



BRAMCO ELECTRONICS

**ICMS (CCMS)
USERS MANUAL**

**Integrated Control
Management System
for Conveyors**

17/11/2008

Preface

This document has been prepared as a functional description of the Integrated Control Management System which is manufactured by Bramco Electronics. The material contained within this document refers to firmware releases of v4.84 and higher. Bramco Electronics are continually updating the functionality of the software as well as introducing new devices which can be placed on the Brambus network. As such, this document should have a limited lifetime. As further software and hardware releases become available this document will also be updated and made available to our customers.

ICMS/SLC Dual mode operation,

Signal Line Conveyor Control System, Failsafe, Redundant dual mode operation, with dual Sequence B and also multiple other sequence channels, Dual PSW Trigger, PSW Fault Monitoring, Mixed PSW Modules or Amplifiers as required, Battery Charge Control, Mixture of Analogue and Digital Nodes, Voice Comms along the conveyor, Monitoring of Lanyard and other Trip and Warn channel inputs, Identification of all Trips and Warnings on the System, Remote Starter Isolation with from any Lanyard with no PLC required, Serial RS485 port using Modbus ASCII for comprehensive monitoring from PLC or PC, and other features too numerous to cover here.

A total of 6 cores, all integrated into a single pull cable.

ICMS RS485 Data monitoring system.

Stand alone monitoring and control system. Without the SLC and Voice comms features of above. 2 cores for pier to pier, or 4 cores if BramBus powered,

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Abbreviations

Brambus	Bramco Electronics RS485 Network/Protocol
EOL	End of Line Unit
ICMS	Integrated Control Management System
NC	Normally Closed Relay Contact
NO	Normally Opened Relay Contact
PLC	Programmable Logic Controller
PreSeq	PreSequence
PSW	PreStart Warning
SeqB	Sequence B
SeqC	Sequence C
SeqD	Sequence D
SLC	Signal Line Control

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2. Overview

2.1. Introduction

The Integrated Control Management System (ICMS) is a microprocessor controlled system which can be used to either control or monitor the status of conveyor belts. This is achieved by a network of devices which communicate serially via an RS485 network. The protocol used on this RS485 network is referred to as the Brambus protocol. Up to two hundred and fifty one nodes can be connected on the Brambus network. All nodes on the Brambus network are powered by a single power supply which forms part of the ICMS Control Module.

A Basic ICMS system is shown below in figure 1.1.1. This Basic ICMS System consists of the following components:

1. ICMS Control Module,
2. ICMS Local LCD Display,
3. ICMS Barrier, and
4. ICMS End of Line node.

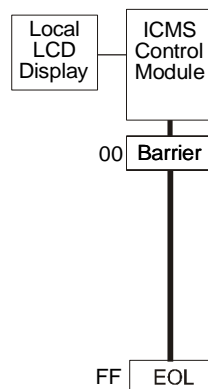


Figure 1.1.1 Basic ICMS System

The basic ICMS System shown in figure 1.1.1 has two nodes on the Brambus network. The first of these nodes is an intrinsically safe barrier. This intrinsically safe barrier has two main tasks, protecting the ICMS Control Module from any problems in the hazardous zone and limiting the power flowing into the hazardous zone. The second node on the basic ICMS system is an End of Line node. This node terminates the Brambus network. If an End of Line node is not detected then the ICMS Control Module assumes that the network is not intact and will therefore not allow the conveyor to start.

By adding nodes with the required functionality to this basic ICMS System, a system can be configured to suit the intended application. A wide variety of nodes are available. These are capable of monitoring the status of both Digital and Analogue signals. The nodes currently available are detailed in Section 6.2 of this document.

2.2. Installation Issues

2.2.1. Data Repeaters

The distance the Brambus signals can be transmitted is determined by the inductance and capacitance of the cable interconnecting the nodes. When the cable length exceeds eight hundred meters the cables inductance and capacitance distorts the data waveforms and causes data communication errors. To overcome this physical limitation a Data Repeater must be installed after every eight hundred meters. The Data Repeater takes the distorted waveform and generates a “cleaner” waveform which can then be transmitted a further eight hundred meters. Figure 1.2.1.1 illustrates this concept for DA, DA is one of the data signals on the Brambus.

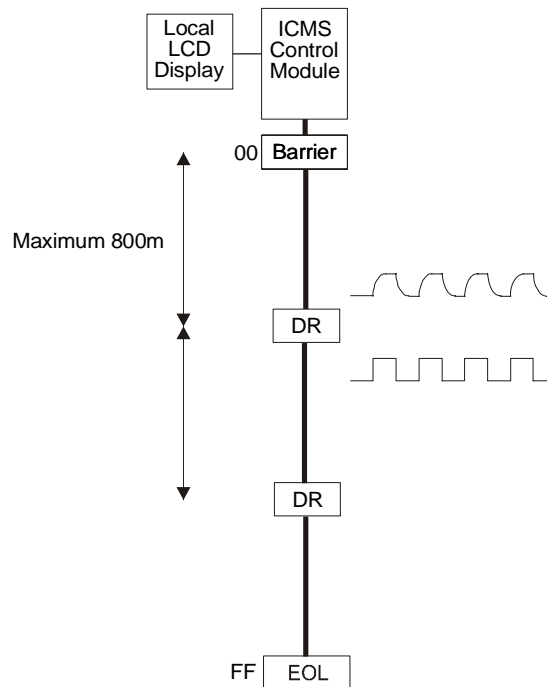


Figure 1.2.1.1 Installation of Data Repeaters

NB. the distance quoted above, eight hundred meters, assumes that Bramco’s yellow pull wire cable, is used. This cable has two 3.2mm² conductors for the power (B+ and B-) and 2 pairs of two 0.75mm² conductors, one pair for the data (DA and DB), the other pair for the SLC and Audio functions.

A data repeater is integrated into the Multi nodes used in the BK400 series of pullkeys.

3. ICMS Control Module

The ICMS System is a distributed I/O system and as such consists of many modules. The main module is referred to as the ICMS Control Module. The ICMS Control Module contains the microprocessor card along with an optically isolated digital I/O card and two power supplies. The power supplies generate the voltages required to power the ICMS Control Module's circuitry as well as that of the external network nodes.

A local LCD display is usually connected to the ICMS Control Module. This allows operating parameters to be set locally as well as displaying the status of the system.

To ensure that the Brambus network is intact an End of Line (EOL) node is required to terminate the Brambus network. This End of Line node is an intelligent device and has a hard wired node address of two hundred and fifty five (255_{10} or FF_{16}). As well as terminating the Brambus network the End Of Line node also returns operational parameters to the ICMS Control Module. This allows the ICMS Control Module to monitor the status of external parameters, such as the bus voltage at the End Of Line node. The ICMS Control Module can then generate warnings whenever it considers that the integrity of the data it is gathering may have been compromised.

On power up the ICMS Control Module must determine the configuration of the nodes on the Brambus network. Two hundred and fifty one (251) nodes can be present on the Brambus network so the ICMS Control Module must poll each of these addresses and wait for a response.. This is referred to as the Initialisation phase of the ICMS Control Module. If a response is received from a node during the Initialisation phase then the address and type of that node is recorded in the ICMS Map. Therefore, the configuration of the entire Brambus network will be recorded in the ICMS Map when the Initialisation phase has been completed. (the addresses 0xFA thru 0xFE may not be used)

The last node polled during Initialisation (FF_{16}) is always the End of Line node. If this node is not found then the ICMS Control Module will display the message "*WARNING EOL not Found*" for approximately five seconds before it again attempts to find the End of Line node. The ICMS Control Module will remain in the Initialisation phase until it finds an End of Line node.

Whilst the ICMS Control Module is initialising the *Main Menu* may be accessed by pressing the *Exit* pushbutton. From the *Main Menu* all diagnostic functions available on the ICMS are accessible. Should the ICMS Control Module be unable to find an End of Line node the diagnostic functions may be used to help determine the problem. The diagnostic functions that would be most useful in this situation would be the *Line Parameters* and *ICMS Map*. This allows the operator to view the Brambus voltages and currents as well as viewing the nodes that have been detected.

Also, during initialisation if an output node is detected and the preconditions for that output to be energised are met then that output will be energised. For example, if the ICMS Control Module detects that the SeqB input is On and a SeqB node is detected then the ICMS Control Module will instruct the SeqB node to energise its output. This feature is also available for the following output nodes:

- (iii) Sequence B node,
- (iv) Sequence C node,
- (v) Sequence D node,

When all nodes have been polled and an End of Line node has been found the ICMS Control Module then compares that map with a map of the previous network configuration which has been stored in non-volatile memory. If these maps are the same then the ICMS exits the initialisation phase of its operation and begins to monitor the status of network nodes. If the maps are not identical the course of action taken depends upon the selected ReConfiguration Mode. ReConfiguration Mode and the courses of actions taken are described in full in the next Section of this document.

When the ICMS Control Module has verified that the map is valid it will then continually poll all the detected nodes. The data returned from the nodes is used to determine the status of the DR relay's. There are three DR relays,

- (i) DR1, Motor Control relay,
- (ii) DR2, Isolate (request) relay, and
- (iii) DR3, Trip relay.

The functionality of these relays are discussed in the ICMS Control Relay section of this document.

The ICMS Control Module is shown below in Figure 2.1.

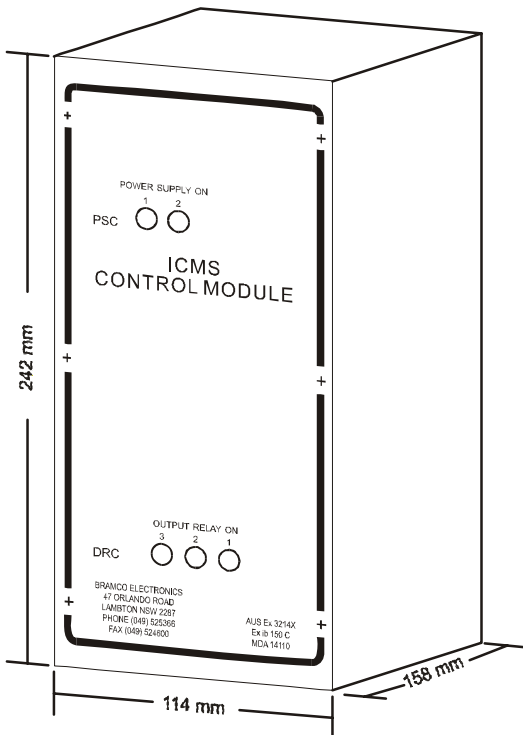


Figure 2.1 ICMS Control Module

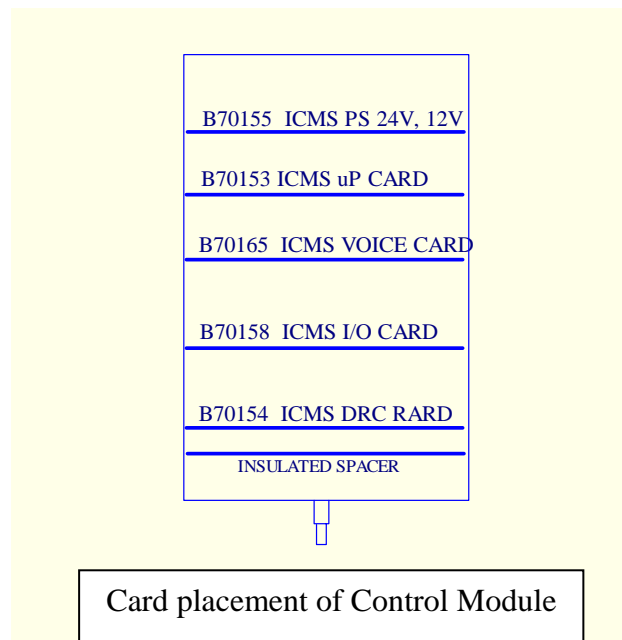


Figure 2.2 ICMS Control Module Card Locations

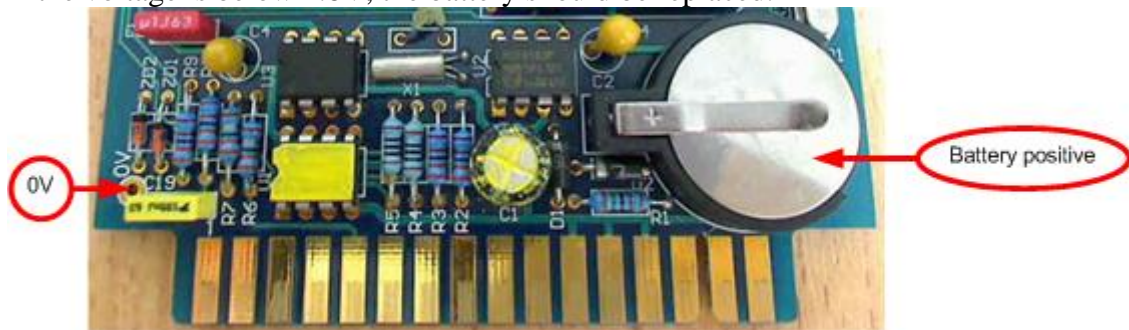
3.1. uP (CPU) Card

- **Battery life**

<i>Operational conditions</i>	<i>Replace battery after this period</i>
ICMS is powered for 90% of the time	5 years
ICMS is not powered. (spare CPU card included)	2 years

To evaluate the battery, take a DMM and measure the voltage as shown in the picture below.

If the voltage is below 2.8V, the battery should be replaced.



Important - The state of the CPU card battery does not impact the safe operation of the ICMS system in any way. This includes a missing battery. The only items effected, are the date and time stamps of the logs.

4. Operating Modes

The ICMS System has three configurable operating modes, these being:

1. ReConfiguration Mode,
2. Restart Mode, and
3. PreStart Warning Failure Mode.

All three of these operating modes can be set via the local LCD display. The procedure used to change modes along with the implications are discussed in the following sub-sections.

4.1. ReConfiguration Mode

When the ICMS Control Module is turned on it immediately polls all the possible two hundred and fifty one nodes to determine which nodes are present. Whilst doing this the ICMS creates a map of the nodes that have been detected. When it has completed polling all the nodes it then compares the newly created map to the map it had created previously. The previously created map is stored in non-volatile memory. The flowchart shown in figure 3.1.1 displays the algorithm which is implemented.

If the newly created map and the previously created map are the same then the ICMS proceeds to controlling and monitoring of the conveyor. However, if there are any discrepancies between the two maps the course of action taken depends on which ReConfiguration Mode is selected.

Automatic ReConfigure Mode

If Automatic ReConfiguration Mode is selected and there is a discrepancy between the two maps then the ICMS Control Module will again poll all two hundred and fifty one node addresses. If the nodes that are found the second time are the same as that found initially then the ICMS Control Module assumes either:

1. A node or several nodes have been added, or
2. A node or several nodes have been removed.

Thus in Automatic ReConfiguration Mode the addition or removal of nodes is automatically accepted after a second verification has been performed.

Manual ReConfigure Mode

If there is a discrepancy between the two maps in Manual ReConfiguration Mode there are two possible outcomes. If the ICMS Control Module determines that the discrepancy is due to the fact that new nodes have been detected then the ICMS Control Module will again poll all two hundred and fifty one node addresses. If the same nodes are detected the second time then the ICMS Control Module automatically accepts the addition of the new nodes and exits the Initialisation phase.

If the discrepancy's between the two maps involve nodes being removed from the network the local LCD display will list all discrepancies one-by-one in numerical order. It is then up to the operator to either accept that each node has either been added or removed from the Brambus network.

Thus in Manual ReConfiguration Mode when it is determined that a node has been removed from the network, verification of the new system configuration is required by the operator before the conveyor can be started.

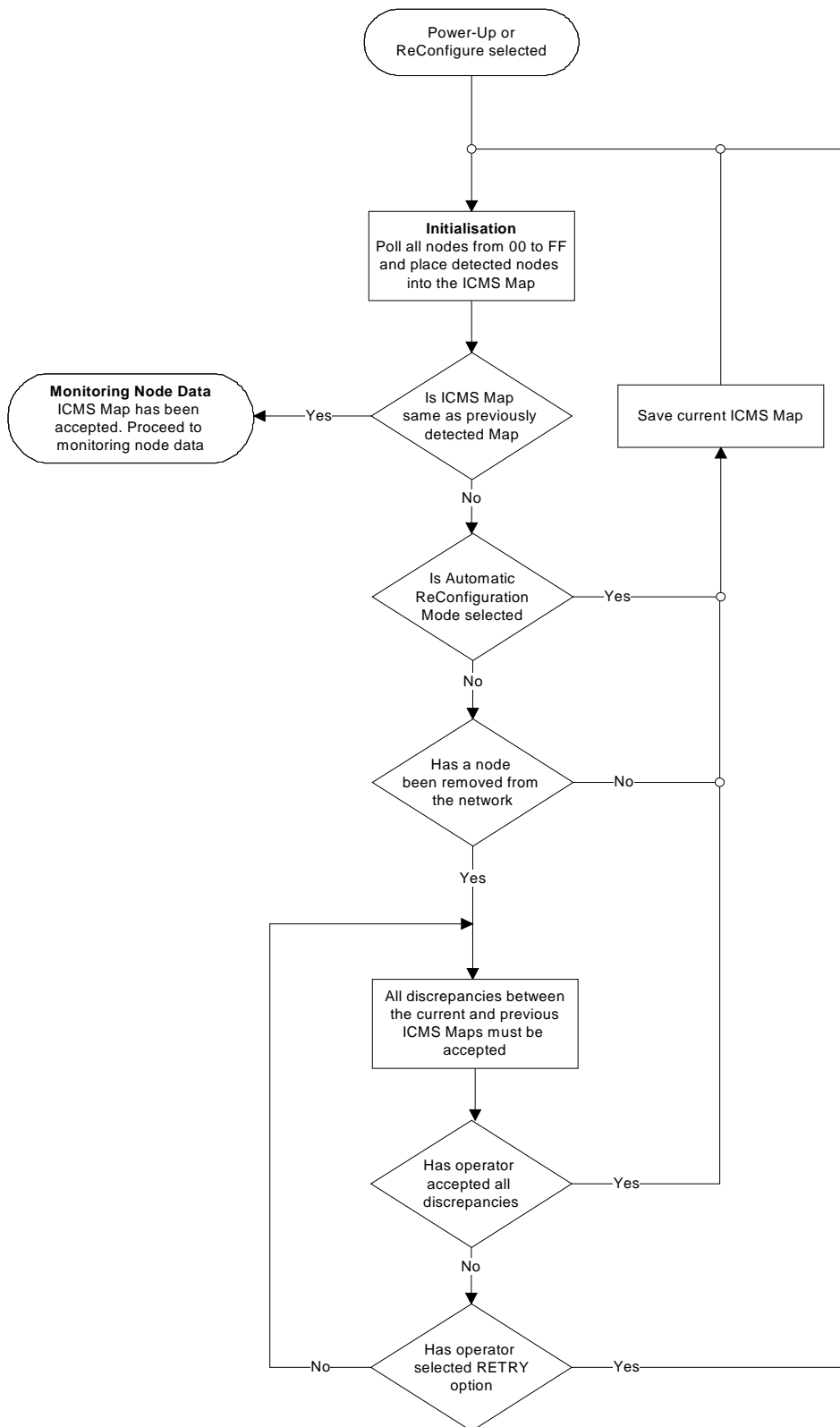


Figure 3.1.1 ReConfiguration Mode Control Flowchart

The procedure required to change the ReConfiguration Mode is described below:

- Return to the *Main Menu* Screen
- Use the cursor to select the *ICMS Config* Screen
- Enter the password **4321** and press the Enter button
- Use the cursor to select the *ReConfig Mode* Screen
- Select the required ReConfiguration Mode,
AUT – Auto and MAN – Manual
- Press the Enter (E) button to accept the change or the Exit (X) button to abort.

NB. Manual ReConfigure Mode is the default setting for the ICMS Control Module. This mode is fail safe, preventing the ICMS Control Module from removing a node from the map unless instructed to do so by the operator. It is therefore recommended that ReConfiguration Mode should always be set to Manual.

4.2. Restart Mode

Restart Mode must be selected to either Manual or Automatic. In Manual Restart Mode when the conveyor has been stopped the ICMS Control Module must see a positive transition on its Start Signal before it will allow the conveyor to run again. This prevents the conveyor from restarting when it has become healthy and requires manual intervention to cycle the ICMS Control Module's Start Signal to again start the conveyor.

In Automatic Restart Mode the conveyor will start anytime the conveyor is healthy and the ICMS Control Module's Start Signal is On. Thus if a conveyor had been stopped by a Lanyard Switch then if that Lanyard were reset and no other faults were preventing the conveyor from running, the conveyor would automatically start. This gives electricians the ability to restart the conveyor remotely, without the need to walk back to the Belt Starter and cycle the ICMS Control Module's Start Signal.

The procedure required to change the Restart Mode is described below:

- Return to the *Main Menu* Screen
- Use the cursor to select the *ICMS Config* Screen
- Enter the password **4321** and press the Enter button
- Use the cursor to select the *Restart Mode* Screen
- Select the required Restart Mode,
AUT – Auto and MAN – Manual
- Press the Enter (E) button to accept the change or the Exit (X) button to abort.

NB. Automatic Restart Mode is the default setting for the ICMS Control Module.

4.3. PreStart Failure Mode

The ICMS System now has the ability to detect if a connected PreStart Warning device has failed to perform its PreStart Warning functions. This is achieved by the PreStart Warning Lanyard node. When the ICMS Control Module is ready to start the conveyor it sends a command to all PreStart Warning Lanyard nodes. The PreStart Warning Lanyard node in turn sends a command to the connected PreStart Warning device. The PreStart Warning Lanyard node then monitors the *PSW OK* output from the PreStart Warning device. The status of all *PSW OK* signals are returned by the PreStart Warning Lanyard nodes to the ICMS Control Module.

The flowchart shown in figure 3.3.2 shows what occurs when a PreStart Warning module does not perform its PreStart Warning functions.

PreStart Failure Warning Mode

If warning mode is selected and a PreStart Warning device fails to perform its PreStart Warning function the conveyor is not prevented from starting. An entry is made in the Event Log for all PreStart Warning devices that have failed. The *Event Log* and the *PSW Module Map*, both accessible from the *Main Menu*, can be used to determine which PreStart Warning devices have failed.

PreStart Failure Trip Mode

If trip mode is selected and a PreStart Warning device fails to perform its PreStart Warning functions then DR1 will not be energised and therefore the conveyor will fail to start. The ICMS Control Module will then generate a list of all the PreStart Warning Devices that have failed and the operator is presented with the screen similar to that shown in figure 3.3.1.

PSW FAILURE	PRV
TRP#01 of 03	NXT
NODE:22	ACCEPT
	RESTART

Figure 3.3.1 PreStart Warning Failure Screen

On the example screen shown in figure 3.3.1 there are three PreStart Warning modules that have failed. The first PreStart Warning device that failed is connected to the node whose address is 22. Using the *Prv* (Previous) and *Nxt* (Next) pushbuttons the operator can scroll through the list of PreStart Warning device failures.

The operator is presented with two options to get the ICMS Control Module to attempt another start, these are:

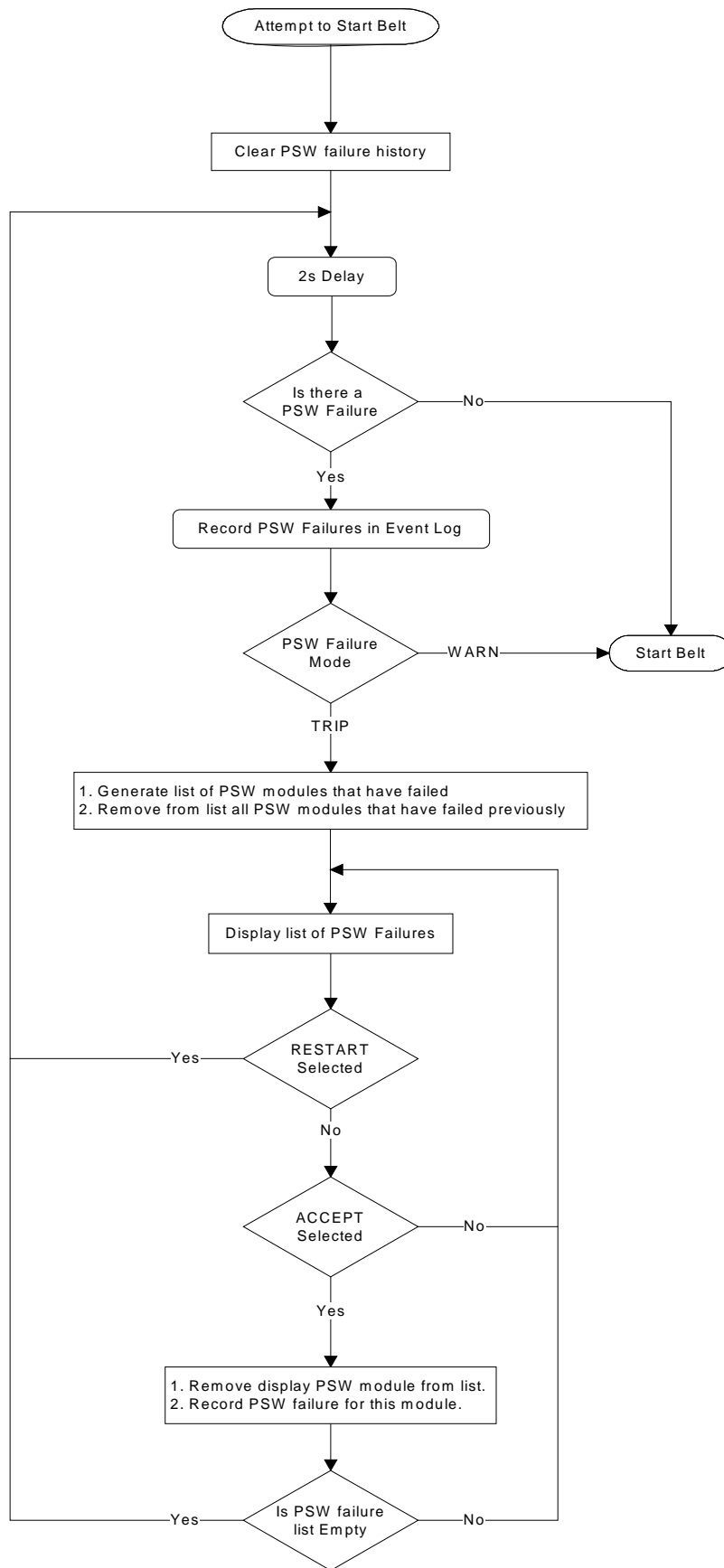


Figure 3.3.2 PreStart Warning Failure flowchart

1. **ACCEPT:** if the *ACCEPT* pushbutton is pressed then the displayed PreStart Warning module is removed from the list of PreStart Warning module failures. As the PreStart Warning modules are removed from this list they are recorded as having failed. When all PreStart Warning failures have been accepted an attempt to start the conveyor will be made. If a PreStart Warning failure is detected on this next start and that PreStart Warning module failed in a previous attempt then the PreStart Warning failure for that node is ignored. Therefore, every time an initial attempt is made to start the conveyor any PreStart Warning failure will prevent the conveyor from starting. After that initial attempt the conveyor will be prevented from starting only when a new PreStart Warning failure is detected.
2. **RESTART:** if the *RESTART* pushbutton is pressed then the ICMS Control Module will attempt another start. If there are any further PreStart Warning failures that have not been accepted then the conveyor will again be prevented from starting.

The procedure required to change the PreStart Warning Failure Mode is described below:

- Return to the *Main Menu* Screen
- Use the cursor to select the *ICMS Config* Screen
- Enter the password **4321** and press the Enter button
- Use the cursor to select the *PSW Failure* Screen
- Select the required Restart Mode - Trip / Warn / Auto
- Press the Enter (E) button to accept the change or the Exit (X) button to abort.

NB. PreStart Warning Failure Trip Mode is the default setting for the ICMS Control Module.

PreStart Failure Auto Mode

This mode is identical in operation to the trip mode, with one addition. If an operator is not present to select “Restart”, the system will automatically perform a restart after 25s.

This allows for starter panels which are some distance from the main control centre.

5. ICMS Control Module Functionality

This Section details the timing of the control signals associated with the ICMS Control Module. Figure 4.1 shows a timing diagram which illustrates how the control signals are associated. This section will then elaborate on the control signals presented in this diagram.

5.1. ICMS Control Relays

The ICMS System provides two categories of Alarms, these are:

1. Trip Conditions, and
2. Secondary Trip, or Optional Warning Conditions.

A Trip Condition is any condition which will either stop the conveyor or prevent the conveyor from starting, eg. a tripped Lanyard Switch.

A Warning Condition is any condition for which an Alarm must be raised but stopping of the conveyor is not required, eg. an activated Belt Wander Warning Limit Switch.

The type of Alarm detected determines what action will be taken in regard to the Control Relays.

5.1.1. DR1 Motor Control

The DR1 Contact provided by the ICMS Control Module is a voltage free set of NO contacts. The specification for these contacts are 100VA, $V_{MAX}=110V_{AC}$ and $I_{MAX}=5A_{AC}$.

When the ICMS Control Module deems it is safe to start the conveyor it energises the DR1 Relay, thus closing the NO DR1 contact. The ICMS Control Module considers it to be safe to start the conveyor if there are no trip conditions and the PreStart Warning Siren has been sounded for the appropriate time period. Should DR1 be energised and a trip condition occur, the ICMS Control Module will de-energise the DR1 Relay, opening the NO DR1 Contact. Thus DR1's NO contacts should be used as a Start Signal in the Belt Starter circuitry.

A LED is provided on the front of the ICMS Control Module that reflects the status of the DR1 Relay. When this LED is On the DR1 Relay is energised.

5.1.2. DR2 Isolate (request)

The ICMS Control Module provide a set of CO contacts on the DR2 Relay. The specification for these contacts are 100VA, $V_{MAX}=110V_{AC}$ and $I_{MAX}=5A_{AC}$.

The DR2 Relay is used as an isolate function and is generally connected in the Belt Starters Isolator circuit. If an isolate signal is detected and the conveyor is not running the DR2 relay will be de-energised. The DR2 relay contacts can then be wired in such a way as to drop out the Isolator and therefore isolate the Belt Starter cubicle. This is advantageous as previously to isolate the conveyor an electrician would have to walk to the Belt Starter, isolate the Belt Starter, then return to fix the initial problem. Using the isolate feature provided by the ICMS it is possible to isolate the Belt Starter remotely, thus eliminating the need to walk to the Belt Starter initially.

A LED is provided on the front of the ICMS Control Module that reflects the status of the DR2 Relay. When this LED is On the DR2 Relay is energised.

5.1.3. DR3 ICMS Trip

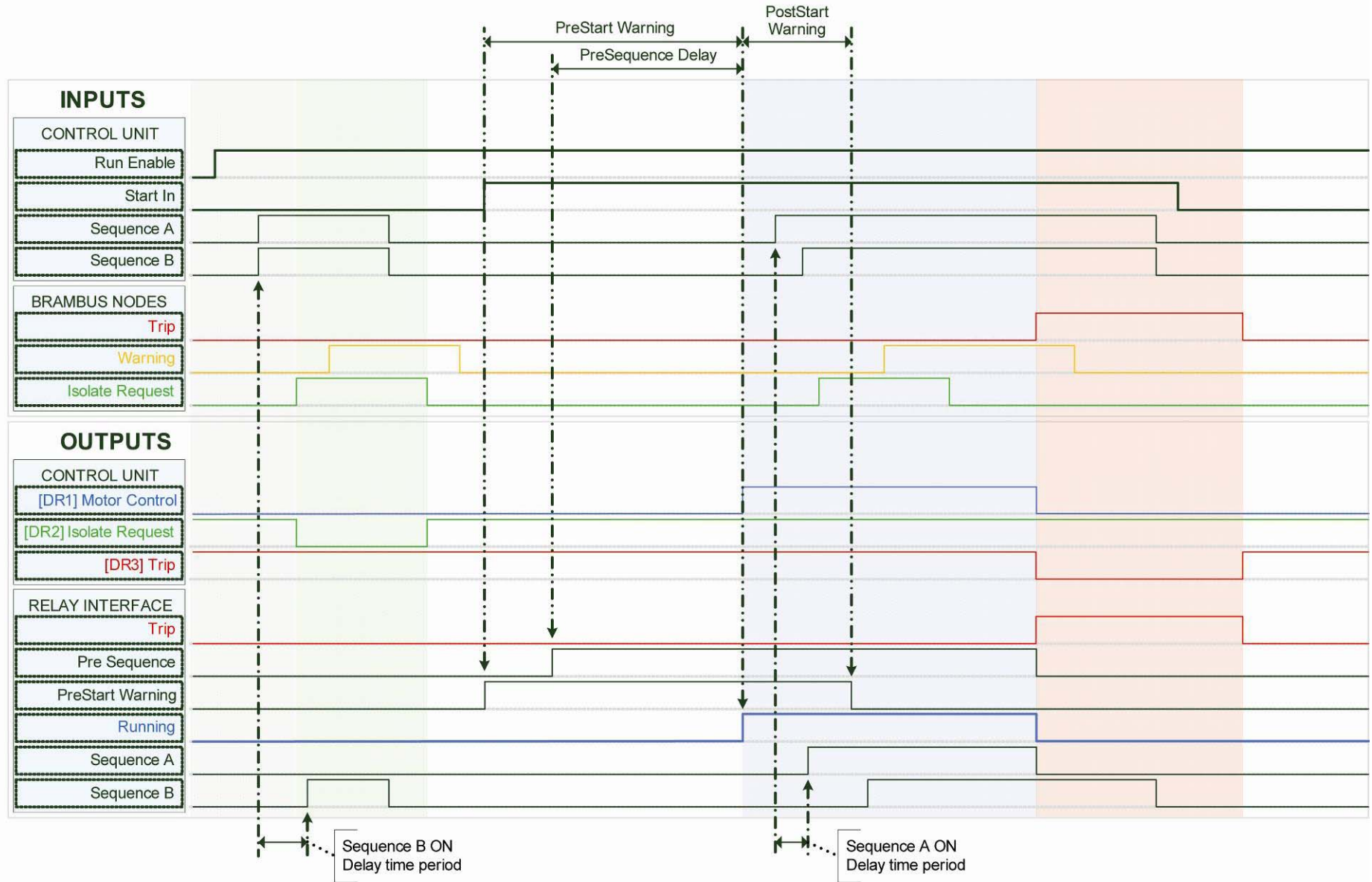
The ICMS Control Module provide a set of CO contacts on the DR3 Relay. The specification for these contacts are 100VA, $V_{MAX}=110V_{AC}$ and $I_{MAX}=5A_{AC}$.

When the ICMS monitoring system is healthy, ie not tripped condition, detected by the ICMS Control Module the DR3 Relay will be energised (closed). The DR3 relay will drop out along with the DR1 relay when a Trip condition occurs.

A LED is provided on the front of the ICMS Control Module that reflects the status of the DR3 Relay. When this LED is On the DR3 Relay is energised.

DR3 will be de-energised (open) during node initialisation.

(This relays function was changed from warn to trip in v4.20 firmware)



5.2. ICMS Control Inputs

The ICMS Control Module has two types of control inputs, these are:

1. local inputs via the optically isolated I/O Card, and
2. remote inputs from nodes on the Brambus network.

Table 4.2.1, shown below, lists the ICMS Control Modules Control Inputs and specifies whether the input is a local input or a remote input.

Input Description	Location	Note
Run Enable	Local	
Start	Local	
Isolated (Aux1)	Local	
Battery charge disable (Aux3)	Local	Implimented in v4.20 fw
SeqA	Local	
SeqB	Local	
SeqC	Remote	
SeqD	Remote	

Table 4.2.1 ICMS Control Inputs

The functionality of each of the Control Inputs is discussed in this section.

5.2.1. Run Enable

The Run Enable Signal is an input to the ICMS Control Module to inform it that all external devices that can prevent the conveyor from starting are healthy. Some of the external devices that may be placed in the Run Enable circuit consist of:

- Auxiliary Contacts from Thermal Overloads (TOL's)
- Signal Line Control Relays (SLC2)

Thus, whenever the ICMS Control Module detects that the Run Enable signal is on it knows that all external devices are healthy and it is free to start the conveyor.

5.2.2. Start Signal

The Start Signal is a signal to the ICMS Control Module that it may start the conveyor. When the ICMS Controller detects the Start Signal it will start the conveyor by closing DR1 if:

- the Run Enable Signal is on,
- there are no Trip Conditions, and
- the PreStart Warning Siren has sounded for the required time period.

5.2.3. Isolated (Aux1)

When the ICMS Control Module detects that an isolate input on a lanyard switch has been activated it de-energies DR2. If DR2 is wired into the Isolator control circuitry this remote request will isolate the conveyor. The isolated input should be connected to an auxiliary contact on the Isolator and is meant as a confirmation that the Isolator has in fact isolated the conveyor.

5.2.4. Battery Charge Disable (Aux3)

This input is to remain active at all times, for installations where battery charging is NOT required for the Prestart warning sirens. Changes to this input will only be seen by the ICMS during powerup and node initialisation. (Implimented in v4.20)

5.2.5. Sequence B

The Sequence B Signal is a general purpose input to the ICMS Control Module. When the ICMS Control Module detects a signal the Sequence B Output is turned On.

The Sequence B Output takes two forms:

1. Local Open Collector Output, and
2. Local Sequence B node

The Sequence B node is a device which sits on the Brambus network and has an internal relay. When it receives the required command from the ICMS Control Module the internal relay is energised. The NO Contacts of this relay may then be used indicate that a particular event has occurred.

5.2.6. Sequence C and D

The Sequence C and D inputs are inputs to nodes which sit on the Brambus network. When one of these inputs is detected by a node, the node sends this data to the ICMS Control Module. The ICMS Control Module then sends a command to an output node. The output node will then energise its internal relay. A set of voltage free NO contacts are provided by this internal relay. With this scheme it is possible to have a remote input activate a remote output.

Alternatives to the sequence C and D nodes are the following nodes that is controlled from a Multi node :

1. Sequence C output node (A01003B),
2. Sequence D output node (A01004B).

The Multi node has a built in Seq C/D input, for more on this, see the section in this document which deals specifically with the Multi node.

6. ICMS Control Algorithm

Figure 5.1 shows a simplified flowchart which represents the control algorithm implemented in the ICMS Control Module.

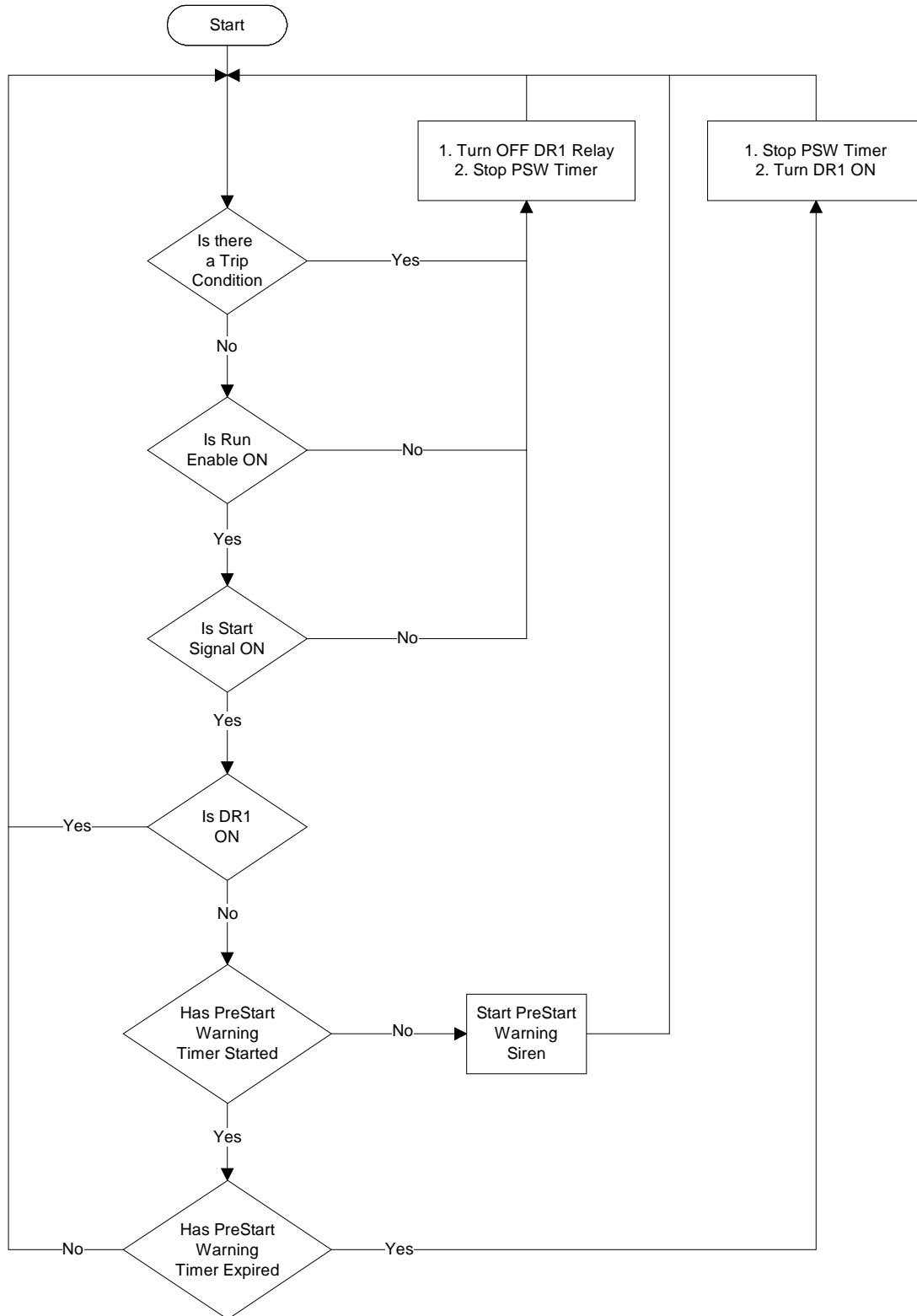


Figure 5.1 Simplified ICMS Control Module Algorithm Flowchart

After the ICMS Control Module has been initialised it is ready to monitor the data that is returned from the nodes connected to the Brambus network. After polling all nodes once the ICMS Control Module is in a position to determine if there is a trip condition present at any of the nodes. If there are no trips then the ICMS Control Module will wait for the Run Enable input to be asserted.

When the Run Enable input is on, the ICMS Control Module knows all devices that are not monitored by the ICMS Control Module are healthy. The ICMS Control Module then waits for the Start Signal to be asserted. When this occurs the PreStart Warning output is turned on for the PreStart Warning time period. After the PreStart Warning time period has expired the DR1 relay is energised, starting the conveyor. The DR1 relay will remain energised until either a Trip condition is detected, the Run Enable input is turned off or the Start Signal is turned off.

As stated before, this is a simplified version of the control algorithm implemented in the ICMS Control Module. The next sub-sections discuss the more complicated aspects of the control algorithm.

7. Brambus Nodes

7.1. Node Address

Each node on the Brambus network must have a unique address. Valid node addresses range from 0_{10} to 250_{10} (00_{16} to FA_{16}). Addresses 250_{10} to 255_{10} (FA_{16} to FF_{16}) are reserved for special purpose nodes. One such node is the End of Line node, it has a hardwired address of 255_{10} or FF_{16} .

The node addresses are set via two rotary switches located on the front of each node. Each switch has positions 0 to 9 and A to F. Therefore the address must be set in a Hexadecimal Format. The left most switch is the most significant digit whilst the right most switch is the least significant digit.

Node address 00_{16} is generally used by the Barrier. This is a convention which has been adopted by Bramco and it is suggested that where an Barrier is fitted the address of this unit be set to 00_{16} . The reasoning behind this being that the Barrier is the first node connected to the Brambus network. The last node connected to the Brambus network is the End of Line node whose address is FF_{16} . Therefore, it would be logical to address all nodes between these two in ascending order. If this is done it may aid in fault finding when the Brambus network becomes disconnected between two nodes.

The table below is an example of how node address allocation should be documented. This will prevent faults occurring due to nodes having duplicate addresses. When a node is added to the Brambus network the node type should be entered in this table at the appropriate address. The allocation of node types is discussed in the next section.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0																
1																
2																
3																
4																
5																
6																
7																
8																
9																
A																
B																
C																
D																
E																
F												X	X	X	X	X

Table 6.1 ICMS Node Address Map Allocation

7.2. Node Types

The ICMS Control Module uses a distributed I/O architecture to acquire its data. Various nodes have been designed to interface to the Brambus network. These nodes are described in this subsection. The table below lists the node types which are currently available. The node type is displayed when the *ICMS Map* is selected from the *Main Menu*. The *ICMS Map* is discussed later in this document in Section 7.5.

Type	Description	Nodes
0	Barrier Node	
D	SequenceB Node	
E	End Of Line Node	
N	EOL Node with SLC Termination	
Q	SeqC Output Node	Support added in v4.20
R	SeqD Output Node	Support added in v4.20
W	Multi Node	Support added in v4.20

Table 6.2.1 Brambus Node Types

7.2.1. Barrier

Part No.: A00666B

Node Type: 0

Address: 00₁₆ (for start and any address for more)

The ICMS Barrier is an electronic current limiter and voltage control device which provides a safe guard against damage to the ICMS Control Module in the event of faults on the signal line. In an installation requiring safety, the barrier is also an energy limiting device protecting against power surges to the signal line.

The current output that may be drawn through the ICMS Barrier is limited electronically and thermally, whilst the maximum output voltage is clipped to safe levels. The ICMS Barrier comes with the following limits:

1. A00666B - Bus Voltage 30V_{max} Current 850mA

Should excessive current be drawn the ICMS Barrier will limit the current to the set point. If the current persists at that set point the electronics will heat and cause a thermal shutdown. This in turn will result in the Bus Voltage reducing to zero.

The ICMS Barrier must be installed in accordance with Bramco Instructions.

The Barrier has four LED's on the front as shown below in figure 6.2.1.1.

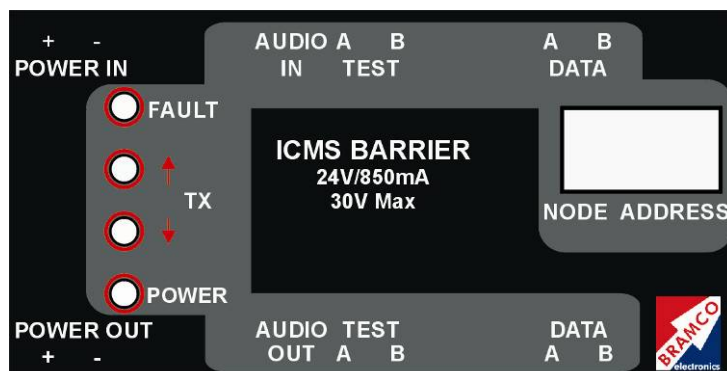


Figure 6.2.1.1 Barrier Label

The functionality of the four LED's are defined as follows:

- **FAULT LED** is currently inoperative and as such is reserved for future use.
- the **↓ LED** is used to indicate that the ICMS Control Module is sending information or requesting data from a node on the Brambus network.
- the **↑ LED** is used to indicate that a node is responding to a request for data from the ICMS Control Module.
- **POWER ON LED** is located at the bottom of the module and is used to indicate that power is being supplied on the **POWER IN** terminals.

The **ADDRESS** switches are used to assign a unique address to the Intrinsically Safe Barrier. This may be any desired address within the range of 00₁₆ to F9₁₆, however, Bramco Electronics recommends the first one to be set to 00₁₆.

In applications the number of nodes that may be placed on the Brambus network is limited by the maximum current that may be drawn through the ICMS Barrier. A typical Brambus node will draw between 3 to 10 mA.

NB. The worst case figure quoted, ie. 10mA, is that of a Brambus node that is also supply current to turn on an internal relay coil, such as a Sequence A node.

7.2.2. Sequence B Node
Part No.: A00339C
Node Type: D

The Sequence B signal is a general purpose input to the ICMS Control Module. When the ICMS Control Module detects a Sequence B signal it sends a command to all Sequence B nodes to turn their outputs on, regardless of whether or not the conveyor is running.

The Sequence B node has an internal relay. When the Sequence B node receives the required command from the ICMS Control Module the internal relay is energised. The NO contacts of this relay may then be used to indicate that a particular event has occurred or initiate a particular event.

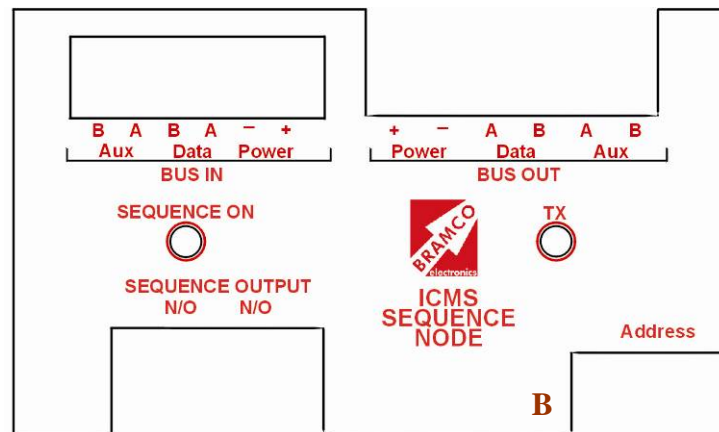


Figure 6.2.3.1 Sequence A Node Label

The *Tx* LED is used to indicate that the node is responding to a request for data from the ICMS Control Module.

The *Sequence On* LED is used to indicate that the internal relay has been energised. When this LED is on the set of voltage free NO Contacts will be closed.

The maximum allowed voltage that may be applied to the set of NO contacts is $40V_{ac}$ whilst the maximum current that may be drawn through this set of contacts is 0.5A. These ratings apply to applications both inside and outside Hazardous Regions.

It should be noted that the *BUS IN* terminals are connected directly to the *BUS OUT* terminals. The *AUX A* and *AUX B* terminals are generally used when a six core cable is used to interconnect nodes and are provided as a convenient method of terminating this six core cable. The *AUX A* and *AUX B* terminals are then used for the SLC Signal and the Audio Signal respectively.

7.2.3. Sequence C Output Node

Part No.: A01003B
Node Type: Q

The Sequence C Output node allows remote inputs to trigger remote outputs on the Brambus network.

There are two internal relays in this node. These relays are energised when commanded to do so by the ICMS Control Module. A set of NO contacts is provided from each of these relays. The LED's positioned above these contacts indicate when the relays are on.

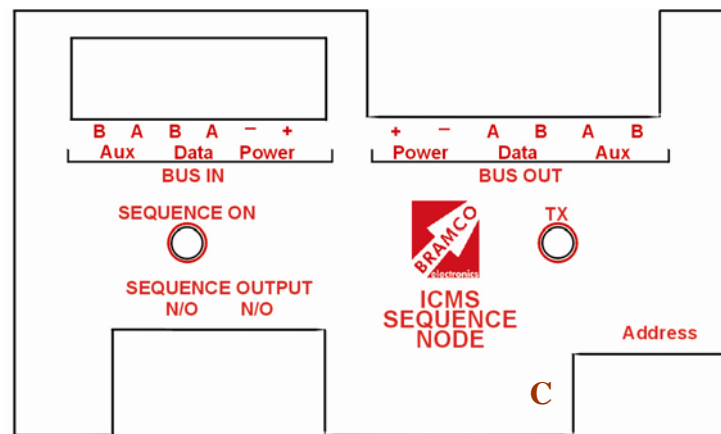


Figure 6.2.17.1 Sequence C Output Node Label

The Tx LED is used to indicate that the node is responding to a request for data from the ICMS Control Module.

The maximum allowed voltage that may be applied to the set of NO contacts is $40V_{ac}$ whilst the maximum current that may be drawn through this set of contacts is 0.5A. These ratings apply to applications both inside and outside Hazardous Regions.

It should be noted that the *BUS IN* terminals are connected directly to the *BUS OUT* terminals. The *AUX A* and *AUX B* terminals are generally used when a six core cable is used to interconnect nodes and are provided as a convenient method of terminating this six core cable. The *AUX A* and *AUX B* terminals are then used for the SLC Signal and the Audio Signal respectively.

7.2.4. Sequence D Output Node

Part No.: A01004B
Node Type: R

The Sequence D Output node allows remote inputs to trigger remote outputs on the Brambus network.

There are two internal relays in this node. These relays are energised when commanded to do so by the ICMS Control Module. A set of NO contacts is provided from each of these relays. The LED's positioned above these contacts indicate when the relays are on.

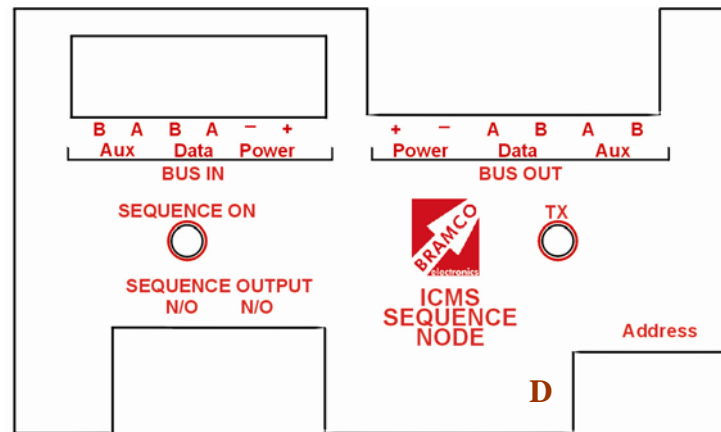


Figure 6.2.17.1 Sequence D Output Node Label

The *Tx* LED is used to indicate that the node is responding to a request for data from the ICMS Control Module.

The maximum allowed voltage that may be applied to the set of NO contacts is 40V_{ac} whilst the maximum current that may be drawn through this set of contacts is 0.5A. These ratings apply to applications both inside and outside Hazardous Regions.

It should be noted that the *BUS IN* terminals are connected directly to the *BUS OUT* terminals. The *AUX A* and *AUX B* terminals are generally used when a six core cable is used to interconnect nodes and are provided as a convenient method of terminating this six core cable. The *AUX A* and *AUX B* terminals are then used for the SLC Signal and the Audio Signal respectively.

7.2.5. End of Line Node with SLC Termination

Part No.: A00263D

Node Type: N

The End of Line node with SLC Termination combines the functions of three devices, these being:

1. End of Line node,
2. ReConfigure node and
3. SLC Termination unit.

The fact that these three devices are combined into the one node is a space saving issue rather than one relating to functionality. The only additional feature provided by this node is the ability to sequence inbye conveyors on the signal line. The new revision of the SLC Relay allows for a sequence signal to be superimposed on the signal line. This allows for more flexibility in the control of the conveyor. Using this configuration allows the conveyor to be controlled by only the ICMS Control Module, only the SLC Relay or both systems operating in parallel.

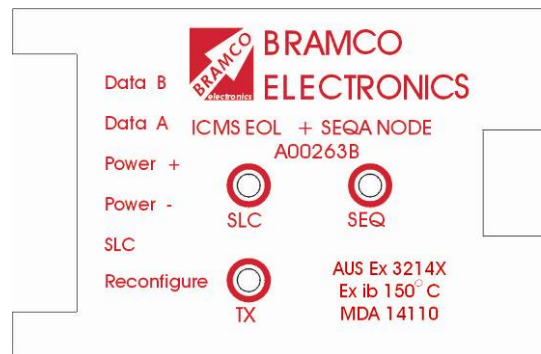


Figure 6.2.21.1 End of Line Node Label

The Reconfigure input is used in conjunction with a NC Pushbutton. This NC Pushbutton is connected across the *Reconfigure* and *Power +* terminals of the End of Line node.

This Reconfigure command will only be performed if the conveyor is:

1. in Automatic ReConfiguration mode, and
2. the conveyor is not Running, ie. DR1 not energised.

There are three LED's on this node. The *Tx* LED is used to indicate that the node is responding to a request for data from the ICMS Control Module. The *SLC* LED is on when there is current flowing on the signal line and the *SEQ* LED is on when the sequence signal is being placed on the signal line by the SLC Relay.

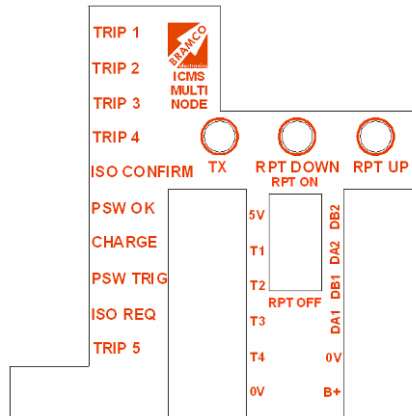
7.2.6. ICMS Multi Node with Temperature Inputs

Part No.: A00980A

Node Type: W

The ICMS Multi Node with Temperature Inputs can perform the following functions:

- Trip (5 trip inputs or 1 sequence + 4 trip inputs)
- Data repeater
- Temperature measurement (4x temperature measurement inputs, not yet implemented)
- Isolate Request (input) and Isolate Confirmed (output)
- Prestart Warning control including battery management



ICMS Multi Node label

Compatibility:

- The A00980A will operate on ICMS v4.00 code or later.
- The A00980A will interface to the BK300 and BK400 pullkeys, and may also be used in general trip-input and warning-input installations not requiring a pullkey
- The A00980A will operate with Bramco’s PSW and communications products: A00550 slave amplifiers, A00675 and A00940 mini amplifiers, A00504 and A00986 PSW modules.

Functionality – tripping:

The trip (TRIPx) contacts on the A00980A use the Brambus 0V as a common reference. They are normally closed (NC) contacts; i.e. the node will indicate healthy when all of the TRIPx contacts are closed.

The node must be included in the ICMS map during initialisation in order to positively indicate a trip or warning on the ICMS contacts.

The voltage on the TRIPx inputs should be 0V for healthy and 5V for tripped (open)

Functionality – sequence input :

Trip 5 can be configured as either a sequence C or D input. This is done using the nodes address.

Node address	Trip 5 input becomes
E0	Sequence C input
E1	Sequence D input

If such a sequence input is tied to 5V, it is considered closed, and any matching sequence output on the same network will thus also be closed.

Functionality – repeater:

In normal (non-repeater) operation, the A00980A will be wired such that the Data A and Data B pair are connected to DA1 and DB1 node contacts, respectively. In this mode, the A00980A does not terminate the data pair.

In repeater mode, the Brambus Data A and Data B pair from the control module are terminated into DA1 and DB1 contacts. The data pair on the end of line side of the Brambus is then connected to DA2 and DB2. A data repeater should be fitted every 800m of connected Brambus cable. Data received from the ICMS control module is retransmitted with the correct waveforms and voltage levels.

The A00980A will register as a type 'W' on the ICMS map if it is in non-repeater mode, and type 'w' if the repeater is enabled.

During correct operation, the behaviour of the LEDs will be as follows:

LED	LED Switches ON under these conditions	
	Repeater OFF	Repeater ON
TX	Node is transmitting a response to a command	Node is transmitting a response to a command
RPT DOWN	Node is transmitting a response to a command	Node is transmitting a response to a command or repeating data in the direction of the control module
RPT UP	Does not illuminate	Node is repeating data in the direction of the EOL node

Functionality – Temperature measurement

Not supported at present

Functionality – Isolate request

The A00980A can send an Isolate Request signal to the ICMS control module. The ISO REQ contact is a NC contact tied to 0V under healthy conditions. When an isolate request is required, the contact should be opened.

Functionality – Isolate confirm

The ISO CONFIRM contact is an open-drain output (i.e. connected to Brambus 0V), used in the BK400 for Isolate Confirm indication. The ISO CONFIRM output will activate when:

- The A00980A has healthy communications with the ICMS control module, and
- The node is receiving an Isolate Request signal on its contacts, and
- The node is receiving an Isolate Confirmed indication from the control module

The contact will de-energise when:

- The node no longer has healthy communications with the control module, or
- The Isolate Confirmed indication from the control module is no longer received.

Functionality – Prestart Warning and Battery Charge:

When the ICMS Control is preparing to start the conveyor it sends a command to all ICMS Multi nodes instructing them to turn on their PSW TRIG outputs (5V). This initiates a prestart warning on the attached amplifier or PSW module.

The node provides feedback to the ICMS module about whether the prestart was successful using the PSW OK contact.

When there is no amplifier attached to the node, the PSW OK contact will be ~5V.

With an amplifier attached, this contact becomes 0V. This indicates to the ICMS module that there is an amplifier attached to the node.

When the prestart works properly, the amplifier or PSW module will release the PSW OK contact for the duration of the prestart, allowing it to once again return to 5V. This indicates to the node and subsequently to the ICMS that the prestart was successful. If the PSW OK contact is not released during prestart, the ICMS Control Module must decide whether it will start the conveyor or not. This decision is based on the PreStart Failure mode setting in the ICMS.

The ICMS module will signal to the node when it must allow the attached amplifier or PSW module to charge its batteries. When this signal is received, the CHARGE contact is pulled low, allowing the attached device to charge its batteries.

The following table describes the correct behaviour of the PSW TRIG and PSW OK contacts:

PSW Signal from ICMS	Amplifier attached	
	YES	NO
YES	PSW TRIG: 5V PSW OK: 5V if PSW success PSW OK: 0V if PSW fail	PSW TRIG: 0V PSW OK: 5V
NO	PSW TRIG: 0V PSW OK: 0V	

8. Menu Structure

A number of different screens and menus are available in the ICMS System. Figure 7.1 shows the menu structure of the ICMS System in a hierarchical representation. All screens shown and their menu options will be discussed in further detail in this section.

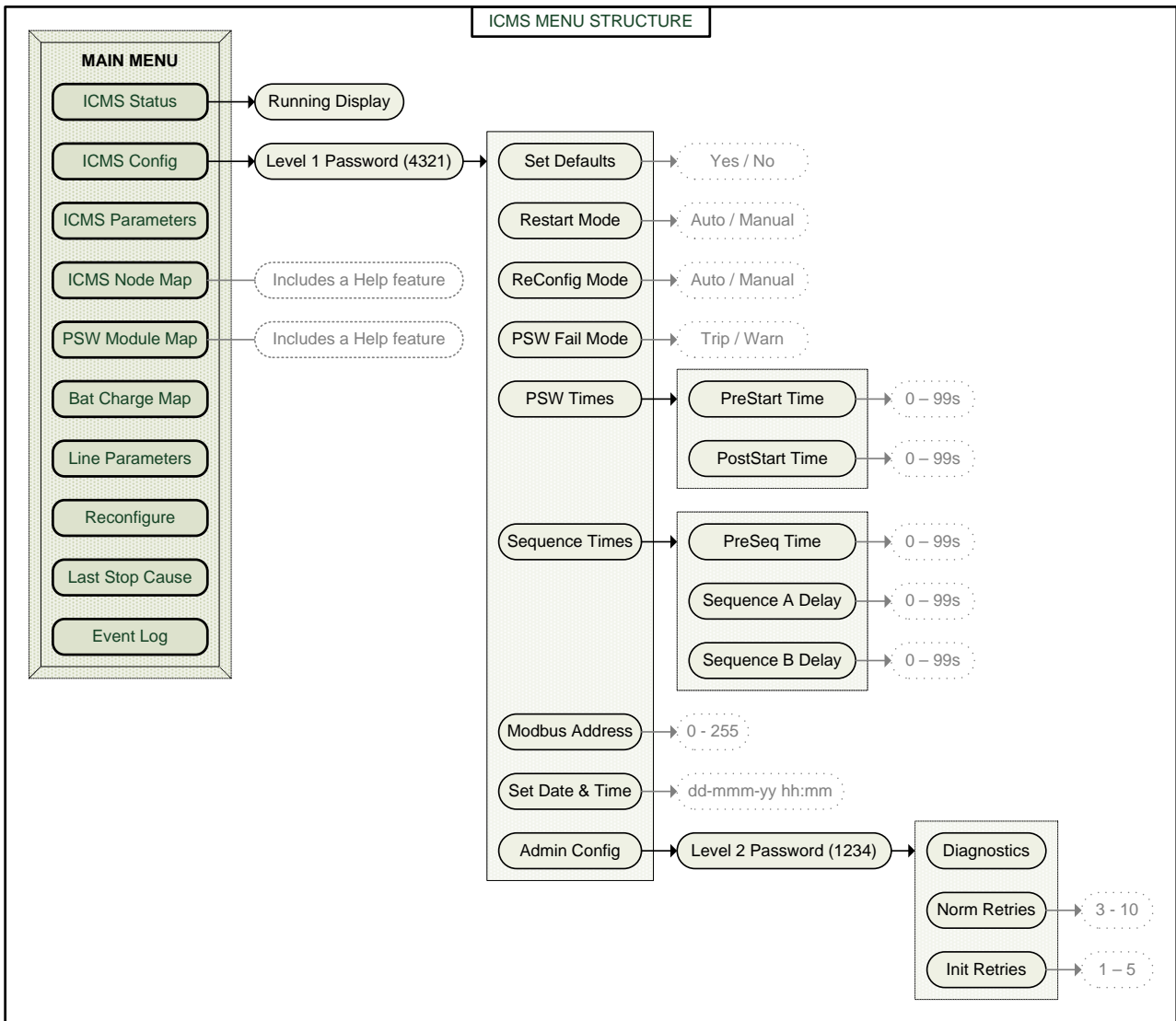


Figure 7.1 ICMS Menu Structure

Figure 7.2 shows the format of the local LCD display. The LCD provided has four lines with twenty characters per line. Eight pushbuttons are provided on the local LCD display.



Figure 7.2 Local LCD Display

Each Pushbutton is associated a particular symbol on the screen. The four pushbuttons on the left hand side are associated with the first characters on each line whilst the four pushbuttons on the right hand side are associated with the last characters on each line. The symbols used in these locations consist of:

1. *E* - Enter
2. *X* - Exit,
3. *H* - Help,
4. ← - Left,
5. → - Right,
6. ↑ - Up, and
7. ↓ - Down.

There are some conventions that have been adopted in generating the screens for the ICMS Control Module. These conventions consist of:

1. Selecting an item from a list of options,
2. Scrolling Up and Down a display screen,
3. Entering a number,
4. Entering a selection, and
5. Help Screens

Selecting an item from a list of options

Figure 7.3 shows an example of a screen where a number of selections can be made from a list. This screen is the *Main Menu* screen and three of the possible eleven options are displayed.

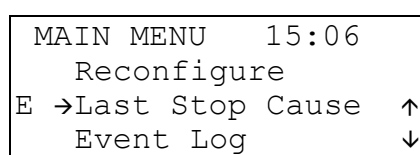


Figure 7.3 Example Menu Screen

The \uparrow and \downarrow pushbuttons move the list of options up and down the screen. The selected option is indicated by the \rightarrow symbol. When the required option has been selected pressing the *E* pushbutton will select that option. In this example when the *E* pushbutton is pressed the *Last Stop Cause* screen will be invoked.

Scrolling Up and Down a display screen

Figure 7.4 shows an example of a screen which is displaying some form of data. This screen is the *Event Log*.

EVENT LOG	15:06	\uparrow
ENTRY #01		\downarrow
02/07/99	12:47:58	
PSW Output	OFF	

Figure 7.4 Example Display Screen

The Event Log has fifty entries so the \uparrow and \downarrow pushbuttons may be used to display the next or previous event.

Entering a number

Figure 7.5 shows an example of how numbers are entered via the pushbuttons. This example screen is the password screen.

X	Enter Password	E
\uparrow		\uparrow
\leftarrow	0000	\rightarrow
\downarrow	^	\downarrow

Figure 7.5 Example Display Screen

To enter a password, or number, the operator move the pointer \wedge using the \leftarrow and \rightarrow pushbuttons. When the pointer is underneath the digit that is to be changed the \uparrow and \downarrow pushbuttons can be used to increment or decrement the number. Should the operator chose to leave this screen and return to the previous screen then the *X* pushbutton can be operated. Should the operator wish to enter the password, or number, and progress to the next screen then the *E* pushbutton can be operated.

Entering a selection

Figure 7.6 shows an example of how selections are entered via the pushbuttons. This example screen is the ReConfiguration Mode selection screen.

X	ReConfiguration	E
	Mode	AUT
	MANUAL	MAN

Figure 7.6 Example Display Screen

In this example the ReConfiguration Mode is selected as manual. The two options available here are automatic and manual. The *AUT* pushbutton can be used to select automatic while the *MAN* pushbutton can be used to select manual. Should the operator chose to leave this screen and return to the previous screen the *X* pushbutton can be operated. Should the operator wish to accept the selection then the *E* pushbutton can be operated.

Help Screens

The ICMS Control module now includes help screens. These help screens explain what is displayed on the screen. If a screen has an associated help screen a *H* is displayed in the bottom right hand corner of the screen. Figure 7.7 shows the *ICMS Map's* help screen. This screen explains what the symbols displayed on the *ICMS Map* represent.

```

ICMS HELP      15:06
0 IS Barrier
4 Temp Node      ↑
5 SequenceA Node ↓

```

Figure 7.7 Example Display Screen

8.1. Main Menu

The *Main Menu* screen lists all the screens available on the ICMS System. The ↑ and ↓ pushbuttons move the list of options up and down the screen. The selected option is indicated by the → symbol. When the required option has been selected pressing the *E* pushbutton will invoke the new screen.

8.2. ICMS Status

This is the default screen for the ICMS Control Module. When there has been no pushbutton activity detected for a set period of time this screen will be displayed. The *ICMS Status* screen is also accessible from the *Main Menu*.

The data displayed on this screen follows a set format. An example of the ICMS Status screen is shown below in figure 7.2.1.

```

Status Message → RUNNING      15:06  ↑
Sequence Output Status → SEQ: A_B_C_D_E_F_ ↓
Warning Information → WRN#01of02 -----
                    NODE:01.2 Warn

```

Figure 7.2.1 Example ICMS Status Screen

The first line indicates the current operational state of the ICMS Control Module. This generally takes the form of a *status message*, eg. *RUNNING*. If the option allowing the time to be displayed is selected then the time will also be displayed on the first line. Should the *status message* require additional information then this will be displayed on the second line in the form of a *prompt*. During the PreStart Warning and whilst the conveyor is running the second line is used to display the status of the sequence outputs.

The third and fourth lines of the *ICMS Config* screen are used to display the status of any warnings that may be active. In the example shown in figure 7.2.1 there are two warnings. The first of these is currently being displayed, ie. node 01₁₆ has a warning on input number 2. The two pushbuttons next to the ↑ and ↓ symbols can be used to scroll up and down the active warnings.

The next sub-sections will discuss specific *ICMS Status* screens.

8.2.1. Initialising

Figure 7.2.1.1 shows the screen that will be displayed when the ICMS is initialising. This screen starts with the current node at 00₁₆ and progresses until the current node is FF₁₆. As the current node increments the bar graph will fill. The number of nodes that have been detected will also be displayed on this screen. Should the operator wish to leave this screen then pressing the *EXIT* pushbutton will force the ICMS Control Module to display the *Main Menu*.

```
INITIALISING 15:06
Current Node:B6
Nodes Detected:17
->->->->->->->*
```

Figure 7.2.1.1 ICMS Status Initialising Screen

When the ICMS Control Module has completed polling all possible nodes and the configuration of nodes on the Brambus network has been verified the ICMS Control Module is then ready to start the conveyor, provided all permissives for this to occur have been satisfied.

8.2.2. Fault Status

This screen displays the contents of the ICMS Control Modules fault table. The ICMS Control Module considers both trips and warnings to be fault conditions. When a fault condition has been detected a screen similar to that shown in figure 7.2.2.1 will be displayed. The number of faults, trips and warnings, detected by the ICMS Control Module is displayed on the second line of this screen. To see the other fault conditions can be displayed by using the \uparrow and \downarrow pushbuttons.

```
FAULT STATUS 15:06  $\uparrow$ 
TRIPS:05 WARNS:01  $\downarrow$ 
TRP#03 -----
NODE:51 DataComm
```

Figure 7.2.2.1 Example ICMS Status Screen

In the example shown above in figure 7.2.2.1 there are six faults, five of these are trips and one is a warning. The third line of this screen displays which event in the fault table is currently being displayed, this is the third trip condition, a DataComm error to node 51₁₆. In future releases of the ICMS Control Module's software it is proposed that each fault condition may be assigned a descriptive message consisting of nine alphanumeric characters. This message will be displayed where the characters "-----" are currently displayed. The last line of this display specifies the fault condition.

Faults are placed in the fault table such that the fault with the highest priority is placed at the top of the table. This has been done so that any parasitic faults are displayed after the real fault. This concept can be more clearly demonstrated by an example. Consider the situation where there is a short circuit between $B+$ and $B-$ in the hazardous region. The only node which the ICMS Control Module will be able to communicate with will be the Intrinsically Safe Barrier. Therefore, there will be a DataComm error to all nodes on the Brambus network except the Barrier. The ICMS Control Module will know there is no output volts from the Barrier so it places this at the top of the fault table followed by the DataComm errors. Using this methodology, correcting the first entry in the fault table, the short circuit between $B+$ and $B-$, should also correct the parasitic faults, the DataComm faults.

The priority of faults as determined by the ICMS Control Module is detailed below in table 7.2.2.1.

Priority	Condition	Description
1	Trip	DataComm error to Barrier
2	Trip	Output voltage from Barrier is 0V
3	Trip	Output voltage from Data Repeater is 0V
4	Trip	Input voltage to End of Line node is less than 12V
5	Trip	DataComm error
6	Trip	Trip conditions generated by nodes: (i) User trip (ii) Lanyard (iii) PreStart Warning Failure
7	Trip	Temperature trip
8	Warning	Input voltage to Barrier is less than 20V
9	Warning	Output voltage from Barrier is less than 18V
10	Warning	Input voltage to End of Line node is less than 14V
11	Warning	Current is at it's limit (800mA)
12	Warning	Current is greater than 700mA
13	Warning	Voltage on DA or DB not with range of 1V to 4V
14	Warning	Warning conditions generated by nodes: (i) User Warning (ii) Isolate (iii) PreStart Warning Failure
15	Warning	Temperature warning
16	Warning	DataComm error

Table 7.2.2.1 Fault Table Priority

8.2.3. ICMS Healthy

When the all nodes on the Brambus network are communicating with the Control Module and the nodes are reporting no trip conditions then the *ICMS Healthy* status message will be displayed. When the ICMS Control Module is in this state it is waiting for the *Run Enable* input to be asserted before it can procedure any further with the starting sequence. The second line of this screen *prompts* the operator, informing them that the ICMS Control Module is “*Waiting for Run Enb*”.

```

ICMS HEALTHY 15:06
Waiting for Run Enb

```

Figure 7.2.3.1 ICMS Status ICMS Healthy Screen

8.2.4. Belt Healthy

When no trip conditions have been detected and the Run Enable input has been detected then the *Belt Healthy* message will be displayed. When the ICMS Control Module is in this state it is waiting for the *Start Signal* to be asserted before it can procedure any further with the starting sequence.

The *prompt* displayed on the second line depends upon the Restart Mode. The two possible options are:

1. **Automatic mode**, the message “*Waiting for Start*” will be displayed.
2. **Manual mode**, the message will depend upon the status of the *Start Signal*. Before an attempt can be made to start the conveyor the *Start Signal* must be cycled. Therefore, depending upon the status of the *Start Signal* the displayed message can be one of the following:
 - (i) “*Wait for Start On*”, or
 - (ii) “*Wait for Start Off*”

```
BELT HEALTHY 15:06
Waiting for Start
```

Figure 7.2.4.1 ICMS Status Belt Healthy Screen

8.2.5. PreStart Warning

When the *Start Signal* has been detected the ICMS Control Module will attempt to start the conveyor. Before the conveyor can be started the PreStart Warning siren's must be sounded. The screen shown below in figure 7.2.5.1 shows the PreStart Warning screen. The status of all sequence outputs is also shown on the second line of this screen.

```
PRESTART WRN 15:06
SEQ:  A _ B _ C _ D _ E _ F _
```

Figure 7.2.5.1 ICMS Status PreStart Warning Screen

8.2.6. Running

After the PreStart Warning time period has expired *DRI* will close causing the conveyor to start. The screen shown below in figure 7.2.6.1 shows the Running screen. The status of all sequence outputs is also shown on the second line of this screen.

```
RUNNING      15:06
SEQ:  A _ B _ C _ D _ E _ F _
```

Figure 7.2.6.1 ICMS Status Running Screen

8.2.7. PreStart Warning Trip Detected

If the PreStart Warning Failure mode is set to trip and a PreStart Warning failure was detected during the PreStart Warning time period then the screen shown below in figure 7.2.7.1 will be displayed. In the example shown in this figure, three PreStart Warning modules have failed. The operator can use the *PRV* and *NXT* pushbuttons to scroll through the list of failed PreStart Warning modules. There are two courses of action that may be taken when this screen is displayed, these are:

1. the operator can individually accept all of the PreStart Warning module failures using the *ACCEPT* pushbutton, or
2. the operator can attempt another start by pressing the *RESTART* pushbutton.

```

PSW FAILURE      PRV
TRP#01of03      NXT
NODE:27         ACCEPT
-----        RESTART
  
```

Figure 7.2.7.1 ICMS Status PreStart Warning Failure Screen

8.2.8. Isolate Requested

When the conveyor is not running, ie. DR1 is off, and the ICMS Control Module detects that an isolate input is on at a Lanyard node then the screen shown below in figure 7.2.8.1 will be displayed. DR2 will be de-energised when the isolate signal is detected and if DR2 is wired into the Isolator circuitry the Belt Starter may be remotely isolated. The status message *ISOL RQSTED* is displayed on this screen indicating that a request to isolate the conveyor has been received but the feedback from the Isolator indicates that it is yet to open.

```

ISOL RQSTED 15:06
TRIPS:00 WARNS:01
TRP#01 -----
NODE:27 Isolate
  
```

Figure 7.2.8.1 ICMS Status Isolate Requested Screen

8.2.9. Isolated

After a request to isolate the Belt Starter has been received and confirmation that the Isolator has opened has been received the screen shown below in figure 7.2.9.1 will be displayed. This screen will be displayed until the Isolator is again closed.

```

ISOLATED      15:06
Node Isolate Reqsted
FLT#01of01 -----
NODE:27 Isolate
  
```

Figure 7.2.9.1 ICMS Status Isolated Screen

8.3. ICMS Config

This screen is password protected to prevent parameters being changed by untrained personnel. The password to enter the *ICMS Config* screen is 4321.

The *ICMS Config* screen is a menu of options that may be selected. The majority of these options will modify an operational parameter of the ICMS Control Module. The \uparrow and \downarrow pushbuttons move the list of available options up and down the screen. The selected option is indicated by the \rightarrow symbol. When the required option has been selected pressing the *E* pushbutton will invoke the selected option.

8.3.1. Set Defaults

The *Set Default* Screen allows the operator to reset the ICMS Control Module to its default settings. This screen is shown in figure 7.3.1.1. There are two options available, *YES* or *NO*. If the pushbutton next to *YES* is selected then the default settings will become active. If the pushbutton next to the *NO* is selected then the *Set Defaults* screen is exited and the *ICMS Config* screen is shown.

```

ICMS CFG      15:06
                Set      YES>
                Defaults NO>
  
```

Figure 7.3.1.1 Set Defaults Screen

The default settings are shown below in table 7.3.1.1.

Option	Default Setting
Display Time	On
Restart Mode	Auto
ReConfiguration Mode	Manual
PreStart Warning Failure Mode	Trip
PreStart Warning Time	10s
PostStart Warning Time	5s
PreSequence Time	3s
Sequence A Delay Time	0s
Sequence B Delay Time	0s
Modbus Address	FF ₁₆
Screen Default Time	90s
Initialisation Retries	3
Run Mode Retries	5

Table 7.3.1.1 Default Settings

8.3.2. Restart Mode

This screen is used to set the Restart Mode. There are two options presented here, *AUT* or *MAN*. When the pushbutton next to *AUT* is pressed Restart Mode will change to *AUTO*. When the pushbutton next to *MAN* is pressed Restart Mode will change to *MANUAL*.

X	ReStart Mode	E
		AUT
	AUTO	MAN

Figure 7.3.2.1 Select Restart Mode Screen

If the *X* pushbutton is pressed the screen will go back to the *ICMS Config* screen and any modifications made to the Restart Mode will be lost. If the *E* pushbutton is pressed then displayed Restart Mode will be saved as the Restart Mode and the screen will revert back to the *ICMS Config* screen. Section 3.2 discusses the implications of selecting either automatic or manual Restart Mode.

8.3.3. ReConfig Mode

This screen is used to set the Reconfiguration Mode. There are two options presented here, *AUT* or *MAN*. When the pushbutton next to *AUT* is pressed Reconfiguration Mode will change to *AUTO*. When the pushbutton next to *MAN* is pressed Reconfiguration Mode will change to *MANUAL*.

X	ReConfig Mode	E
		AUT
	MANUAL	MAN

Figure 7.3.3.1 Select Reconfiguration Mode Screen

If the *X* pushbutton is pressed the screen will go back to the *ICMS Config* screen and any modifications made to the Reconfiguration Mode will be lost. If the *E* pushbutton is pressed then displayed Reconfiguration Mode will be saved as the Reconfiguration Mode and the screen will revert back to the *ICMS Config* screen. Section 3.1 discusses the implications of selecting either automatic or manual Reconfiguration Mode.

8.3.4. PSW Failure

This screen is used to set the PSW Failure Mode. There are 3 options presented here, *TRIP*, *WARN* and *AUTO*. Press the button adjacent to the option, to make the selection.

X	PSW Fail Mode	E
		TRIP
	TRIP	WARN
		AUTO

Figure 7.3.4.1 PSW Failure Mode Selection Screen

If the *X* pushbutton is pressed the screen will go back to the *ICMS Config* screen and any modifications made to the PSW Failure Mode will be lost. If the *E* pushbutton is pressed then displayed PSW Failure Mode will be saved as the PSW Failure Mode and the screen will revert

back to the *ICMS Config* screen. Section 3.3 discusses the implications of selecting PSW Failure Mode as either a trip or a warning.

8.3.5. PSW Times

This screen contains a menu that allows the operator to select the PSW Time that is to be modified. There are two PSW Times, these are:

1. PreStart Time, and
2. PostStart Time.

8.3.5.1.PreStart Time

This screen allows the operator to enter the PreStart Warning time period. This time period can be any number in the range of 10 to 99 seconds. When the required time period has been entered pressing the *E* pushbutton will save this change and the *PSW Times* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the PreStart time will be lost.

8.3.5.2.PostStart Time

This screen allows the operator to enter the PostStart Warning time period. This time period can be any number in the range of 0 to 99 seconds. When the required time period has been entered pressing the *E* pushbutton will save this change and the *PSW Times* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the PostStart time will be lost.

8.3.6. Sequence Times

This screen contains a menu that allows the operator to select the Sequence Time that is to be modified. There are three Sequence Times, these are:

1. PreSequence time,
2. Sequence A Delay time, and
3. Sequence B Delay time.

8.3.6.1.PreSeq Time

This screen allows the operator to enter the PreSequence time period. This time period can be any number in the range of 0 to 99 seconds. When the required time period has been entered pressing the *E* pushbutton will save this change and the *Sequence Times* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the PreSequence time will be lost.

7.3.6.2 Sequence A Delay

This screen allows the operator to enter the Sequence A delay time period. This time period can be any number in the range of 0 to 99 seconds. When the required time period has been entered pressing the *E* pushbutton will save this change and the *Sequence Times* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the Sequence A delay time will be lost.

8.3.6.2. Sequence B Delay

This screen allows the operator to enter the Sequence B delay time period. This time period can be any number in the range of 0 to 99 seconds. When the required time period has been entered pressing the *E* pushbutton will save this change and the *Sequence Times* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the Sequence B delay time will be lost.

8.3.7. Comms Address

The ICMS Control Module's serial port supports the Modbus ASCII protocol. The Modbus ASCII protocol specifies that each device connected to this multi-dropped serial bus must have an address in the range of 00_{16} to FF_{16} . This screen allows the operator to enter that address. When the required address has been entered pressing the *E* pushbutton will save this change and the *ICMS Config* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the address will be lost.

8.3.8. Set Time

The Event Log and Last Stop Cause functions are time stamped and as such a valid time and date should be entered via this screen. Figure 7.3.8.1 shows the *Set Time* screen.

X	Set Time	15:06	E
↑			↑
←	05-Jul-99	15:06	→
↓		^	↓

Figure 7.3.8.1 Set Time Screen

The cursor ^ can be moved around by the ← and → pushbuttons. Once the desired field has been selected it can then be modified by the ↑ and ↓ pushbuttons. When the correct time and date have been entered the operator can save this by pressing the *E* pushbutton. If the operator wishes to abort the changes they may press the *X* pushbutton.

8.3.9. Admin Config

This screen contains a menu that allows the operator to modify advanced ICMS Module parameters. As such another layer of security has been provided in the form of another password. The password required to enter the *Admin Config* screen is 1234. From the *Admin Config* menu there are five available options, these are:

1. Diagnostics,
2. Initialisation Retries, and
3. Normal Retries.

8.3.9.1. Diagnostics

The Diagnostic screen is shown in figure 7.3.9.1.1. The second line of this screen displays information relating to the software release version and the release date of that revision. The scan time displays how often the ICMS End of Line is polled. The End of Line node is the only node that must be connected to the Brambus network. Therefore, the time taken between consecutive requests for data from the End of Line node is a good indication as to how fast the Brambus network is functioning. The last line shows how much memory has been used on the ICMS Control Module's uP Card. The amount of memory used depends on the configuration of the Brambus network.

```
DIAGNOSTICS 15:06
V4.84 04 Dec 2007
Scan Time 0880ms
RAM Usage 20.1%
```

Figure 7.3.9.1.1 Diagnostic Screen

8.3.9.2. Init Retries

This screen allows the operator to change the number of times the ICMS Control will try to communicate with a node during the Initialisation phase before it decides that there is no node at that address. The number of retries has a minimum value of one and a maximum value of five. When the required number of retries has been entered pressing the *E* pushbutton will save this change and the *Admin Config* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the Initialisation Retry count will be lost.

8.3.9.3. Norm Retries

This screen allows the operator to change the number of times the ICMS Control will try to communicate with a node during the normal operation before it decides that there is a DataComm error to the node at that address. The number of retries has a minimum value of three and a maximum value of ten. When the required number of retries has been entered pressing the *E* pushbutton will save this change and the *Admin Config* screen will be displayed. If the *X* pushbutton is pressed then this screen is exited and any changes made to the Normal Retry count will be lost.

8.4. ICMS Parameters

This screen is provided to allow operators who do not have access to the *ICMS Config* screen to view the operational parameters of the ICMS Control Module. The operational parameters that are displayed on this screen consist of the following:

Items	Notes
Restart Mode	
ReConfiguration Mode	
PSW Failure Mode	
PreStart Warning time	
PostStart Warning time	
PreSequence time	
Sequence A delay time	
Sequence B delay time	
Screen default time	
Modbus Address	
Number of detected Nodes	
Number of detected PreStart Warning modules	
Diagnostics (Factory use)	Added in v4.20
Diagnostics (Factory use)	Added in v4.20
Diagnostics (Factory use)	Added in v4.20
Diagnostics (Factory use)	Added in v4.20

8.5. ICMS Map

When selected this screen displays the current Brambus network configuration. Figure 7.5.1 shows the ICMS Map screen.

	01234567	89ABCDEF	
0	0CB-----	-----	↑
1	FHG-----	-----	↓
2	-8-----	-----	H

Figure 7.5.1 ICMS Map Screen

The ICMS Map is displayed in a matrix format. Each node on the Brambus network is represented by an alphanumeric character in this matrix. This alphanumeric character represents the type of node at this address. There is an *ICMS Map Help* screen available from the *ICMS Map* screen that displays all the alphanumeric characters along with a description as to what node type that character represents. Figure 7.5.2 shows a small portion of the *ICMS Map Help* screen.

ICMS HELP	15:06
8	Lanyard Node
A	Data Repeater
B	2T+2W Node

Figure 7.5.2 ICMS Map Help Screen

The ICMS Map is displayed using the format illustrated below in figure 7.5.3. The address of a node is broken up into two components, the most significant digit (MSD) and the least significant digit (LSD). In the example shown in figure 7.5.3 there is a Lanyard node at address 93_{16} . In this case the MSD is 9_{16} and the LSD is 3_{16} . The MSD and LSD are displayed on the *ICMS Map* screen to help in locating the node address and therefore the node type.

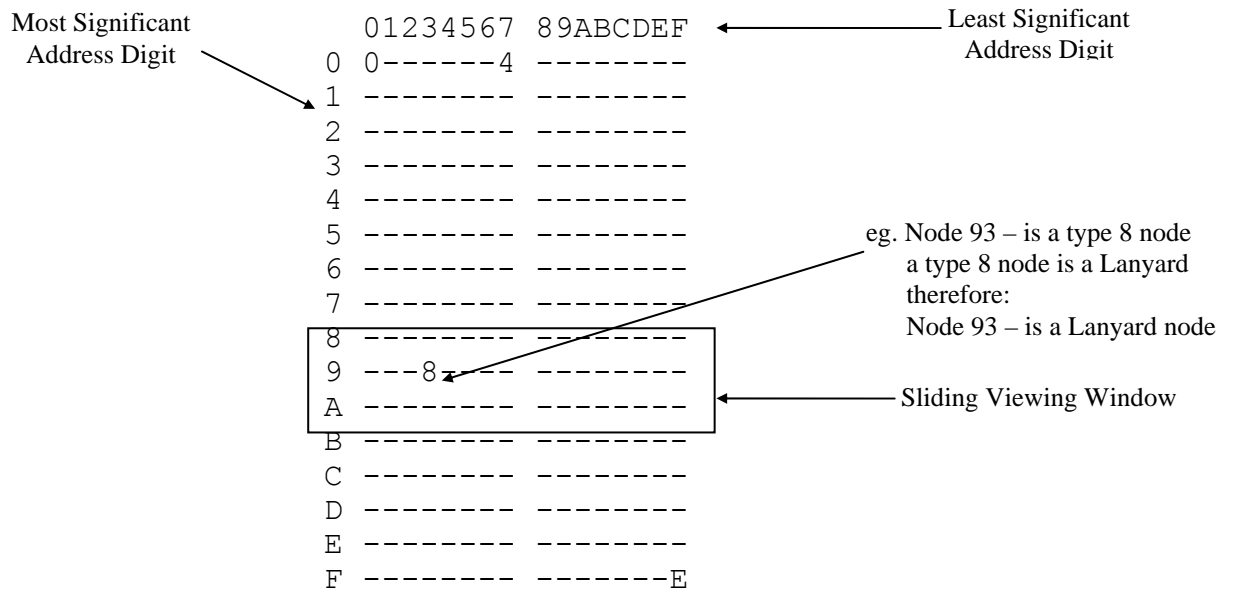


Figure 7.5.3 ICMS Map Screen Representation

8.6. PSW Module Map

The *PSW Module Map* screen displays the status of PreStart Warning modules connected to PreStart Warning Lanyard nodes. A screen similar to that used for the ICMS Map is used for the PSW Module Map. A matrix is again used to locate the address of the PreStart Warning Lanyard nodes, with the most significant digit shown in the first column of the display and the least significant digit shown in the top line of the display. There are three symbols presented in the PSW Module map, these are shown in table 7.6.1.

Symbols	Description
W	a PSW Lanyard node is present at this address and the connected PSW module performed its PSW functions correctly last start. (Pass)
X	a PSW Lanyard node is present at this address and the connected PSW module failed last start. (Fail)
?	a PSW Lanyard node has been detected at this address but there is no PSW module connected to this node.

Table 7.6.1 PSW Module Map Symbols

The information contained in table 7.6.1 is available in an abbreviated form on the *PSW Module Map Help* screen. This help screen may be viewed from the PSW Module Map by pressing the *H* pushbutton.

8.7. Line Parameters

The *Line Parameter* screen displays the current and voltages returned by the various nodes on the Brambus network. These parameters consist of:

Item	Notes
Barrier 1 Voltage In	
Barrier 1 Voltage Out	
Barrier 1 Current	
Barrier 2 Voltage In	Added in v4.20
Barrier 2 Voltage Out	Added in v4.20
Barrier 2 Current	Added in v4.20
Barrier 3 Voltage In	Added in v4.20
Barrier 3 Voltage Out	Added in v4.20
Barrier 3 Current	Added in v4.20
Barrier 4 Voltage In	Added in v4.20
Barrier 4 Voltage Out	Added in v4.20
Barrier 4 Current	Added in v4.20
Multi node with the lowest supply voltage	Added in v4.20
Multi node with the highest supply voltage	Added in v4.20
End of Line Voltage	

8.8. ReConfigure

The *ReConfigure* screen is shown in figure 7.10.1. This screen allows the user to ReConfigure or re-initialise the ICMS Control Module. If the *YES* option is selected the ICMS Control Module will reset and begin to search for nodes connected to the Brambus network. The only precondition for reconfiguring is that DR1 is off, ie. the conveyor is not running.

```

ICMS RECONFIGURATION
Perform ReConfig ?
<NO                YES>
NB.DR1 must be OFF

```

Figure 7.10.1 Reconfigure Screen

8.9. Last Stop Cause

The *Last Stop Cause* screen displays the reason why the ICMS Control Module stopped the conveyor. The last ten stops are available for display. Figure 7.11.1 shows the format of the *Last Stop Cause* screen.

```

LAST STOP    15:06  ↑
ENTRY #01    ↓
08/07/99 15:00:44
Run Enable Off

```

Figure 7.11.1 Last Stop Cause Screen

Using the ↑ and ↓ pushbuttons the operator is able to scroll through the last ten stop causes. The third line of display indicates the time at which the last stop cause was recorded whilst the last line indicates the cause of the stoppage. This screen is particularly helpful in determining the cause of intermittent stoppages.

A special case last stop cause is when a communication failure to a node on the Brambus network causes the conveyor to stop. As a DataComm fault can be the result of a number of causes the ICMS Control Module will perform the following checks to determine what the real cause of the stoppage is. The algorithm implemented in the ICMS Control Module is shown in figure 7.11.2.

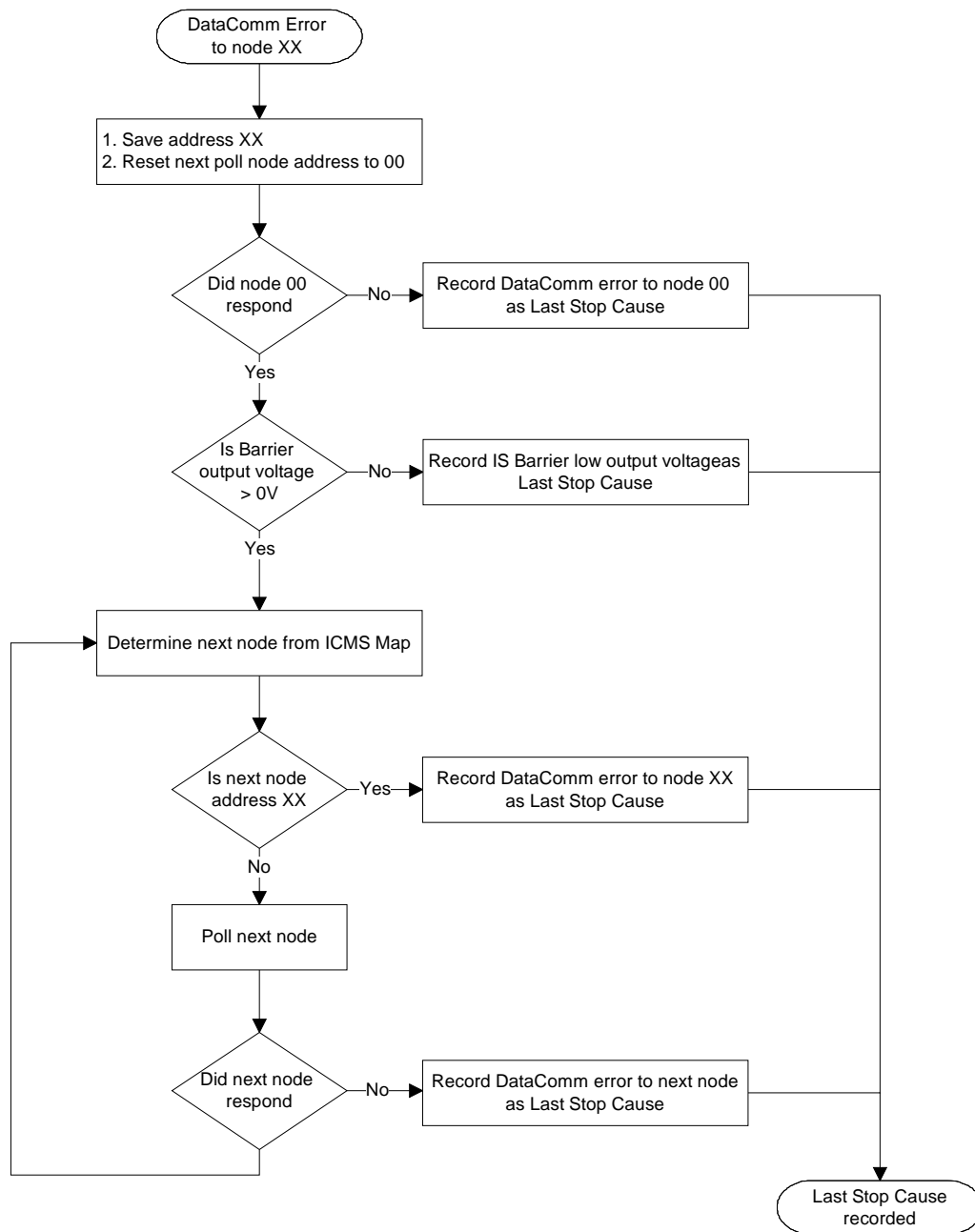


Figure 7.11.2 Last Stop Cause DataComm Algorithm

Using the algorithm shown in figure 7.11.2 it is possible to determine if the DataComm fault was caused by:

1. low voltage on B+ in the hazardous region (generally caused by a S/C between B+ and B- or B+ and Gnd)
2. the first node after an open circuit in the Brambus network cabling, or
3. a faulty node failing to respond.

8.10. Event Log

The *Event Log* screen displays all of the ICMS Control Modules I/O activity. The last fifty events are recorded, time-date stamped . Figure 7.12.1 shows the format of the *Event Log* screen.

```
EVENT LOG    15:06  ↑
ENTRY #01 TRIP ON  ↓
08/07/99 15:00:44
NODE:34 Lanyard
```

Figure 7.12.1 Event Log Screen

Using the ↑ and ↓ pushbuttons the operator is able to scroll through the last fifty events. The second line of the *Event Log* screen displays the event log entry number. If the event is an event that is classed as a trip or a warning condition then this will also be displayed on this line along with a message stating whether this condition has just occurred or has been cleared. The third line of display indicates the time at which the event occurred whilst the last line indicates the actual event.

9. Modbus

Refer to the ICMS Modbus Users Manual

10. Hardware

10.1.1. Wiring Conventions

The ICMS System operates over a 6-Core Armoured Cable. The Standard Colour Code adopted for the ICMS System is presented in the table below.

Colour	Conductor Size	Allocation	Description
Black	3.2mm ²	B-	Brambus -ve Supply
Blue	3.2mm ²	B+	Brambus +ve Supply
Red	0.75mm ²	DA	Brambus RS485 Data A Signal
White	0.75mm ²	DB	Brambus RS485 Data B Signal
Green	0.75mm ²	AUD	Audio Communication Signal (spare)
Yellow	0.75mm ²	SLC	Signal Line Control

Table 8.3.1.1 Bramco ICMS Wiring Colour Convention

10.1.2. External Connections

The External Wiring Connections of the ICMS Control Module Base is shown below in figure 8.3.2.1. External wires can either be connected to the terminals provided or directly into the connectors at the bottom of the ICMS Control Module Base.

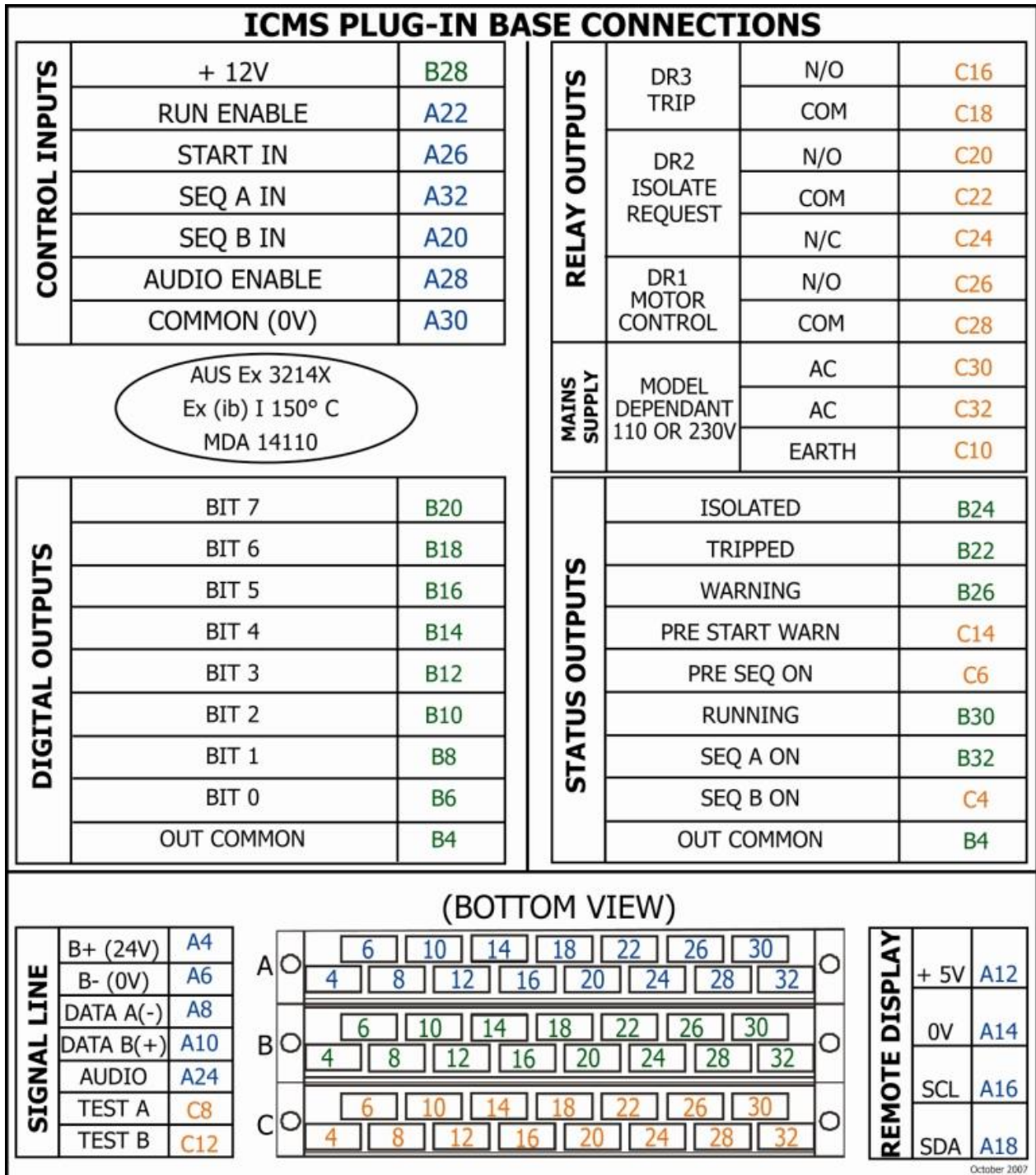


Figure 8.3.2.1 ICMS Control Module External Wiring Connections

A female DB25-pin connector is provided at the top of the ICMS Control Module. This DB25-pin connector provides access to:

1. The Multi-dropped RS485

The Local LCD Display may also be connected to DB25-pin connectors. The pin-out of the female DB25 connector is detailed below in table 8.3.2.1.

Pin No.	Allocation	Signal Description
2	RS485 (+)	Multi-dropped Receive Data (Modbus)
3	RS485 (-)	Multi-dropped Transmit Data (Modbus)
7	0V	Multi-dropped Ground (Modbus)

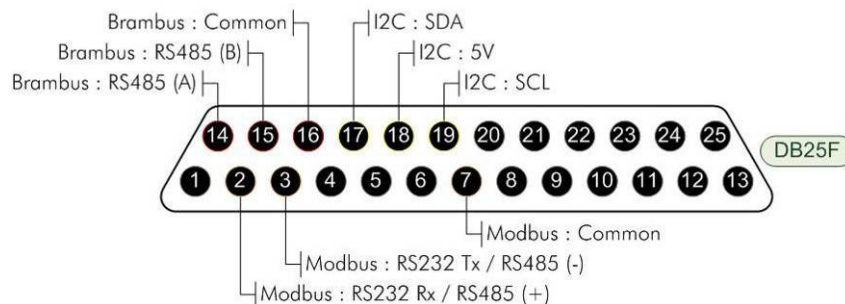
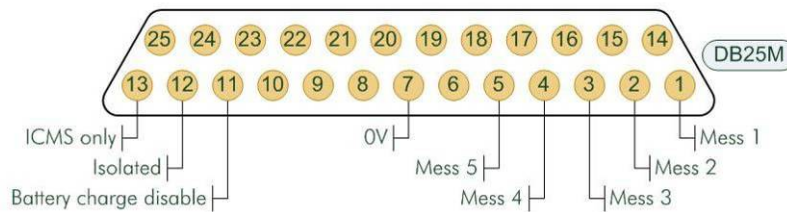
Table 8.3.2.1 Relevant Pinouts

The male DB25-pin connector at the top of the ICMS Control Module provides access to :

Pin No.	Allocation	Signal Description
11	AUX3	Battery charge disable

Table 8.3.2.2 Relevant Pinouts

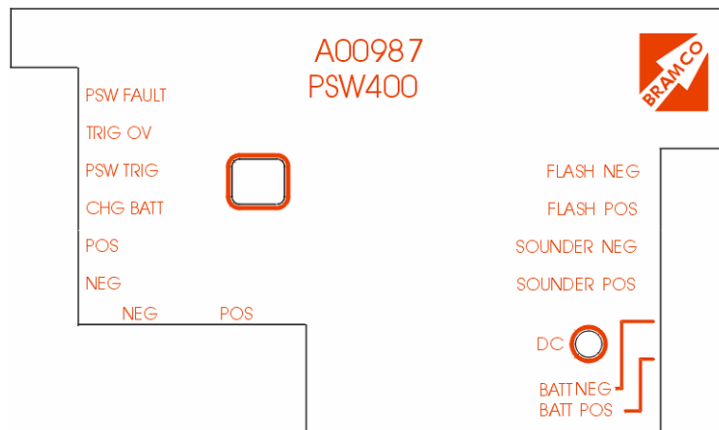
ICMS ENCLOSURE : TOP : REAR



11. PSW Module (PSW400)

The A00987 PSW400 module is designed to complement the functionality of the A00403 and A00980A pullkey nodes. The features of the PSW400 system are:

- Provides audible and visual prestart and poststart warning alarms
- Generates prestart warning success/fail feedback to ICMS
- Battery powered, with controllable battery recharging
- Wide range voltage tolerance: 16-48VDC
- Optically isolated inputs/outputs
- Low quiescent current draw of 1mA
- 0.6VA additional loading for battery charge (25mA @24V)



The three main functional operations of the PSW400 system are as follows:

Functionality – Prestart/poststart alarm

The PSW400 responds to a trigger signal provided by the A00980A or A00403 node. Whilst this trigger signal is activated, the PSW400 will sound the audible alarm (2x 100dB piezoelectric sirens) and the visual flashers.

Functionality – Prestart success/fail feedback

This function is twofold; it informs the connected node of the presence of a PSW device and also indicates to the broader ICMS system whether the PSW was successful or not.

To achieve both functions, the PSW400 uses the PSW FAULT connection. When the PSW400 module is connected to a node, the PSW FAULT line (which is connected to the PSW OK terminal on the node) pulls the PSW OK connection down from 5V to 0V. This signals to the node that there is a PSW device attached. When the node makes the ICMS aware of the PSW400 device (at initialisation), the ICMS can then include the PSW400 in the battery charging and PSW schemes.

While the PSW400 is being triggered and is generating a prestart alarm, it is also measuring feedback from the sirens and the flashers to ensure that they have operated correctly. If they have successfully operated, the PSW FAULT line is released from 0V (allowing the PSW OK terminal on the node to go back to 5V). The node uses this signal to indicate to the ICMS controller that the PSW400 unit has prestarted successfully. If the measurement circuit does not get the correct

feedback, it will not release the PSW FAULT line from 0V, indicating to the node that the prestart was unsuccessful.

Functionality – Battery / Capacitor charging

The PSW400 operates its prestart alarm from an external battery source (A00xxx or A00yyy). The battery charging introduces an additional 0.6VA loading on the power supply. For that reason, the battery charging may be switched on and off for individual PSW400 units by the ICMS control module to mitigate the loading effect of the battery charging. See section 6.1 for details.

To switch on battery charging, the A00980A or A00403 node connects the CHG BATT terminal to 0V. To turn battery charging off, the CHG BATT terminal is released from 0V (and allowed to return to the voltage on the POS terminal).

When the battery is charging, the DC LED will be illuminated.

Connections

The following table outlines the connections used in a typical installation with an A00980A node.

Terminal	Connect to...
NEG (on two-way)	Brambus 0V OR auxiliary 16-60V supply negative
POS (on two-way)	Brambus positive OR auxiliary 16-60V supply positive
FLASH NEG	Negative terminal of visual flasher alarm
FLASH POS	Positive terminal of visual flasher alarm
SOUNDER NEG	Negative terminal of siren
SOUNDER POS	Positive terminal of siren
BATT NEG	Negative terminal of battery
BATT POS	Positive terminal of battery
PSW FAULT	PSW OK terminal, A00980A node
TRIG 0V	Brambus 0V
PSW TRIG	PSW TRIG terminal, A00980A (Active high - 5V)
CHG BATT	CHARGE terminal, A00980A (Active low - 0V)
NEG (on six-way)	Brambus 0V
POS (on six-way)	Brambus positive

Installation Considerations

- There are two options for powering the PSW400 system. Either the 24V Brambus power lines or an external, auxiliary supply may be used on the main power terminals. If an external supply is being used, the customer may opt to permanently enable battery charging. This may be done by linking the CHG BATT and TRIG 0V terminals.
- Depending on the type of battery being used, a different battery voltage may be required. Use a jeweller's screwdriver to adjust the potentiometer on the front of the unit until the open-circuit voltage on the battery terminals is correct. Make this adjustment before a battery is connected. The unit is shipped with this voltage set to 12V.

12. Appendix A - ICMS System Part Numbers

ICMS Control Module Components and Accessories

Part No.	Description
A01002	ICMS Control Module
A00262	ICMS Local LCD Display Module

ICMS Barrier nodes

Part No.	Description
A00666B	ICMS Barrier (30V 850mA)

ICMS End of Line nodes

Part No.	Description
A00263D	ICMS End of Line node with SLC termination ,Reconfig, Sequencing

ICMS Sequence nodes

Part No.	Description
A00339C	ICMS Sequence B input node
A01003B	ICMS Sequence C output node
A01004B	ICMS Sequence D output node

ICMS Multi feature nodes

Part No.	Description
A00980A	ICMS Multi node

NB. These are basic Part Numbers and as such may be included in Assemblies with different resultant Part Numbers.