NVD elements

Note : the instrument displays are updated as often as the software routines can service them, however the RMS voltage measurands have a response time of approximately 500msec.

Figure 5 shows the display menu structure from where the available instruments can be accessed. Note that pressing the ⇨ Test/Reset key can clear three of the instruments, the Trip Counter, Waveforms and Events.

## 4.2 Data Storage

Details of relay operation are recorded in three forms, namely Waveform records, Event records and Fault Data records. All records are time and date stamped with a year 2000 compatible real time clock which maintains the time even when the relay is de-energised [see Note below]. Time and date can be set either via the relay fascia using appropriate commands in the System Config menu or via the communications interface. In the latter case, relays connected in a network can be synchronised by a global time sync command.

Alternatively, synchronising pulses can be received via a status input. To use this feature one of the status inputs has to be assigned to the 'Clock Sync' feature in the Status Config menu. Additionally the 'Clock Sync Period' setting in the System Config menu should be set to either 'seconds' or 'minutes'. If 'seconds' are selected then the energisation of the selected status input will result in the clock being synchronised to the nearest second with the milliseconds set to zero. If 'minutes' are selected then the clock is synchronised to the nearest minute with both seconds and milliseconds set to zero.

Note : the real-time clock, waveform records and event records are all maintained, in the event of loss of auxiliary d.c. supply voltage, by the backup storage capacitor. This capacitor has the ability to maintain the charges on the real-time clock IC and the SRAM memory device for typically 2-3 weeks time duration. This time, however, is influenced by factors such as temperature and the age of the capacitor and could be shorter.

### 4.2.1 Waveform Records.

The waveform record feature stores analogue and digital information for the voltage inputs, status inputs and output relays. The waveform record is 1.0 second long (0.833sec at 60Hz) with a sampling resolution of 16 samples per cycle. The recorder feature has the ability to store records for the previous five trip operations of the relay. These are labelled 1-5 with 1 being the most recent record.

The waveform recorder can be triggered in the following ways ;

- Via the waveform trigger status input signal.
- From any element Trip operation, including, Voltage, Frequency, NVD and NPS elements.
- Via the IEC870-5-103 communications interface.

The waveform recorder has a settable pre-fault triggering capability.

### 4.2.2 Event Records

The event recorder feature allows the time tagging of any change of state (event) of the relay. As an event occurs the actual event condition is logged as a record along with a time and date stamp to a resolution of 5ms. There is capacity for a maximum of 500 event records to be stored in the relay and when the event buffer is full, any new record will over-write the oldest. The following events are logged :

- Change of setting (though not the actual setting change). Also indication of which group of settings is active.
- Change of state of each output relay.
- Change of state of each status Input.
- Change of state of any of the protection functions of the relay.
- Trip indication reset
- Trip test.
- Trip supply failure.

For a full list of all the events available see Table 6.

### 4.2.3 Fault Data Records

When issuing a trip output under fault conditions, the Argus 8 relay will illuminate the Trip LED, store a fault record and display the fault indication screen. The fault indication screen displays a summary of the fault data record, giving immediate, easily understood information on what has occurred. It displays date (DD/MM), time (HH:MM:SS) and the poles which were picked up when the trip signal was issued e.g.

```
25/04 17:25:51
TRIP A B C
```

This display is held until the TEST/RESET button is pressed, upon which the LED will turn off and any latched output relays are reset. The relay enters 'Fault Data Display Mode' at which point the fault indication screen is replaced by a more detailed scrolling fault data display. This shows date and time of fault and for each pole the elements which were picked up and the voltages measured at the time of trip e.g.

```
FAULT 1 25/04/00 17:25:51.5400 G1, VAB VE1 VE2 VE3 VE4 110.22V, Vo
<3VoE1> <3VoE2> 110.215V,FE1 FE2 FE3 FE4 50.499Hz
```

```
FAULT 1
<< Fault Data >>
```

The fault record is viewed in the 'Fault Data Display Mode' of the menu system and can be viewed again at a later date. The relay will store the last 10 fault records, which are numbered 1-10, with 1 being the most recent record. To view them, scroll downwards using the ⇩ button.

Depending upon the relay application, some of the protection elements may not be used for tripping purposes but for alarm purposes. In these cases it would be undesirable for the Argus to light the Trip LED and give fault indication. It is therefore necessary to define a 'Fault' for the cases where a trip is issued. A 'Fault Trigger' setting exists in the Data Storage Menu, which allows a fault condition to be defined by selecting any combination of output relays as tripping outputs. The Trip LED and the fault record storage will be triggered when any of the selected output relays are energised. Note that a trip output can still be generated even if the fault trigger setting is not used, though no trip indication will be given.

Fault records are stored in non-volatile memory.

### 4.3 Communications

A fibre optic communication port is provided which gives superior EMC performance. Communication is compatible with the IEC870-5-103 FT 1.2 transmission and application standards. For communication with the relay via a PC (personal computer) a user-friendly software package, REYDISP EVOLUTION [1], is available to allow transfer of the following:

- Relay Settings
- Waveform Records
- Event Records
- Fault Data Records
- Instrument and meters
- Control Functions

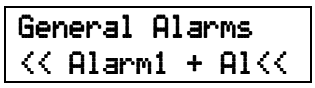
Communications operation is described in detail in Section 4 of this manual.

### 4.4 General Alarm Screens

The Argus 8 relay has an independent display function that provides up to nine General Alarm screens, each of which may be programmed by the user to display a message associated with an external alarm.

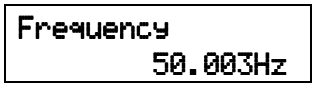
Within the System Config Menu, each alarm message can be text edited by the user to display up to 13 characters. Also, each alarm can be user mapped to any status input, via the Status Config Menu, so that on energisation of that input the associated alarm message is automatically displayed. Where more than one General Alarm is raised then the display will scroll right to left to show all energised screens sequentially, with screens separated by a '+' sign. If required, more than one alarm may be mapped to a single status input, allowing long messages to be displayed.

The message will appear on the LCD for the duration of the time that the status input is energised.




### 4.5 Default Instrument Screens

The menu presentation of the various instruments allows the user to view a single screen at a time. However, for in-service use, it is desirable that a small number of high interest, user selectable, screens are presented automatically by default without user intervention. The instrument screens of interest to the user e.g. those required to be presented to a visiting engineer for record purposes can be selected by the user by pressing **ENTER** when viewing the required screen. On pressing **ENTER** a 'Screen Set As Default' message will be flashed up and a '  ' will appear at the top right of that screen. The '  ' indicates that a screen is a 'default screen'. To de-select a default screen, simply press **ENTER** while on that particular screen and a 'Screen Cleared As Default' message will be flashed up. The '  ' symbol will be cleared.




If no keys have been pressed for a pre-determined time the relay will jump to the default instrument display regardless of where the menu system has been left by the user. It will then scroll through each of the selected default instruments and remain on each for 5 seconds. The main timer, which sets the time to elapse before the relay goes into the default instruments mode is found in the System Config Menu. This is the Default Screen Timer setting and it can be set to a range of values from 10 seconds to 1 hour. See relay settings, Section 3 of this manual.

If any General Alarm is raised, then the general alarm screen will be presented in the default screen sequence. The general alarm screen, which has a scrolling display, will present one pass of its display message.

Any key press while in the default screen sequence will result in a return to the 'Relay Identifier' screen at the top of the menu structure.

### 4.6 Multiple Settings Groups.

Argus relays provide eight alternative setting groups, making it possible to edit one group while the relay protection algorithms operate using another 'active' group. An indication of which group is being viewed is given by the 'Gn' character in the top left of the display. The relay can then be switched from one group of settings to another to suit alterations in the power system configuration. Changeover will occur within 25ms.

A change of group can be achieved either locally at the relay fascia, remotely via a communication interface command or by energisation of a status input. In the case of the latter method, the 'Settings Group Select' setting is used to configure any one (or more) of the status inputs to select a settings group. The selected group is then made active if the status input is energised and remains active for as long as the input remains energised.

### 4.7 Password Feature

The programmable password feature enables the user to enter a 4 character alphanumeric code to secure access to the relay settings. The relay is supplied with the password set to 'NONE' which means that the password feature is not activated. Once a password has been entered then it will be required thereafter to change settings. It can, however, be de-activated by using the password to gain access and by resetting it back to 'NONE'.

As soon as the user attempts to change a setting the password is requested before any setting alterations are allowed. Once the password has been validated, the user is 'logged on' and any further changes can be made without re-entering the password. If no more changes are made within 1 hour then the user will automatically be 'logged off', re-enabling the password feature.

Note that the password validation screen also displays a numerical code. If the password is lost or forgotten, this code can be communicated to Reyrolle Protection by authorised personnel, and the password can be retrieved.

### 4.8 Trip Circuit Supervision

A trip circuit supervision feature is provided within the relay. The Argus 8 can monitor its own trip circuit by configuring one of its status inputs using the 'Trip Circuit Fail' setting and connecting the status input into the trip circuit. Indication is then given instantaneously of 'Trip Circuit Fail' should a fault be detected and this display also identifies which input has detected the fault. Since the status inputs can be programmed to operate output contacts, an alarm can be also generated from the trip circuit supervision feature.

See Section 5 - Applications Guide, subsection 2.6 for more details on the trip circuit supervision scheme.

## 5 USER INTERFACE

The user interface is designed to provide a user-friendly method of entering settings and retrieving data from the relay. The relay fascia includes a 16 character by 2 line, backlit, liquid crystal display (LCD), 3 light emitting diodes (LED) and 5 push buttons.

### 5.1 Liquid Crystal Display

The liquid crystal display is used to present settings, instrumentation and fault data in a textual format. To conserve power the display backlighting is turned off if no push buttons are pressed for 5 minutes. After one hour the whole display is de-activated except if the display

is left in the 'Instruments Mode' where it remain visible permanently so that instruments can be displayed continuously. Also, if any default instruments have been selected then the display will not power down, only the backlight will turn off. Once the backlight is turned off, any following keypress will turn the backlight on without changing the display.

### 5.2 LED Indications

The following indications are provided :

- **Protection Healthy – Green LED (flashes with fault).**

This LED is solidly illuminated to indicate that DC volts have been applied to the relay and that the relay is operating correctly. If the internal relay watchdog detects a permanent fault then this LED will continuously flash.

- **Starter – Yellow LED (self resetting).**

This LED indicates that any of the protection element starters are operating.

- **Trip – Red LED (latched).**

This LED indicates that a trip as defined by the user has occurred. Such a trip may be issued by any of the relay's protection functions.

### 5.3 Keypad

Five pushbuttons are used to control the functions of the relay. They are labelled ⇧ ⇩ ⇨ **ENTER** and **CANCEL**. Note that the ⇨ button is also labelled **TEST/RESET**.

When the relay front cover is in place only the ⇩ and ⇨ buttons are accessible. This allows only read access to all the menu displays. It is not possible to change settings.

### 5.4 Navigating the Menu System

The display menu structure is shown in Figure 5. This diagram shows the three main modes of display, which are the Settings Mode, Instruments Mode and the Fault Data Mode.

On relay start up the user is presented with a default relay identifier,

```
    ARGUS 8
Factory Settings
```

which shows that the relay has been set with the standard factory default settings. The top line of the LCD can be changed to some user-definable identifier or code if preferred.

Pressing the ⇨ key on this display initiates an LED test. Pressing ⇩ at this display allows access to the three display modes which are accessed in turn by pressing the ⇨ key.

The 'Settings Mode' contains up to 10 setting sub-menu's. (Note :- this number can vary depending upon relay configuration). These hold all of the programmable settings of the relay in separate logical groups. The sub menu's are accessed by pressing the ⇨ key. This enters the sub menu and presents a list of all the settings within that sub menu. Pressing the ⇩ key scrolls through the settings until after the last setting in the group the next sub menu is presented. Access to this group is via the same method as before. If a particular sub menu is not required to be viewed then pressing the ⇩ key will skip past that particular menu and present the next one in the list. Note that all screens can be viewed even if the password is not known. The password only protects against unauthorised changes to settings.

While viewing an editable screen pressing the **ENTER** key allows the user to change the displayed data. The editable field will be indicated by a flashing character(s). Pressing ⇧ or ⇩ scrolls through the available setting values or, pressing the ⇨ key moves right through the edit fields. Note that all settings can be incremented or decremented using the ⇧ or ⇩ keys and they all wrap-around so that to go from e.g. a setting minimum value to the maximum value it is quicker to press the ⇩ key, rather than scroll up through every setting. Also, to facilitate quicker setting changes an acceleration feature is available which if ⇧ or ⇩ are depressed and held, then the rate of scrolling through the setting values increases.

If **CANCEL** is pressed during a setting change operation the original setting value is restored and the display is returned to the normal view mode.

If changes are made to the setting value then pressing **ENTER** disables the flashing character mode and displays the new setting value. This is immediately stored in non-volatile memory.

Note : the relay exhibits a method of hiding settings which are not relevant to a particular customer scheme which is known as setting dependencies. Some settings are dependant on others being enabled and if a function is not enabled then associated settings are not displayed e.g. if Voltage Element 1 is not required then set,

Gn V Element 1 Operation to OFF ; the following associated settings will not be displayed ;

Gn V Element 1 Setting,

Gn V Element 1 Delay,

Gn V Element 1 Hysteresis,

Gn V Element 1 O/P Phases,

Also hidden are all associated output relays options and status input inhibits.

There are many examples of setting dependencies and care must be taken to ensure a function is enabled before looking for other associated settings which otherwise would be hidden.

The 'Instruments Mode' contains a maximum of 17 instruments. This number is dependent upon the relay configuration and therefore some instruments may not be displayed. Pressing the ⇩ key scrolls down through the list of instruments and pressing ⇧ scrolls up through them. For more information on the relay's instruments see Sections 4.1 and 4.5.

The 'Fault Data Mode' can contain a maximum of 10 fault records. These are accessed in the same way as the other display modes. For more information on the fault record displays see Section 4.2.3.

For a complete list of all possible settings see Section 3 – of this manual. This section also shows all setting ranges and factory default values, as well as including a brief description of each setting function.

| | Function | | Terminal | Terminal | | Function |
|---|---|---|---|---|---|---|
| Terminal Block 1 | Va / (Vab) | Start | **1** | **2** | Finish | Va / (Vab) |
| | Vo / (Vbc) | Start | **3** | **4** | Finish | Vo / (Vbc) |
| | Status Input 1 | (+) | **5** | **6** | (–) | Status Input 1 |
| | Relay 1 (N/C) | – | **7** | **8** | – | Relay 1 (N/C) |
| | Relay 2 (N/O) | – | **9** | **10** | – | Relay 2 (N/O) |
| | Relay 4 (N/O) | – | **11** | **12** | – | Relay 4 (N/O) |
| | Aux. Volts | (+) | **13** | **14** | (–) | Aux. Volts |
| | Earth | | **15** | **16** | – | Relay 3 (N/O) |
| | Relay 3 (COM) | – | **17** | **18** | – | Relay 3 (N/C) |
| | Relay 5 (N/O) | – | **19** | **20** | – | Relay 5 (N/O) |
| | Relay 6 (N/O) | – | **21** | **22** | – | Relay 6 (N/O) |
| | Relay 7 (N/O) | – | **23** | **24** | – | Relay 7 (N/O) |
| | Status Input 4 | (+) | **25** | **26** | (+) | Status Input 3 |
| | Status Input 2 | (+) | **27** | **28** | (–) | Status Common |

**Table 4 - Connection Table (E4 Versions)**

| | Function | | Terminal | Terminal | | Function |
|---|---|---|---|---|---|---|
| Terminal Block 1 | Not Used | – | **1** | **2** | – | Not Used |
| | Status Input 1 | (+) | **3** | **4** | (–) | Status Input 1 |
| | Relay 1 (N/C) | – | **5** | **6** | – | Relay 1 (COM) |
| | Relay 1 (N/O) | – | **7** | **8** | – | Relay 2 (N/O) |
| | Relay 2 (COM) | – | **9** | **10** | – | Relay 2 (N/C) |
| | Relay 4 (N/O) | – | **11** | **12** | – | Relay 4 (N/O) |
| | Aux. Volts | (+) | **13** | **14** | (–) | Aux. Volts |
| | Earth | | **15** | **16** | – | Relay 3 (N/O) |
| | Relay 3 (COM) | – | **17** | **18** | – | Relay 3 (N/C) |
| | Relay 5 (N/O) | – | **19** | **20** | – | Relay 5 (N/O) |
| | Relay 6 (N/O) | – | **21** | **22** | – | Relay 6 (N/O) |
| | Relay 7 (N/O) | – | **23** | **24** | – | Relay 7 (N/O) |
| | Not Used | – | **25** | **26** | – | Not Used |
| | Not Used | – | **27** | **28** | – | Not Used |
| Terminal Block 2 | Status Input 5 | (+) | **29** | **30** | (–) | Status Input 5 |
| | Status Input 4 | (+) | **31** | **32** | (–) | Status Input 4 |
| | Status Input 3 | (+) | **33** | **34** | (–) | Status Input 3 |
| | Status Input 2 | (+) | **35** | **36** | (–) | Status Input 2 |
| | Relay 8 (N/O) | – | **37** | **38** | – | Relay 8 (N/O) |
| | Relay 9 (N/O) | – | **39** | **40** | – | Relay 9 (N/O) |
| | Relay 10 (N/O) | – | **41** | **42** | – | Relay 10 (N/O) |
| | Relay 11 (N/O) | – | **43** | **44** | – | Relay 11 (N/O) |
| | Not Used | – | **45** | **46** | – | Not Used |
| | Not Used | – | **47** | **48** | – | Not Used |
| | Not Used | – | **49** | **50** | – | Not Used |
| | Vc / (Vca) / (Vo) | Start | **51** | **52** | Finish | Vc / (Vca) / (Vo) |
| | Vb / (Vbc) | Start | **53** | **54** | Finish | Vb / (Vbc) |
| | Va / (Vab) | Start | **55** | **56** | Finish | Va / (Vab) |

Alternative expansion board :

| | | | | | | |
|---|---|---|---|---|---|---|
| | Status Input 9 | (+) | **37** | **38** | (–) | Status Input 9 |
| | Status Input 8 | (+) | **39** | **40** | (–) | Status Input 8 |
| | Status Input 7 | (+) | **41** | **42** | (–) | Status Input 7 |
| | Status Input 6 | (+) | **43** | **44** | (–) | Status Input 6 |

**Table 5 - Connection Table (E6 Versions)**

The following event codes can be stored in the relay and will be time stamped to a resolution of 5ms. There can be a maximum of 500 events stored in the event buffer as per the Argus range of relays. The Argus 8 events are assigned to function code 167.

| Event Description | Frame Type | Event Operation | GI | Code |
|---|---|---|---|---|
| Data Lost | 1 | RaisedOnly | × | 0 |
| Reset FCB | 5 | RaisedOnly | × | 2 |
| Reset CU | 5 | RaisedOnly | × | 3 |
| Start/Restart | 5 | RaisedOnly | × | 4 |
| Power On | 5 | RaisedOnly | × | 5 |
| External Trip | 1 | RaisedOnly | × | 18 |
| LED's Reset | 1 | RaisedOnly | × | 19 |
| Trip Test | 1 | RaisedAndCleared | × | 21 |
| | | | | |
| Settings Changed | 1 | RaisedAndCleared | × | 22 |
| Setting Group 1 Selected | 1 | RaisedAndCleared | ✓ | 23 |
| Setting Group 2 Selected | 1 | RaisedAndCleared | ✓ | 24 |
| Setting Group 3 Selected | 1 | RaisedAndCleared | ✓ | 25 |
| Setting Group 4 Selected | 1 | RaisedAndCleared | ✓ | 26 |
| Setting Group 5 Selected | 1 | RaisedAndCleared | ✓ | 35 |
| Setting Group 6 Selected | 1 | RaisedAndCleared | ✓ | 36 |
| Setting Group 7 Selected | 1 | RaisedAndCleared | ✓ | 37 |
| Setting Group 8 Selected | 1 | RaisedAndCleared | ✓ | 38 |
| | | | | |
| Input 1 | 1 | RaisedAndCleared | ✓ | 27 |
| Input 2 | 1 | RaisedAndCleared | ✓ | 28 |
| Input 3 | 1 | RaisedAndCleared | ✓ | 29 |
| Input 4 | 1 | RaisedAndCleared | ✓ | 30 |
| Input 5 | 1 | RaisedAndCleared | ✓ | 45 |
| Input 6 | 1 | RaisedAndCleared | ✓ | 46 |
| Input 7 | 1 | RaisedAndCleared | ✓ | 47 |
| Input 8 | 1 | RaisedAndCleared | ✓ | 48 |
| Input 9 | 1 | RaisedAndCleared | ✓ | 49 |
| | | | | |
| Output 1 | 1 | RaisedAndCleared | ✓ | 51 |
| Output 2 | 1 | RaisedAndCleared | ✓ | 52 |
| Output 3 | 1 | RaisedAndCleared | ✓ | 53 |
| Output 4 | 1 | RaisedAndCleared | ✓ | 54 |
| Output 5 | 1 | RaisedAndCleared | ✓ | 55 |
| Output 6 | 1 | RaisedAndCleared | ✓ | 56 |
| Output 7 | 1 | RaisedAndCleared | ✓ | 57 |
| Output 8 | 1 | RaisedAndCleared | ✓ | 58 |
| Output 9 | 1 | RaisedAndCleared | ✓ | 59 |
| Output 10 | 1 | RaisedAndCleared | ✓ | 60 |
| Output 11 | 1 | RaisedAndCleared | ✓ | 61 |
| Voltage Block | 1 | RaisedAndCleared | ✓ | 79 |
| Waveform Stored | 1 | RaisedOnly | × | 80 |
| Remote CTRL Interrupted | 1 | RaisedOnly | × | 81 |

| Event Description | Frame Type | Event Operation | GI | Code |
|---|---|---|---|---|
| Power On Counter Alarm | 1 | RaisedAndCleared | ✓ | 92 |
| | | | | |
| Trip Circuit Fail | 1 | RaisedAndCleared | ✓ | 20 |
| Trip Count Alarm | 1 | RaisedAndCleared | ✓ | 33 |
| | | | | |
| General Alarm 1 | 1 | RaisedAndCleared | ✓ | 121 |
| General Alarm 2 | 1 | RaisedAndCleared | ✓ | 122 |
| General Alarm 3 | 1 | RaisedAndCleared | ✓ | 123 |
| General Alarm 4 | 1 | RaisedAndCleared | ✓ | 124 |
| General Alarm 5 | 1 | RaisedAndCleared | ✓ | 125 |
| General Alarm 6 | 1 | RaisedAndCleared | ✓ | 126 |
| General Alarm 7 | 1 | RaisedAndCleared | ✓ | 127 |
| General Alarm 8 | 1 | RaisedAndCleared | ✓ | 128 |
| General Alarm 9 | 1 | RaisedAndCleared | ✓ | 129 |
| | | | | |
| V Element 1 Starter | 1 | RaisedAndCleared | ✓ | 170 |
| V Element 2 Starter | 1 | RaisedAndCleared | ✓ | 171 |
| V Element 3 Starter | 1 | RaisedAndCleared | ✓ | 172 |
| V Element 4 Starter | 1 | RaisedAndCleared | ✓ | 173 |
| F Element 1 Starter | 1 | RaisedAndCleared | ✓ | 174 |
| F Element 2 Starter | 1 | RaisedAndCleared | ✓ | 175 |
| F Element 3 Starter | 1 | RaisedAndCleared | ✓ | 176 |
| F Element 4 Starter | 1 | RaisedAndCleared | ✓ | 177 |
| 3Vo Element 1 Starter | 1 | RaisedAndCleared | ✓ | 178 |
| 3Vo Element 2 Starter | 1 | RaisedAndCleared | ✓ | 179 |
| V2 Element 1 Starter | 1 | RaisedAndCleared | ✓ | 180 |
| V2 Element 2 Starter | 1 | RaisedAndCleared | ✓ | 181 |
| | | | | |
| V Element 1 Trip | 1 | RaisedOnly | × | 182 |
| V Element 2 Trip | 1 | RaisedOnly | × | 183 |
| V Element 3 Trip | 1 | RaisedOnly | × | 184 |
| V Element 4 Trip | 1 | RaisedOnly | × | 185 |
| F Element 1 Trip | 1 | RaisedOnly | × | 186 |
| F Element 2 Trip | 1 | RaisedOnly | × | 187 |
| F Element 3 Trip | 1 | RaisedOnly | × | 188 |
| F Element 4 Trip | 1 | RaisedOnly | × | 189 |
| 3Vo Element 1 Trip | 1 | RaisedOnly | × | 190 |
| 3Vo Element 2 Trip | 1 | RaisedOnly | × | 191 |
| V2 Element 1 Trip | 1 | RaisedOnly | × | 192 |
| V2 Element 2 Trip | 1 | RaisedOnly | × | 193 |

**Table 6 - Event Codes**

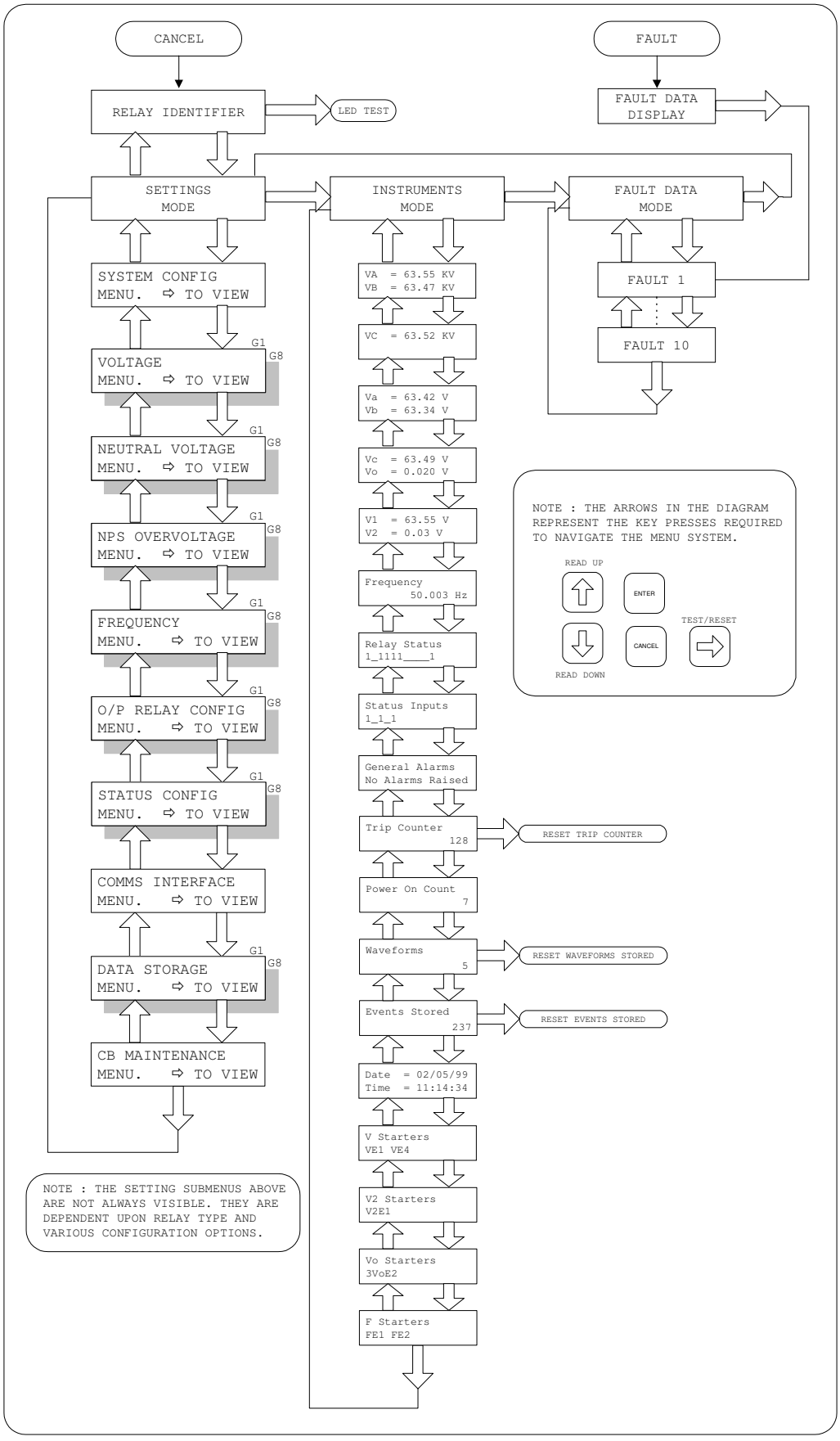



**Figure 5 - Display Menu Structure**

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## TABLE OF FIGURES

## 1 GENERAL

The relay complies with the relevant clauses in the following specification :-

- IEC 60255 - 3

## 2 CHARACTERISTIC ENERGIZING QUANTITY

| | |
|---|---|
| AC Voltage Vn | 63.5 / 110 Vrms |
| Frequency | 50 / 60Hz |

## 3 AUXILIARY ENERGIZING QUANTITY

### 3.1 DC Power Supply

| | Nominal | Operating Range |
|---|---|---|
| $V_{AUX}$ | 24, 30, 48V | 18V to 60V dc |
| $V_{AUX}$ | 110, 220V | 88V to 280V dc |

### 3.2 DC Status Inputs

| Nominal Voltage | Operating Range |
|---|---|
| 30 / 34 | 18V to 37.5V |
| 48 / 54 | 37.5V to 60V |
| 110 / 125 | 87.5V to 137.5V |
| 220 / 250 | 175 to 280V |

NB : the status operating voltage need not be the same as the main energising voltage. For 110/125V or 220/250V working, a standard Argus relay with 48/54V status can be supplied for use with external dropper resistors as follows:-

**Status Input External Resistances**

| Nominal Voltage | Resistor Value (Wattage) |
|---|---|
| 110 / 125V | 2k7 ± 5% ; (2.5W) |
| 220 / 250V | 8k2 ± 5% ; (6.0W) |

**Status Input Performance**

| | |
|---|---|
| Minimum DC current for operation | 10mA |
| Reset/Operate Voltage Ratio | ≥ 90% |
| Typical response time | < 5ms |
| Typical response time when programmed to energise an output relay contact | < 15ms |
| Minimum pulse duration | 40ms |

Each status input has associated timers which can be programmed to give time delayed pick-up and time delayed drop-off. The drop-off timers have default settings of 20ms, thus providing immunity to an AC input signal. Status inputs will not respond to the following:

- 250V RMS 50/60Hz applied for two seconds through a 0.1µF capacitor.
- 500V RMS 50/60Hz applied between each terminal and earth.
- Discharge of a 10µF capacitor charged to maximum DC auxiliary supply voltage.

The inputs meet the requirements of ESI 48-4.

**Note :** special versions of status input are available for direct operation from 110V and 220V supplies. These do not comply with the ESI 48-4 specification and will operate with a DC current of less than 10mA.

## 4 SETTING RANGES

**Voltage Element Settings**

| | |
|---|---|
| V Element Setting | 5V – 200V step 0.5V |
| V Element Delay | 0.00-20.00 step 0.01sec<br>20.0-100.0 step 0.5sec<br>100-600 step 1.0sec |
| V Element Hysteresis | 1% – 90% step 1% |

**Neutral Voltage Settings**

| | |
|---|---|
| 3Vo Element Setting | 1V – 100V step 0.5V |
| 3Vo Element Delay | 0.00-20.00 step 0.01sec<br>20.0-100.0 step 0.5sec<br>100-600 step 1.0sec |

**NPS Overvoltage Settings**

| | |
|---|---|
| V2 Element Setting | 1V – 100V step 0.5V |
| V2 Element Delay | 0.00-20.00 step 0.01sec<br>20.0-100.0 step 0.5sec<br>100-600 step 1.0sec |

**Frequency Element Settings**

| | |
|---|---|
| F Element Setting | 47.00Hz - 62.00Hz step 0.01Hz |
| F Element Delay | 0.00-20.00 step 0.01sec<br>20.0-100.0 step 0.5sec<br>100-600 step 1.0sec |

**Voltage Blocking Element**

| | |
|---|---|
| Voltage Blocking Threshold | OFF, 1V – 100V step 1.0V |

## 5 ACCURACY REFERENCE CONDITIONS

| | |
|---|---|
| General | IEC 60255 –3 |
| Auxiliary Supply | Nominal |
| Rating | 63.5 or 110 Vrms |
| Frequency | 50 or 60Hz |
| Ambient Temperature | 20℃ |

## 6 ACCURACY

The following accuracy is specified at reference conditions.

### 6.1 Overvoltage Element

| **Overvoltage Element** | |
|---|---|
| Operate Level | Setting ± 1% or 0.25V |
| Reset Level | ≥ (operate level – hysteresis setting) |
| Operate Time (see Fig.1) – to output contact | |
| 0V to 2x setting | ≤ 45ms |
| 0V to 1.1x setting | ≤ 55ms |
| Reset Time | |
| 1.1x to 0.9x setting | ≤ 50ms |

### 6.2 Undervoltage Element

| **Undervoltage Element** | |
|---|---|
| Operate Level | Setting ± 1% or 0.25V |
| Reset Level | ≤ (operate level + hysteresis setting) |
| Operate Time (see Fig.2) | |
| 1.1x to 0.9x setting | ≤ 65ms |
| Reset Time | |
| 0V to 1.1x setting | ≤ 75ms |
| 0V to 2x setting | ≤ 65ms |

### 6.3 Neutral Voltage Element

| **Neutral Voltage Element** | |
|---|---|
| Operate Level | Setting ± 1% or 0.25V |
| Reset Level | > 95% of operate value[1] |
| Operate Time | |
| 0V to 2x setting | ≤ 85ms |
| 0V to 1.1x setting | ≤ 85ms |
| Reset Time | |
| 1.1x to 0.9x setting | ≤ 80ms |
| 1.1x to 0V | ≤ 70ms |

[1] – For NVD settings below 7.5V the Reset Level can be upto 60% of operate value.

### 6.4 NPS Overvoltage Element

| **Negative Phase Sequence Element** | |
|---|---|
| Operate Level | Setting ± 1% or 0.25V |
| Reset Level | > 95% of operate value[2] |
| Operate Time | |
| 0V to 2x setting | ≤ 85ms |
| 0V to 1.1x setting | ≤ 85ms |
| Reset Time | |
| 1.1x to 0.9x setting | ≤ 80ms |
| 1.1x to 0V | ≤ 70ms |

[2] – For NPS settings below 3.5V the Reset Level can be upto 80% of operate value.

### 6.5 Overfrequency Element

| **Overfrequency Element** | |
|---|---|
| Operate Level | Setting ± 10mHz |
| Reset Level | Operate – 20mHz |
| Operate Time | |
| For ROCOF between 0.1-10 Hz/sec | Typically < 140ms<br>Maximum < 175ms |
| | Typically < 100ms : AG8 - 300 series only<br>Maximum < 150ms |

### 6.6 Underfrequency Element

| **Underfrequency Element** | |
|---|---|
| Operate Level | Setting ± 10mHz |
| Reset Level | Operate + 20mHz |
| Operate Time | |
| For ROCOF between 0.1-10 Hz/sec | Typically < 140ms<br>Maximum < 175ms |
| | Typically < 100ms : AG8 - 300 series only<br>Maximum < 150ms |

### 6.7 DTL Timing Elements

| **All Timers** | |
|---|---|
| Timing Accuracy | ±1% or 30ms |

## 7 ACCURACY GENERAL

**Measuring Accuracy (50 or 60 Hz)**

| | |
|---|---|
| Phase Voltage | ± 1% or 0.25V |
| Vo (Measured) | ± 1% or 0.5V |
| Vo (Calculated) | ± 1% or 0.5V |
| V2 (NPS) | ± 1% or 0.5V |
| Frequency | < ± 10mHz |

## 8 ACCURACY INFLUENCING FACTORS

**Temperature**

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

**Frequency**

| | |
|---|---|
| Range | 47Hz to 52Hz<br>57Hz to 62Hz |
| Setting variation | ≤ 1% |
| Operating time variation | ≤ 1% |

**Auxiliary DC Supply - IEC 60255-11**

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

## 9 THERMAL WITHSTAND

**Continuous Overload**

| | |
|---|---|
| AC Voltage | 250Vrms ( 353Vpk) |

## 10 BURDENS

**AC Burden**

| | AC Burden |
|---|---|
| 110Vrms Input | ≤ 0.1VA |
| 63.5Vrms Input | ≤ 0.05VA |

**DC Burden**

| | DC Burden |
|---|---|
| Quiescent (Typical) | 3 Watts |
| Max | 10 Watts |

## 11 OUTPUT CONTACTS

Contact rating to IEC 60255-0-20.

**Carry continuously** 5A ac or dc

**Make and Carry**
(limit L/R ≤ 40ms and V ≤ 300 volts)

| | |
|---|---|
| For 0.5 sec | 20A ac or dc |
| For 0.2 sec | 30A ac or dc |

**Break**
(limit ≤ 5A or ≤ 300 volts)

| | |
|---|---|
| Ac resistive | 1250VA |
| Ac inductive | 250VA @ PF ≤ 0.4 |
| Dc resistive | 75W |
| Dc inductive | 30W @ L/R ≤ 40 ms<br>50W @ L/R ≤ 10 ms |

| | |
|---|---|
| Minimum number of operations | 1000 at maximum load |
| Minimum recommended load | 0.5W, limits 10mA or 5V |

## 12 ENVIRONMENTAL WITHSTAND

### 12.1 General

**Temperature - IEC 60068- 2-1/2**

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

**Humidity - IEC 60068- 2-3**

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

**Transient Overvoltage – IEC 60255-5**

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

**Insulation - IEC 60255-5**

| | |
|---|---|
| Between all terminals and earth | 2.0kV rms for 1 min |
| Between independent circuits | 2.0kV rms for 1 min |
| Across normally open contacts | 1.0kV rms for 1 min |

### 12.2 Immunity

**High Frequency Disturbance -**
**IEC 60255-22-1 Class III**

| | Variation |
|---|---|
| 2.5kV Common (Longitudinal) Mode | ≤ 5% |
| 1.0kV Series (Transverse) Mode | ≤ 5% |

**Electrostatic Discharge -**

**IEC 60255-22-2 Class 3**

| | Variation |
|---|---|
| 6kV contact discharge | ≤ 5% |
| 8kV air discharge (to fascia) | ≤ 5% |

**Radio Frequency Interference -**
**IEC 60255-22-3 Class III**

| | Variation |
|---|---|
| 80MHz to 1000MHz, 10V/m | ≤ 5% |

**Fast Transient – IEC 60255-22-4 Class IV**

| | Variation |
|---|---|
| 4kV 5/50ns 2.5kHz repetitive | ≤ 5% |

**Conducted RFI – IEC 60255-22-6**

| | Variation |
|---|---|
| 0.15 to 1000MHz - 10V | ≤ 5% |

**12.3 Emissions**

**Radiated Limits – IEC 60255-25**

| Frequency Range | Limits at 10m<br>Quasi-peak dB (μV/m) |
|---|---|
| 30 to 230MHz | 40 |
| 230 to 1000MHz | 47 |

**Conducted Limits – IEC 60255-25**

| Frequency Range | Limits dB (μV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.5MHz | 79 | 66 |
| 0.5 to 30MHz | 73 | 60 |

**12.4 Mechanical**

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

| | | Variation |
|---|---|---|
| Vibration response | 0.5gn | ≤ 5% |
| Vibration endurance | 1.0gn | ≤ 5% |

**Shock and Bump – IEC 60255-21-2 Class 1**

| | | Variation |
|---|---|---|
| Shock response | 5 gn 11ms | ≤ 5% |
| Shock withstand | 15 gn 11ms | ≤ 5% |
| Bump test | 10 gn 16ms | ≤ 5% |

**Seismic – IEC 60255-21-3 Class 1**

| | | Variation |
|---|---|---|
| Seismic Response | 1gn | ≤ 5% |

**Mechanical Classification**

| | |
|---|---|
| Durability | In excess of $10^6$ operations |

**Qualification**
Product :- CE compliant to all relevant EU directives.
Quality Systems :- accredited to ISO 9001

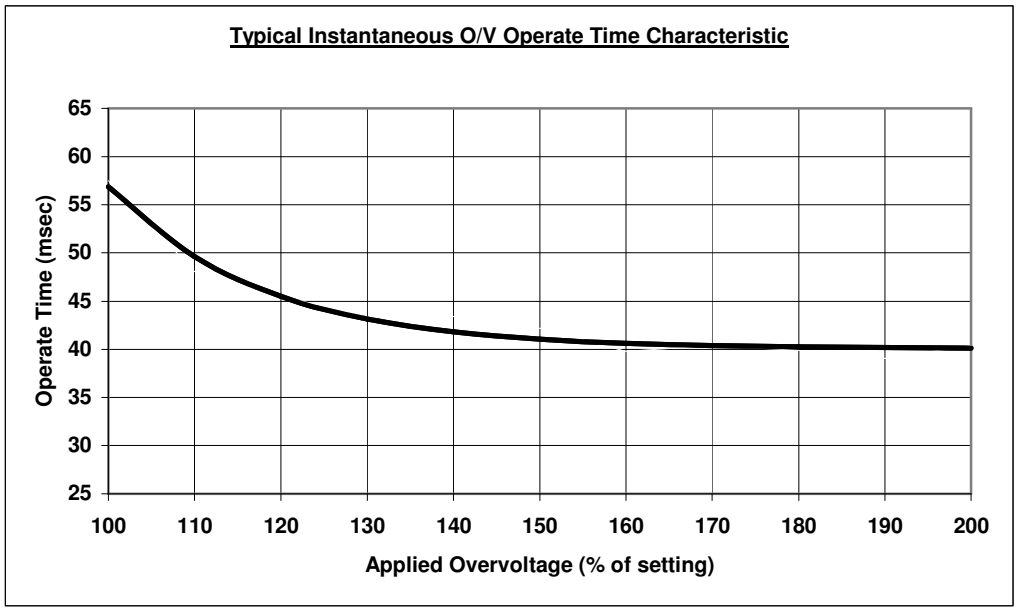


**Figure 1 - Typical O/V Operate Time Characteristic**

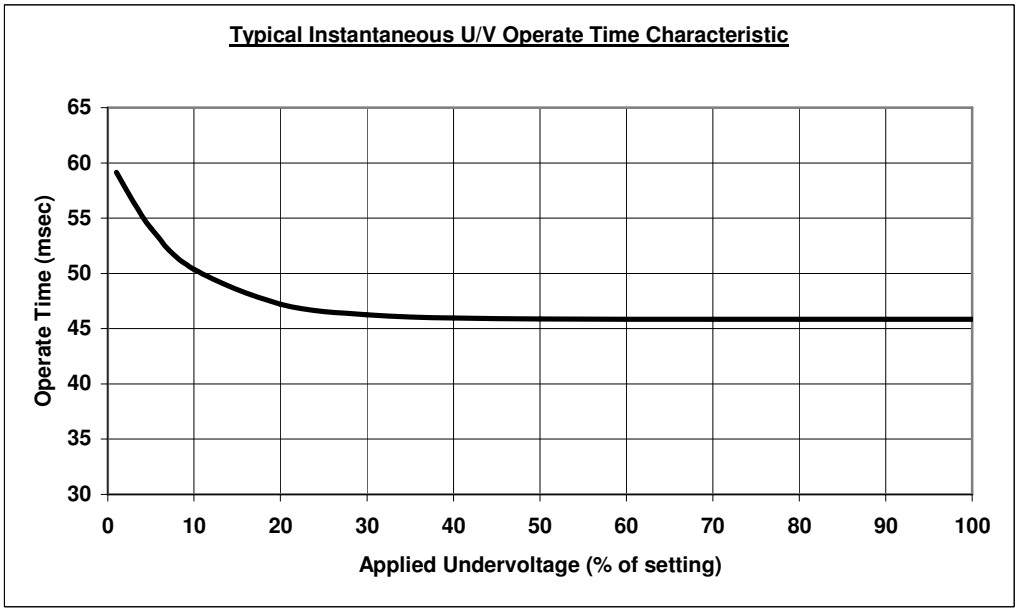


**Figure 2 - Typical U/V Operate Time Characteristic**

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## 1 SYSTEM CONFIG MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Active Settings Group**<br>*selects the settings group that the relay will act upon* | G1-G8 | G1 |
| **Settings Group Edit/View**<br>*selects the settings group to be displayed on the LCD* | G1-G8 | G1 |
| **Copy Group**<br>*allows the contents of one settings group to be copied completely to another group. Note that Copy Group will not allow the copying of a group onto the currently active group* | From G1-G8 to G1-G8 | From G1-G2 |
| **Power System Frequency**<br>*selects between 50 or 60Hz nominal frequencies* | 50 / 60 Hz<br>(Note: 300 series are 50Hz only) | 50Hz |
| **Voltage Blocking Threshold**<br>*sets the blocking threshold level which acts to block the Voltage, Frequency and NPS elements* | OFF, 1V – 100V step 1V | 5V |
| **Connection *(3 pole versions)***<br>*selects different relay configurations and therefore different functions will be made available* | 3Ph-Ph<br>3Ph-N+NVD<br>2Ph-Ph+NVD | 3Ph-Ph |
| **Connection *(2 pole versions)***<br>*selects different relay configurations and therefore different functions will be made available* | 2Ph-Ph<br>Ph-N+NVD<br>Ph-Ph+NVD<br>2 Systems A/B | 2Ph-Ph |
| **Ph VT Primary**<br>*sets the primary system rated voltage* | 000000 to 999999<br>(each of the 6 digits can be set individually) | 11000 |
| **Ph VT Secondary**<br>*sets the secondary system rated voltage* | 40 – 70 step 0.1<br>70 – 150 step 0.5 | 110.0 |
| **3Vo VT Primary**<br>*sets the primary neutral rated voltage* | 000000 to 999999<br>(each of the 6 digits can be set individually) | 11000 |
| **3Vo VT Secondary**<br>*sets the secondary neutral rated voltage* | 40 – 70 step 0.1<br>70 – 150 step 0.5 | 110.0 |
| **Set Identifier**<br>*allows a 13 character alphanumeric code or unique identification reference to be entered for the relay* | Up to 16 alphanumeric characters | ARGUS 8 |
| **Set Alarm 1**<br>*allows a 13 character alphanumeric string to be entered for the General Alarm screen. It will be displayed on energisation of the ALARM 1 status input* | Up to 13 alphanumeric characters | ALARM 1 |
| **Set Alarm ..n**<br>*as Alarm 1. There are a maximum of 9 alarms available in Argus 8 relays* | Up to 13 alphanumeric characters | ALARM n |
| **Calendar – Set Date**<br>*sets the current date in DD/MM/YY format* | DD/MM/YY | 01/01/00 |
| **Clock - Set Time**<br>*sets the current time in HH/MM/SS format. Note that only hours and minutes can be set. The seconds default to zero on pressing the ENTER key* | HH:MM:SS | 00:00:00 |
| **Clock Sync. From Status**<br>*sets the period of synchronisation of the clock to the nearest second or minute. The synchronisation occurs on energisation of the Clock Sync. status input* | Seconds or Minutes | Minutes |
| **Default Screen Timer**<br>*sets the time delay after which, if no key presses have been detected, the relay will begin to poll through any screens which have been selected as default instrument screens* | 10sec, 60sec, 5min, 1hour | 5 min |

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Change Password**<br>*allows a 4 character alphanumeric code to be entered as the password. Note that the display shows a password dependant encrypted code on the second line of the display* | 4 alphanumeric characters | NONE |

## 2 VOLTAGE MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn V Element 1 Operation**<br>*sets the mode of operation of Voltage Element 1, whether under or over-voltage* | OFF, O/V, U/V | OFF |
| **Gn V Element 1 Setting**<br>*sets the pickup level of Voltage Element 1* | 5V – 200V step 0.5V | 80V |
| **Gn V Element 1 Delay**<br>*sets the DTL timer value for Voltage Element 1* | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | 0.00 sec |
| **Gn V Element 1 Hysteresis**<br>*sets the amount of hysteresis required i.e. the PU/DO ratio* | 1% – 90% step 1% | 2% |
| **Gn V Element 1 O/P Phases**<br>*sets the number of phases required to operate before an output can be given* | Any 1, All | Any 1 |
| **Gn V Element 2 Operation** | As per Element 1 | OFF |
| **Gn V Element 2 Setting** | As per Element 1 | 80V |
| **Gn V Element 2 Delay** | As per Element 1 | 0.00 sec |
| **Gn V Element 2 Hysteresis** | As per Element 1 | 2% |
| **Gn V Element 2 O/P Phases** | As per Element 1 | Any 1 |
| **Gn V Element 3 Operation** | As per Element 1 | OFF |
| **Gn V Element 3 Setting** | As per Element 1 | 80V |
| **Gn V Element 3 Delay** | As per Element 1 | 0.00 sec |
| **Gn V Element 3 Hysteresis** | As per Element 1 | 2% |
| **Gn V Element 3 O/P Phases** | As per Element 1 | Any 1 |
| **Gn V Element 4 Operation** | As per Element 1 | OFF |
| **Gn V Element 4 Setting** | As per Element 1 | 80V |
| **Gn V Element 4 Delay** | As per Element 1 | 0.00 sec |
| **Gn V Element 4 Hysteresis** | As per Element 1 | 2% |
| **Gn V Element 4 O/P Phases** | As per Element 1 | Any 1 |

The following two menus appear if the '2 Systems A/B' option is selected. They replace the Voltage Menu.

## 3 SYSTEM A MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn V Element 1 Operation**<br>*sets the mode of operation of Voltage Element 1, whether under or over-voltage* | OFF, O/V, U/V | OFF |
| **Gn V Element 1 Setting**<br>*sets the pickup level of Voltage Element 1* | 5V – 200V step 0.5V | 80V |
| **Gn V Element 1 Delay**<br>*sets the DTL timer value for Voltage Element 1* | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | 0.00 sec |
| **Gn V Element 1 Hysteresis**<br>*sets the amount of hysteresis required i.e. the PU/DO ratio* | 1% – 90% step 1% | 2% |
| **Gn V Element 2 Operation** | As per Element 1 | OFF |
| **Gn V Element 2 Setting** | As per Element 1 | 80V |
| **Gn V Element 2 Delay** | As per Element 1 | 0.00 sec |
| **Gn V Element 2 Hysteresis** | As per Element 1 | 2% |

## 4 SYSTEM B MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn V Element 3 Operation**<br>*sets the mode of operation of Voltage Element 3, whether under or over-voltage* | OFF, O/V, U/V | OFF |
| **Gn V Element 3 Setting**<br>*sets the pickup level of Voltage Element 3* | 5V – 200V step 0.5V | 80V |
| **Gn V Element 3 Delay**<br>*sets the DTL timer value for Voltage Element 3* | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | 0.00 sec |
| **Gn V Element 3 Hysteresis**<br>*sets the amount of hysteresis required i.e. the PU/DO ratio* | 1% – 90% step 1% | 2% |
| **Gn V Element 4 Operation** | As per Element 1 | OFF |
| **Gn V Element 4 Setting** | As per Element 1 | 80V |
| **Gn V Element 4 Delay** | As per Element 1 | 0.00 sec |
| **Gn V Element 4 Hysteresis** | As per Element 1 | 2% |

## 5 NEUTRAL VOLTAGE MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn 3Vo Element 1 Setting**<br>*sets the pick up level of NVD Element 1* | 0FF, 1 – 100V step 0.5V | OFF |
| **Gn 3Vo Element 1 Delay**<br>*sets the DTL timer value for NVD Element 1* | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | 0.00 sec |
| **Gn 3Vo Element 2 Setting** | As per Element 1 | OFF |
| **Gn 3Vo Element 2 Delay** | As per Element 1 | 0.00 sec |

## 6 NPS OVERVOLTAGE MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn V2 Element 1 Setting**<br>*sets the pick up level of NPS Element 1* | 0FF, 1 – 100V step 0.5V | OFF |
| **Gn V2 Element 1 Delay**<br>*sets the DTL timer value for NPS Element 1* | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | 0.00 sec |
| **Gn V2 Element 2 Setting** | As per Element 1 | OFF |
| **Gn V2 Element 2 Delay** | As per Element 1 | 0.00 sec |

## 7 FREQUENCY MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn F Element 1 Operation**<br>*sets the mode of operation of Frequency Element 1, whether under or over-frequency* | OFF, O/F, U/F | OFF |
| **Gn F Element 1 Setting**<br>*sets the pick up level for Frequency Element 1* | 47.00Hz – 62.00Hz step 0.01Hz | 50.00Hz |
| **Gn F Element 1 Delay**<br>*Sets the DTL timer value for Frequency Element 1* | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | 0.00 sec |
| **Gn F Element 1 Inhib**<br>*sets which voltage element operation should block Frequency Element 1 from operating* | VE1, VE2, VE3, VE4 | NONE |
| **Gn F Element 2 Operation** | As per Element 1 | OFF |
| **Gn F Element 2 Setting** | As per Element 1 | 50.00Hz |
| **Gn F Element 2 Delay** | As per Element 1 | 0.00 sec |
| **Gn F Element 2 Inhib** | As per Element 1 | NONE |
| **Gn F Element 3 Operation** | As per Element 1 | OFF |
| **Gn F Element 3 Setting** | As per Element 1 | 50.00Hz |
| **Gn F Element 3 Delay** | As per Element 1 | 0.00 sec |
| **Gn F Element 3 Inhib** | As per Element 1 | NONE |
| **Gn F Element 4 Operation** | As per Element 1 | OFF |
| **Gn F Element 4 Setting** | As per Element 1 | 50.00Hz |
| **Gn F Element 4 Delay** | As per Element 1 | 0.00 sec |
| **Gn F Element 4 Inhib** | As per Element 1 | NONE |

## 8 O/P RELAY CONFIG MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn Relay Healthy**<br>*sets the output relay operated by the relay(s) watchdog monitor. An output relay with a changeover or normally closed contact should be used for this function* | RL1..RLn | RL1 |
| **Gn V Block Alarm**<br>*sets the output relay(s) operated by the Voltage Blocking Threshold function* | RL1..RLn | None |
| **Gn VE1 Starter**<br>*sets the output relay(s) operated by the Voltage Element 1 starter function* | RL1..RLn | None |
| **Gn VE1 Trip**<br>*sets the output relay(s) operated by the Voltage Element 1 trip function* | RL1..RLn | None |
| **Gn VE2 Starter** | RL1..RLn | None |
| **Gn VE2 Trip** | RL1..RLn | None |
| **Gn VE3 Starter** | RL1..RLn | None |
| **Gn VE3 Trip** | RL1..RLn | None |
| **Gn VE4 Starter** | RL1..RLn | None |
| **Gn VE4 Trip** | RL1..RLn | None |
| **Gn 3VoE1 Starter**<br>*sets the output relay(s) operated by the NVD Element 1 starter function* | RL1..RLn | None |
| **Gn 3VoE1 Trip**<br>*sets the output relay(s) operated by the NVD Element 1 trip function* | RL1..RLn | None |
| **Gn 3VoE2 Starter** | RL1..RLn | None |
| **Gn 3VoE2 Trip** | RL1..RLn | None |
| **Gn V2E1 Starter**<br>*sets the output relay(s) operated by the NPS Element 1 starter function* | RL1..RLn | None |
| **Gn V2E1 Trip**<br>*sets the output relay(s) operated by the NPS Element 1 trip function* | RL1..RLn | None |
| **Gn V2E2 Starter** | RL1..RLn | None |
| **Gn V2E2 Trip** | RL1..RLn | None |
| **Gn FE1 Starter**<br>*sets the output relay(s) operated by the Frequency Element 1 starter function* | RL1..RLn | None |
| **Gn FE1 Trip**<br>*sets the output relay(s) operated by the Frequency Element 1 trip function* | RL1..RLn | None |
| **Gn FE2 Starter** | RL1..RLn | None |
| **Gn FE2 Trip** | RL1..RLn | None |
| **Gn FE3 Starter** | RL1..RLn | None |
| **Gn FE3 Trip** | RL1..RLn | None |
| **Gn FE4 Starter** | RL1..RLn | None |
| **Gn FE4 Trip** | RL1..RLn | None |
| **Gn Status 1**<br>*sets the output relay(s) operated by Status Input 1 energisation* | RL1..RLn | None |
| **Gn Status ..n**<br>*sets the output relay(s) operated by Status Input n energisation* | RL1..RLn | None |

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn Trip counter Alarm**<br>*sets the output relay(s) operated by the Trip Counter Alarm function* | RL1..RLn | None |
| **Gn PowerOn Count**<br>*sets the output relay(s) operated by the Power On Count Alarm function* | RL1..RLn | None |
| **Gn Hand Reset**<br>*sets the output relay(s) which are to stay latched after operation. These can be reset via the fascia, a status input, or a communications command* | RL1..RLn | None |
| **Min O/P Energise Time**<br>*sets the minimum output pulse length of energised output relays* | 100 – 500ms step 50ms | 100ms |

## 9 STATUS CONFIG MENU

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Settings Group Select**<br>*sets the status input(s) required to select a settings group to become the active settings group. Note that the lower the number of status input, the higher precedence that it has e.g. Status 1 will take precedence over all the rest* | S1..Sn<br>(each status can be set from 1-8 to select active group 1-8) | None |
| **Inverted Inputs**<br>*sets the status input(s) required to be inverted. Any function assigned to an inverted input becomes active when the input is de-energised* | S1..Sn | None |
| **Gn VE1 Inhibit**<br>*sets the status input(s) which will inhibit Voltage Element 1* | S1..Sn | None |
| **Gn VE2 Inhibit** | S1..Sn | None |
| **Gn VE3 Inhibit** | S1..Sn | None |
| **Gn VE4 Inhibit** | S1..Sn | None |
| **Gn 3VoE1 Inhibit** | S1..Sn | None |
| **Gn 3VoE2 Inhibit** | S1..Sn | None |
| **Gn V2E1 Inhibit** | S1..Sn | None |
| **Gn V2E2 Inhibit** | S1..Sn | None |
| **Gn FE1 Inhibit** | S1..Sn | None |
| **Gn FE2 Inhibit** | S1..Sn | None |
| **Gn FE3 Inhibit** | S1..Sn | None |
| **Gn FE4 Inhibit** | S1..Sn | None |
| **Gn Trip Circuit Fail**<br>*sets the status input(s) which will be used within the Trip Circuit Monitoring scheme* | S1..Sn | None |
| **Gn ALARM 1**<br>*sets the status input(s) which, on energisation, will cause the Alarm 1 message to be displayed on the LCD* | S1..Sn | None |
| **Gn ALARM ..n** | S1..Sn | None |
| **Gn Waveform Trigger**<br>*sets the status input(s) which, on energisation, will cause a waveform record to be stored* | S1..Sn | None |
| **Gn Clock Sync.**<br>*sets the status input(s) which, on energisation, will synchronise the real time clock to the nearest second or minute* | S1..Sn | None |
| **Gn Reset Outputs**<br>*sets the status input(s) which, on energisation, will reset the Trip LED and any latched output relays* | S1..Sn | None |

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn Status 1 P/U Delay**<br>*sets the delay period to be applied to the pick-up of Status Input 1* | 0 – 2.00 sec step 10ms<br>2.10 – 20.00 sec step 100ms<br>21 – 300 sec step 1 sec<br>360 – 3600 sec step 60 sec<br>3900 – 14400 sec step 300 sec | 0.02sec |
| **Gn Status 1 D/O Delay**<br>*sets the delay period to be applied to the drop-off of Status Input 1* | As above | 0.00sec |
| **Gn Status n P/U Delay** | As Status 1 | 0.02sec |
| **Gn Status n D/O Delay** | As Status 1 | 0.00sec |

**10 COMMS INTERFACE MENU**

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Comms Baud Rate**<br>*sets the required communications Baud Rate* | 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200 | 19200 |
| **Comms Parity**<br>*selects whether a parity check is transmitted with the comms data* | NONE, EVEN | EVEN |
| **Relay Address**<br>*sets the required address of a particular relay within a network* | 0 – 254 | 0 |
| **Line Idle**<br>*sets the required communications line idle sense* | LIGHT ON, LIGHT OFF | LIGHT OFF |
| **Data Echo**<br>*enables Data Echo which is necessary for use with relays connected in a ring* | OFF / ON | OFF |

**11 DATA STORAGE MENU**

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Gn Fault Trigger**<br>*sets the output relay(s) which are connected as trip outputs for the purpose of giving trip information and storing fault records* | RL1..RLn | None |
| **Gn Waveform Trig**<br>*selects which functions trigger a waveform record* | STA, V, F, NPS, NVD | STA+V+NPS +NVD+F |
| **Gn Waveform Pre-trigger**<br>*selects which functions trigger a waveform record* | OFF, 10%-100% step 10% | 50% |
| **Clear All Waveforms**<br>*clears all the waveform records stored. Note that this can also be done at the instruments display. (see Section 1 Fig 6)* | NO, YES (Confirmation required) | NO |
| **Clear All Events**<br>*clears all the event records stored. Note that this can also be done at the instruments display. (see Section 1 Fig 6)* | NO, YES (Confirmation required) | NO |
| **Clear Fault Data**<br>*clears all the fault data records stored* | NO, YES (Confirmation required) | NO |

**12 CB MAINTENANCE MENU**

| SETTING | RANGE | DEFAULT |
|---|---|---|
| **Trip Counter Alarm**<br>*sets a target value for which an alarm output will be given when the value is reached* | OFF, 1 – 999 step 1 | OFF |
| **Trip Counter Reset**<br>*resets the Trip Counter to zero* | NO, YES (Confirmation required) | NO |
| **Power On Count Alarm**<br>*sets a target value for which an alarm output will be given when the value is reached* | OFF, 1 – 999 step 1 | OFF |
| **Power On Count Reset**<br>*resets the Trip Counter to zero* | NO, YES (Confirmation required) | |
| **O/P Test**<br>*allows any combination of output relays to be energised. This is achieved by selecting one of the output settings defined in the O/P Relay Config Menu. Note that the relay is energised after 10 seconds have elapsed and is energised for only 100 ms* | Any output relay option | OFF |

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### GLOSSARY

| | |
|---|---|
| **Baud Rate** | See *bits per second*. |
| **Bit** | The smallest measure of computer data. |
| **Bits Per Second (BPS)** | Measurement of data transmission speed. |
| **Data Bits** | A number of *bits* containing the data. Sent after the *start bit*. |
| **Half-Duplex Asynchronous Communications** | Communications in two directions, but only one at a time. |
| **Hayes 'AT'** | Modem command set developed by Hayes Microcomputer products, Inc. |
| **Master Station** | See *primary station*. |
| **Modem** | MOdulator / DEModulator device for connecting computer equipment to a telephone line. |
| **Parity** | Method of error checking by counting the value of the bits in a sequence, and adding a parity bit to make the outcome, for example, even. |
| **Parity Bit** | *Bit* used for implementing parity checking. Sent after the *data bits*. |
| **Primary Station** | The device controlling the communication. |
| **PSTN** | Public Switched Telephone Network |
| **RS232C** | Serial Communications Standard. Electronic Industries Association Recommended Standard Number 232, Revision C. |
| **Secondary Station** | The device being communicated with. |
| **Slave Station** | See *secondary station*. |
| **Start Bit** | *Bit* (logical 0) sent to signify the start of a byte during data transmission. |
| **Stop Bit** | *Bit* (logical 1) sent to signify the end of a byte during data transmission. |

# 1 INTRODUCTION

This document describes how to connect the IEC870-5-103 compliant communications interface to a control system or interrogating computer.

To access the interface the user will need appropriate software within the control system or on the interrogating computer (e.g. Reydisp Evolution).

# 2 CONNECTION SPECIFICATION AND RELAY SETTINGS

This section defines the connection medium as defined by IEC 870-5-103. Appendix A shows some typical communication connections.

## 2.1. Recommended cable

Selection of fibre optic cable is critical. Fibres should be terminated with 9mm SMA connectors.

The recommended type is 200µm Plastic Coated Silica (PCS). This will allow a maximum transmission distance of 100m between Argus relays. It will also be the maximum distance between the ring network and the fibre to RS232 converter.

Alternatively, 1mm polymer cable may be used to reduce cost. This will provide transmission distances of upto 43m between relays. Note that the distance from the transmit output of the RS232 / fibre optic converter to the receive input of the first Argus relay should be not more than 6m. The distance from the transmit output of the last Argus to the receive input of the converter may be upto 43m.

No other types of cable are suitable for use with Argus relays.

## 2.2. Connection Method

Argus relays can be connected in either a Star or Ring fibre-optic communications network. If star connected then a passive fibre optic hub must be used. A lower cost option is the ring configuration where the Argus relays are 'daisy chained.' That is, the transmit output of the first relay is connected to the receive input of the second relay, and so on until the ring is complete.

Communication to the ring may be achieved either locally in the substation or remotely via the Public Switched Telephone Network (PSTN). If remote communication is desired, then additional modem equipment must be installed.

Reydisp Evolution is a PC based software package providing capability for both local and remote communication. It provides features such as download of disturbance and event records, upload of relay settings, real-time monitoring of measurands and remote control of plant.

## 2.3. Transmission Method

The transmission method is Half Duplex serial asynchronous transmission. In IEC 870-5-103 the line idle state is defined as Light ON. This can alternatively be selected as Light OFF in the Communications Interface menu of the relay if required for use with alternate hardware (See Section 2.5).

## 2.4. Transmission Rate

Rates of 19200, 9600, 4800, 2400, 1200, 600, 300, 150, 110 and 75 bits per second (BPS) are provided. Only 19200 and 9600 BPS are standard in IEC 870-5-103, the additional rates are provided for local or modem communications.

### 2.5. Line Idle Setting

The line idle setting can be set to be either ON or OFF and the setting must be compatible with the device connected to the relay. The IEC 870-5-103 standard defines a line idle state of Light On. If the device the relay is connected to does not have a compatible fibre-optic port then a suitable electrical to optical converter is required to connect it to a standard RS232C electrical interface. A suitable converter is the Sigma 4 type, which is available from Reyrolle Protection.

Alternative converters are the Reyrolle Dual RS232 Port (Sigma 3) or Reyrolle Passive Fibre-Optic Hub (Sigma 1).

1. The Sigma 3 Dual RS232 port provides a fibre-optic interface to a relay and two RS232 ports. The RS232 system port is typically connected to a control system while the second port is a local port. When the local port is in use the system port is automatically disabled. The Sigma 3 has an internal link to switch between line idle Light ON or Light OFF. The default configuration is Light OFF.
2. The Sigma 1 Passive Fibre-Optic Hub provides fibre-optic interfaces for up to 29 relays. It has a fibre-optic port to the control system and multiple relay connections. Each of the 30 fibre-optic ports can be configured for either Light ON or Light OFF operation. Default for all is OFF.

### 2.6. Parity Setting

IEC 870-5-103 defines the method of transmission as using EVEN Parity. However, in some instances an alternative may be required. This option allows the parity to be set to NONE.

### 2.7. Address Setting

The address of the relay must be set to a value between 1 and 254 inclusive before any communication can take place. Setting the address to zero disables communications to the relay, although if it is in an optical ring it will still obey the Data Echo setting. All relays in an optical ring must have a unique address. Address 255 is reserved as a global broadcast address.

## 3 MODEMS

The communications interface has been designed to allow data transfer via modems. However, IEC 870-5-103 defines the data transfer protocol as an 11 bit format of 1 start, 1 stop, 8 data and 1 parity bit which is a mode most commercial modems do not support. High performance modems, for example, Sonix (now 3Com), Volante and MultiTech Systems MT series will support this mode but are expensive. For this reason a parity setting (see section 2.6) to allow use of easily available and relatively inexpensive commercial modems has been provided. The downside to using no parity is that the data security will be reduced slightly and the system will not be compatible with true IEC870 control systems.

### 3.1 Connecting a modem to the relay(s)

The RS232C standard defines devices as being either Data Terminal Equipment (DTE) e.g. computers, or Data Communications Equipment (DCE) e.g. modems. To connect the modem to a relay requires a fibre-optic to electrical connector and a Null Terminal connector which switches various control lines. The fibre-optic converter is then connected to the relay in the following manner :

| Fibre-Optic Converter | Relay Connection |
|---|---|
| **Tx** | **Rx** |
| **Rx** | **Tx** |

### 3.2 Setting the Remote Modem

Most modems support the basic Hayes 'AT' command format, though, different manufacturers can use different commands for the same functions. In addition, some modems use DIP switches to set parameters while others are entirely software configured. Before applying the following settings it is necessary to return the modem to its factory default settings to ensure that it is in a known state.

The remote modem must be configured as Auto Answer, which will allow it to initiate communications with the relays. Auto answer usually requires 2 parameters to be set. One switches auto answer on and the other, the number of rings after which it will answer. The Data Terminal Ready (DTR) settings should be forced on which tells the modem that the device connected to it is ready to receive data. The parameters of the modem's RS232C port need to be set to match those set on the relay i.e. baud rate and parity to be the same as the settings on the relay, and number of data bits to be 8 and stop bits 1.

Note : although it may be possible to communicate with the modem at e.g. 19200bps, it may not be possible to transmit at this rate over the telephone system which may be limited to 14400. A baud rate setting needs to be chosen which is compatible with the telephone system. As 14400 is not available in the relay, the next lowest rate, 9600, would have to be used.

Since the modem needs to be transparent, simply passing on the data sent from the controller to the device and vice versa, the error correction and buffering must be turned off. In addition if possible force the Data Carrier Detect (DCD) setting to ON as this control line will be used by the fibre-optic converter.

Finally these settings should be stored in the modem's memory for power on defaults.

### 3.3 Connecting to the remote modem

Once the remote modem is configured correctly it should be possible to dial into it using the standard configuration from a local PC. As the settings on the remote modem are fixed, the local modem should negotiate with it on connecting and choose suitable matching settings. If it does not, however, set the local modem to mimic the settings of the remote modem described above.

## APPENDIX A - COMMUNICATION CONNECTIONS

Figures 1 to 6 illustrate a number of methods of connecting relays in communications networks.

(Note that in the case of the optical ring configuration (figure 5), the Data Echo feature must be switched ON in the communications settings menu of the relay. In all other cases this setting should be set to OFF).

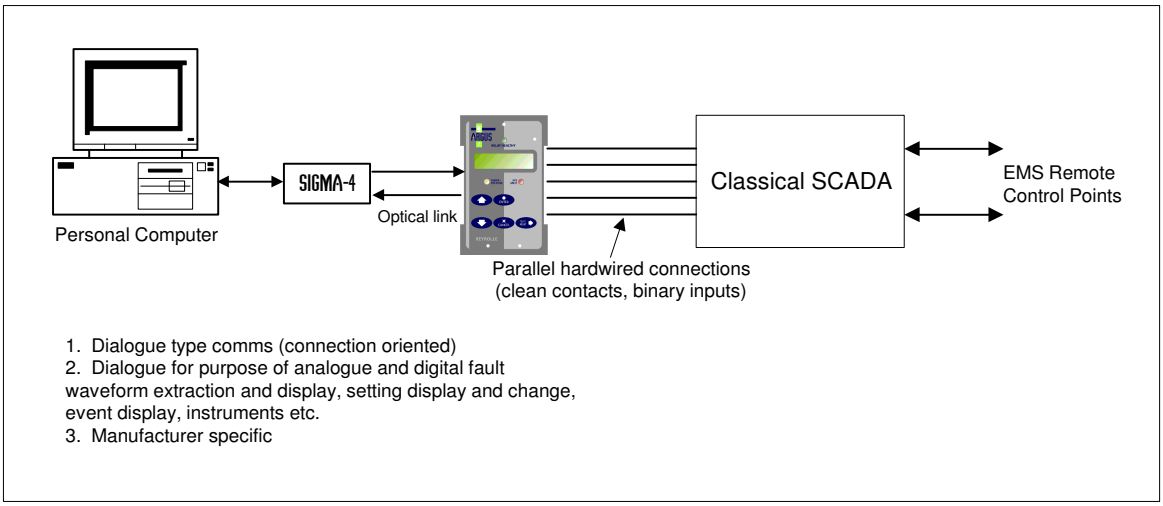


**Figure 1 - Basic Communications Configuration**

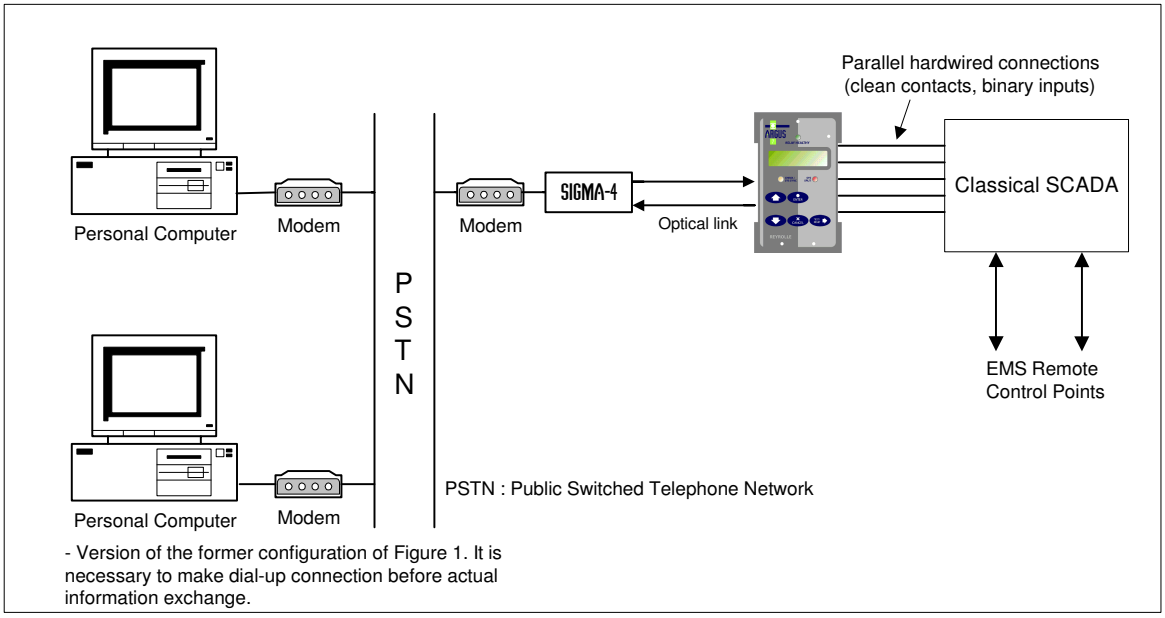


**Figure 2 - Basic Communications Configuration (Remote)**

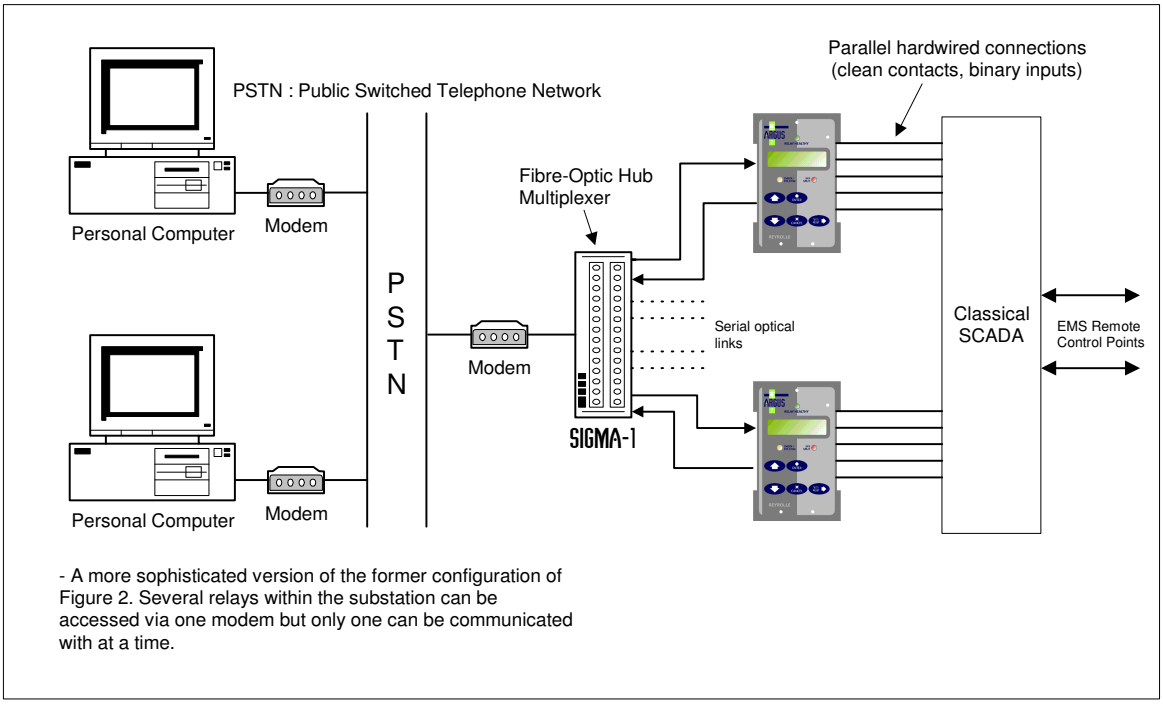


**Figure 3 - Star Type Configuration (Multiplexer)**

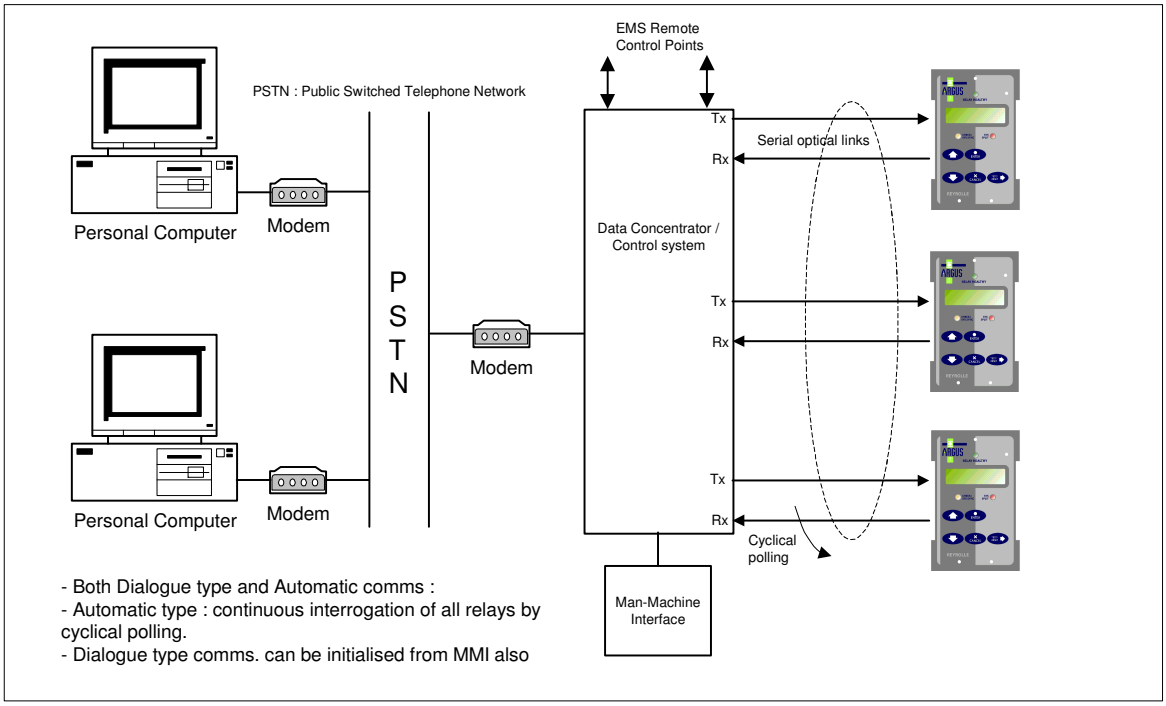


**Figure 4 - Data Concentrator Configuration**

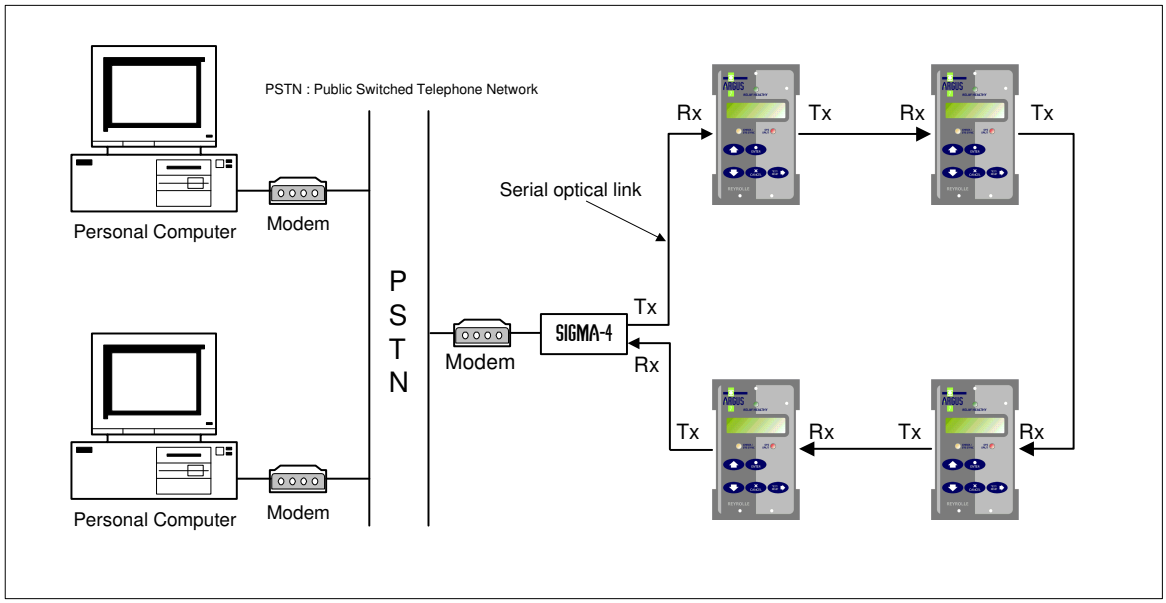


**Figure 5 - Optical Ring Configuration**

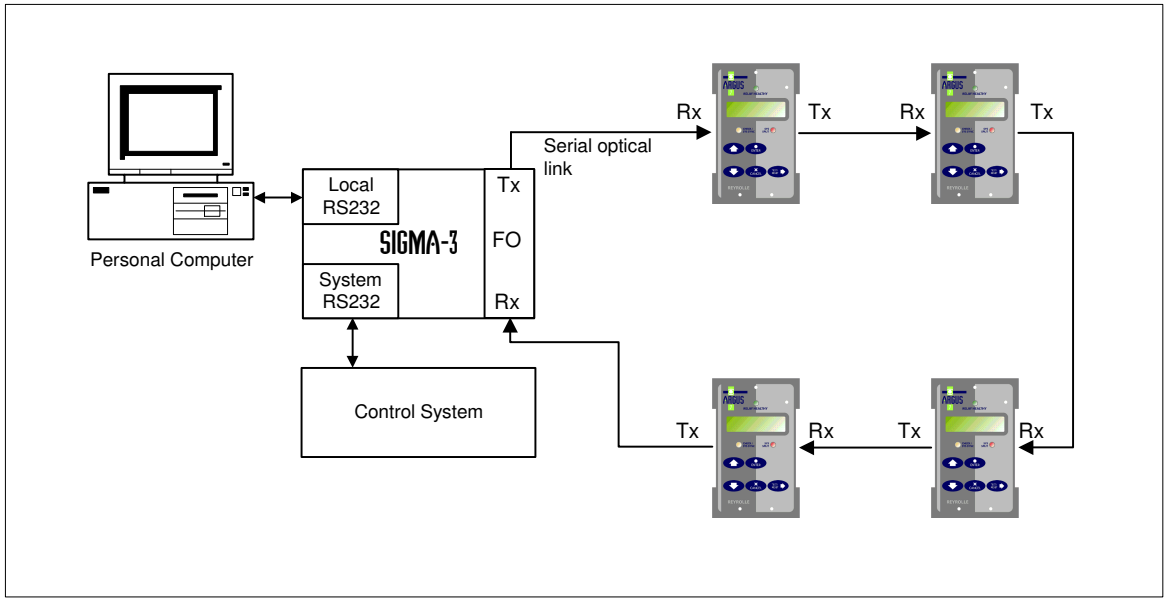


**Figure 6 - Configuration using the Sigma 3 – Dual Port RS232 Device**

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## TABLE OF FIGURES

# 1 INTRODUCTION

There are numerous applications for the Argus 8 series of relays, which have been developed suitable for generation, industrial, distribution and transmission systems. This application guide will illustrate some typical examples, though actual setting guidelines or recommendations will be limited, as these are very much system dependent.

# 2 GENERAL INFORMATION

## 2.1 Relay External Connections

The Argus 8 relay can be configured in many different ways, which usually involve different external connections to the relay. For phase-neutral and phase-phase connections the relay assumes nominal 63.5V and 110V systems respectively. This does not mean that the relay cannot be applied to nominal 57.7V and 100V systems. For these systems the normal operation of the relay is identical to that of the 63.5 / 110V systems.

Note, however, that if the relay is used in 57.7 / 100V systems and the communications interface is accessing the relay's measurand data, any Class 2 measurands will be normalised to 63.5 / 110V nominal secondary voltages.

Figures 2 through to 7 are typical application diagrams, which show ways of connecting and using the relays in different configurations.

## 2.2 Voltage Blocking Element

The voltage blocking element acts as a block to the Voltage, Frequency and NPS elements in the relay. If all phase voltages fall below the threshold level then the blocking operation will operate. This block does not apply to the NVD elements.

The voltage blocking element performs a number of functions :

1. If the relay has been set up with undervoltage elements enabled and is switched on with no volts applied to its inputs then, an undervoltage starter would pickup and the relay may issue a trip. The relay would then stay locked in this trip condition until volts are applied and the element is reset. To prevent this from happening the voltage blocking threshold has to see volts above its set level otherwise the relay is fully blocked and no starter or trip operation will follow.
2. In auto-reclose schemes the voltage blocking threshold can be used to prevent unnecessary operations of the undervoltage elements during the time when the line is de-energised. For this type of blocking operation the threshold is typically set to 20% of rated volts, though it should always be set to a value above the expected level of induced voltages on the line.

## 2.3 Output Contact Delay Time

The output relay contacts have a typical close response time of 7ms.This inherent delay is not, however, the only factor determining the actual contact closure time. The relay has a main software control loop of 10ms. Any software decision or external interrupt to the microcontroller involves a maximum possible delay of 10ms while the software completes the loop. This time should be added to the contact closure time of 7ms to give a maximum response time.

e.g. - if an energisation signal is applied to a status input which is programmed to directly operate an output relay the following delays should be added :

Status I/P response time (< 5ms) + Status PU delay setting + S/W loop (max. 10ms) + O/P contact closure (typically 7ms).

This gives a total time of < 22ms + Status PU delay setting.

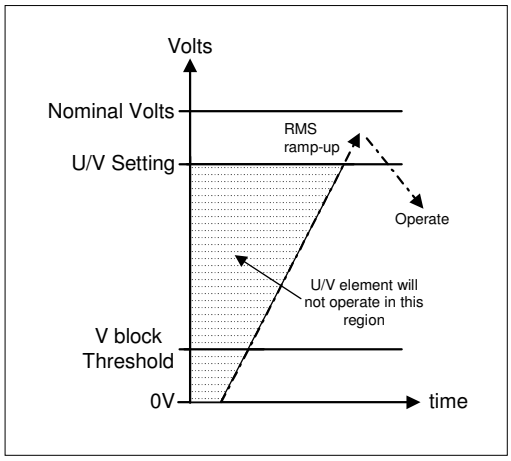
## 2.4 Setting DTL Times

When applying a DTL timer with any of the protection elements the instantaneous operate time of the element will have to be determined so that the overall required time delay can be set.

**Total Delay Time = Instantaneous Operate Time + DTL Time**

The performance specification - Section 2 of this manual gives typical instantaneous operate times for all of the different characteristics. The instantaneous operate time of an under voltage element for example can vary between < 65ms to about 47ms at its fastest. This variation is due to the level of applied undervoltage and is in fact a function of the method of calculation.

Note that the instantaneous operate time of an undervoltage element is marginally slower than that for an equivalent overvoltage element. This is because the undervoltage element is deliberately 'slugged' so that, when nominal voltage is applied, the RMS calculation has time to ramp up to the correct level without issuing an invalid trip during the ramp up sequence. This is shown in the diagram below :




## 2.5 Voltage Element Hysteresis

Each under and over voltage element has a variable hysteresis setting which allows the user to alter the pick-up / drop-off ratio (or drop-off / pick-up ratio) of the element. Note that the NPS, NVD and frequency elements have fixed levels of hysteresis which are not adjustable.

When using the variable hysteresis, care has to be taken to ensure that with undervoltage elements, the reset level of the element is not set to a value higher than that at which the system rated voltage is expected to operate. The system rated voltage will have a tolerance of typically ± 6% and so the upper level of the hysteresis must be below the lower limit of the tolerance, otherwise the element might not reset in practice. Conversely, the level of hysteresis set for an overvoltage element should not be set below that at which the system rated voltage is expected to run.

Typical values for the amount of hysteresis applied to a voltage element are < 5%. When setting the hysteresis level the user has to be aware that if the amount of hysteresis is set too low e.g. 1%, then for large frequency excursions and low values of voltage element setting, the element might become unstable and 'chatter'. This will produce nuisance alarms / tripping and generate large numbers of stored event records. A minimum recommended level is 2% for this reason.

## 2.6 Trip Circuit Supervision

This is based upon the Electricity Association standard H6 scheme. Status inputs on the Argus relay can be used to supervise trip circuits while the associated circuit breaker (CB) is either open or closed. A low value of dc current, derived from the auxiliary supply, is passed through the entire trip circuit to monitor the trip coil, it's auxiliary switch, the CB secondary

isolating contacts and the relevant wiring. If the current flow ceases, the energised status input drops off and if it is user-programmed to operate one of the output relays, this relay will close an output contact to signal trip circuit failure. In addition, the LCD display on the Argus relay will indicate 'Trip Circuit Fail'.

To avoid giving spurious alarm messages while the CB is operating, or protection device on adjacent supply circuits is operating, the status input should be programmed to have a 500ms drop-off delay.

The Electricity Association H6 Scheme is shown in Figure 1.

## 3 APPLICATION OF FUNCTIONS

### 3.1 Undervoltage Protection

Undervoltages are reasonably frequent events on power systems and can occur for a number of different reasons. Faults on the system can cause the phase voltages to be depressed, the actual voltage drop being dependent upon a number of factors including the fault type and system earthing etc. During system earth fault conditions, the undervoltage protection is not generally required to operate and thus connecting the relay in the phase-phase configuration will make it less susceptible to single-phase voltage depressions.

Another cause of undervoltage is an increase in system loading, which should be corrected by system regulating equipment such as tap-changers and AVR's. However, if this equipment is defective then an undesirable situation will occur which will require an undervoltage relay to trip non-essential loads to correct for this voltage excursion and to bring it back to its nominal level. This tripping should happen after an appropriate time delay has expired. Generally, wherever voltage relays are employed, timing elements should be used to prevent operation during transient disturbances.

If the system is supplying 3-phase induction motors or variable frequency thyristor drives, undervoltages can have the following effect. Voltage depressions down to approximately 80% of rated voltage cause the load current to increase, possibly resulting in a larger voltage depression due to the supply source impedance. Below 80% the current drawn is proportional to the voltage and an induction motor is likely to stall. The current drawn is then dependent on the drive design e.g. thyristor drives include current limitation. An undervoltage element can be set to trip out a motor circuit when the voltage falls below a preset value, selected based on the motor drive and system design parameters, and after a preset time delay. The time delay is required to ensure voltage dips due to remote system faults do not result in an unnecessary trip.

If the system supply to a group of motors is lost, undervoltage protection can be applied to ensure that each of the motor circuit breakers or contactors are tripped so that on restoration of the main supply, it is not overloaded by the simultaneous starting of all the motors. A 3-phase undervoltage relay may be used for this task of tripping a feeder for the detection of a complete loss of voltage. Also, where a supply to induction motors is lost, the undervoltage relay can be used to detect the loss of supply or to monitor any busbar residual voltage e.g. resulting from back e.m.f. generated by the induction motors as they run down. The relay can act as a guard prior to re-connecting a supply from an alternative source.

Where undervoltage relays are used on a system, the voltage elements should be set to a value below that where a normal system voltage excursion can be expected. (See also section 2.5). Typically the set values may be of the order of 65-80% of nominal for protection of the system or plant. For confirmation that a monitored supply is 'dead' or that any residual voltage has reduced to a safe level, typical set values should be of the order of 10-30% of nominal voltage.

### 3.2 Overvoltage Protection

Overvoltages may be caused for a number of different reasons. On generator sets for example, it may be caused by defective operation of the voltage regulator, or, if there is a sudden loss of load due to line tripping. Under this load rejection situation the generator set may overspeed causing a dangerous voltage rise. This should be corrected by system regulating equipment such as tap changers and AVR's, but if this equipment mal-functions then, voltage levels may rise. High levels of overvoltages on a system cannot be sustained for long periods because they can cause damage to the system insulation and severely affect the life of the insulation. An overvoltage element with an appropriate DTL time delay setting to allow for the normal system regulating equipment to operate can be used to protect against this type of condition.

With a maximum of four overvoltage elements available, the Argus 8 relay can provide for a variety of different applications. If the overvoltage condition is only small a relatively long DTL time delay can be set on an element to clear the fault. If the overvoltage is more severe then another element, set at a higher pickup level and with a faster DTL time, can be used to clear the fault more quickly. Alternatively, elements can be set to provide alarm and tripping stages, with the alarm levels set lower than the tripping stages.

Note - the use of instantaneous and wide ranging DTL settings allows a simple and secure grading system to be applied to co-ordinate the network design, the regulating plant design and system plant insulation withstand. The use of IDMTL protection is not recommended because of the difficulty of choosing settings to ensure correct co-ordination and security of supply.

Generally, wherever voltage relays are employed, timing elements should be used to prevent operation during transient disturbances. Also, overvoltage relays must be co-ordinated with other overvoltage relays elsewhere on the system.

### 3.3 Neutral Voltage Displacement Protection

The three phases of a balanced healthy system summate to zero. When a single-phase earth fault occurs the system balance is upset and a 'residual' voltage is produced. The residual voltage is therefore a means of detecting earth fault conditions without any measurement of current. This may be essential for high impedance earthed or insulated systems where it might not be viable to provide core balance CT's on each feeder.

The residual voltage can be measured at the secondary terminals of a VT having an 'open delta' secondary connection. The VT must be a standard five limb type or three single phase VT's can be used. This is because the residual voltage is three times the zero sequence voltage and therefore zero sequence flux has to flow in the core. For this to happen there must be a return path for the resultant summated flux and this occurs on a five limb type because the outer limbs are unwound. Where three single phase VT's are used, each phase unit has a core with a closed magnetic circuit. A three limb VT is not suitable for this application because there is no magnetic path, through the core, which the zero sequence flux can flow.

Another requirement for the VT is that the primary winding neutral has to be earthed. Without this an earth zero sequence exciting current cannot flow. Figures 4 and 7 are typical connection diagrams showing the two versions of relay with a residual voltage connection to a five limb VT.

On some configurations of the relay the residual voltage can be calculated from the three phase voltage inputs so a five limb VT or three single phase VT external connection are not required. Internally the relay performs a zero sequence calculation, which is multiplied by 3 to derive the residual voltage. (The actual residual voltage element setting is referred to as 3Vo). Note that the 'Vo' instrument in the 'Instruments Display Menu' displays the zero sequence voltage regardless of whether the residual voltage is directly measured or calculated internally. The actual system residual voltage is three times the indicated Vo reading.

The output voltage of the open delta winding can contain triplen harmonics, with the 3rd being the most predominant. These triplen harmonics appear across the open delta winding even when there is no earth fault on the network and no zero sequence voltage. The relay's main measuring algorithm being based upon a DFT, coupled with the anti-aliasing filter in the input stage, ensures that any 3rd harmonic present is heavily attenuated and will not cause a mal-trip.

Where a power transformer delta or unearthed star winding is connected to a transformer feeder it is essential to ensure that this unearthed winding cannot remain energised under system earth-fault conditions. This condition will result in danger to life and possible hazard to the sound phases due to intermittent arcing via system earth capacitance. Initiation of tripping may be by means of a neutral displacement relay arranged to detect residual voltage to earth at the transformer using either a voltage transformer or coupling capacitors. The relay will operate for external as well as internal feeder faults and must, therefore, be provided with a time delay to ensure discrimination.

The NVD protection in the relay consists of 2 independent stages which can be used for alarm and trip purposes. Each has a user settable DTL time delay element associated with it. These are useful for applications such as insulated systems where, following an earth fault, the phase voltages may have to withstand sustained overvoltages. An alarm from the first stage can be issued after a short delay to indicate that there is an earth fault on the system. If this is not satisfactorily cleared then the second stage can issue a trip signal to isolate the fault.

### 3.4 NPS Overvoltage Protection

Unbalanced voltage on 3-phase network results as a consequence of unbalanced load current causing unequal voltage drops in network impedances. The unbalanced load current could be the result of single phase open circuits (isolator failures, broken conductors etc.), or because of loads generating harmonics (e.g. thyristor drives). Unbalanced voltage generated at a busbar has the knock-on effect of causing healthy balanced loads to become unbalanced.

In the case of generators, unbalanced loading causes negative phase sequence (NPS) currents in the generator stator, which induces double frequency currents in the rotor causing heating of the machine. If the NPS current exceeds the limit of the generator, protection on the generator will operate and could result in all the generators connected being tripped. Induction motors also are vulnerable to NPS current and again, as for generators, NPS overcurrent protection is provided and included on the majority of industrial plant motors.

The NPS or unbalanced voltage function in the Argus 8 relay can be employed to monitor the quality of the 3-phase ac supply and thus provide early warning of developing problems of NPS currents, which might cause tripping of generators or motors. In this respect the NPS overvoltage protection is very beneficial.

The NPS protection consists of 2 independent stages, each with a user settable DTL time delay element associated with it. These can be used for both alarm and tripping purposes.

Where the 3-phase VT's supplying an Argus 8 relay are protected by fuses, special consideration has to be made. Any single fuse operating e.g. due to ageing or a winding / wiring fault, will result in NPS voltage in the input to the relay. Where miniature circuit breakers (MCB's) are employed they can be provided with an "all phases trip" feature which prevents the mal-operation of an NPS voltage monitoring relay. (An "all phases trip" MCB will operate for any fault condition). However, where fuses are employed, allowance must be made for the impact of a single fuse operation. If the NPS overvoltage function of the relay is used only for alarm purposes, there is no serious consequence. If, however if it used for delayed tripping, then consideration should be given to blocking for single fuse failure. One method is to use the two separate NPS stages, one set as a high set instantaneous for blocking a trip and the other as a lower set, time delayed stage for protection of the rotating plant. However, a problem arises in that a broken primary circuit phase has a similar effect to single fuse operation. The preferred solution is to provide MCB's with an "all phases trip" feature for the secondary circuit protection.

### 3.5 Frequency Protection

When a power system is in stable operation at normal frequency, the total mechanical power input from the prime movers to the generators is equal to the sum of all the connected loads, plus all real power losses in the system. Any frequency variation is an indication of generator-load imbalance in the system. If an interconnected system splits, for example, there might be a situation where the load in one of the subsystems is in excess of the generator capacity in that subsystem. In this instance the generator speed will begin to decrease causing a proportional frequency drop. An underfrequency condition at nominal voltage can lead to over-fluxing of plant such as generators and transformers. If the governors and other regulating equipment cannot respond quickly enough, a sustained underfrequency condition may lead to a system collapse. Conversely, if there is an excess of generation in the subsystem then the generator speed will increase causing a proportional frequency rise. This may be unacceptable to industrial loads, for example, where the running speeds of synchronous motors will be affected.

In the situation where the system frequency is collapsing rapidly it is common practise to disconnect non-essential loads for short periods of time, until the generation-load requirements and network configuration can be corrected. This is designed to preserve system integrity and minimise outages. Normally utilities will avoid intentionally interrupting service, but in this case non-critical loads can be interrupted for short periods. This type of scheme is known as an underfrequency load shedding scheme. Usually, automatic load shedding, based on underfrequency, is necessary since sudden, moderate-to-severe frequency shifts can throw a system into a dangerous state much faster than an operator can react. Underfrequency relays are usually installed at distribution substations, or industrial plant, where selected loads can be disconnected and where similar priority loads are often grouped together.

The object of load shedding is to re-establish the generator-load equation. At the instant of a disturbance a measure of the amount of overload is not readily available and thus load is shed in stages until the frequency stabilises and returns to within the nominal band. An example scheme would have the first load shedding stage set just below the nominal frequency, e.g. between 49.0 - 49.5Hz. A time delay element would be associated with this and this would be set to allow for transient dips in frequency, as well as to provide a time for the system regulating equipment to respond. The first load shedding stage would be set to shed a significant percentage of the system load. If this drop is sufficient, the frequency will stabilise and perhaps increase and return to nominal. If, however, this is not sufficient then a second load shedding stage, set at a lower frequency, will now shed a smaller percentage of load until the overload is relieved. This process will continue until all stages have operated. In the event of the load shedding being unsuccessful, a final stage of underfrequency protection should be provided to totally isolate all loads before plant is damaged, e.g. due to overfluxing.

An alternative type of load shedding scheme would be to set all underfrequency stages to about the same frequency setting but to have different length time delays set on each stage. If after the first stage is shed the frequency doesn't recover then subsequent stages will shed after longer time delays have elapsed.

As has been mentioned earlier, where there is an excess of generation in a subsystem the frequency will rise. This is most commonly due to loss of load situations, which cause the generators to speed up. Normally the generator control equipment will respond to regain the normal running speed, but if this equipment fails then the overfrequency protection can be used as a backup. The settings for the overfrequency elements should be set to allow for transient frequency excursions following a loss of load condition and allow time for the generator control systems to recover the situation.

The Argus 8 relay has four frequency elements, each of which can be set for underfrequency operation. These, coupled with independent voltage elements and a large number of output contacts available, enable economic application for complex load shedding schemes. The accuracy and security of operation built into the numeric algorithms makes them ideally suited for this type of application. All frequency elements can be blocked in a number of different ways. Section 1 - 3.5 of this manual describes the ways in which this can be

achieved. It is important to note that where there is other load shedding equipment on a system, the Argus 8 relay should be set to co-ordinate with it.

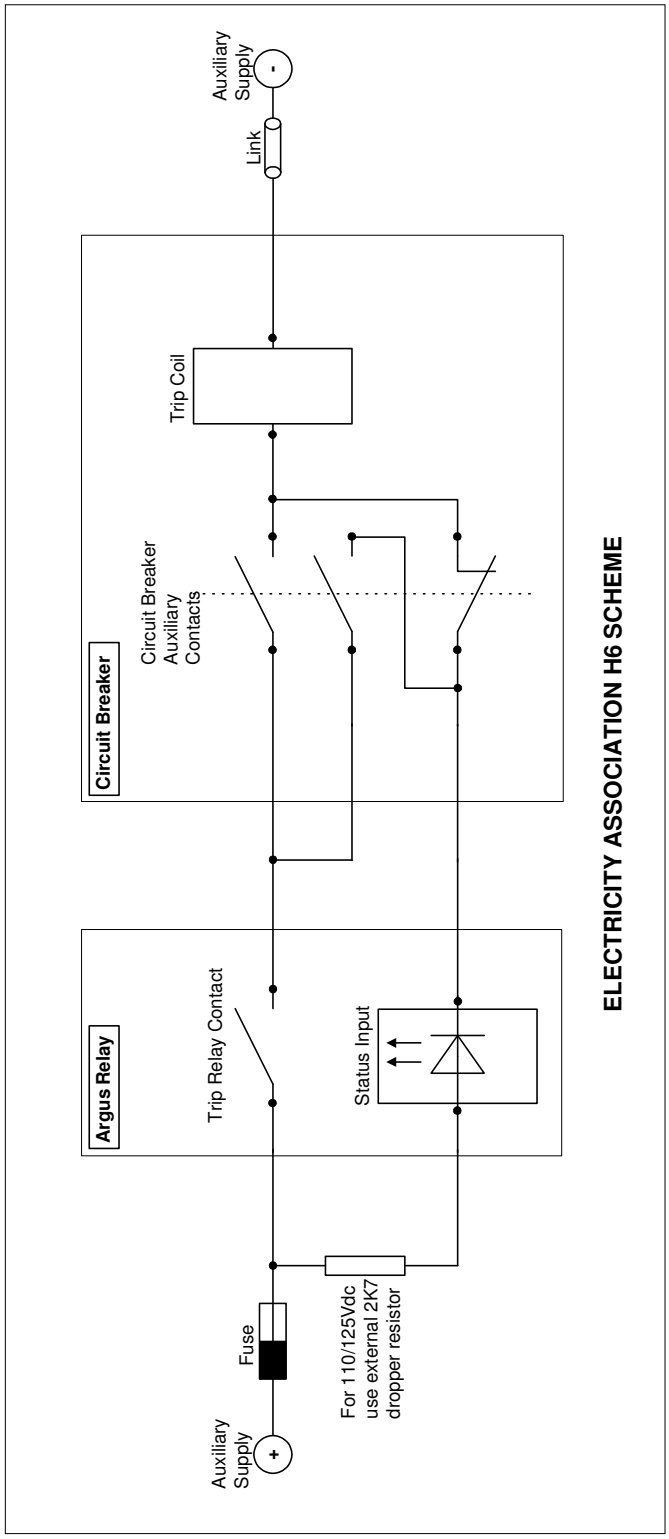



**Figure 1 – Trip Circuit Supervision Scheme**

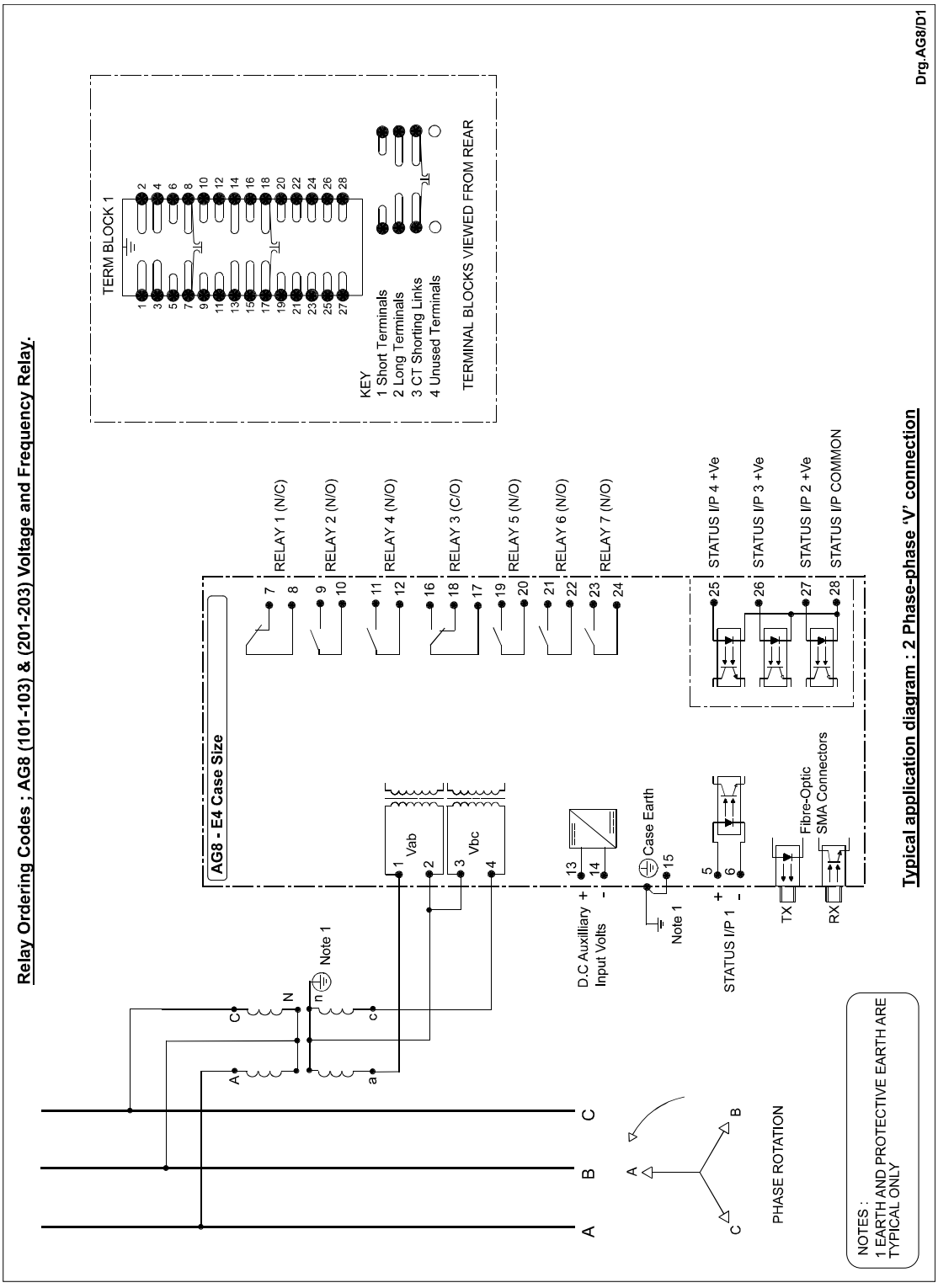



**Figure 2 – 2 Phase-Phase 'V' Connection**

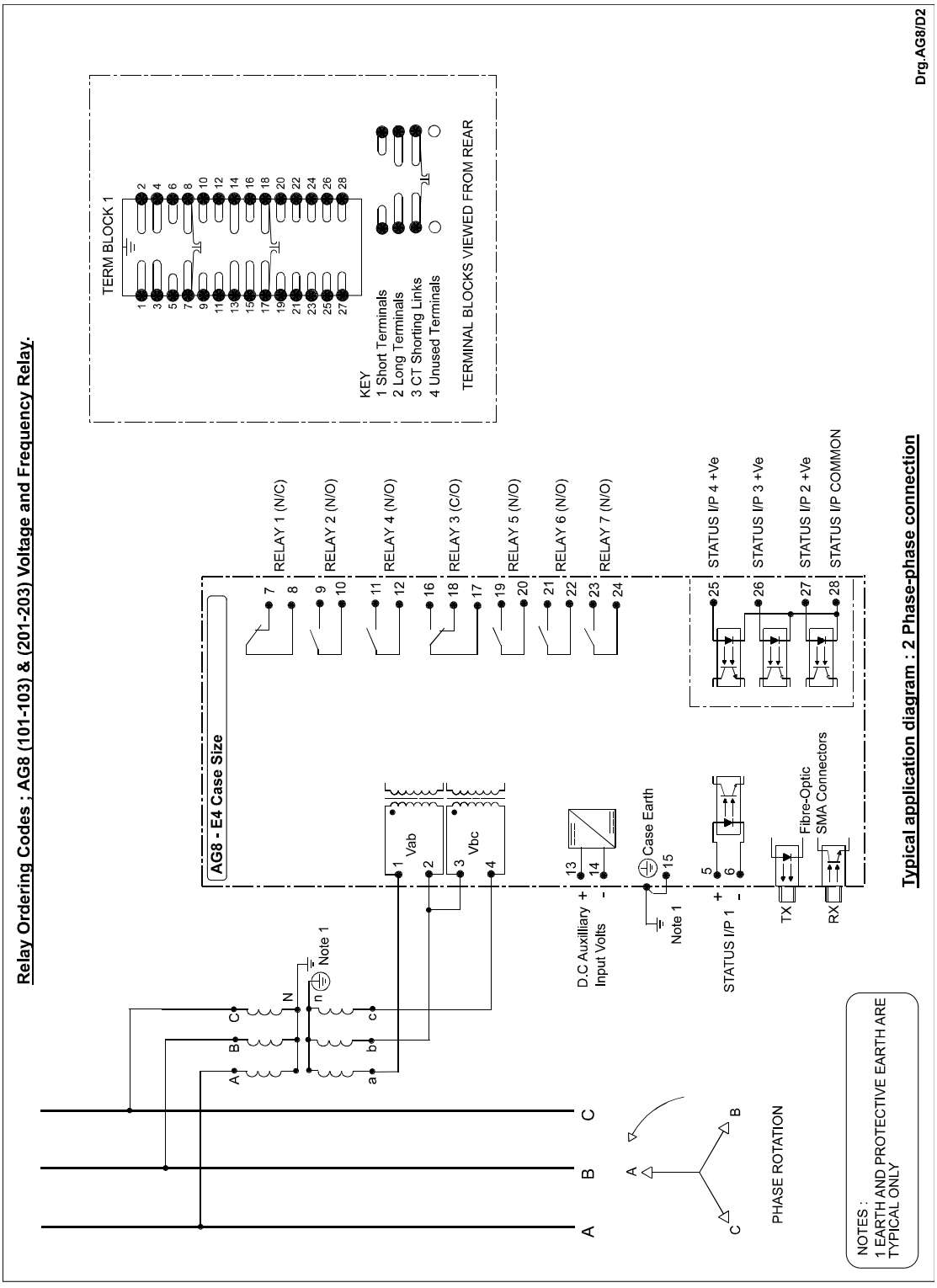



**Figure 3 – 2 Phase-Phase Connection**

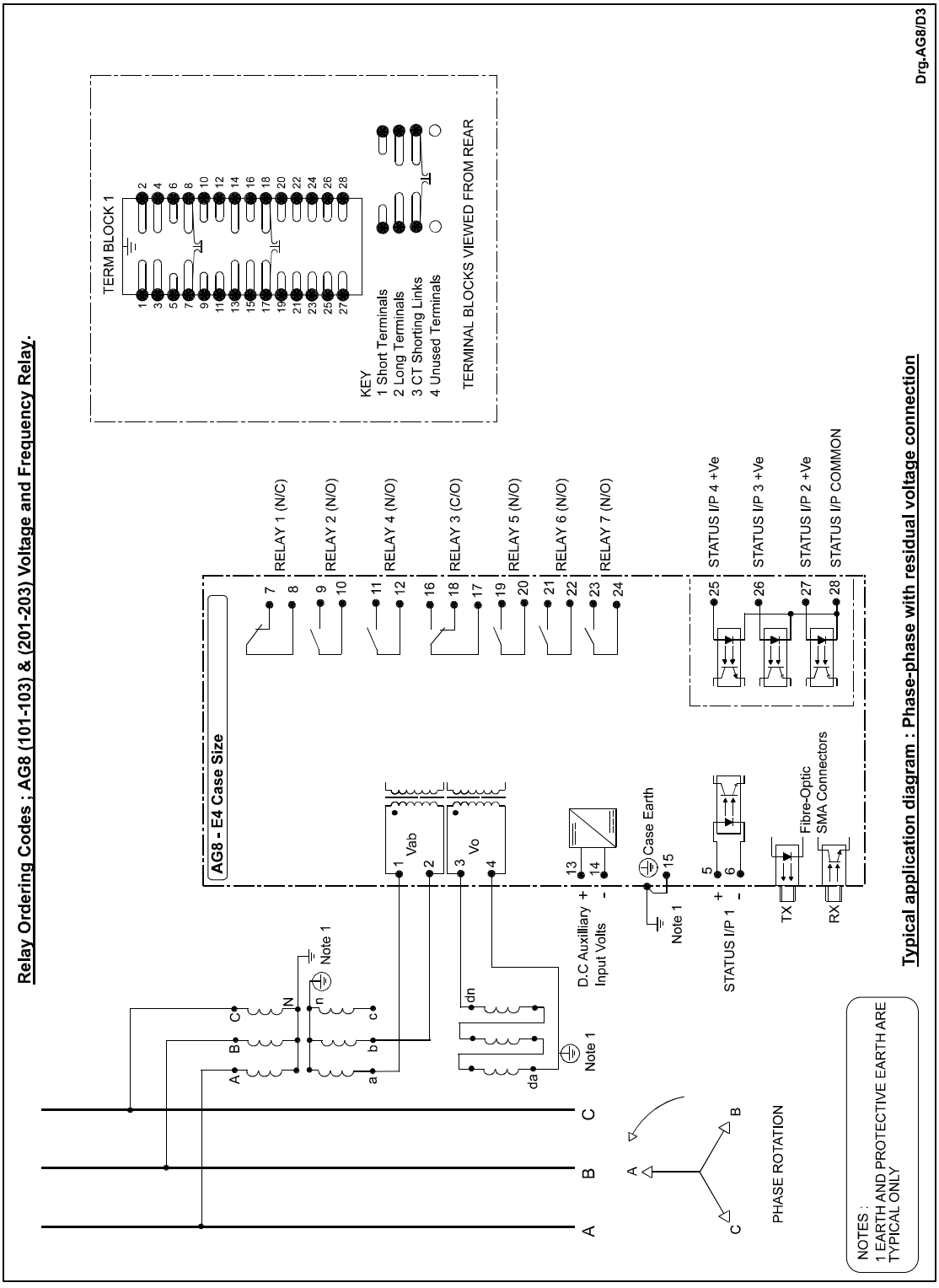



**Figure 4 – Phase-Phase with Residual Voltage Connection**

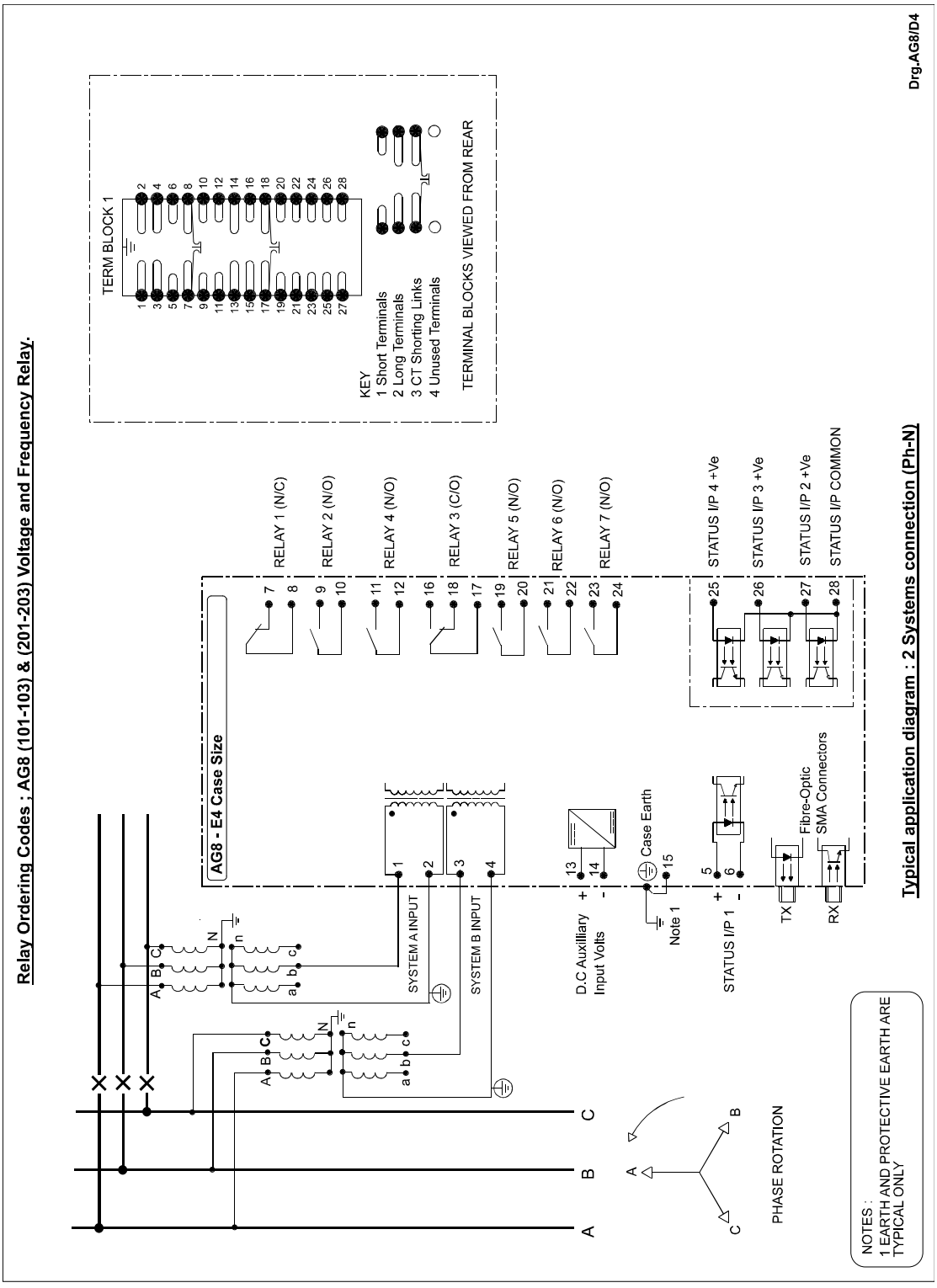



**Figure 5 – 2 Systems Connection (Ph-N)**

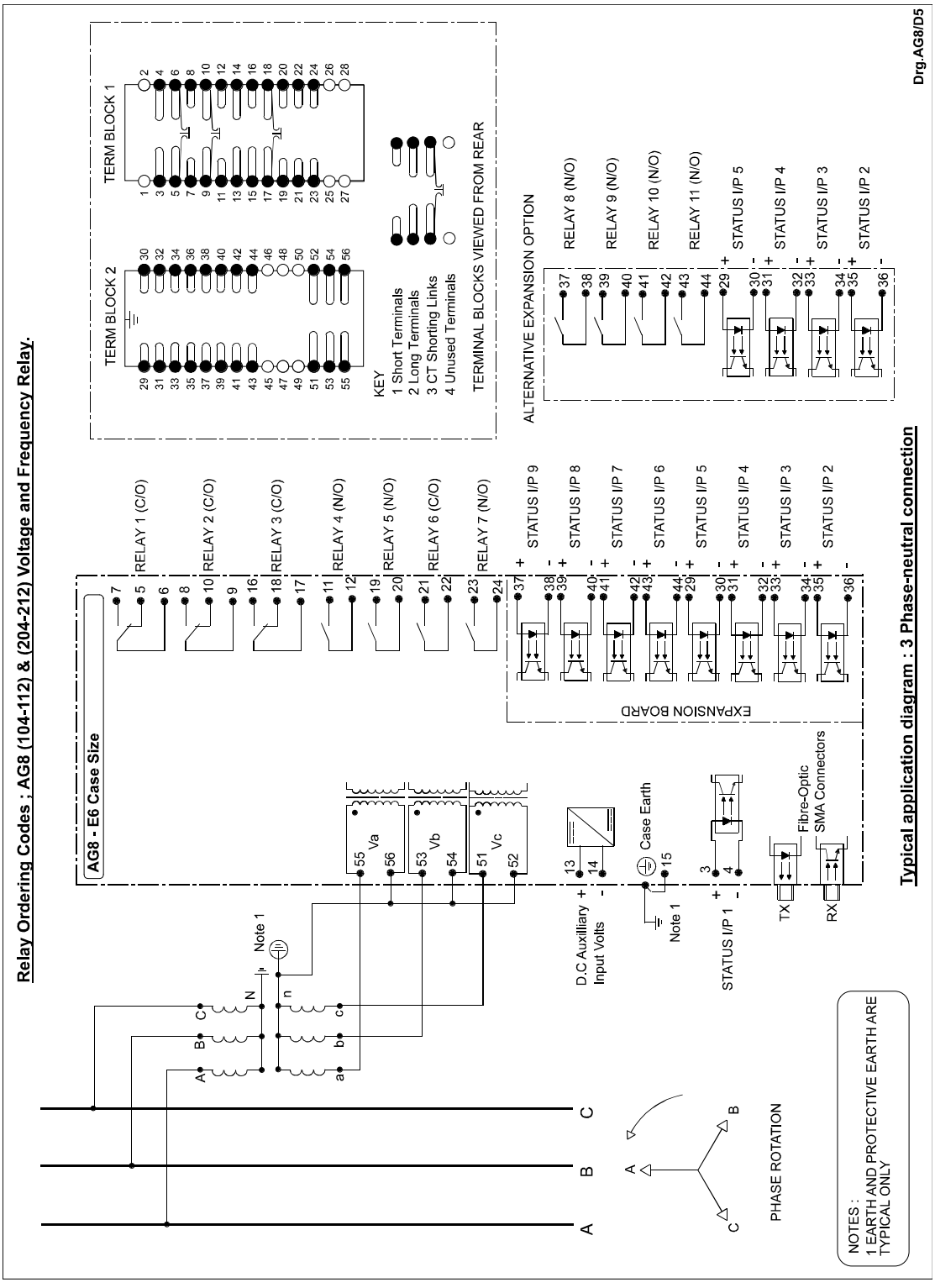



**Figure 6 – 3 Phase-Neutral Connection**

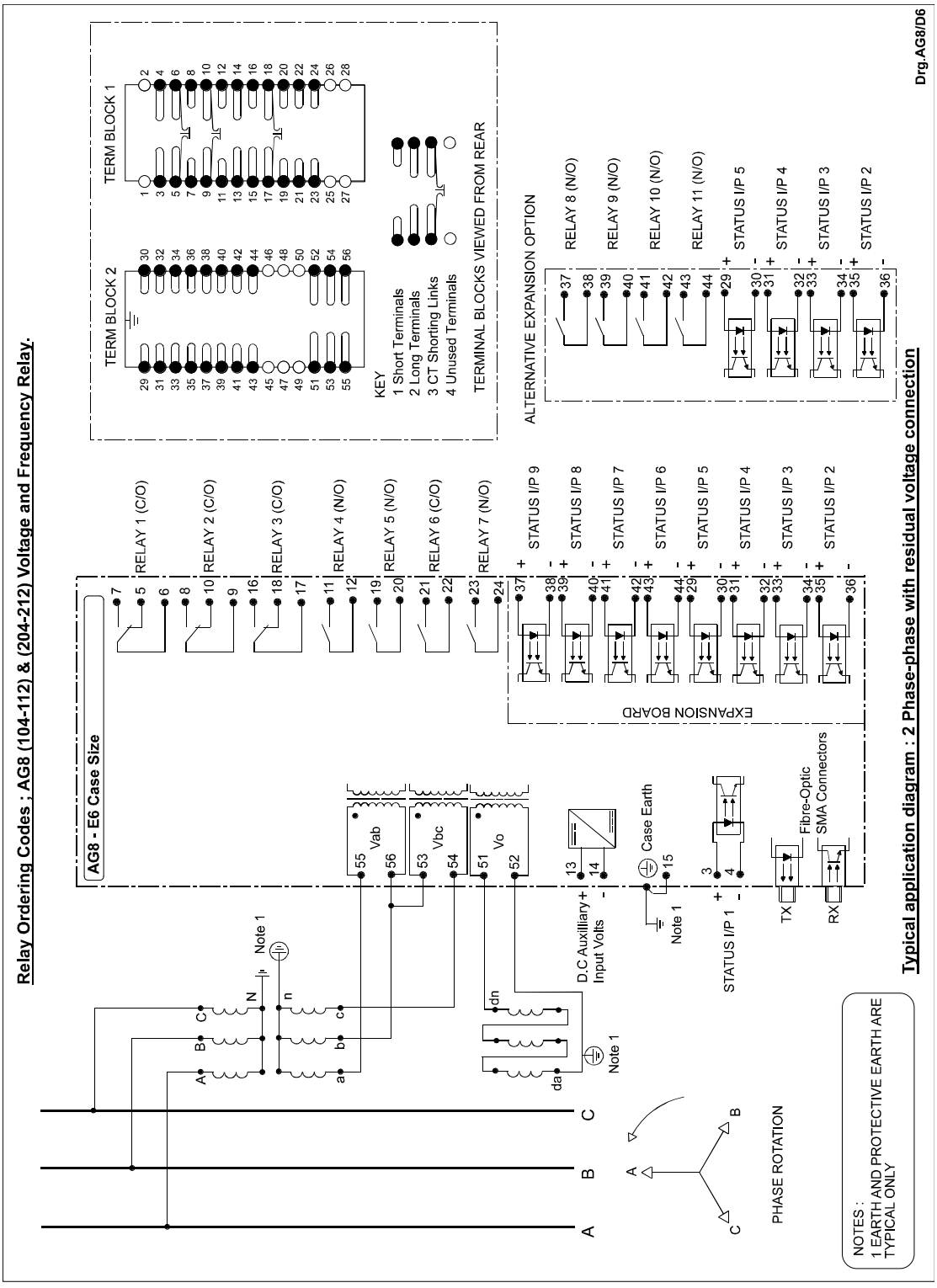



**Figure 7 – 2 Phase-Phase with Residual Voltage Connection**

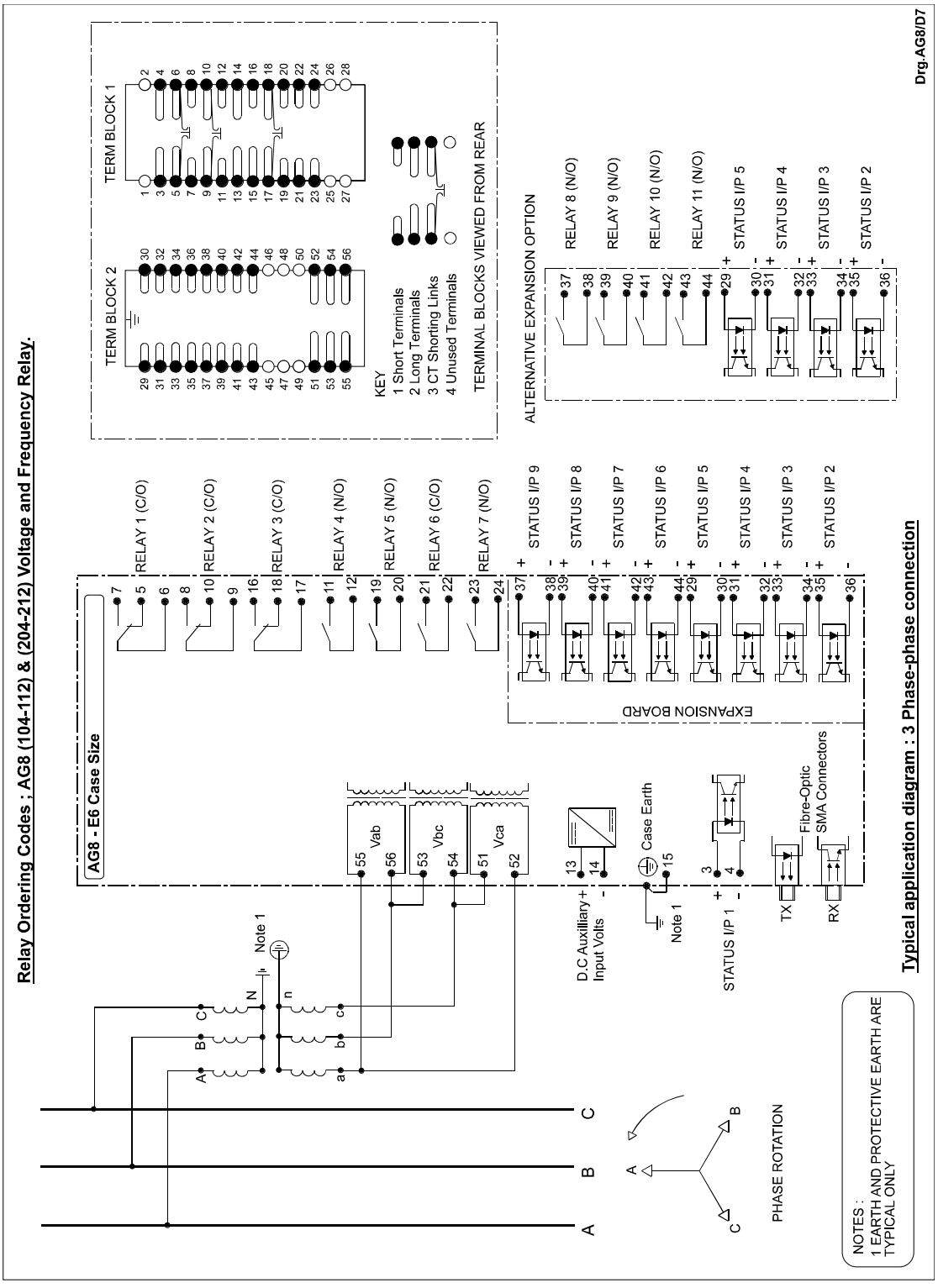



**Figure 8 – 3 Phase-Phase Connection**

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## TABLE OF FIGURES

## 1 UNPACKING, STORAGE AND HANDLING

On receipt, remove the relay from the container in which it was received and inspect it for obvious damage. Check that the relay is the correct model number and the rating information is correct. It is recommended that the relay is not removed from the case. To prevent the possible ingress of dirt, the sealed polythene bag should not be opened until the relay is to be used. If damage has been sustained a claim should immediately be made against the carrier and Reyrolle Protection and the nearest Reyrolle agent should be informed.

When not required for immediate use the relay should be returned to its original carton and stored in a clean, dry place. The relay contains static sensitive devices, which are susceptible to damage due to static discharge and for this reason it is essential that the correct handling procedure is followed. The relays' electronic circuits are protected from damage by static discharge when it is housed in its case. When it has been withdrawn from the case, static handling procedures should be observed.

- Before removing the relay from its case the operator must first ensure that he is at the same potential as the relay by touching the case.
- The relay must not be handled by any of the relay terminals on the rear of the chassis.
- Relays must be packed for transport in an anti-static container.
- Ensure that anyone else handling the relays is at the same potential as the relay.

As there are no user serviceable parts in the relay, then there should be no requirement to remove any modules from the chassis. If any modules have been removed or tampered with, then the guarantee will be invalidated. Reyrolle Protection reserves the right to charge for any subsequent repairs.

## 2 RECOMMENDED MOUNTING POSITION

The relay uses a liquid crystal display (LCD) which displays setting and metering information. It has a viewing angle of ± 70º and an internal back light. The recommended viewing position is at eye level.

The relay should be mounted onto the circuit breaker or panel at a level which allows the user easiest access to the relay functions.

## 3 RELAY DIMENSIONS

The relay is supplied in either the Epsilon size E4 case or E6 case. Mechanical diagrams of the case dimensions and panel cut-out requirements are shown in Figures 1 and 2 respectively.

## 4 FIXINGS

### 4.1 Crimps

Amp Pidg or Plasti Grip Funnel entry ring tongue

| Size | AMP Ref | Reyrolle Ref |
|---|---|---|
| 0.25-1.6mm$^2$ | 342103 | 2109E11602 |
| 1.0-2.6mm$^2$ | 151758 | 2109E11264 |

### 4.2 Panel Fixing Screws

Kit – 2995G10046 comprising :

- Screw M4 X10TT 2106F14010 – 4 off
- Lock Washers 2104F70040 – 4 off
- Nut M4 2103F11040 – 4 off

### 4.3 Communications

9mm SMA fibre optic connections – 2 per relay.

(Refer to Section 4 of this manual – Communications Interface).

## 5 ANCILLARY EQUIPMENT

The relay can be interrogated locally or remotely by making connection to the fibre optic terminals on the rear of the relay. For local interrogation a portable PC with a fibre to RS232 modem (Sigma 4) is required. The PC must be capable of running Microsoft Windows Ver 3.1 or greater, and it must have a standard RS232 port in order to drive the modem. For remote communications more specialised equipment is required. Refer to Section 4 of this manual – Communications Interface.

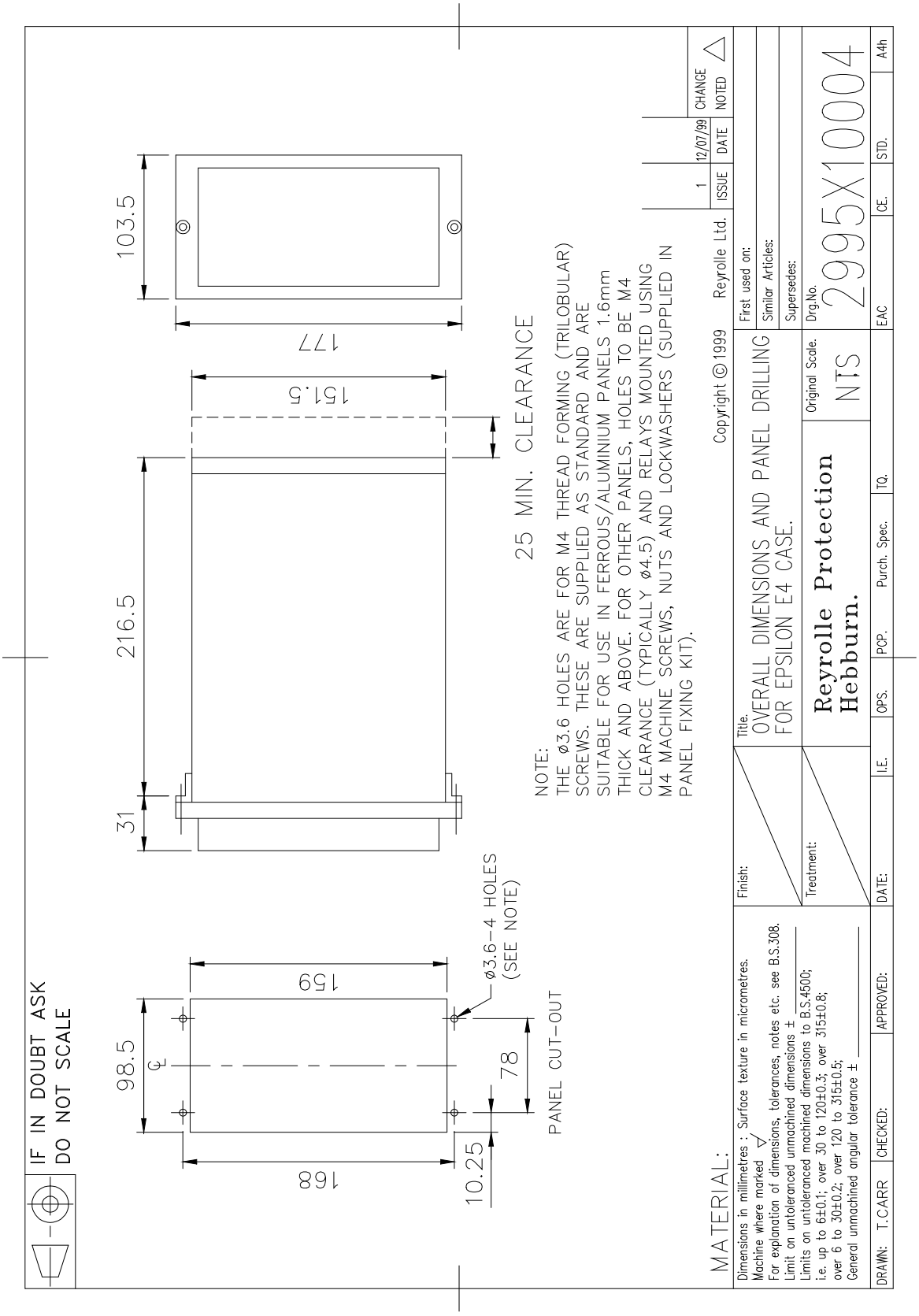


**Figure 1 - Overall dimensions of E4 case**

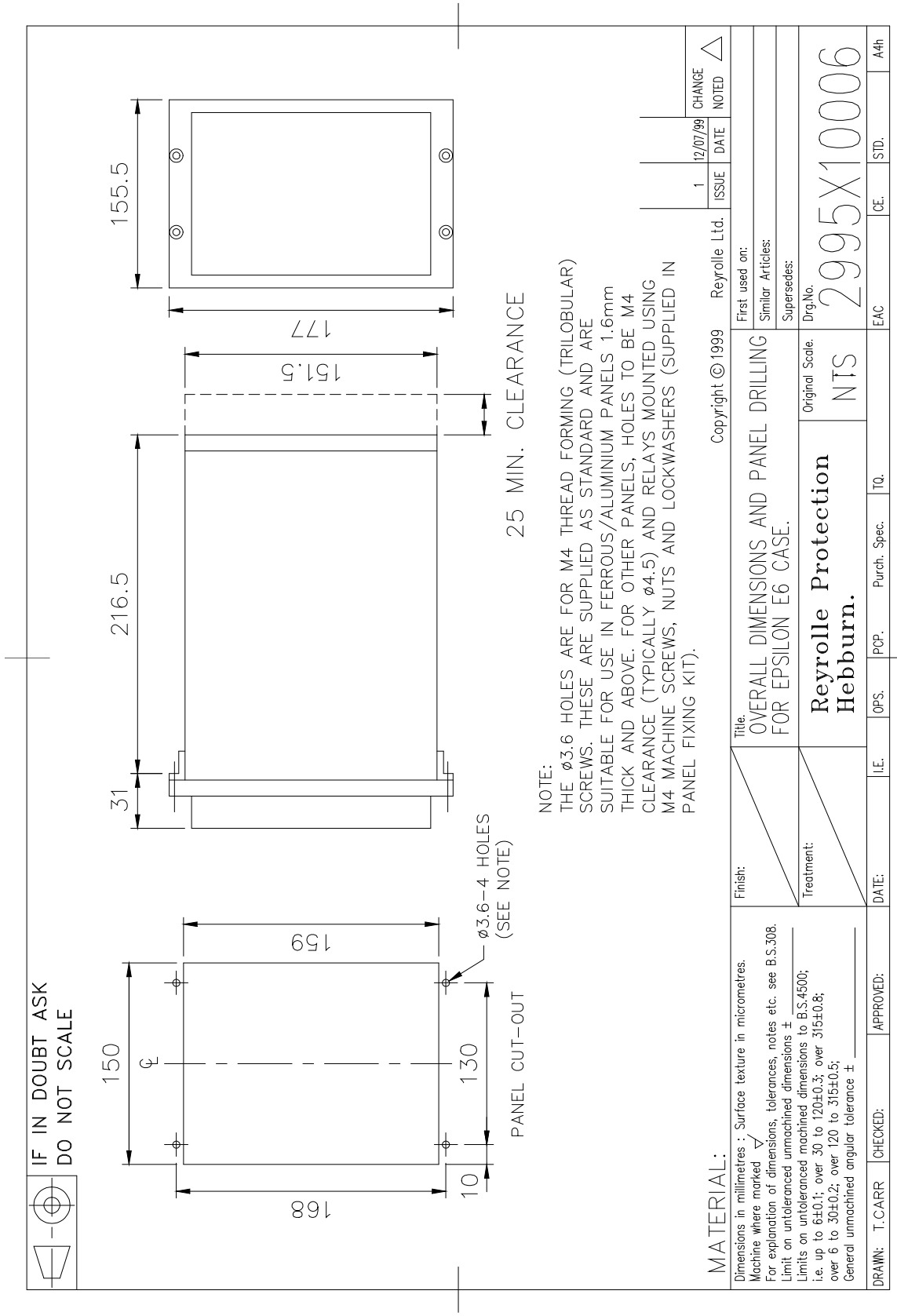


**Figure 2 - Overall dimensions of E6 case**

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## TABLES

## 1 INTRODUCTION

Before any commissioning work is carried out, the user should be familiar with the following sections :

- Section 1 - Description of Operation.
- Section 3 - Relay Settings.
- Section 6 - Installation. Particular attention should be paid to unpacking, storage and handling.

The Argus range of relays are fully numeric and incorporate many self-checking features which, if a fault occurs on the relay, will inhibit the protection functions of the relay and give an alarm output. This inherent self-checking gives high levels of confidence in the relays which means that commissioning tests do not have to be as comprehensive as with static or electromechanical type relays.

The recommended commissioning procedure for this type of numeric relay is to carry out the following tests :

1 Examine the relay for any damage.

2 Energise the relay and check that the hardware is working correctly.

3 Verify that the settings are as required for the application.

4 Verify that the external wiring is as required by the scheme diagram.

5 Perform secondary injection tests.

6 Perform on-load tests.

## 2 REQUIRED TEST EQUIPMENT

The following equipment will be required to perform commissioning tests on Argus 8 relays.

- 500V Insulation resistance test set.
- A variable ac voltage source, ideally a portable relay test set e.g. Doble, Omicron etc.
- Electronic Timer. (Required only if portable relay test set is not available).
- Multimeter with ac and dc voltage ranges.
- A dc supply with nominal voltage within the working range of the relay's dc auxiliary supply rating.
- A dc supply with nominal voltage within the working range of the relay's dc status input rating.
- Continuity tester e.g. multimeter.
- Phase rotation meter.

Additional equipment for testing the communications channel :

- Portable PC with an electrical-to-optical RS232 converter and fibre optic connectors.
- A copy of Reydisp Evolution software installed on the PC to exercise the communications channel.
- Optional printer (for printing a hard copy of the settings file if required).

# 3 COMMISSIONING TESTS

## 3.1 Inspection

Check that the relay has not been damaged in any way since being installed into the panel. Remove the relay from the case and check that the serial numbers of the relay, the case and the relay cover are all identical. Check also that the relay is the correct model and that the rating information is correct for the particular installation.

Ensure that all external connections are tight and that the relay case is solidly bonded to a local earth point by checking the earthing connection to the case. Replace the relay back into the case and check that it is fully inserted.

## 3.2 Insulation

When required, insulation tests to check the relay and associated wiring can be performed using a 500V electronic insulation resistance test set. The wiring may be tested between :-

1. All electrically isolated circuits.
2. All circuits to earth.

Accessible terminals of the same circuit should be connected together and deliberate circuit earthing links removed for the tests. Normal connections must be restored after testing. Satisfactory values for the various readings above depend upon the amount of wiring concerned. Where considerable multi-core wiring is involved a reading of 2.5 to 3.0 MΩ can be considered satisfactory. For short lengths of wiring higher values can be expected. A value of 1.0 MΩ or less should not be considered satisfactory and should be investigated.

We do not recommend a 2KV site pressure test on the secondary wiring with relays connected. If this has to be carried out then, as above, deliberate earth links must be removed. Note that both the positive and negative feeds to the relay's DC/DC converter are earthed via 5KV capacitors and the leakage current of these capacitors may trip the 2KV pressure test set. Also note that the capacitance effect of the secondary wiring may give rise to test set calibration errors that give impressed voltages higher than measured. To avoid this phenomenon, the pressure test set used should have the metering on the secondary (high voltage) side. Suitable test sets are manufactured by T&R Test Equipment (Type KV5 – 100).

While performing the tests, HV test voltages should be smoothly increased form zero and smoothly decreased to zero after the test to avoid arcing and trapped charge.

All Reyrolle relays are comprehensively pressure tested during manufacture.

## 3.3 Wiring Check

Check that the wiring to the back of the relay is as required by the external connection diagram or the relevant scheme diagram.

## 3.4 Auxiliary Supply Check

Before energising the relay check with a multimeter that the dc auxiliary supply voltage is within the operating range of the relay given in the table below :

| | Rating (V) | Operating Range (V) |
|---|---|---|
| Vaux | 24 / 30 / 48 | 18 – 60 |
| Vaux | 110 / 220 | 88 – 280 |

Note that the relay can withstand a superimposed ac ripple of upto 12% on the upper limit of the operative dc voltage range.

### 3.5 Energising the Relay

If the power supply is within the correct operating range then energise the relay. Indication of correct relay power up will be given by the green Protection Healthy LED being lit. This should be held permanently on and should not flash. After the relay has completed its startup initialisation routines, the LCD backlight will be switched on the display will revert to whichever screen was last selected.

At this point a continuity tester can be used to check that the chosen watchdog relay contacts are in their correct position for a healthy energised relay.

### 3.6 Visual Inspection

If the relay is powered up and in a healthy state, remove the relay cover and perform the following checks :

1. Press **CANCEL** a number of times to so that the relay displays the identifier screen. Now press **TEST/RESET** so that an LED test is initiated. The yellow Starter and red Trip LED's should operate momentarily and the LCD will display 'LED Test' .
2. View the LCD from a point directly in front of the relay. If the LCD is too faint or too dark then adjust the contrast by inserting a small flat screwdriver into the hole on the fascia above the LCD. The potentiometer is a multi-turn type and may require a number of turns before any changes are seen. Turning clockwise will increase the contrast, anti-clockwise will reduce the contrast. Ensure that the contrast is not too dark otherwise scrolling alarm screens will not be displayed clearly.

### 3.7 Precautions

Before testing commences the relay should be isolated from the voltage transformers in line with the local site procedures. The closing and alarm circuits should also be isolated where practical. Ensure that the correct dc auxiliary voltage is applied to the circuit. See the relevant scheme diagrams for the relay connections.

### 3.8 Status Input Tests

This test checks that the status input circuits are functioning correctly. The status input circuits should be energised in turn and observed to be operating using the instruments mode 'Status Inputs' display. A '1' indicates that the status circuit is energised, a '_' indicates that it is not.

Note : if the Status Invert feature is used, then when an input is externally energised, the instrument display will show a '_'. When the input is de-energised it will display a '1'.

Connect the correct dc voltage to the following terminals to energise the status inputs :

For E4 case size relays :

| Status Input | + DC Volts | - DC Volts |
|---|---|---|
| Status 1 | 5 | 6 |
| Status 2 | 27 | 28 |
| Status 3 | 26 | 28 |
| Status 4 | 25 | 28 |

For E6 case size relays :

| Status Input | + DC Volts | - DC Volts |
|---|---|---|
| Status 1 | 3 | 4 |
| Status 2 | 35 | 36 |
| Status 3 | 33 | 34 |
| Status 4 | 31 | 32 |
| Status 5 | 29 | 30 |
| Status 6 | 43 | 44 |
| Status 7 | 41 | 42 |
| Status 8 | 39 | 40 |
| Status 9 | 37 | 38 |

Record the operation of the Status Inputs in Table 1.

### 3.9 Output Relay Tests

This test checks that the output relays are functioning correctly. The output relays should be energised in turn and the contacts should be checked for correct operation using a continuity tester. The output relays can be energised in a number of ways. The following is the recommended method :

Assign each output relay in turn to 'Protection Healthy' in the output relay menu. On pressing the **ENTER** key the output relay selected will be energised. Check with a continuity tester that the actual contacts have operated. De-select the output relay and check that the contact returns.

(Assigning the output relays to 'Protection Healthy' ensures that they stay energised until they are de-selected. Otherwise, if they were assigned to a protection element, they may only be energised for the minimum output contact time, which is 100ms. This might not be long enough time for a continuity tester to register.)

Connect the continuity tester between the following terminals to test the output relays :

For E4 case size relays :

| Output Relay | Type | Terminal No. |
|---|---|---|
| Relay 1 | N/C | 7 – 8 |
| Relay 2 | N/O | 9 – 10 |
| Relay 3 | C/O | 17 (COM)<br>18 (N/C)<br>16 (N/O) |
| Relay 4 | N/O | 11 – 12 |
| Relay 5 | N/O | 19 – 20 |
| Relay 6 | N/O | 21 – 22 |
| Relay 7 | N/O | 23 – 24 |

For E6 case size relays :

| Output Relay | Type | Terminal No. |
|---|---|---|
| Relay 1 | C/O | 6 (COM)<br>5 (N/C)<br>7 (N/O) |
| Relay 2 | C/O | 9 (COM)<br>10 (N/C)<br>8 (N/O) |
| Relay 3 | C/O | 17 (COM)<br>18 (N/C)<br>16 (N/O) |
| Relay 4 | N/O | 11 – 12 |
| Relay 5 | N/O | 19 – 20 |
| Relay 6 | N/O | 21 – 22 |
| Relay 7 | N/O | 23 – 24 |
| Relay 8 | N/O | 37 – 38 |
| Relay 9 | N/O | 39 – 40 |
| Relay 10 | N/O | 41 – 42 |
| Relay 11 | N/O | 43 – 44 |

Note : when finished testing the output relays make sure that the 'Protection healthy' is re-assigned to the correct output relay given in the settings file and that all other relays have been de-selected from this option.

Record the operation of the Output Relays in Table 2.

### 3.10 Voltage Input Tests

This test checks that the voltage measurements are within acceptable tolerances.

Apply rated ac volts to each of the voltage input circuits of the relay, in turn, using the ac variable voltage source or the portable relay test set. Using a multimeter check the voltage at the relay terminals. This should equal the voltage displayed on the relay's secondary voltage displays, although there is a tolerance of ± 2% on the measurement display meters. If a phase VT ratio has been set, then the primary instrument displays can be viewed. These will be scaled by the 'Ph VT Ratio' setting.

| Relay Case Size | Voltage Input Type | Apply Voltage Between Terminals |
|---|---|---|
| E4 | Va (Vab) | 1 – 2 |
| E4 | Vo (Vbc) | 3 – 4 |
| E6 | Va (Vab) | 55 – 56 |
| E6 | Vb (Vbc) | 53 – 54 |
| E6 | Vc (Vca) | 51 – 52 |

Record the measured and displayed voltages in Table 3.

### 3.11 Applying Settings

Wherever possible, the relay should be commissioned with the actual settings calculated for the particular scheme. If this is not practical, however, one of the unused settings groups could be used as a commissioning test group. For information on selecting 'Active Settings Groups', see Section 1 of this manual. Note that Alarm and Tripping contacts must be programmed correctly before any scheme tests are carried out.

Settings can be entered into the relay using the keypad on the front of the relay or they can be sent to the relay, from a file, using a portable PC and the Reydisp Evolution software package. Entering the settings by hand can be a slow process and therefore using a previously prepared settings file is the recommended method. Using Reydisp Evolution also allows a hardcopy of the settings file to be easily acquired and saved.

Once the settings have been entered they will have to be verified. This is not essential, however, if the settings have been uploaded using Reydisp Evolution. If they have been entered by hand then the user should step through the relay settings list and compare them with the required setting record. (Note : see the Appendix section of this manual for Setting Configuration Sheets).

### 3.12 Optional Test

It is not necessary to perform tests on all internal elements of the relay. If the settings have been verified, the external wiring checked, the status inputs and output relays verified and the relay measures satisfactorily then the relay can be considered to be working to its design requirements. It will operate correctly, to the performance claims, and its operation under all service conditions is guaranteed. For this reason it is not essential to test the operation of any of the internal relay elements. However, if added confidence is required, then an element can be checked. Ideally an element employed in the scheme would be the best candidate to be tested. The following example shows the basic testing of a Voltage Element.

#### 3.12.1 Under/Over Voltage Element

Using either the scheme settings or convenient settings, which are suitable for the limitations of the available test equipment, energise a Voltage Element and record its pick-up and drop-off values in Table 3. The pick-up and drop-off will be indicated by the yellow starter LED coming on, though more detailed information is given at the starter screens in the instruments display mode of the menu system e.g. the following display :

```
V Starters
VE1
```

Set the Delay Time to 0.00 sec so that the instantaneous operate time of the chosen voltage element can be determined. Curves showing the instantaneous operate time for voltage elements are given in Section 2 of this manual. Take 3 timings and average them to get the instantaneous operate time. (Note that the instantaneous operate time is dependant upon the level of undervoltage applied).

Apply a Delay Time, ideally the time required for the scheme. Take 3 timings and average the values. The overall delay time should be the sum of the instantaneous operate time and the DTL time. Record the times in Table 4.

Performing this test is all that is essentially required to prove that the relay is functioning correctly. This is because the timing test also proves that the crystal oscillator, which clocks the microprocessor, is running at the correct frequency.

## 4 PUTTING INTO SERVICE

After all of the tests have been performed satisfactorily the relay should be put into service as follows :

- Remove all test connections and replace any external wiring, which may have been removed to allow testing.
- Replace all fuses and links.
- It is important to check that the correct settings group is active, if more than one group has been programmed.

### 4.1 On-load Testing

This test should only be performed if there are no restrictions on energising the system which is being commissioned.

Energise the system and measure the secondary voltages. Compare these with the relay's measured values which are displayed in the instruments display mode. The values should compare and be within ± 2%.

Look at the relay's primary voltage displays. These will be indicating the primary voltages which have been scaled to the correct ratio of the line voltage transformers.

If the relay is a 2 pole version and has been configured as 2Ph-Ph connection, or a 3 pole version, configured as 3Ph-Ph or 3Ph-N+NVD, then look at the V1 and V2 instruments displays. These will prove that the system phasing is correct. For correct phasing and rated system volts the V1 instrument should read full rated volts and the V2 instrument should read 0V.

If the relay versions are not configured as mentioned above, then test that the system volts are phased correctly using a phase rotation meter.

### 4.2 Final Checks

- Remove any test leads and links which have been used during the on-load testing phase.
- In the CB Maintenance menu reset the Trip Counter if any trips have been registered.
- Reset any alarms and LED's.
- Replace the relay cover and secure.

If a password has been entered the relay will automatically log the user out after a time of 1 hour has elapsed.

## 5 TROUBLE SHOOTING

| OBSERVATION | ACTION |
|---|---|
| Relay does not power up. | Check that the correct auxiliary DC voltage is applied and that the polarity is correct. |
| Relay won't accept the password. | The Password being entered is wrong. Enter correct password.<br>If correct password has been forgotten, note down the Numeric Code which is displayed at the Change Password screen e.g.<br>Change Password<br>Code= 123456789<br>To retrieve the password communicate this code to the nearest Reyrolle representative. |
| Protection Healthy LED flashes | General failure. Contact Reyrolle. |
| LCD screen flashes continuously. | The LCD has many possible error messages which when displayed will flash continuously. These indicate various processor card faults.<br>General failure. Contact Reyrolle. |
| Backlight is on but no text can be seen. | Adjust the contrast. |
| Scrolling text messages are unreadable. | Adjust the contrast. |
| Relay displays one instrument after another with no user intervention. | Default instruments are enabled. Remove all instruments from the default list and only add those which are required.<br>Frequency<br>50.003Hz<br>The ' ' indicates that the instrument is a default instrument. Press **ENTER** to deselect it.<br>(See Description of Operation – subsection 4.5 of this manual). |
| The LCD is stuck at the 'General Alarms' screen and is displaying 'Trip Circuit Failure Sx'. (x = 1..5) | The trip circuit failure feature is enabled and is expecting a healthy status input signal. Energise the correct Status Input, or disable the trip circuit feature if it is not required. |
| Cannot communicate with the relay. | • Check that all of the communications settings match those used by Reydisp Evolution.<br>• Check that the Tx and Rx fibre-optic cables are connected correctly.<br>( Tx –> Rx and Rx –> Tx ).<br>• Check that all cables, modems and fibre-optic cables work correctly.<br>• Set the line idle setting to Light On. Examine the Tx port on the back of the relay, with the fibre removed, and check that it is glowing red. If it is not then the communications board on the case may not be aligned correctly with the processor card socket.<br>Contact Reyrolle. |

| | |
|---|---|
| | (WARNING : DO NOT LOOK AT THE FIBRE-OPTIC TRANSMITTER FOR A PROLONGED TIME).<br>(See Communications Interface section of this manual). |
| Relays will not communicate in a ring network. | • Check that the Data Echo setting on all relays is set to ON.<br>• Check that all relays are powered up.<br>• Check that all relays have unique addresses. |
| Status inputs do not work. | • Check that the correct DC voltage is applied and that the polarity is correct.<br>• Check that the status input settings such as the Pick-up and Drop-off timers and the status inversion function are correctly set. |
| Relay instrument displays show small voltages even though the system is dead. | • This is normal. The relay is displaying calculation noise. This will not affect any accuracy claims for the relay. |

If the above checklist does not help in correcting the problem please contact your nearest Reyrolle representative.

## Appendix 1 : COMMISSIONING TEST RESULTS

| | |
|---|---|
| **Date :** | |
| **Station :** | |
| **Circuit :** | |

**RELAY INFORMATION**

| | |
|---|---|
| **Relay Type** | |
| **Article Number** | |
| **Serial Number** | |
| **Auxiliary Voltage (Vx)** | V dc |
| **Rated Frequency (Fn)** | Hz |
| **Status Input Voltage** | V dc |

**STATUS INPUT TESTS**

| **Status Input** | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** | **S9** |
|---|---|---|---|---|---|---|---|---|---|
| **Working ? (Yes / No / N/A)** | | | | | | | | | |

**Table 1 - Status Input Tests**

**OUTPUT RELAY TESTS**

| **Output Relay** | **RL1** | **RL2** | **RL3** | **RL4** | **RL5** | **RL6** | **RL7** | **RL8** | **RL9** | **RL10** | **RL11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Working ? (Yes / No / N/A)** | | | | | | | | | | | |

**Table 2 - Output Relay Tests**

| Input Pole | Voltage @ Relay Terminals (V) | Relay Secondary Displays (V) | VT Ratio | Relay Primary Displays (V) | PASS / FAIL |
|---|---|---|---|---|---|
| Va (Vab) | | | | | |
| Vb (Vbc) | | | | | |
| Vc (Vca) | | | | | |
| Vo | | | | | |

**Table 3 - Measured Voltages**

| V Element Number | Operation Mode | O/P Phases | Output Relay(s) | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| Setting (V) | Hysteresis (%) | PU Level (V) | DO Level (V) | PU Error (%) | DO Error (%) | Ratio (%) | PASS / FAIL |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Delay Time (sec) | Operate Time 1 (sec) | Operate Time 2 (sec) | Operate Time 3 (sec) | Average Time (sec) | | | PASS / FAIL |
| | | | | | | | |
| | | | | | | | |

**Table 4 - Under/Over Voltage Element Tests**

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## APPENDIX

## 1 MAINTENANCE INSTRUCTIONS

The Argus 8 is a maintenance free relay, with no user serviceable parts. During the life of the relay it should be checked for operation during the normal maintenance period for the site on which the product is installed. It is recommended the following tests are carried out :

1 Visual inspection of the metering display (every year)

2 Operation of output contacts (every 2 years)

3 Secondary injection of each element (every 5 years)

**DEFECT REPORT FORM**

Please copy this sheet and use it to report any defect which may occur.

<table>
<tr><td colspan="3">Customers Name & Address:</td><td colspan="3">Contact Name:</td></tr>
<tr><td colspan="3" rowspan="3"></td><td colspan="3">Telephone No:</td></tr>
<tr><td colspan="3">Fax No:</td></tr>
<tr><td colspan="3">Supplied by:</td><td colspan="3">Date when installed:</td></tr>
<tr><td colspan="3">Site:</td><td colspan="3">Circuit:</td></tr>
<tr><td>Date Found:</td><td>During Commissioning:</td><td>During Maintenance:</td><td>From a System Fault:</td><td colspan="2">Other, please state:</td></tr>
<tr><td colspan="3">Product Name:</td><td colspan="3">Article Number:</td></tr>
<tr><td colspan="3">Software Version:</td><td colspan="3">Serial Number:</td></tr>
<tr><td colspan="6">Copy any message displayed by the relay:</td></tr>
<tr><td colspan="6">Describe Defect:</td></tr>
<tr><td colspan="6">Describe any other action taken:</td></tr>
<tr><td colspan="2">Signature:</td><td colspan="2">Please print name:</td><td colspan="2">Date:</td></tr>
<tr><td colspan="6">For Reyrolle Protection use only:</td></tr>
<tr><td>Date Received:</td><td>Contact Name:</td><td>Reference No:</td><td>Date Acknowledged:</td><td>Date of Reply:</td><td>Date Cleared:</td></tr>
</table>

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## APPENDIX

Attached are Setting Configuration Sheets, which can be photocopied and used to store a record of a relay's settings. Also, attached is a Programming Matrix, which is a convenient way of recording the input / output logic for a relay.

| GENERAL INFORMATION |
|---|
| **Relay Type :** |
| **Article Number :** |
| **Serial Number :** |
| **Date :** |
| **Station :** |
| **Circuit :** |

| The following Setting Menu Tables are for **SETTINGS GROUP G** |
|---|

| SYSTEM CONFIGURATION MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Active Settings Group | G1-G8 | |
| Power System Frequency | 50 / 60 Hz | |
| Voltage Blocking Threshold | 1V – 100V step 1V | |
| Connection *(3 pole versions)* | 3Ph-Ph<br>3Ph-N+NVD<br>2Ph-Ph+NVD | |
| Connection *(2 pole versions)* | 2Ph-Ph<br>Ph-N+NVD<br>Ph-Ph+NVD<br>2 Systems A/B | |
| Ph VT Primary | 000000 – 999999 | |
| Ph VT Secondary | 40, 40.1…70.0, 70.5…150.0 | |
| 3Vo VT Primary | 000000 – 999999 | |
| 3Vo VT Secondary | 40, 40.1…70.0, 70.5…150.0 | |
| Set Identifier | Up to 16 alphanumeric characters | |
| Set Alarm 1 | Up to 13 alphanumeric characters | |
| Set Alarm 2 | Up to 13 alphanumeric characters | |
| Set Alarm 3 | Up to 13 alphanumeric characters | |
| Set Alarm 4 | Up to 13 alphanumeric characters | |
| Set Alarm 5 | Up to 13 alphanumeric characters | |
| Set Alarm 6 | Up to 13 alphanumeric characters | |
| Set Alarm 7 | Up to 13 alphanumeric characters | |
| Set Alarm 8 | Up to 13 alphanumeric characters | |
| Set Alarm 9 | Up to 13 alphanumeric characters | |
| Calendar – Set Date | DD/MM/YY | |
| Clock - Set Time | HH:MM:SS | |
| Clock Sync. From Status | Seconds or Minutes | |
| Default Screen Timer | 10sec, 60sec, 5min, 1hour | |
| Change Password | 4 alphanumeric characters | |

| VOLTAGE MENU (can be used also for SYSTEM A and SYSTEM B MENUS) | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn V Element 1 Operation | OFF, O/V, U/V | |
| Gn V Element 1 Setting | OFF, 5V – 200V step 0.5V | |
| Gn V Element 1 Delay | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | |
| Gn V Element 1 Hysteresis | 1% – 90% step 1% | |
| Gn V Element 1 O/P Phases | Any 1, All | |
| Gn V Element 2 Operation | OFF, O/V, U/V | |
| Gn V Element 2 Setting | OFF, 5V – 200V step 0.5V | |
| Gn V Element 2 Delay | As Element 1 Delay | |
| Gn V Element 2 Hysteresis | 1% – 90% step 1% | |
| Gn V Element 2 O/P Phases | Any 1, All | |
| Gn V Element 3 Operation | OFF, O/V, U/V | |
| Gn V Element 3 Setting | OFF, 5V – 200V step 0.5V | |
| Gn V Element 3 Delay | As Element 1 Delay | |
| Gn V Element 3 Hysteresis | 1% – 90% step 1% | |
| Gn V Element 3 O/P Phases | Any 1, All | |
| Gn V Element 4 Operation | OFF, O/V, U/V | |
| Gn V Element 4 Setting | OFF, 5V – 200V step 0.5V | |
| Gn V Element 4 Delay | As Element 1 Delay | |
| Gn V Element 4 Hysteresis | 1% – 90% step 1% | |
| Gn V Element 4 O/P Phases | Any 1, All | |

| NEUTRAL VOLTAGE MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn 3Vo Element 1 Setting | 0FF, 1 – 100V step 0.5V | |
| Gn 3Vo Element 1 Delay | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | |
| Gn 3Vo Element 2 Setting | 0FF, 1 – 100V step 0.5V | |
| Gn 3Vo Element 2 Delay | As Element 1 Delay | |

| NPS OVERVOLTAGE MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn V2 Element 1 Setting | 0FF, 1 – 100V step 0.5V | |
| Gn V2 Element 1 Delay | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | |
| Gn V2 Element 2 Setting | 0FF, 1 – 100V step 0.5V | |
| Gn V2 Element 2 Delay | As Element 1 Delay | |

| FREQUENCY MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn F Element 1 Operation | OFF, O/F, U/F | |
| Gn F Element 1 Setting | 47.00Hz – 62.00Hz step 0.01Hz | |
| Gn F Element 1 Delay | 0.00 – 20.00 step 0.01 sec<br>20.0 – 100.0 step 0.5 sec<br>100 – 600 step 1.0 sec | |
| Gn F Element 1 Inhib | VE1, VE2, VE3, VE4 | |
| Gn F Element 2 Operation | OFF, O/F, U/F | |
| Gn F Element 2 Setting | 47.00Hz – 62.00Hz step 0.01Hz | |
| Gn F Element 2 Delay | As Element 1 Delay | |
| Gn F Element 2 Inhib | VE1, VE2, VE3, VE4 | |
| Gn F Element 3 Operation | OFF, O/F, U/F | |
| Gn F Element 3 Setting | 47.00Hz – 62.00Hz step 0.01Hz | |
| Gn F Element 3 Delay | As Element 1 Delay | |
| Gn F Element 3 Inhib | VE1, VE2, VE3, VE4 | |
| Gn F Element 4 Operation | OFF, O/F, U/F | |
| Gn F Element 4 Setting | 47.00Hz – 62.00Hz step 0.01Hz | |
| Gn F Element 4 Delay | As Element 1 Delay | |
| Gn F Element 4 Inhib | VE1, VE2, VE3, VE4 | |

| O/P RELAY CONFIG MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn Relay Healthy | RL1..RL11 | |
| Gn V Block Alarm | RL1..RL11 | |
| Gn VE1 Starter | RL1..RL11 | |
| Gn VE1 Trip | RL1..RL11 | |
| Gn VE2 Starter | RL1..RL11 | |
| Gn VE2 Trip | RL1..RL11 | |
| Gn VE3 Starter | RL1..RL11 | |
| Gn VE3 Trip | RL1..RL11 | |
| Gn VE4 Starter | RL1..RL11 | |
| Gn VE4 Trip | RL1..RL11 | |
| Gn 3VoE1 Starter | RL1..RL11 | |
| Gn 3VoE1 Trip | RL1..RL11 | |
| Gn 3VoE2 Starter | RL1..RL11 | |
| Gn 3VoE2 Trip | RL1..RL11 | |
| Gn V2E1 Starter | RL1..RL11 | |
| Gn V2E1 Trip | RL1..RL11 | |
| Gn V2E2 Starter | RL1..RL11 | |
| Gn V2E2 Trip | RL1..RL11 | |
| Gn FE1 Starter | RL1..RL11 | |
| Gn FE1 Trip | RL1..RL11 | |
| Gn FE2 Starter | RL1..RL11 | |
| Gn FE2 Trip | RL1..RL11 | |
| Gn FE3 Starter | RL1..RL11 | |
| Gn FE3 Trip | RL1..RL11 | |
| Gn FE4 Starter | RL1..RL11 | |
| Gn FE4 Trip | RL1..RL11 | |
| Gn Status 1 | RL1..RL11 | |
| Gn Status 2 | RL1..RL11 | |
| Gn Status 3 | RL1..RL11 | |
| Gn Status 4 | RL1..RL11 | |
| Gn Status 5 | RL1..RL11 | |
| Gn Status 6 | RL1..RL11 | |
| Gn Status 7 | RL1..RL11 | |
| Gn Status 8 | RL1..RL11 | |
| Gn Status 9 | RL1..RL11 | |
| Gn Trip counter Alarm | RL1..RL11 | |
| Gn PowerOn Count | RL1..RL11 | |
| Gn Hand Reset | RL1..RL11 | |
| Min O/P Energise Time | 100 – 500ms step 50ms | |

| STATUS CONFIG MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Settings Group Select | S1..S9<br>(Note : special setting where each status can be set from 1-8 to select active group 1-8) | |
| Inverted Inputs | S1..S9 | |
| Gn VE1 Inhibit | S1..S9 | |
| Gn VE2 Inhibit | S1..S9 | |
| Gn VE3 Inhibit | S1..S9 | |
| Gn VE4 Inhibit | S1..S9 | |
| Gn 3VoE1 Inhibit | S1..S9 | |
| Gn 3VoE2 Inhibit | S1..S9 | |
| Gn V2E1 Inhibit | S1..S9 | |
| Gn V2E2 Inhibit | S1..S9 | |
| Gn FE1 Inhibit | S1..S9 | |
| Gn FE2 Inhibit | S1..S9 | |
| Gn FE3 Inhibit | S1..S9 | |
| Gn FE4 Inhibit | S1..S9 | |
| Gn Trip Circuit Fail | S1..S9 | |
| Gn ALARM 1 | S1..S9 | |
| Gn ALARM 2 | S1..S9 | |
| Gn ALARM 3 | S1..S9 | |
| Gn ALARM 4 | S1..S9 | |
| Gn ALARM 5 | S1..S9 | |
| Gn ALARM 6 | S1..S9 | |
| Gn ALARM 7 | S1..S9 | |
| Gn ALARM 8 | S1..S9 | |
| Gn ALARM 9 | S1..S9 | |
| Gn Waveform Trigger | S1..S9 | |
| Gn Clock Sync. | S1..S9 | |
| Gn Reset Outputs | S1..S9 | |
| Gn Status 1 P/U Delay | 0 – 2.00 sec step 10ms<br>2.10 – 20.00 sec step 100ms<br>21 – 300 sec step 1 sec<br>360 – 3600 sec step 60 sec<br>3900 – 14400 sec step 300 sec | |
| Gn Status 1 D/O Delay | As above | |
| Gn Status 2 P/U Delay | As above | |
| Gn Status 2 D/O Delay | As above | |
| Gn Status 3 P/U Delay | As above | |
| Gn Status 3 D/O Delay | As above | |
| Gn Status 4 P/U Delay | As above | |
| Gn Status 4 D/O Delay | As above | |
| Gn Status 5 P/U Delay | As above | |
| Gn Status 5 D/O Delay | As above | |
| Gn Status 6 P/U Delay | As above | |
| Gn Status 6 D/O Delay | As above | |
| Gn Status 7 P/U Delay | As above | |

| STATUS CONFIG MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn Status 7 D/O Delay | As above | |
| Gn Status 8 P/U Delay | As above | |
| Gn Status 8 D/O Delay | As above | |
| Gn Status 9 P/U Delay | As above | |
| Gn Status 9 D/O Delay | As above | |

| COMMS INTERFACE MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Comms Baud Rate | 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200 | |
| Comms Parity | NONE, EVEN | |
| Relay Address | 0 – 254 | |
| Line Idle | LIGHT ON, LIGHT OFF | |
| Data Echo | OFF / ON | |

| DATA STORAGE MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Gn Fault Trigger | RL1..RL11 | |
| Gn Waveform Trig | STA, V, F, NPS, NVD | |
| Gn Waveform Pre-trigger | OFF, 10%-100% step 10% | |

| CB MAINTENANCE MENU | | |
|---|---|---|
| **SETTING** | **RANGE** | **SET VALUE** |
| Trip Counter Alarm | OFF, 1 – 999 step 1 | |
| Power On Count Alarm | OFF, 1 – 999 step 1 | |

| | |
|---|---|
| Relay Identifier | |
| Relay Address | |
| Settings Group No. | |

Note:
This programming matrix can be used for both E4 and E6 case size ARGUS 8 variants. For different I/O options and particular relay configurations ignore the redundant features.

Alarm 1
Alarm 2
Alarm 3
Alarm 4
Alarm 5
Alarm 6
Alarm 7
Alarm 8
Alarm 9

Relay Healthy

VE1 Inhibit
VE2 Inhibit
VE3 Inhibit
VE4 Inhibit
3VoE1 Inhibit
3VoE2 Inhibit
V2E1 Inhibit
V2E2 Inhibit
FE1 Inhibit
FE2 Inhibit
FE3 Inhibit
FE4 Inhibit

**PROTECTION FUNCTIONS**

V Block Alarm
VE1 Starter
VE1 Trip
VE2 Starter
VE2 Trip
VE3 Starter
VE3 Trip
VE4 Starter
VE4 Trip
3VoE1 Starter
3VoE1 Trip
3VoE2 Starter
3VoE2 Trip
V2E1 Starter
V2E1 Trip
V2E2 Starter
V2E2 Trip
FE1 Starter
FE1 Trip
FE2 Starter
FE2 Trip
FE3 Starter
FE3 Trip
FE4 Starter
FE4 Trip

Settings Group Select
Clock Sync.
Waveform Trig
Reset Outputs
Trip Circuit Fail

Trip Counter Alarm
PowerOn Count

DO TIMER
PU TIMER
INVERTED INPUTS

1 2 3 4 5 6 7 8 9

Status Inputs

LATCHED / HAND RESET

1 2 3 4 5 6 7 8 9 10 11

Output Relays

**ARGUS 8 - Programming Matrix**

**Notes Pages**

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The policy of Easun Reyrolle is one of continuous improvement and development. The company therefore reserves the right to supply equipment which may differ slightly from described and illustrated in this publication.


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Man/Argus 8/Rev 0/1105 IMAGIC CREATIVES