7SG11 Argus 7

Check and System Synchronising Relays

Document Release History

This document is issue 2010/02 The list of revisions up to and including this issue is:
Pre release

2010/02	Document reformat due to rebrand

Software Revision History

Contents

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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.

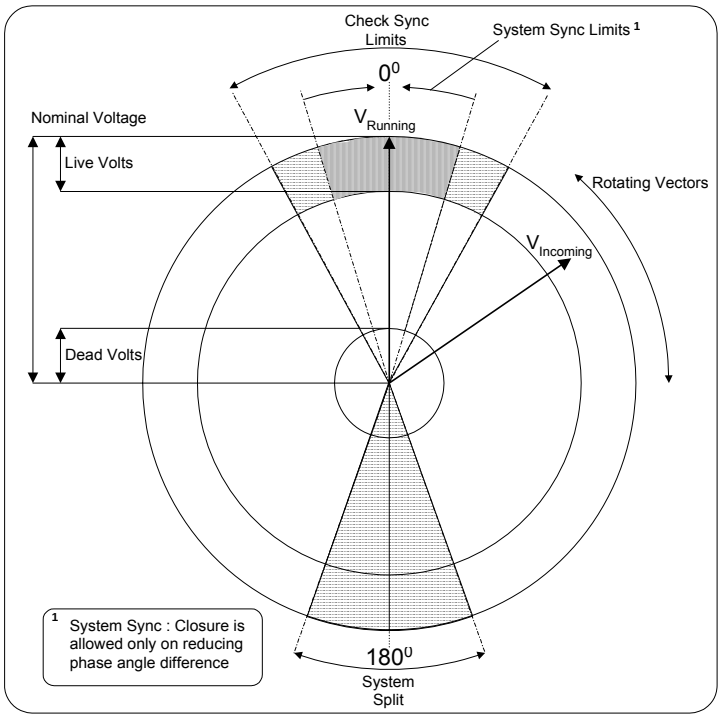
1. Introduction

Check Synchronising or System Synchronising is required whenever two parts of a power system network, each containing generation, have to be connected or re-connected together. To avoid shock loading and possible damage to primary electrical plant the voltage, frequency and phase angle difference between the two systems should be within acceptable limits relative to one another.

Where the two systems have been previously interconnected before a circuit breaker (CB) was opened then the frequencies of the two systems will drift apart slowly and the phase angle difference will increase. Relatively large voltage and phase angle differences can be allowed with this slow slip rate since closing the CB will merely re-configure the system to its previous state. The relay will detect these conditions and apply the Check Synchronising settings as limiting parameters.

However, if the two systems are asynchronous and one system is an 'island' of generation then a high rate of slip may result causing the two systems to pass through anti-phase conditions. The rate of slip between the frequencies of the two systems will be much higher and be outside of the Check Synchronising setting parameters. The relay will detect this system split condition, inhibit the Check Synchronising algorithms and automatically apply System Synchronising settings as limiting parameters. Typically, in this mode, there will be a narrower allowable phase angle difference and also closure of the CB will only be allowed under decreasing phase angle difference conditions.

Figure 1 - Check and System Synchronising



The Argus 7 series Check and System synchronising relay is 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, instrumentation and operational data.

The relay conforms to NGTS 3.7.7 and the relevant IEC255 standards.

2. Hardware Description

2.1 General

The Argus 7 series of relays are all housed in the Epsilon E4 size case. They consist of the following versions which differ only in their auxiliary and status supply voltages :

Relay Article No.	Nominal Aux. Volts	Status Volts
AG7-101	24/30/48VDC	48VDC
AG7-102	110/220VDC	48VDC
2732H30006	24/30/48VDC	30VDC

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 the Argus 7 relay measures two basic quantities, V_{Line} and V_{Bus}. The voltage transformer inputs are suitable for either phase to phase or phase to neutral connections and the input stage measures over the range of 1 Vrms to 200 Vrms. It maintains accuracy within ±1% over the range 5 Vrms to 132 Vrms.

In order to ensure high accuracy true RMS measurements and accurate phase and slip frequency 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

The Argus 7 relay has 7 output relays in total, which are rated for handling breaker control duty. All 7 relays are fully user configurable and can be programmed to operate from any or all of the control functions. They consist of 1 C/O contact, 1 N/C contact and 5 N/O contacts.

In their normal mode of operation output relays remain energised for at least 100ms. 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.

Note :- When output relays are required to perform control functions such as circuit breaker closing, care must be taken in applying relay settings to ensure that the outputs do not latch unless specifically required to do so.

2.4 Status Inputs

There are a total of 4 status inputs available in the relay. All status inputs are fully user programmable and have associated pick-up and drop-off timers. 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 or more of the following functions :

Start Check Synchronising.

Start System Synchronising.

Synchronising Bypass.

Inhibit Check or System synchronising.

Select an alternative settings group.

Trigger storage of a waveform record.

Synchronise the real time clock.

Reset the Lockout condition.

Reset latched output relays.

Energise an output relay.

Raise an Alarm annunciation.

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

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 voltage rails are also continuously supervised and the microprocessor is reset if any of the rails falls outside of their working ranges. Any failure is detected in sufficient time so that the micro can be shut down in a safe and controlled manner.

3. Control Functions

3.1 Voltage Monitoring Elements

3.1.1 Undervoltage Detector Elements

The undervoltage detector elements, if enabled, can block a close output command if either the line or bus voltages are below the undervoltage setting value. Both line and bus voltages have their own independent settings.

Note : if any of the input voltages falls below 5Vrms all synchronising algorithms are blocked and a close will not be possible. However, a bypass close will be possible in this situation, see section 3.1.4.

3.1.2 Differential Voltage Detector Element

The differential voltage detector element, if enabled, can block a close output command if the scalar difference between the line and bus voltages is greater than the differential voltage setting value.

3.1.3 Voltage Level Elements

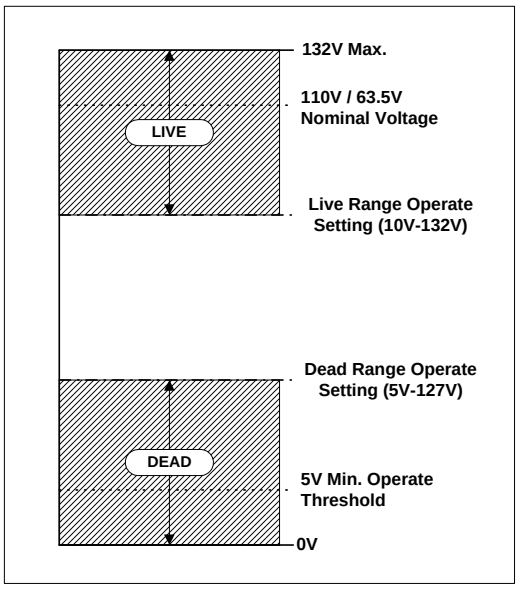
The voltage level elements determine the status of the line or bus. If the voltages on either the line or bus are below a set threshold level they can be considered to be ‘dead’. If the voltages are within a setting band around the nominal voltage they are classed as ‘live’. Independent voltage level elements are provided for both line and bus voltage inputs.

If a voltage is in the dead band range then it will be classed as dead until it has reached the live band area. Similarly, if a voltage is live, it continues to be live until it has reached the dead band area. This effectively allows for variable amounts of hysteresis to be set. Figure 2 illustrates the voltage detector operation.

Note : the area between the dead and live zones is not indeterminate. When any voltage is applied to the relay it will ramp up the software RMS algorithm and always pass through the dead zone first.

Although a wide range is provided for live and dead voltage level elements, these must not overlap. The relay software acts to prevent this from happening, this is to stop unusual alarm outputs and conflicts with internal logic elements. If the user attempts to increment the dead voltage level to the live voltage level, the relay will automatically increase the live voltage to be 5V above the dead voltage level. Similarly, if the live level is decremented to the dead level, the dead level will drop keeping a hysteresis gap of 5V. The two voltages are displayed simultaneously on the LCD display so that this operation is clear to the user.

Figure 2 - Voltage Level Element Operation



3.1.4 Sync Bypass Logic

For switching operations, which involve connecting an uncharged line or bus to a live line or live bus, a means of bypassing the synchronising operation is required. This is achieved using the Sync Bypass setting. The range of setting values for this are :

Dead Line AND Live Bus : (DL & LB)

Live Line AND Dead Bus : (LL & DB)

Dead Line AND Dead Bus : (DL & DB)

Dead Line OR Dead Bus : (DL or DB)

Dead Line Exclusive OR Dead Bus : (DL xor DB)

To bypass the synchronisation feature and issue a Bypass Close output the particular line and bus conditions have to be met and the Sync Bypass status input has to be energised. The Bypass Close output will stay on for the duration of the status input energisation and while the line and bus conditions are met.

Alarms outputs can be generated from these conditions and these are dead line (DL), dead bus (DB), DL&LB, LL&DB, and DL&DB.

3.1.5 Voltage Trim Feature

The relay incorporates a voltage trim feature, which allows small adjustments to the input voltages of the relay. For 110V nominal or 63.5V nominal connections, the relay in service may not see exactly the expected nominal voltages. This is due to losses from cable lengths and joints and also due to small inaccuracies in the voltage transformers (VT's). Sometimes, interposing VT's are used to trim the voltages seen by the relay back to their nominal values. This feature does away with the need for interposing VT's because the relay can digitally adjust the incoming samples by a scaling factor back to their expected nominal values.

Each voltage input, V_{Line} and V_{Bus}, has an independent voltage trim in the range of – 5.0V to + 5.0V with a step size of 0.1V.

Internally to the relay the voltage trim value will be turned into a multiplying factor derived from the Rated Voltage setting. Therefore on a 110V connected system with secondary losses making the system voltage e.g. 108V, a 2.0V trim could be applied. The relay will convert this to a multiplier of 110 / 108 = 1.0185 which will be applied to the sampled voltage data. An important point to note is that the accuracy of the trim feature is only guaranteed where the system voltages are either 110V or 63.5V because the internal multiplier is based on the rated voltage.

3.2 Check Synchronising (CS) Operation

For the relay to issue a Check Sync Close the following conditions have to be met :

CS PHASE ANGLE – the phase difference between the line and bus voltages has to be less than the phase angle setting value. Whilst within the limits the phase angle can be increasing or decreasing and the element will still issue a valid close signal.

CS SLIP TIMER, [If ENABLED] – the phase angle and voltage blocking features have to be within their parameters for the duration of the slip timer setting. If either the phase angle or the voltage elements fall outside of their limits the slip timer is reset. If they subsequently come back in then the slip timer has to time out before a close output is given. (This ensures that a close output will not be given if there is a transient disturbance on the system due to e.g. some remote switching operations).

CS SLIP FREQUENCY, [If ENABLED] – the frequency difference between line and bus voltages has to be less than the slip frequency setting value.

LINE U/V DETECTOR, [If ENABLED] – the line voltage has to be above the line undervoltage setting value and also above 5V for an output to be given.

BUS U/V DETECTOR, [If ENABLED] – the bus voltage has to be above the bus undervoltage setting value and also above 5V for an output to be given.

DIFFERENTIAL VOLTAGE DETECTOR, [If ENABLED] – the scalar difference between the line and bus voltages has to be less than the □V detector setting value for an output to be given.

The Check Synchronising operation of the relay can be initiated in two different ways.

This is set by the 'Check Sync Enable' setting which has two parameters : **AUTO** and **MANUAL**.

AUTO : The relay will issue a Check Sync Close output automatically if the relevant conditions mentioned above are met.

MANUAL : The relay will only issue a Check Sync Close output if the relevant conditions are met AND if it has received a command to do so. This command is issued via the Start Check Sync status input. (See also section 3.2.1 Close Guard Feature).

Note : the Check Sync Close output relay will stay on for a minimum time of 100ms and for the whole duration of the time that the system parameters are met.

Figure 3 illustrates the Check Sync Function logic.

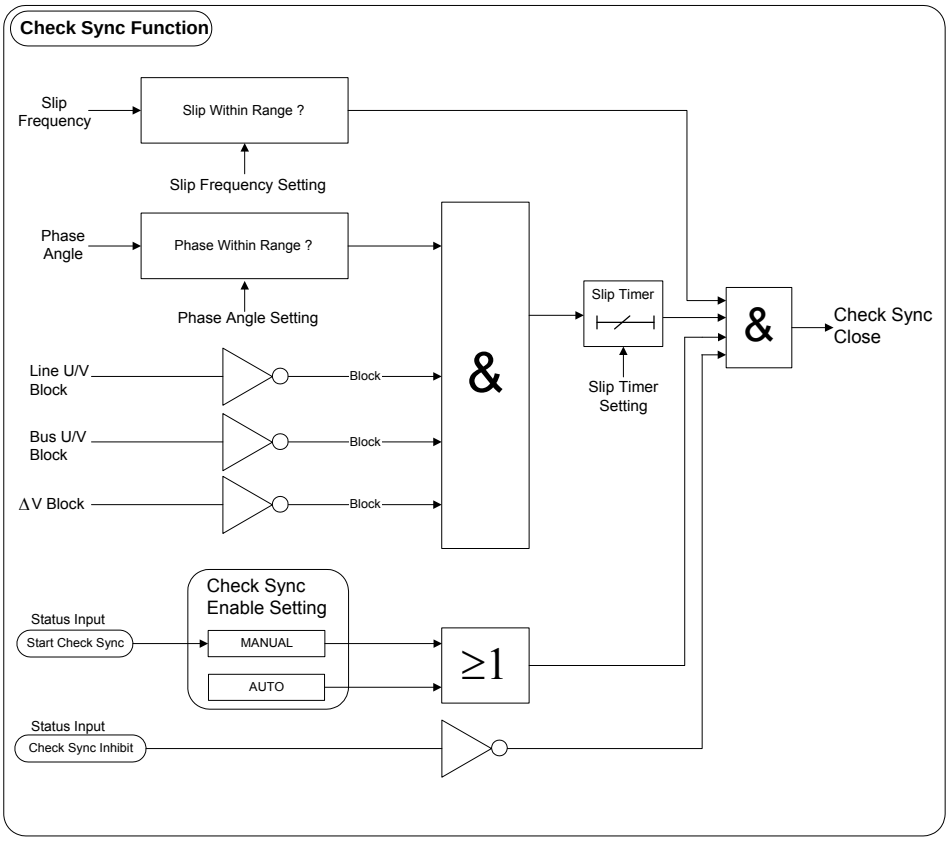


Figure 3 - Check Sync Function

3.2.1 Close Guard Feature

If manual closes are required to be carried out via an operator, the ‘Close Guard’ feature can be enabled which prevents the operator from initiating a CB close before the relay issues a valid Check Sync Close signal. This prevents the operator from pre-empting the relays’ decision. When active and the operator is trying to pre-empt the relay the LCD will display the following message :

General Alarms **Close Guard Acti**

(The bottom line of the General Alarm screen will continuously scroll sideways with the message ‘Close Guard Active’.)

To enable the feature the Close Guard setting has to be set to ON. This setting is found in the Check Sync menu. When the Start Check Sync status input is then energised the close guard feature will be active and a Check Sync Close output will not be given unless all of the relay setting parameters are met by the system.

3.3 System Split Detector

A system split occurs where the opening of a CB disconnects two separate sections of a grid network. Since the two grid sources are not coupled the frequencies can drift apart even though the independent control systems employ the same reference frequency. A small drift in frequency can lead to a major phase angle difference. The system

split detector operates when the phase angle difference exceeds a pre-set value. The setting range for a system split is from 90° to 175° (setting step is 1°).

Note : the system split setting is effectively an absolute value and therefore a split will occur at the value regardless of the direction of the frequency slip e.g. if an angle of 170° is selected, then starting from 0°, a split will occur at either +170° or -170° (effectively +190°).

The system split detector has an associated timer, the Split Timer which holds the system split output on for a minimum time set by the timer setting value. This can be used when interfacing with delayed autoreclose (DAR) schemes.

If a system split occurs during a Check Sync operation and the System Split Detector has been enabled then the following events occur :

The Check Sync function is inhibited.

The System Sync function is started if the setting has been set to AUTO. If the System Sync function has been set to LOCKOUT, then, only a system split LED indication is given and the relay will be in lockout mode. The relay will stay in this lockout mode until one of the following methods of resetting it is performed:

1) The AC voltage supplies are removed and re-applied.

2) The Test/Reset button is pressed on the relay fascia.

3) A status input command is received.

4) An appropriate IEC870-5-103 communications command is received.

An event is recorded.

The split flag can be mapped to an output relay for alarm indication.

The system split LED will stay on for the split timer delay time.

3.4 System Synchronising (SS) Operation

For the relay to issue a System Sync Close the following conditions have to be met :

SS PHASE ANGLE – the phase difference between the line and bus voltages has to be less than the phase angle setting value and the phase angle has to be decreasing before the element will issue a valid close signal.

SS SLIP TIMER, [If ENABLED] – the phase angle and voltage blocking features have to be within their parameters for the duration of the slip timer setting. If either the phase angle or the voltage elements fall outside of their limits the slip timer is reset. If they subsequently come back in then the slip timer has to time out before a close output is given. (This ensures that a close output will not be given if there is a transient disturbance on the system due to e.g. some remote switching operations).

SS SLIP FREQUENCY, [If ENABLED] – the frequency difference between line and bus has to be less than the slip frequency setting value.

LINE U/V DETECTOR, [If ENABLED] – the line voltage has to be above the line undervoltage setting value and also above 5V for an output to be given.

BUS U/V DETECTOR, [If ENABLED] – the bus voltage has to be above the line undervoltage setting value and also above 5V for an output to be given.

DIFFERENTIAL VOLTAGE DETECTOR, [If ENABLED] – the scalar difference between the line and bus voltages has to be less than the □V detector setting value for an output to be given.

The System Synchronising operation of the relay can be initiated in two different ways.

This is set by the ‘System Sync Enable’ setting which has three parameters : **AUTO**, **MANUAL** and **LOCKOUT**.

AUTO : The relay will only start system synchronising after a split condition has occurred. It will issue a System Sync Close automatically if the relevant conditions are met.

MANUAL : The relay will only start system synchronising after a split condition has occurred. It will only issue a System Sync Close output when it has received a command to do so. This command can be issued via the Start System Sync status input or it can come via the communications interface.

(An ASDU20 general command can be used to start the System Sync function. This can be sent using REYDISP EVOLUTION [1] or via any communications network with IEC870-5-103 driver capability. For more information see [2]).

LOCKOUT : After a split has occurred the relay will go into lockout mode.(See section 3.3)

Note : the System Sync function has a close pulse timer, which is set by the SS Close Pulse setting. The System Sync Close output will be given for a minimum of 100ms or for the duration of the SS Close Pulse setting.

Figure 4 overleaf illustrates the System Sync Function logic.

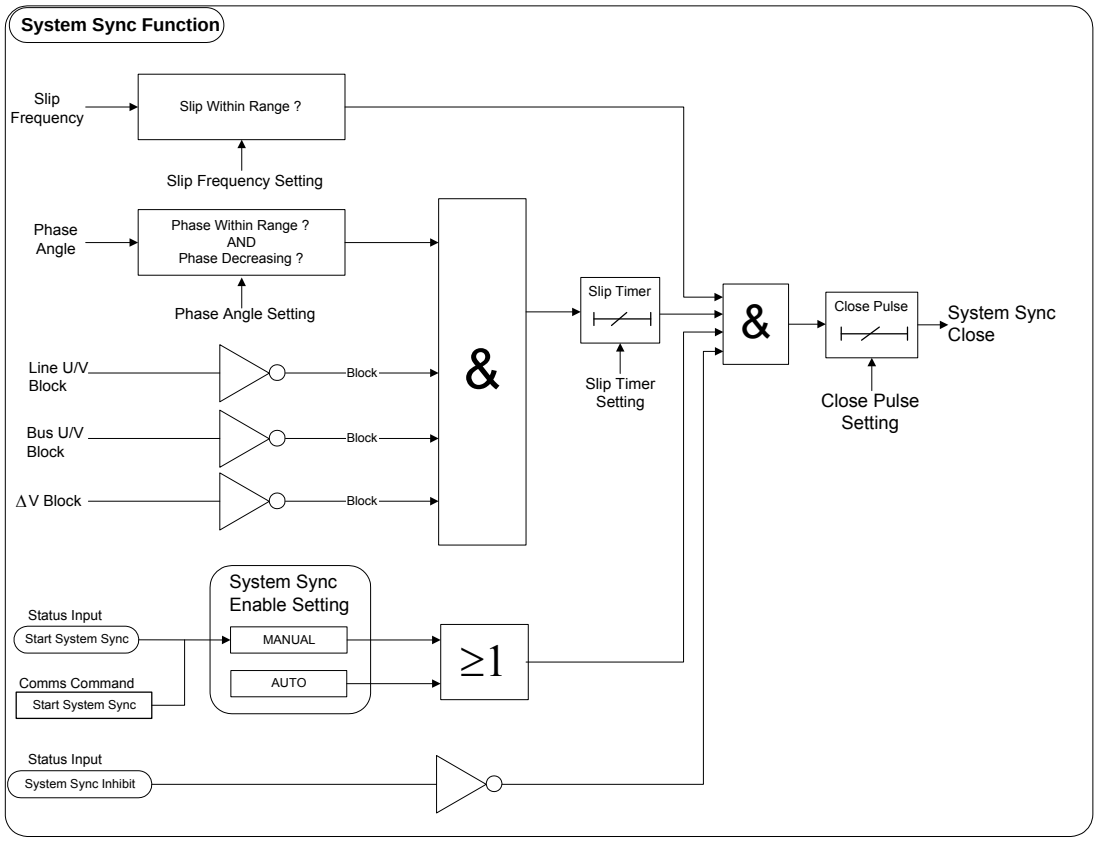


Figure 4 - System Sync Function

4. Other Features

4.1 Instrumentation

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 both Line and Bus

Secondary RMS volts for both Line and Bus

Frequency of both Line and Bus

Phase difference between Line and Bus

Frequency slip between Line and Bus

Phase - In / Out of limits

Slip - In / Out of limits

Line and Bus health status i.e. Live or Dead

Voltage blocking element status

Output relay status

Digital input status

General alarm screen

Number of waveforms recorded

Number of events stored

Date - displayed in DD/MM/YY format

Time - displayed in HH:MM:SS format

Relay Mode :- This is a special instrument which shows the mode of operation of the relay and its particular state in a single display. This shows if the relay has been set as a Check synchroniser or as both a Check and System synchroniser. It also shows, in real-time, the health of the line and bus volts and the particular operational state i.e. whether it is check synchronising, system synchronising or in bypass or system split modes.

Note : while the instrument displays are updated as often the software routines can service them, some have their response time deliberately slowed down to enable them to be read. The first four displays in the list, which show the analogue measurands have a response time of approximately 500ms.

Figure 5 shows the display menu structure from where the available instruments can be accessed. Note that pressing the Test/Reset key can clear two of the instruments, waveforms and events.

4.2 Data Storage

Details of relay operation are recorded in three forms, namely Waveform records, Event records and Close 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]. 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, however, 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 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. A single phase waveform record for both the line and bus voltages can be stored and this shows the voltages at either side of the circuit breaker at the moment of closing of the switch. The waveform record is 1.5 second wide (1.25sec at 60Hz) with a sampling resolution of 16 samples per cycle. The recorder feature has the ability to store records for the previous five close 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.

If the synchronising mode is set to AUTO then on issuing a Check or System synchronising close output.

If the synchronising mode is set to MANUAL, then on receipt of a Start Check Sync command signal, the relay will trigger the waveform recorder when it issues a Check Sync Close output signal. (Note: if the Close Guard feature is operating and blocking the close output then a waveform record will not be triggered).

If the synchronising mode is set to MANUAL, then on receipt of a Start System Sync command signal, the relay will trigger the waveform recorder when it issues a System Sync Close output signal. (Note: the Close Guard feature is not available for system synchronising operations).

If Sync Bypass is enabled, then, the relay will trigger the waveform recorder when it issues a Bypass Close output signal.

4.2.1 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 control functions of the relay.

Change of state of any of the voltage elements.

For a full list of all the events available see Table 1.

4.2.2 Close Data Records

The relay has a ‘Close Data Mode’ display which provides information about a close decision that the relay has made. The information stored includes the date and time, the setting group used, the type of closure, the phase and slip measurands and the line and bus voltages and frequency information at the time of the close decision. There are 10 close data records stored in a cyclical buffer labelled 1-10 with record 1 being the newest. Whenever the relay issues any type of close e.g. check sync, system sync or bypass close, a record of its decision is stored off. To examine the close data records navigate the menu to the Close Data Mode and press the □ arrow (See Figure 5 - Display Menu Structure). A scrolling message with the following typical information will then be displayed :-

CLOSE 1 01/01/00 00:02:09.5750 G1, SS CLOSE, PHASE= +2.3º, SLIP= -0.03Hz, BUS= 109.5V 50.01Hz, LINE= 110.7V 49.98Hz.

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

Close Data Records

Instrument and meters

Control Functions

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

4.4 Default Displays and General Alarms

Any one or more of the Argus 7 instrument displays can be selected as a default display by pressing the ENTER key while viewing the particular display. When a display has been selected it shows a block '□' on the top line of the LCD. To de-select simply press ENTER again which toggles it between on and off.

Vline = 110.0V □
Vbus = 110.0V

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 the relay settings Section 3 of this manual.

Argus 7 provides a General Alarm screen which can place user-defined messages of upto 13 characters in length onto the LCD. Alarms are triggered when a status input is energised and the display will jump to the general alarm screen automatically and display the message. The message appears on the LCD for the duration of the time that the status input is energised. The Argus 7 has 4 status inputs and so can have 4 different alarms to display. If more than one status input is energised then the alarm screen will scroll with the messages separated by a '+' sign.

General Alarms
<< Alarm1 + Al<<

To set up a general alarm requires the LCD message to be entered. This is input with the Set Alarm settings found in the System Config menu. Each general alarm screen has to then be assigned to a status input and this is done with the Alarm settings in the Status Config menu.

4.5 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 cater for reconfiguration of the power system. Changeover will occur within 25 ms.

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.

4.6 Password Feature

The programmable password feature enables the user to enter a 4 character alpha-numeric 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.

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. Figure 6 shows the Argus 7 fascia.

5.1 Liquid Crystal Display

The liquid crystal display is used to present settings, instrumentation and close 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. This is so that instruments such as voltages 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 off, any following key press will turn the backlight on without changing the display.

5.2 LED Indications

The following indications are provided :

Relay Healthy – Green LED.

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.

Check / System Sync – Yellow LED.

This indicates that a Check Sync or System Sync output is being issued.

System Split – Red LED

This LED indicates when a system split occurs, i.e. whenever the phase angles are within the system split limits. If the system split timer is set to 0 seconds, then the LED will reset as soon as the phases fall outside of the system split limits. Otherwise the LED will stay on for the system split timer setting time and reset after this.

If the relay has been set up as a Check synchroniser only and not Check and System synchroniser then, if a system split occurs, the system split LED will remain on until the Test/Reset button is pressed, or, the voltage supplies are removed and re-applied.

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.

6. Settings and Displays

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 Close Data Mode.

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

ARGUS 7 **Factory Settings**

which shows that the relay has been set with the standard factory default settings. The bottom 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 8 setting sub-menu's. 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 employed 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.

The next sections give a description of each setting in the relay. The actual setting ranges and default values can be found in the Relay Settings section of this manual.

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 and if a function is not enabled then associated settings are not displayed e.g. if there is no requirement for sync bypass then the setting Gn Sync Bypass should be set to OFF. This automatically removes the Gn Bypass Close option from the Output Relay Config. Menu because it is not required. Another example is the System Split Detector. If this is set to OFF then the System Split Timer is not displayed as it is not required.

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 following list of settings shows all possible settings that can be displayed.

6.1 System Config Menu

Active Setting Group – this setting selects the settings group that the relay will act upon.

Settings Group Edit/View – this setting selects the settings group to be displayed on the LCD.

Copy Group – this setting 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.

Power System Frequency – this setting selects between 50Hz or 60Hz nominal system frequencies.

Rated Voltage – this setting sets the rated voltage of the relay, either 63.5V or 110V.

Line Voltage Trim – this setting adjusts the incoming line voltage samples to compensate for losses.

Bus Voltage Trim – this setting adjusts the incoming bus voltage samples to compensate for losses.

V.T. Ratio – this setting sets the VT ratio, which allows the relay to calculate the primary voltage quantities displayed in the instruments mode.

Set Identifier – this setting allows a 16 character alphanumeric code or unique identification reference to be entered for the relay.

Set Alarm 1 – this setting allows a 13 character alphanumeric string to be entered for the General Alarm screen. It will be displayed on the energisation of the ALARM 1 status input.

Set Alarm 2 – this setting allows a 13 character alphanumeric string to be entered for the General Alarm screen. It will be displayed on the energisation of the ALARM 2 status input.

Set Alarm 3 – this setting allows a 13 character alphanumeric string to be entered for the General Alarm screen. It will be displayed on the energisation of the ALARM 3 status input.

Set Alarm 4 – this setting allows a 13 character alphanumeric string to be entered for the General Alarm screen. It will be displayed on the energisation of the ALARM 4 status input.

Calendar – Set Date – this setting sets the current date in DD/MM/YY format.

Clock – Set Time – this setting sets the time in HH:MM:SS format. Note that only the hours and minutes can be set. The seconds default to zero on pressing the ENTER key.

Clock Sync. From Status – this setting 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.

Default Screen Timer – this setting sets the time required to have elapsed before the LCD jumps to the default instruments display.

Change Password – this setting 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 LCD.

6.2 Voltage Setting Menu

Gn DeadL : LiveL – this setting sets the Line input dead and live voltage limits.

Gn DeadB : LiveB – this setting sets the Bus input dead and live voltage limits.

Gn Line U/V Detector – this setting sets the Line undervoltage blocking element level.

Gn Bus U/V Detector – this setting sets the Bus undervoltage blocking element level.

Gn Voltage Detector – this setting sets the differential voltage blocking element level.

Gn Sync Bypass – this setting sets the synchronisation bypass logic.

6.3 Check Sync Menu

Gn Check Sync Enable – this setting sets the mode of operation of the Check Sync. element.

Gn CS Phase Angle – this setting sets the phase angle limits for the Check Sync. element.

Gn CS Slip Timer – this setting sets the Check Sync. slip timer delay time.

Gn CS Slip Freq. – this setting sets the Check Sync. slip frequency limit.

Gn System Split Detector – this setting sets the angle at which a system split will occur.

Gn System Split Timer – this setting sets the system split timer delay time. This holds the split flag on for the set value.

Gn Close Guard – this setting enables the close guard logic feature.

6.4 System Sync Menu

Gn System Sync Enable – this setting sets the mode of operation of the System Sync. element.

Gn SS Phase Angle – this setting sets the phase angle limits for the System Sync. element.

Gn SS Slip Timer – this setting sets the System Sync. slip timer delay time.

Gn SS Slip Freq. – this setting sets the System Sync. slip frequency limit.

Gn SS Close Pulse. – this setting sets the time that the System Sync. Close output relay will stay energised for.

6.5 Output Relay Config Menu

Gn Relay Healthy – this setting sets the output relay operated by the relay watchdog monitor. An output relay with a changeover or normally closed contact should be used for this function.

Gn Check Sync Close – this setting sets the output relay(s) which is operated when a check synchronising close output is given.

Gn System Sync Close – this setting sets the output relay(s) which is operated when a system synchronising close output is given.

Gn Bypass Close – this setting sets the output relay(s) which is operated when a bypass synchronising close output is given.

Gn System Split – this setting sets the output relay(s) which is operated when a system split output is given.

Gn U/V Line – this setting sets the output relay(s) which is operated when the Line undervoltage blocking element operates.

Gn U/V Bus – this setting sets the output relay(s) which is operated when the Bus undervoltage blocking element operates.

Gn Voltage – this setting sets the output relay(s) which is operated when the differential voltage blocking element operates.

Gn Live Line (LL) – this setting sets the output relay(s) which is operated when the Line voltage reaches the live range limits.

Gn Live Bus (LB) – this setting sets the output relay(s) which is operated when the Bus voltage reaches the live range limits.

Gn Dead Line (DL) – this setting sets the output relay(s) which is operated when the Line voltage reaches the dead range limits.

Gn Dead Bus (DB) – this setting sets the output relay(s) which is operated when the Bus voltage reaches the dead range limits.

Gn DLLB – this setting sets the output relay(s) which is operated when the Line voltage reaches the dead range limits AND the Bus voltage reaches the live range limits.

Gn LLDB – this setting sets the output relay(s) which is operated when the Line voltage reaches the live range limits AND the Bus voltage reaches the dead range limits.

Gn DLDB – this setting sets the output relay(s) which is operated when the Line voltage reaches the dead range limits AND the Bus voltage reaches the dead range limits.

Gn Status 1 – this setting sets the output relay(s) which is operated when status input 1 is energised.

Gn Status 2 – this setting sets the output relay(s) which is operated when status input 2 is energised.

Gn Status 3 – this setting sets the output relay(s) which is operated when status input 3 is energised.

Gn Status 4 – this setting sets the output relay(s) which is operated when status input 4 is energised.

Gn Hand Reset – this setting sets the output relay(s) which is to be latched on operation.

O/P Relay Test – this setting allows any combination of output relays to be energised. This is achieved by selecting one of the output settings defined in the above list. The software will energise the particular control function e.g. U/V Line and energise it's associated output relay for 100ms.

6.6 Status Config Menu

Settings Group Select – this setting sets the status input, required to be energised, to enable a particular 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 of the rest.

Inverted Inputs – this setting sets the status input(s) which are required to have their operating logic inverted.

Gn Start Check Sync – this setting sets the status input(s) which, when energised, starts the check synchronising operation of the relay.

Gn Start System Sync – this setting sets the status input(s) which, when energised, starts the system synchronising operation of the relay.

Gn Sync Bypass – this setting sets the status input(s) which, when energised, bypasses the synchronisation operation.

Gn Check Sync Inhibit – this setting sets the status input(s) which, when energised, will inhibit the check synchronising close operation.

Gn System Sync Inhibit – this setting sets the status input(s) which, when energised, will inhibit the system synchronising close operation.

Gn ALARM 1 – this setting sets the status input which, when energised, causes the Alarm 1 character string to be displayed on the general alarm screen.

Gn ALARM 2 – this setting sets the status input which, when energised, causes the Alarm 2 character string to be displayed on the general alarm screen.

Gn ALARM 3 – this setting sets the status input which, when energised, causes the Alarm 3 character string to be displayed on the general alarm screen.

Gn ALARM 4 – this setting sets the status input which, when energised, causes the Alarm 4 character string to be displayed on the general alarm screen.

Gn Waveform Trig – this setting sets status input which, when energised, triggers a waveform record storage.

Gn Clock Sync. – this setting sets status input which, when energised, will synchronise the clock to either the nearest second or minute.

Gn Reset Lockout Mode – this setting sets status input which, when energised, will reset the relay lockout condition.

Gn Reset Outputs – this setting sets status input which, when energised, will reset all latched output relays.

Gn Status 1 P/U Delay – this setting sets the time delay to be applied to the pick-up of status input 1.

Gn Status 1 D/O Delay – this setting sets the time delay to be applied to the drop-off of status input 1.

Gn Status 2 P/U Delay – this setting sets the time delay to be applied to the pick-up of status input 2.

Gn Status 2 D/O Delay – this setting sets the time delay to be applied to the drop-off of status input 2.

Gn Status 3 P/U Delay – this setting sets the time delay to be applied to the pick-up of status input 3.

Gn Status 3 D/O Delay – this setting sets the time delay to be applied to the drop-off of status input 3.

Gn Status 4 P/U Delay – this setting sets the time delay to be applied to the pick-up of status input 4.

Gn Status 4 D/O Delay – this setting sets the time delay to be applied to the drop-off of status input 4.

6.7 Comms Interface Menu

Comms Baud Rate – this setting sets the required communications Baud rate.

Comms Parity – this setting sets the required communications parity bit.

Relay Address – this setting sets the required address of a particular relay within a network.

Line Idle – this setting sets the required communications line idle sense.

Data Echo – this setting enables data echo, which is necessary for use with relays connected in a ring.

6.8 Data Storage Menu

Gn Waveform Trig – this setting selects the control functions which trigger the storage of a waveform record.

Gn Waveform Pre-Trigger – this setting sets the percentage of pre-trigger that is required.

Clear All Waveforms – this setting clears all waveform records stored. Note that this can also be done at the instruments display. (see Figure 5).

Clear All Events – this setting clears all event records stored. Note that this can also be done at the instruments display. (see Figure 5).

Clear Close Data – this setting clears all close data records stored.

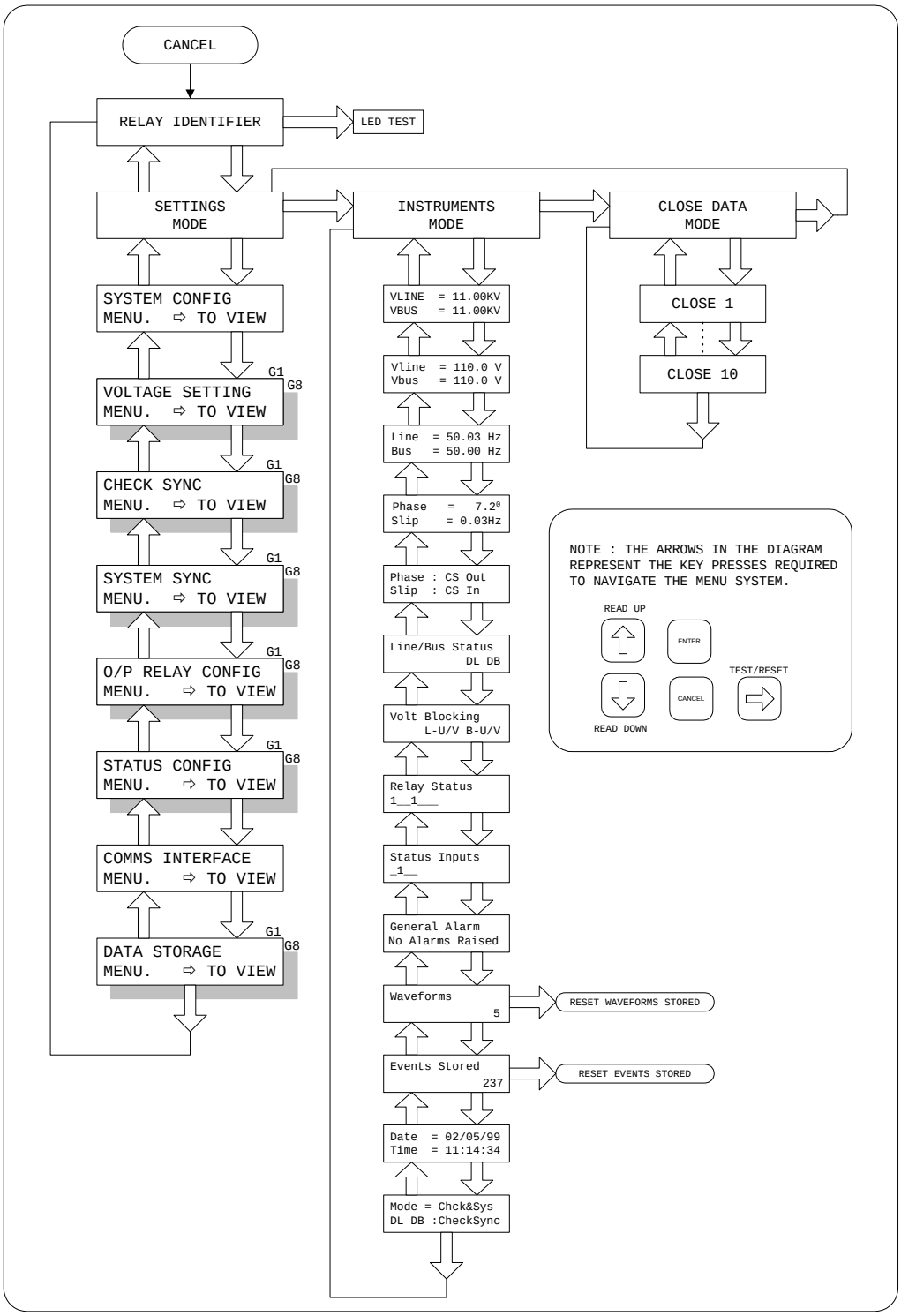
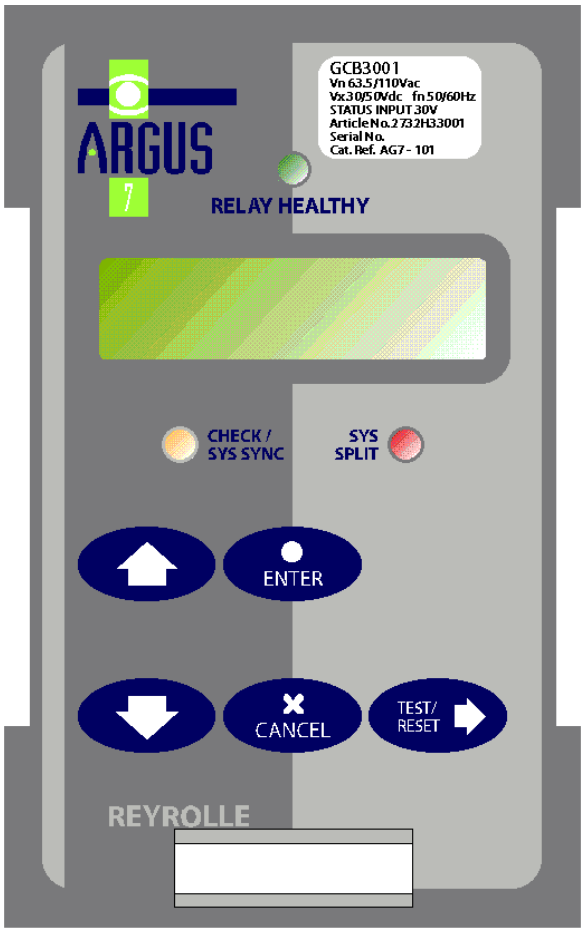


Figure 5 - Display Menu Structure

Figure 6 - Argus 7 Relay Fascia



Event Description	Event Code	GI	Frame Type
Data lost	0	6	1
Reset FCB	2	6	5
Reset CU	3	6	5
Start/Restart	4	6	5
Power On	5	6	5
Setting G1 selected	23	4	1
Setting G2 selected	24	4	1
Setting G3 selected	25	4	1
Setting G4 selected	26	4	1
Setting G5 selected	35	4	1
Setting G6 selected	36	4	1
Setting G7 selected	37	4	1
Setting G8 selected	38	4	1
LEDs reset	19	6	1
Trip Test	21	6	1
Settings changed	22	6	1
Input 1	27	4	1
Input 2	28	4	1
Input 3	29	4	1
Input 4	30	4	1
Output 1	51	4	1
Output 2	52	4	1
Output 3	53	4	1
Output 4	54	4	1
Output 5	55	4	1
Output 6	56	4	1
Output 7	57	4	1
Waveform stored	80	4	1
Remote control interrupted	81	6	1
Lockout	83	4	1
Reset Lockout Mode	84	6	1

Event Description	Event Code	GI	Frame Type
Check Sync Start	90	4	1
System Sync Start	91	4	1
Check Sync Inhibit	92	4	1
System Sync Inhibit	93	4	1
Sync Bypass	94	4	1
Check Sync Close	96	4	1
System Sync Close	97	4	1
Bypass Close	98	4	1
Slip In Sync	99	4	1
Phase In Sync	100	4	1
Live Line	101	4	1
Live Bus	102	4	1
Bus U/V Detector	103	4	1
Line U/V Detector	104	4	1
Volts Differential	105	4	1
System Split	106	4	1
Alarm 1	121	4	1
Alarm 2	122	4	1
Alarm 3	123	4	1
Alarm 4	124	4	1

KEY :

Event Code – is the allocated number given to a particular event.

GI – If the relay is interrogated for its events using the general interrogation (GI) command then only those indicated with the 4 will respond.

Frame Type – a ‘1’ indicates that the event is time tagged. A ‘5’ indicates an event which is generated only on power-on or reset of the relay.

Table 1 - Argus 7 Event Codes