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Warning Sign User Manual

003-024

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SWARCO I First in Traffic Solutions.

Document Control

Document Reference: 003-024

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Approver: Roberto Ricci Date: 18/12/2017

Revision	Date	Notes
1	14/09/2017	Initial Draft
2	03/05/2018	Updated for inverted fault output and detection stats analysis
3	14/06/2018	Updated Wi-Fi section for module reset. Radio long range section corrected.
4	25/05/2018	Updated to support battery only MVAS, MYSI type builds.

CONTENT

1 Introduction 5

2 Description 6

2.1 Chassis 6

2.2 Microwave Radar Vehicle Detector 7

2.3 Profectus CPU STL022 8
2.3.1 Connector Details 9

2.4 LED Driver Module STL042 11
2.4.1 Connector Details 12
2.4.2 Address Selection 14
2.4.3 Driver Output 15

2.5 Photocell 15

2.6 Drive Inverter and Power Monitoring 17
2.6.1 LED Drives & Monitoring 17
2.6.2 LED Groups 20
2.6.3 LED Triggers 21

2.7 Analogue Sensor Inputs 24

2.8 Real time Clock 24
2.8.1 GPS Clock Support 25
2.8.2 NTP Clock Server Support 25
2.8.3 Radio Clock Source Update 25
2.8.4 Clock Configuration 25

2.9 Timetables & Special Days 26

2.10 Remote Network Connection Mobile Data (Option) 27

2.11 Local Master Slave Networking 29
2.11.1 Short Range Radio Connection 31
2.11.2 Long Range Radio Connection (Option) 31
2.11.3 Radio Configuration 31

2.12 Digital I/O 32
2.12.1 Input timeouts 32

2.13 Wi-Fi Access Point 32

2.14 Ethernet 33

2.15 Fault Management 34
2.15.1 Fault Masks 35
2.15.2 Email and SMS Faults 36

2.16 SMS Sign Control 37

2.17 UTMC Operation 37

2.18 Power Supply 40

2.19 Battery Charging 41

2.20 LED Emitters 42

3 Your Speed is…Sign Configuration 43

3.1 conf.ini file details 43

4 Webserver User Interface 49
4.1 Remote Webserver Access 49
4.2 Wifi Webserver Access 49
4.3 Webserver Pages 49
4.3.1 Status Screen 50
4.3.2 LED Drives 54
4.3.3 Digital I/O Screen 55
4.3.4 Logs Screen 56
4.3.5 Timetable 57
4.3.6 Configuration Screen 58
4.3.7 File Manager 59

5 Datalogging 62

6 Detection Logging 63
6.1 Analysis of Sign Data Logging (Standalone) 65
6.1.1 Downloading data 65
6.1.2 Analysing Data and Generating Reports 68

7 Installation 77
7.1 Mounting the Sign 77
7.2 Electrical Installation 78
7.2.1 110 / 230VAC Mains 78
7.2.2 230VAC Switched Mains 78
7.2.3 12VDC Solar 78
7.3 Solar Panel 78
7.4 Radar Alignment (Optional) 80
7.5 Configuration 81
7.6 Testing 81
7.6.1 110/230VAC Mains Supply 81
7.6.2 110/230VAC Switched Mains Supply 81
7.6.3 Solar 81
7.6.4 LED Chain Failure Monitoring 82
7.6.5 Time Source Check 82
7.6.6 Vehicle Logging Check (Optional) 83
7.6.7 Slave Sign Check 83

8 Specifications 84

1 Introduction

The SWARCO Warning Sign is used to warn road approaching users to take care when approaching a hazard. Operation of the sign can happen from multiple sources including timetable, vehicle detection, remote control etc. The sign can display a single image or select from multiple fixed images to display pictograms, text, numbers with or without flashers.

Sign displays are taken from TSRGD although alternative custom displays can also be generated upon request.

The sign is configured for normal operation as required for local operation. Alternatively, the unit can be accessed remotely from the SWARCO central system Zephyr to control and monitor the sign across the mobile data network. Signs can be linked in a master slave arrangement allowing a single point of control and monitoring. Fault monitoring and data logging are widely supported and available locally or remotely.

2 Description

The Warning Sign consists of the following primary components.

2.1 Chassis

The Warning Sign chassis is constructed from 3mm aluminium which is powder coated. The example below shows a 30mph speed warning with red roundel, “SLOW DOWN” message and amber alternating flasher. The front face is hinged to allow maintenance access. Once the front face is open, support struts can be locked to prevent unexpected door closure. Alternative arrangements can be supplied on request.

The chassis is IP55 rated and all cable glanding entry points are protected to maintain this rating. Locks are fitted at multiple points to secure the front face of the sign once closed and to ensure the seal rating is maintained in use.

2.2 Microwave Radar Vehicle Detector

The radar is the vehicle detector which is integrated within the sign front face. The radar is a 24.2GHz module Doppler detector which detects Doppler shift. As a target approaches the radar some of the signal is reflected at a shifted frequency and the measured difference between the transmitted and received frequency is proportional to the speed of the approaching vehicle. To save energy the radar module powers up and activates every 200ms to assess the reflected readings and a tracking algorithm then compares these readings to track vehicles in the path of the radar, thus improving accuracy of speed readings.

The normal detection range of the radar is 100m although this is conditional on the radar reflection so a larger vehicle such as a truck may be detected further than 100m away whilst a motorbike or similar small vehicle may be detected at a shorter range.

The vehicle speed of approaching vehicles is continuously monitored by the radar and fed through into the main CPU for processing. At pre-configured speed thresholds triggers operate functions within the sign.

The vehicle data is stored and collected in data bins every 15 minutes and stored as a count in 5 mph speed data bins. Each time a vehicle is detected approaching the radar its speed is recorded and sorted into these data bins. The data is stored in a USB drive on the “Profectus” CPU so is limited by the storage capacity of the USB drive.

The radar requires configuration within the conf.ini as follows:

#Set the active detector for car logging

```
#Radar
[radar]
com_port=com1           #for com0,com1 for rs485
com_mode=rs232          #rs232/rs485
baud=115200
detection_range=90%     #relevant for radar det
log_time=5              #logging time [mins]
use_kmph=00             #Set to 1 if kmph or 0 for mph.


#Active detector
[detectors]
radar=on                #on/off
analog_sensor1=on       #on/off
analog_sensor2=on       #on/off
```

In this case the radar is connected to the sign CPU on Com port 2. The communications link between the CPU and radar is RS232 at a baud rate of 115.2K. The radar detector range is set to 90% of the 100m maximum and the data is logged at 15 minute intervals in mph.

The radar detector input is set as active, among the sensor inputs.

2.3 Profectus CPU STL022

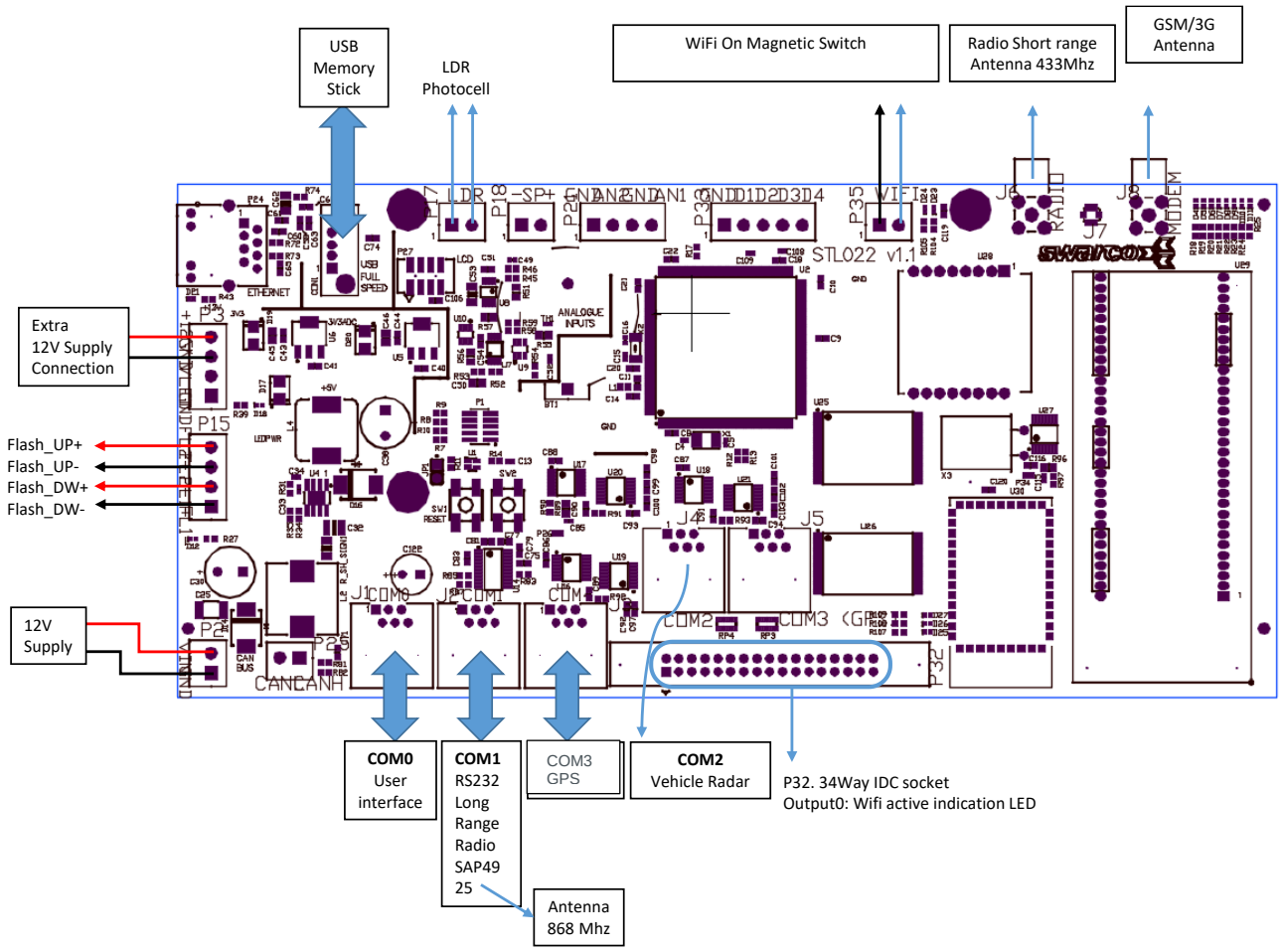
The STL022 CPU has been designed to integrate the control of the warning sign into a single board including communications. The STL-022 is provided in two variants:

Variant 1: Standard
Variant 2: Standard + 2/3/4G Mobile Data Modem

The following facilities are provided by the CPU:

- 12/24V nominal supply voltage, within the operating range 8-30V.
- Internal supply regulation to internal 5V and 3.3V.
- 12V to 24/48V DC-DC converter rated at 48W (Operation controlled by CPU).
- Processor
    - CPU: LPC1857. ARM Cortex M3 Based, 1MB flash, 136kB RAM, 16kB EEPROM.
    - 8MB Flash
    - 2MB RAM
    - Ethernet 10/100MB.
    - USB. Device class. Host
    - Wi-Fi 802.11 b/g Enabled by an external push button. When pressed, an access point will be visible for service, diagnosis and data download.
    - CAN Bus 1Mbit
    - 2x RS232/485. The CPU is able to switch between RS232/485, and switch on/off the level converters.
    - 1x RS232
    - 3x RS232 through I^2C expansion
    - RTC with battery backup
    - Embedded Short Range Radio Module (through RS232).
    - Photocell Input.
    - Analogue Temperature Sensor.
    - Solar Panel Voltage analogue input.
    - Battery Voltage or Power Fail digital input.
    - Sign Power Consumption input
    - Detector input * 4
    - Reset Switch
    - LED indicators * 8
    - 15 digital inputs:
    - 15 digital outputs: voltage free contacts
    - 2 Analogue inputs 0-12V.
    - Option: Modem 2/3/4G Penta band, supporting SMS and Email

Port Connections for the CPU are as follows:



2.3.1 Connector Details

Power Supply

Name	Pin	Comment
VIN	CONN P2 Pin 1	Supply 8-30VDC
GND	CONN P2 Pin 2	GND 0VDC Connection to PSU or battery

Can Bus (LED Driver)

Name	Pin	Comment
CANH	CONN P25 Pin 1	Can Bus High
CANL	CONN P25 Pin 2	Can Bus Low

External Supply and LED Drives

Name	Pin	Comment
GND	CONN P3 Pin 1	GND 0VDC LED drives operating at 24/48VDC
VLED	CONN P3 Pin 2	24/48VDC Supply for LED drives
GND	CONN P3 Pin 3	GND 0VDC for external 12V peripherals
+12V	CONN P3 Pin 4	same as VIN

24/48V Configuration

Name	Pin	Comment
48V_EN	JP4	Fitted LED drive is configured to 48V Not Fitted LED drive is configured for 24V

LDR Photocell Analogue Input

Name	Pin	Comment
LDR IN	CONN P17 Pin 1	Analogue input from LDR
LDR OUT	CONN P17 Pin 2	+3.3VDC Supply to LDR

Wifi Access Point Activation

Name	Pin	Comment
GND	CONN P35 Pin 1	GND 0V for Wi-Fi switch input
WIFI	CONN P35 Pin 2	Input from volt free contact of Wi-Fi switch

Digital Inputs

Name	Pin	Comment
IN0	CONN P32 Pin 2	Digital input 0
IN1	CONN P32 Pin 4	Digital input 1
IN2	CONN P32 Pin 6	Digital input 2
IN3	CONN P32 Pin 8	Digital input 3
IN4	CONN P32 Pin 10	Digital input 4
IN5	CONN P32 Pin 12	Digital input 5
IN6	CONN P32 Pin 14	Digital input 5
IN7	CONN P32 Pin 16	Digital input 6
IN8	CONN P32 Pin 18	Digital input 7
IN9	CONN P32 Pin 20	Digital input 8
IN10	CONN P32 Pin 22	Digital input 9
IN11	CONN P32 Pin 24	Digital input 10
IN12	CONN P32 Pin 26	Digital input 11
IN13	CONN P32 Pin 28	Digital input 12
IN14	CONN P32 Pin 30	Digital input 13
GND	CONN P32 Pin 32,34	GND 0V for Digital Inputs

Digital Outputs

Name	Pin	Comment
OUT0	CONN P32 Pin 1	Digital output 0 (Default Wi-Fi LED indicator)
OUT1	CONN P32 Pin 3	Digital output 1
OUT2	CONN P32 Pin 5	Digital output 2
OUT3	CONN P32 Pin 7	Digital output 3
OUT4	CONN P32 Pin 9	Digital output 4
OUT5	CONN P32 Pin 11	Digital output 5
OUT6	CONN P32 Pin 13	Digital output 5
OUT7	CONN P32 Pin 15	Digital output 6
OUT8	CONN P32 Pin 17	Digital output 7
OUT9	CONN P32 Pin 19	Digital output 8
OUT10	CONN P32 Pin 21	Digital output 9
OUT11	CONN P32 Pin 23	Digital output 10
OUT12	CONN P32 Pin 25	Digital output 11
OUT13	CONN P32 Pin 27	Digital output 12
OUT14	CONN P32 Pin 29	Digital output 13

GND	CONN P32 Pin 33	Digital output 14

Serial Port COM2 Optional Radar

Name	Pin	Comment
GND	CONN J4 Pin 1	0V Supply
TX	CONN J4 Pin 2	COM2 RS232 Transmit
NC	CONN J4 Pin 3	Not Connected
NC	CONN J4 Pin 4	Not Connected
RX	CONN J4 Pin 5	COM2 RS232 Receive
GND	CONN J4 Pin 6	0V Supply

Serial Port COM4 Optional GPS Receiver

Name	Pin	Comment
VOUT	CONN J4 Pin 1	5VDC Supply
TX	CONN J4 Pin 2	COM4 RS232 Transmit
NC	CONN J4 Pin 3	Not Connected
NC	CONN J4 Pin 4	Not Connected
RX	CONN J4 Pin 5	COM4 RS232 Receive
GND	CONN J4 Pin 6	0V Supply

Serial Port COM1 Optional Long Range Radio Transceiver

Name	Pin	Comment
GND	CONN J4 Pin 1	0V Supply
TX	CONN J4 Pin 2	COM1 RS232 Transmit
TX	CONN J4 Pin 3	COM1 RS232 Transmit
NC	CONN J4 Pin 4	Not Connected
RX	CONN J4 Pin 5	COM1 RS232 Receive
GND	CONN J4 Pin 6	0V Supply

Serial Port COM0 User Interface

Name	Pin	Comment
GND	CONN J4 Pin 1	0V Supply
TX	CONN J4 Pin 2	COM0 RS232 Transmit
TX	CONN J4 Pin 3	COM0 RS232 Transmit
NC	CONN J4 Pin 4	Not Connected
RX	CONN J4 Pin 5	COM0 RS232 Receive
GND	CONN J4 Pin 6	0V Supply

2.4 LED Driver Module STL042

The STL042 LED Driver Board provides 20 LED drivers which can be operated in 48V mode for current designs or 24V mode to retrofit into legacy equipment. Each output drive can be connected to multiple chains of the same colour and these in turn can be monitored for failure monitoring.

Please note monitoring for failure is for a chain of LEDs not an individual LED. During normal failure of an LED this leads to all LEDs in the chain failing which is then detected as a failure.

Addressing of the LED driver board allows for 8 boards to be used together allowing the sign to have 160 LED drivers.

Facilities of the driver board are as follows:

- 20 LED drivers
- 12/48V LED drive
- Can Bus for connection to Profectus CPU
- 12V Supply
- 24/ 48 V LED Supply
- Address Selector
- Ribbon connectors for Digi-boards (speed indicator signs)
- Colour Selector Digi-boards

2.4.1 Connector Details

Power Supply

Name	Pin	Comment
VIN	CONN P2 Pin 2	Supply 8-30VDC
GND	CONN P2 Pin 1	GND 0VDC Connection to PSU or battery

External Supply and LED Drives

Name	Pin	Comment
VLED	CONN P4 Pin 1	24/48VDC Supply for LED drives
GND	CONN P4 Pin 2	GND 0VDC LED drives operating at 24/48VDC

Digi-board XX1 Digit 1

Name	Pin	Comment
OUT5	CONN P6 Pin 1	Digit 1 Segment a
OUT6	CONN P6 Pin 2	Digit 1 Segment e
OUT7	CONN P6 Pin 3	Digit 1 Segment b
OUT8	CONN P6 Pin 4	Digit 1 Segment f
OUT9	CONN P6 Pin 5	Digit 1 Segment c
OUT10	CONN P6 Pin 6	Digit 1 Segment g
OUT11	CONN P6 Pin 7	Digit 1 Segment d
N/C	CONN P6 Pin 8-12	
COLOUR0	CONN P6 Pin 13	48V Colour 1 Red/White/Yellow
COLOUR1	CONN P6 Pin 14	48V Colour 2 Green

Digi-board X1X Digit 2

Name	Pin	Comment
OUT12	CONN P8 Pin 1	Digit 2 Segment a
OUT13	CONN P8 Pin 2	Digit 2 Segment e

OUT14	CONN P8 Pin 3	Digit 2 Segment b
OUT15	CONN P8 Pin 4	Digit 2 Segment f
OUT16	CONN P8 Pin 5	Digit 2 Segment c
OUT17	CONN P8 Pin 6	Digit 2 Segment g
OUT18	CONN P8 Pin 7	Digit 2 Segment d
N/C	CONN P8 Pin 8-12	
COLOUR0	CONN P8 Pin 13	48V Colour 1 Red/White/Yellow
COLOUR1	CONN P8 Pin 14	48V Colour 2 Green

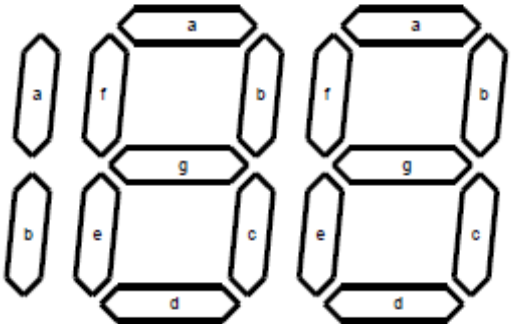
1XX Half Digit

Name	Pin	Comment
N/C	CONN P10 Pin 1	
N/C	CONN P10 Pin 2	
OUT19	CONN P10 Pin 3	Half Digit
N/C	CONN P10 Pin 4	
OUT19	CONN P10 Pin 5	Half Digit
N/C	CONN P10 Pin 6-12	
COLOUR0	CONN P6 Pin 13	48V Colour 1 Red/White/Yellow
COLOUR1	CONN P6 Pin 14	48V Colour 2 Green

N.B. Half digit only used when speed exceed 100 km/h or mph.

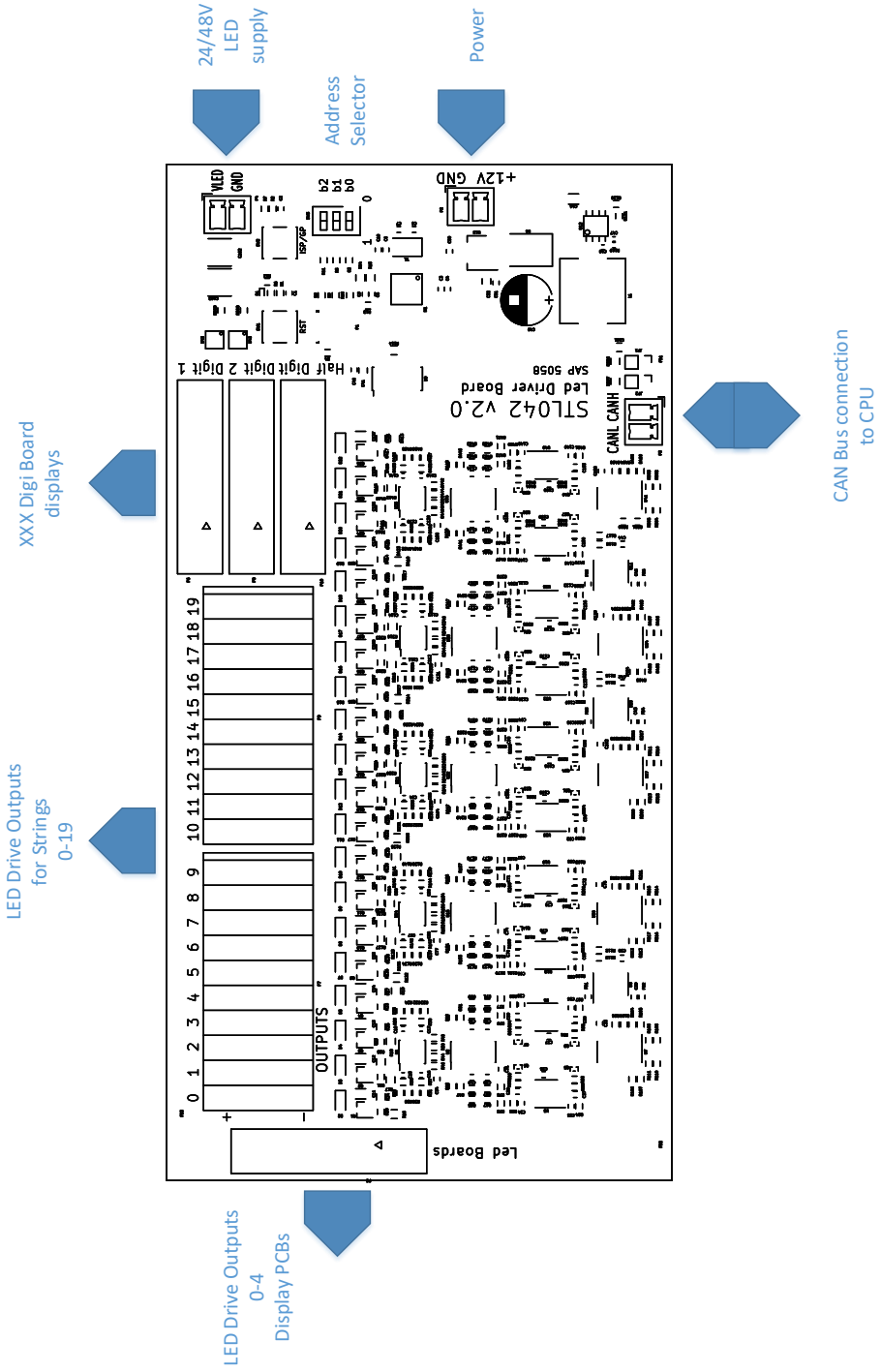
Below a representation of the segments within the actual LED displays.

Digit Configuration Front View



LED Display Boards LED Boards

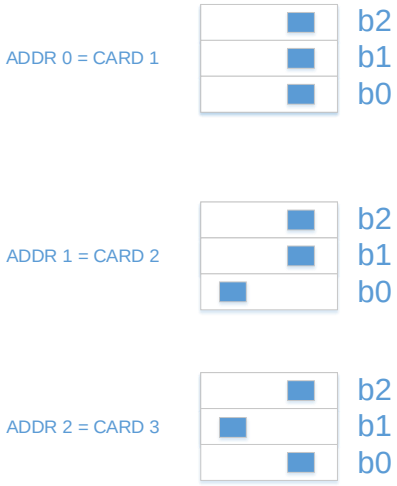
Name	Pin	Comment
OUT0	CONN P5 Pin 1	Flasher Top
OUT1	CONN P10 Pin 2	Flasher Bottom
OUT2	CONN P10 Pin 3	Red Ring / Triangle
OUT3	CONN P10 Pin 4	Speed
OUT4	CONN P10 Pin 5	Warning Message
VLED	CONN P5 Pin 6-12	24/48VDC Supply for LED drives



2.4.2 Address Selection

More than one LED driver can be used with the CPU to ensure the correct LED driver is being used address selection switches must be set.

The switches are binary waited and the first card is always address zero as follows:



Using this approach, a maximum of 8 LED driver boards can be used.

2.4.3 Driver Output

The LED driver provides 20 driver outputs each capable of driving LEDS chains 0V switched at either 24/48V. IT is important that all switches must be switching at the same voltage. The driver can switch and monitoring a maximum of 300mA.

Where LED monitoring is required all colours must be on separate switches.

2.5 Photocell

To allow the sign display to dim the sign drivers using PWM a photocell is connected to the CPU module STL022 on CONN17 between pins 1 and 2. Dimming is used to ensure the sign is efficiently powered to suit the ambient conditions. The photocell input is calibrated to monitor an ambient light level between 0 and 40,000 lux. During operation, the photocell measurements are filtered with a 30s-time constant to avoid sudden changes in light intensity of the display.

To comply with EN12966 the following dimming levels are configured in the sign

4 Lux
40 Lux
400 Lux
4,000 Lux
10,000 Lux
40,000 Lux

This results in 6 dimming levels as a basic standard, however a total of 20 levels can be configured if alternative non-standard dimming settings are required or a finer control of the sign is needed.

Within the configuration file for the CPU Lux levels are configured as follows:

#Photocell lux level thresholds: insert sorted values 0-1023
#max 20 entries (lux_level_19)
#lux_lev_0=0 always
[photocell]

lux_lev_0=0
lux_lev_1=48 (4 Lux)
lux_lev_2=244 (40 Lux)
lux_lev_3=679 (400 Lux)
lux_lev_4=947 (4,000 Lux
lux_lev_5=985 (10,000 Lux)
lux_lev_6=1010 (40,000 Lux)

When configuring the dimming levels these are associated with the colour of the LED drive so each colour has a dimming level setup as follows:

#Brightness level (1.0-100.0%) associated to LDR threshold
#number of ldr_lev and br_lev must match
[led_red:brightness]
br_lev_0=0.18%
br_lev_1=0.59%
br_lev_2=1.41%
br_lev_3=5.15%
br_lev_4=29.04%
br_lev_5=29.04%

[led_amber:brightness]
br_lev_0=0.27%
br_lev_1=0.90%
br_lev_2=2.16%
br_lev_3=7.90%
br_lev_4=44.55%
br_lev_5=44.55%

[led_blue:brightness]
br_lev_0=0.08%
br_lev_1=0.25%
br_lev_2=0.61%
br_lev_3=2.23%
br_lev_4=12.55%
br_lev_5=12.55%

[led_white:brightness]
br_lev_0=0.23%
br_lev_1=0.76%
br_lev_2=1.83%
br_lev_3=6.70%
br_lev_4=37.55%
br_lev_5=37.55%

[led_green:brightness]
br_lev_0=0.07%
br_lev_1=0.24%
br_lev_2=0.58%
br_lev_3=2.14%
br_lev_4=12.05%
br_lev_5=12.05%

Brightness levels are set for each colour for a 25mm pixel pitch sign in the previous examples to meet the requirements of EN12966. When alternative LED types or pixel pitches are required then the Profectus LED Calculator must be used to confirm brightness levels.

The status of the photocell is monitored if the output does not change over a 24 hour period then a fault is logged and the light output of the display is set to a preconfigured fault level normally the 400 lux ambient light levels.

2.6 Drive Inverter and Power Monitoring

The Profectus CPU operates from a 12VDC supply any 12VDC peripherals such as the optional GPS clock receiver are operated from the peripheral supply this allows power consumption of the Profectus and it peripherals to be monitored and data logged. Internally the 12VDC supply is regulated to 5V and 3.3VDC for internal use.

When driving LED emitters for LED displays these are normally driven from a 48VDC supply from the LEDr drives. To generate the 48VDC supply the Profectus CPU is able to invert the 12VDC supply to 48VDC at a maximum loading of 1A. To support legacy installations where the LED emitters were powered from the 24VDC supply the inverter can be configured to supply 24VDC at a maximum of 2A. Simply remove jumper JP4 to configure the inverter to provide 24VDC instead of 48VDC.

2.6.1 LED Drives & Monitoring

Warning signs provide a mixture of alternating flashing roundels, warning message roundels etc. during their timed periods of operation. Swarco provide many dedicated PCB display boards as well has chains which can be arranged to make any text or shapes.

Now considering a typical warning sign LED drives must be allocated to drive a physical switch and colour and configured.

```
#Led Drivers
[led0]
colour=amber          #amber/red/blue/white/green
type= alternating     #static/alternating
state0 = 400 on             #if the type is alternating
state1 = 400 off      #if the type is alternating
fault_current=18
name_field=Flash_Top        #name to indicate in web server only
```

Taking the configuration statement above the LED drive 0 is being configured. The colour the LED driver is driving is amber LED. As this drive is a flasher it is of type alternating and therefore has an on and off time of 400ms. The flash rate configured will equate to operation at a rate of 75 flashes per minute. To assist monitoring the current failure threshold is 18mA so once the current drops by 18mA a fault is recorded. To assist identifying the LED drive on the web interface it is labelled in this case “Flash Top”

A static LED drive is configured as follows:

```
[led1]
colour=red
type= static
fault_current=18
name_field=Circle
```

With the example above LED drive 1 is drivng red LEDs in static operation again with an 18mA failure threshold.

The LED drives are monitored in case of a fault in the LED chain emitters. During a cold start of the sign when the LED drive is first operated the current loading is stored as a calibration reference value. During subsequent operation of the LED drive or on a warm start the current loading of the LED emitter is compared to check for faulty emitters.

As the flashers are operated the current loading of the emitters is checked and compared against the calibration levels. Once the loading falls by the threshold level then a fault is recorded. Considering the flasher roundels each emitter chain consumes 20mA. Therefore, the fault current is set to 18mA, once the current drops by more than this level a fault is detected.

#Led Drive Fail Time, after this time reported as error
[led_drive_fail_time]
led_driv_f_tm=5000 #250-5000 ms, if empty default 250

To avoid spurious faults being reported the system will look for a number of consecutive readings to ensure a real fault is detected. This provides the failure response time in this case 5s (5000ms).

During operation, environmental changes will mean the loading of the flashers will change with time due to factors such as ageing and temperature, these gradual changes are filtered out by automatically recalibrating the loading values.

Further LED configuration examples are shown below:

[led2]
colour=white
type= static
fault_current=18
name_field=Number

[led3]
colour=amber
type= static
fault_current=18
name_field=Slow

[led4]
colour=amber
type= static
fault_current=18
name_field=Down

[led5]
colour=amber
type= alternating
state0 = 400 on
state1 = 400 off
fault_current=18
name_field=Flash_Bottom

The LED drive configured above has been set again as an alternating flasher to allow the bottom flasher drive to be configured on the sign.

2.6.1.1 Speed Displays

When considering seven segment speed displays the configuration process is slightly different as each digit has to be covered as a group of 7 LED drive outputs.

```
#7Segment
[seven_segment]
led_board_addr=1          #0 to 7
half_digit=off            #on/off
dual_colour=on            #on/off
colour0=green             #amber/red/blue/white/green
colour1=red               #amber/red/blue/white/green
fault_current=18
```

Given the example above a speed display using 7 segment displays is required. The display will be configured on LED driver address 1 so the 2nd display board. If the display is required to show more than 99mph or kmh then the half digit is required to display “105” etc.

When using a 7 segment display it automatically allocated LED drives to match the connection points this means the following LED drives are allocated:

Digi-board XX1 Digit 1

Name	Pin	Comment
OUT5	CONN P6 Pin 1	Digit 1 Segment a
OUT6	CONN P6 Pin 2	Digit 1 Segment e
OUT7	CONN P6 Pin 3	Digit 1 Segment b
OUT8	CONN P6 Pin 4	Digit 1 Segment f
OUT9	CONN P6 Pin 5	Digit 1 Segment c
OUT10	CONN P6 Pin 6	Digit 1 Segment g
OUT11	CONN P6 Pin 7	Digit 1 Segment d
N/C	CONN P6 Pin 8-12	
COLOUR0	CONN P6 Pin 13	48V Colour 1 Red/White/Yellow
COLOUR1	CONN P6 Pin 14	48V Colour 2 Green

Digi-board X1X Digit 2

Name	Pin	Comment
OUT12	CONN P8 Pin 1	Digit 2 Segment a
OUT13	CONN P8 Pin 2	Digit 2 Segment e
OUT14	CONN P8 Pin 3	Digit 2 Segment b
OUT15	CONN P8 Pin 4	Digit 2 Segment f
OUT16	CONN P8 Pin 5	Digit 2 Segment c
OUT17	CONN P8 Pin 6	Digit 2 Segment g
OUT18	CONN P8 Pin 7	Digit 2 Segment d
N/C	CONN P8 Pin 8-12	
COLOUR0	CONN P8 Pin 13	48V Colour 1 Red/White/Yellow
COLOUR1	CONN P8 Pin 14	48V Colour 2 Green

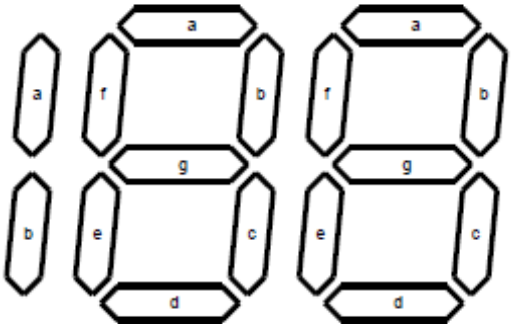
1XX Half Digit

Name	Pin	Comment
N/C	CONN P10 Pin 1	
N/C	CONN P10 Pin 2	
OUT19	CONN P10 Pin 3	Half Digit
N/C	CONN P10 Pin 4	
OUT19	CONN P10 Pin 5	Half Digit
N/C	CONN P10 Pin 6-12	
COLOUR0	CONN P6 Pin 13	48V Colour 1 Red/White/Yellow
COLOUR1	CONN P6 Pin 14	48V Colour 2 Green

N.B. Half digit only used when speed exceed 100 km/h or mph.

Below a representation of the segments within the actual LED displays.

Digit Configuration Front View



Seven segment displays can be monochrome or they can display in dual colours so below a speed threshold they are green and above the speed threshold they are red. Within this configuration the display is dual colour with green and red being the active colours.

The seven segment digits are monitored in case of a fault in the LED emitters. During a cold start of the sign when the sign is first operated the current loading is stored as a calibration reference value. During subsequent operation of the displays or on a warm start the current loading of the LED emitter is compared to check for faulty emitters.

As the displays are operated the current loading of the emitters is checked and compared against the calibration levels. Once the loading falls by the threshold level then a fault is recorded. Considering the LED drives each emitter chain consumes 20mA. Therefore, the fault current is set to 18mA, once the current drops by more than this level a fault is detected.

2.6.2 LED Groups

LED Groups are used to configure LED drives which may be used together even though they are different colours. Once groups are configured they can be activated using LED triggers see section 2.6.3.

```
#Led Group
[led_group0]
name=Flashes                    #name to reference the led group
output_type=standard            #standard/seven_segments
leds=0,5                #0 - 159
```

Within the LED group definition, the group has been given an name of “Flashes” to assist engineers access to make identification easier. Where a display is not related to a seven segment display its output type is “standard”. LED group when active will drives LED outputs 0 and 5.

```
[led_group1]
name=Circle
output_type=standard            #standard/seven_segments
leds=1                  #0 - 159

[led_group2]
name=Speed
output_type=standard            #standard/seven_segments
leds=1,2                #0 - 159

[led_group3]
name=SlowDown
output_type=standard            #standard/seven_segments
leds=3,4                        #0 - 159

[led_group4]
name=30mph
output_type=standard            #standard/seven_segments
leds=0,1,2,3,4,5                        #0 – 159
```

In the case above the LED group is call 30mph and LED outputs 0,1,2,3,4 and 5 will all be active when triggered.

```
[led_group5]
name=7Segment Low
output_type=seven_segments              #standard/seven_segments
colour=0                        #0/1 colour0 or colour1

[led_group6]
name=7Segment High
output_type=seven_segments              #standard/seven_segments
colour=1                        #0/1 colour0 or colour1
```

When using seven segment displays the output type needs to be “seven_segments” and the active colour when dual colour must also be specified. Here the high speed has been set to colour 1 previously defined as Red and the Low speed is colour 0 previously defined as green.

2.6.3 LED Triggers

Triggers provide a method to activate LED drives, LED triggers can use the radar detector speed thresholds, digital inputs, analogue sensors etc. as source to activate the pre-configured triggers.

```
#triggers
[trigger0]
detector=combined_det           #radar/digital_input/analog sensor's name
combination_logic = 2*3         # * = AND Operation, + = OR Operation
calling_delay = 0
canc_delay = 4000
groups=Speed+Flashes            #led group names
```

Triggers are operated by a detector normally as a source at present the source can be the radar sensor, a digital input, an analogue input, remote trigger or a combination of triggers. With trigger 0 listed above the trigger is a logical AND of trigger's 2 and 3. In the case trigger 2 is active from digital input 1 and trigger 3 is active on digital input 2. So trigger 0 is active when digital inputs 1 and 2 are both active. The calling delay means the detector has to be active for some time before the trigger starts in this case 0ms. The cancel delay means even when the detector is no longer active the trigger will continue to operate for a delay in this case 4000ms. When the trigger is active it will call up the LED groups Speed and Flashes so in this case a speed warning with roundel and alternating flashers.

```
[trigger1]
detector=combined_det              #radar/digital_input/analog sensor's name
combination_logic = 2*3+8          # * = AND Operation, + = OR Operation
calling_delay = 0
canc_delay = 4000
groups=7SegmentHigh                #led group names
```

Trigger 1 is a combined logic detector input composed of triggers 2,3 logically "And'ed", logically "Or'ed" with trigger 8. Given trigger 8 is a radar speed of 25-30 mph this alone will trigger the speed on the 7 segment displays in Red. Alternatively if the radar detects a speed of 0-20mph and digital inputs D1 and D2 are active then the display will also trigger a Red speed display.

```
[trigger2]                         #dummy trigger only for combination
detector=digital_input             #radar/digital_input/analog sensor's name
input=D1                           #if the detector is digital_input(D1-D4)
calling_delay = 0
canc_delay = 4000

[trigger3]                         #dummy trigger only for combination
detector=digital_input             #radar/digital_input/analog sensor's name
input=D2                           #if the detector is digital_input(D1-D4)
calling_delay = 0
canc_delay = 4000

[trigger4]
detector=radar                     #radar/digital_input/analog sensor's name
interval = 30,150
calling_delay = 0
canc_delay = 4000
groups=30mph                       #led group names

[trigger5]
detector=water_sensor              #radar/digital_input/analog sensor's name
interval = 3,15
calling_delay = 0
canc_delay = 4000
groups=Flashes                     #led group names

[trigger6]
detector=temp_sensor               #radar/digital_input/analog sensor's name
interval = -3,1
calling_delay = 0
```

```
canc_delay = 4000
groups=Flashes+SlowDown          #led group names
```

With trigger 6 a temperature sensor showing between -3C and 1C will trigger a slow down with flashers message.

```
[trigger7]
detector=radar                   #radar/digital_input/analog sensor's name
interval = 0,20
calling_delay = 0
canc_delay = 4000
groups=7SegmentLow               #led group names
```

Here with Trigger7 the radar will trigger a green speed display if if detects a vehicle travelling between 0 and 20mph.

```
[trigger8]
detector=radar                   #radar/digital_input/analog sensor's name
interval = 25,30
calling_delay = 0
canc_delay = 4000
groups=7SegmentHigh              #led group names
```

Remote triggers can be configured for a master sign:

```
#remote trigger master
[trigger3]
detector=digital_input          #radar/digital_input/analog sensor's name
input = D1
calling_delay = 0
canc_delay = 3000
groups=SlowDown
remote_command=2
```

On a slave

```
#remote trigger slave
[trigger6]
detector=remote_trigger          #radar/digital_input/analog sensor/remote trigger
remote_command=2
calling_delay = 0
canc_delay = 3000
groups=Circle,SlowDown
```

To use a remote trigger the slave radio must be enabled. Detector=remote_trigger is only valid for a slave sign.

Here trigger 8 is working from the radar detector source when a vehicle is travelling at 25-30 mph the speed display will show in colour red. Once the vehicle is not being detected the display will continue the calling delay for a further 4000ms.

```
#Default Triggers
[default_triggers]
trigger=0,1,4,5,6,7,8            #trigger numbers
```

It should be noted that triggers can be called up within the timetable facility in section 2.9. Manual control, UTMC control and timetables can overrule operation of a trigger when these modes of control are not available default triggers can be specified. In the example above triggers 0,1,4,5,6,7 and 8 have been made default triggers.

2.7 Analogue Sensor Inputs

When the sign is operated in conjunction with an analogue sensor such as a temperature or water pressure sensor the warning sign must most an analogue value and use this as a trigger.

Profectus provides two analogue inputs available to external sensors.

The analogue sensors inputs are configured as follows:

```
#new field analog sensors
[analog_sensor1]
name=water_sensor          #name to describe the detector
unit=mm
input_vs_output=x1:y1, x2:y2, x3:y3, x4:y4
polling_time=120           #seconds

[analog_sensor2]
name=temp_sensor           #name to describe the detector
unit=C
input_vs_output=x1:y1, x2:y2, x3:y3, x4:y4
polling_time=10                    #seconds
```

In the case above a water pressure sensor has been configured to be polled every 200s. The scale factor allows the sensor output to be adjusted over the range of the sensor input. An additional temperature sensor is being polled every 10s and has a scaling factor of 0.5 converting the impedance of the sensor into a temperature range in centigrade.

Triggers can be set from analogue inputs just as a digital or detector input as follows:

```
[trigger6]
detector=temp_sensor       #radar/digital_input/analog sensor's name
interval = -3,1
calling_delay = 0
canc_delay = 4000
groups=Flashes+SlowDown          #led group names
```

In the configuration above the temperature sensor will trigger the LED groups Flashes and SlowDown when the temperature is between -3 and 1 °C. A cancel delay requires the temperature to be outside this range for 4000ms for the trigger to be cancelled.

2.8 Real time Clock

The Profectus CPU has an integral real-time clock which is battery backup in case of a power failure. The clock provides a running clock for time date and year. The battery backup provides 3 months of support via the battery backup coin cell which can be replaced. The

clock provides 4-digit year recording and is configured to support leap year operation automatically. The 10ppm resolution clock source provides an accuracy of 0.86s per day.

In addition, the clock setup allows configuration of DST (Daylight Saving Time) week changes are calculated automatically per the week number and geographical location. The location requires the time zone to be specified and the times for advance and retard clock times. Typically, within Europe the time is advanced at 1AM and retarded at 2AM.

2.8.1 GPS Clock Support

Where greater clock accuracy is required for example to operate timetables the clock accuracy needs to be improved to provide greater accuracy over time. An external GPS clock module can be fitted to the sign CPU to provide access to the Global Positioning System (GPS) where a mobile data connection is not available. GPS provides a centrally managed time source managed from an atomic clock source. The GPS receiver can receive the signals from orbiting satellites to update the on board RTC. At start up when the clock has not been set the Profectus CPU will power up the GPS receiver and update the real-time clock. At all other times the GPS receiver is powered down to save power. At 3AM each day the GPS receiver is automatically powered up and the clock updated from the satellite source.

2.8.2 NTP Clock Server Support

Where greater clock accuracy is required for example to operate timetables the clock accuracy needs to be improved to provide greater accuracy over time. A mobile data connection allows the Profectus CPU to connect to an NTP (Network Time Protocol) server across the internet to gain access to a UTC (Coordinated Universal Time) time source. This facility can also be accessed from the Ethernet port for an alternative internet connection. At start up when the clock has not been set the Profectus CPU will power up the mobile data modem and update the real-time clock. At all other times the modem is powered down to save power. At 3AM each day the modem is automatically powered up and the clock updated from the NTP source.

2.8.3 Radio Clock Source Update

Where greater clock accuracy is required for example to operate timetables the clock accuracy needs to be improved to provide greater accuracy over time. A slave sign connected to the master sign can have the clock signal transmitted to provide clock updates. At start up when the clock has not been set the Profectus CPU will power up the radio data modem and update the real-time clock. At all other times the radio modem is powered down to save power. At 3AM each day the modem is automatically powered up and the clock updated from the master sign source.

2.8.4 Clock Configuration

Within the conf.ini file the clock configuration details are setup as follows:

```
[clock]
update_method=gps        #gps/ntp/radio or empty
update_time=03:00        #scheduled time update request
ntp_server=              #ntp server address
ntp_port=                #ntp server port
ntp_interface=           #ethernet/ modem
timezone=UTC+0:00        #timezone
dst=on                   #on/off daylight saving
advance_time=1:00        #time when DST is applied
```

retard_time=3:00 #time when DST is removed

As an example, here the clock is updated from the GPS source at 3AM. Daylight saving is enabled and the DST changes will take place at 1AM and 3AM for advance and retard respectively. When configuring for a radio connection config should be as follows:

```
[clock]
update_method=radio     #gps/ntp/radio or empty
update_time=            #scheduled time update request
ntp_server=             #ntp server address
ntp_port=               #ntp server port
timezone=               #timezone
dst=on                  #on/off daylight saving
advance_time=1:00       #time when DST is applied
retard_time=3:00        #time when DST is removed
```

All other settings will be taken from the master sign clock configuration.

When an external NTP server is used this can be specified to operate through the Ethernet port or GPRS modem interface.

2.9 Timetables & Special Days

The Profectus CPU support 255 timetable entries and 30 special days allowing repetitive events or one-off events to be pre-programmed up to 3 years in advance. Timetable entries are stored in their own ASCII configuration file, which can be edited locally or controlled from the central control system.

A timetable entry defines the event itself and when it starts and finishes. An entry is defined as follows:

```
[entry0]
year=2017
days=0,1,2,3,4
weeks=46-50
event=Flashes
timeon=07:30
timeoff=08:45
```

In this case timetable 0 starts at 07:30 in the morning and finishes at 08:45. The event called up now in the timetable is “Flashes” which was defined as alternating flashers running at 75 flashes per minutes in section 2.6.2. The flashing will happen on weeks 46 through to 50 on Monday to Friday, where days are defined as follows:

Day Number	Day
0	Monday
1	Tuesday
2	Wednesday
3	Thursday
4	Friday
5	Saturday
6	Sunday

Another use of the timetable is considering the operation of the modem, if the modem is operating continuously on a solar or battery solution it increases the power requirements. Using the example below the modem can be switched active on a timetable to check in periodically each day.

[entry12]
year=2017
days=0,1,2,3,4,5,6
weeks=0
event=modem
timeon=07:15
timeoff=07:30

Here timetable entry 12 operates the modem 07:15 to 07:30 every day of the week for all weeks of the year

Timetables can also be used to call triggers so that at different times of the day different triggers can be used:

[entry1]
days=0,1,2,3,4,5,6
year=2017
weeks=23-46
event=trigger0, trigger1, trigger2
timeon=11:00
timeoff=12:30

Within timetable entry 1 for all days of the week trigger 0, 1 and 2 are active from 11AM to 12:30pm in weeks 23-46.

Special days are supported as one off events. A maximum of 30 special days can be configured as follows:

[special0]
date=25/12/2019
event=Flashes
timeon=07:30
timeoff=20:00

With the example above Special day 0 has been configured to operating the Flashes LED group between 7:30AM and 8PM on 25th December 2019.

2.10 Remote Network Connection Mobile Data (Option)

The Profectus CPU can be equipped with a mobile data modem capable of communicating with the Swarco central PGS in station. The modem supports 2/3/4G communication depending on the available mobile data network coverage.

During operation, the local sign can initiate communications with PGS for the following purposes:

- Fault Reporting from sign

- Configuration Updates to sign
- Timetable Updates to sign
- Datalogging updates from sign
- Detection Log updates from sign

In addition, the modem can be used to gain access to an NTP server for daily updates to the real-time clock. To save power consumption the modem is normally operated under timetable control so updates are held until the next scheduled transmission. If the modem is unable to make a connection to PGS for some technical reason data is accumulated until the next successful connection so no data is lost. Where the sign connecting to PGS has slave signs then it will transfer:

- Fault Reporting from sign
- Configuration Updates to sign
- Timetable Updates to sign
- Datalogging updates from sign
- Detection Log updates from sign

On behalf of the slave signs before updating those signs via radio modem links.

To timetable operation of the modem the following entry must be made in the timetable configuration file ttab.txt:

```
[entry0]
year=2017
days=0,1,2,3,4,5,6
weeks=0
event=modem
timeon=10:15
timeoff=10:30
```

In this case the modem will operate at 10:15 to 10:30 on Monday through Sunday on every week of the year. Modem transmission slots are normally allocated as 15 minute periods to allow full updates but again to reduce power consumption.

Using this approach timetabled events can be scheduled when most convenient i.e. before and after operation of the sign.

The modem also requires configuration within the conf.ini file:

```
[Modem]
mode=webserver      #pgs/webserver/empty(only faults reporting)
apn=myapn
username=myusername
password=mypassword
ping_addr=8.8.8.8
keep_alive_t=10     #mins

[PGS]
ip_address=swarcopgs.com
port=5000
update_time=2
sign_id=test_sign
```

Within the above configuration settings, the modem is configured to connect to PGS using the EE?? mobile data network settings. The network APN settings maybe specific to the network provider or for a customer's private APN account. When referring to the PGS in station itself the static IP address of the server or DNS (Domain Name System) will need to be referred to plus the PGS port for firewall port forwarding.

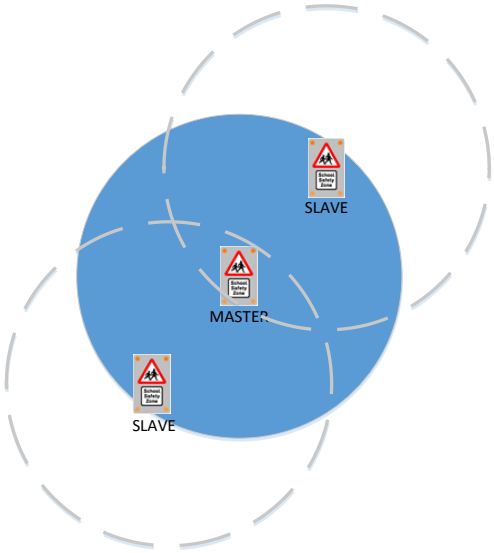
It should be noted all historical information is maintained within the USB memory storage on the Profectus CPU. Using this approach if communications are corrupted or PGS logs lost the information can be fully downloaded as the next timed communication.

2.11 Local Master Slave Networking

The Profectus CPU has communications links via radio modem data links, these are line of site connections using an inbuilt radio for 300m range or an external longer range radio data modem to extend the range to 6km.

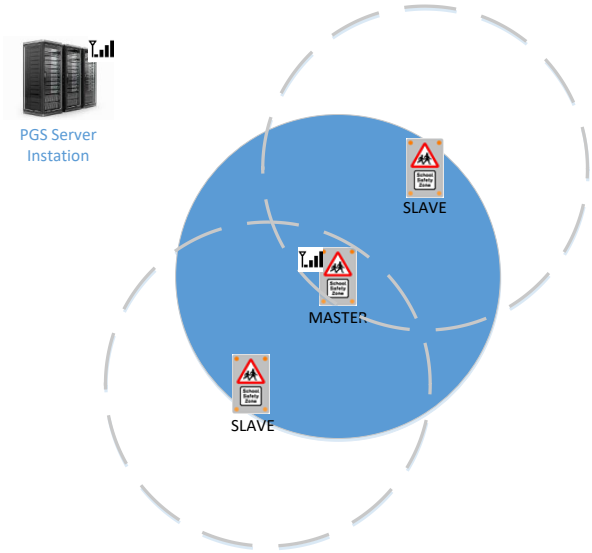
Using this approach, it is possible to build up networks of warning signs all operating from a single sign with or without a remote mobile data connection.

Example 1 Master Sign with local slaves



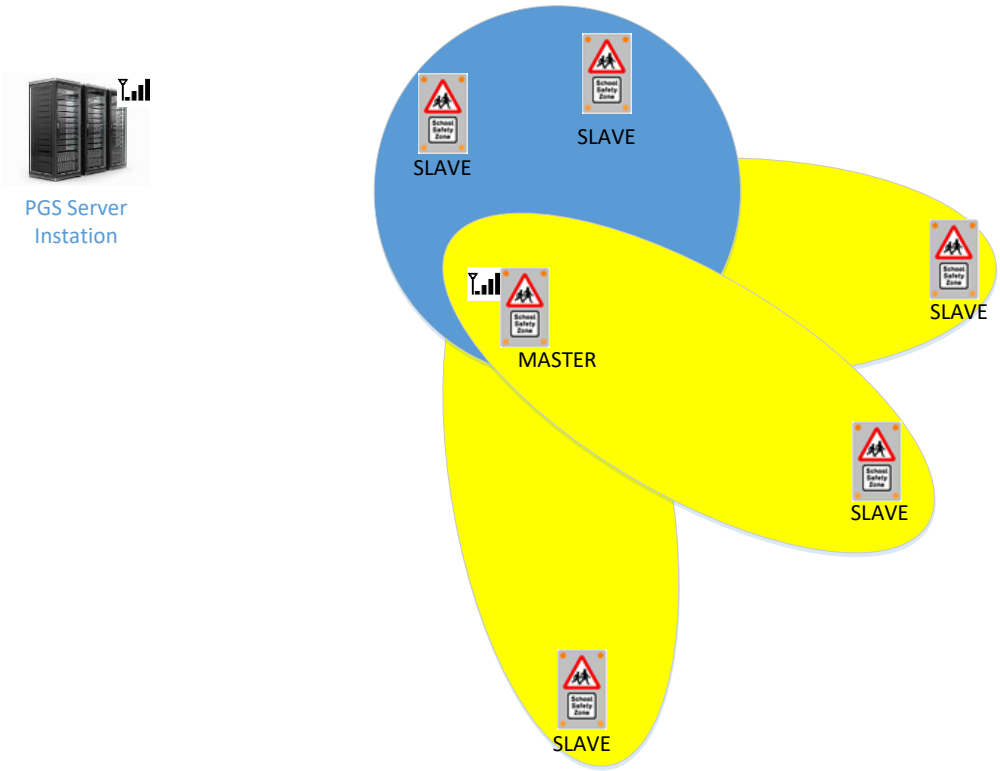
Within this scheme the master sign holds all configuration and fault information for the master and 1-8 slave signs.

Example 2 Master Sign with Remote Connection and Local Slaves



Within this scheme the master sign holds all configuration and fault information for the master and 1- 8? slave signs. All this information is then synchronised with the PGS central in station. Using this approach configuration and timetables can be updated from PGS to the master and then the slave signs using a single mobile data connection.

Example 3 Master Sign with Remote Connection with Local and Remote Slaves



Within this scheme the master sign holds all configuration and fault information for the master and 1-11 slave signs. Some of the slave signs are local on the short-range radio link while others are on the long-range radio link. All this information is then synchronised with the PGS central in station. Using this approach configuration and timetables can be updated from PGS to the master and then the slave signs using a single mobile data connection.

2.11.1 Short Range Radio Connection

The Profectus CPU is equipped with an on-board radio data modem operating on the licence free 433Mhz frequency band. The radio provides full serial data communications between master and slave Profectus CPUs. Operating at a maximum board rate 19.2K the radio allows connection with up to 11 equivalent Profectus CPU radios at a maximum line of sight range of 300m.

Depending on the radio installation different antenna are required for the radio installation as a guide the following should be considered:

Radio Type	Range	Antenna Gain	Antenna Type	SAP No.
Master	<50m	3dB	Omnidirectional	4959
Master	>50m	6dB	Omnidirectional	1013
Slave	<50m	3dB	Omnidirectional	4959
Slave	>50m	6dB	Directional	1003

If line of sight installation is not possible between antennae then the antenna needs to be re-positioned to a more suitable location or maximum range will be reduced.
It should be considered the 433MHz band is licence exempt and neighbouring equipment can affect performance when used during or after installation of equipment.

2.11.2 Long Range Radio Connection (Option)

Where radio data connections are required from a master sign but beyond the 300m range limit a long-range radio can be interface to the Profectus CPU to provide 2km line of sight range. The long-range radio module is a DIN rail mounted unit that connects to the Profectus CPU on COM1 for power and communications. Operating at a maximum board rate of 38.4K the radio allows connection with equivalent Profectus CPU radios at a maximum line of sight range of 2km.

Radio Type	Range	Antenna Gain	Antenna Type	SAP No.
Master	<2km	1.5dB	Omnidirectional	4958
Master	>2km	6dB	Omnidirectional	4042
Slave	<2km	1.5dB	Omnidirectional	4958
Slave	>2km	6dB	Directional	4957

2.11.3 Radio Configuration

Short and long range radios require configuration within the conf.ini file as follows:

In the following example a sign is configured as a master sign with a short-range slave configured as address 2 and a long-range sign configured as address 3. Signs information is updated to the master every 60 minutes.

```
#Radio network
 [Radio]
sign_type=master              #master/slave Leave empty no radio
longr_com_port=com1

[Radio:master]
sign_addr=1
slave_sr=2
slave_lr=3
```

keep_alive_t=3600 #keep alive time in [s]. 60-3600

[Radio:slave]
master_addr=
sign_addr=

2.12 Digital I/O

The CPU provide 15 digital inputs of which are referenced to the 3.3VDC logic rail. A volt free contact from interfacing equipment can be wired between the input and the digital I/O GND to provide an active digital input.

In addition to the digital inputs 15 digital outputs are also provided. The digital outputs are Darlington drivers rated at Vmax 50VDC and Imax 500mA with a common 0V connection. It is important that the interfacing equipment must be connected to the common 0V connections at CONN P32 Pin 31 and 33.

Digital inputs can be used as the basis for sign triggers see section 2.6.3.

Digital outputs can be configured to indicate fault log conditions allocating a fault mask see section 2.15.1 to the output. The output can then be connected to an LED indicator.

[fault_outputs]
output1=2048
output2=!2097151

In the example above digital output 1 is activated if the radar detector goes faulty. While output 2 goes inactive for any fault.

2.12.1 Input timeouts

Digital inputs are monitored to check for faulty operation looking for permanent active and inactive operation. Permanent operation is check in 1-255 mins and permanent inactive time is measured in 1-255 hours.

#Input monitoring section
[inputs_timeout]
active_input3=5 #min
inactive_input3=20 #hours

[det_inputs_timeout]
active_input1=1 #min
inactive_input1=200 #hours

With the example above the input will show a fault when active for 1 min and inactive for 200 hours or more. IF these values are not set then input fault monitoring is disabled.

2.13 Wi-Fi Access Point

During normal operation, the Wi-Fi access point is disabled, if a magnetic is brought into proximity of the magnetic sensor on the lower surface of the sign then the switch is activated waking the Wi-Fi access point.

An LED indicator confirms the access point is active. On the laptop or handheld device, the user should search for the Wi-Fi SSID default “SwarcoAP“ then select the Wi-Fi network and enter the default password “swarco1234“.

These details are configured within the conf.ini file as follows:

```
[communication]
wifi=on
modem=on                    #on/off/ttab
ethernet=off                #on/off

[Wifi]
ssid=SwarcoAP
passkey=swarco1234          # >=8 char
timeout=10
channel=7
ext_ant=0
```

If the Wi-Fi is being accessed by the user the access point will be maintained. Once data activity ceases beyond the timeout period (default 10 mins) the access point will be powered down to save power. Once the Wi-Fi access point switches off the LED indicator will also be extinguished. If the user wishes to restart the Wi-Fi access point then simply re-trigger the magnetic proximity switch.

If users experience problem with the Wi-Fi connectivity the module can be reset by approaching a magnet to the activation switch for 5 seconds. The indication LED will start blinking while the module is under configuration. Once the LED is permanently on, the user can try to associate to the access point again.

2.14 Ethernet

The Ethernet port provide a 10mb full duplex connection via an RJ45 connector on the Profectus CPU. The Ethernet port provides an alternative connection to the 4G modem particularly if an external router is required.

Configuration of the Ethernet port is as follows:

```
[ethernet]
mode=pgs                #pgs/webserver/utmc
dhcp=on                                 #on/off
ip_address=192.168.1.1
subnet=255.255.255.255
gateway=0.0.0.0
dns=255.255.255.255
```

The user needs to set the mode of operation for the Ethernet port supporting a connection to PGS, UTMC commands or routing of the Webserver facilities. Please check the configuration of your route to ensure the IP address, subnet mask and default gateway match your configuration requirements.

2.15 Fault Management

The fault log monitors any faults detected within the warning sign and records the last 255 faults detected. Each fault is timestamped and given a description so for diagnosis purposes the fault and the time of the fault are all logged.

The fault log can log the following fault types:

Fault No.	Fault Code	Description	Comment
1	FAULT_LOW_VOLTAGE	Low supply voltage	The voltage supply to the sign has fallen below the min threshold (Default 10.5V)
2	FAULT_HIGH_VOLTAGE	High supply voltage	The voltage supply to the sign has exceeded the max threshold (Default 30.0V)
4	FAULT_UPS_POWER	UPS Power failure	Mains supply to UPS has failed
8	FAULT_UPS_BATTERY	UPS battery failure	Battery to UPS has failed
16	FAULT_HIGH_TEMPERATURE	High temperature	The CPU temperature has exceeded the maximum limit of 80 °C
32	FAULT_LOW_TEMPERATURE	Low temperature	The CPU temperature has exceeded the minimum limit of -20 °C
64	FAULT_LED	LED chain failure n identified	LED drive has detected an LED failure.
128	FAULT_LED_BOARD n	Error detected on LED display board n	LED driver board is not working.
256	FAULT_RADIO_SR	Radio short range error	The slave sign has failed to respond for three successive communications
512	FAULT_RADIO_LR	Radio long range error	The slave sign has failed to respond for three successive communications
1024	FAULT_LDR	LDR error	The photocell sensor has failed to change its reported LUX level in the last 24 hours
2048	FAULT_RADAR_COM	Radar communication error	The CPU is unable to communicate with the radar detection module
4096	FAULT_INPUT	Input n timeout.	Activity/inactivity timer expired for input n
8192	FAULT_STARTUP	Power applied to sign	The CPU has restarted successfully on resumption of the power supply, this may follow a

			FAULT_LOW_VOLTAGE indicating a power outage
16384	FAULT_MODEM	Modem error	The CPU detect an error with the modem device
32768	FAULT_MODEM_COM	Modem communication error	The CPU cannot make an external data connection through the modem
65536	FAULT_ETHERNET_COM	Communications error on Ethernet Port	The CPU cannot make an external data connection through the Ethernet port
131072	FAULT_GPS_COM	GPS communication error	The CPU has not been able to get a clock update from the GPS module
262144	FAULT_CLOCK_UPDATE	Clock update failed	The CPU has not been able to update the clock from the NTP server
524288	FAULT_SLAVE_CLOCK_UPDATE	Slave unable to get clock update	The slave sign has not been able to get a clock update from the master sign
1048576	FAULT_DST_ADVANCE	DST advance confirmed	The change of Daylight Saving Time advance has completed.
2097152	FAULT_DST_RETARD	DST retard confirmed	The change of Daylight Saving Time retard has completed.

An example fault log is show below

23/01/2017 16:58	Low supply voltage
23/01/2017 17:04	High supply voltage
23/01/2017 17:12	Power applied to sign
23/01/2017 17:29	Power applied to sign
23/01/2017 17:35	Power applied to sign
23/01/2017 17:36	Low supply voltage

2.15.1 Fault Masks

Fault masks are used to configure the system so that only faults of interest are reported. Within the conf.ini file fault masks are used to configure the reporting of SMS and Email initiated fault reports.

[Sms:alert]
sms_alert=on
faults_mask=3
dest_numb=+447955432961

In the example above an SMS message will send faults to the user number when high and low voltage faults are recorded in the fault log.

Using the codes in the fault table in section 2.15.

Add together all the fault codes of interest so to report all faults the fault mask will be 4194303

faults_mask=4194303

Alternatively, if you were not interested in radio faults i.e. fault codes 64 and 128 the fault mask will be:

faults_mask=2096383

Using this approach faults masks can be adjusted to report as many or as few as faults as required.

2.15.2 Email and SMS Faults

When a fault is recorded, it can be used to trigger an SMS or email alert to a user/s. The settings of this facility need to be added to the conf.ini file as follows:

[Sms:alert]
sms_alert=on
faults_mask=3
dest_numb=+447955432961

Within this configuration statement SMS alerts are enabled to the telephone number specified using the fault mask. Please see section 2.15.1 for an explanations of fault masks.

In addition, email alerts, can be sent to a single email address and once again this needs to be configured in the conf.ini file as follows:

[Email:alert]
email_alert=on
faults_mask=3
dest_addr= faults.stl@swarco.com
subj_prefix=St Peters School
sender_addr=john.smith@swarco.com
smtp_server=smtp.office365.com
smtp_username=faults.stl@swarco.com
smtp_password=password

Within the example above the email alert is configured and the fault mask sets the faults that will trigger an email report, see section 2.15.1 for details of fault masks. The email is sent to a destination address using the subject “St Peters – Fault”.

The email account used for sending emails is now defined in this case the details are:

sender_addr=john.smith@swarco.com
sender_name=St Peters School
smtp_server=smtp.office365.com
smtp_username=faults.stl@swarco.com
smtp_password=password

Please check with your email administrator for the required settings for your account.

2.16 SMS Sign Control

During operation, the warningl sign is normally controlled using its timetables as a reference and these can also be adjusted or amended either locally or remotely. However, the sign can also be controlled by sending commands on SMS (Short Message Service). With this approach users, can simply send an SMS message from their mobile phone to the sign to check on its status or force the operation of the sign.

To provide a safeguard against anybody being able to send text messages changing the operation of the sign numbers must be registered in the conf.ini file during the configuration process. Please note all numbers must be specified as per the international format.

[Sms:control]
sender_numb_0=+447595207311
sender_numb_1=
sender_numb_2=

Here a maximum of three numbers can be configured the sign will only accept SMS commands from these numbers.

The following command can be sent via SMS:

Command	Remark
LEDCTRL ON:G0,G1	Switch on LED drivers for LED groups G0 and G1
LEDCTRL OFF	Switch off all Sign LED drivers
LEDCTRL AUTO	Sign control to normal
STATUS	Report status of sign
FAULTS	Report faults

Where ‘n’ is the flash event as defined into the configuration file. When addressing a slave sign with a radio network “s<ns>-“ prefix must precede the command. As an example “s2 – status” will report the status for slave sign number 2.
Using this approach signs can be checked and forced into operation. Normal operation will resume at the next timetabled operation of the sign.

2.17 UTMC Operation

The warning sign can be operated using the UTMC (Urban Traffic Monitoring & Control) open protocol. The UTMC protocol can be obtained from https://www.utmc.eu/. The Profectus warning sign uses the UTMC MIB UM/003 defined in UTMC-TS004.006 Objects.

This means the sign can be configured to operate with a Common Database or instation supporting UM/003 UTMC operation. The Profectus CPU can be operated in conjunction with UTMC message on SNMP V1 and SNMPV2.

The following UTMC MIB functions are supported

SubObject: utmcVMSType1 1.3.6.1.4.1.13267.6.1

SysInfo 1.3.6.1.4.1.13267.6.1.1

Name	Object	Supported by Profectus
vmsMibSoftwareVersion	.1	Y
vmsMaxHeight	.2	Y. It returns number of slave signs + 1(master)
vmsMaxWidth	.3	Y. Return maximum number of characters used in MessageTable
vmsMaxFontSpacing	.4	N
vmsMaxFontHeight	.5	N
vmsMaxFontWidth	.6	N
vmsLanternsPresent	.7	Y master sign only
vmsMinHeight	.8	Y. Always 1
vmsMinWidth	.9	Y. Always 0
vmsMinFontSpacing	.10	N
vmsMinFontHeight	.11	N
vmsMinFontWidth	.12	N

sysConfig 1.3.6.1.4.1.13267.6.1.2

Name	Object	Supported by Profectus
signID	.1	Y
vmsPassword	.2	Y
signType	.3	Y
vmsLanterns	.4	Y Master sign only.
vmsConfigTime	.5	Y
vmsHeight	.6	Y
vmsWidth	.7	Y
vmsFontSpacing	.8	N
vmsFontHeight	.9	N
vmsFontWidth	.10	N
vmsReturnIpAddress	.11	N
vmsLogIn	.12	Y
vmsSetTime	.13	Y
vmsPort	.14	N

vmsDisplayConfig 1.3.6.1.4.1.13267.6.1.3

Name	Object	Supported by Profectus
messageTable	.1	Y
messageTableEntry	.1.1	Y
messageLineID	.1.1.1	Y. Contains 0 in case of a master sign, slave address otherwise. It is not possible to write a value different than the current one.
displayText	.1.1.2	Y. Message face ID
lanternsOnOff	.2	Y Master sign only
msgTime	.3	Y
vmsLuminanceOverride	.4	Y Master Sign only Read Only
vmsLuminance	.5	Y Master Sign Only

vmsFaultStatus 1.3.6.1.4.1.13267.6.1.4

Name	Object	Supported by Profectus
faultStatus	.1	Y
statusTime	.2	Y
internalCommsStatus	.3	Y. Raise in case of Radar, radio, and led board faults
messageFail	.4	Y
ledFailNonCritical	.5	Y. Any led faults
ledFailCritical	.6	Y. Any led faults
heaterFail	.7	Y Low Temperature Warning
watchDogReset	.8	N
overTemperature	.9	Y
luminanceFail	.10	Y. LDR error
lanternFail	.11	Y Master Sign Only
invalidSignAddress	.12	N
configError	.13	N
powerFail	.14	Y. Low and high voltage. UPS faults
noConfigFile	.15	N
noSysInfoFile	.16	N
noSignID	.17	N
vmsExternalCommsFault	.18	Y
faultDescription	.19	Y. List of faults as per native faultlog. These a prepended by slave# in case of a slave.
numberFaults	.20	Y

vmsCommsCheckStatus 1.3.6.1.4.1.13267.6.1.5

Name	Object	Supported by Profectus
vmsCommsCheck	.1	N
vmsCheckTimer	.2	Y
vmsBlankOnFault	.3	Y
vmsTimeOut	.4	N

Extras 1.3.6.1.4.1.13267.6.1.7

Name	Object	Supported by Profectus
vmsVoltage	.2	Input voltage. Master only

To configure UTMC interface the following configuration commands are required.

[utmc]
read_community=public
write_community=public
password=PASSWORD
check_timer=0 #0 to 1440. 0->disabled
blank_on_fault=0 #0 or 1

[utmc:faces]
face0= <blank>
face1=Circle
face2=SlowDown
lanterns=Flashes

Password may need to be adjusted according to customer specific UTMC network configuration. Within the configuration above message faces have been configured to match LED groups i.e. face1 is the Circle group.

2.18 Power Supply

The warning sign can be powered using the following permutations:

- Mains 110/230 50/60Hz
- Switched Mains
- Solar
- Battery only (see section 2.19)

In the case of the mains supply option a switch mode power supply provides conversion of the mains supply to a 12VDC logic for the Profectus CPU. Switched mains is specified when a mains supply is available part time such as a street lighting column. With the switched mains supply a 12VDC gel acid battery pack is charged via a battery charger from the mains supply when available. The Profectus CPU can regulate the 12VDC from the battery to operate the sign. Solar solutions require a south facing solar panel to collect energy from sun light. The photovoltaic panel converts the sun light into electrical energy and a solar regulator uses this to charge a battery. As in the switched main solution the battery is used to supply 12VDC to the Profectus CPU to regulate the sign.

The Profectus CPU constantly monitors the nominal 12DC voltage supply if the voltage is between 10.5V and 30VDC the CPU will continue to operate normally. If the power supply falls below 10.5V then the CPU will shut down and a “Low Power Fault” is raised. Above 30VDC the CPU will detect the high voltage and shutdown the CPU raising a “High Power Fault”.

The power supply configuration for a main electricity solution is held in the conf.ini file as follows:

```
[power]
pwr_supply=mains     #mains/sw_mains/solar
pwr_volt=12v         #nominal supply voltage
pwr_max=30v          #max supply voltage
pwr_min=10.5v        #min supply voltage
dcdc_conv=auto       #on/off/auto
```

When considering solar or switched mains solutions further configuration is required.

```
[power:battery]
volt_vs_capacity= 13.5 100 11.5 30    # voltage percentage couples
```

In the case of the power supply available options are mains, switched mains and solar for the warning sign configuration. Given the example configuration file above the sign is set to operate from the mains 230VAC supply and the nominal voltage at the sign will be 12VDC. The sign could also be configured to operate at 24VDC if required.
The pwr_max and pwr_min settings configure the CPU for max and min voltage levels once this tolerance range on the supply is exceeded a fault is logged to indicate the upper or lower threshold have been breached and the sign will shut down to prevent any damage.
The Profectus CPU provides an inverter which is capable providing 24VDC or 48VDC to drive sign LED supplies, this is configured using link JP4 on the CPU.

24/48V Configuration

Name	Pin	Comment
48V_EN	JP4	Fitted LED drive is configured to 48V Not Fitted LED drive is configured for 24V

Normally the inverter will be configured to run in automatic mode so operational only when required it can also be forced permanently to the active or inactive state. Automatic mode is normally, this reduces power consumption of the sign only activating the inverter when required.

The battery voltage-vs-capacity of the sign is used to allow calculation of the battery capacity. Normal sizes for the warning sign batteries when fitted in the sign are:

7000 mAhr
15000 mAhr
22000 mAhr

Please check the battery used in the specific sign build to set this value.

2.19 Battery Charging

The battery only option is typically used for moveable signs where the battery is charged, and the sign deployed for days or weeks and then collected for recharge. The warning sign is fitted with one to two lithium ion battery packs, each battery pack is fitted with a charge level indicator. Press and hold the charge level indicator button on each battery pack to confirm the battery state. 3 green LED's indicates fully charged and red indicates the battery is discharged and requires charging. It is important for safety reasons that lithium ion batteries are not over discharged: the battery output will be switched off at 9V battery level for this reason.

The battery is rated for discharge over the temperature range rating of the sign -20C to +60C however the battery can only be charged over the temperature range 0 to +45C, therefore do not attempt to charge the battery outside this temperature range. Do not attempt to charge the battery while the sign is in use.

The batteries are rated for 300 charge / discharge cycles if the sign is operating for a maximum of one month then the sign has a maximum battery life of 25 years.

When charging it is important that the batteries are removed from the sign, a mains 230V charger is supplied with the sign as well as a 12V cigar lighter charger. It is important to only use the chargers supplied with the sign to avoid damage to the batteries and avoid any risk of damage to the battery.

The battery fuel gauge can be used to identify the charge remaining in the battery. Once the battery is off load for 2 minutes or more press the fuel gauge button and read the LED pattern as follows:

• No Lights	Empty	Recharge within 12 hours
• 1 Red Light	<10% Full	Battery will switch off to prevent over discharge
• 2 Red Lights	10-20% Full	Recharge ASAP
• 1 Green & 2 Red	20%-50% Full	
• 2 Green & 2 Red	50-75% Full	
• 3 Green & 2 Red	75-100% Full	

WARNING: ONCE THE BATTERY IS FULLY CHARGED DISCONNECT FROM THE CHARGER DISCONNECT THE CHARGER FROM THE MAINS SUPPLY. DO NOT LEAVE THE BATTERY CONNECTED TO THE CHARGER FOR LONG PERIODS

NOTE: ENSURE WHEN THE SIGN IS FIRST SUPPLIED THE BATTERIES ARE FULLY CHARGED FROM THE MAINS SUPPLY USING THE CHARGER PROVIDED.

2.20 LED Emitters

When the sign is active it operates LED chains and display boards providing each emitter as a pixel. Each pixel of the display is formed from an LED and lens. The combination of LED and lens provides optical contrast for the sign and allows the signs to meet standards for optical uniformity and distribution of the light across the road surface.

The LED emitters provide a sign display certified to EN12966 with the following characteristics:

Beam Width	B3
Luminance Ratio	R3
Colour	C2
Luminance	L3

Depending on the ambient light conditions the LED emitters need to be more or less bright, therefore a photocell measures the ambient light conditions on the front face of the sign. The radar module then uses PWM to control the intensity of the LEDs to 6 different light levels. Using this approach also avoids users seeing excessively bright sign displays in low ambient light as well as saving energy where possible.

3 Your Speed is…Sign Configuration

A typical use of the warning sign is the Your Speed is… Sign which appears as follows:

The warning configuration is set using two data files stored on the Profectus CPU:

conf.ini – Responsible for all hardware and software configuration parameters except for timetables
ttab.txt – Timetable configuration file information

These datafiles can be updated in several ways:

- Update files on USB memory device plugged into Profectus CPU
- Update at site using Webserver accessed via Wi-Fi hotspot
- Update centrally from Swarco PGS in station.

Files can be copied to the USB memory device and then uploaded into the CPU or via a wirelessly using the Wi-Fi hotspot please see section 0 for details.

3.1 conf.ini file details

The confi.ini file details all of the hardware and software configuration details within the sign, it is a simple ASCII txt file which can be edited in Windows Notepad or equivalent. Each section of the file contains configuration details relevant to each operating area of the sign.

The config file for this type of sign with no remote communications would be as follows:

```
#########################################################
####  MODE16 VAS-YSI Sign Configuration file  ####
#########################################################
[power]
pwr_supply=mains     #mains/sw_mains/solar/mains_ups
pwr_volt=12v         #nominal supply voltage
pwr_max=30v          #max supply voltage
pwr_min=10.5v        #min supply voltage
dcdc_conv=off        #on/off/auto
ups_pwr_fail_inp=
ups_batt_fail_inp=
```

[power:battery]
volt_vs_capacity= 13.5 100 11.5 30 # voltage percentage couples

All power and battery configuration requirements are detailed fully in section 2.18

[clock]
update_method= *#gps/ntp/radio or empty*
update_time=03:00 *#scheduled time update request*
ntp_server= *#ntp server address*
ntp_port= *#ntp server port*
timezone=UTC+0:00 *#timezone*
dst=on *#on/off daylight saving*
advance_time=1:00 *#time when DST is applied*
retard_time=2:00 *#time when DST is removed*

All clock configuration requirements are detailed fully in section 2.8.4

#Photocell lux level thresholds: insert sorted values 0-1023
#max 20 entries (lux_level_19)
#lux_lev_0=0 always
[photocell]
lux_lev_0=0
lux_lev_1=128
lux_lev_2=256
lux_lev_3=512
lux_lev_4=675
lux_lev_5=750

All photocell configuration requirements are detailed fully in section 2.5

#Brightness level (1.0-100.0%) associated to LDR threshold
#number of ldr_lev and br_lev must match
[led_red:brightness]
br_lev_0=1%
br_lev_1=10%
br_lev_2=20%
br_lev_3=60%
br_lev_4=80%
br_lev_5=100%

[led_amber:brightness]
br_lev_0=1%
br_lev_1=10%
br_lev_2=20%
br_lev_3=60%
br_lev_4=80%
br_lev_5=100%

[led_blue:brightness]
br_lev_0=1%
br_lev_1=10%
br_lev_2=20%

br_lev_3=60%
br_lev_4=80%
br_lev_5=100%

[led_white:brightness]
br_lev_0=1%
br_lev_1=10%
br_lev_2=20%
br_lev_3=60%
br_lev_4=80%
br_lev_5=100%

[led_green:brightness]
br_lev_0=1%
br_lev_1=10%
br_lev_2=20%
br_lev_3=60%
br_lev_4=80%
br_lev_5=100%

All brightness level configuration requirements are fully detailed in section 2.5

#Led Drive Fail Time, after this time reported as error
[led_drive_fail_time]
led_driv_f_tm=5000 #250-5000 ms

#Led Drivers
[led0]
colour=amber
type= alternating
state0 = 400 on
state1 = 400 off
fault_current=18
name_field=Flash_Top

[led1]
colour=green
type= static
fault_current=18
name_field=ThankYou

[led2]
colour=red
type= static
fault_current=18
name_field=Slow

[led3]
colour=red
type= static
fault_current=18
name_field=Down

[led4]

colour=amber
type= alternating
state0 = 400 off
state1 = 400 on
fault_current=18
name_field=Flash_Bottom

LED Drive configuration requirements are defined in section 2.6.1

#7Segment
[seven_segment]
led_board_addr=0 *#0 to 7*
half_digit=off *#on/off*
dual_colour=on *#on/off*
colour0=red
colour1=green
fault_current=25

LED 7 Segment display configuration requirements are defined in section 2.6.1.1

#Led Group
[led_group0]
name=Flashes
output_type=standard *#standard/seven_segments*
leds=0,4 *#0 - 159*

[led_group1]
name=ThankYou
output_type=standard *#standard/seven_segments*
leds=1 *#0 - 159*

[led_group2]
name=SlowDown
output_type=standard *#standard/seven_segments*
leds=2,3 *#0 - 159*

[led_group3]
name=RedSpeed
output_type=seven_segments *#standard/seven_segments*
colour=0

[led_group4]
name=GreenSpeed
output_type=seven_segments *#standard/seven_segments*
colour=1

LED group configuration requirements are defined in section 2.6.2

#Active detector
[detectors]
radar=on *#on/off*
analog_sensor1=off *#on/off*
analog_sensor2=off *#on/off*

```
#Radar
[radar]
com_port=com1                    #for com0,com1 for rs485
com_mode=rs232                   #rs232/rs485
baud=115200
detection_range=90%              #relevant for radar det
log_time=15                      #logging time [mins]
demo_mode = off
```

All vehicle detection configuration requirements are detailed fully in section 2.2

```
#triggers
[trigger0]
detector=radar                   #radar/digital_input/analog sensor's name
interval=0,30                    #two values like 30,50
calling_delay = 0
canc_delay = 5000
groups=GreenSpeed+ThankYou

[trigger1]
detector=radar                   #radar/digital_input/analog sensor's name
interval=30,35                   #two values like 30,50
calling_delay = 0
canc_delay = 5000
groups=RedSpeed+Flashes

[trigger2]
detector=radar                   #radar/digital_input/analog sensor's name
interval=35,50                   #two values like 30,50
calling_delay = 0
canc_delay = 5000
groups=RedSpeed+SlowDown+Flashes

[trigger3]
detector=radar                   #radar/digital_input/analog sensor's name
interval=50,150                  #two values like 30,50
calling_delay = 0
canc_delay = 5000
groups=SlowDown+Flashes

#Default Triggers
[default_triggers]
trigger=0,1,2,3                  #trigger numbers
```

Trigger configuration requirements are defined in section 2.6.3

```
####################################
#######Communication setup#######
####################################
[communication]
wifi=on
modem=on                    #on/off/ttab
```

ethernet=off *#on/off*

[wifi]
ssid=MODE16_VAS-YSI
passkey=cicciociccio *# >=8 char*
timeout=0
channel=7
ext_ant=0 *#1 if present*

All Wi-Fi configuration requirements are detailed fully in section 2.13

Fixed Speed YSI

As an alternative for a YSI speed display it may be required to fix the speed display beyond a limit. This can be achieved by the following statements:

[led_group5]
name=Speed30
output_type=standard *#standard/seven_segments*
leds=12,13,14,15,18,5,6,7,8,9,10 *#12-18 for 3: 5-10 for 0: 5=A1,11=G1: 12=A2,18=G2*

In the example above the LED group has been configured to pick up the LED drives in the 7 segment displays for 30 display

[trigger0]
detector=radar *#radar/digital_input/analog sensor's name*
interval=30,150 *#two values like 30,50*
calling_delay = 0
canc_delay = 5000
groups=Speed30+SlowDown+Flashes

The trigger above now calls up the speed 30 display along with flashers and slow down LED groups. Please note this facility can only be used with monochrome speed displays.

4 Webserver User Interface

To provide access to the warning sign for control and monitoring purposes the sign provides a webserver. The webserver can be accessed on any device supporting Chrome, Firefox or Internet Explorer web browsers on a PC or mobile device.

4.1 Remote Webserver Access

Using the optional 4G modem the webserver can be accessed remotely through the mobile data network. Using this approach, the modem will need to be fitted with a public static IP SIM card on the mobile phone network.

The modem will need to be configured to operate on the correct mobile data network and operating in webserver mode as follows:

[Modem]
mode=webserver #pgs/webserver
apn=3test.m2m.co.uk
username=web
password=web
ping_addr=
keep_alive_t=

The modem can be timetabled to operate 24/7 or at certain times of the day. During active modem times the user can simply access with the IP address of their SIM card from their internet browser, multiple sites could even be stored as bookmarks.

4.2 Wifi Webserver Access

Alternatively, the webserver can be accessed via the wifi interface built into the sign. The warning sign provides a wifi access point which is normally powered down. A magnetic switch at the base of the sign needs to be activated via a magnet. The confirmation LED will indicate to the user the wifi access point is now active.

On your PC or mobile device look for the access point among your wifi connection and then connect.

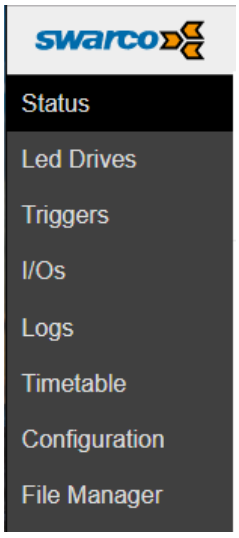
[Wifi]
ssid=MyWifi
passkey=school # >=8 char
timeout=10

The wifi access point is configured in the conf.in file in the case above the SSID for the connection is “MyWifi” and the password is school. The wifi access point will power down to save energy once it has not been used for 10 minutes.

4.3 Webserver Pages

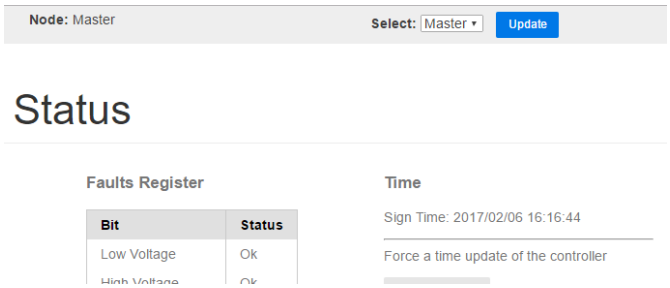
To access the webserver simply type in the IP address of the sign if using locally the IP address is identified on the sign label.

As soon as you connect to the webserver you are connected directly to the Home screen. The Home screen is the status page, down the left panel is the navigation panel providing access to the following areas:



Section	Description
Status	Home screen and status page providing status of sign and overview of facilities
LED Drives	Details for LED control groups and LED chain failure monitoring
Triggers	Trigger Configuration details
I/Os	Status of Digital I/O
Logs	Check fault, data and detection logs
Timetable	Configured timetable entries
Configuration	Display the contents of the conf.ini file
File Manager	Download and upload files to the sign to a local host

When working with master and slave signs the webserver at the master can access the slave signs as well as the master.

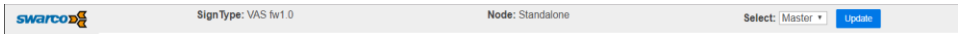


At the “SELECT” option select the slave address of interest and simply press the update button to look at the same screen for the slave sign. N.B. Access the webserver from a slave sign it will not be able to access information on any other signs.

4.3.1 Status Screen

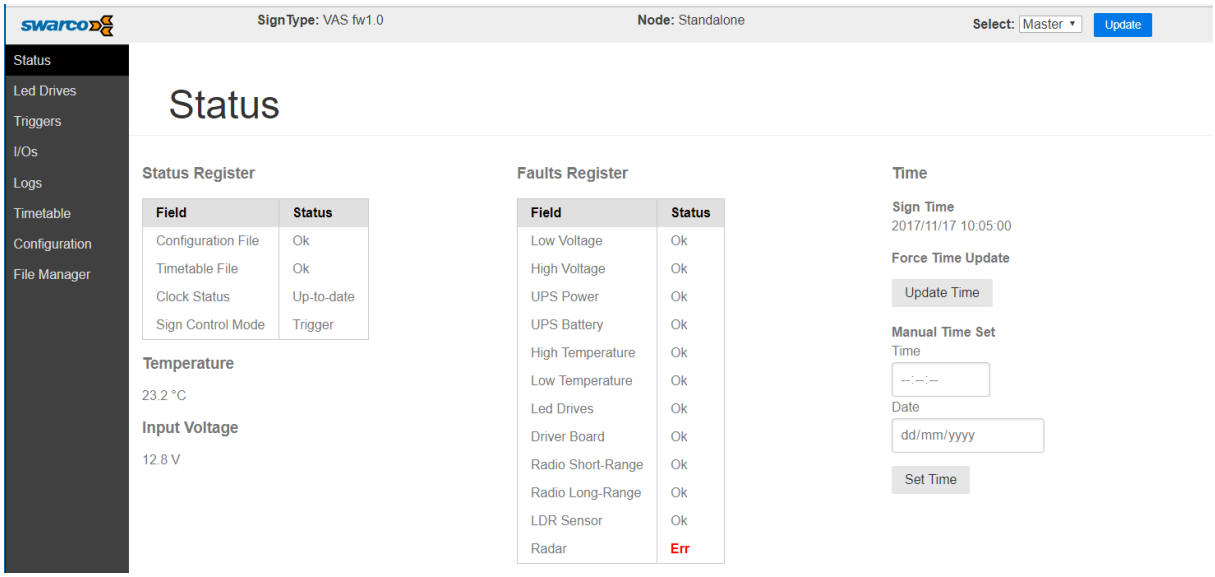
The main section highlighting operation and status of the warning. Across the top of the screen from left to right identifies:

- Firmware version
- Node currently being accessed (Master,2,3,4…11 all configured slaves)
- Select (Master,2,3,4..11 all configured slaves)



N.B. A master can access itself plus all configured slave signs. A slave can only access itself.

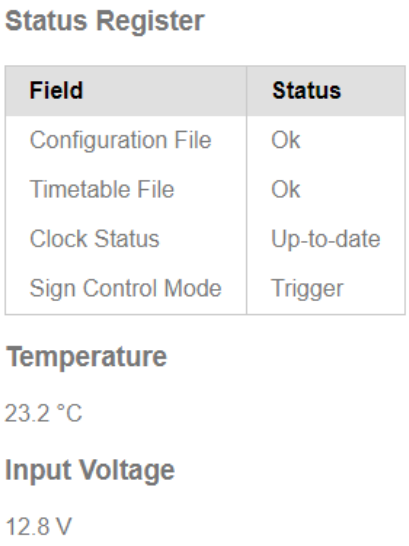
When accessing any sign whether a master or a slave sign use the select box to choose the master or slave address and then the “update” button. This selection process can be used to check the same functionality for all signs in the network.



Within the main screen we have the following sections:

4.3.1.1 Status Register

The status register provides a quick overview of the status within the Warning Sign.



Status Bit	Description
Config File	Indicates the conf.ini file is present on the CPU and no errors are detected in the file.
Timetable File	Indicates the ttab.txt file is present on the CPU and no errors are detected in the file.
Clock Status	Indicates whether the clock has received it latest update if an external clock source is configured.
Sign Ctrl	Indicates the current control mode for the sign

In addition, the status register provides a measurement of the ambient temperature of the CPU and the input supply voltage to the CPU a nominal 12VDC.
When the sign power supply is configured as switched mains or solar, a battery icon will indicate the capacity left.

4.3.1.2 Fault Register

The fault register provides a quick indication of the status of main hardware modules within the sign and its CPU full details of fault will be provided in the fault log in section 4.3.4.

Each fault status bit corresponds to an alarm or hardware module within the warning sign fundamental to the operation of the sign.

Faults Register

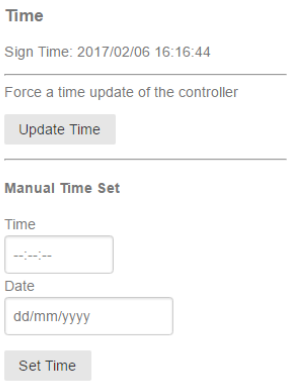
Field	Status
Low Voltage	Ok
High Voltage	Ok
UPS Power	Ok
UPS Battery	Ok
High Temperature	Ok
Low Temperature	Ok
Led Drives	Ok
Driver Board	Ok
Radio Short-Range	Ok
Radio Long-Range	Ok
LDR Sensor	Ok
Radar	Ok
Inputs	Ok

Status Bit	Description
Low Voltage	The voltage supply, a nominal 12VDC has dropped to the minimum configured value (Default 10.5VDC)
High Voltage	The voltage supply, a nominal 12VDC has exceeded the minimum configured value (Default 30VDC)
UPS Power	The UPS power has failed if fitted
UPS Battery	The UPS battery has failed if fitted
High Temperature	The ambient temperature of the CPU has exceeded the maximum limit of 80°C
Low Temperature	The ambient temperature of the CPU has exceeded the minimum limit of -20°C
LED Drives	An LED chain failure has been detected
Driver Board	The LED driver has developed a fault
Radio S-Range	The short range radio has suffered a communications failure
Radio L-Range	The long range radio has suffered a communications failure if fitted
LDR Sensor	The CPU has detected a faulty photocell used to dim the LED driver outputs
Radar	The radar detector us faulty
Inputs	Digital input has been reported active or inactive for excessive time indicating fault

4.3.1.3 Time

When operating a warning sign with timetables timing accuracy is vital as a consequence the sign would normally be configured to use a GPS clock source or an NTP server if a modem is configured. Slave signs will take their clock source from the master sign to ensure all signs in the cluster have the same time.

The time displayed in this window shows the current time on the CPU. N.B. the time is not automatically updated so use the “UPDATE” button to display refresh to the latest time.



The time on a master sign can be manually set simply change the date and time in the manual time set boxes and then use the “SET TIME” button.

Once completed the interface will indicate the acceptance with the message “SUCCESS” the date and time will be updated accordingly.

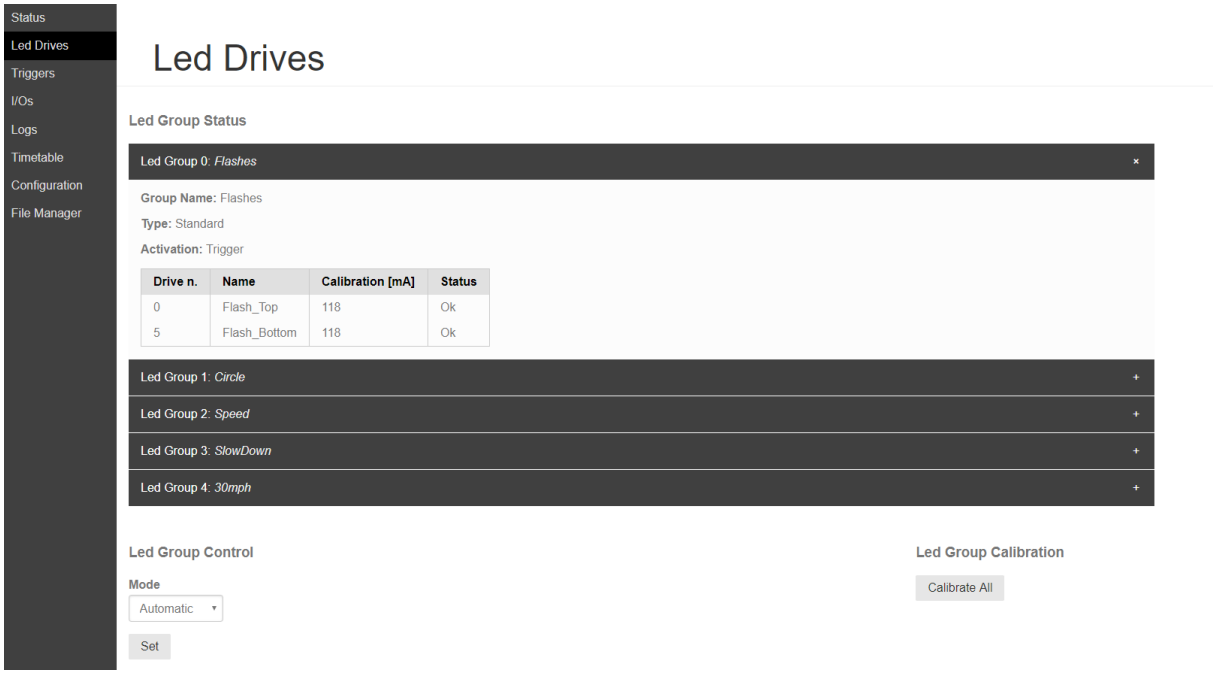
To get a clock update from the automatic source such as GPS or NTP server simply select the “UPDATE TIME” button and the clock will be updated from the automatic source, the message “SUCCESS” will be displayed. The automatic update will then take a further 30s to complete use the “UPDATE” button to display the current time once complete.

When accessing a slave sign the Manual Time set option will be missing but an “UPDATE TIME” button will force a clock update from the master sign via the radio links.

4.3.2 LED Drives

The Led Drives screen provides direct control and monitoring of the warning sign LED groups.

When accessing any sign whether a master or a slave sign use the select box to choose the master or slave address and then the “update” button. This selection process can be used to check the same functionality on all of the signs in the network.



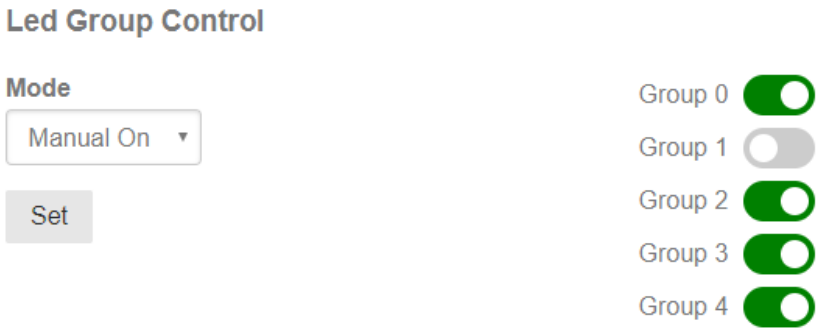
Expanding an LED group reveals the LED group name and number. As well as this information the user has the group type defined and the activation method see section 2.6.2 for full details of LED groups and their configuration.

4.3.2.1 LED Group Control

The default mode of operation for the warning sign is automatic meaning the sign operates according to triggers, timetable, digital input etc.

Alternatively, the warning sign can be forced to start or cease operation. Simply select the LED Control mode as “On” or “Off” and then click the “Set” button.

When selecting manual mode all configured LED groups are displayed and



Once updated the status will change to indicate operation

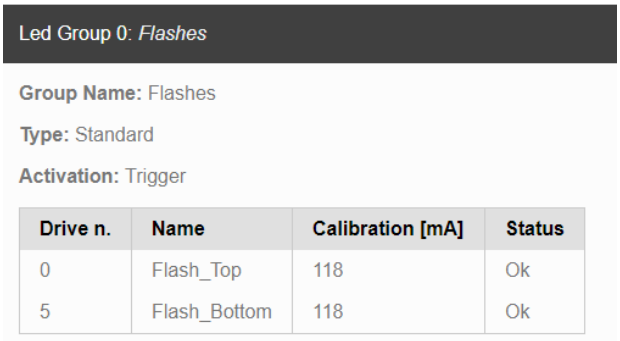
- Automatic
- Manual Off
- Manual On

4.3.2.2 LED Chain Monitoring

The LED drives on the warning sign are fault monitored when a string of LEDs fails on a drive this is detected and reported as a fault. To assist diagnostics, the current monitoring of the LED drives is available from the webserver, together with the failure status.

The status of the LED drives is indicated where OK indicates no faults and Error indicates a failure has been detected. More information can be found in the fault logs in section 4.3.4.

When the LED group and its associated LED drives are first operated the current monitored on the LED drive current is recorded as the calibration reading. From this time onwards the current readings of the LED drives are compared to the calibrated reading.



Within the conf.ini file the monitoring section declares the current threshold for the drive monitor see section 2.6.1 for details. So if the calibration is 40mA and the threshold is 18mA, once the measured current falls to less than 22mA a fault is recorded.

If the calibrated current is considered incorrect or a new LED module has been fitted, then the “Re-calibrate” button can be used to force new calibration values to be recorded.

4.3.3 Digital I/O Screen

The digital I/O screen displays the status of the digital inputs and outputs of the CPU.

When active I/O is as follows:

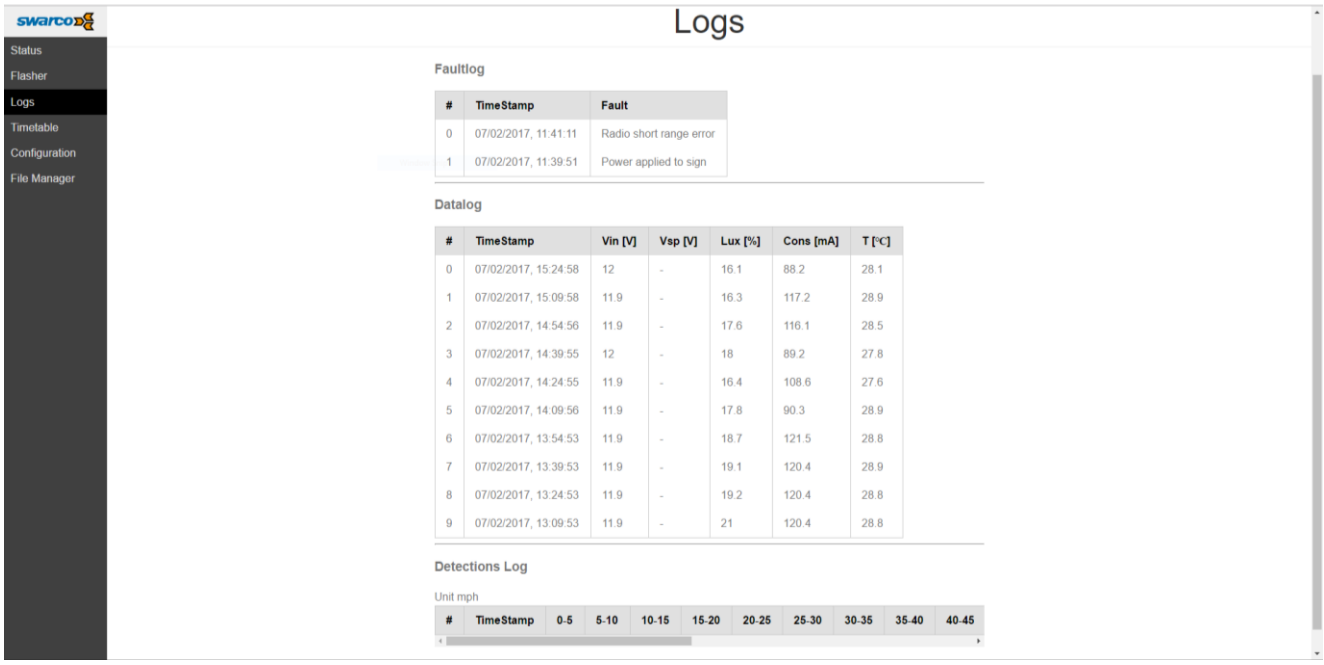
Green = Digital Input On
Red = Digital Output On

4.3.4 Logs Screen

The logs screen provides access to the following logs for viewing from the web interface:

- Fault Log
- Data Log
- Detection Log (If vehicle detection fitted)

When accessing any sign whether a master or a slave sign use the select box to choose the master or slave address and then the “update” button. This selection process can be used to check the same functionality on all of the signs in the network.



4.3.4.1 Fault Log

The fault log provides a list of the fault in chronological order with the most recent faults at the top of the list. All faults are timestamped by time and date. All faults are detailed in section 2.15 in addition the fault log can be downloaded from the sign for details see section 4.3.7.

4.3.4.2 Data Log

The data log lists all of the data samples taken within the sign, each sample period is time and date stamped. The controller monitors:

- Sign Supply Voltage (Vin)
- Solar Panel voltage if fitted (Vsp)
- Photocell Lux Level (Lux%)
- Current Consumption (Cons mA)
- CPU Temperature (T Cdeg)

Samples are recorded at 15 minute intervals and stored within the data logging file. The data log can be downloaded from the sign see section 4.3.7 for details. Full details on the data logging facilities are provided in section 0.

4.3.4.3 Detection Log

The detection log is split into speed bins, the number of vehicles in each speed bin are totalled over the sampling period and entered into the log. The sampling period is set to a default of 15minutes but can be modified within the conf.ini file, please see section 6 for full details of detection logging. In addition, the detection log can be downloaded from the sign and this is detailed in section 4.3.7.

4.3.5 Timetable

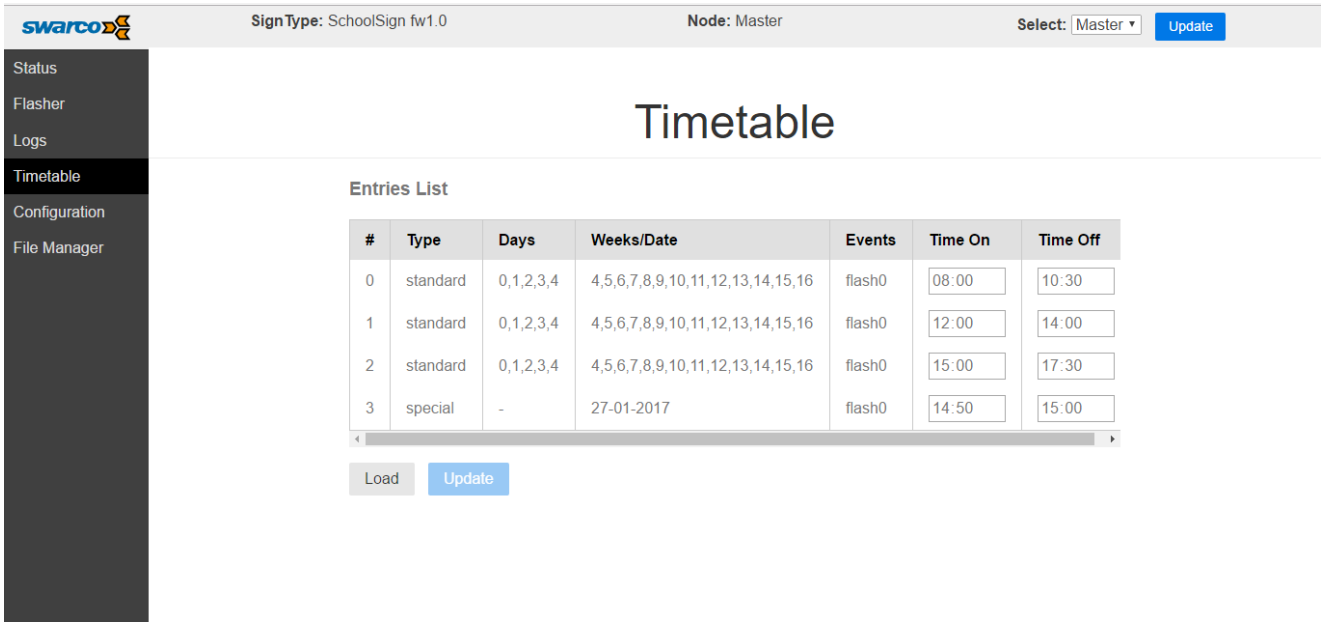
The timetable screen will initially not show any detail use the “LOAD” button to load the timetable file into the web interface.

The timetable displayed identifies the following information:

- Timetable No.
- Type Standard or Special
- Year active
- Days of the week active (0=Mon….6=Sun)
- Week or Date active
- Time On
- Time Off

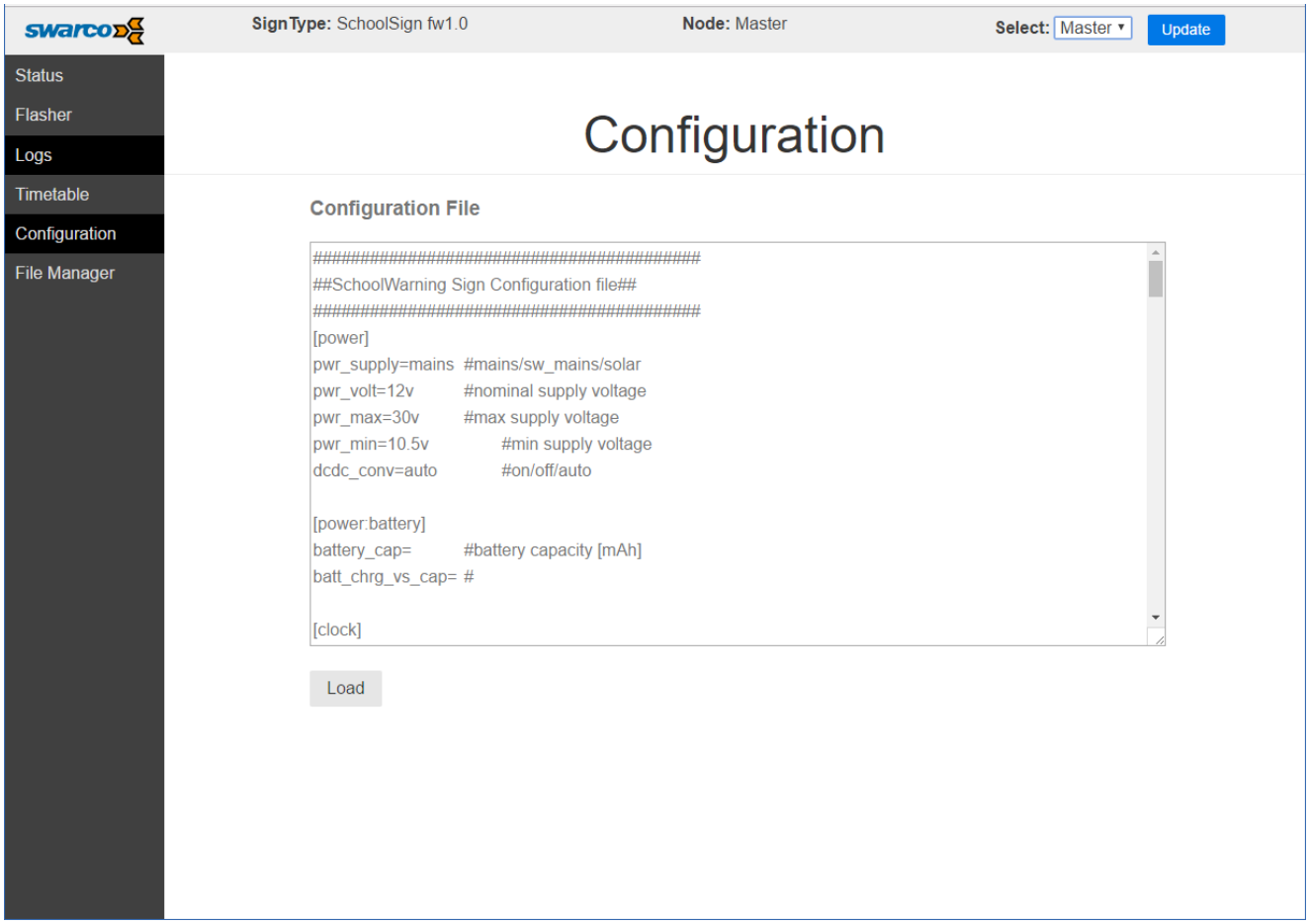
Timetable start and end time can be modified from the interface to disable to timetable set the Time On and Time Off times to the same value. Simply select the Time On or Time off time and then enter the new time or use the time selectors to make changes. Once changed have been completed used the “Update” button to store the changes. New timetables can only be created in the ttab.txt file, for more information please see section **Error! Reference s ource not found.** for more details.

When accessing any sign whether a master or a slave sign use the select box to choose the master or slave address and then the “update” button. This selection process can be used to check the same functionality on all of the signs in the network.



4.3.6 Configuration Screen

The configuration screen is able to display the contents of the conf.ini file which holds the configuration data of the warning sign see section **Error! Reference source not found.** for f ull details of configuration settings.

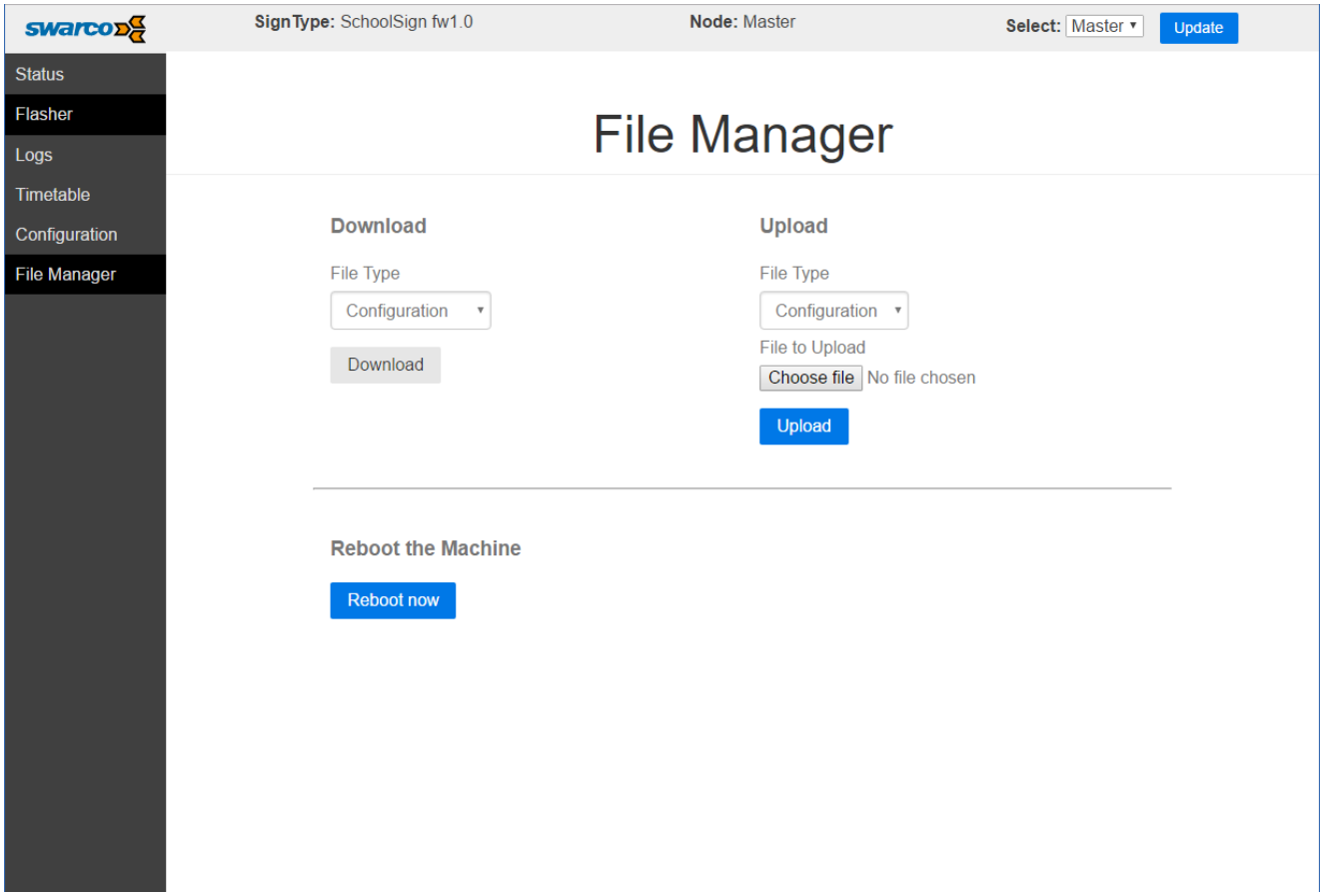


To access the configuration file simply select the “LOAD” button and the conf.ini file details will be loaded into the web interface.

When accessing any sign whether a master or a slave sign use the select box to choose the master or slave address and then the “update” button. This selection process can be used to check the same functionality on all of the signs in the network.

4.3.7 File Manager

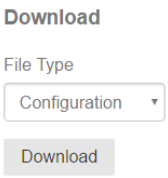
The file manager allows the users to upload or download files associated with the operation of the warning sign.



4.3.7.1 Downloads

File downloads are available for the following files stored on the warning sign to enable the files to be downloaded locally:

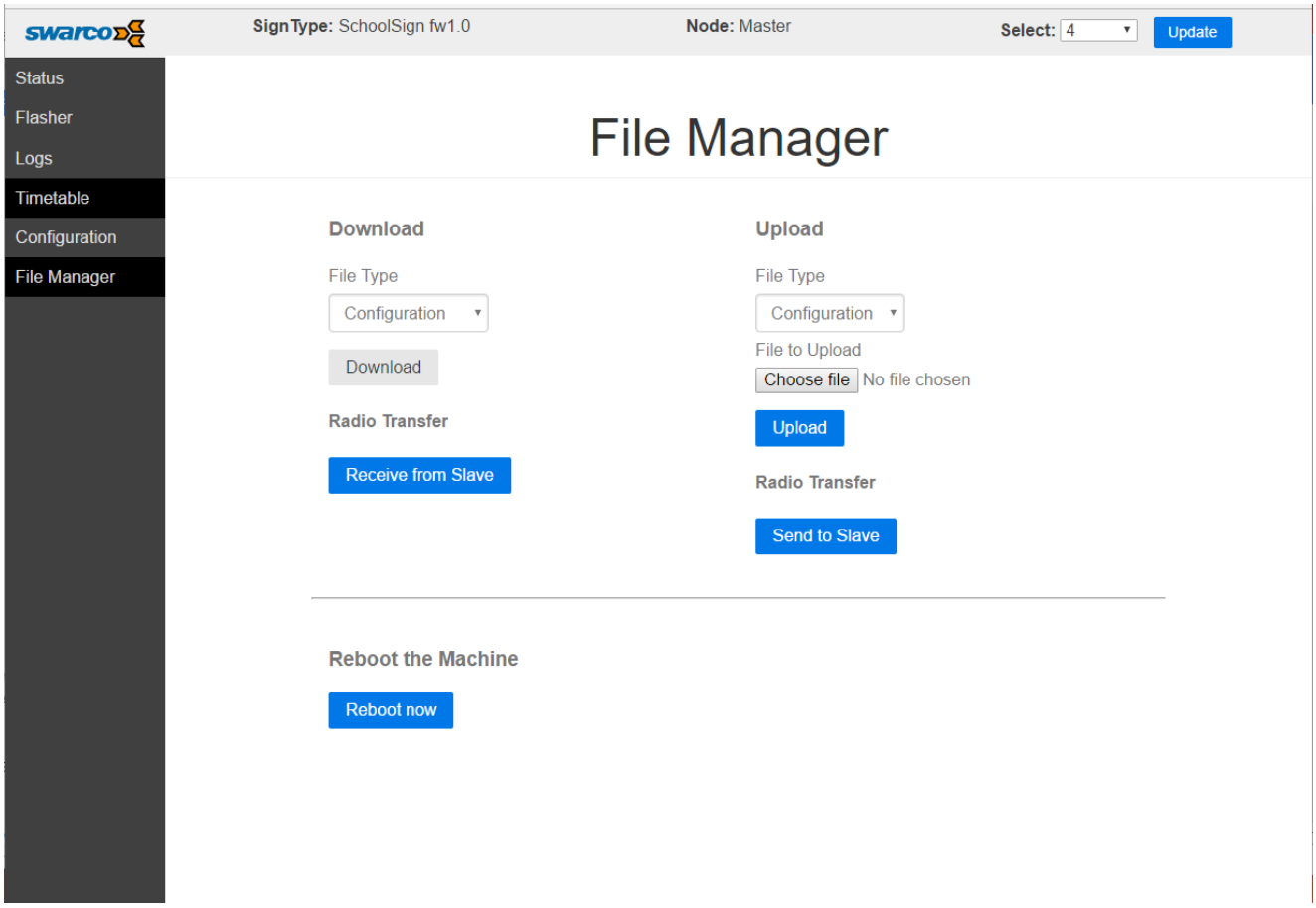
- Configuration conf.ini
- Timetable ttab.txt
- Data log dlog.csv
- Fault log fltlog.csv
- Detection Log detlog.csv
- Detection Log detlog.dat (Master Sign Only)



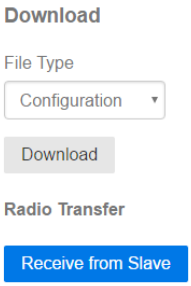
Once the file type for download is selected select the “Download” button to start the download process. Your Internet browser may ask for confirmation of download to proceed.

4.3.7.1.1 Slave Downloads

When considering a slave sign the process is slightly different. Firstly, from the select menu select the address of the sign of interest in this case address 4.



Within the Download section of the web page a new option “Receive from Slave” is now available. The file for download can simply be downloaded as in section 4.3.7.1. The master sign holds a copy of all of the files available for download. However, if you need to get the latest data from the slave sign simply select the button “Receive from Slave”. The master sign will now request the latest version of all files on the slave. Once this process is complete then download the required file as before.



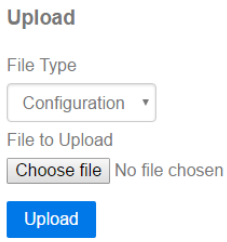
4.3.7.2 Uploads

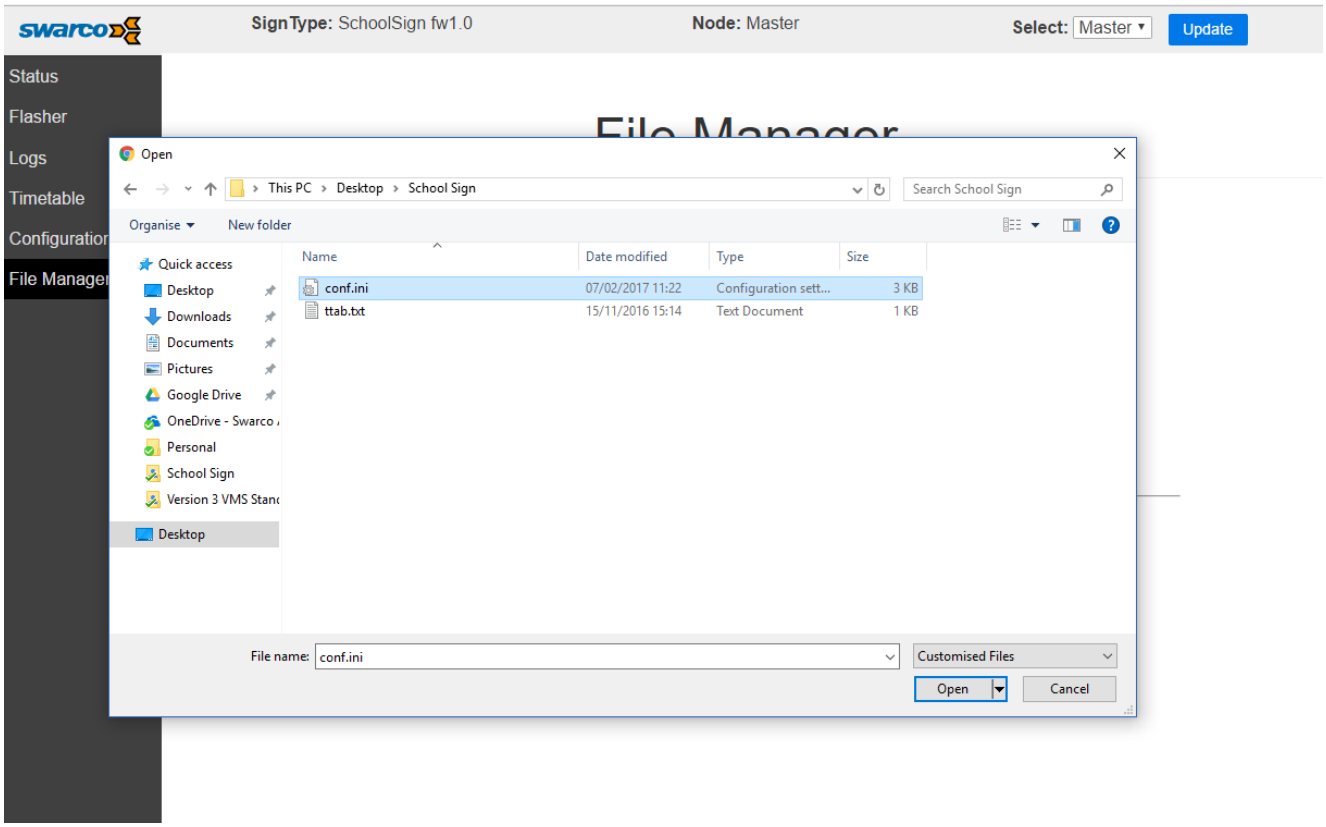
File uploads are available for the following files stored on the warning sign to enable the files to be uploaded from local copies:

- Configuration conf.ini
- Timetable ttab.txt

Once the file type for upload is selected select the “Choose file” the host machine will then open a dialogue box to identify the file for upload.

Now select the new file and then select the “Upload” button to start the upload process.

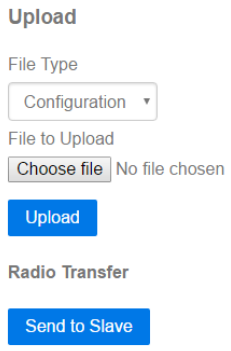




4.3.7.2.1 Slave Uploads

When considering a slave sign the process is slightly different. Firstly, from the select menu select the address of the sign of interest in this case address 4.

Within the Upload section of the web page a new option “Send to Slave” is now available. The file for upload can simply be uploaded as in section 4.3.7.2. The master sign holds a copy of all of the files available for upload for all of the slave signs, during the next update the slave will be updated automatically. However, if you need to get the latest file update data to the slave sign simply select the button “Send to Slave”. The master sign will now update the latest version of all files on the slave.



5 Datalogging

The Profectus CPU monitors the performance of the sign recording readings at 15 minute intervals to assist performance monitoring and diagnostics. The data log is stored as a file on the USB memory device with the filename dlog.csv.

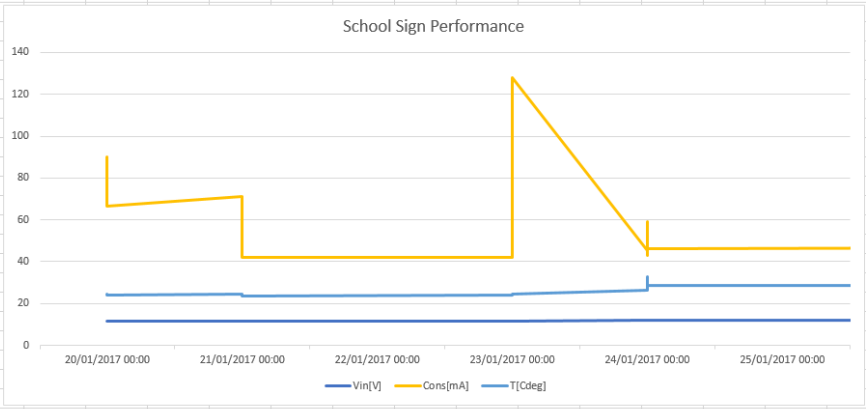
Where the sign is connected to a central system the data log is automatically uploaded when connected to the central system. Alternatively, the file can be manually retrieved from the USB memory device or downloaded from the sign via the Webserver see section 0.

At present the CPU logs data for the following data sources within the sign:

- Sign Supply Voltage (Vin)
- Solar Panel voltage if fitted (Vsp)
- Photocell Lux Level (Lux%)
- Current Consumption (Cons mA)
- CPU Temperature (T Cdeg)

All readings are timestamped and can be imported into Microsoft Excel for monitoring and diagnostics.

	A	B	C	D	E	F
1	Ts	Vin[V]	Vsp[V]	Lux[%]	Cons[mA]	T[Cdeg]
2	20/01/2017 17:12	11.8	-1	0.1	90.3	24.6
3	20/01/2017 17:59	11.8	-1	0.1	89.2	24.3
4	20/01/2017 19:31	11.8	-1	0.1	66.7	24.1
5	20/01/2017 03:11	11.8	-1	0.1	80.6	24.6
6	29/10/2017 02:02	11.8	-1	0.1	76.3	23.7
7	29/10/2017 01:59	11.8	-1	0.1	89.2	23.7
8	21/01/2017 03:08	11.8	-1	0.1	71	24.5
9	21/01/2017 03:14	11.8	-1	0.1	46.2	24
10	21/01/2017 03:30	11.8	-1	0.1	44.1	23.7
11	21/01/2017 03:45	11.8	-1	0.1	41.9	23.5
12	23/01/2017 14:08	11.8	-1	0.1	41.9	23.9
13	23/01/2017 15:28	11.8	-1	0.1	59.1	24
14	23/01/2017 17:05	11.7	-1	0.1	128	24.6
15	24/01/2017 10:34	12	-1	0.1	45.2	26.5
16	24/01/2017 10:49	12	-1	0.1	44.1	27
17	24/01/2017 11:04	12	-1	0.1	46.2	30.4
18	24/01/2017 11:19	12	-1	0.1	44.1	31
19	24/01/2017 11:34	12	-1	0.1	45.2	32
20	24/01/2017 11:49	12	-1	0.1	46.2	32.8
21	24/01/2017 12:04	12	-1	0.1	44.1	32.6
22	24/01/2017 12:19	12	-1	0.1	45.2	32.5
23	24/01/2017 12:34	12	-1	0.1	45.2	30.9
24	24/01/2017 12:49	12	-1	0.1	43	31.3
25	24/01/2017 13:04	12	-1	0.1	45.2	31.9
26	24/01/2017 13:19	12	-1	0.1	45.2	32.1
27	24/01/2017 13:34	12	-1	0.1	59.1	31.3
28	24/01/2017 13:49	12	-1	0.1	44.1	32.1



6 Detection Logging

When fitted with a vehicle detecting radar the warning sign is able to log vehicles approaching the sign. Approaching vehicles are logged into speed bins as follows:

0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100

Within the conf.ini file the detection logging is configured as follows:

#Set the active detector for car logging

[radar]
com_port=com1 *#for com0,com1 for rs485*
com_mode=rs232 *#rs232/rs485*
baud=115200
detection_range=90% *#relevant for radar det*
log_time=5 *#logging time [mins]*
use_kmph=00 *#Set to 1 if kmph or 0 for mph.*

In this case the *log_time* is set to 15 minutes. Using this approach, each vehicle seen in a 15-minute period is categorised into a speed bin. The totals of the speed bins over the 15-minute period are then totalled and stored.

The log time can be increased or reduced as required it should be considered bin counts are limited to 255 vehicles so if logging time is increased on a busy road then vehicles may not be counted. Reducing the logging time to say 3 minutes will give a better resolution at the expense of making the detection log files much larger.

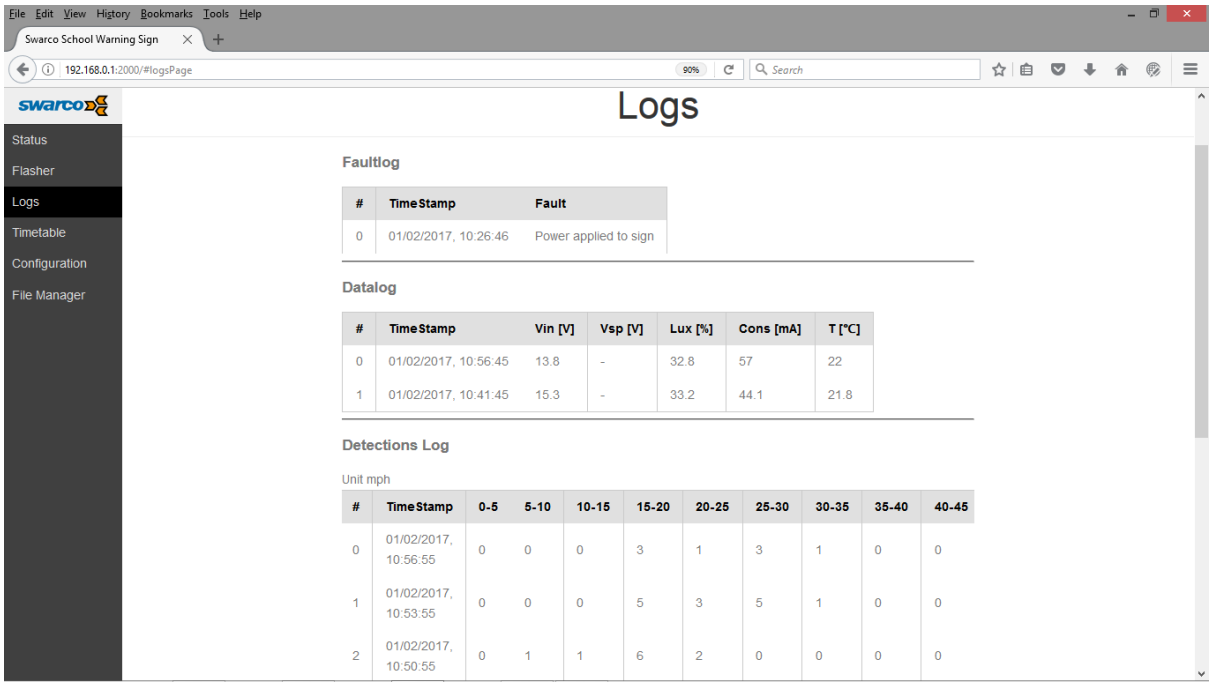
As an example the following vehicles detected:

10:22:05 33 mph vehicle
10:23:34 6 mph vehicle
10:23:55 31 mph vehicle
10:24:05 36 mph vehicle

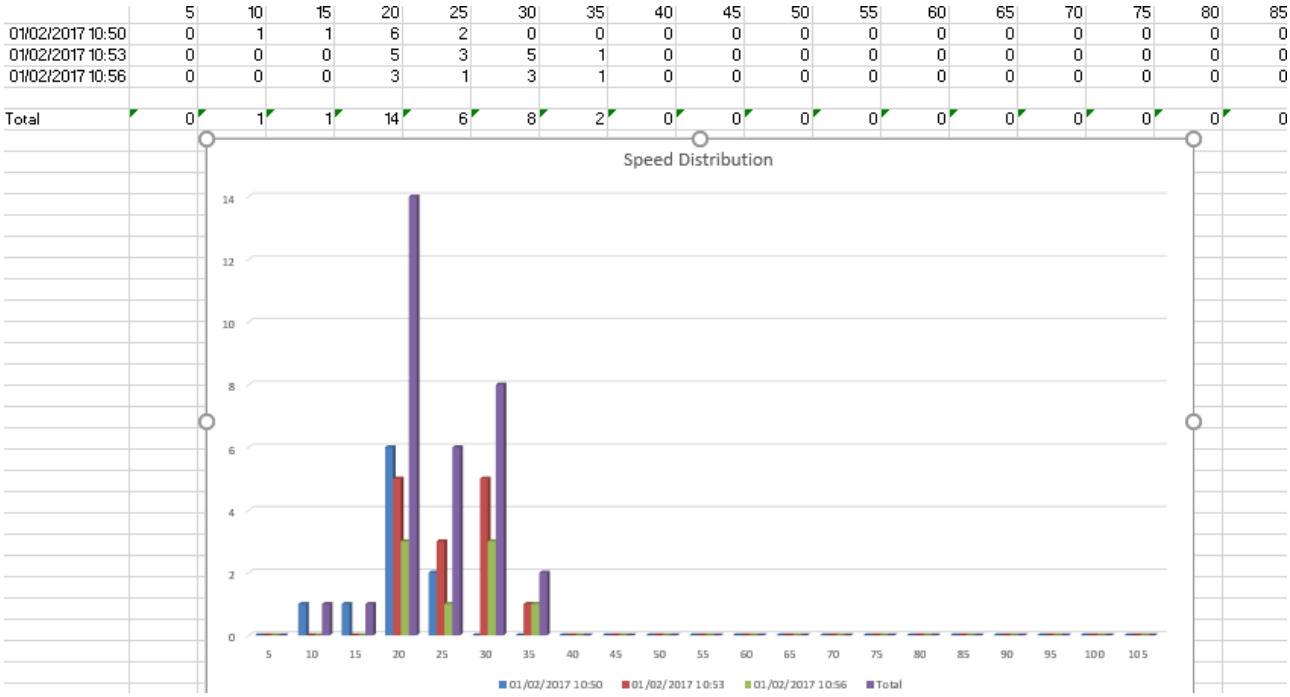
Would be reported as follows:

0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
0	1	0	0	0	0	2	1	0	0
50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100
0	0	0	0	0	0	0	0	0	0

Detection logs can be reported in the user interface webserver see section 0 as follows:



In addition, the detection log can be uploaded to the PGS instation or downloaded as a CSV file. Once available as a CSV file it can be opened in Microsoft Excel for data analysis as required.



Alternatively the detection log file can be downloaded in .DAT format for use by the Swarco Stats Analysis software 001-187.

6.1 Analysis of Sign Data Logging (Standalone)

6.1.1 Downloading data

All data that needs to be analysed must be first downloaded into a project. A project is simply a place to organize different sets of data together. You will require the Swarco Stats analysis software 001-187.

The user is the best judge of how they want to organize their data. Some possibilities are:

1. Fixed location sign or data taken at various times from the same location.
If the sign is in a fixed location, or you return to the same location over different periods of time of the month or year, you may create a project for that location. Then you can import data at different times from the same location into the same project. This will allow you to analyse different sets of data from that location together and even run comparison over time to see how traffic patterns are changing.

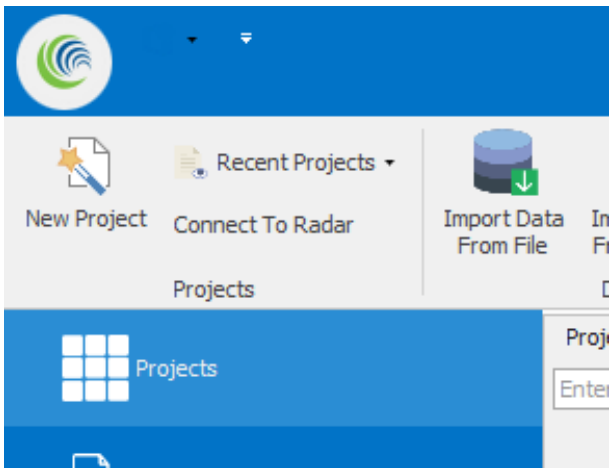
2. Speed studies at various locations.
In this case, you may want to create a project per speed study, or by date. There are pros and cons to each approach.

Project Per Speed Study: In this case, you may end up with a lot of projects. There is no inherent limitation to the number of projects allowed, but projects are created and displayed in a single level view and a lot of projects may get difficult to navigate after many studies.

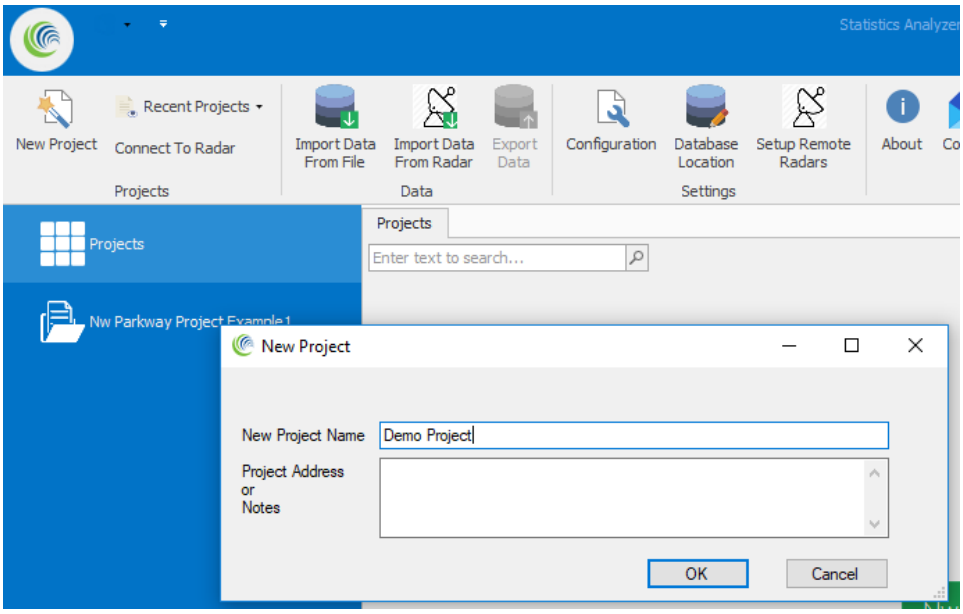
Project per date: You may create a project date named by “year-month”. This will allow easy navigation if you track your speed studies by date.

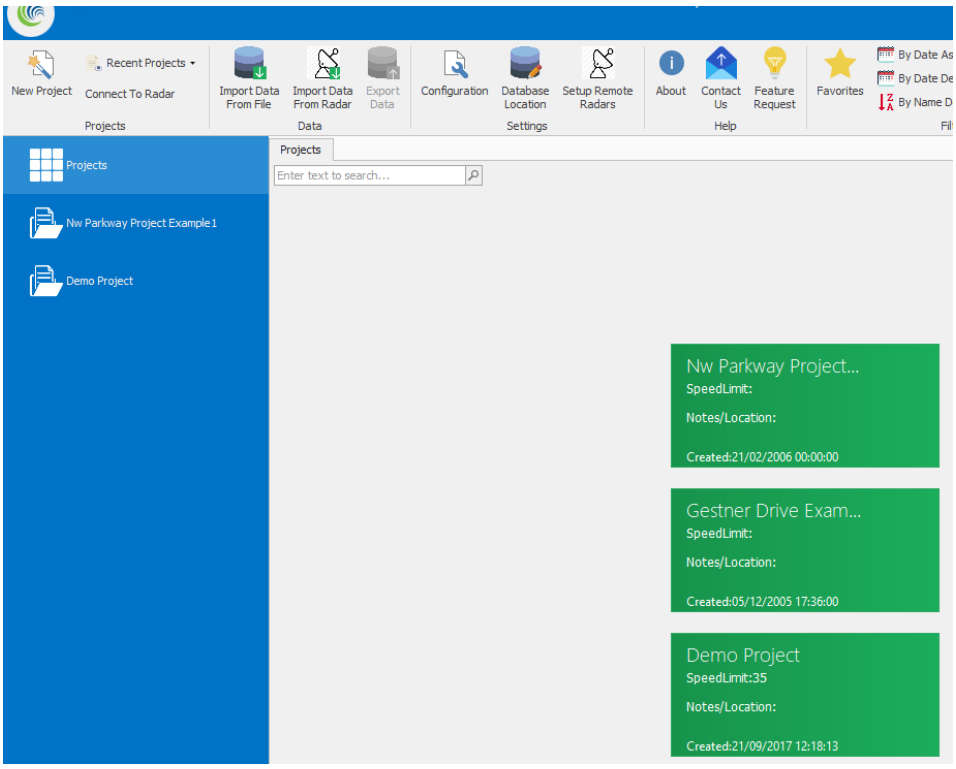
The software allows you to label each individual import of data from the radar. The project name and import label are printed on each report and chart. Thus, even if you collect your data by “Year-Month” format, you can easily have multiple speed studies in the same project even if they are from different sites.

STEP 1: Create (or Open) a project to import your data into



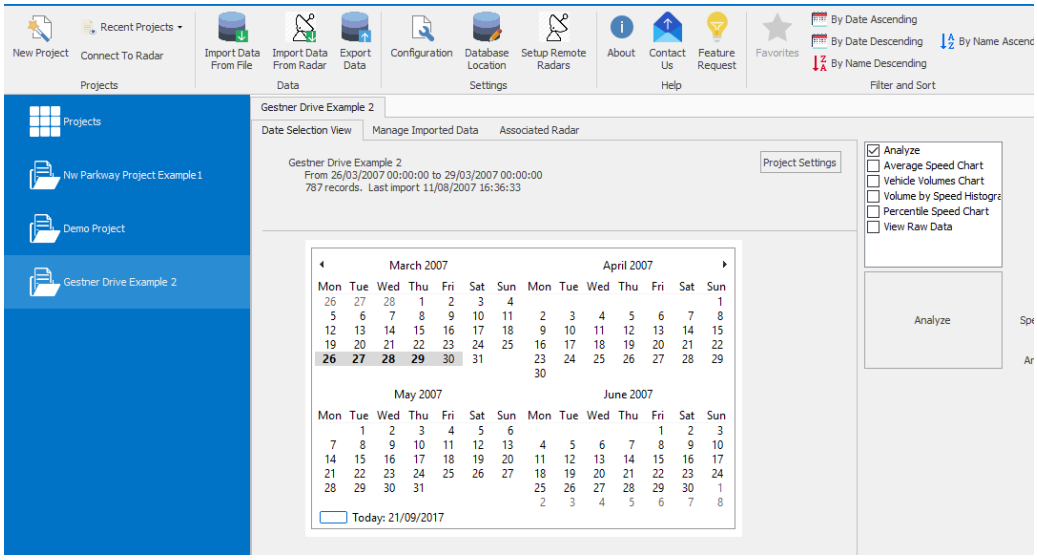
STEP 2: Name your project or Open Existing Project





Step 3: Import Data From Your Connected Radar. Ensure the project you wish to import is selected. Data will be imported into this project.

If this is an existing project, previously imported data will be shown here and the new data will be imported separately and a summary shown as another line in the table as shown below.

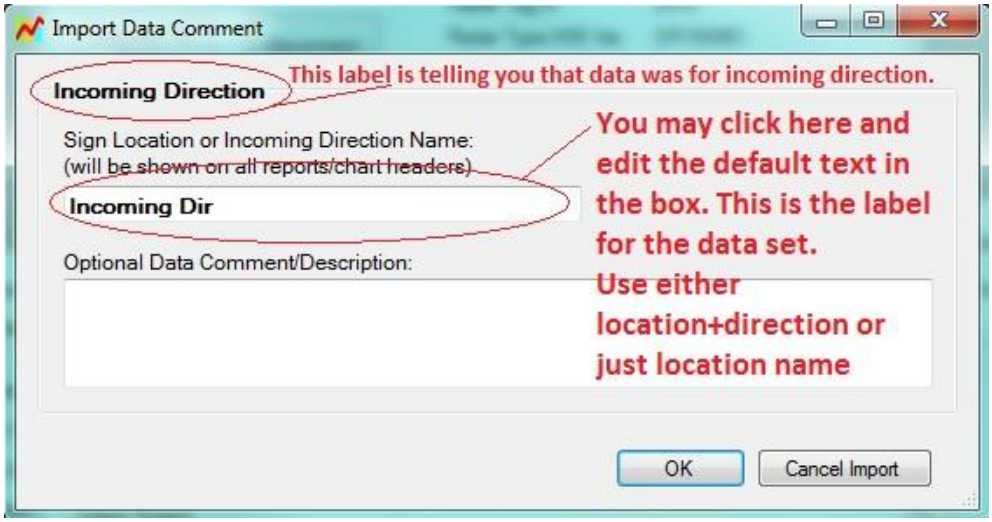


Select Data then Import Stats Data From File…

Now select the .dat file this can be downloaded from the sign see section 4.3.7.1.

If you are organizing the data into projects created by year-month, we suggest that you label your import by location name and traffic direction (e.g *main and dartmouth-NB*). If you are organizing your projects by location name, we suggest you simply use the traffic direction as the import label (e.g. *incoming* or *north bound* or *NB* etc.).

You may also insert a comment to be attached to this import.
Both the label and comment are easily editable later via the project data window.



Click on OK button when you are done with your label and comment. At this point you will see a progress bar as the data is being imported into the SQL server.

Once the import is complete, a new entry summary will be shown in the project window.

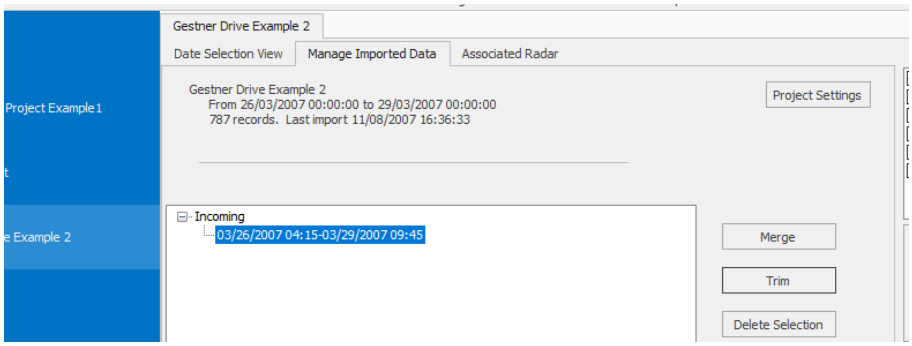
You have now successfully imported data from the radar into the database project.

6.1.2 Analysing Data and Generating Reports

6.1.2.1 Generating Monthly, Weekly and Daily Counts and Speed Reports

STEP 1: Open the project and select the data set you want to analyse
Refer to the section 6.1.1 to create and import data into a project. Once your project is open you have two choices to select your data set.

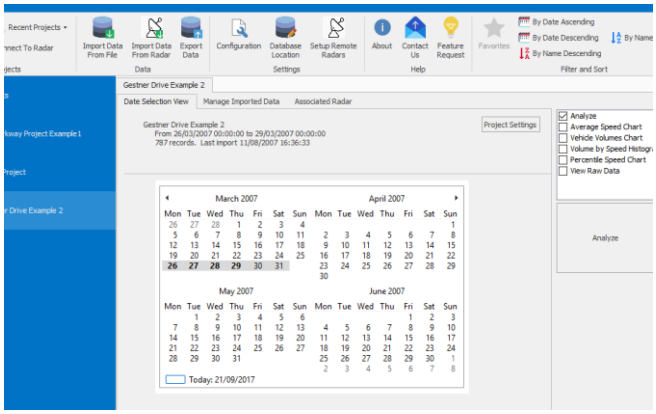
Option 1: Run report over one complete data set (import)
You would choose this option if this is the only data set you have from this one study or the time period of your interest lies completely within this data set and the dataset is from the same location. The start/end times of records in a dataset are listed in the summary window as shown below.



You should not proceed with this option if this data set contains data from different locations or for some reason you do not wish to run a combined report over all this data.

If your dataset contains data from more than one location, and you know the start/end date for your data from your different locations, you should import the same file multiple times and trim the data for each import to correspond to the different traffic studies.

Once you have selected the data set to analyse, simply ensure the *Generate Analysis Report* checkbox is selected and then click on the *Analyse* button.



Option 2: Run report over a specified period of time including multiple data sets

The software allows you to specify start/end period to run the analysis. Using this option automatically includes all data in all import sets in ***this*** project that are within the specified timeframe.

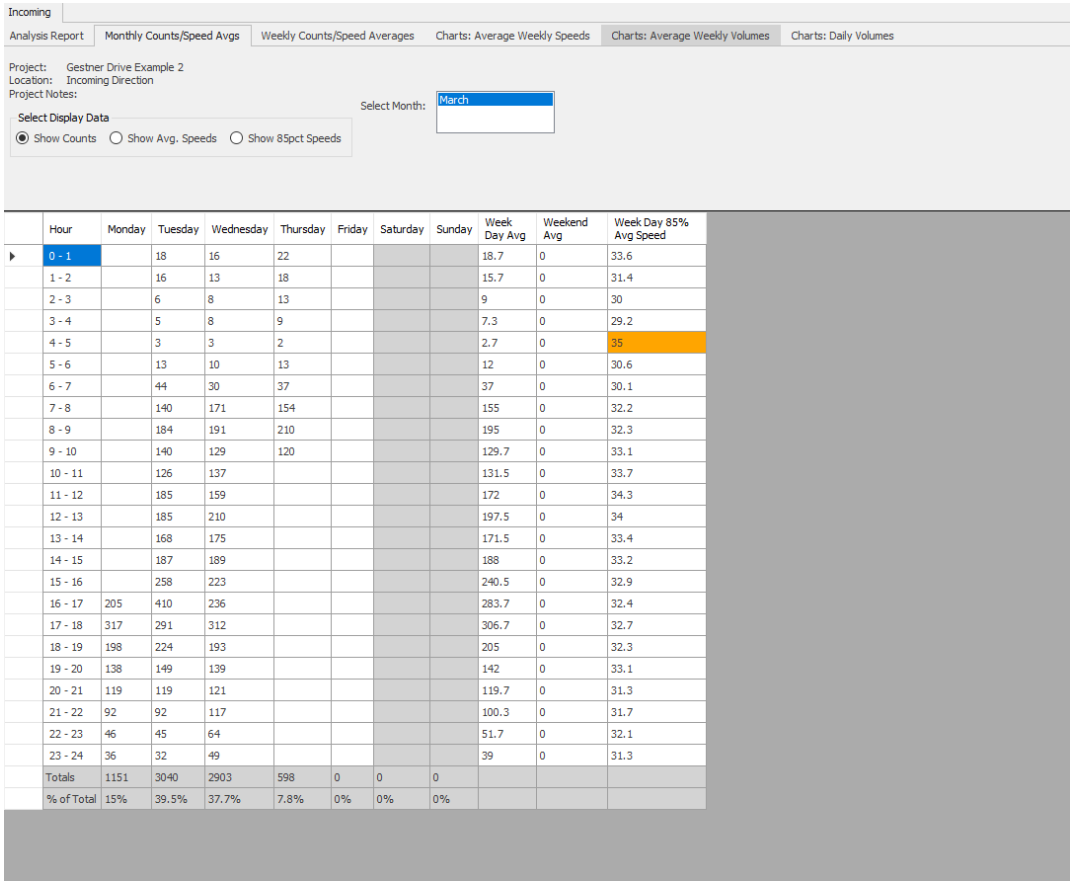
You may not want to use this option if you have data from different locations in this project. This is a great way to run a complete analysis that gets filled out as more and more data is available. In this case import all available data (as and when available) into the same project and run a user defined date range study across the entire time frame as shown below:

Ensure the *User Defined Date Analysis* tab is selected before you proceed.

After you have selected the filter you want (default or created your own), click the “Analyse User Range” button and the reports window will pop up. We will next discuss the report and the type of analysis it performs.

6.1.2.2 Interpreting the Analysis Report

Once you click the *Analyse* or *Analyse User Range* button, the program selects the data you need analysed, runs an analysis and returns the results in the following window. *Interpreting the Monthly Counts/Speed Avgs tab:*



Hour	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week Day Avg	Weekend Avg	Week Day 85% Avg Speed
0 - 1		18	16	22				18.7	0	33.6
1 - 2		16	13	18				15.7	0	31.4
2 - 3		6	8	13				9	0	30
3 - 4		5	8	9				7.3	0	29.2
4 - 5		3	3	2				2.7	0	35
5 - 6		13	10	13				12	0	30.6
6 - 7		44	30	37				37	0	30.1
7 - 8		140	171	154				155	0	32.2
8 - 9		184	191	210				195	0	32.3
9 - 10		140	129	120				129.7	0	33.1
10 - 11		126	137					131.5	0	33.7
11 - 12		185	159					172	0	34.3
12 - 13		185	210					197.5	0	34
13 - 14		168	175					171.5	0	33.4
14 - 15		187	189					188	0	33.2
15 - 16		258	223					240.5	0	32.9
16 - 17	205	410	236					283.7	0	32.4
17 - 18	317	291	312					306.7	0	32.7
18 - 19	198	224	193					205	0	32.3
19 - 20	138	149	139					142	0	33.1
20 - 21	119	119	121					119.7	0	31.3
21 - 22	92	92	117					100.3	0	31.7
22 - 23	46	45	64					51.7	0	32.1
23 - 24	36	32	49					39	0	31.3
Totals	1151	3040	2903	598	0	0	0			
% of Total	15%	39.5%	37.7%	7.8%	0%	0%	0%			

As you can see, the report title bar contains the project name and location and this information is also repeated within the report window as well.

All analysis is done on an hourly basis and reported by the day of the week.

For example, if you select the *Monthly Counts/Speed Avgs* tab, you are presented with an option to view the average hourly speeds by hour of day for each day of week.

If you selected 85th percentile speeds for the month of June on this tab, the value in the 1st cell (hour = 0-1, Day = Monday) is the average of the 85th percentile speeds from the midnight hour to 1am on all Mondays in June (where there is data). And so on and so forth for all the cells.

The *Week Day 85th % Avg Speed* (last) column contains the average of that row excluding the weekends. So the 1st cell in the last column is the average 85th percentile speed during the weekday in June for the midnight to 1am time slot.

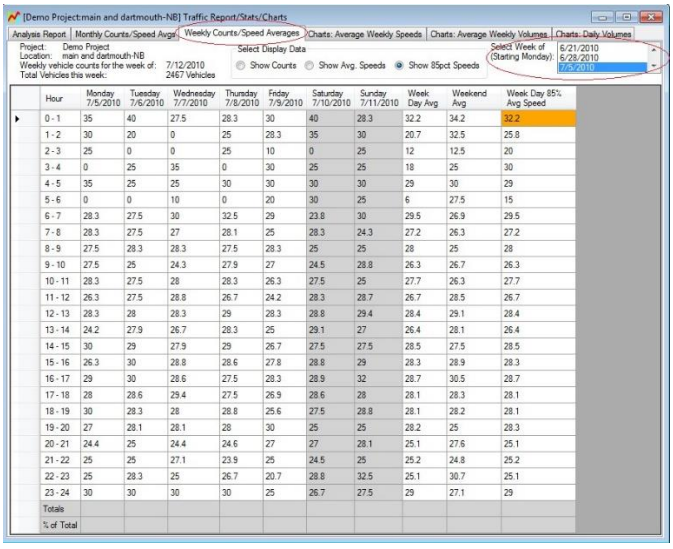
Similarly, the average speed and counts selector on this tab shows the average of the average speeds and average counts for the specified hour for the specified day of the week in June.

If data for more than 1 month is available, you can select it on the top right.

Interpreting the Weekly Counts/Speed Averages tab
Click on the Weekly Counts/Speed Averages tab to show the data by actual week.

When viewing counts, the cells in this tab contain actual count data for the selected week by hour of the day.
When viewing average or 85th percentile speeds, the cells contain the average or 85th percentile speed data for the selected week by hour of day.

If the analysis has more than one week of data available, you may select it on the top right as shown below.

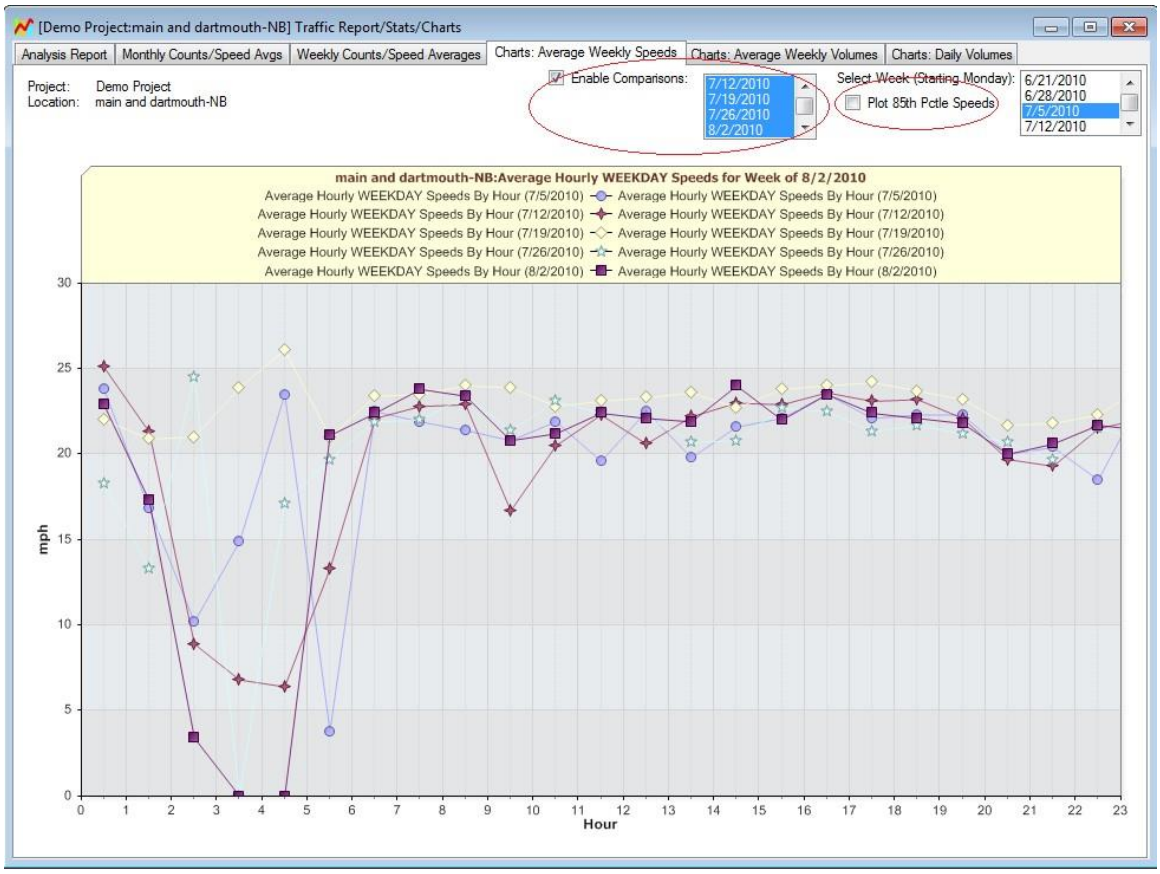


Hour	Monday 7/5/2010	Tuesday 7/6/2010	Wednesday 7/7/2010	Thursday 7/8/2010	Friday 7/9/2010	Saturday 7/10/2010	Sunday 7/11/2010	Week Day Avg	Weekend Avg	Week Day 85% Avg Speed
0 - 1	35	40	27.5	28.3	30	40	28.3	32.2	34.2	32.2
1 - 2	30	20	0	25	28.3	35	30	20.7	32.5	25.8
2 - 3	25	0	0	25	10	0	25	12	12.5	20
3 - 4	0	25	35	0	30	25	25	18	25	30
4 - 5	35	25	25	30	30	30	30	29	30	29
5 - 6	0	0	10	0	20	30	25	6	27.5	15
6 - 7	28.3	27.5	30	32.5	29	23.8	30	29.5	26.9	29.5
7 - 8	28.3	27.5	27	28.1	25	28.3	24.3	27.2	26.3	27.2
8 - 9	27.5	28.3	28.3	27.5	28.3	25	25	28	25	28
9 - 10	27.5	25	24.3	27.9	27	24.5	28.8	26.3	26.7	26.3
10 - 11	28.3	27.5	28	28.3	26.3	27.5	25	27.7	26.3	27.7
11 - 12	26.3	27.5	28.8	26.7	24.2	28.3	28.7	26.7	28.5	26.7
12 - 13	28.3	28	28.3	29	28.3	28.8	29.4	28.4	29.1	28.4
13 - 14	24.2	27.9	26.7	28.3	25	29.1	27	26.4	28.1	26.4
14 - 15	30	29	27.9	29	26.7	27.5	27.5	28.5	27.5	28.5
15 - 16	26.3	30	28.8	28.6	27.8	28.8	29	28.3	28.9	28.3
16 - 17	29	30	28.6	27.5	28.3	28.9	32	28.7	30.5	28.7
17 - 18	28	28.6	29.4	27.5	26.9	28.6	28	28.1	28.3	28.1
18 - 19	30	28.3	28	28.8	25.6	27.5	28.8	28.1	28.2	28.1
19 - 20	27	28.1	28.1	28	30	25	25	28.2	25	28.3
20 - 21	24.4	25	24.4	24.6	27	27	28.1	25.1	27.6	25.1
21 - 22	25	25	27.1	23.9	25	24.5	25	25.2	24.8	25.2
22 - 23	25	28.3	25	26.7	20.7	28.8	32.5	25.1	30.7	25.1
23 - 24	30	30	30	30	25	26.7	27.5	29	27.1	29
Totals										
% of Total										

Interpreting the Charts:Average Weekly Speeds tab
Click the Charts:Average Weekly Speeds tab to show a hourly graph of the average **Weekday** speeds by hour for the week selected as shown below.

When you select a week on any of the weekly tabs, the selection is maintained when you click over to another tab. This way, you can simply select a week (say) on the **Weekly Counts/Speed Averages** tab and then click over to the **Charts:Average Weekly Speeds** or **Charts:Average Weekly Volumes** tab to examine the data in different views for the same week.

The charts also allow you to compare data from multiple weeks to see if traffic patterns are changing over time. Click the “Enable Comparison” checkbox and select more or more weeks to compare to. To select more than one week, hold down the CTRL key while clicking to make your selection.



You may also plot the 85th percentile speeds by checking the "Plot 85th Percentile Speeds" checkbox found next to the week selector box as shown by the red circle in the image above.

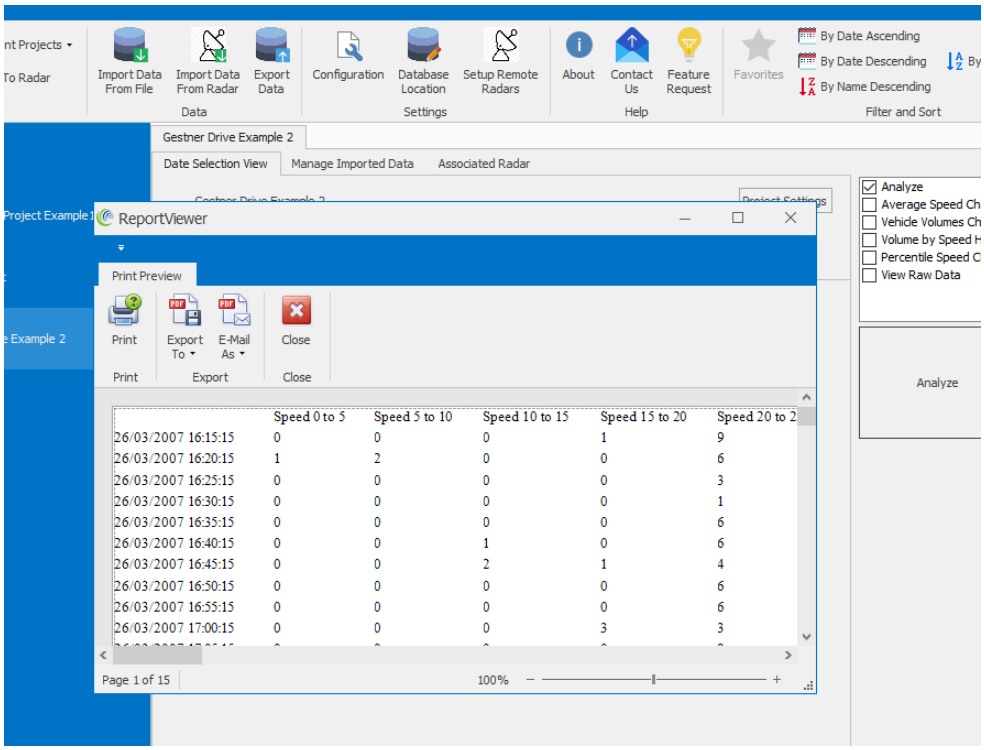
Printing and exporting tables or charts

All tables or charts may be printed or copied to the "Windows Clipboard" for pasting into another document. Select the tab page you wish to print or copy. To print it, click File->Print… and to copy click Edit->Copy Graph/Spreadsheet to Clipboard…

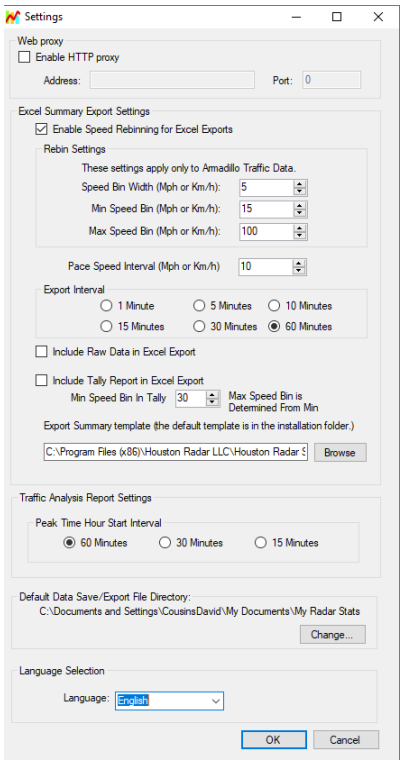
Once you copy a graph or a spreadsheet to the Windows clipboard, you may then open another application (e.g. Word) and paste it into a document. Graphs are pasted as images whereas tables (spreadsheets) are pasted as text data in a Word document and numbers in Excel.

6.1.2.3 Exporting Summary Report Data

The software also allows you to export 15, 30 or 60 minute and daily summaries. For this to work. Select the Export Data menu. On the menu select the data output required whether PDF, Excel or Image file:



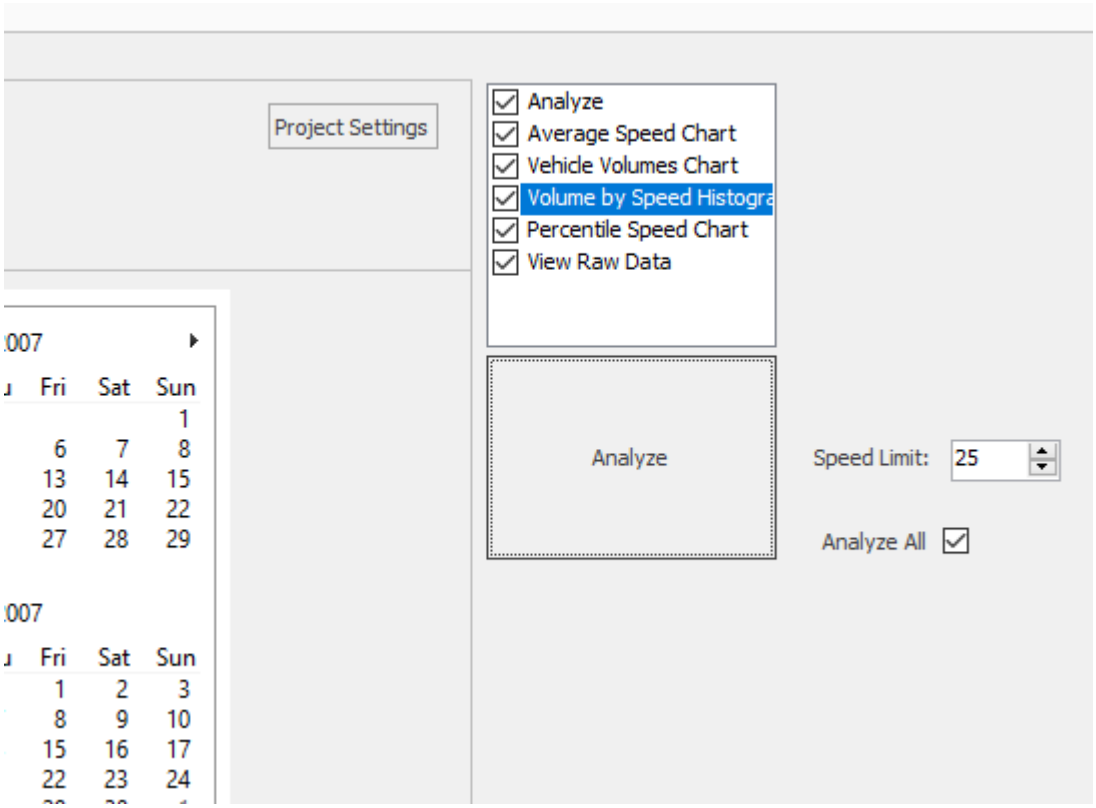
You may specify a summary time interval of 15, 30 or 60 minutes and pace speed interval to be used during the summary export.
To change these settings please go to the Configuration Menu item.
You will be presented the following window where you may make your selections. These settings are applicable to all projects and may be changed at any time and another analysis run with the new settings.



6.1.2.4 Generating Interactive Charts

The stats analyser software has a powerful feature where the user may generate interactive charts of raw data and navigate through the entire dataset easily and quickly. This feature provides a bird's eye graphical view of the entire data set.

You may generate interactive graphs via the individual checkboxes circled below.



Average Speed Interactive Chart

The average speed interactive chart plots all the vehicle speeds vs. time. Depending on the amount of data being plotted in the selected dataset, the data is automatically aggregated in optimal time bins.

For example, in the chart shown above, the entire data contains over four months of data for 58012 vehicles. This is so much data, that the software has automatically re- aggregated it in 4 hour intervals. Aggregation level is shown on the left side via selected "4 Hr" radio box as well as printed on the y axis.
The above selection means that the count values (shown as gold circles) and the average speeds (shown as blue circles) are count totals and average speeds over 4 hours.

Also from the bird's eye view it becomes apparent that there is a large gap in the data from around the 16th of October through the 7th of November.

There are a few ways to navigate around this data. To examine a smaller time period, click the left mount button at the start date you want to examine and then click the left mouse button again at the end date. The graph will automatically zoom to this range.

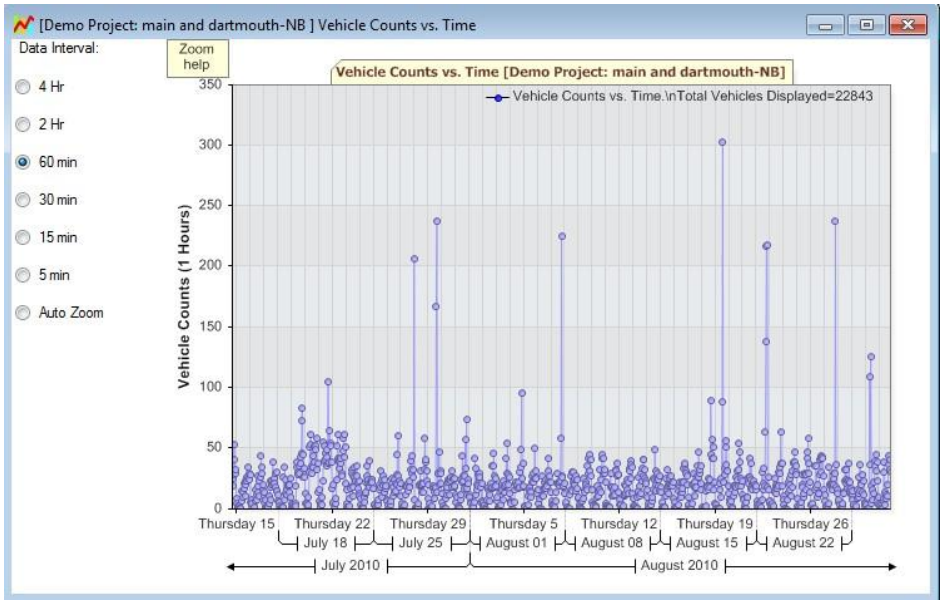
Once you zoom in, you can easily click another aggregation period on the left pane and the data will redraw with higher resolution (e.g. 30 minute or 15 minute as you choose).

If you want the software to automatically pick the best resolution automatically, select “Auto Zoom” on the left pane. Now the software will automatically determine the optimal aggregation period based on how much data can be displayed on the screen without too much clutter.

As you zoom around in the data, the total number of vehicles in the view is automatically recalculated and displayed on the top in the legend area. This is a great way to get vehicle totals across different or non-standard time periods.

Total Counts (Volume) Interactive Chart

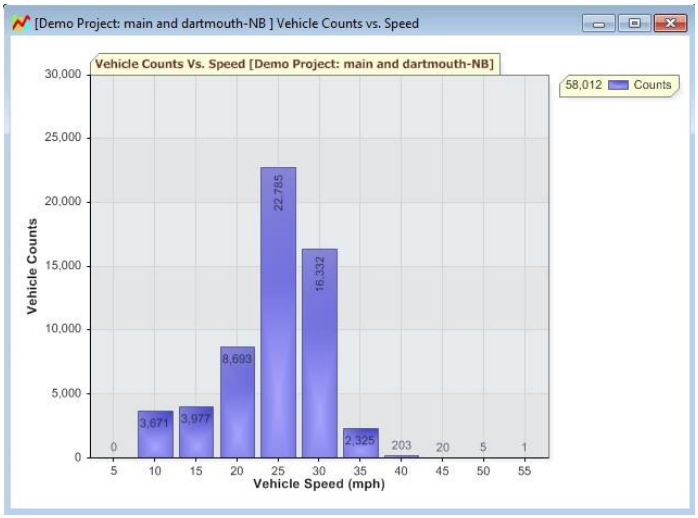
Check the *Generate Vehicle Volume Chart* checkbox to get an interactive chart of vehicle counts (volumes) vs. time. An example is shown below:



Selecting the 60 minute aggregation option is a great way to get a bird’s eye view of the hourly volume of traffic throughout the dataset. Just as with the average speed chart, this chart is completely interactive and you can navigate around in it by mouse clicks, mouse scroll wheel and arrow keys. Click on the “Zoom Help” button in the chart area for instant help.

Histogram Chart

Click on the Generate Volume by Speed Histogram Chart to generate the following chart. This chart plots the number of vehicles in the data set vs. the speed bin they were recorded in.

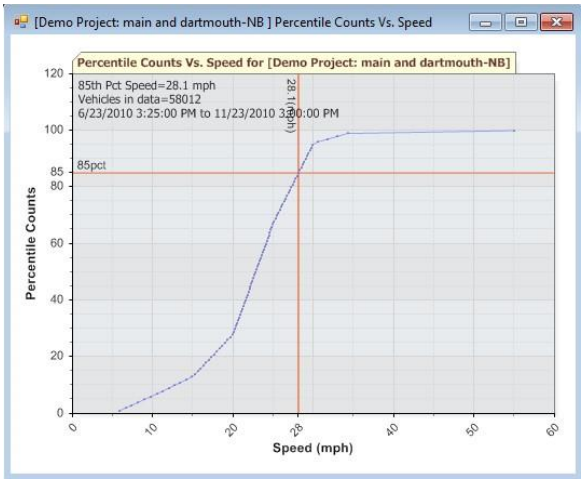


Percentile Vs. Speed Interactive Chart

Determining the 85th percentile speed of traffic on the road is an important requirement for a speed study.

The software allows you to automatically calculate the 85th percentile speed on the road. Additionally, it also calculates the speed associated with all percentiles of vehicles from 0 to 100. This information is plotted as a well known “S” chart.

Check the *Generate Percentile Vs. Speed Chart* checkbox and click the *Analyse* button to generate the following chart. This chart plots the total percentile counts of vehicles on the road traveling at every speed up to the maximum speed in the dataset. The 85th percentile speed is also automatically marked by the red crosshairs. For example, in this data set, the 85th percentile speed is 28mph. You may also click anywhere on the chart and obtain the percentile value and speed at that point.



7 Installation

7.1 Mounting the Sign

During design of the sign, fixing channel sizes and positions will be calculated and integrated into the sign so that when it is mounted on its pole/s it meets the structural requirements of EN12899. It is important to note that to meet these requirements the post and more importantly its foundation should also be designed to comply with the requirements of EN12899.

A typical structural installation is shown below:

First in Traffic Solutions.

SignPlot v3.30 [BS EN 12899-1:2007 support design]

Project Name: DRDNI Road Services
Sign Reference: VM8815 002
Prepared by: MB
Date: 15-12-16

Sign Dimensions (mm):
Width: 930, Height: 1235, Area: 1.15 m²

Mounting height: 2.3m
BS EN 12899-1:2007 classes:
WL7, TDB4, PL3, PAF1

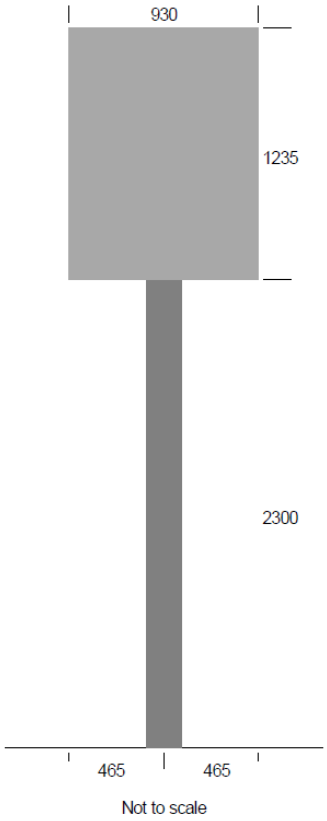
Geographical details:

Location Postcode:

For the above sign, a satisfactory structure is:
Structure Details:
1 no. SPS straight post with door: 168.3x5.0
Post strength capacity (%) : 39

Foundation strength capacity (%) :

Substrate: Aluminium 11g (3mm)
Rennicks Small channel section suitable at 380 mm centres.
4 channels needed.



Once the mounting pole has been confirmed as structurally suitable then the sign can be mounted using standard sign fixing clips, available from Sign Post Solutions.

Optimal alignment of the sign is based on the centre of the sign facing the approaching lane at 80-90m.

7.2 Electrical Installation

7.2.1 110 / 230VAC Mains

Where the equipment is to be installed operating from a 230VAC mains supply to meet safety regulations the equipment should be connected to the mains supply via a suitable electrical cut-out. It is recommended the cut-out should isolate the live and neutral supplies with a minimum 3mm isolation gap. The electrical cut-out should be in a supply pillar externally located providing access to isolate the mains supply to the sign in case of an accident or for maintenance purposes.

7.2.2 230VAC Switched Mains

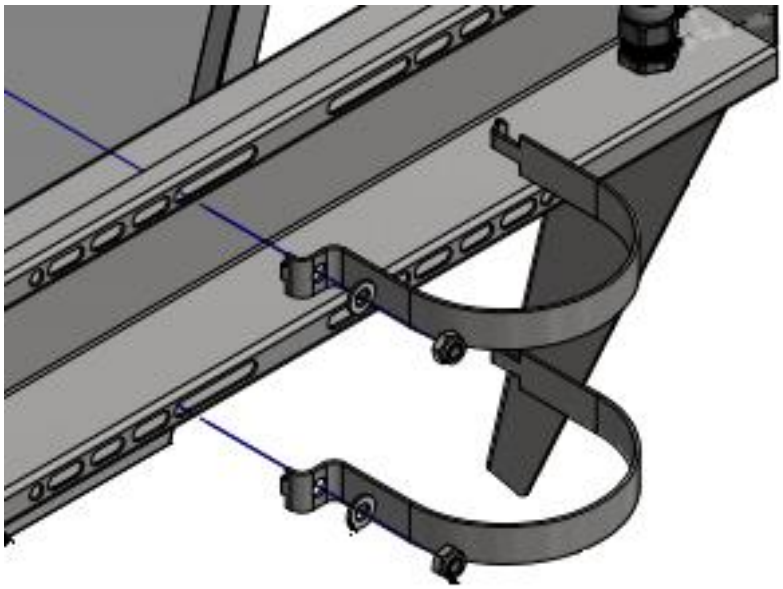
Where the equipment is to be installed operating from a 230VAC switched mains supply to meet safety regulations the equipment should be connected to the mains supply via a suitable electrical cut-out. It is recommended the cut-out should isolate the live and neutral supplies with a minimum 3mm isolation gap. The electrical cut-out should be in a supply pillar externally located providing access to isolate the mains supply to the sign in case of an accident or for maintenance purposes or alternatively within the base of a street lighting column.

7.2.3 12VDC Solar

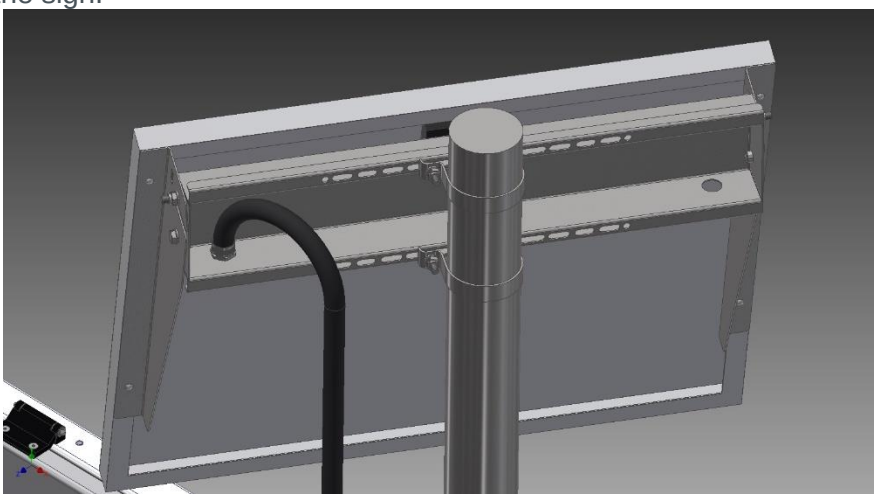
Where equipment is to be operated from a 12VDC solar panel the 2 core cable from the solar panel should be routed via its conduit into the waterproof entry gland at the rear of the sign enclosure. Once inside the 2 cores should be terminated in the terminations marked Solar + and Solar – at the termination panel.

7.3 Solar Panel

The solar panel is mounted to the pole in two pieces. First the mounting bracket is mounted to the pole above the sign. Ensuring the solar panel will be facing due south. The siting of the solar panel is critical to its operation and shading is to be avoided where sunlight hitting the solar panel is obscured.



Now slot the solar panel section onto the mounting bracket and secure, to complete assembly of the solar panel to the pole. The cable from the panel should then be routed down through the connecting gland in the back of the sign and connected into the solar panel terminals in the sign.

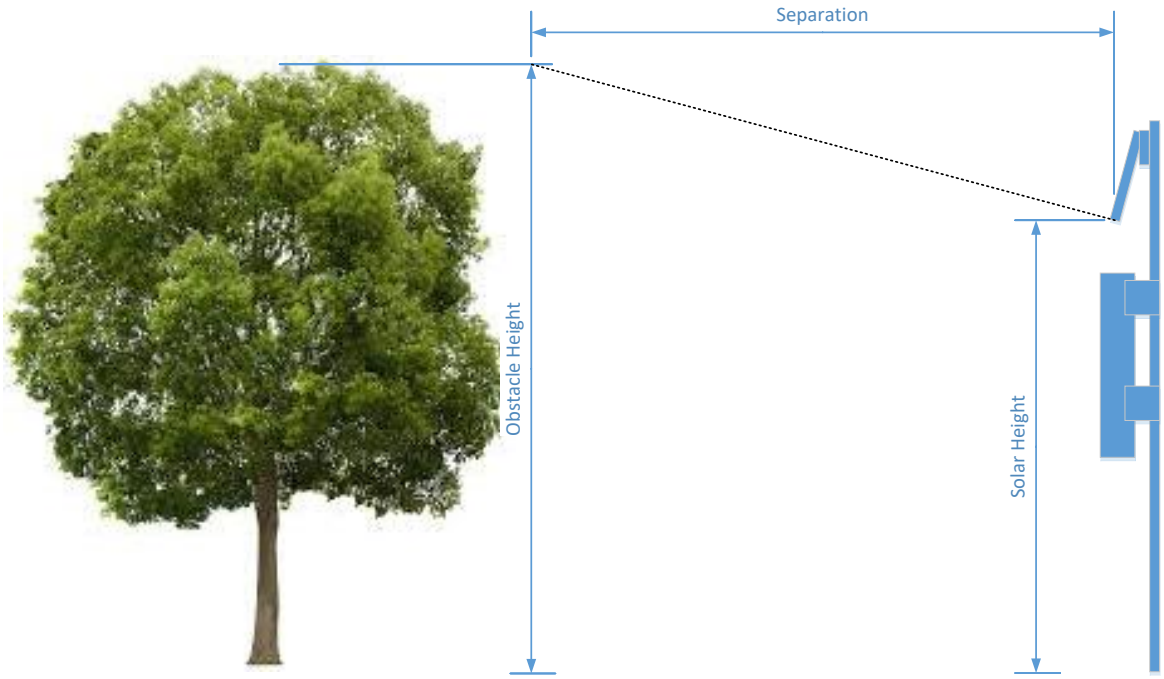


To ensure obstacle are not preventing full sunlight access on the solar panels the minimum distance to an obstacle can be calculated as follows:

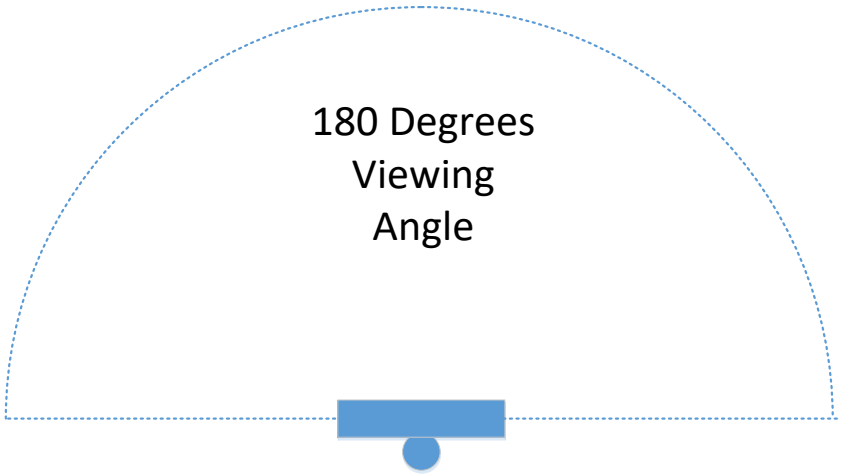
Where:

Solar Height = Height of the bottom surface of the solar panel to the ground
Obstacle Height = Height of top of Obstacle to the ground
Separation = Minimum Distance of the Obstacle to the solar panel

$$Separation = (Obstacle\ Height - Solar\ Height) * 4$$



The solar panel should have this minimum clear line of site in a 180° arc about the centre of the panel horizontally as well.



Only siting the panel within these guidelines will ensure optimum solar panel efficiency throughout the year. If the site is installed on an incline, then please adjust height measurements to suit.

7.4 Radar Alignment (Optional)

When positioning the sign on the mounting pole it is important to realise that the radar unit is mounted parallel to the front surface of the sign. The sign should be targeted to ensure the radar is aligned to the centre of the approaching traffic at 60-90m along the carriageway. The road from the sign to the 60-90m point needs to be straight. Care should be taken with regards any metallic obstructions in the field of view of the radar as they may affect the range and accuracy of detection.

7.5 Configuration

Ensure the sign is correctly configured and the conf.ini and ttab.txt files have been loaded onto the sign see section 4.3.7.2 for complete details of the file upload process.

Ensure the configuration link to select 24 / 48V LED drive is set correctly to match the sign design

24/48V Configuration

Name	Pin	Comment
48V_EN	JP4	Fitted LED drive is configured to 48V Not Fitted LED drive is configured for 24V

7.6 Testing

Once installation is complete the installation need to be tested.

7.6.1 110/230VAC Mains Supply

Using a digital voltmeter check the voltage being supplied to the Profectus board on Conn 2 is 11.5-12.5VDC.

Power Supply

Name	Pin	Comment
VIN	CONN P2 Pin 1	Supply 8-30VDC
GND	CONN P2 Pin 2	GND 0VDC Connection to PSU or battery

7.6.2 110/230VAC Switched Mains Supply

Using a digital voltmeter check the voltage being supplied to the Profectus board on Conn 2 is 11.5-13.75VDC. Within the mains supply to the sign removed.

Power Supply

Name	Pin	Comment
VIN	CONN P2 Pin 1	Supply 8-30VDC
GND	CONN P2 Pin 2	GND 0VDC Connection to PSU or battery

If the voltage is below the required minimum value, then the battery needs to be charged or checked as its voltage at installation is not sufficient.

7.6.3 Solar

The solar sign uses an external solar regulator module typically a Solsum 6.6F module.

The unit provides 4 Status LEDs ideally the LEDs should indicate as above

- Info LED Green Normal Operation
- Battery LED Green Battery Good
- Battery LED Green Flashing Battery Full

Alternative displays can indicate a problem with the solar solution as follows:

- Battery LED Yellow Battery Low
- Battery LED Flashing Yellow Battery disconnected charging battery
- Battery LED Red Flashing Fast Battery low close to disconnection
- Battery LED Red Flashing Slowly Battery Extremely low and disconnected
- Info LED Red Flashing Slowly System Fault

If the battery is identified as being is indicating anything other than Green or Green Flashing, then it should be replaced.

7.6.4 LED Chain Failure Monitoring

Using the web interface force the warning sign into manual operation see section 4.3.2.1 to identify how to force the warning sign manually active.

Now check the LED drive group calibration values are correct. Once testing is complete return the sign to automatic ready for normal operation.

7.6.5 Time Source Check

The warning sign can be optionally fitted with a GPS clock receiver or a modem for data communications. The clock source needs to be checked using the web interface manually set the clock to 01/01/2010 at 09:00:00 this is fully detailed in section 4.3.1.3. Once the clock has been updated and confirmed request a clock update. After 30 to 60s delay check the clock is now the correct time and date against your own watch.

7.6.6 Vehicle Logging Check (Optional)

If a vehicle data logging radar is fitted in the sign once some vehicles have been seen passing the sign check the vehicle data log using the web interface, full details of how to access the log are in section 4.3.4.3.

7.6.7 Slave Sign Check

Now using the master sign access the web interface and repeat the test in sections 7.6.1 - 7.6.6 accessing each sign address configured from the master sign in turn.

8 Specifications

Operating conditions:

Temperature -15 to +60C
IP Rating: IP55
Supply Voltage 230VAC / 12VDC
Battery Only 2* 22 AHr Lithium Ion Battery
Alternative builds 14Ahr, 14Ahr, 22Ahr providing alternative life between charges.

Radar:

Fundamental Frequency 24.2GHz (K Band)
Beam Angle 38° * 45°
Beam Polarisation Linear
RF Power 5mW
Maximum Detection Range 100m

CE Certification

EN12966 Road Vertical Signs – Variable Message Signs

Uniformity: Pass

Requirement	White	Red	Yellow	Blue	Green
Colour	C2	C2	C2	C2	C2
Luminance	L3	L3	L3	L3	L3
Luminance Ratio	R3	R3	R3	R3	R3
Beam Width	B3	B3	B3	B3	B3

Protection: P2
Temperature: T1
Dynamic Snow Pressure: DSL4
Point Load: PL3
Wind Loading: WL7
Temporary Deflection Bending: TDB5
Partial Action Factor: PAF1

EN50293 Electromagnetic Compatibility
EN50556 Road Traffic Signal Systems - Electrical Safety