Rubber Switch Panel (RSP)

User Guide

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Contents

Introduction

The RSP is the next generation of switch panel from Cosworth Electronics. Designed to withstand harsh environments from 24-hour endurance racing to rallying, the RSP features tactile feedback switches as well as raised switch guards to ensure accurate button activation.

The RSP range has been designed to work seamlessly with Cosworth's family of Intelligent Power Supplies (IPS) and ECU's.

Available in 10 or 20 switch variants. Each switch is independently backlit by 4 powerful tri-colour LEDs providing ultimate visibility in all light conditions. Switch colours, flash patterns, brightness levels and switch functions are all fully configurable ensuring ultimate readability for day or night use.

The RSP features user-configurable CAN allowing for IDs, rates of the packets as well as BUS termination. The state of each switch is transmitted over CAN at 200Hz by default as well as the additional 2 digital inputs providing external switches. All communication is made through a single double density Deutsch Autosport connector including the RS232 Debug comms.

Once installed an IP rating of IP66 can be achieved at the front surface. The RSP's design means the rear surface is almost completely flat, allowing it to easily be incorporated into any application.

As standard each RSP is supplied with the RSP Switch Identification Label Set which provides a selection of icons to cover the most common switch functions.

Specifications

Electrical Data	
Supply Voltage	6.5-32V
Supply Current	RSP10-5x2 159mA @ 13.8V[*1]
	RSP20-5x4 292mA @ 13.8V[*1]
Push Switches	RSP10-5x2 10 Switches
	RSP20-5x4 20 Switches
Switch Type	Momentary
External Digital Inputs	2 x with 10K pull up to +5V
LED's	7 Colours per Switch
Debug Communication	RS232
RS232 Settings	115200, 8, none, 1
CAN Communication	1 x CAN 2.0A
CAN Rate	100/125/250/500/1000 Kbps

Mechanical Data	
Material	Black PU 60 Shore
Dimensions	RSP10-5x2 137.00 x 70.00 x 15.10mm[*2]
	RSP20-5x4 137.00 x 123.00 x 15.10mm[*2]
Weight	RSP10-5x2 130g
	RSP20-5x4 230g
Connector	Deutsch Autosport
Fixings	RSP10-5x2 6x M4 x 11.4mm
	RSP20-5x4 8x M4 x 11.4mm
Temperature Rating	Operating -20 to +70°C
	Storage -30 to +80°C
IP Rating	IP66 / IP64[*3]

Ordering Information

Part Number	
01D-620120-C	Cosworth RSP10-5x2
01D-620130-C	Cosworth RSP20-5x4
34D-620112-C1	RSP Switch Identification Label Set
60D-620111	RSP Debug Loom

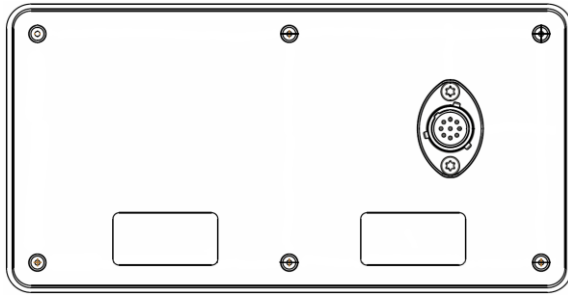[*1] Current based on all LED's ON White.

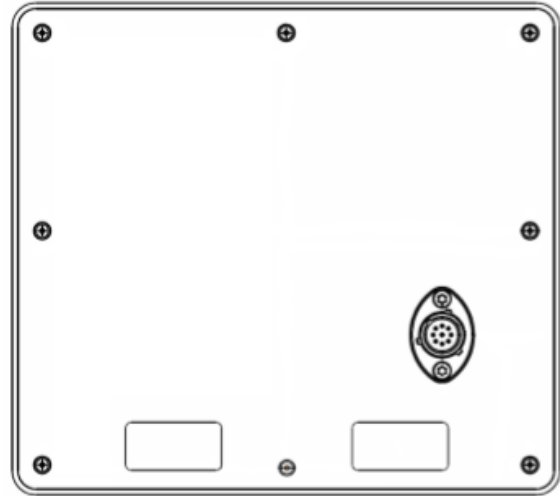[*2] Front panel thickness not including rear connector protrusion.

[*3] See dimensional drawing for IP rating zones.

Connector Information

RSP10-5x2 Connector

RSP20-5x4 Connector

Connector	Mating connector
ASDD206-09PB-HE	ASDD606-09SB-HE

Connector	Mating connector
ASDD206-09PB-HE	ASDD606-09SB-HE

RSP10-5x2 Pinout

Pin	Signal	Description	
1	BATT+	Battery 6.5-32V Input Voltage	
2	DEBRX	Debug Rx	DB9 Pin 3
3	DEBTX	Debug Tx	DB9 Pin 2
4	EXT DIN1	External Digital Input 1	
5	EXT DIN2	External Digital Input 2	
6	CANL	CAN Low	
7	CANH	CAN High	
8	Gnd	Digital/ Debug	DB9 pin 5
9	BATT-	Battery 0V	

RSP20-5x4 Pinout

Pin	Signal	Description	
1	BATT+	Battery 6.5-32V Input Voltage	
2	DEBRX	Debug Rx	DB9 Pin 3
3	DEBTX	Debug Tx	DB9 Pin 2
4	EXT DIN1	External Digital Input 1	
5	EXT DIN2	External Digital Input 2	
6	CANL	CAN Low	
7	CANH	CAN High	
8	Gnd	Digital/ Debug	DB9 pin 5
9	BATT-	Battery 0V	

Dimensions

RSP10-5x2

RSP20-5x4

Switch Top

DETAIL A
ILLUMINATED BUTTON AREA
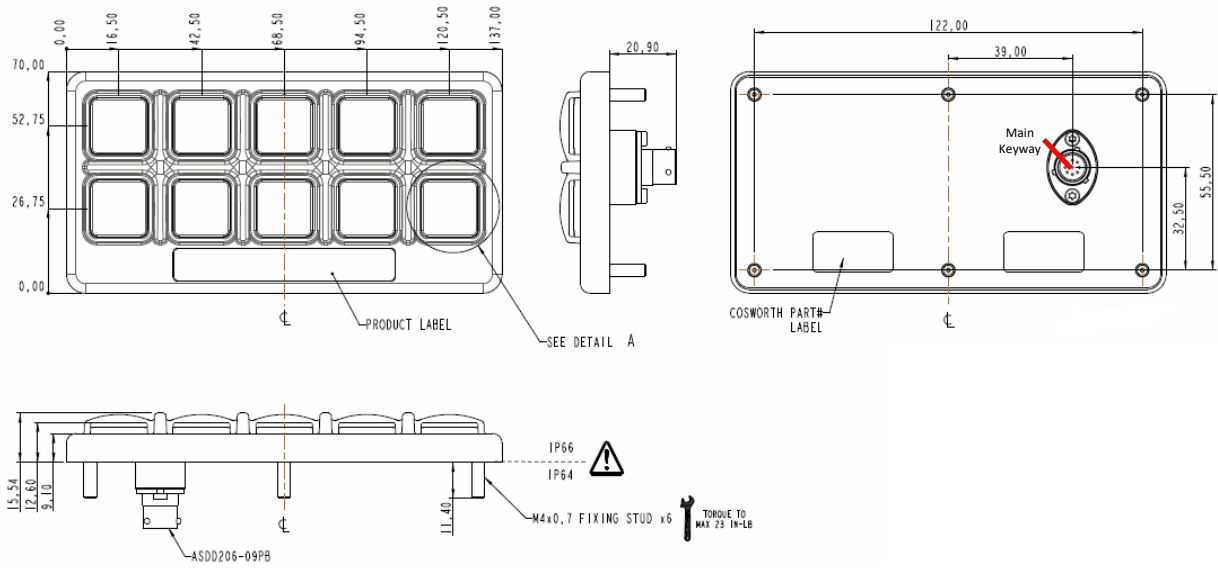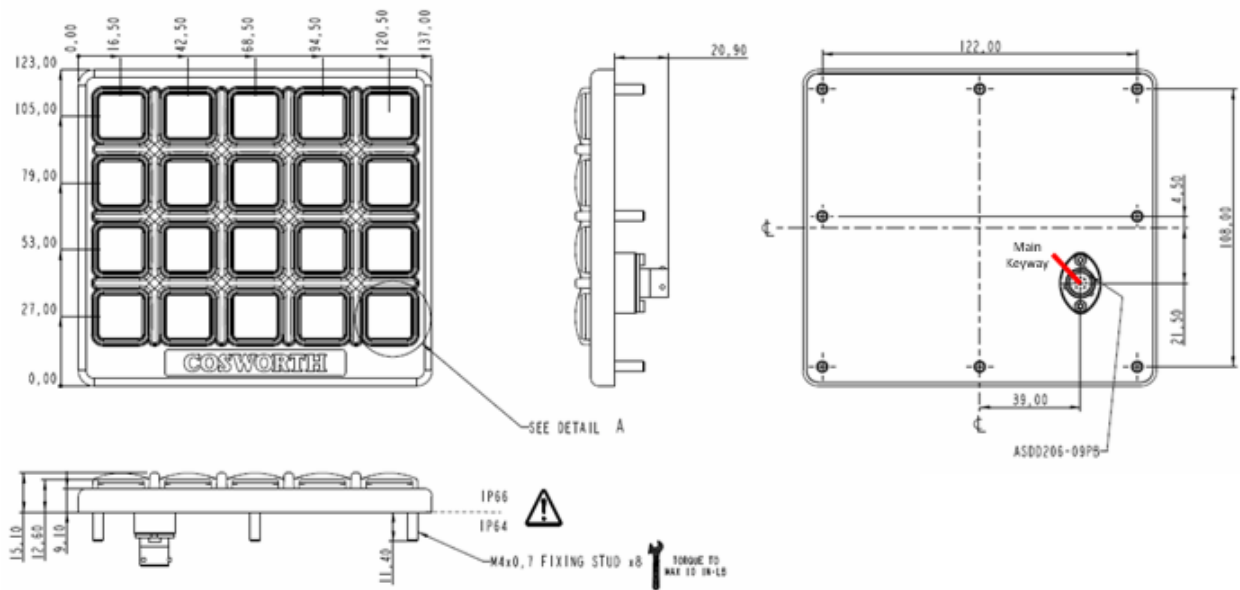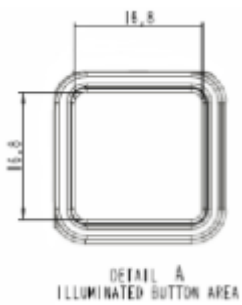
Interfaces

CAN

There is one CAN port:

Software configurable BAUD rates,

100, 125, 250, 500 and 1000kbit/sec the default is 1000kbit/sec.

Software configurable CAN identifiers (IDs).

Software configurable termination (default = termination OFF).

Bid endian format

Serial

There is one serial ports on the RSP.

The Debug port is configured to operate at a fixed rate of 115k2 Baud, 8 data bits, No parity and one stop bit

The Debug serial port is used to access a RSP configuration menu.. The serial port is also used for firmware updates.

Switch and LED Identification

RSP10-5x2 Switch's

The RSP switches are as follows and are always referenced from top left to bottom right.
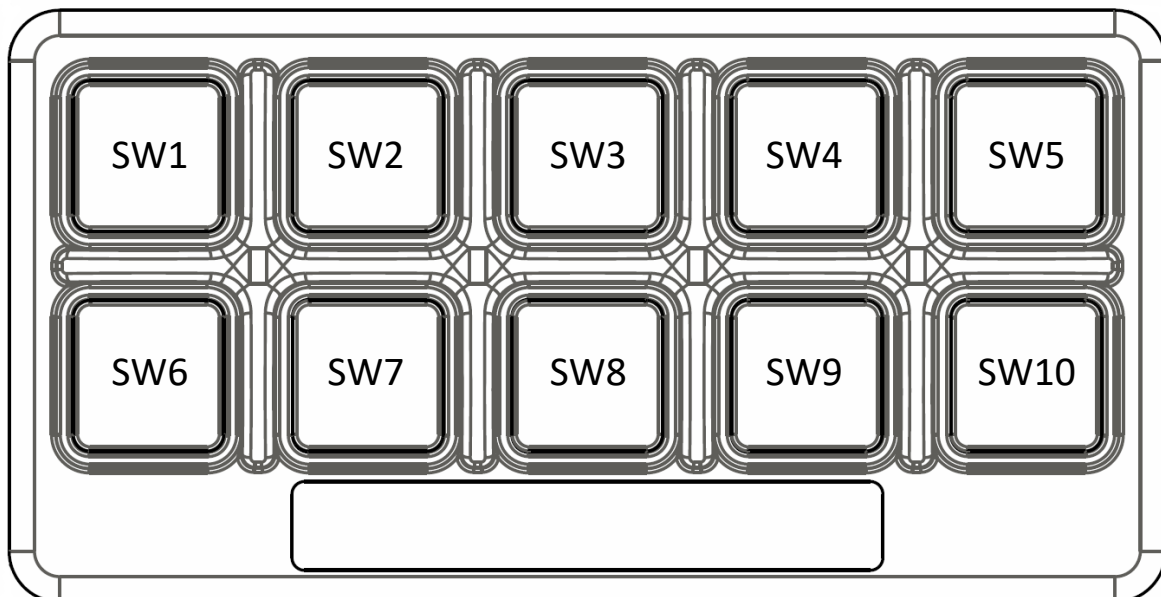
RSP20-5x4 Switch's
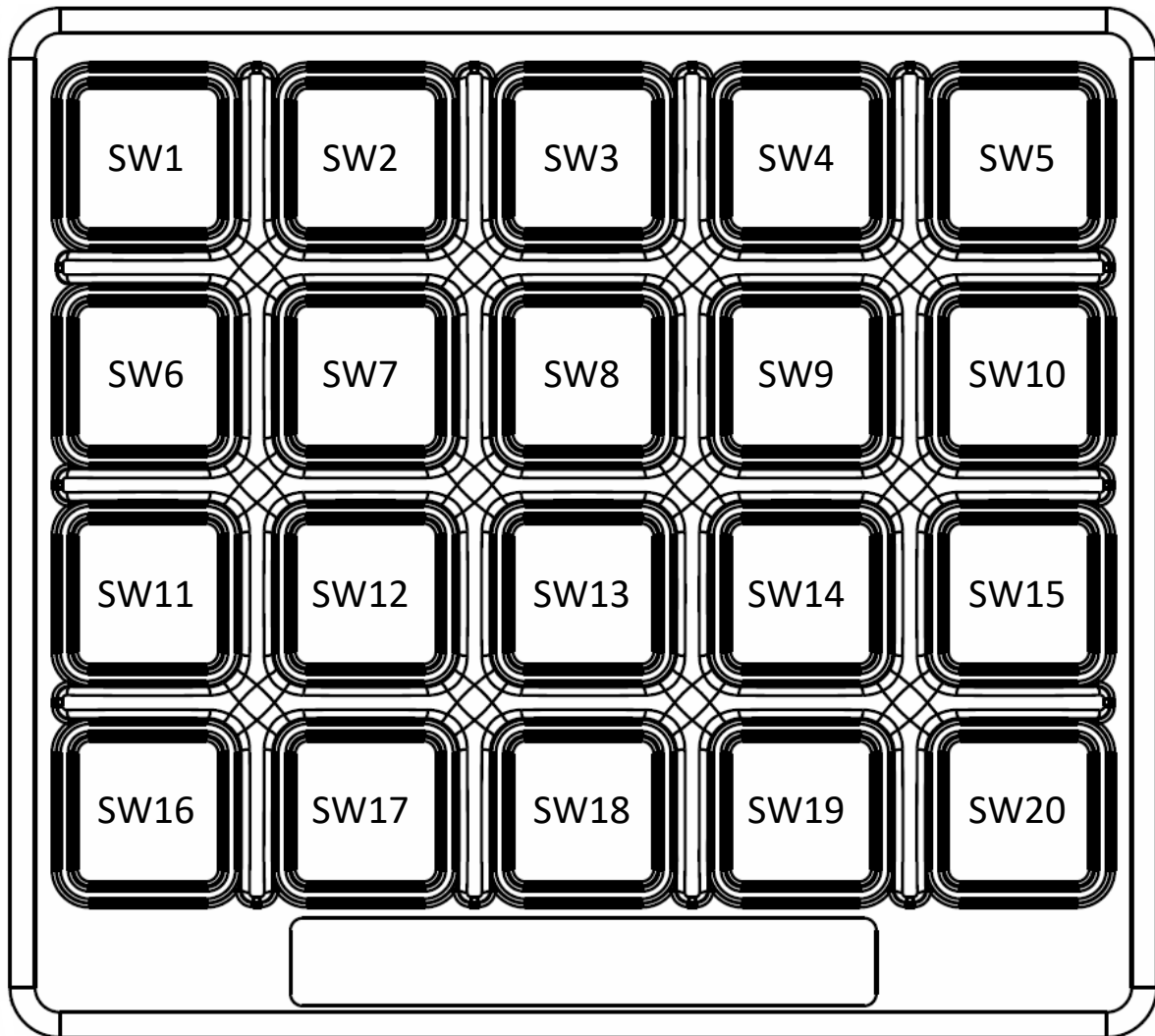
Switch Inputs

There are up to 20 switches on the RSP using a row/column matrix which is decoded by the processor, for this reason it is not possible to operate more than 2 switches at the same time.

External Digital Inputs

There are 2 external Digital inputs available through the system connector, these are also internally pulled up to +5V supply via a 10K resistor.

LED's

There are 4 tri colour LED's behind each switch, these are controlled to give a single colour across the entire switch cap.
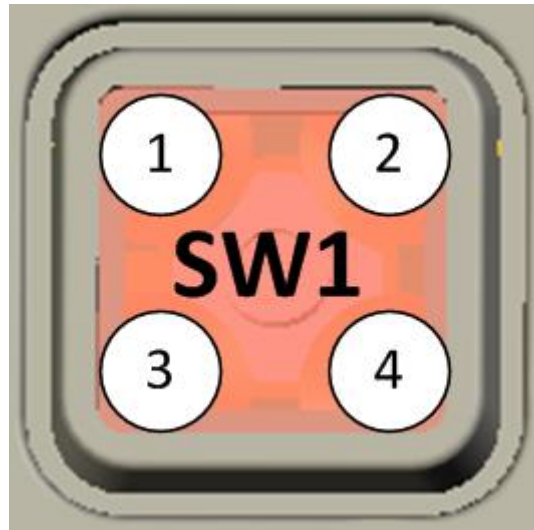
Each switch can be configured to be the following colours:

- Red
- Green
- Yellow
- Blue
- Magenta
- Cyan
- White

CAN Communications

All CAN is big endian format.

CAN Transmission

The following CAN message are transmitted from the RSP to show the state of the RSP parameters including battery voltage and temperature. The message ID's of the CAN packets can be changed refer to the *"Setup and Debug"* section for more information.

The switch inputs are also transmitted as follows

- o Switch Message   Digital Input Message
  - 1 = Switch closed   1 = Digital input connected to 0V.
  - 0 = Switch open   0 = Digital input open circuit (pulled-up).

All switches are treated as momentary. If the switch is required to operate as a latch or multi state switch, this logic will be performed by the device responsible for interpreting the switch presses.

The digital inputs have pull-up resistors on the RSP, the user must pull these inputs to 0V to activate the input.

Switches are de-bounced by ensuring the switch status is the same for 2off consecutive 10mS readings prior to the updated switch status being transmitted over CAN.

To ensure message stability and the ability to use the RSP along with a Pectel ECU the RSP features the Cosworth validation word (CVW).

Message 0x694 - CAN System Parameters

| ID	0x694h (System Parameters and Switch Status)			
Dir	RSP Tx			
Rate	Up to 200Hz			
Bits	**Name**	**Scaling**	**Notes**	
56-63	Cosworth CVW MSByte	U16		
48-55	Cosworth CVW LSByte			
43-47	Software Version Major			
40-43	Device ID			
32-39	Battery Voltage		0.1V/Bit	
24-31	Box Temp		0.5˚C/Bit	
23	CAN Termination	Bit	0=Off, 1=On	
0-22	Switch States	Bitfield	22	Reserved – Set to zero
			21	Digital Input 2
			20	Digital Input 1
			19	Switch 20
			18	Switch 19
			17	Switch 18
			16	Switch 17
			15	Switch 16
			14	Switch 15
			13	Switch 14
			12	Switch 13
			11	Switch 12
			10	Switch 11
			9	Switch 10
			8	Switch 09
			7	Switch 08
			6	Switch 07
			5	Switch 06
			4	Switch 05
			3	Switch 04
			2	Switch 03
			1	Switch 02
			0	Switch 01

CAN Receive

There are 2 CAN receive packets required to run an RSP, multiplexed switch led control and the LED brightness.

- Switch 1-20 LED Control

- LED Brightness Control

Message 0x721 Switch 1-20 LED Control

The LED control is implemented by a single multiplexed CAN packet.

The LED's within each switch can only be controlled to be a single colour, it is not possible to independently control the colour of each LED within a single switch.
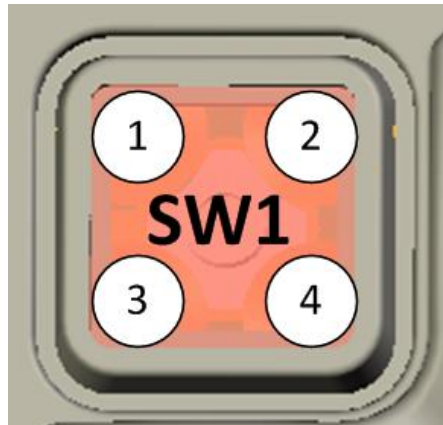
The Colours of the LEDS can be controlled to one of 7 colours, the CAN has been designed to be compatible with a possible increase to 4096 colours. For this reason the CAN control has been expanded so that in future this can be done without a need to update the CAN.

SWXX LED Colour reference table

To allow for future expansion of colour control each colour must be enabled in full meaning a decimal value of 15 must be set as shown below.

Message Bits		Blue, Green, Red, Bits 11 to 0											
Sub Bits		Blue sub message bits				Green sub message bits				Red sub message bits			
Colour	Decimal	Bits 11 to 8				Bits 7 to 4				Bits 3 to 0			
OFF	0	0	0	0	0	0	0	0	0	0	0	0	0
Red	15	0	0	0	0	0	0	0	0	1	1	1	1
Green	240	0	0	0	0	1	1	1	1	0	0	0	0
Blue	3840	1	1	1	1	0	0	0	0	0	0	0	0
Yellow	255	0	0	0	0	1	1	1	1	1	1	1	1
Magenta	3855	1	1	1	1	0	0	0	0	1	1	1	1
Cyan	4080	1	1	1	1	1	1	1	1	0	0	0	0
White	4095	1	1	1	1	1	1	1	1	1	1	1	1

Switch 1-20 Multiplex Counter and Data Payload

ID	721h (Switches 1-20 LED Colours)		
Dir	System to RSP		
Rate	Up to 100Hz		
Bits	Name	Scaling	Notes
60-63	Multiplex Counter (Mux_Counter_RSP)		
0-59	Data Payload		

Switch 1-5 Data Payload Multiplex Counter 0

ID	Multiplex Counter 0			
Bits	Name	Scaling	Notes	
48-59	SW01 LED Colour (Mux SwA LED Colour RSP)		8-11 4-7 0-3	Blue Green Red
36-47	SW02 LED Colour (Mux SwB LED Colour RSP)		8-11 4-7 0-3	Blue Green Red
24-35	SW03 LED Colour (Mux SWC LED Colour_RSP)		8-11 4-7 0-3	Blue Green Red
12-23	SW04 LED Colour (Mux_SWD LED Colour_RSP)		8-11 4-7 0-3	Blue Green Red
0-11	SW05 LED Colour (Mux_SWE LED Colour_RSP)		8-11 4-7 0-3	Blue Green Red

Switch 6-10 Data Payload Multiplex Counter 1

ID	Multiplex Counter 1			
Bits	Name	Scaling	Notes	
48-59	SW06 LED Colour (Mux_RSP SWA LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
36-47	SW07 LED Colour (Mux_RSP SWB LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
24-35	SW08 LED Colour (Mux_RSP SWC LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
12-23	SW09 LED Colour (Mux_RSP SWD LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
0-11	SW10 LED Colour (Mux_RSP SWE LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red

Switch 11-15 Data Payload Multiplex Counter 2

ID	Multiplex Counter 2			
Bits	Name	Scaling	Notes	
48-59	SW11 LED Colour (Mux_SWA LED Colour_RSP)		8-11 4-7 0-3	Blue Green Red
36-47	SW12 LED Colour (Mux_RSP SWB LED Colour_RSP)		8-11 4-7 0-3	Blue Green Red
24-35	SW13 LED Colour (Mux_RSP SWC LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
12-23	SW14 LED Colour (Mux_RSP SWD LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
0-11	SW15 LED Colour (Mux_RSP SWE LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red

Switch 16-20 Data Payload Multiplex Counter 3

ID	Multiplex Counter 3			
Bits	Name	Scaling	Notes	
48-59	SW16 LED Colour (Mux_RSP SWA LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
36-47	SW17 LED Colour (Mux_RSP SWB LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
24-35	SW18 LED Colour (Mux_RSP SWC LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
12-23	SW19 LED Colour (Mux_RSP SWD LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red
0-11	SW20 LED Colour (Mux_RSP SWE LED Colour_CHP)		8-11 4-7 0-3	Blue Green Red

Message 0x72F LED Intensity

The intensity of the LEDs are controlled by a single byte. There is 1 bit (day/night) which changes the maximum brightness of the LEDs for different conditions. There are 5 bits which are used to control the intensity of the LEDs from 0 (minimum brightness) to 31 (maximum brightness).

ID	72Fh (Intensity)		
Dir	System to RSP		
Rate	Up to 100Hz		
Bits	Name	Scaling	Notes
0-7	LED Brightness	7	1 = Day brightness (bright), 0 = night
		6	Reserved – set to zero
		5	Reserved – set to zero
		4	LED Brightness Control Bit 4
		3	LED Brightness Control Bit 3
		2	LED Brightness Control Bit 2
		1	LED Brightness Control Bit 1
		0	LED Brightness Control Bit 0
8–63	Reserved		Must be set to zero

Setup and Debug

The setup and debug menu is available using the debug pins on the RSP.

There is one serial port which is configured to operate at a fixed rate of 115k2 Baud, 8 data bits, one stop bit and parity.

The serial port is used to access a menu, from here you can configure the RSP. The serial port is also used to update the code level.

Config Menu

This menu is available at any time by pressing the <Esc> key within 0.5 seconds after power up, the <Esc> key can be held during power up but the Config menu will scroll multiple times until the <Esc> key is released.. All CAN functionality is suspended whilst in this menu. The present values of the parameters are shown in square brackets. The test menu display is shown below:

```
*** RSP Ver X.X ***

        C - CAN Configuration
        H - Hardware Information
        L - LED Intensity
        M - Operation Mode
        R - Restore Factory Defaults
        T - Test Menu
        U - Update System EEPROM
        W - Watch
        X - Exit Config Menu and return to Run Mode
        Z - Go to sleep and wait for watchdog
                Enter selection:
```

When an option is selected which requires user input, each option will be displayed one line at a time with the present value being displayed inside square brackets. If <cr> is pressed then the value is not modified and the next parameter is displayed. The EE will not be updated unless specifically requested from the menu. The following example shows 2 entries in a sub-menu, user input is shown in red:

```
Sub menu configuration
  Parameter 1 [0xf0]: <cr>
  Parameter 2 [0x12]: 0x13<cr>
```

CAN Configuration

When 'C' is selected from the main menu the user can display/modify CAN parameters one at a time, as shown below. The configuration can be exited at any time by pressing <Esc>, rather than having to step through the complete list:

```
CAN Configuration
        CAN Baud Rate (0=1Mbit, 1=500k, 2=250k, 3=125k, 4=100k) [ 1MBit ] :
        CAN Extended Addressing (Ext (E) or Std (S)) [ Std ] :
        CAN Termination (On or Off) [ Off ] :
        System Parameter and Switch Tx ID [ 0x00000694 ]
        Sw 1-20 LED Colour Rx ID [ 0x00000721 ]
        LED Intensity Rx ID [ 0x0000072f ]
        Sys Msg Tx Rate (0, 1, 2, 5, 10, 100, 200 Hz) [ 100 ] :
```

Hardware Information

The Hardware information menu is only available for use by Cosworth.

LED Intensity

When 'L' is selected from the main menu the user can configure the default LED intensity to be used should the user not send the brightness via CAN. This value will be replaced by the values sent via CAN if it is present.

```
LED Intensity:
        LED Day (D) or Night (N) Setting [ Day ] :
        LED intensity (max = 31, min = 0) [ 31 ] :
```

Operation Mode

When 'M' is selected from the main menu the user can select the mode that the RSP works in, "***Run"*** or ***"Test"***.

In run mode the RSP will respond to and transmit CAN messages as described above. In automatic test mode the RSP runs test code, when a switch is depressed the 4 LEDs around the depressed switch will be illuminated white.

```
        Start Up Mode (Run (R) or Test (T)) [ Run ] :
```

Restore Defaults

When 'R' is selected from the main menu, the following factory defaults are restored into the EEPROM:

Description	Default	Options
CAN Baud Rate	1000kbit/sec	1000, 500, 250, 125, 100kbit/sec
CAN Addressing	Standard	Standard 11 bit or Extended 29 bit
CAN Termination	OFF	Off, On
Sys Parameter and Switch Tx ID	0x0694	0 to 0x7ff (or 0 to 0x1FFFFFFF)
SW1-20 LED Colour Rx ID	0x0721	0 to 0x7ff (or 0 to 0x1FFFFFFF)
Sys Tx Rate	100Hz	Off, 1Hz, 2Hz, 5Hz, 10Hz, 20Hz, 50Hz, 100Hz, 200Hz

Test Menu

When 'T' is selected from the main menu the following menu will be displayed allowing the RSP to be tested.

```
Tests:
        1 - Turn on one LED at a time
        2 - LED brightness test (checks day/night# signal)
        3 - Keyboard Test A - status displayed via serial output
        4 - Keyboard Test B - LEDs around switch illuminate when pressed
        5 - Digital input test - status displayed via serial output
        6 - LED driver test - test each display driver in turn
        X - Exit this menu
```

Test Menu option 1

When option '1' is selected from the test menu the user can turn on one LED at a time. Once selected the user will be prompted to select the number of switches that the RSP has meaning a user with a 5 switch RSP does not have to wait for all 20 switches to be tested.

```
Range to Test:
        1 - test LEDs for 5 switches
        2 - test LEDs for 10 switches
        3 - test LEDs for 15 switches
        4 - test LEDs for 20 switches
```

LED Brightness Test

When option '2' is selected for the test menu the user can test the brightness mode setting for the LED's once selected the LEDs should turn on at night brightness then day brightness. Once complete the following will be shown.

```
## LEDs dim then bright and then off - Test Complete
```

Keyboard Test A

When option '3' is selected the test menu the user can test each switch on the RSP and see the switch state on the screen. For each switch the value under it represents its state.
0= OFF 1 = ON

```
Display Switch Status
    20 19 18 17 16 15 14 13 12 11 10  9  8  7  6  5  4  3  2  1
     0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

Keyboard Test B

When option '4' is selected from the test menu the user can test the switch function by checking that the LED's around the switch turn on white. This is the same as when the unit is placed into *"Test"* mode.

Digital Input Test

When option '5' is selected from the test menu the user can check the state of the 2 external digital inputs

```
Display Digital Input Status
    2   1
    0   0
```

LED Driver Test

When option 6 is selected from the main menu the LED driver for each bank of LED's will be tested. The following information will be displayed to the user.

```
## Put LED driver devices into test mode  (CTRL+C or ESC to abort)
```

Update System EEPROM

After changes have been made to the system the parameters must be written to the EEPROM so they can be stored over a power cycle. When "U" is selected from the main menu (and when changes to any EEPROM parameter have been made) the following message will be displayed.

```
Some settings have been changed.
  Update System EEPROM? (Y or N):
```

Watch

When 'W' is selected from the main menu the user can display the live parameters from the

```
Box Voltage= 14.630  Box Temp= 28.7C  Dig 1=OFF  Dig 2=OFF  (ESC to exit)
```

Exit Config Menu

When "X" is selected from the main menu the user will take the RSP out of debug mode and return it to *"Run"* mode.