BLACK PEAR

BMS Interface for
Mitsubishi Electric
City-Multi
Air-Conditioning

Installation and User Guide

*micro***trol**

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Contents

1. Supplied Parts

Black Pear with display

or

Black Pear without display

USB cable

Cat-5 'Straight-Through'
Ethernet cable

DIN-rail clips

2. Important Information

- ➤ **All electrical work should be carried out by a competent person and wiring must be in accordance with the national electrical installation regulations.**
- ➤ **Ensure that installation work is done correctly using the information contained in this manual.**
- ➤ **Make all connections securely so that any outside forces acting on the cables are not applied to the terminals.**
- ➤ **Never modify or repair the Black Pear by yourself.**
  Any attempt to do so will void the warranty.
- ➤ **To dispose of this product, consult your dealer.**

> **This unit will require setting up, using the free configuration software available on our website.**
> **Please go to www.microtrol.co.uk and click on the 'Support' link.**

3. Product Overview

The Black Pear allows a building management system (BMS) to monitor and control air-conditioning units on a Mitsubishi city-multi system without the need for a central controller.

The unit incorporates a port which allows direct connection to the Mitsubishi M-Net network and allows up to 50 groups to be monitored and controlled.

There are 2 hardware variants, one with an LCD display and one with LED indicators. The display version also includes a simple keypad. providing convenient local control.

There are 3 models, each available with or without a display, providing different protocol solutions:
MM-50,MM-50D   Modbus RTU via RS232 / RS485 and Modbus/TCP.
MB-50,MB-50D   BACnet/IP.
MT-50,MT-50D   Trend via ethernet. (Also requires an IQ3/4 outstation with spare memory).

> The BACnet and Trend models also have Modbus available

The Black Pear can also be used on systems where a G-50A, GB-50A or AG-150 central controller is already present.

3.1 Product Variants

With Display
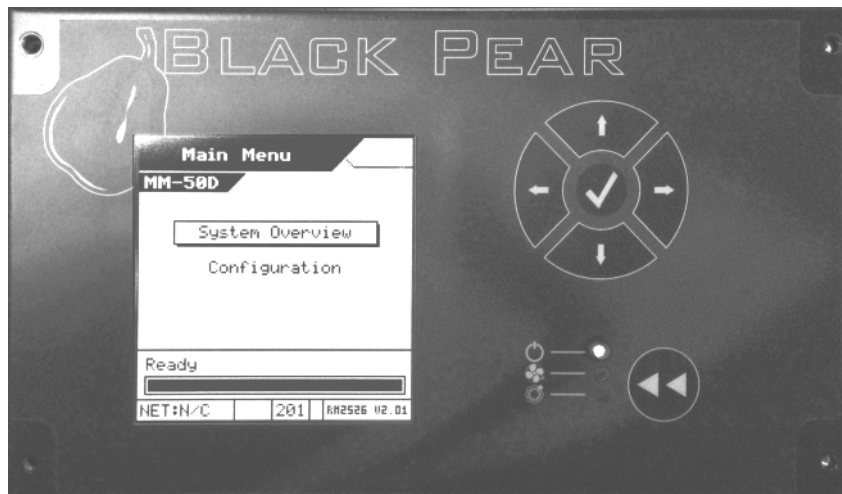
Without Display
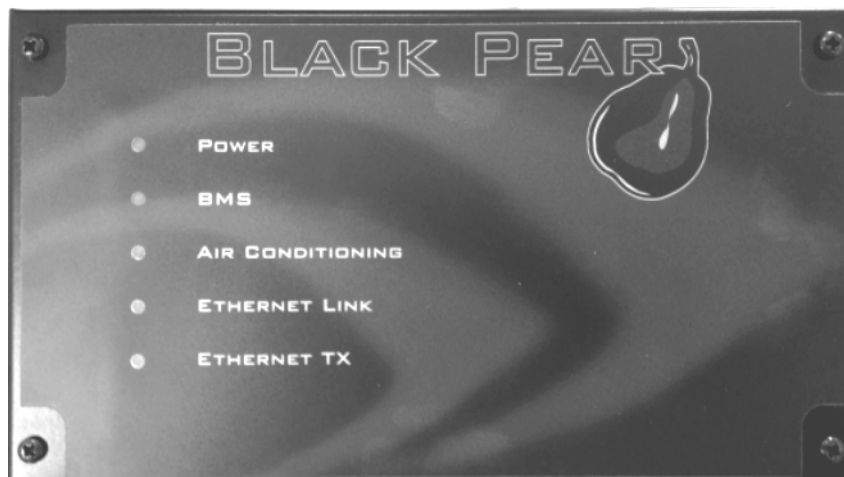
4. Connection Details

> **All electrical work should be carried out by a competent person and wiring must be in accordance with the national electrical installation regulations.**
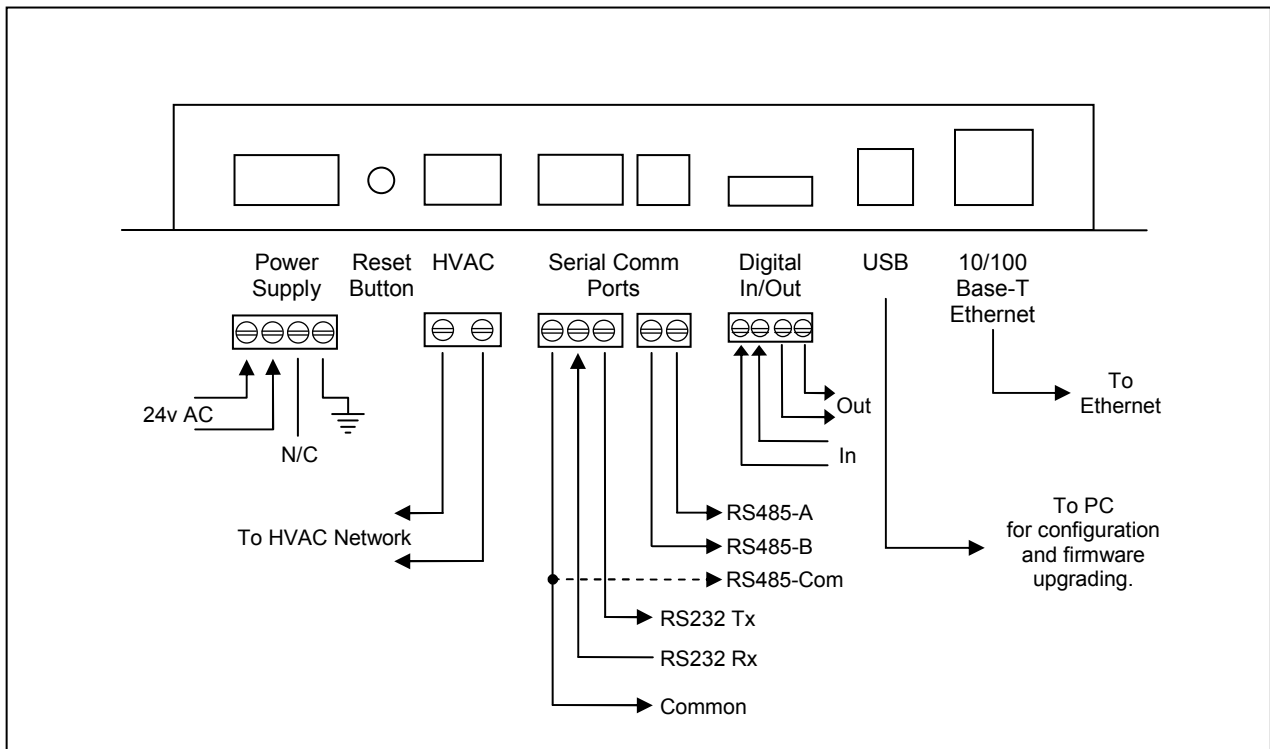
Fig. 1 Connection Details

4.1 Power Supply

The Black Pear requires a 24v AC supply and has a consumption not exceeding 5VA. The internal fuse is rated T630mA.

> **THIS EQUIPMENT MUST BE EARTHED**

4.2 HVAC Communications Network (M-Net)

Connect to the centralised control line, which is connected to TB7 of the outdoor unit. These are non-polarized.

> **Do not connect to the indoor unit control line, which is connected to TB3 of the outdoor unit.**

4.3 Serial Communications Ports

These connectors provide access to the Modbus registers using RS232 or 2-wire RS485. The port configuration is as follows:

Modbus RTU
9600 baud, 8 data bits, no parity, 1 stop bit
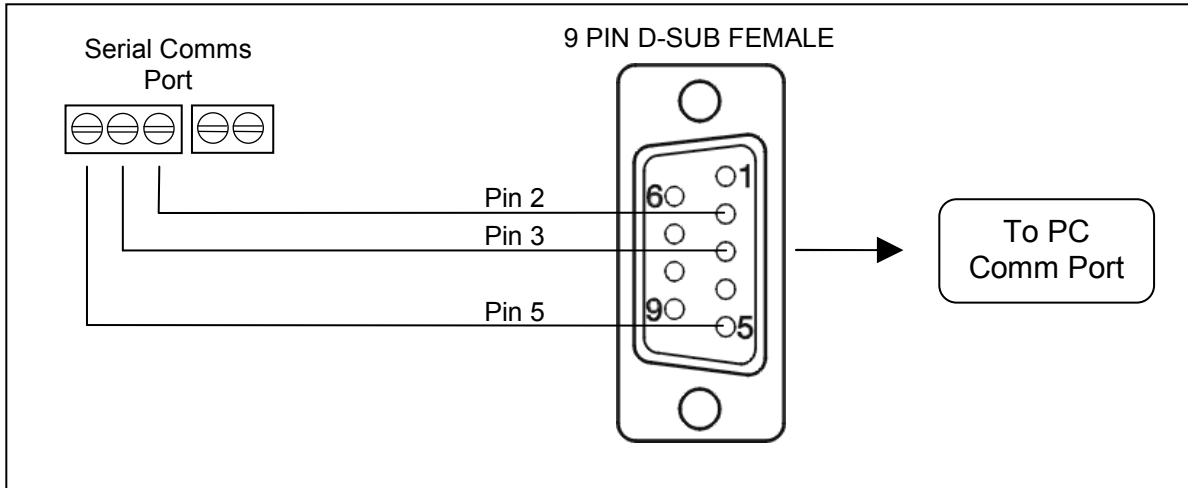
Fig. 2 RS232 Comms Lead Wiring Diagram

The RS485 interface can be used on a compatible serial communications network shared by multiple RS485 devices. The 'Base Slave Address' must be set to prevent multiple units using the same slave numbers.

It is recommended that screened twisted-pair cable is used.
RS485-A is the non-inverting signal and is also named RS485+
RS485-B is the inverting signal and is also named RS485-
Common should be connected to the cable screen.
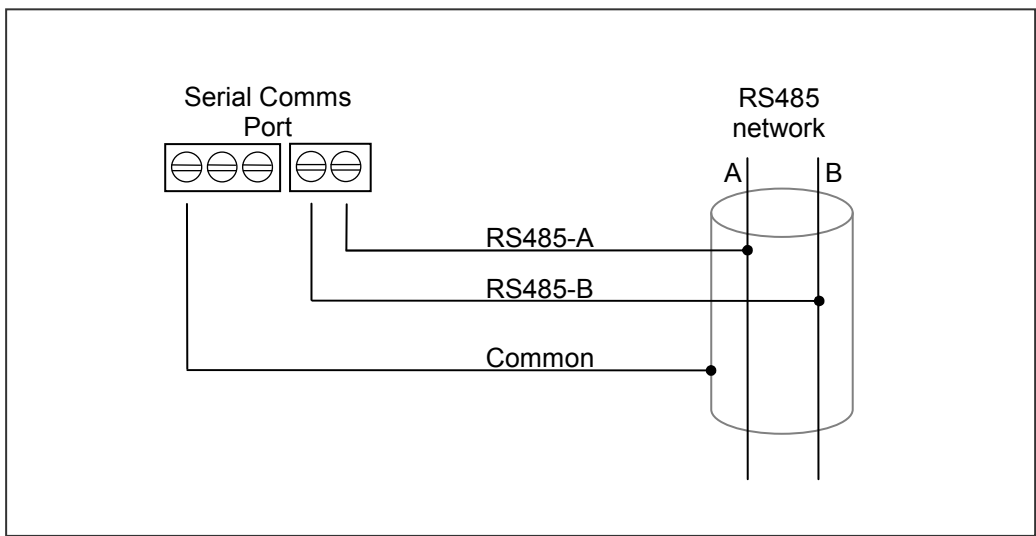
Fig. 3 RS485 Comms Lead Wiring Diagram

4.4 Digital Input / Output

As of firmware v2.27, the digital input functions as the 'Global Forced Off' signal. This is a normally-closed, volt-free signal.

Upon detecting an 'Open' input, all available fancoils will be switched off and their remote-controllers will be inhibited. These settings are refreshed every 10 seconds while the input is 'Open'.

When the input is subsequently 'Closed', the remote-controller inhibits are removed, but the fancoils remain off.

The digital output currently has no functionality.

4.5 USB

The USB interface is used for configuration via a PC and for upgrading the firmware.

> **Ensure that the correct USB driver has been installed prior to connecting the Black Pear to a PC.**

4.6 Ethernet

The Black Pear is a 10/100Base-T half/full duplex device. It supports auto-negotiation and also features auto-crossover (Auto-MDIX), allowing the use of either a straight-through or crossover cable.

It does not currently support DHCP and will therefore require the IP address, gateway address and subnet-mask configuring to match the host network it is attached to.

If the unit is only being accessed via the local network then set the gateway address to be the same as the IP address, otherwise enter the address of the appropriate gateway or router.

5. Air-Conditioning Group Configuration (Mitsubishi)

Black Pear

Outdoor 51

TB7   TB3

M-Net

IC 01 *   IC 02

Group 01

Outdoor 53

TB7   TB3

IC 03 *   IC 04   IC 05

Group 03

Outdoor 56

TB7   TB3

IC 06 *   IC 07

Group 06

Outdoor 58

TB7   TB3

IC 08 *

Group 08

Important (When a central controller is not fitted)
To provide power to the M-Net system, the link on CN41 of only one of
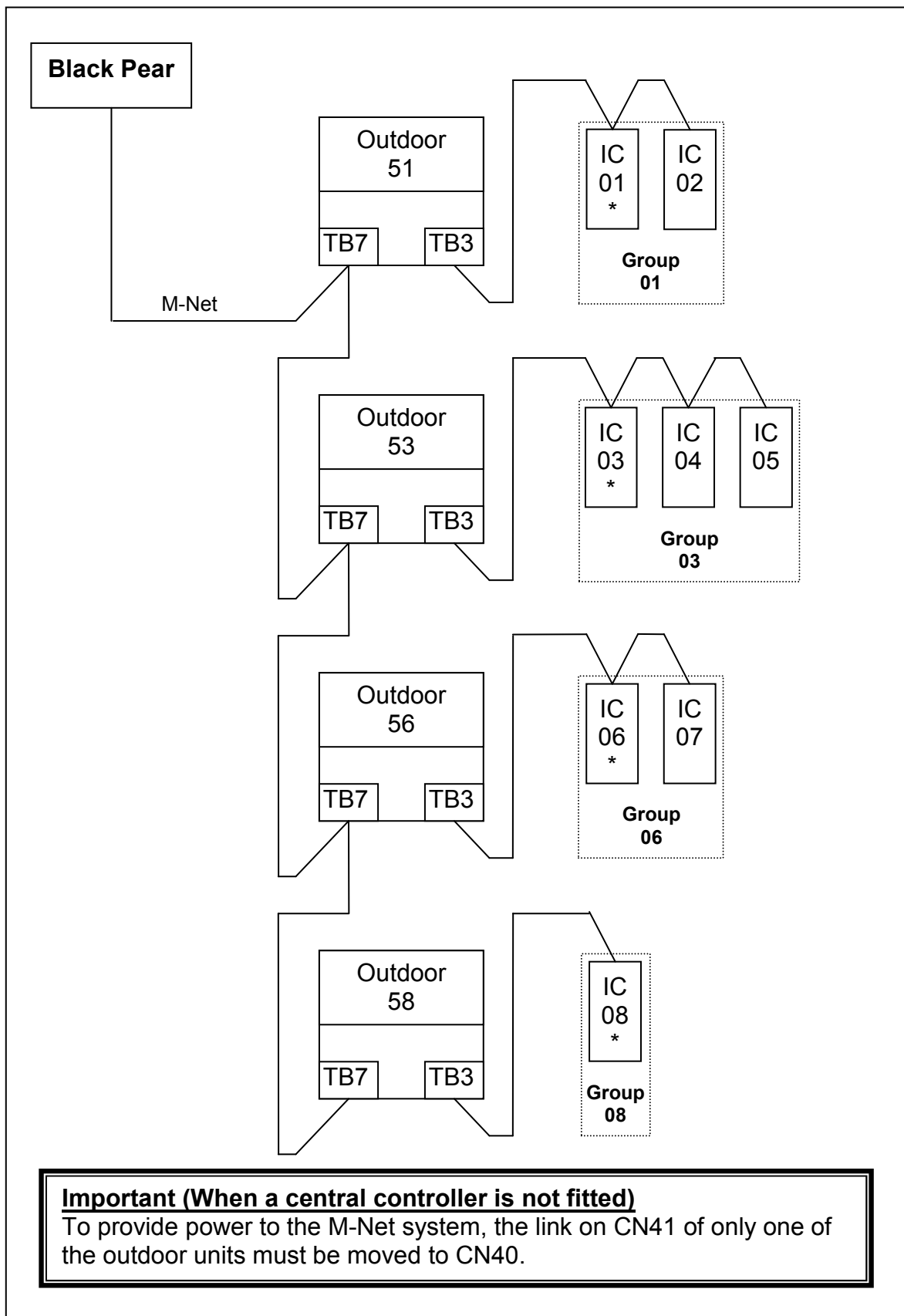the outdoor units must be moved to CN40.

Fig. 4 Grouping Example

The groupings determine which unit addresses can accept commands from the BMS system.

The group number is defined as 'the lowest indoor unit address within the group'. This then becomes the 'master' address for the group, and is the only address within that group that can accept commands.

The other units within a group can be classed as 'slave' units and contain the same status parameter values as the 'master', apart from Return Air Temp and Error Code, which are unique to each unit.

In the example shown in Fig 4, addresses 01, 03, 06 and 08 are the 'master' units, and 02, 04, 05 and 07 are the 'slave' units.

> **Attempting to write a command to a 'slave' unit will have no effect.**

When a central controller is not fitted, the indoor unit grouping is handled by the Black Pear and is setup using the PC configuration software.
If a group consists of multiple units and it is required to control these from a wall controller, then the wall controller must be linked to the relevant indoor units. See the HVAC manufacturers' instructions for details.

If a central controller is present on the system, the Black Pear will automatically discover the grouping information.

6. User Interface (Display Version)
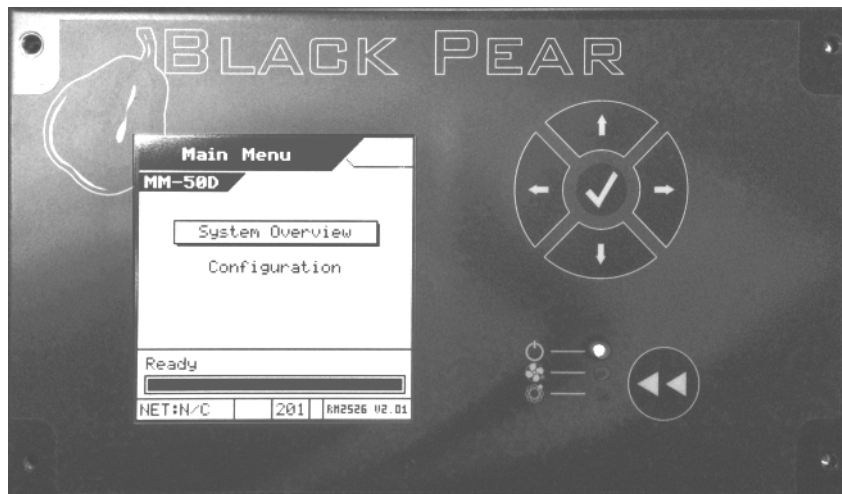
	Navigation Buttons	Power LED	
	Enter/Accept Button		HVAC Network LED Flashes on a valid incoming message
	Back/Cancel Button		BMS Network LED Flashes on a valid incoming message
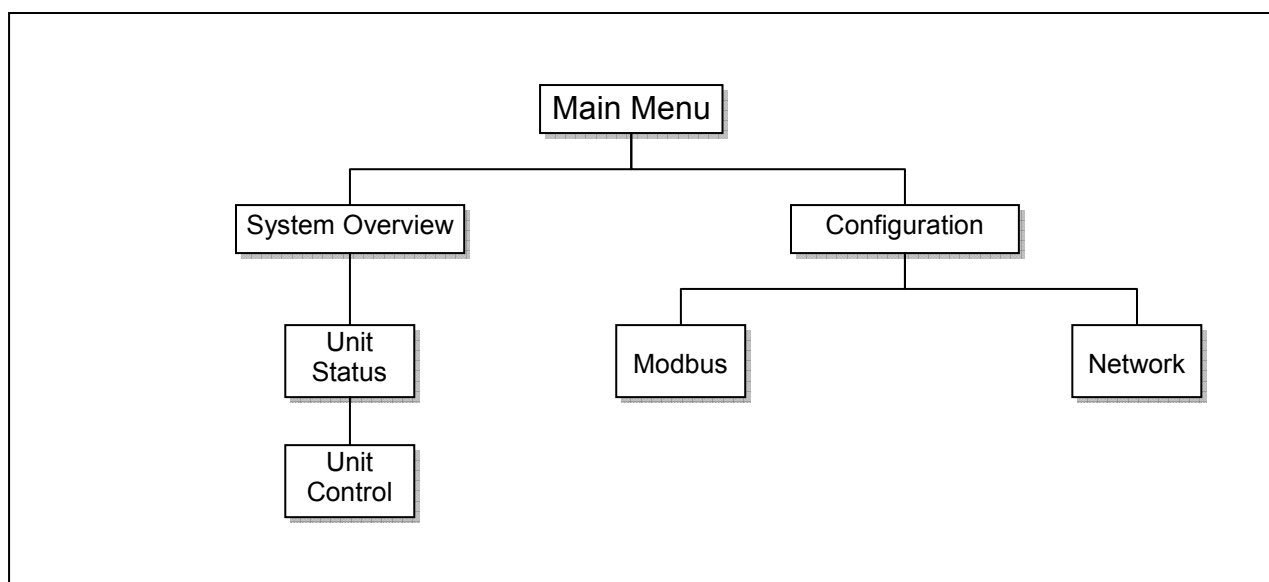
Fig. 5 Screen Hierarchy

6.1 Main Menu
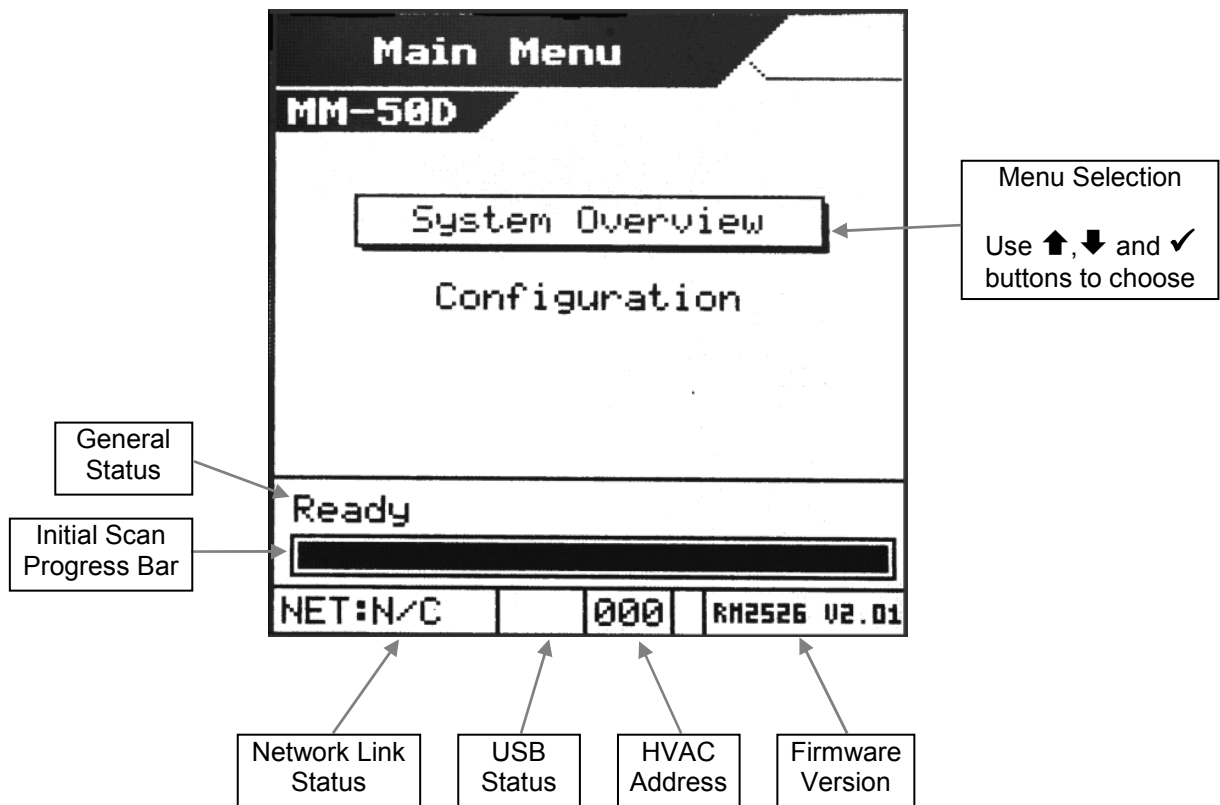
General Status	Waiting…	The Black Pear has been restarted and is preparing to start scanning the HVAC network.
	Searching…	The Black Pear is performing an initial scan to determine which unit addresses are active on the HVAC network. The progress bar shows how much of the scan has been performed.
	Ready	The initial scan is complete.
Network Link Status	N/C	Not connected.
	???	Auto-negotiation in progress.
	10hd	10Mb half duplex
	10fd	10Mb full duplex
	100hd	100Mb half duplex
	100fd	100Mb full duplex
USB Status	<blank>	Not connected
	USB	Connected
HVAC Address	0	Fixed address when the Black Pear is acting as the central controller.
	201 to 250	User configured address when a central controller is already present on the system.

6.2 System Overview

Displays a grid showing the address of any unit discovered by the Black Pear, in the address range 1 to 50.
Pressing the ◄◄ key will return to the Main Menu screen.
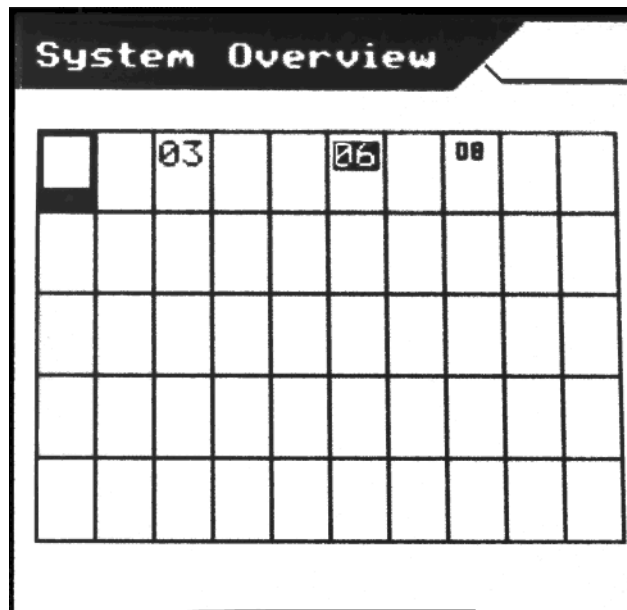
Selection Cursor. Controlled using the navigation buttons. Pressing ✔ on a numbered cell will display the unit status screen.
03	A large number is a 'Group Master'.
08	A small number is a 'Slave Unit'.
06	An inverted number indicates the unit is ON.
06	A flashing number indicates the unit is in error.

6.3 Unit Status Screen

```
┌─────────────────────────────┐        ┌─────────────────────────────┐
│◄ 03 Unit003          ►       │        │◄ 08 Unit008          ►       │
│      Group 03      Master     │        │      Group 03      Slave      │
│                               │        │                               │
│   Return Air    +28°C         │        │   Return Air    +28°C         │
│   Error Code    8000 [ok ]    │        │   Error Code    8000 [ok ]    │
│  ┌─────────────────────────┐  │        │                               │
│  │ Operation     Off       │  │        │   Operation     Off           │
│  └─────────────────────────┘  │        │   Setpoint      20°C          │
│   Setpoint      20°C          │        │   Mode          Cool          │
│   Mode          Cool          │        │   Fan Speed     High          │
│   Fan Speed     High          │        │   Air Direction Vert          │
│   Air Direction Vert          │        │                               │
└─────────────────────────────┘        └─────────────────────────────┘
```

| Group Master Status Screen | Slave Unit Status Screen |

This screen shows the status of a single fan coil.

Pressing the ← or → key cycles backward and forward through all available fan coils.
The ◄◄ key will return to the System Overview screen.

Only a 'Group Master' will show a cursor to allow the current settings to be altered.
Use the ↑,↓ and ✓ keys to select a setting to be changed.
The appropriate parameter setting window will be displayed.
Use the ↑,↓ keys to choose a new setting, ✓ to accept the change or ◄◄ to cancel the change.

7. Modbus Interface
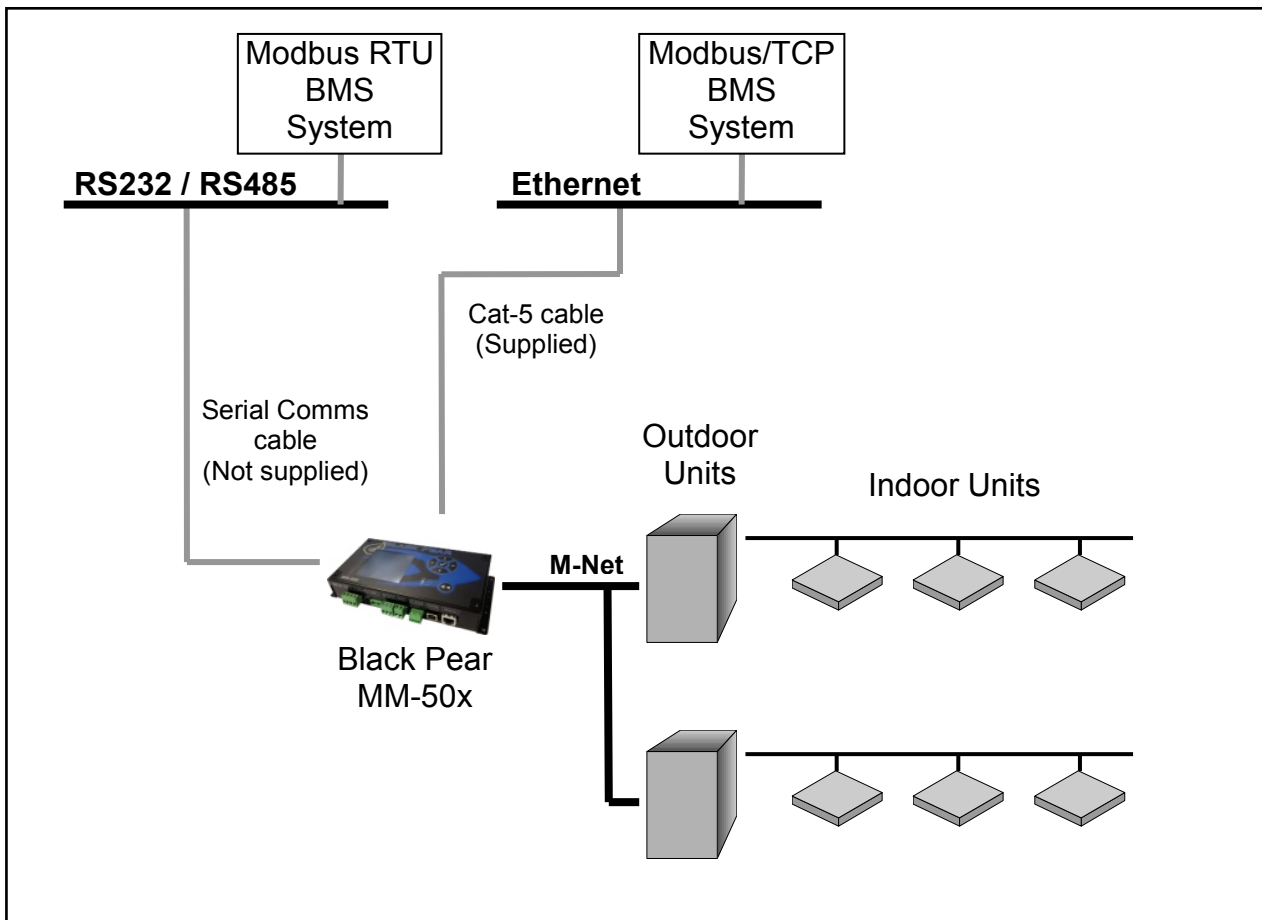
Fig. 6 Modbus System Example

7.1 Port Configurations

RS232/RS485 interface
 Modbus RTU
 9600 baud, 8 data bits, no parity, 1 stop bit

Network interface
 Modbus/TCP
 2 simultaneous Modbus/TCP client connections are supported:
   1 only uses TCP port 502 (default Modbus/TCP port)
   2 uses a user configurable TCP port number

Modbus functions supported
 Fn 1   Read Coils
 Fn 3   Read Holding Registers
 Fn 5   Write Single Coil
 Fn 6   Write Single Register
 Fn 16   Write Multiple Registers (Max. 16 registers at once)

7.2 HVAC Status and Control Registers

The Black Pear MM-50x behaves as 24 modbus slaves. Slaves 1 to 22 each have 90 registers (Offset = 0 to 89). Slaves 23 and 24 are used for configuration.

Slaves 18 to 22 are not used by this version of the Black Pear. They are required for systems which have a maximum of 64 units.

The default 'Base Slave Address' is 1, meaning the Black Pear will respond to msgs for slaves 1 to 24. The Base Slave Address can be adjusted from 1 up to 200. A setting of 200 means the Black Pear will respond to msgs for slaves 200 to 223.
This is useful to prevent address clashing when the Black Pear unit is attached to a serial communications network containing multiple Modbus devices.

Some BMS systems have limited slave address resources, so the 'Single Slave Access' feature means the Black Pear can be configured to respond to just 1 slave address (i.e. the 'Base Slave Address' setting).

The Black Pear maps the data from the air conditioner units into Modbus registers accessed by two Modbus parameters 'Slave No.' and 'Offset'.

All slave numbers referred to in this document assume the default Base Address.

Slaves 1 to 16 each represent 3 units, and slave 17 represents 2 units.
Each slave is organised as follows:

General Information		
Unit A	Unit B	Unit C
Offset 0	Offset 10	Offset 20

Extended Information		
Unit A	Unit B	Unit C
Offset 30	Offset 40	Offset 50

Extra Information		
Unit A	Unit B	Unit C
Offset 60	Offset 70	Offset 80

General information for a single unit	
Register Offset	Stored Value
0	Return Air Temp
1	Error Code
2	Setpoint (R)
3	Mode (R)
4	Fan Speed (R)
5	Setpoint (W)
6	Mode (W)
7	Fan Speed (W)
8	On/Off (R)
9	On/Off (W)

Extended information for a single unit	
Register Offset	Stored Value
0	Air Direction (R)
1	Air Direction (W)
2	Inhibit (R)
3	Inhibit (W)
4	Ventilation (R) ∗
5	Ventilation (W) ∗
6	Error Code (DispA)
7	Error Code (DispB)
8	CN32 state
9	Unused

Extra information for a single unit	
Register Offset	Stored Value
0	'Hi-res' Return Air
1	'Hi-res' Setpoint (R)
2	'Hi-res' Setpoint (W)
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused
8	Reserved
9	Reserved

See Section 7.5 for an overview of Modbus slave and offset usage..

Examples:
1) To read the current fan speed of unit 8

Single Slave Access = Off		
Slave	Function	Offset
3	3	14

Single Slave Access = On		
Slave	Function	Offset
1	3	194

2) To read the current mode of unit 48

Single Slave Access = Off		
Slave	Function	Offset
16	3	23

Single Slave Access = On		
Slave	Function	Offset
1	3	1373

∗ Not currently supported

On/Off and Inhibit can also be accessed via 'Coils'. Each slave contains 12 coils, organised as follows:

Coil Offset	Definition
0	Unit A On/Off (R)
1	Unit A On/Off (W)
2	Unit B On/Off (R)
3	Unit B On/Off (W)
4	Unit C On/Off (R)
5	Unit C On/Off (W)
6	Unit A Inhibit (R)
7	Unit A Inhibit (W)
8	Unit B Inhibit (R)
9	Unit B Inhibit (W)
10	Unit C Inhibit (R)
11	Unit C Inhibit (W)

Note
Coil access is not available when 'Single Slave Access' is enabled.

7.3 Additional Register Usage

Slave	Offset	Single Slave Offset	Description	Valid Settings
22	150	2040	HVAC Network Status	00: Waiting 01: Searching 02: Ready 03: Unknown
22	151	2041	System Force Off ∗	00: Not active 01: Active

See Section 9.5 for a description of the various settings.

∗ Not currently supported

7.4 Parameter Settings

Parameter	Settings	Notes
Return Air Temperature	0°C to 99°C	
'Hi-res' Return Air	0.0^{o}C to 99.9^{o}C	register contains the value multiplied by 10. eg. 237 = 23.7^{o}C
Error Code	4 digit error code where 8000 = 'No Error' 6999 = 'Unit Not Present'	
Setpoint Temperature	Air Conditioner : Cool/Dry : 19°C to 30°C Heat : 17°C to 28°C Auto : 19°C to 28°C	
	Boiler : Heating : 30°C to 45°C Heating ECO : 30°C to 45°C Hot Water : 30°C to 70°C Anti-Freeze : 10°C to 45°C Cooling : 10°C to 30°C	$\ast$
'Hi-res' Setpoint	10.0^{o}C to 70.0^{o}C depending on mode	register contains the value multiplied by 10. eg. 258 = 25.8^{o}C
Operation Mode	00: Fan (Draft) 01: Cool 02: Heat 03: Dry 04: Auto 05: (Not Used)	
	06: AutoCool 07: AutoHeat	Not settable
	08: Heat Recovery 09: LC_Auto 10: Bypass	Non-interlocked Lossnay only
	11: Heating 12: Eco-Heating 13: Hot-Water 14: Anti-Freeze 15: Cooling	Heat-pump boiler only $\ast$
Fan Speed	00: Low 01: Mid2 (Low Medium) 02: Mid1 (High Medium) 03: High 04: Auto	Auto fan speed available as of firmware v2.19
On/Off	00: Off 01: On	
Air Direction	00: Horizontal 01: Mid1 02: Mid2 03: Vertical 04: Swing	
Local Inhibit	00: Not inhibited 01: Inhibited	

Parameter	Settings	Notes
Ventilation	00: Off 01: Low 02: High	Interlocked Lossnay / OA units only ∗

7.5 Modbus Table Overview

Unit Address	Slave	General Info Base Offset	Extended Info Base Offset	Extra Info Base Offset	Single Slave Access General Info Base Offset	Single Slave Access Extended Info Base Offset	Coil Base Offsets On/Off	Coil Base Offsets Inhibit
1	1	0	30	60	0	30	0	6
2	1	10	40	70	10	40	2	8
3	1	20	50	80	20	50	4	10
4	2	0	30	60	90	120	0	6
5	2	10	40	70	100	130	2	8
6	2	20	50	80	110	140	4	10
7	3	0	30	60	180	210	0	6
8	3	10	40	70	190	220	2	8
9	3	20	50	80	200	230	4	10
10	4	0	30	60	270	300	0	6
11	4	10	40	70	280	310	2	8
12	4	20	50	80	290	320	4	10
13	5	0	30	60	360	390	0	6
14	5	10	40	70	370	400	2	8
15	5	20	50	80	380	410	4	10
16	6	0	30	60	450	480	0	6
17	6	10	40	70	460	490	2	8
18	6	20	50	80	470	500	4	10
19	7	0	30	60	540	570	0	6
20	7	10	40	70	550	580	2	8
21	7	20	50	80	560	590	4	10
22	8	0	30	60	630	660	0	6
23	8	10	40	70	640	670	2	8
24	8	20	50	80	650	680	4	10
25	9	0	30	60	720	750	0	6
26	9	10	40	70	730	760	2	8
27	9	20	50	80	740	770	4	10
28	10	0	30	60	810	840	0	6
29	10	10	40	70	820	850	2	8
30	10	20	50	80	830	860	4	10
31	11	0	30	60	900	930	0	6
32	11	10	40	70	910	940	2	8
33	11	20	50	80	920	950	4	10
34	12	0	30	60	990	1020	0	6
35	12	10	40	70	1000	1030	2	8
36	12	20	50	80	1010	1040	4	10
37	13	0	30	60	1080	1110	0	6
38	13	10	40	70	1090	1120	2	8
39	13	20	50	80	1100	1130	4	10
40	14	0	30	60	1170	1200	0	6
41	14	10	40	70	1180	1210	2	8
42	14	20	50	80	1190	1220	4	10

∗ Not currently supported

Unit Address	Slave	General Info Base Offset	Extended Info Base Offset	Extra Info Base Offset	Single Slave Access		Coil Base Offsets	
					General Info Base Offset	Extended Info Base Offset	On/Off	Inhibit
43	15	0	30	60	1260	1290	0	6
44	15	10	40	70	1270	1300	2	8
45	15	20	50	80	1280	1310	4	10
46	16	0	30	60	1350	1380	0	6
47	16	10	40	70	1360	1390	2	8
48	16	20	50	80	1370	1400	4	10
49	17	0	30	60	1440	1470	0	6
50	17	10	40	70	1450	1480	2	8

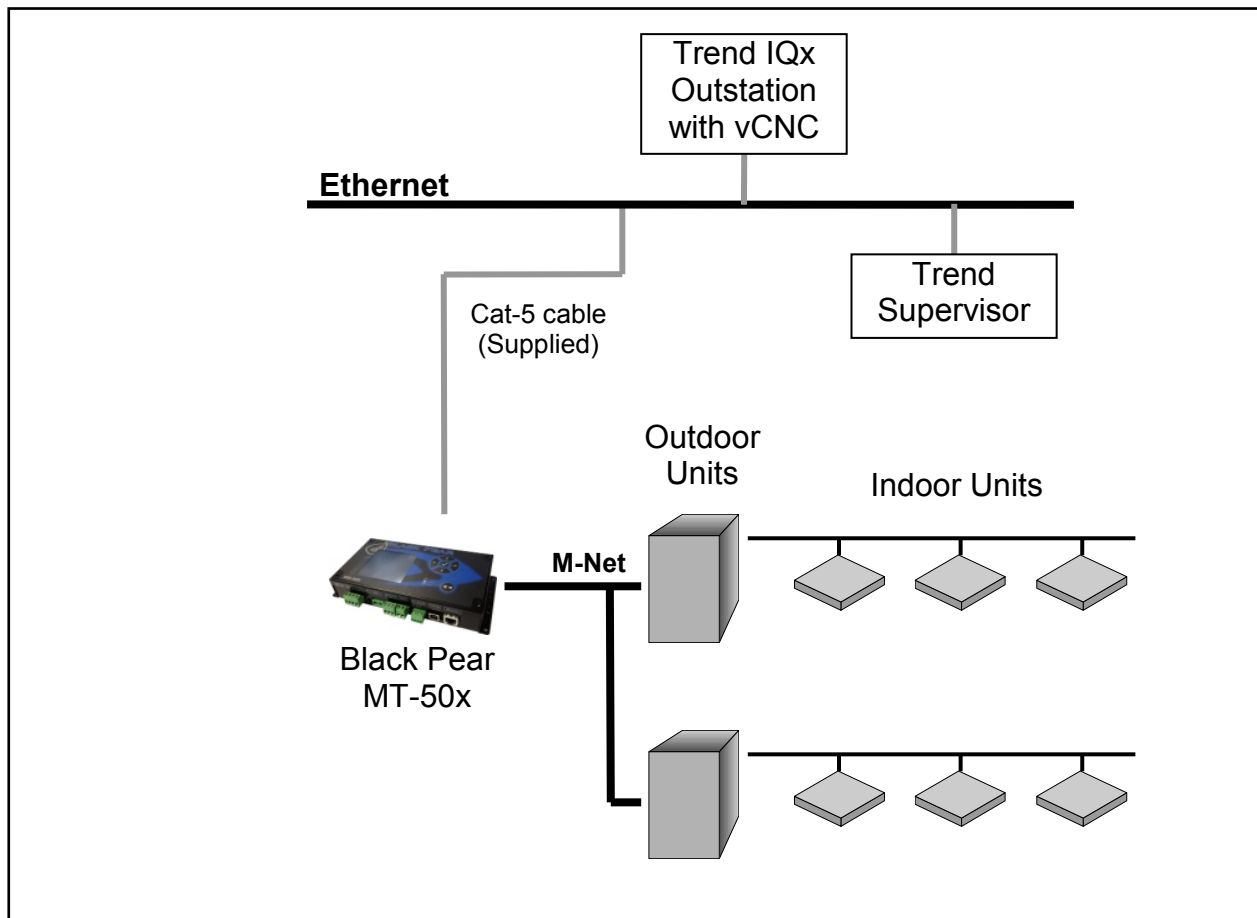# 8. Trend Interface (MT-50x only)

Fig. 7 Trend System Example

The Black Pear connects via Ethernet to a CNC or the virtual CNC port of a Trend IQ outstation, and uses sensors, switches and knobs defined in the IQx memory to mirror a range of HVAC parameters, making them available on a Trend network.

8.1 Trend Process Description

Startup Sequence

1) Power up
2) Waiting for initial scan
3) Perform initial HVAC scan
4) Initial scan complete
5) Connect to CNC port
6) Transfer current HVAC status to required Trend outstation ("First Pass")
7) Disconnect from CNC port
8) Wait for re-connection time
9) Connect to CNC port
10) Poll the objects for each active HVAC unit in the Trend outstation, then either
    Update the HVAC if the value of a Trend object has been altered, or
    Update the Trend object if the value of an HVAC parameter has changed.
11) Disconnect from CNC port
12) Wait for re-connection time
13) Goto 9

At power-up, the Black Pear will wait for the initial HVAC scan to begin. During this scan, all available 'active' HVAC units are discovered. Once the scan is complete, the Black Pear will transfer all current parameter settings to the appropriate objects in the destination Trend outstation. This process is called the 'First Pass'. This ensures that the values in the Black Pear and the Trend device are in sync. Until the 'First Pass' is complete, all commands sent from the Trend network to the Black Pear will be ignored.

The re-connection time is calculated from the CNC Usage setting within the Black Pear. This ensures that all Black Pear devices sharing a single CNC have enough time to connect.

Notes:
①   Some Trend systems will generate 'network alarms' due to the repeated connection and disconnection of the Black Pear to the CNC.
Setting the CNC Usage = 0 will allow a single Black Pear to remain connected to the CNC, thus preventing these alarms from being generated.
This feature was added in firmware v2.19.

Following a reconfiguration of the Trend outstation, it is important that the Black Pear is restarted, to guarantee that all parameters are in sync.

8.2 Trend IQx Outstation Configuration

3 sensors, 2 switches and 4 knobs are required to store all the parameters for a single unit.

The table below shows how to calculate the number of each object required :

Fan Coil Parameter	Sensor No.	Switch No.	Knob No.
Return Air	S+((FC-1)*3)		
Error Code	S+((FC-1)*3)+1		
CN32 State	S+((FC-1)*3)+2		
On/Off		W+((FC-1)*2)	
Inhibit		W+((FC-1)*2)+1	
Setpoint			K+((FC-1)*4)
Mode			K+((FC-1)*4)+1
Fan Speed			K+((FC-1)*4)+2
Air Direction			K+((FC-1)*4)+3

where   FC   = Fan Coil Address (1 to 50)
S   = Sensor Base Address
W   = Switch Base Address   } Set using configuration software
K   = Knob Base Address

E.g.
If   Sensor Base Address   =100
Switch Base Address   = 50
Knob Base Address   = 50

then the following table shows the object numbers required for addresses 1,2,49 and 50.

	FC 1	**FC 2**	…..	**FC 49**	**FC 50**
Sensors	100 to 102	103 to 105	…..	244 to 246	247 to 249
Switches	50 to 51	52 to 53	…..	146 to 147	148 to 149
Knobs	50 to 53	54 to 57	…..	242 to 245	246 to 249

The Black Pear can be configured to enable only those objects of interest to the user, therefore reducing the memory overhead required in the IQ outstation. Any objects enabled in the Black Pear which aren't defined in the Trend outstation will simply be ignored during the polling sequence.
Note that this does not change the sensor, switch and knob numbers associated with each HVAC parameter.

> **If a sensor has been added to the sequence table then its 'Value' output must be connected to its 'Source Value' input, otherwise it will return a reading of zero.**

See Appendix C for details of the memory requirements in the Trend outstation.

8.3 Parameter Settings

See the table in Section 7.4 for a list of valid parameter settings.

Notes:

① As of firmware v2.29, the return air sensor and the setpoint knob will contain temperatures valid to 1 dp. Setting the setpoint to 1 dp is reliant on the HVAC unit accepting setpoint commands to this resolution.

9.BACnet Interface (MB-50x only)
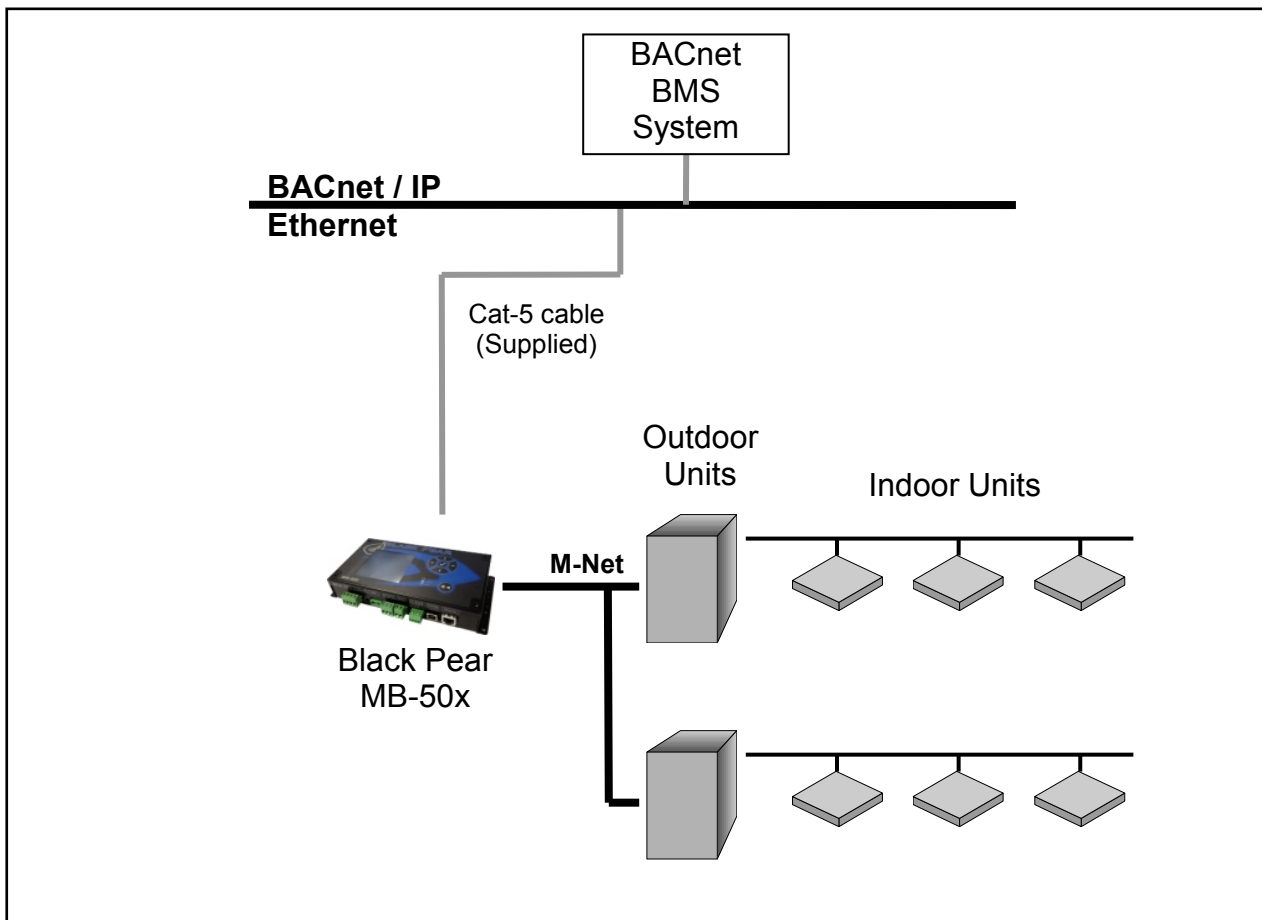
Fig. 8 BACnet System Example

The BLACK Pear MB-50x is designed to work with a BACnet/IP network as described in the ANSI/ASHRAE Standard 135-2004.

Property	Setting
Segmentation	Not Supported
Maximum APDU length supported	206 octets
Object List	Supported
Device ID	User settable [1]
Device Name	User settable [1]
Object Names	User settable [1]

Notes: (1) Only settable via PC configuration program.

9.1 Object Types

Object Type		Supported
Analog Input	0	Yes
Analog Output	1	Yes
Analog Value	2	
Binary Input	3	Yes
Binary Output	4	Yes
Binary Value	5	Yes
Calendar	6	
Command	7	
Device	8	Yes
Event Enrollment	9	
File	10	
Group	11	
Loop	12	
Multi-State Input	13	Yes
Multi-State Output	14	Yes
Notification Class	15	
Program	16	
Schedule	17	
Averaging	18	
Multi-State Value	19	
Trend Log	20	

9.2 Service List

Supported Services	
Read Property	12
Read Property Multiple	14
Write Property	15
Write Property Multiple	16
Who-Has	33
I-Have	27
Who-Is	34
I-Am	36

9.3 Object List

Object	Object Type	Instance No.	'Present Value' Settings	Notes
On/Off (Setup)	Binary Output	1xxx01	Inactive:Off Active:On	
On/Off (State)	Binary Input	1xxx02	Inactive:Off Active:On	
Error Code	Analog Input	1xxx03	4 digit error code where 8000= 'No Error' 6999= 'Unit Not Present'	
Operation Mode (Setup)	Multi-State Output	1xxx04	01: Fan 02: Cool 03: Heat 04: Dry 05: Auto 06: N/A	
			07: Auto Cool 08: Auto Heat	Not settable
			09: Heat Recovery 10: LC_Auto 11: Bypass	Non-interlocked Lossnay only
			12: Heating 13: Eco-Heating 14: Hot-Water 15: Anti-Freeze 16: Cooling	Heat-pump boiler only ∗
Operation Mode (State)	Multi-State Input	1xxx05	01: Fan 02: Cool 03: Heat 04: Dry 05: Auto 06: N/A	
			07: Auto Cool 08: Auto Heat	
			09: Heat Recovery 10: LC_Auto 11: Bypass	Non-interlocked Lossnay only
			12: Heating 13: Eco-Heating 14: Hot water 15: Anti-Freeze 16: Cooling	Heat-pump boiler only ∗
Fan Speed (Setup)	Multi-State Output	1xxx06	01: Low 02: Mid2 03: Mid1 04: High 05: Auto	Auto fan speed available as of v2.19
Fan Speed (State)	Multi-State Input	1xxx07	01: Low 02: Mid2 03: Mid1 04: High 05: Auto	Auto fan speed available as of v2.19

Object	Object Type	Instance No.	'Present Value' Settings	Notes
Room Temperature	Analog Input	1xxx08		①
Setpoint Temperature (Setup)	Analog Output	1xxx09	Cool/Dry : 19°C to 30°C Heat : 17°C to 28°C Auto : 19°C to 28°C	①
			Boiler : 10°C to 70°C	＊①
Setpoint Temperature (State)	Analog Input	1xxx10	Cool/Dry : 19°C to 30°C Heat : 17°C to 28°C Auto : 19°C to 28°C	①
			Boiler : 10°C to 70°C	＊①
Local Inhibit (Setup)	Binary Output	1xxx11	Inactive:Off Active:Inhibit	
Local Inhibit (State)	Binary Input	1xxx12	Inactive:Off Active:Inhibited	
Air Direction (Setup)	Multi-State Output	1xxx13	01: Horizontal 02: Mid1 03: Mid2 04: Vertical 05: Swing	
Air Direction (State)	Multi-State Input	1xxx14	01: Horizontal 02: Mid1 03: Mid2 04: Vertical 05: Swing	
Ventilation (Setup)	Multi-State Output	1xxx15	01: Off 02: Low 03: High	Interlocked Lossnay / OA units only ＊
Ventilation (State)	Multi-State Input	1xxx16	01: Off 02: Low 03: High	Interlocked Lossnay / OA units only ＊
CN32 (State)	Analog Input	1xxx17	0-3	Appendix D
(Unused)		1xxx18		
(Unused)		1xxx19		
(Unused)		1xxx20		
(Unused)		1xxx21		
(Unused)		1xxx22		
HVAC Network Status	Multi-State Input	100023	01: Waiting 02: Searching 03: Ready 04: Unknown	
System Force Off	Binary Value	100024	Inactive:Off Active:On	＊
Device	Device	zzz		zzz = 1 to 4194302

where xxx represents unit address 001 to 050

9.4 Object Names

Object	Object Name	Notes
On/Off (Setup)	nnn (ON_w)	
On/Off (State)	nnn (ON_r)	
Error Code	nnn (ECode)	
Operation Mode (Setup)	nnn (MD_w)	
Operation Mode (State)	nnn (MD_r)	
Fan Speed (Setup)	nnn (FS_w)	
Fan Speed (State)	nnn (FS_r)	
Room Temperature	nnn (RA)	①
Setpoint Temperature (Setup)	nnn (SP_w)	①
Setpoint Temperature (State)	nnn (SP_r)	①
Local Inhibit (Setup)	nnn (LI_w	
Local Inhibit (State)	nnn (LI_r)	
Air Direction (Setup)	nnn (AD_w)	
Air Direction (State)	nnn (AD_r)	
Ventilation (Setup)	nnn (VN_w)	Interlocked Lossnay / OA units only ∗
Ventilation (State)	nnn (VN_r)	Interlocked Lossnay / OA units only ∗
CN32 (State)	nnn (CN32)	
HVAC Network Status	Sys_HVAC_Network_Status	
System Force Off	Sys_Force_Off	

where 'nnn' is the unit name entered via the configuration program.

① As of firmware v2.29, the room temperature object and the setpoint read and write objects will contain temperatures valid to 1 dp. Setting the setpoint to 1 dp is reliant on the HVAC unit accepting setpoint commands to this resolution.

∗ Not currently supported

∗ Not currently supported

9.5 System Objects

There are 2 'System' objects contained within the Black Pear, which are classed as global objects. A description of each is detailed below.

| System Object	Description
HVAC Network Status	Read-only object providing an indication of the communication status between the Black Pear and the HVAC network. The various states are defined as follows: Waiting: The Black Pear has been restarted and is preparing to start scanning the HVAC network. Searching: The Black Pear is performing its initial scan of the HVAC network, looking for active units with addresses in the range 1 to 50. Ready: The initial scan is complete and the Black Pear will now accept new commands. Unknown: An undefined state has been detected. Note: Until the status = 'Ready', commands send to the Black Pear will be ignored.
System Force Off	Writeable object to enable and disable the global off command. Note: This object appears in the object list but its function is currently disabled.

Appendix A : Physical Dimensions
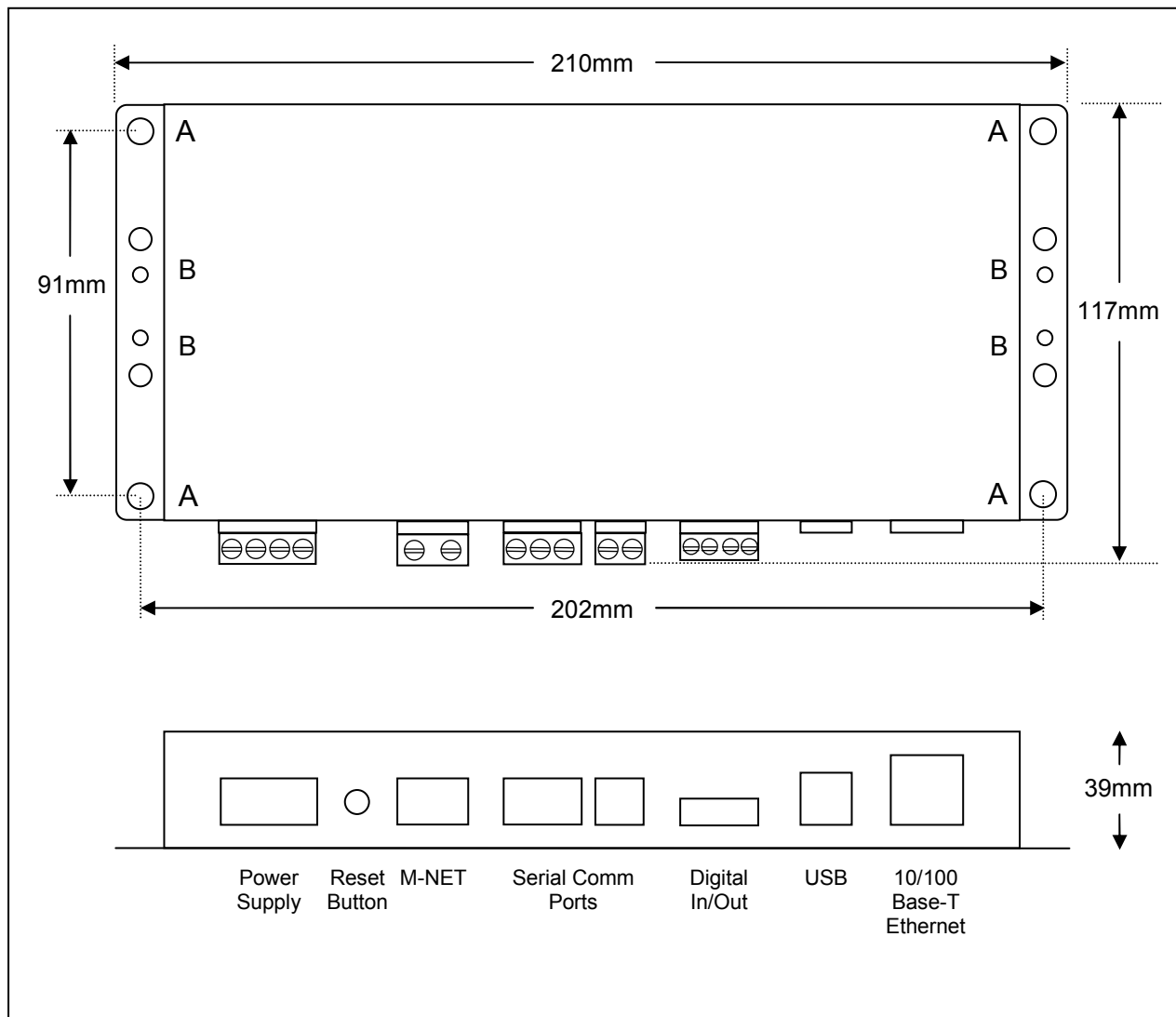
Fig. 9 Dimensions

The holes marked 'A' should be used when mounting the enclosure on a back panel.

The holes marked 'B' can be used to attach the supplied din-rail clips.

<u>Appendix B : Reset Button and Factory Defaults</u>

The Reset Button has 2 functions :

1) To restore various internal settings to their factory default,

2) To force the unit into 'bootloader' mode ready for a firmware update.

Function 1 – Restore Factory Defaults

There are 2 levels to this function.

Level 1: With the unit already ON, press and hold in the reset button.
After approximately 5 seconds, and depending on the type of unit, either the 'Power' led will start to flash slowly (approx 3 per second) or the 'Level-1 Reset' message will be displayed. Releasing the reset button at this point will activate Level 1, and then reset the unit.

Settings Restored: None

Level 2 : With the unit already ON, press and hold in the reset button.
After approximately 5 seconds, and depending on the type of unit, either the 'Power' led will start to flash slowly (approx 3 per second) or the 'Level-1 Reset' message will be displayed. Continue to hold in the reset button until either the 'Power' led starts to flash rapidly (approx 10 per second), or the 'Level-2 Reset' message is displayed. Releasing the reset button at this point will activate Level 2, and then reset the unit.

Settings Restored:

Device Name	'product specific name'
IP Address	192.168.1.20
Gateway Address	192.168.1.20
Subnet Mask	255.255.255.0
Base Slave Address	1
Single Slave Access	Off
Alternate Modbus/TCP Port	502
Max. Accessible Slaves	24
HVAC Address	250
Central Controller	Present
Group Configuration	Cleared

Additional Settings Restored for Trend Interfaces (MT-50x):

Pin Code	Disabled
Sensor Base Address	100
Switch Base Address	50
Knob Base Address	50
Object Enable Mask	All Objects Enabled
OutStation Address	2
CNC IP Address	192.168.1.1
CNC Address	1
CNC Port Number	10001
CNC Usage	1

Additional Settings Restored for BACnet Interfaces (MB-50x):

Device ID	200
UDP Port	47808
New Setting Comparison	Disabled
Register as Foreign Device	Disabled
Foreign Device Reg TTL	1800 seconds
Preserve PVs & PAs	Disabled
Input PV -> Output PV	Disabled

Function 2 – Enable 'Bootloader' Mode

Bootloader mode allows the firmware to be updated from a PC.

Press and hold in the reset button while powering up the unit. Continue to hold in the reset button for approx. 5 seconds. The unit is now in bootloader mode.

Note:
Enabling the bootloader in this way is only necessary if the firmware update software fails to automatically put the unit into bootloader mode.

Appendix C : Trend Outstation Memory Usage (MT-50x only)

1) The table below shows how much memory (in brIQs) each parameter requires :

Parameter	Trend Module	Size (brIQs)	Comments
Return Air Temp	Sensor	76	
Error Code	Sensor	76	
CN32 state	Sensor	76	Mitsubishi Only
On/Off	Switch	10	
Inhibit	Switch	10	
Setpoint	Knob	13	
Mode	Knob	13	
Fan Speed	Knob	13	
Air Direction	Knob	13	

2) A Trend IQ3 has a capacity of 10000 to 45000 brIQs depending on the model and an IQ41x has a capacity of 10000 brIQs.

	IQ3xcite	IQ3xact	IQ3xcite			IQ41x
I/O Max	0	12	16	96	128	
IQ3 brIQs	-	10,000	30,000	30,000	37,000	-
IQ3/XNC brIQs	45,000	20,000	-	45,000	-	-
IQ41x brIQs						10,000

3) This table shows the number of brIQs needed for various system sizes and parameter requirements:

Parameter Usage	brIQs per FC	10 FC system	25 FC system	50 FC system
All parameters (Mitsubishi)	300	3000	7500	15000
Return Air Error Code	152	1520	3800	7600
Return Air Error code On/Off Setpoint	175	1750	4375	8750
Return Air Error Code On/Off Inhibit Setpoint Mode Fan Speed	211	2110	5275	10550

4) This table shows the absolute maximum number of FCs which can be stored in various Trend outstations.

Parameter Usage	IQ3xcite/ XNC	IQ3xact	IQ3xact/ XNC	IQ3xcite/ 16	IQ3xcite/ 96	IQ3xcite/ 128	IQ41x
All parameters (Mitsubishi)	150	33	66	100	100	123	33
Return Air Error Code	296	65	131	197	197	243	65
Return Air Error code On/Off Setpoint	257	57	114	171	171	211	57
Return Air Error Code On/Off Inhibit Setpoint Mode Fan Speed	213	47	94	142	142	175	47

Note:

1) When calculating the number of outstations required for a system, it is recommended to allow some spare capacity for strategy and other configuration data.

2) A single Black Pear device can only communicate with 1 Trend outstation, but multiple Black Pears can communicate with the same Trend outstation, provided there is enough memory in the Trend unit.

Appendix D : CN32 Connector

The CN32 connector on an indoor unit has 2 digital inputs which are normally used for remote operation via an external switch or timer.

Setting SW1-9 ON and SW1-10 ON disables the remote operation functionality and converts CN32 into general purpose digital inputs.
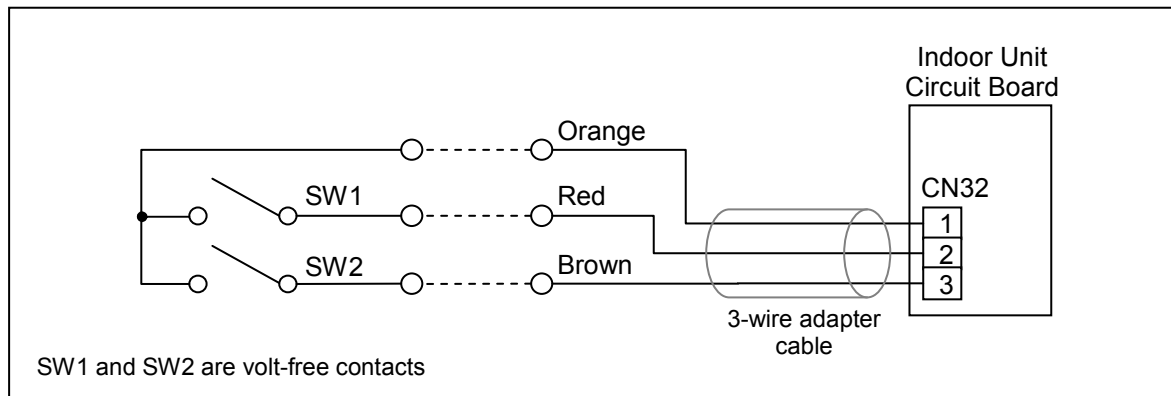

Fig. 10 CN32 Connection Diagram

The register 'CN32 State' for each indoor unit will contain the following values depending on the state of SW1 and SW2 :

Register Value	SW1 State	SW2 State
0	Open	Open
1	Closed	Open
2	Open	Closed
3	Closed	Closed

Appendix E : Document Revision History

Date	Document Ver	Firmware Ver	By	Comments
05/08/2013	v1.00	v2.03	mcb	First complete version.
06/08/2013	v1.01	v2.03	mcb	Added various clarifications.
04/11/2013	v1.02	v2.11	mcb	Non-interlocked Lossnay modes now supported. 'Max. Accessible Slaves' added to Factory Reset list.
22/05/2014	v1.03	v2.18	mcb	Important Information now includes comment about configuration software.
29/05/2014	v1.04	v2.19	mcb	Added support for 'Auto' fan speed setting. Added description of how to permanently connect to Trend CNC.
11/07/2014	v1.05	v2.22	mcb	added CN32 to BACnet object list
23/04/2015	v1.06	v2.27	mcb	updated section 4.4 to describe 'Global Forced Off' feature.
11/11/2015	v1.07	v2.29	mcb	Modbus registers now include 'hi-res' RA and SP. Trend and BACnet sections now mention 'hi-res' RA and SP.
23/12/2015	v1.08	v2.30	mcb	Corrected mode list in BACnet object table.

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