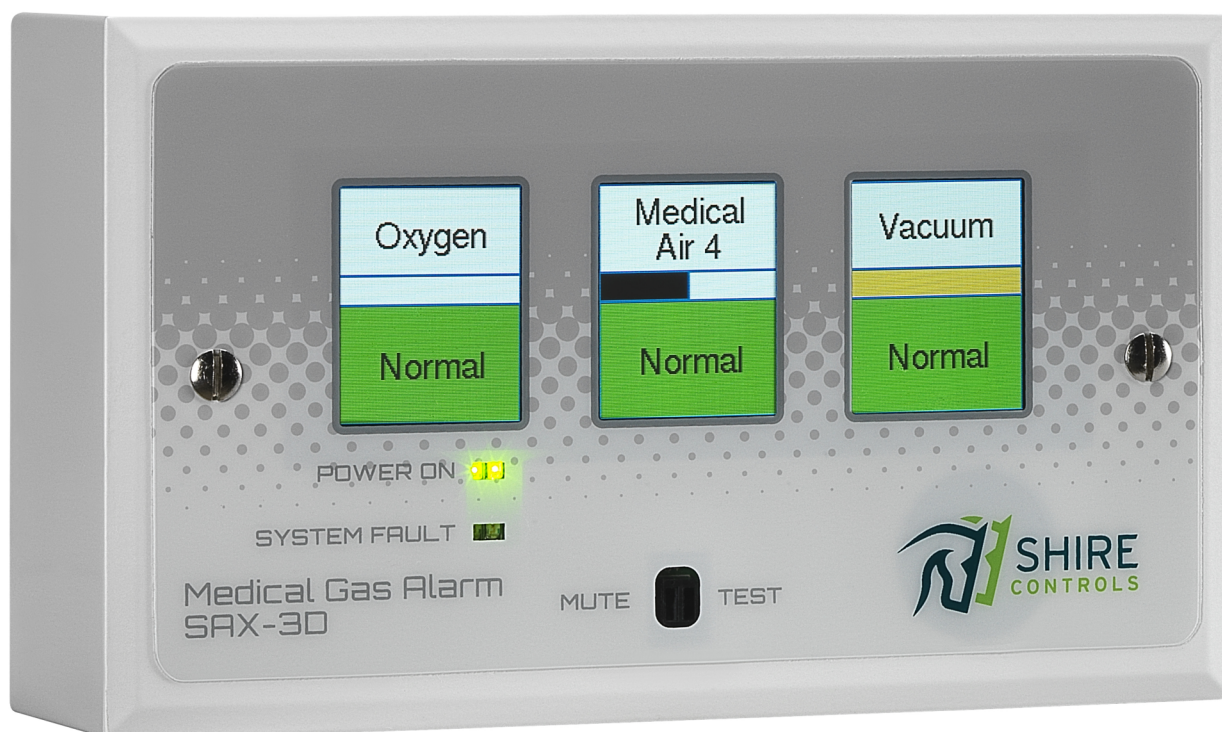


# The SAX-D Area Alarm

for

## Piped Medical Gases



## INTRODUCTION

The SAX-D area alarm panel is designed to monitor pipeline pressures on up to 6 gases, via 4-20ma 0-16bar transducers mounted in the pipeline, downstream from the final Area Valve Service Unit (AVSU).

Each gas is assigned a 1.7inch OLED display, which includes the following:

- Gas Description and,
- Gas Colour Band and,
- Green “Normal” Status or,
- Red “High Pressure” Status or,
- Yellow “Pressure Drop” Status or,
- Red “Low Pressure” Status

Each Display unit includes:

- Monitoring for up-to 3 gases
- Separate green twin LED “Power On” status
- Separate red twin LED “System Fault” status
- Mutable audible alarm with volume control

The Encoder/Transmitter provides connection to:

- 12vdc supply via incoming 230vac power supply
  - (separate 3amp spur required)
- Up-to 4no 3-Gas Alarm Units
- Volt-Free Common Fault relay
- Modbus2 interface
- SAX Bus interface.
  - Here the alarm can transmit data to existing SAX-6 alarms, which can then remain in service as analogue repeaters.

## OPERATOR

The SAX-D Area Alarm is designed for manual operation via the Test/Mute push-button. Hence it is envisaged that the operator is able to visually monitor from within 90cm or arms-length.

The inherent colour coded design includes Red/Yellow/Green indication and the use of gas colour recognition within the title bar of each gas OLED, which ensures that the alarm can be monitored comfortably from 3-4 metres away.

Consideration should be made for final location, in accordance with the latest HTM guidelines, prior to installation.

### About this manual



**When you see this symbol, the associated text in bold type refers to something which may cause damage or danger.**

## MOUNTING

To install the Display unit (flush or surface):

- Remove the 2no 3.5mm screws from the fascia.
  - The Display printed circuit board (PCB) is integral to the fascia plate assembly and can be placed safely.
- Drill the 2gang socket back box and mount.
  - Up-to 2no separate cable entries should also be drilled out at this point.
- Select which gases are to be displayed via the 4-way DIL switch on reverse side of the PCB.
  - Switch 4 is set DOWN (Gas channels 1-3) or UP (Gas channels 4-6)
  - Switch 3 is set DOWN (3 Gas display) or UP (6 Gas Twin Display)
    - Where Twin Displays are used, both should be set to the Up position
  - Switches 1 & 2 are not used at this point.
- Connect the battery via the 2-way white Molex socket, on to the twin Molex pins and press the white push-button marked 'Battery' on reverse of PCB.
- Set the volume control to the required level. Activate the audible by covering the Mute Test window, use a small terminal screwdriver in the volume pre-set and rotate as appropriate.
  - Clockwise to Increase volume & Anti-clockwise to decrease volume.
- The fascia can then be temporarily replaced via the two no fixing screws until cabling is ready for termination (see 'Connection' Section under CABLING in this manual).

The Encoder is provided in a surface mount plastic box.

- Unscrew 4no screws and remove the lid.
- Unscrew 4no self tapper screws and remove the mounting plate assembly.
  - This plate holds the PCB, fused mains input and power supply.
- Drill through rear of box via suggested mounting points and securely fix.
- Use pre-drilled cable entry holes for the following:
  - 1no for 230vac supply
  - 1no for Display unit 4-core connection
  - 1no for each Pressure transducer (i.e. 1no per gas monitored)
  - 1no for Common Fault Relay (optional)
  - 1no for SAX Bus Interface (optional)
  - 1no for Modbus2 Interface (optional)
- Replace the mounting plate assembly with the 4no self-tap screws
- Connect the 230vac to the fused input terminal
- Connect the pressure transducer input and Display unit output via marked pluggable terminals
- Connect the battery via the 2-way white Molex socket, on to the twin Molex pins on from of PCB.



**Always ensure that you are in contact with earth when handling electronic components to avoid damage by static discharges.**

## CABLING

The following connections are required:-

**A 230 volt 50/60 Hz supply, fused at 3 amps.**



**This equipment is not suitable for connection to an IT power system. A readily accessible means of disconnecting the supply must be provided. The maximum prospective fault current must not exceed 1500 amps.**

If the panel is to receive data directly from pressure transducers, a 2-core cable, minimum 0.5 square mm CSA, is required between the panel and the Encoder box.

If the panel is to be connected to existing SAX-6 alarms, a 2-core screened cable, minimum 0.5 square mm CSA, is required between the Encoder and the existing SAX-6 Alarms.

If the panel is to interface via the Modbus2 output, a 3-core screened cable, minimum 0.5 square mm CSA, is required between the Encoder and other system.



**Any cable screens should be earthed. Continuity must be maintained through any junction boxes. A minimum of 20mm clearance must be maintained between the alarm system cabling and any other cables (including the 230vac to the alarm system).**

**FAILURE TO CARRY OUT THESE INSTRUCTIONS MAY CAUSE INTERMITTENT FAULTS AND INVALIDATES THE DECLARATION OF CONFORMITY RELATING TO THIS ALARM.**

## CONNECTING

All terminal for the Display and Encoder are a plug-socket format and can be unplugged for easy connection, by pulling the terminals away from the PCB mounted socket.

At the Display,

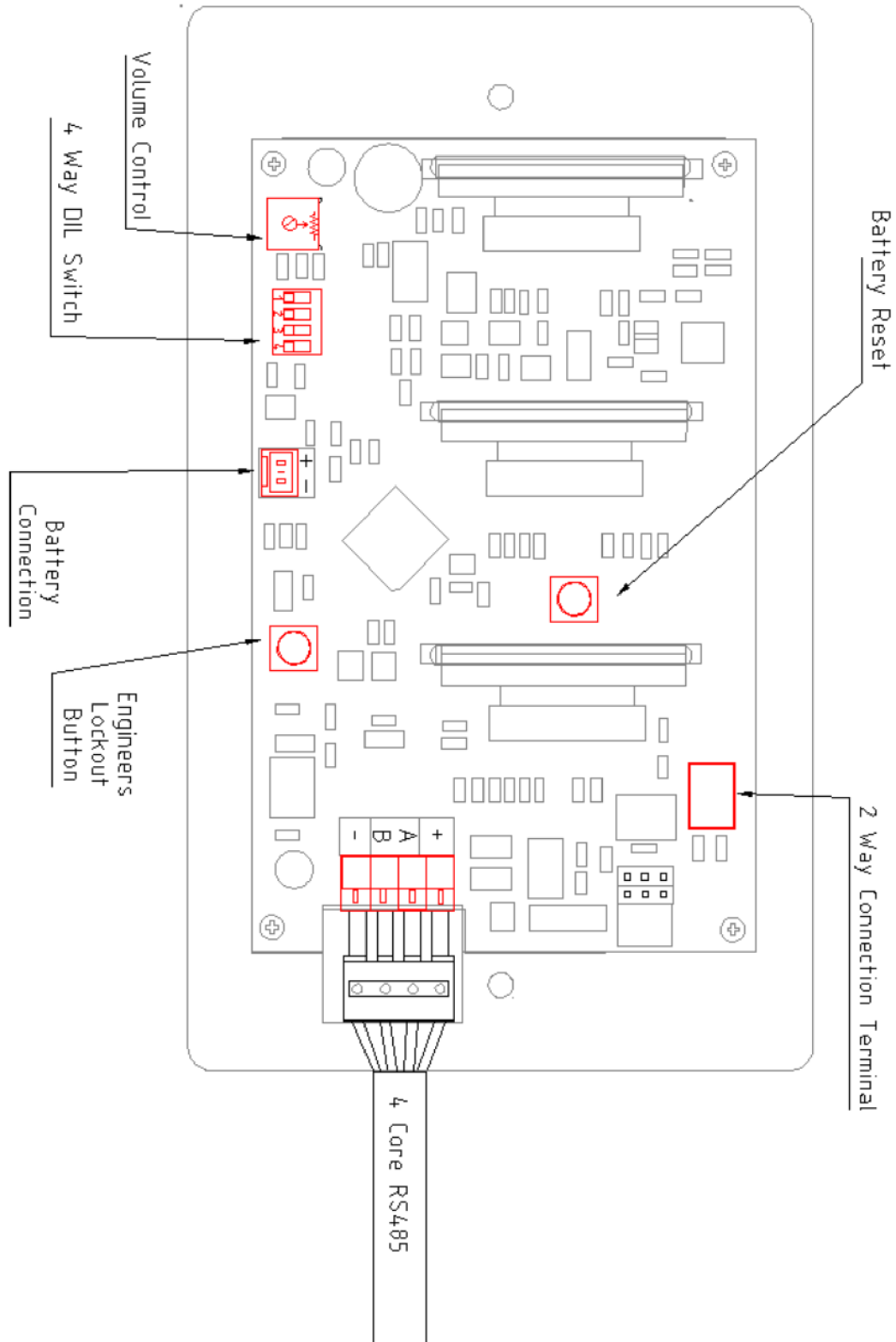
- Connect the 4-core cable into the 4-way terminal block.
  - Check +, -, A and B cores match the connections used in the Transmitter.

At the Transmitter/Encoder, connect:

- Live, Earth & Neutral to the fused input terminal connections on mounting plate.
- Check connection from the 12vdc output should be factory fitted to the 12v + and - terminals on the PCB.
- 4-core cable into the 4-way Display terminal block and plug-in.
  - Check +, -, A and B cores match the connections used in the Display.
- 2-way connection for each Transducer input onto terminals marked Gas + and -. Check Transducers manual for correct cores or colours.
- Optional 2-core connection (marked SAX Bus B C) to existing SAX-6 alarms which are to work as analogue repeaters from this transmitter box.
- Optional 3-core connection (marked MODBUS A B and GND) to provide interface to other site based system.

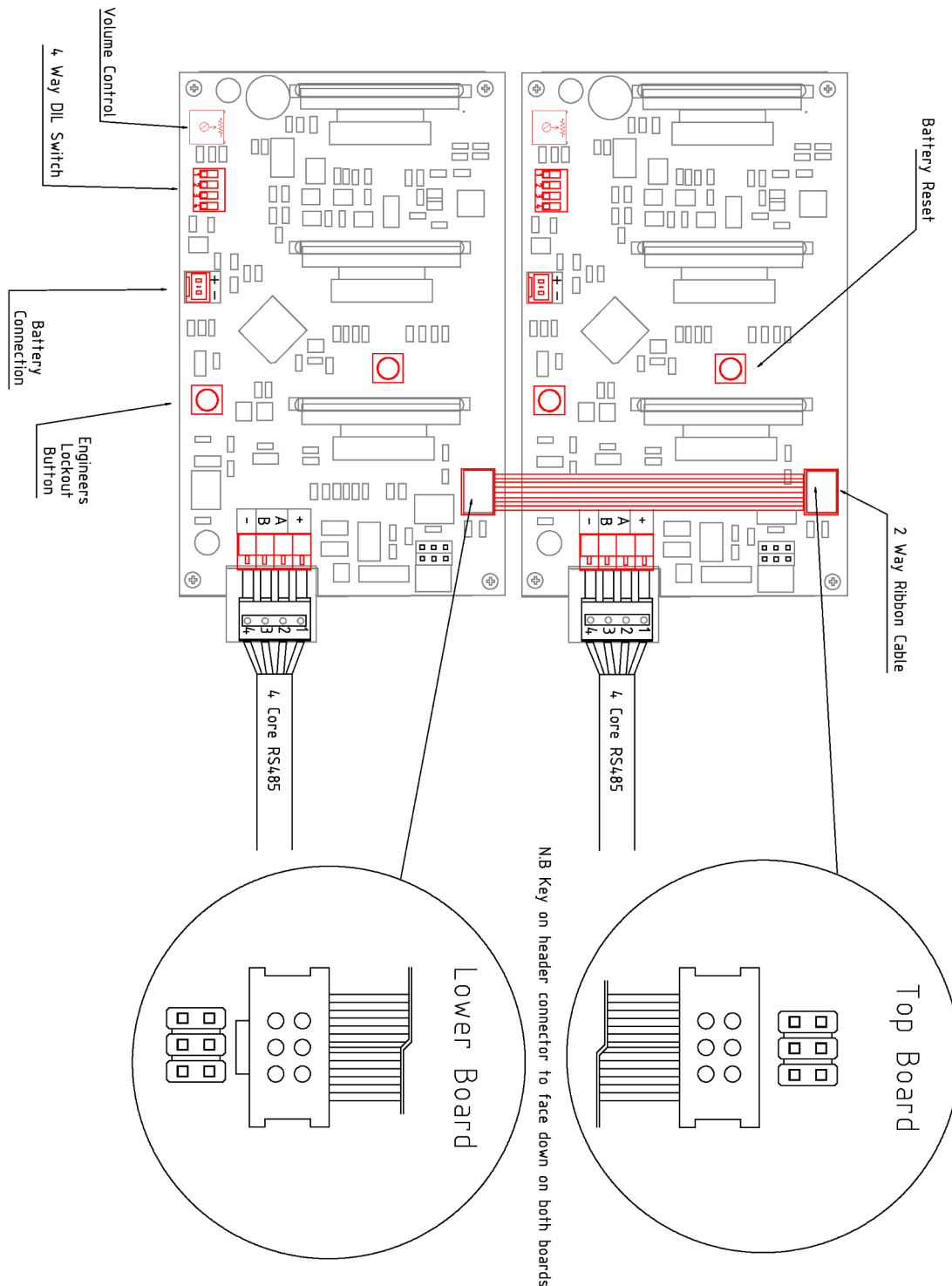
## Display Unit (Single 1-3 Gas Set Up)

Below is a drawing of the reverse of the printed circuit board (PCB), highlighting the location of switches, push-buttons and connections required for setting-up and installation of the Display Unit.



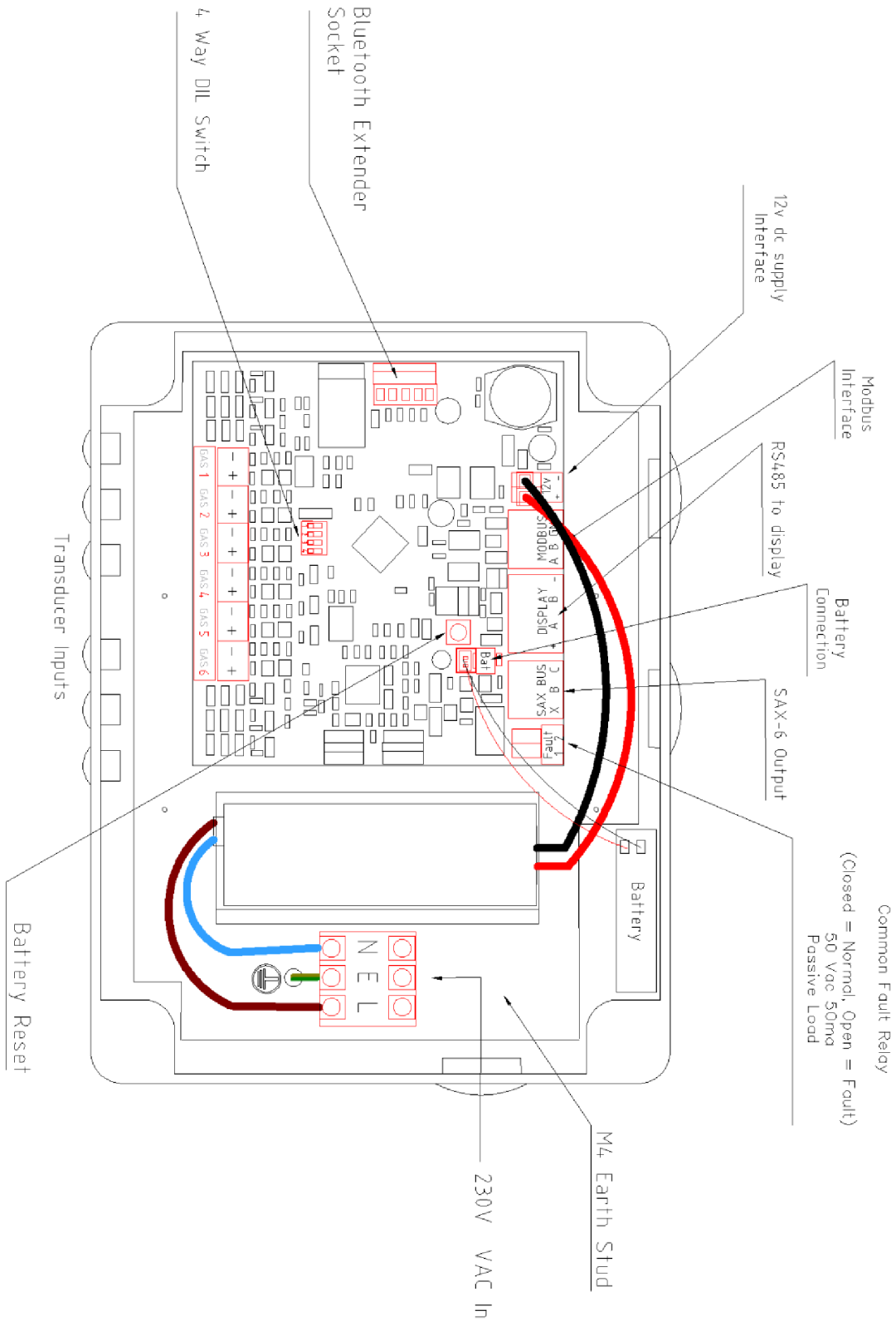
## Twin Display Unit (4-6 Gases)

Below is a drawing of the reverse of the printed circuit boards, highlighting the interconnection between Display Units and the Encoder. All switches push-buttons and connectors are similar to that shown for 1-3 Gas set up on last page.



# Transmitter/Encoder Unit

Below is a drawing of the PCB, highlighting the location of input terminals for pressure transducers, 230vac, switches and push-buttons required for setting-up and installation of the Alarm Transmitter Unit.



## SETTING UP

At the Display,

- This has already been covered in this manual. The Display should be ready to operate.

At the Encoder

- Enable the Bluetooth device via the 4-way DIL switch on the PCB.
  - Set switch 1 to ON (Enabled – recommended) or OFF (Disabled).
  - Switches 2,3 & 4 are not used at this point.

All other Gas Settings, Descriptions, Switching Levels and more, are set via a Bluetooth application. Access to this application and available commands are detailed in Appendix A at the back of this manual.

Replace the Display fascia and secure 2xM3.5 fixing screws tightly.  
Replace the Encoder lid via 4 fixing screws.

## PRIORITY SIGNALS

All normal conditions are represented by Green LEDs:

- “Power On” if 230vac is present.
- “Normal” when no fault on a gas is present.
  - (i.e. gas is operating within desired pressure range).

High level fault conditions are represented by flashing Red LEDs. When:

- A “System Fault” is displayed if there is:
  - Any data cable fault between:-
    - Transducers and the Alarm Transmitter.
    - The Alarm Transmitter and the Display.
  - Loss of 230vac detected and battery backup is activated.
- A High gas level warning is displayed individually for each gas if:
  - the gas pressure rises above the maximum pre-set operating range.
- A Low gas level warning is displayed individually for each gas if:
  - the gas pressure falls below the minimum pre-set operating range.

**All high level conditions are accompanied by an audible warning, which can be manually suspended for a 15 minute period from the Mute/Test button integral to each Display Unit.**

Medium level fault conditions are reported by flashing Yellow LEDs. When:

- Pressure drops on a specific gas, but is still within operational guidelines.

**All medium level warnings are accompanied by an alternating beep audible warning, which can be manually stopped from the Mute/Test button integral to each Display Unit.**



## OPERATION

When a pressure transducer reports a pressure level between the pre-set High Pressure and Pressure Drop switching levels, the bottom half of the gas OLED display will show NORMAL and have a solid GREEN background.

When a High or Low Pressure is reported, the bottom half of the appropriate gas OLED screen will show HIGH or LOW PRESSURE and flash Red/Black with a two-tone audible. Operating the mute button will silence the audible. If the alarm condition remains, the audible will re-trigger after a nominal 15 minute period.

If the 2-core cable from a transducer to the Encoder unit has been damaged the bottom half of the appropriate gas OLED screen will flash to show FAULT O/C or FAULT S/C and flash Red/Black with a two-tone audible. Additionally, the 'System Fault' Twin LEDs will Flash. Operating the mute button will silence the audible. If the alarm condition remains, the audible will re-trigger after a nominal 15 minute periods.

When Pressure has dropped just below the NORMAL range, the bottom half of the appropriate gas OLED screen will show PRESSURE DROP with a flashing Yellow with an alternating beep audible. Operating the mute button will silence the audible permanently or until a further gas condition occurs or the same gas continues to drop into LOW PRESSURE range as described above.

If an alarm condition will be present for an extended period, the alarm condition can be permanently muted. Here, remove the Display unit fascia while the alarm condition is present and operate the white lockout push-button on the reverse of the PCB. You can check which alarm conditions are locked out by covering the Mute/Test switch until the alarm reverts to Test Mode. Here the following will happen

- a Gas in NORMAL will flash Red/Green
- a Gas In HIGH or LOW will Show Red Background
- a Gas in Fault S/C or O/C will show Red Background
- a Gas in Pressure Drop will flash Red/Green

Also the

- POWER ON twin Led with remain On
- SYSTEM FAULT twin Led will Pulse/flash
- Two-Tone Audible will sound

During normal operation when 230vac is present, the POWER ON twin Led will be ON.

During power failure, the internal batteries will run the alarm. The POWER ON twin LEDs will switch off and the SYSTEM FAULT twin LEDs flash, whilst a two-tone audible will sound. If the 230vac supply remains off for a longer period, the display will show the message FAULT DATA ERROR once the Encoder battery has become exhausted.

Whilst all gas conditions can be muted or locked out via the engineers button. ALL SYSTEM FAULTS will re-trigger the audible within 15 minutes - this function can not be disabled as it forms a minimum requirement of the HTM.

To prolong the life of the OLED screens, when all gases are at NORMAL and SYSTEM FAULT is NOT present, the screens will be dimmed to a sleep mode - 50% brightness. The sleep mode should not operate when any FAULT error is present.

## CABLE TYPES

Use only the following types of data cable for wiring the alarm system:-

- 4-core screened or
- SWA or
- Single core cable in steel conduit (**Must not contain any other cables**).

Note:

Core size of 1.0sq.mm CSA recommended.

**Solid cable (i.e. telephone cable) should NOT be used.**



**Continuity of screens, armouring or conduit must be maintained at all times. Particular attention should be given to plastic junction boxes. Multi-core cables must not be shared with other systems.**

### Manufacturer

Shire Controls Ltd  
Studio 3 Channoeks Farm,  
Gilston, Harlow  
Essex CM20 2RL, United Kingdom

### Product Type

SAX-D Area Alarm System

**Year of manufacture 2023**

## DECLARATION OF CONFORMITY

EU EMC Directive 2014/30/EU

'UK Electromagnetic Compatibility Regulations 2016 SI 2016 No.1091'

The Low Voltage Directive 2007/47/EC

Medical Devices Directive 93/42/EEC

## Standards Used (2020)

### Emissions Standard for Medical Equipment

EN60601-1-2, 4th Edition Professional Healthcare Environments

### Emissions Standard (ERM) for radio equipment

EN 301 489-1

### Conducted Emissions AC Port

EN55011, Class A

### Conducted Emissions Discontinuous Disturbance

EN55011, Class A / EN 55014

### Radiated Emissions

EN55011, Class A

### Immunity Standard for Medical Equipment

EN60601-1-2, 4th Edition Professional Healthcare Environments

### Immunity Standard (ERM) for radio equipment

ETSI EN 301 489-1

**Electrostatic Discharge** EN61000-4-2

**Radiated Immunity** EN61000-4-3

**Fast Transient Bursts** EN61000-4-4

**Surges** EN61000-4-5

**Conducted Immunity** EN61000-4-6

**Magnetic Field Immunity** EN61000-4-8

**Voltage Dips** EN61000-4-11

**Voltage Interruptions** EN61000-4-11

Authorised

C. Caswell

Director



## APPENDIX A

### Down Load The App

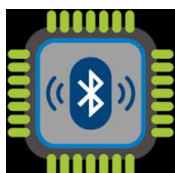
#### **Andriod**

From **Google Play Store** download and the Install “BLE Terminal” by “mightyIT”.



#### **Apple**

From **App Store** download and the Install BLE Terminal HM-10.



### Connect To Bluetooth

- Check that LED1 on the encoder PCB is pulsing a single flash (this shows that the Bluetooth link is available and currently disconnected).
- Ensure Bluetooth is enabled from your mobile device
- Open the App.
- Scan for devices (see fig 1).
  - You should find device name Shire\_SAX\_xxxx and select.
- Check that LED1 now pulses with a double flash (this confirms connection).
- You should have a message saying “connected” “password” (see fig 2).
- Terminal screen will open as per figure opposite.
- For Apple ISO Only
  - just below the black terminal window press the blue button marked
    - 'selected xxxxxxxx'.
  - From the menu selection menu select.
    - Characteristic Notify Write WriteWithoutResponse (see fig 3).
- Enter the default password “studio3” (see fig 4).
  - If all is working you will get message saying “Welcome to Shire SAX Command Line Interface” (see fig 5).

fig 1

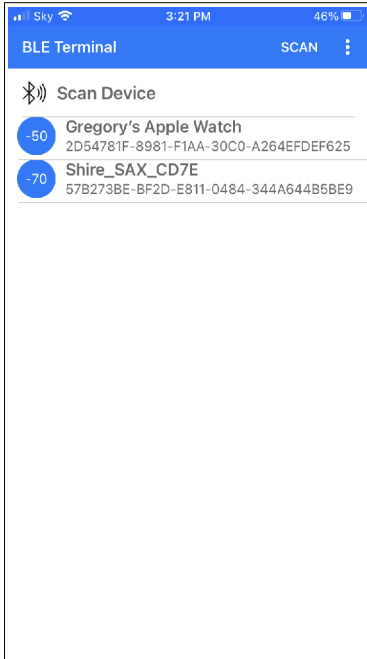


fig 2

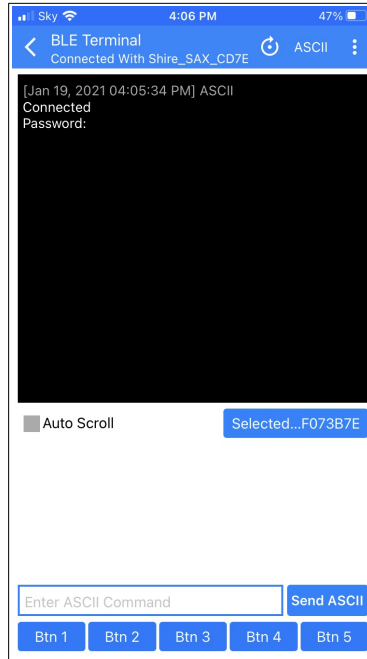


fig 3

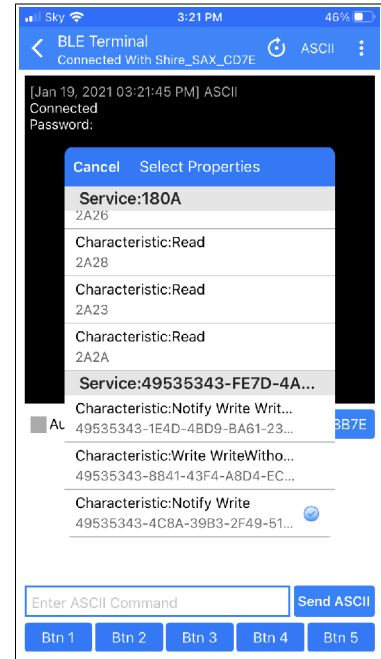


fig 4

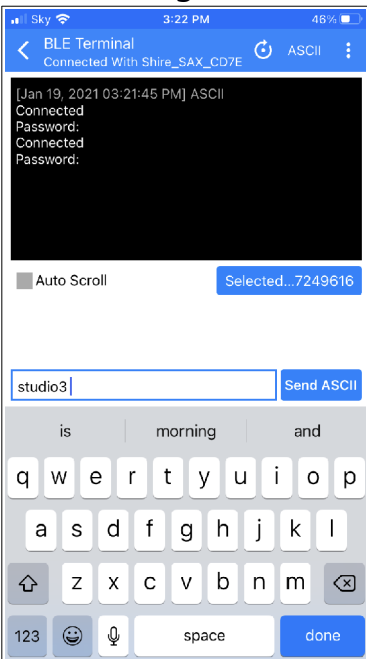
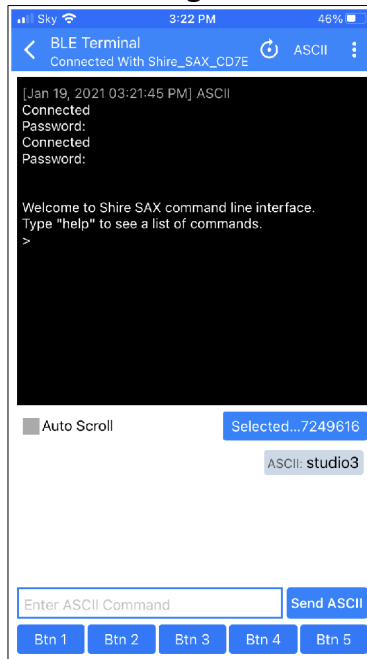


fig 5



You are now ready to write to the Alarm System from your mobile device as per table below.

### Option

There are short-cut buttons provided at the bottom of the screen. Hold down 'Btn1' and typing 'studio3' in the pop up window that follows. This means that whenever you need to pair with the device, 'Btn1' will log in from the password prompt.

## Command List

Typing 'gashelp' will produce a list of available instructions for gas settings. The command structure, description and useful notes are listed in the table below:

Instruction	Brief Description	command format	Notes
list	List All Parameters For A Gas	gas x list  w here (x = gas 1-6 or a for all)	Lists Gas Type, Current Pressure, Current Condition Also Text Used For Name, Normal, High Pressure, Low Pressure, Drop Pressure, Fault Out Of Range Also Gas High Pressure Set:4.80bar, Gas Pressure Drop Set:3.70bar, Low Pressure Set:3.40bar Also Condition (on/off), Display (on/off/w ith Test), Unit: (bar/mmhg), Demo (off)
name	Change Text In Gas Name Window	gas x name y  w here (x=gas 1-6 or a for all gases)  and (y = new name)	Use \n Betw een Lines Of Text Use \s For Space
normal	Change Text For Gas Normal Status	gas x normal y  w here (x=gas 1-6 or a for all gases)  and (y = new name)	Use \n Betw een Lines Of Text Use \s For Space
high	Change Text For Gas High Pressure Status	gas x high y  w here (x=gas 1-6 or a for all gases)  and (y = new name)	Use \n Betw een Lines Of Text Use \s For Space
drop	Change Text For Gas Pressure Drop Status	gas x drop y  w here (x=gas 1-6 or a for all gases)  and (y = new name)	Use \n Betw een Lines Of Text Use \s For Space
low	Change Text For Gas Low Pressure Status	gas x low y  w here (x=gas 1-6 or a for all gases)  and (y = new name)	Use \n Betw een Lines Of Text Use \s For Space
fault	Change Text For Gas Fault (out Of Range) Status – Line Monitoring With System Fault	gas x fault y  w here (x=gas 1-6 or a for all gases)  and (y = new name)	O/C and S/C are show n w hen Pressure Is Enabled
hi_set	Set High Pressure Warning Level (i.e. If Pressure Rises To/Above This Level, High Pressure Warning Will Activate	gas x hi_set y  w here (x=gas 1-6 or a for all gases)  and (y = set level in x.xx format)	
hi_diff	sets hysteresis width below hi_set level	gas x hi_diff y  w here (x=gas 1-6 or a for all gases)  and (y = set level 0.1-0.4)	0.1 to 0.4 set as 0.2 default
pd_set	Set Pressure Drop Warning Level (i.e. If Pressure Drops To/Below This Level, Pressure Drop Warning Will Activate	gas x pd_set y  w here (x=gas 1-6 or a for all gases)  and (y = set level in x.xx format)	

pd_diff	sets hysteresis width above pd_set level	gas x pd_diff y w here (x=gas 1-6 or a for all gases) and (y = set level 0.1-0.4)	0.1 to 0.4 set as 0.2 default – needs changing to pd_clr
lo_set	Set Low Pressure Warning Level (i.e. If Pressure Drops To/Below This Level, Low Pressure Warning Will Activate)	gas x lo_set y w here (x=gas 1-6 or a for all gases) and (y = set level in x.xx format)	
lo_diff	sets hysteresis width above lo_set level	gas x lo_diff y w here (x=gas 1-6 or a for all gases) and (y = set level 0.1-0.4)	0.1 to 0.4 set as 0.2 default
on	Switches Gas Channel On	gas x on w here (x=gas 1-6 or a for all gases)	
off	Switches Gas Channel Off	gas x off w here (x=gas 1-6 or a for all gases)	
press_on	Specific Gas Pressure Can Be Displayed In 3 Different Modes Or Switched Off	gas x press_on w here (x=gas 1-6 or a for all gases)	Specific Gas Pressure Always Displayed
press_al		gas x press_al w here (x=gas 1-6 or a for all gases)	Specific Gas Pressure Displayed When Alarm Condition Occurs Or With Test Function (i.e. Not Displayed When Gas Is Operating At Normal Pressure)
press_eng		gas x press_eng w here (x=gas 1-6 or a for all gases)	Specific Gas Pressure Displayed When Mute/Test Function Is Operated (i.e. Not Displayed When Whilst Mute/Test Button Is Not Operate)
press_off		gas x press_off w here (x=gas 1-6 or a for all gases)	Specific Gas Pressure Never Displayed
type	Load Pre-Determined Medical Gas Macros	gas x type w here (x=gas 1-6 or a for all gases)	Options = USER, O2, N2O, ENT, MA_4, MA_7, SA_7, VAC, N2, CO2
units	Set units - <b>bar</b> for gases or <b>mmHg</b> for vacuum	gas x units y w here (x=gas 1-6 or a for all gases) and (y = bar or mmhg)	
cal	Use 2+ pressure settings to create characteristic to match transducer output for a channel	gas x cal y w here (x=gas 1-6) and (y = set level in x.xx format)	Uses the current input signal from the transducer to set whatever pressure reading you want the alarm channel to read.
atm	This can be used as Zero-bar point for vacuum channels	gas x atm cal w here (x=gas 1-6)	Creates a zero pressure point for vacuum channels

Typing 'help' will produce a list of available instructions for general settings. The command structure, description and useful notes are listed in the table below:

Instruction	Brief Description	command format	Notes
tone	Change Audible Tone	tone x w here (x=gas 0, 1 or 2)	0= two tone 1 = EN475 2 = Alternating Bleep
mute	change duration of mute audible re-trigger time	mute x w here (x=0-240)	Where 0 = off and 1-240 = 1-240 minutes
logout	logout of BLE terminal	logout	This will disconnect blue-tooth to allow other users access
logouttime	adjusts the time that you stay logged in without activity	logouttime x w here (x=1-60)	1-60 minutes
passwd	change passwd	passwd x	Enter New Password (6-15 characters) then retype to confirm Default passwd = studio3
modbus	set modbus interface output channel	modbus x w here (x= 1-20)	set to channel 1-20
location	change blue-tooth device Identity	Location x w here (x=new location name)	Default uses SAX_xx:xx (mac address). Rename will take format SAX-xxxxxxx (upto 15 characters). Use with reboot to force update.
settings	check general encode settings	settings	Lists name, pw, supply, battery, modbus address, tone, screensaver, mute, logouttime, logtime, bluetooth ver, hardware ver, software ver, build ver, serial, webaddress
screensave	adjusts the time that you stay logged in without activity	screensave x w here (x= 0-60)	Where 0 = disabled and 1-60 = 1-60 minutes
logtime	data collection of pressures	logtime x	Set 1-60. Default = 5mins, providing a 53hr record
logdump	data collection of pressures	logdump	640 records recorded per logtime
logclear	Clear data collection log	logclear	Confirm Y or N
factory	reset to factory default	factory	Confirm Y or N

## APPENDIX B

### Modbus Settings (upto software version 002 RC206.elf)

Modbus type: RTU RS485                      Baud Rate: 115200 baud  
Data bits: 8                                      Stop bits: 1 stop bits  
Flow control: No                                Scan rate/Timeout: 1000ms

Modbus address: Set Modbus xx instruction in App

Read continuous block of holding register (0x03) Good

Reading an address above 69 will produce an error

Function	address	data
Condition Status	0 + gas	0 = OFF, 1 = NORMAL 1, 2 = HIGH2, 3 = LOW, 4 = FAULT, 5 = OC, 6 = SC, 7 = NORMAL_A
Gas pressure	10 + gas	Gas pressure reading. Integers, see units
Set point to go into high alarm	20 + gas	Gas high alarm setpoint. Integers, see units
Set point to go into low alarm	30 + gas	Gas low alarm setpoint. Integers, see units
Gas type	40 + gas	0 = O2, 1 = N2O, 2 = ENT, 3 = MA_4, 4 = MA_7, 5 = SA_7, 6 = VAC, 7 = N2, 8 = CO2 9 = USER,
Gas Units	50 + gas	0 = BAR, 1 = MMHG, 2 = PSI, 3 = NON,

Gas offset range 0-5.

i.e. gas 3 pressure = address 12

Gas pressure = 418

If gas units = 000 then Bar so divide by 100.

If gas units = 100 then mmHg so divide by 1.

If gas units = 200 then PSI so divide by 1.

If gas units = 300 then NON so divide by 1.

Pressure/100 = 4.18 Bar

Pressure/1 = 418 mmHg

Pressure/1 = 418 PSI

Pressure/1 = 418



## Test ModBus:

- Install QModMaster <https://sourceforge.net/projects/qmodmaster/> software on windows PC.
- Connect serial/RS485 bus to PC and ModBus connector on the Encoder PCB.
- Find the com port that windows has set up for the RS485 port (Run Device manager and look for (COM & LPT))

Modbus Master

File Options Commands View Language Help

Modbus Mode: RTU Slave Addr: 1 Scan Rate (ms): 1000

Function Code: Read Holding Registers (0x03) Format: Decimal

Start Address: 0 Number of Registers: 60

1	1	1	1	1	1	0	0	0	0
470	415	570	430	420	565	0	0	0	0
480	480	800	480	480	800	0	0	0	0
370	370	300	370	370	300	0	0	0	0
340	340	270	340	340	270	0	0	0	0
0	3	106	8	2	106	0	0	0	0

RTU : COM6: | 115200,8,1,None Packets : 250 Errors : 0

Annotations:

- Function Code: Read Holding Registers (0x03)
- Start Address: 0
- Number of Registers: 60
- Gas 1: points to the first cell (1,1)
- Gas 6: points to the sixth cell (2,6)
- Gas 7,8,9,10 Not Implemented: points to the last four cells (0,7-10)
- Number of registers to be read: points to the Number of Registers field (60)

**Note:** gas type/units have now been split to give  
 Gas Type addresses 50-55  
 Gas units addresses 60-65  
 New maximum address=69

## APPENDIX C

### Transducers

Pressure transducers set up as 4-20ma 16bar (0Bar=4ma, 16Bar=20ma)

Vacuum transducers set up as 4-20ma -1bar (0mmHg=20ma, 760mmHg=4ma)

Approved with

- Gems Vac: 3300 B 000P V 01 E 0 00
- Kavlico 16 bar: PTE5000-016-1-B-1-C
- 4-20ma cable M12F-A-STR 4P 0RA.PVC LEAD 2M
- Scatergood PN: RKT4-07/2M
  - Brown 1 +VE ( Connect to + on encoder transducer input )
  - White 2 DNC ( Do Not Connect )
  - Blue 3 -VE ( Connect to - on encoder transducer input )
  - Black4 DNC ( Do Not Connect )

Shire Controls Ltd  
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Gilston  
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Essex CM20 2RL

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Website: [shirecontrols.com](http://shirecontrols.com)  
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