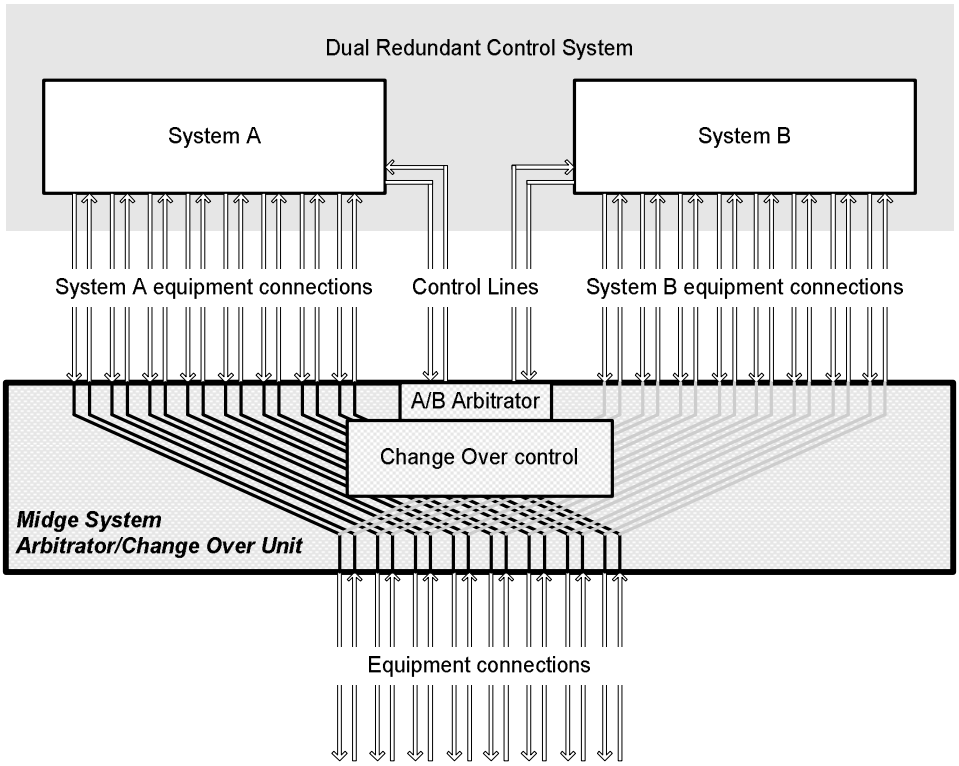
Integrated Arbitrator
And
8 Port Change Over Unit

Product Specification
Version 2.0
July 2006

1 Product Description

The Integrated Arbitrator and 8 Port Change-Over Unit provides a means of connecting a set of equipment connections to a dual redundant control system.



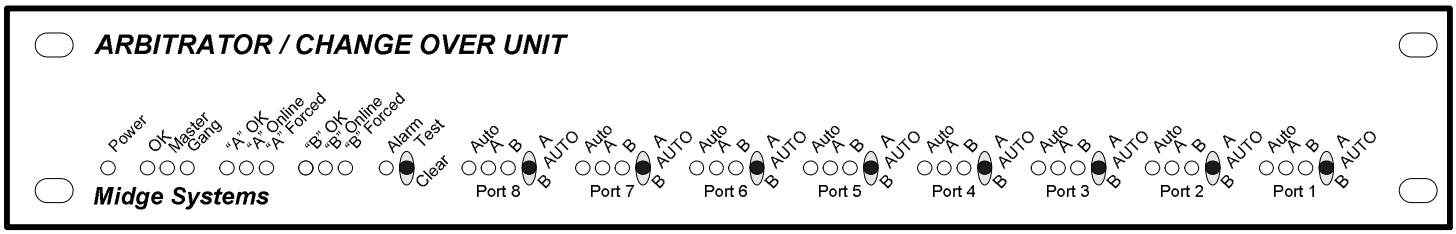
The Integrated Arbitrator and 8 Port Change Over Unit interfaces to a dual redundant control system by way of “Health” and “Force” signals from each of the control system sides. The microprocessor controlled arbitrator circuitry selects a system by analysing the systems’ signals and issuing an “Online” signal to the selected side. The Change Over circuitry then connects the selected side to the attached equipment connections by way of voltage free relay contacts.

A single Arbitrator / Change Over Unit provides 8 ports of 8 lines each (a total of 64 lines) of connectivity for low voltage low speed connections.

A total of eight (8) Arbitrator / Change Over Units can be cascaded together to provide a total switching capacity of 64 ports or 512 lines.

The Arbitrator / Change Over Unit can also be configured so that each port can be manually switched by a front panel toggle switch.

2 Front Panel



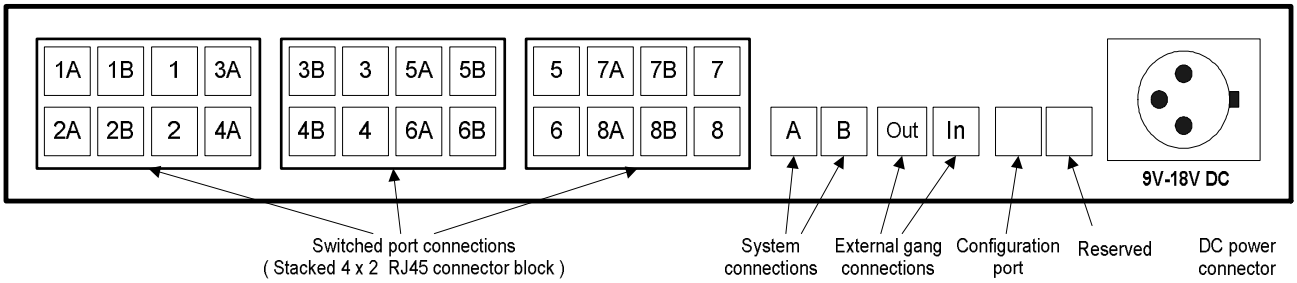
2.1 LEDs

Power	DC Power supplied to the unit when the LED is lit.
OK:	Indicates that the unit is operating correctly when flashing.
Master:	Indicates that the unit is operating in “Master” mode when lit.
Gang:	Indicates that the unit is operating in “Gang” mode when lit.
“A” OK:	Indicates the state of the attached system “Health” output line. When lit, the attached systems “Health” output is active.
“A” Online:	Indicates the state of the units online output line. When lit the online output is active.
“A” Forced:	Indicates the state of the attached system “Force” output line. When lit, the attached systems “Force” output is active.
“B” OK:	Indicates the state of the attached system “Health” output line. When lit, the attached systems “Health” output is active.
“B” Online:	Indicates the state of the units online output line. When lit the online output is active.
“B” Forced:	Indicates the state of the attached system “Forced” output line. When lit, the attached systems “Force” output is active.
Alarm:	Indicates the number of change overs that have occurred since last cleared.
Port LEDs:	
Auto:	Indicates that the port operating in automatic switching mode when lit.
A:	Indicates port A is selected when lit.
B:	Indicates port B is selected when lit.

2.2 Toggle Switch

Alarm Switch:	
Up position:	no function
Centre position:	no function.
Down position:	Clears alarm LED.
Switching Switch	
Up position:	Forces the selection of port A.
Centre position:	Automatic switching.
Down position:	Forces the selection of port B.

3 Rear Panel



3.1 Switched Port Connections

Connector: RJ45 – 8 Pins

Pin	Description
1	User defined
2	User defined
3	User defined
4	User defined
5	User defined
6	User defined
7	User defined
8	User defined

Each switched port consists of three (3) RJ45 connectors. (i.e. “1”, “1A” and “1B” for Port 1)

Each switched port provides 8 voltage free contacts between the switched port (i.e. “1”) and either the “A” or “B” ports (i.e. “1A” or “1B”). The selection of the “A” or “B” depends upon the arbitrator’s selection of the “Online” system.

3.2 System Connectors – A & B

Connector: RJ45 – 8 Pins

Pin	Description		Direction
1	n/c[1]		-
2	Health	(+5V to +12V)	Input
3	Force	(+5V to +12V)	Input
4	Ground		Ground
5	Online	(0VDC / 5VDC)	Output
6	OK	(0VDC / 5VDC)	Output
7	Other system OK	(0VDC / 5VDC)	Output
8	Ground		Ground

[1] No connection

3.3 Gang Port - Out

Connector: RJ45 – 8 Pins

Pin	Description	Direction
1	Control Output	Output
2	Cascaded Gang supply (from Gang In)	Output
3	Control Output	Output
4	n/c[2]	-
5	n/c	-
6	Gang supply	Output
7	n/c	-
8	n/c	-

3.4 Gang Port - In

Connector: RJ45 – 8 Pins

Pin	Description	Direction
1	Control Return	Output
2	Cascaded Gang supply	Input
3	n/c	-
4	n/c	-
5	n/c	-
6	n/c	-
7	n/c	-
8	n/c	-

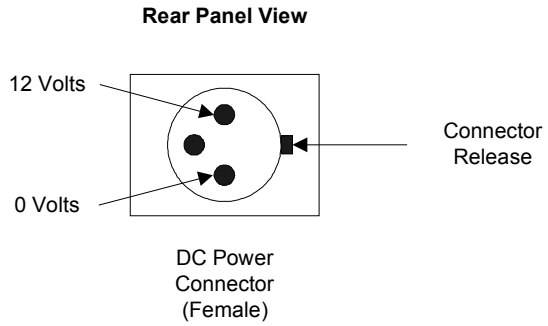
[2] No connection

3.5 Configuration Port

Connector: RJ45 – 8 Pins

Pin	Description	Direction
1	n/c[3]	-
2	n/c	-
3	TxD	Output
4	Gnd	Ground
5	n/c	-
6	RxD	Input
7	n/c	-
8	n/c	-

3.6 DC Power Connector



Chassis mounted receptacle: XLR 3 pole Female (Amphenol AC3FDZ)

Cable terminated plug: XLR 3 pole Male (Amphenol AC3M)

[3] No connection

4 Mode of Operation

The Integrated Arbitrator and 8 Port Change Over Unit can operate in either one of two modes. These modes are:

- Automatic System Controller Port Switching - arbitrator function, and
- Manual Port Switching - no arbitrator function.

The operational mode selection is made by changing the units operating parameters via the RS232 configuration port.

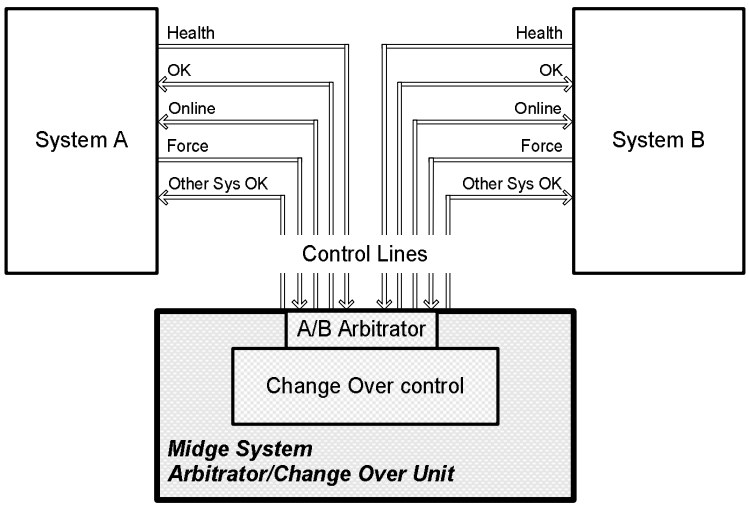
4.1 Automatic Operation

The Arbitrator / Change Over Unit operates in automatic mode by selecting "Gang Master" or "Gang Slave" configuration options via RS232 configuration port[4].

The following description describes the operation of the Arbitrator / Change Over Unit when "Gang Master" option has been selected. The "Gang Slave" option is described in section 4.1.6.

When the Arbitrator / Change Over Unit operates in automatic mode, the unit interfaces with the dual redundant control system via a set of control signals.

These control signals, show in Section 3.2, are Health, OK, Online, Force and Other System OK.



For the Arbitrator / Change Over Unit to operate in automatic mode, the Port 1 toggle switch must be placed in the middle, or "Auto" position.

If the Port 1 toggle switch in not placed in the "Auto" position, the internal arbitration logic is by-passed and all ports are switched to the side indicated by the toggle switch.

Toggle switches 2 though to 8 have no function in this mode of operation.

[4] When "Gang Master" mode is selected both the Master and Gang LEDs are lit on the front panel. When "Gang Slave" is selected, only the Gang LED is lit.

4.1.1 Control Signals - Health and OK

In order to determine the status of the attached control system, the Arbitrator / Change Over Unit monitors the “Health” signals generated by each side of the control system.

The Arbitrator / Change Over Unit checks the “Health” signal’s state against the unit’s configured parameters to determine if the attached control system side is ready to connect to the equipment connections.

If an attached control system side is “Healthy” the Arbitrator / Change Over Unit indicates this by:

- Lighting the “OK” LED on the front panel, and
- Grounding (0VDC) the “OK” output. [5]

If the control system is NOT “Healthy”, then:

- The front panel LED will be OFF, and
- The “OK” output signal will be +5VDC [6]

4.1.2 Control Signals - Online

After determining the state of each attached control system side, the Arbitrator / Change Over Unit then selects which control system side is to be set to “Online” and then connects to the selected equipment connections. The rules for Online selection are:

- If only one side is health, this side is selected for connection to the equipment,
- If two sides are healthy, then the first side to be measured healthy will be selected,
- On Arbitrator / Change Over Unit power-up, with both sides healthy, Side A will be selected.

On selection of the side, all relays within the unit will be switched to the selected side.

The Online control signal operates as follows:

- Online : Grounded (0VDC) [7]
- Offline : +5VDC [8]

[5] This signal is able to sink 25mA
[6] Internally pulled up to 5VDC via a 4k7 resistor
[7] This signal is able to sink 25mA
[8] Internally pulled up to 5VDC via a 4k7 resistor

4.1.3 Control Signals - Force

A second output from the attached control systems can be used to select the Online system. This control signal is called the “Force” signal.

The Force signal is used to bypass the Arbitrator / Change Over Units automatic selection of an Online side.

When an attached control system asserts the Force signal, the Arbitrator / Change Over Unit uses the following rules for side selection:

- If only one side has a Force signal that is active, this side is selected as Online,
- If both sides have their Force signal active, then the current Online side will remain Online,
- On Arbitrator / Change Over Unit power-up, if both sides have their Force signal active, Side A will be selected.

4.1.4 Control Signals - Other System OK

One additional control line is used between the attached control systems and the Arbitrator / Change Over Unit. This signal indicates the state of the other control systems “OK” signal.

This control line allows each attached control system to monitor the health of the “Other system”.

The “Other System OK” control signal operates as follows:

- Online : Grounded (0VDC) [9]
- Offline : +5VDC [10]

4.1.5 Configuration Options

When the Arbitrator / Change Over Unit is configured for automatic operation, a number of options exist relating to the two input control signals Health and Force.

4.1.5.1 Input Signal Type

The Arbitrator / Change Over Unit can accept these signals as either

- a static voltage – “Level” signal, or
- a toggling input – “Pulsed” signal

When “Level” is selected, the Health and Force signals are only considered active when a positive dc voltage is attached to these inputs.

When “Pulsed” is selected, the Health and Force signals are only considered active when these signals toggle from 0VDC to a positive voltage and return to a 0VDC.

Note : The input voltage level must be in the range of +5VDC to +12VDC. A voltage greater than +12VDC will permanently damage the equipment.

[9] This signal is able to sink 25mA
[10] Internally pulled up to 5VDC via a 4k7 resistor

4.1.5.2 Healthy Period

A second configuration item relating to these input signals is the “Healthy period”. This is the time period that the signal must remain active before the Arbitrator / Change Over Unit recognises the signal as valid and can perform a change over.

The “Healthy period” value is used to restrict the system from changing over to quickly and reduces the problem of “flip-flopping” from side to side, under some system failure conditions.

For a “Level” signal, this means that the signal must remain active, or at +5 to +12VDC for greater that the configured time period.

For a “Pulsed” signal, this means that the signal must continue to toggle for greater that the configured time period.

4.1.5.3 Health Pulses

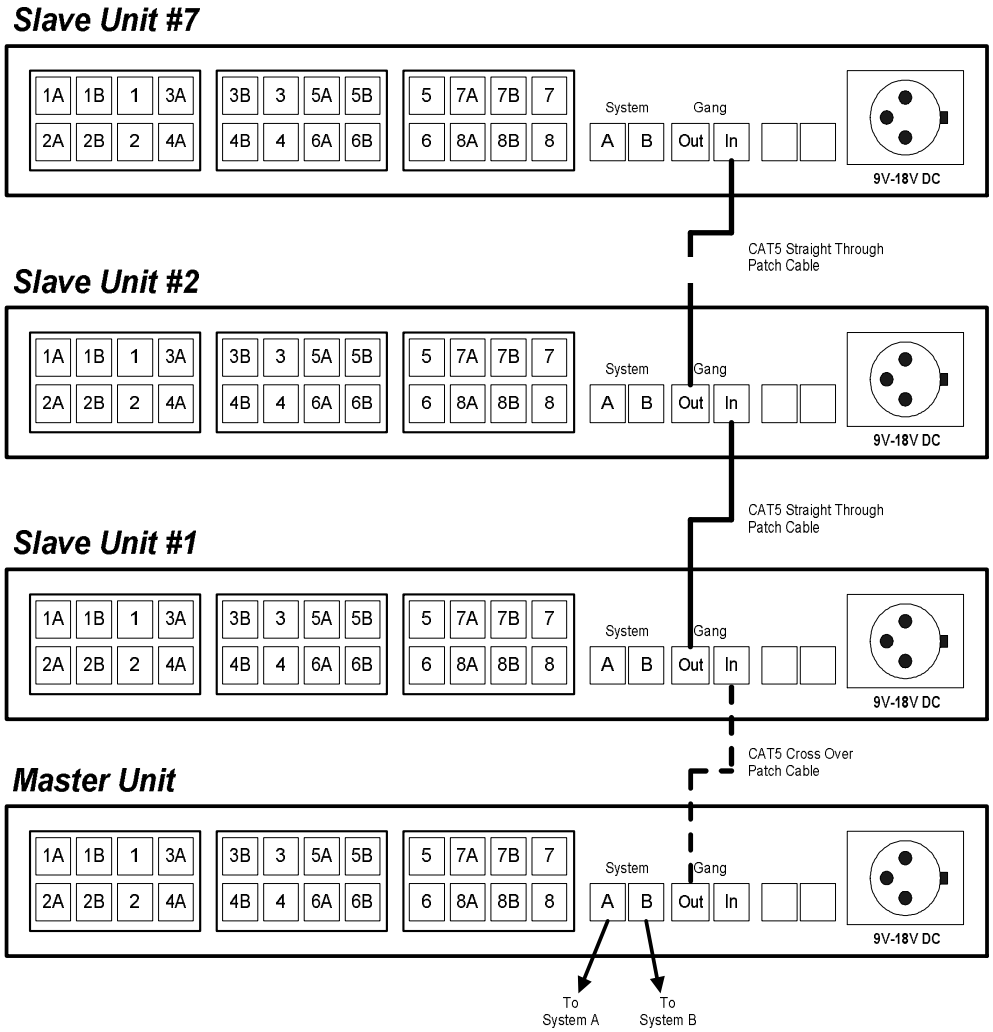
When “Pulsed” is selected as the input signal type, a toggle frequency value defines the toggle rate per second that is required before the Arbitrator / Change Over Unit recognises the signal as a valid input.

If the attached control system toggles the input signals at a rate slower that the configured value, the Arbitrator / Change Over Unit will not recognise the signal as active and will not act upon it.

4.1.6 Gang Slave Configuration Option

In order to allow a dual redundant control system to interface to up to 64 lines, eight Arbitrator / Change Over Units can be cascaded together to allow selection of up to 512 lines.

This is achieved by cascading up to seven “Slave” Arbitrator / Change Over Units to a “Master” unit. The units are cascaded using interconnecting cables connected to the “Gang Out” and “Gang In” ports on each unit, as depicted below.



Slave mode operation is selected from via the RS232 configuration port. Slave mode has no configurable parameters.

4.2 Manual Operation

The Arbitrator / Change Over Unit operates in manual mode by selecting the “Individual Control” configuration option via RS232 configuration port[11].

When the Arbitrator / Change Over Unit operates in manual mode, no interfaces connections are required to any control systems.

Each of the 8 ports on the Arbitrator / Change Over Unit is directly controlled from the front panel toggle switch designated for each port.

For the Arbitrator / Change Over Unit to operate in this mode, the attached control system must be able to cope with each port being individually switched.

[11] When “Individual Control” mode is selected both the Master and Gang LEDs are off,

5 Unit Operation

5.1 Power Up

When the Arbitrator / Change Over Unit is powered up the following LEDs are lit for 5 seconds.

- Power,
- OK,
- Master,
- Gang,
- "A Online", and
- Auto and "A" on each port.

The "OK" LED will flash fast for 5 seconds.

This indicates that the Arbitrator / Change Over Unit is ready to accept a firmware download on the configuration port, if initiated.[12]

5.2 "OK" LED

After the 5 second initialisation period the unit will begin to operate in the mode previously configured.

If the unit has been previously configured, and all configuration values are valid, the "OK" LED will flash once per second. This is the normal expected operation of the unit.

If the "OK" LED is not flashing once per second, then the unit is not operating in a configured mode. This can be cause by two situations:

- The configured mode or parameters are invalid.
- The unit has entered the configuration or maintenance mode via the RS232 configuration port.

If the configured mode or parameters are invalid, the configured mode of the unit must be reprogrammed via the RS232 configuration port.

If the unit is in the configuration or maintenance mode, this mode must be exited before the unit will commence operating in the configured mode.

[12] From time to time, Midge Systems may release new versions of the Arbitrator / Change Over Unit's firmware. Firmware updates contain improvements and fixes to problems that may have existed. Contact with Midge Systems to check if there is a new firmware update available.

5.3 "Alarm" LED

The Alarm LED provides a visual indication that a changeover has occurred.

The alarm LED will operate as follows:

- If there have been no changeovers, the LED will remain off.
- If more than 10 changeovers have occurred, the LED will remain on.
- If between 1 and 10 changeovers have occurred, the LED will:
  - flash the number of changeovers,
  - wait 7 seconds,
  - then flash the number of changeovers, and
  - repeat this sequence.

To clear the Alarm LED, switch the alarm toggle switch to the clear position and then return it to the centre position.

If the Alarm LED function is not required, the alarm toggle switch can be left in the clear position. This will disable the Alarm LED from displaying the changeover count.

5.4 "Master" & "Gang" LEDs

The Master and Gang LEDs indicate the operational mode of the unit.

The operational mode can be determined by decoding the following LED combinations.

	Operational Mode	Automatic Mode Gang Master	Automatic Mode Gang Slave	Manual Mode Individual Control
Master LED		ON	OFF	OFF
Gang LED		ON	ON	OFF

5.5 "A OK", "A Online", "A Force", "B OK", "B Online", "B Force" LEDs

These LEDs display the input and output status of the unit.

The "A OK", "A Force", "B OK" and "B Force" LEDs are only lit when active signals have been received from the attached control systems. The LEDs remain lit whilst the input signals remain active.

The "A Online" and "B Online" LEDs indicate the selected side.

Note that an "A Online" or "B Online" will be lit even if no "OK" or "Force" LEDs are lit.

The Arbitrator / Change Over Unit will always indicate that the equipment connections of one side have been selected, even if both systems are not ready.

5.6 "Auto", "A" & "B" LEDs

The "Auto", "A" and "B" port LEDs display the status of each port.

The "Auto" LED is lit when the port is operating in automatic mode.

The "Auto" LED off when
- the associated port switch is toggled to the "A" or "B" position, or
- the port is operating in manual mode.

The "A" and "B" LEDs are lit when the side is selected, either from the switch or automatically.

5.7 Toggle Switches

5.7.1 Alarm toggle switch

The Alarm toggle switch is used to clear the Alarm LED changeover indicator.

When this switch is toggled down, the changeover indicator count is cleared and the Alarm LED is switched off.

An upward toggle of this switch has no effect.

5.7.2 Port toggle switch

The port toggle switch is used to select the side of the associated port.

When the unit is operating in Gang Master mode, only the Port 1 toggle switch is operational. This switch selects the function of all ports on the Master unit and any attached slave units.

When it is placed in the "Auto" position, the internal arbitrator selects the side for all ports.
When it is placed in the "A" position, the "A" port is selected for all ports.
When it is placed in the "B" position, the "B" port is selected for all ports.

When a unit is configured as a Gang Slave, no toggle switches are operational.

When a unit is configured for Individual Control, each switch controls the function of its associated port.

6 Configuration Menus

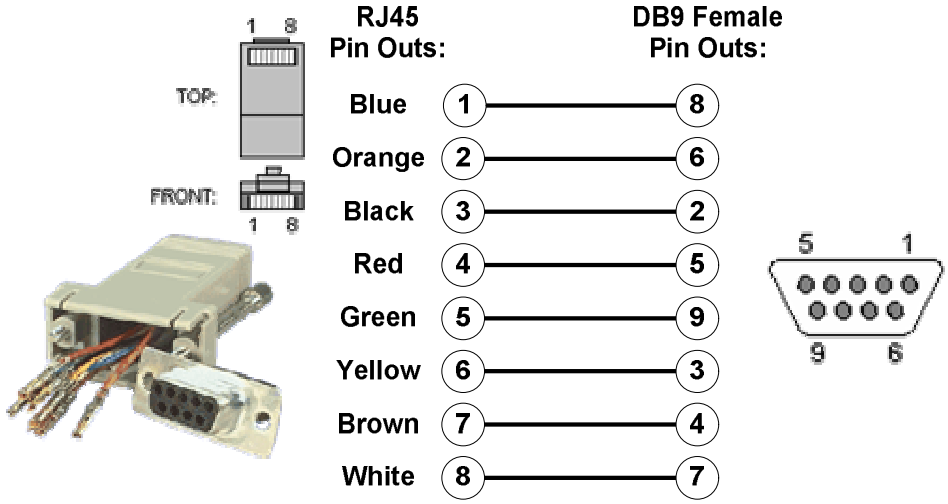
6.1 Accessing the configuration port

The Arbitrator / Change Over Unit is configured via the RS232 configuration port using a PC/laptop running a terminal program, configured to 115,200 bps, 8 Data bits, No Parity, 1 Stop Bit and "No flow control".

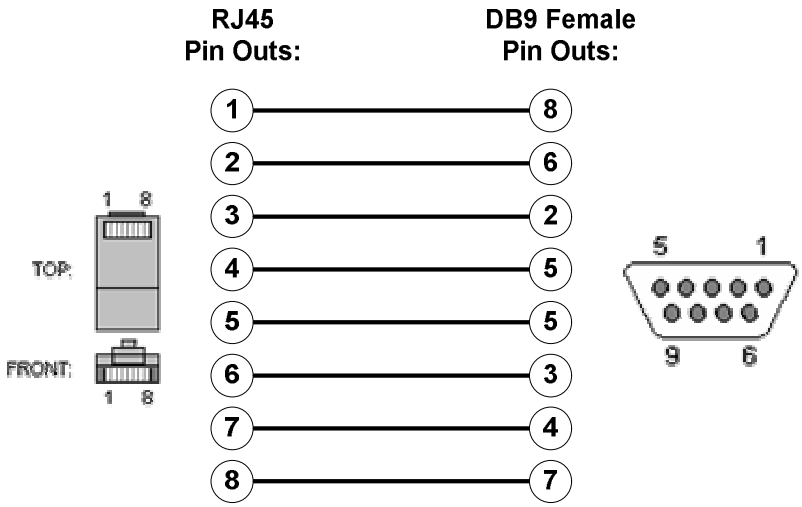
Accessing the configuration port requires a special cable to allow connection between the PC and the Arbitrator / Change Over Unit's RJ45 configuration port.

The cable can be constructed by:

1) Using a RJ45 Female to DB9 Female adaptor, assembled as illustrated below, and a straight through Ethernet patch cable.



2) Constructing a cable as illustrated below:



6.2 Start- up Messages

The following section displays the start up messages that will be displayed on the configuration terminal after power has been applied to the unit.

All messages consist of the following structure.

Displayed Message	***Message Description***
^	Software update initialisation character
COU Reset	COU reset message
Operational Mode	Operational Mode message
XXXXXXX	Mode Specific messages

6.2.1 Gang Master Mode

```
^
COU Reset
Operational Mode  OK   - Gang Master mode
CS1-H [   0] CS2-H [   0]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [   0] CS2-H [   0]   CS1-F [   0] CS2-F [   0]   CS1 Online
```

The mode specific message indicates the status of the inputs to the Arbitrator / Change Over Unit and which Control System (CS) is currently selected as “Online”.

A breakdown of the message elements is listed below.

- CS1-H Control System 1 (Port A) Health signal
- CS2-H Control System 2 (Port B) Health signal
- CS1-F Control System 1 (Port A) Force signal
- CS2-F Control System 2 (Port B) Force signal

The value contained within the square brackets indicates the Arbitrator / Change Over Unit interpretation of the input signal.

“Level” Inputs

A value of 0 indicates that this input is *not* active
A value of 1 indicates that this input is active

“Pulsed” inputs

The value indicates the number of pulses per second that the unit has received.

Below are a few examples of the mode specific messages displayed in Gang Master mode.

```
CS1-H [  32] CS2-H [   0]   CS1-F [  32] CS2-F [   0]   CS1 Online
```

The health signal from Control System 1 toggled 32 times in one second. No other input signals toggled. The unit has selected CS1 as the online system.

```
CS1-H [  32] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [  15] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [   0] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [   0] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [   0] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [   0] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS1 Online
CS1-H [   0] CS2-H [  32]   CS1-F [   0] CS2-F [   0]
Number of changeover event = 1  CS2 Online
CS1-H [   0] CS2-H [  32]   CS1-F [   0] CS2-F [   0]   CS2 Online
```

The health signal from Control System 1 stopped toggling. The health signal for Control System 2 continued to toggle at 32 toggles per second. After 5 seconds the unit changed over from CS1 to CS2.

6.2.2 Gang Slave Mode

```
^
 COU Reset
 Operational Mode  OK   - Gang Slave mode  CS1 Online Slave Mode
  CS1 Online Slave Mode
  CS1 Online Slave Mode
```

6.2.3 Individual Control

```
^
 COU Reset
 Operational Mode  OK   - Individual Control mode
```

6.2.4 Start-up Message – Invalid Configuration Parameters

If upon start up the Arbitrator / Change Over Unit detects an invalid configuration parameter, a start-up message displays the invalid parameter(s) and the “OK” LED stops flashing.

```
^
 COU Reset
Invalid < Input type >
Invalid < Healthy pulses >
Invalid < CS Healthy period >
 Operational Mode configuration Error !!!!!!!!!
```

6.3 Configuration and Diagnostic Menus

Once connection to the configuration port has been made, two menu options are available.

- "P" – Programming / Configuration Mode
- "M" – Diagnostics Menu.

6.3.1 Programming Mode

The Programming Mode is entered by pressing the "P" key on the configuration terminal screen. The following messages will be displayed, allowing configuration of the unit.

```
Midge Systems - Arbitrator / Change Over Unit (Rev 1.4)
 Set Parameters
Operational Mode
 Options : 0 = Gang - Master
           1 = Gang - Slave
           2 = Individual Control
Current setting  <   Gang - Master   > =


Health Input Type
 Options : 0 = Pulsed
           1 = Level
Current setting  <       Pulsed      > =


Health Pulses
 Options :  1 - 100 (per second)
Current setting  < 5 > =


CS Healthy Period
 Options :  1 - 30 (seconds)
Current setting  < 5 > =
```

After each message is displayed, a configuration parameter can be entered. The current configuration is displayed in the < > brackets.

If the configuration is needed, the new value is entered, otherwise the Escape key <ESC> or Enter <CR> will make no configuration change.

The configuration messages displayed are dependent upon the Operational Mode selected. For example, if "Individual Control" is selected no other configuration options are displayed.

6.3.2 Diagnostics Menu

The Diagnostics Menu is entered by pressing the “M” key on the configuration terminal screen. This menu allows manual testing of a number of Arbitrator / Change Over Unit functions. The following message will be displayed.

```
Entering Manual mode

   Manual Mode
 1  to toggle OK LED
 2  to toggle Master LED
 3  to toggle Gang LED
 Q  to toggle Alarm LED
 ]  to toggle Auto 1
 [  to toggle Auto 2
 P  to toggle Auto 3
 O  to toggle Auto 4
 I  to toggle Auto 5
 U  to toggle Auto 6
 Y  to toggle Auto 7
 T  to toggle Auto 8
 '  to toggle COU 1
 ;  to toggle COU 2
 L  to toggle COU 3
 K  to toggle COU 4
 J  to toggle COU 5
 H  to toggle COU 6
 G  to toggle COU 7
 F  to toggle COU 8
 0 to test serial 2
 Z  to toggle CS1 CS2 OK
 X  to toggle CS1 OK
 C  to toggle ONLINE
 M  to toggle CS2 CS1 OK
 N  to toggle CS2 OK
 ,  to toggle CS1 FORCE
 .  to toggle CS2 FORCE
 9  to toggle Gang Output
 V  to get a snap shot of the CS inputs
 5 to read switch inputs (1 and 5)
 6 to read switch inputs (2 and 6)
 7 to read switch inputs (3 and 7)
 8 to read switch inputs (4 and 8)
 W to read alarm switch
 A to force ALL to A side
 B to force ALL to B side
 E  to exit
 ?  for this message
```

7 Specifications

Features:

Integrated Arbitrator and 8 port Change Over
Microprocessor controller switching
Manual force switch
19" Rack Mount Chassis

Switched Port:

Contacts	8 voltage free contacts per port
Ports	8 ports per unit

Expansion:

Cascade limit	8 units

Operational Modes: Gang Switch Master
Gang Switch Slave

Configuration: 3 wire RS232 via dumb terminal
(115200 baud)

Environmental:

Temperature	0°C to 55°C
Humidity	0 to 95% Non-condensing
MTBF	56, 948 hours (MIL-HDBK-217F – Notice 2)

Mechanical:

1RU 19" Rack mount

Width	492mm
Height	44mm
Depth	150mm
Weight	3.0Kg

Power Requirements:

Input power	12V DC @ 800mA
Input voltage range	9V DC to 18V DC

Self reset-able fuse
Reverse polarity protection
Input voltage protection

Order information:

Part number	ARB-COU-12RM

8 Document Revision

Version 2.0	July 2006	Document re-write
Version 1.1	July 2004	Added Configuration and Installation
Version 1.0	June 2004	Initial Release

9 Contact Details

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