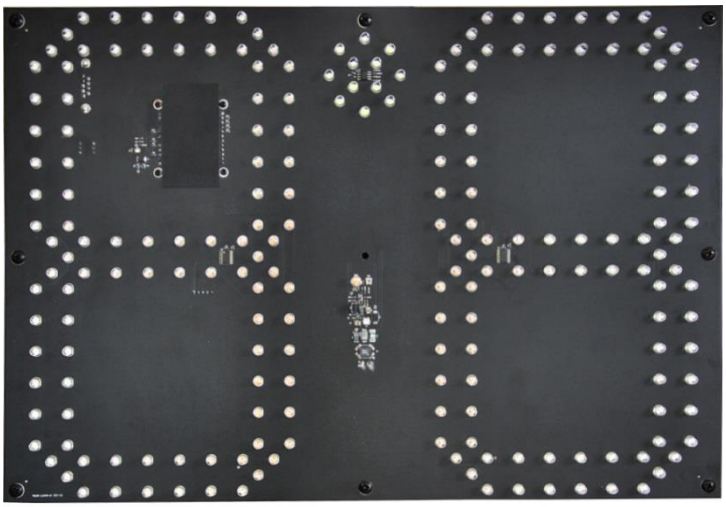
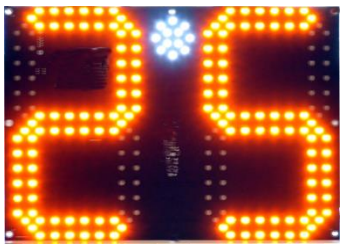
PNL10

OEM Radar Speed Sign Kit

Installation and User Manual

K-Band Doppler Speed Measurement and Display Kit
Rev 8 May 18, 2023





Amber LED option

While LED option

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http://www.houston-radar.com
Toll free 1-888-602-3111

The Doppler radar module incorporated in this device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Any modification or use other than specified in this manual will strictly void the certification to operate the device.

The radar in this device carries FCC modular approval and as such is labeled with FCC ID TIASS300 or TIASS400. If this label is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed SS300/SS400 module. This exterior label can use wording such as the following: “Contains Transmitter Module FCC ID: TIASS300” or “Contains FCC ID: TIASS300.” If your PNL10 has an SS400 radar installed, substitute “TIASS300” for “TIASS400.” Any similar wording that expresses the same meaning may be used.

Warning: The PNL10 is supplied in an open frame format with exposed electronics and thus is a static sensitive device. Please use static precautions when handling. Warranty does not cover damage caused by inadequate ESD procedures and practices.

Note: Specifications may change without notice.
Note: Not liable for typographical errors or omissions.

Table Of Contents

INTRODUCTION

Congratulations on your purchase of the Houston Radar directional Doppler radar speed sign kit PNL10. This state of the art two-digit speed display with integrated ultra-low power 24GHz K-band microwave Doppler radar is specifically designed for the license free solar power or battery operated speed sign and traffic calming sign market.

Utilizing high performance, ultra low power DSP (Digital Signal Processing) technology and microwave components based on a planar patch array antenna with integrated low power PHEMT oscillator, you will find that this high quality product meets your exacting standards for performance and reliability.

Some of the highlights of this product include:

- Zero cables highly integrated design assembles into your enclosure in minutes
- 10.5" (27cm) digit height with 30% inter-character separation is matched to 300+ ft (90+ m) detection range of the radar for optimal display legibility
- Best in class power efficiency achieved by:
  - Low power SS300/SS400 radar directly drives display thus eliminating display controller
  - Built-in ambient light sensing and automatic brightness control
  - Ambient temperature compensation of the LED drive voltage
  - High efficiency boost regulator for LED drive voltage
- When no traffic is present, the radar automatically powers down display further reducing power consumption to only 0.1W
- Wide input supply voltage operation allows flexible power supply options ranging from 3, 4 or 5 cell Lithium Ion packs to 6 or 12V Lead Acid batteries without sacrificing sign efficiency
- Built-in rotary switch allows user to set cutoff and violator speed alerts in the field without connecting to a computer
- White LED strobe light and display flashing can be optionally activated to draw attention to speeding
- An expansion connector allows addition of a third digit or a fixed custom external message, e.g "SLOW DOWN" when speed violation is detected
- Built-in radar is FCC approved with CE mark and available in 24.125GHz and 24.200GHz versions for worldwide deployment
- Advanced In-Radar Traffic Statistics collection option now available

INSTALLATION

PNL10 is supplied in an "open frame" format. It requires a weatherproof enclosure before it may be operated outdoors.

Direction Pointing:

The SS300/SS400 radar used in the PNL10 is directional in nature. It may be configured to detect and measure the speed of incoming or outgoing traffic. It then rejects traffic moving in the opposite direction. Direction of detection is configured via a bit in the MO (MO and MD for SS400) variable(s) in the radar. In the usual "speed sign" configuration the radar is set to measure and display speeds of incoming vehicles and is the default shipped from the factory.

To achieve optimal performance please follow a few simple rules:

- ✓ PNL10 should be pointed into the direction of the oncoming traffic.
- ✓ PNL10 should be placed along the size of the road to minimize the angle of the oncoming traffic to the sign.
  - If it cannot be placed right along the side of the road, it should be pointed at least 100-150 feet up the road into oncoming traffic.
- ✓ The radar in the unit may pickup rotating fans, compressor blades, etc. Avoid pointing it at any machinery containing moving parts.
- ✓ PNL10 should be mounted at least 3 feet high from the ground for proper operation and at least 5 feet high for maximum pickup distance
- ✓ PNL10 utilizes 15° viewing angle LEDs. For maximum visibility of the digits the sign should be pointed at the incoming traffic with better than 10° accuracy. Alternatively, the sign may be oriented towards traffic to maximize the LED brightness from the desired viewing location on the road. We suggest providing an adjustable mounting bracket for your enclosure that will allow at least a ±15° horizontal rotation to allow the user to make an adjustment during installation.

Recommended Enclosure for the PNL10:

The PNL10 display kit must be protected by a weatherproof enclosure for outside use. The following needs to be observed for optimal performance:

1. Any plastic cover or window in front of the unit may be mounted as close to the LEDs as desired. However, please consider any potential damage from flexing due to an external impact on the sign face (vandalism, etc.) being transferred to the PNL10. For maximum field reliability we recommend that you test the

proposed enclosure design to ensure the front face does not flex sufficiently to transfer an impact to the PNL10.

The PNL10 provides a clear hole in the center to allow you to pass a bracing standoff through it to transfer any face impact to the back of the enclosure. Do not mount the PNL10 using this center hole. The center standoff should be mounted from the rear of the enclosure and clear through the PNL10 display PCB and stop at the front face. This will allow any front face impact force to transfer to the rear wall of the sign enclosure.

2. The optimum material for the front window/face is Lexan (Polycarbonate) plastic.
3. The optimum thickness of polycarbonate window/sign face is half wavelength at 24.125Ghz or about 137mils to 146mils (3.5 to 3.7mm) thick.
    a. Commonly available ¼" or 3/8" thick Lexan is not optimal and will reduce pickup range. 3/16" thick Lexan is a better choice if the recommended thickness is not available. For metric sizes, 4mm thick Lexan is a reasonably good choice.
    b. Frosted (anti-glare) plastic have been successfully used as well. It does not matter which side (into the sign or into the traffic) the frosting faces and is left to your discretion.
4. Other plastic materials may be used as a front window, but the optimum thickness will wary with the material's dielectric constant. Please contact Houston Radar for details.
5. If you want to make a metal mask to hide the electronics on the PNL10 PCB with holes for the LEDs to pass through, you must provide a plastic window for the radar microwave beam to pass through. The location and size of this window is shown in Appendix A.
   A dxf drawing to use as a template for the metal mask is available. Please contact Houston Radar for the drawing.

We strongly recommend that you prototype and test your enclosure on the road to verify that the radar detection range is not affected by your choice of plastic and mechanical design prior committing to full production.

Hookup:

Power Input:

The PNL10 may be powered from a DC supply with output voltage between 5.6 and 18VDC. This allows great flexibility in power options including 6V or 12V (nominal) lead acid batteries (SLA), 3, 4 or 5 cell Lithium Ion (LiOn) or Lithium Iron Phosphate (LiFePO4) cells. In all cases, a highly efficient input power regulation system in the PNL10 adjusts the LED drive voltage to the optimum level required by the sign based on ambient temperature. There is no other speed sign in the world that even comes close to the resulting ultra-low power usage of the PNL10. Competing products may consume up to 5 to 10 times more power. This ultra low operational power translates directly into a longer battery life or gives you an option to power the unit from smaller batteries and smaller solar panels.

As an example of the PNL10's prowess, a 3 cell 96WHr ultra thin and light LiFePO4 battery pack weighing less than 1Kg will power the entire sign on the road for over 2 weeks of continuous operation! A convenient battery life calculator is available on our website to estimate the run time under different traffic and power supply situations.

Data/PC Connection:

The PNL10 features a standard RS232 interface that is used to configure the sign as explained later in this document. It also sends out the measured speed over this interface when a vehicle is detected which may be used to an external controller board to monitor the speed measured by the radar in the PNL10 kit or display on a connect PC running our Stats Analyzer or Configuration software programs.

PNL10's with an SS400 installed may also use this port to receive speeds from an external radar such as the Houston Radar DR600. This will dramatically increase the PNL10 pickup range. Please refer to Appendix D for more information on this application.

Measured Speed Output:

In addition to showing the measured speed on the LED digits, the PNL10 will also send out the speed via the ASCII interface as a 3-digit speed with an optional direction indicator in standard resolution mode. Extended resolution mode adds up to 3 digits after the decimal point. The format is:
[?,+]nnn[\r,\n] or in extended resolution mode [?,+]nnn[.n[n[n]]][\r,\n]
The format of the speed output can be adjusted to any combination of:
"?": Optional prefix sent when 000 selected to be sent when no vehicles are detected
"+": Optional prefix sent when nnn speed is sent for incoming vehicles
"nnn": Three digit ascii speed in the units selected via the UN variable

"[.n[n[n]]]": Optional decimal point with up to 3 digits of extended resolution selected via UN variable.
"\r": Carriage Return character, optional line ending
"\n": Line Feed character, optional line ending
Please see serial port configuration section for details on how to select the above format.

The radar used in the PNL10 is the Houston Radar SS300 or SS400. Please see the SS300 user manual or SS400 user manual for more details on setting the output format and decimal point options. The LED digits on the PNL10 will only display the whole integer speed even when the decimal point is enabled.

IO Connector Signal Descriptions:

DB9 RS232 Female Connector:

Connector Pin #	Signal Name	Direction (wrt Radar)	Description
1	+VCC Note 1	PWR Note 1	Radar VCC (battery "+" terminal) Note 1
2	RS232 TX	OUT	RS232 Serial port TX pin from sign
3	RS232 RX	IN	RS232 Serial port RX pin into sign
4	N/C	-	Do not connect
5	GND	PWR	Signal/PWR Ground
6	N/C	-	Do not connect
7	N/C	-	Do not connect
8	N/C	-	Do not connect
9	N/C	-	Do not connect

Note 1: Pin 1 optionally connected to +VCC (supply +) if PCB pad labeled "DB9 PWR" near DB9 connector is bridged. This may be bridged by the OEM or by us if you require this feature.

AUX Connector:

You may optionally connect an off board speed selection switch, DB9 serial connection port or ambient light sensor.

Connector Pin #	Signal Name	Direction (wrt Radar)	Description
1	Vext0 Note 2	IN Note 2	External Light Sensor Input Note 2
2	+ VCC	PWR	Connected to input supply voltage +
3	B1 Note3	IN	External BCD speed switch B1 pin Note3
4	RS232 RX	IN	RS232 Serial port RX pin into sign
5	GND	PWR	Signal/PWR Ground
6	RS232 TX	OUT	RS232 Serial port TX from radar
7	B4 Note3	IN	External BCD speed switch B4 pin Note3
8	B2 Note3	IN	External BCD speed switch B2 pin Note3

Note 2: Contact us for the part number and hookup schematic for the light sensor. Two different types of sensors may be used, passive LDR or active IC (recommended). Internal light sensor must be disabled by removing R24 on the front of the PCB in order to use an external light sensor.

Note 3: You may also connect an external BCD rotary switch or thumbwheel switch to use in place of the on-board rotary switch. In this case the on-board switch must be set to the "0" position or removed at the factory.

USE

Turn on the power to the PNL10 to make it operational. The display will count up to from 1 to 10 and then blank out. The sign is now fully operational.

If the rotary speed switch is enabled (see later section on configuration), turn the speed switch to the desired position (0 through 7) determined by the speed limits on the road to set the low-speed display cutoff, violator display flashing speed and the high-speed display cutoff.

Typically, users set the violator flashing speed at or just above the speed limit on the road and the high-speed display cutoff at a speed sufficiently above the speed limit to capture most of the speeding traffic but not high enough to encourage “racing against the radar”. For example, for a 25mph speed limit road, the violator limit may be set to 26 mph and the low and high cutoffs will be set 15 mph below and above this value respectively. The exact values are of course left to the judgment of the user.

No other action is required. The PNL10 will display the measured speed when an incoming vehicle is detected between the low-speed and high-speed limits. The display will blink at about 1.4Hz rate if the measured speed is above violator speed. This indicates to the driver that they are driving above the speed limit.

If the white LED cluster is populated (this is the default, you may choose to have it removed), and enabled through the software configuration- it will strobe at a 10Hz rate. The strobe can also be configured to blink at 1.4 Hz rate when activated.

Finally, if the vehicle speed is above the high-speed display cutoff, the display will be blanked. This prevents drivers from “racing against the sign” (trying to see how high a speed they can display).

The strobe may be configured to stay active or go blank above this speed.

As long as the radar is tracking a target between the low-speed cutoff and the high-speed cutoff, the radar will transmit the speed in user selected ASCII format over the serial interface. This may be observed via our PC based configuration tool or captured by an external user provided controller board. Monitoring or capturing this speed is not required for normal operation of the speed sign.

Serial output is affected by low, high and violator speed configuration in the same way as the display panel.

Force Activating Display

In order to test integrity of the LED digits, converting PNL10 into a slave display unit or any other purposes the user may activate PNL10 display by using the following procedure:

1. Make sure that PNL10 is connected to a computer or a controller with a standard RS232 cable. PNL10 provides DB9 connector on the back for this purpose. Optionally a Bluetooth wire replacement may be utilized.
2. Set RS232 parameters (baud rate, parity, etc.) to match that of the PNL10. For PNL10 these parameters are configured via RS variable in SS300/SS400 radar non-volatile memory as described in the SS300/SS400 manual.
3. Provide power to the PNL10.
4. After the initial count-up is completed, issue "bcd" command. This command supports one or two parameters, must be terminated by a carriage return or line feed and has the following format:
   bcd:speed [flags]
   where *bcd* is the command, *speed* is the value to be displayed and *flags* is an optional parameter that can be used to activate or de-activate the white strobe or an optional external message board. For example:
   "*bcd:20"* will activate PNL10 and display the number 20
   "bcd:55 1" will change the number to 55 and activate the strobe
   "bcd:55 0" or *"bcd:55"* will turn the strobe off and continue to display 55
   "bcd:0" will deactivate display and turns off the digits. Speed value of 0 cannot be displayed since it has a special meaning.

Note 1: bcd command overrides speed output from the detected targets but all other PNL10 features such as brightness control and statistics collection remain operational.
Note 2: bcd command is supported by SS300 firmware version 129 and above.

Triggering an External Custom Message:

The PNL10 makes it very easy for OEM's to connect an external custom LED string message like "SLOW DOWN" (or any string of LEDs arranged in a local language). This message can be activated whenever the strobe is active and will also blink if the strobe is configured to blink. A second "THANK YOU" message can also be activated by the PNL10 when the digits are turned on but the vehicle is below the limit at which the strobe will be activated.

This configuration allows you to make a full functionality speed sign with a "SLOW DOWN" type message that is activated if the measured speed is above the speed limit or above the high-speed display cutoff and a "THANK YOU" activated below the speed limit. Please refer to Appendix B for a schematic of this simple external message board. Alternatively contact us to purchase this message board.

Collecting and Analyzing In-Radar Traffic Statistics

The PNL10 supports optional “In-Radar” advanced traffic statistics collection. This feature is sold separately. If this feature is enabled you may collect the stored statistics by using the provided Houston Radar Advanced Statistics Analyzer Windows program.

This program must be installed on a MS Windows 7, Windows 2000, XP or Vista PC (32 bit and 64 bit versions) and allows the retrieval of stored statistics from the radar by using a PC serial port. It also has features to generate traffic reports, plot interactive graphs and export the raw data to a MS Excel file.

Please refer to the on line help functionality of the program after you install it on your computer for detailed instructions on how to use its functionality.

Real Time Traffic Statistics In the Radar:

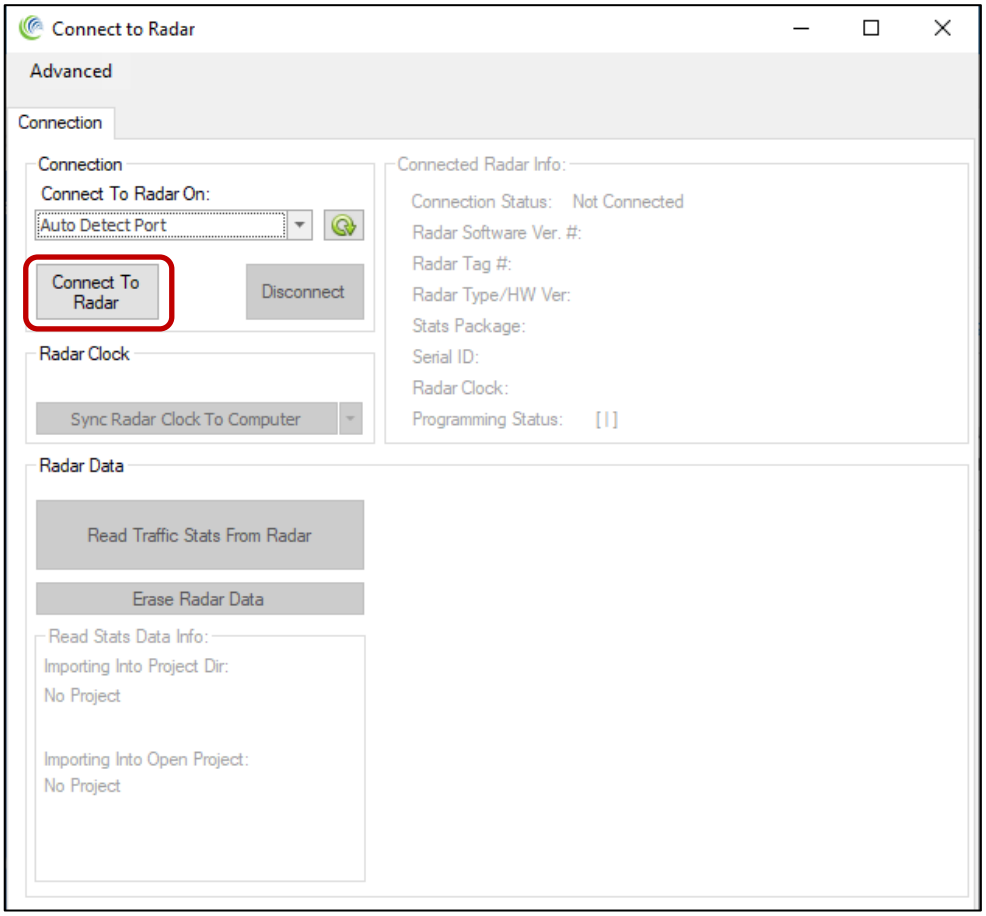
The PNL10 In-Radar stats software now features “real time” histogram statistics. These are updated as soon as a vehicle is detected and may be read out as a speed bin count “histogram”. Thus no historical records need be read out and parsed to read statistics. This feature requires a host program to be on-line to read the live statistics. Please contact Houston Radar for more information if you are interested in acquiring live statistics from the radar.

Configuring the PNL10:

The PNL10 supports many user options and configurations that make it a very versatile device. A user-friendly MS Windows PC based graphical user interface (GUI) software is provided to make this configuration a snap for the end user.

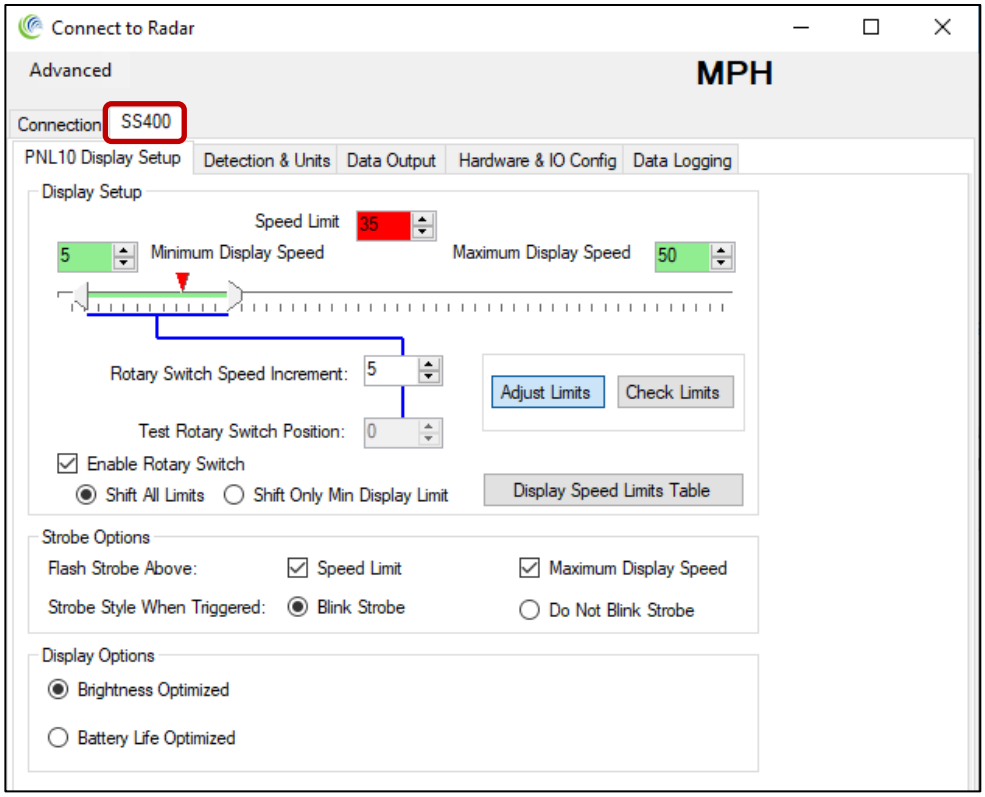
Install the Houston Radar Stats Analyzer or Houston Radar Configuration Tool provided with the sign on your MS Windows PC. After starting the installed program, click on "File->Connect to Radar…" at which time you will see the following screen.

Connect To The Unit:
Step 1: Connect to the PNL10 in the "Connection" tab. Ensure you get "Radar Found" message and another window with radar details. Click past these messages.



Read The Radar Configuration:

Step 2: Click on the "SS300/SS400" tab. The software will read the radar configuration and you should see this screen (actual values will depend on your PNL10).



This screen contains the most frequently used settings in the PNL10.

Setup The Display Limits (Permanent Location, Rotary Switch Disabled):

Step 3: Setup the display limits for your permanent location.

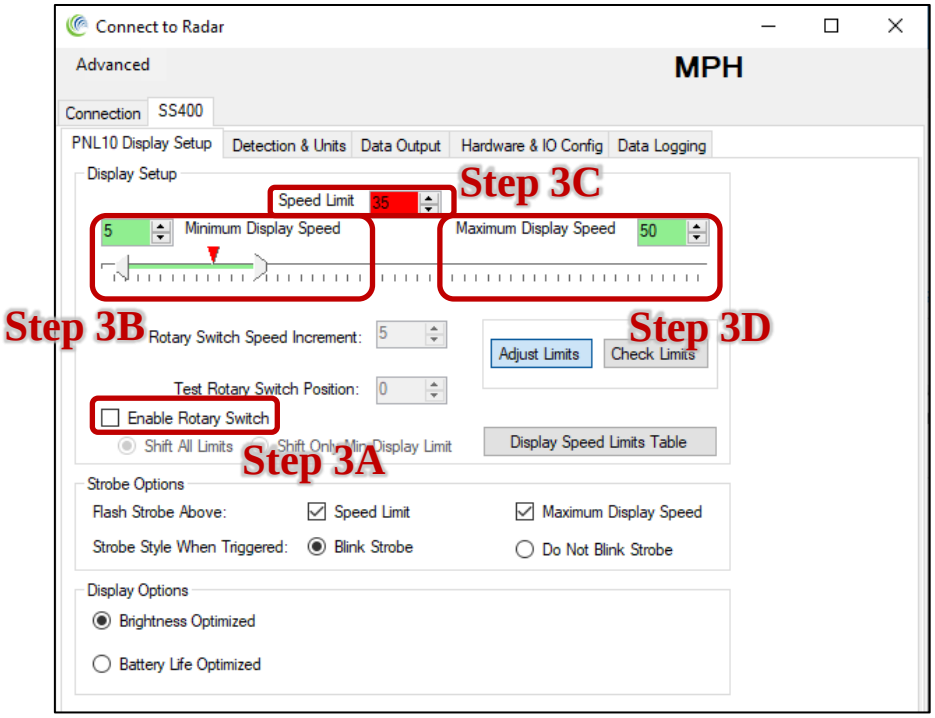
The following screen shows the simplest option with the rotary switch disabled. We will discuss the rotary switch in the next section.

Step 3A: Disable the rotary switch if the sign will be in a permanent location and the display limits will be fixed (skip to next section if sign will be portable unit).

Step 3B: Set the Minimum display speed. Display will be blank below this speed.

Step 3C: Set the Maximum display speed. Display will be blank above this speed.

Step 3D: Set the Speed Limit. Display will flash above this speed to attract further attention. Users may choose to set this slightly above the actual speed limit on the road to prevent excessive flashing if traffic is moving just above the posted speed limit. However, the end user is the best judge of this value.



Setup The Display Limits (Portable Sign, Rotary Switch Enabled):

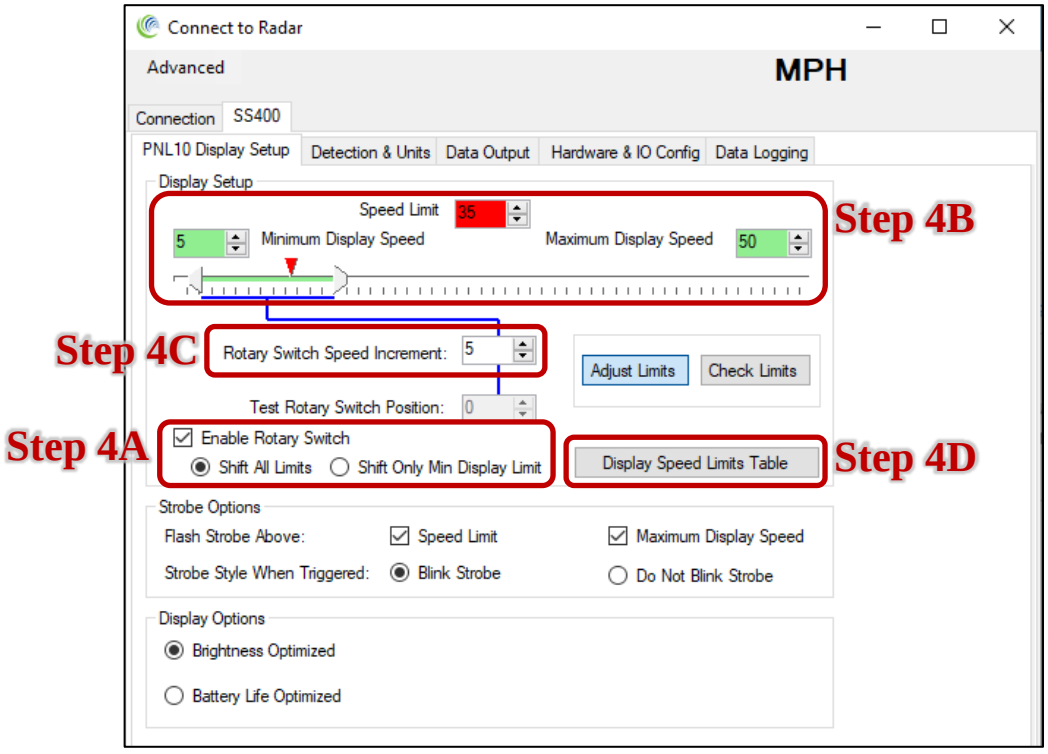
Step 4: Alternatively set the display limits for your portable sign where you may turn the rotary switch (or thumbwheel switch) provided with the PNL10 to conveniently change the display limits for different locations without using a computer.

Step 4A: Enable the Rotary switch and choose if you wish to shift all limits together (as shown in the image) or just the minimum display limit. The blue underline will change to reflect your choice.

Step 4B: Set the Minimum Display Speed, Speed Limit and Maximum display speed to the desired value *for position 0 of the switch (important!)*.

Step 4C: Now set the rotary switch increment. This increment will apply to all display limits **or** just to your minimum display speed depending on the rotary switch mode you picked in *Step 4A* above.

Step 4D: Check your setup. Click the "Display Speed Limits Table" to see the display limit values for the other positions or click on "Check Limits" button and spin the "Test Rotary Switch Position" box. The slider will move to show you the effective values.



Please note that spinning this "virtual" rotary switch on the GUI does not affect the actual sign. To change the speed limits in the sign, the actual rotary switch on the back of PNL10 needs to be adjusted. The simulated values are provided as a tool to check what actual speed settings you will get when your configuration is saved to the sign.

Setup White Strobe Configuration:

Step 5: Set the White Strobe cluster option and blink style to your preference. If you do not wish the strobe to be activated, simply uncheck both checkboxes.

The PNL10 has a white LED cluster (strobe light) arranged in a circle in between the two digits (this option may not be present in your display). The cluster strobes at a fast 10Hz rate to attract attention and may be selected to activate above the flashing speed limit as well as above the maximum display speed.

Note that if enabled above the flashing speed limit, the cluster will also illuminate above the maximum display speed.

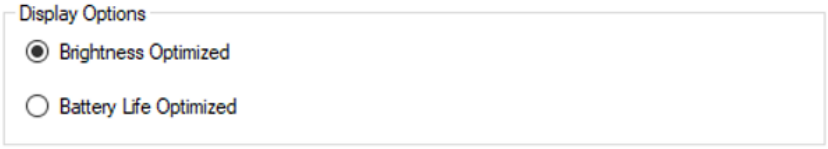
Strobe light is typically used to draw attention of the driver to the display and the fact that their current vehicle speed is above the posted speed limit or that they are driving at an unsafe speed.

The 10Hz modulation is implemented in the hardware and cannot be disabled via software. Contact Houston Radar if you require it to be disabled in hardware.

Additionally, this strobe can be configured from this screen to blink on/off at a 1.4Hz rate together with the speed display.

If you connect an external message as described in Appendix B, then that message is activated along with the strobe. Thus the strobe configuration options become the external message options as well. Note that the 10Hz strobing effect does affect the external message. However, the 1.4Hz blinking effect is propagated to the external message.

Setup Display Brightness Configuration:
Step 6:



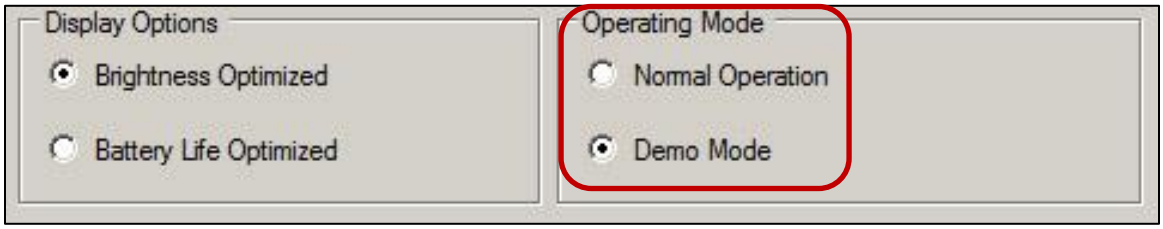
The PNL10 automatically controls the display brightness for optimal visibility under all ambient lighting conditions. The ambient light is sampled by a built in light sensor located on the front face of the PCB or by an optional external light sensor wired to the AUX connector. A control algorithm computes the optimal brightness and adjusts the average LED current via a PWM circuit. PWM circuit is designed to prevent flicker and color distortion.

You may choose to bias automatic brightness control algorithm towards saving battery (Battery Life Optimized) or making the display brighter and hence more noticeable (Brightness Optimized).

In the "Battery Life Optimized" setting the display brightness is reduced by about 30% from the factory default setting for any ambient lighting condition. This can be particularly advantageous for portable signs operating solely off a battery and allow the sign to operate up to 30% longer under heavy traffic conditions. If you find the display brightness in-adequate then set the display to "Brightness Optimized".

Setup Operating Mode Configuration:
Step 7:

Step 7A (For SS300 only):

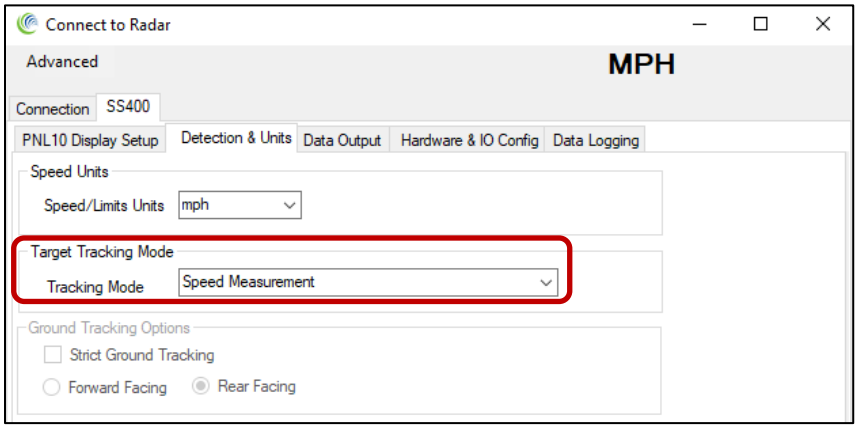


1. **Normal Operation**
   For normal operation of the sign on the road select "Normal Operation". In this mode the radar will pickup actual targets in front of the unit and display them on the digits if they range between the Minimum Display Limit and Maximum Display Limit.
2. **Demo Mode**
   The PNL10 also supports a "Demo Mode". In this mode, the radar generates a pre-programmed sequence of speeds and shows them on the display. Note that the speed limits still apply to these speeds, so selecting different limits will change what speeds are displayed and if the strobe is activated. The ambient light sensor and automatic display brightness control work as normal. This can be a useful tool to test the sign on a low traffic road or inside an office or trade show floor.

*In demo mode, the radar will **not** pickup and display actual traffic speeds*.

SS300 Only:
A power cycle is required for the change to take affect after going from Normal to Demo mode or vice-a-versa. If you change modes and save the configuration to the radar, the software will prompt you for a reboot. This allows you to change the mode from the PC without opening the PNL10 box and physically power cycling the unit.

Step 7B (For SS400 only):



The Radar may be set into one of the following operating modes:

1. **Speed Measurement**
   In this mode the radar operates as a Doppler radar that measures and outputs the speed of targets within its range. The radar measures the speeds of multiple targets and outputs one speed based on the user configuration of "fastest target" or "strongest target" (see later). The radar is expected to be stationary and measure the speed of moving targets.
2. **Speed Measurement With Ground Speed Correction**
   In this mode the radar is expected to be mounted on a moving vehicle (for example in a "Your Speed" sign on the back of a truck) and measure and output the speed of moving targets within its range. However, the output speed is corrected for the speed of the radar itself. Doppler radars always measure the relative speed between itself and the target. So if the radar is moving, a ground speed correction is required if the target speed relative to the ground needs to be measured.
   This allows for the correct speed display of approaching vehicles from the rear and displays their speeds for speed awareness.

Ground speed correction mode only operates when the radar is mounted on the rear of the truck and corrects for the speed of the truck moving forward. However, in this mounting configuration it can correct for speeds of both incoming and outgoing targets.

Speeds of targets that are moving exactly the same speed as the truck itself cannot be measured because there is no relative speed between the radar and the target. Doppler radars require a relative speed between the radar and the target.

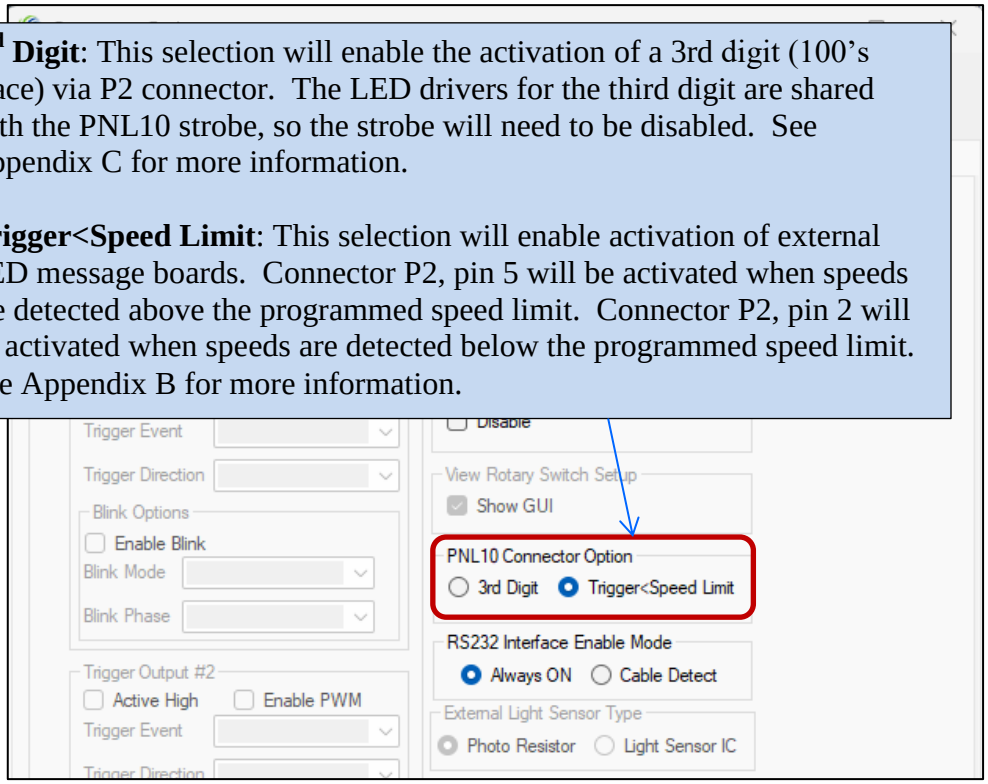
3. **External Radar Sensor Mode**
   In this mode, the SS400 will accept a list of speeds from an external radar such as the Houston Radar DR600. This will substantially increase pickup range while also allowing for more mounting options. Once placed in this mode, the SS400 RF antenna will be completely disabled. Speed limits, speed display selection options, and PNL10 behavior settings are still used. Detection sensitivity, detection direction, and slow speed filtering options are not available on the SS400. Please refer to Appendix D for more information on this mode.
4. **Demo Mode**
   In this mode the radar will simulate detection of different targets and output their speeds. This is a useful mode for demonstration purposes (especially when the radar is connected to a sign), for example at a trade show. Note that the speed limits still apply to these speeds, so selecting different limits will change what speeds are displayed and if the strobe is activated. The ambient light sensor and automatic display brightness control work as normal. This can be a useful tool to test the sign on a low traffic road or inside an office or trade show floor.

Setup PNL10 Connector Option:

Step 8: A connector (P2, "To 1st digit") is available on the back of PNL10 that can be used to trigger a 3rd digit (100's place) or an external LED message.

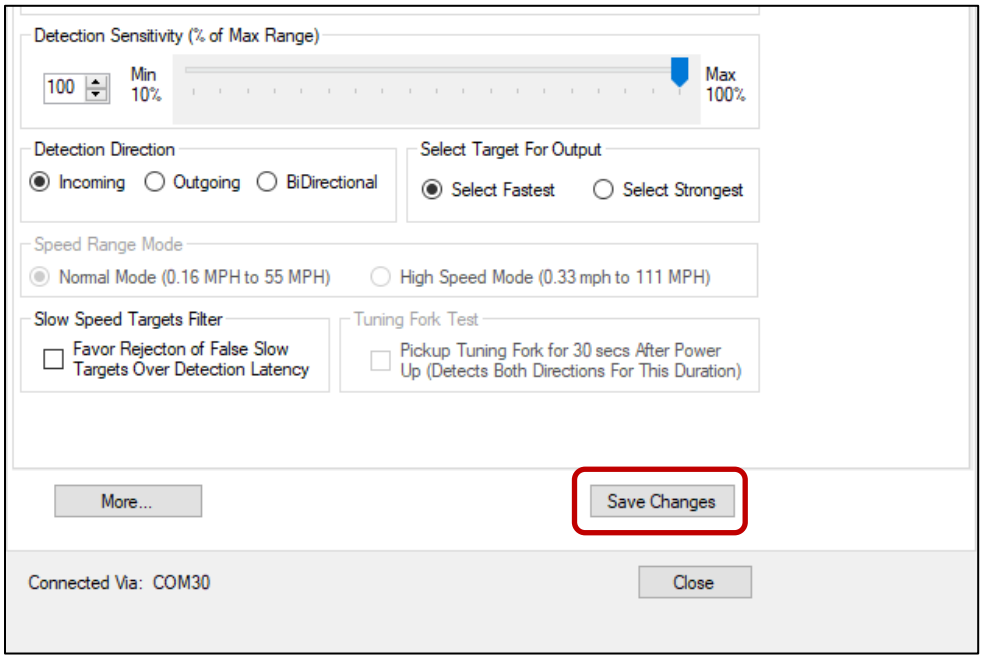
3rd Digit: This selection will enable the activation of a 3rd digit (100's place) via P2 connector. The LED drivers for the third digit are shared with the PNL10 strobe, so the strobe will need to be disabled. See Appendix C for more information.

Trigger<Speed Limit: This selection will enable activation of external LED message boards. Connector P2, pin 5 will be activated when speeds are detected above the programmed speed limit. Connector P2, pin 2 will be activated when speeds are detected below the programmed speed limit. See Appendix B for more information.



Write the Configuration to the PNL10:

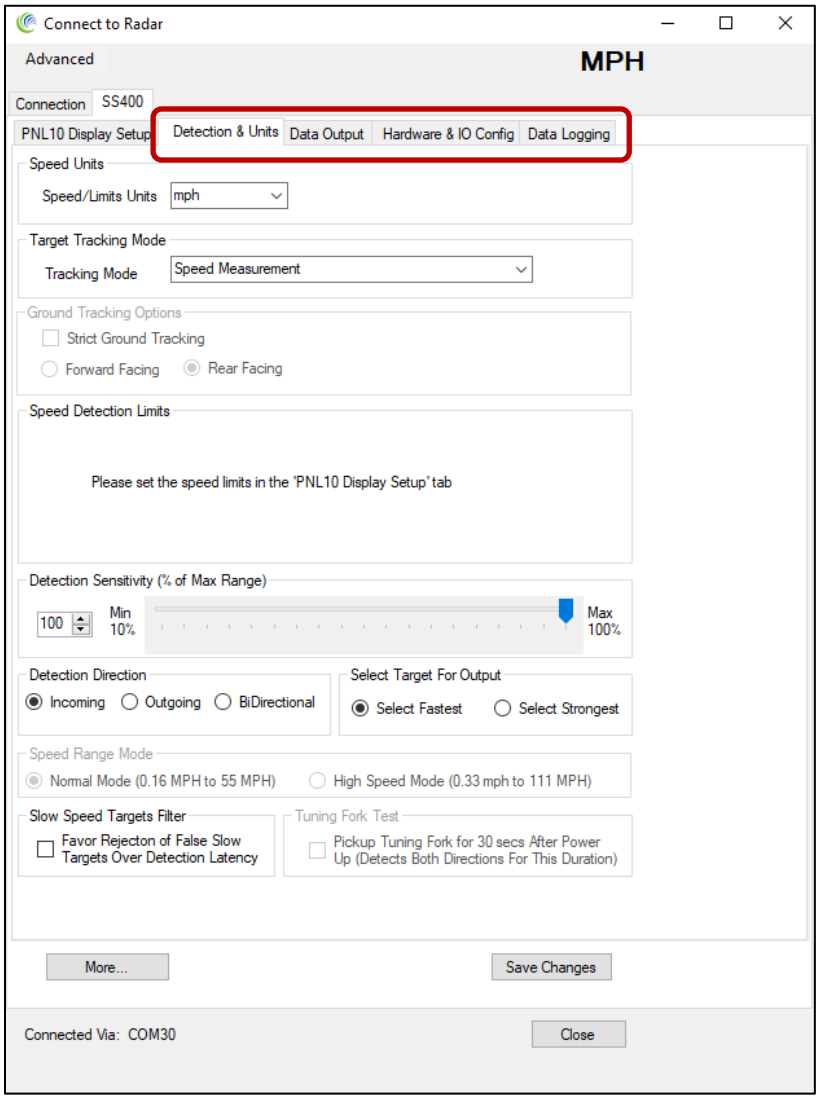
Step 9: Write the Configuration to the PNL10 by clicking on the "Save Changes" button. You must click this button and be presented with the" Configuration Saved" message before your changes are saved to the connected PNL10.



Setup Additional Configuration Options:

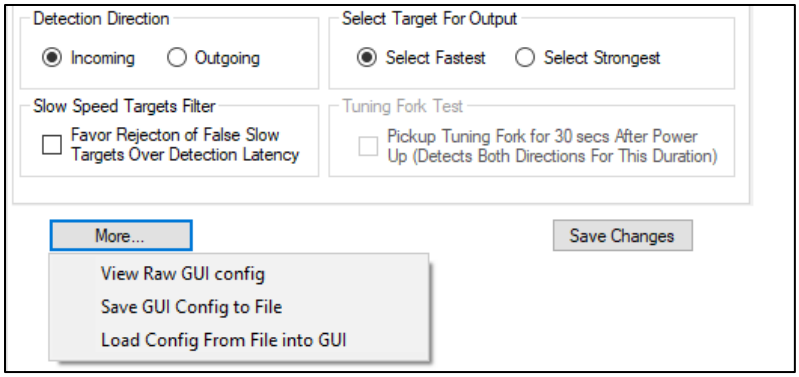
The radar utilized in the PNL10 is the Houston Radar model SS300 or SS400. It supports numerous other options like detection sensitivity, programmable serial port baud rate, different measurement units (mph, kph, fps, mps) and fractional high precision speed output over the serial port.

If you wish to configure these options, click the "Detection and Units", "Data Output" and "Hardware and IO" tables to make changes to these other infrequently adjusted settings.



The SS300 and SS400 user manuals are also freely available on our website and we recommend that you refer to them for more details.

More Button:
Click the "More" button to access the options "View Raw GUI Config", "Save GUI Config to File", and "Load Config From File into GUI".



View Raw GUI Config:
Select this option to view the underlying radar variable configuration in a text file. This is not required in normal operation.

Save GUI Config To File:
Select this option to save the radar configuration on the screen to a local file on your PC.

This button will save the configuration reflected in the screen GUI. If you have made changes to the GUI but not yet saved them to the radar, you can save these changes to a local file without altering the radar.

To save the configuration of the radar instead, either:
1. Click the "Save Config to File" button before making any GUI changes or
2. Click on "Advanced->Radar Configuration->Copy Config From Radar To Local File" menu item.

Load Config From File into GUI:
Select this option to load a radar configuration from a local file on your PC into the GUI. You can then further modify the configuration before saving it back to a file or to the radar.

Simply loading the configuration does not immediately save it to the radar. You must still click the "Write To Radar" button.

To directly copy a local configuration from a local file to the radar click on "Advanced->Radar Configuration->Restore Config From Local File To Radar" menu item. This is the fastest and easiest way to set the PNL10 to a known configuration you may have saved off before.

PNL10 SPECIFICATIONS

General

Operating Band	K-Band
Frequency	24.125 GHz ±50Mhz (US) or 24.20Ghz (UK, Australia)
Power Output	5mW
Antenna Beam Pattern	45 deg x 38 deg
Polarization	Linear
Supply Voltage	
SS300	5.6V DC to 16V DC (18VDC Maximum)
SS400	6.2V DC to 18V DC
Reverse Battery	Protected
Nominal Current Draw (@12VDC including radar)	Display blank: 9.5 mA Display at night: 21 mA Display at max brightness: 415 mA
Operating Temp.	-40°F to +185°F (-40°C to +85°C).
Weatherproof	No. User supplied enclosure required.
IR Remote Programmable	No

Approvals

Radar Approvals	FCC Part 15, modular approval (US Version), CE Mark.

Data Interfaces

Serial Communication	RS232
Data Rate	1200 to 115200 baud
Data Connector	DB9 Female with RS232 levels wired as a DCD. Use 3 wires straight through cable to PC RS232 port.
Power	Screw terminal default. Can be user specified. Minimum quantity order size may apply. Contact us for details.
AUX	2mm pitch 4x2rows. Sullins part # NPPN042GFNS-RC Use mating Sullins part # NRPN042MAMS-RC or equivalent

Optical

LED Color	ITE Amber (592nm ±4nm) for digits. White for strobe cluster *White LED digits are available as an option. Contact us for more information.*
Brightness	11,000 nits (cdm) maximum, controlled automatically via onboard light sensor 550nits at night minimum
Viewing Angle	15° cone off normal

Mechanical

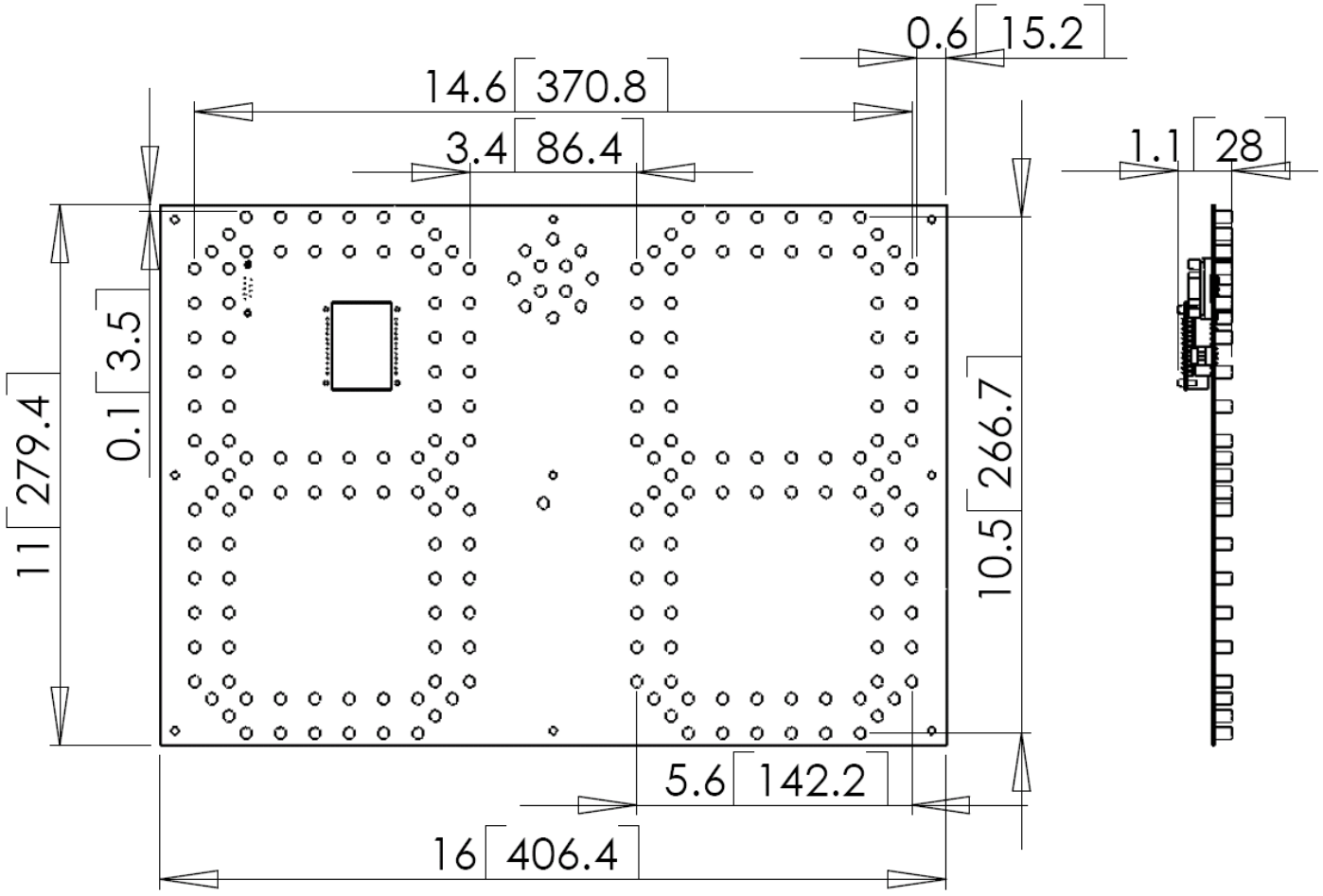
Weight	approx 450 grams (1 lbs)
Dimensions	11”x16”x1.1” (28 x 41 x 2.8 cm)
Mounting	8x #6 screw plated through holes connected to system GND. 1x #6 center non-plated hole for passing bracing standoff from the back. Do not use to mount PNL10 PCB.

Specifications continued on next page …

Performance

Resolution	±0.006 mph (internal and available on serial port) rounded to whole mph (kph) when shown on display.
Accuracy	±0.4% of reading + 0.1mph
Detection Range	Typically 90+ m (300+ feet) for compact vehicles on open and level road with radar mounted 1.5 m (5 feet) high and pointed straight into oncoming traffic. 150+ m (500+ feet) for larger trucks, lorries and vehicles with inherently large radar cross-section. May vary with installation and road conditions. Detection range specified is typical for speeds between 20kph and 88kph (12 to 55 mph). It tapers off below and above this speed range. At the low end of the speed range (2mph (5kph), the detection range is about 34+ m (110+ feet). PNL10 is not recommended for roads with speeds above 90 kph (56 mph) due to reduced range and tracking time. *Contact Houston Radar if a low speed operation (down to 0.25 mph) is required*.

Mechanical Outline Dimensions



Rev 1.3 PCB. Dimensions in inches [mm]

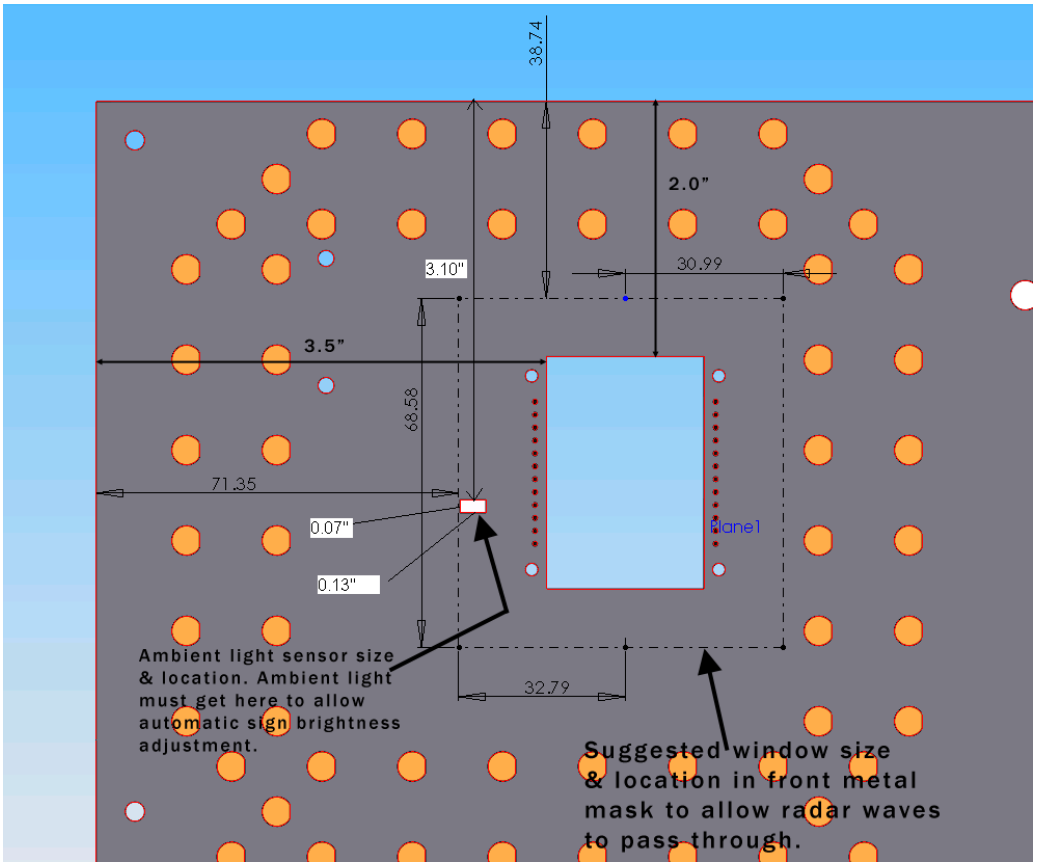
Appendix A: Plastic Window Location and Size When Using Front Metal Mask

If you chose to use a metal front mask (with holes in the LED locations to allow the LED's to show through), you must provide a plastic window for the radar beam to pass through. Use the drawing below for the recommended location and size for the plastic window in your metal mask.

The cutout in the PCB in the center of the figure is the actual size and location of the integrated SS300 radar. The dotted and dashed larger rectangle is the suggested window size.

The suggested window is larger than the actual radar because the radar waves diverge at a 38x45° angle from the face of the radar. The recommended window size is for a metal mask within a few mm from the top of the LED's. If the window is materially further away from this position a larger size window may be required.

Note: the white rectangle is an on-board light sensor. The light sensor is used to adjust the brightness of the LEDs based on ambient light conditions. You must allow ambient light to reach this sensor. Alternatively you may provide an external light sensor wired to the AUX connector on the back of PNL10. Contact Houston Radar for more details.

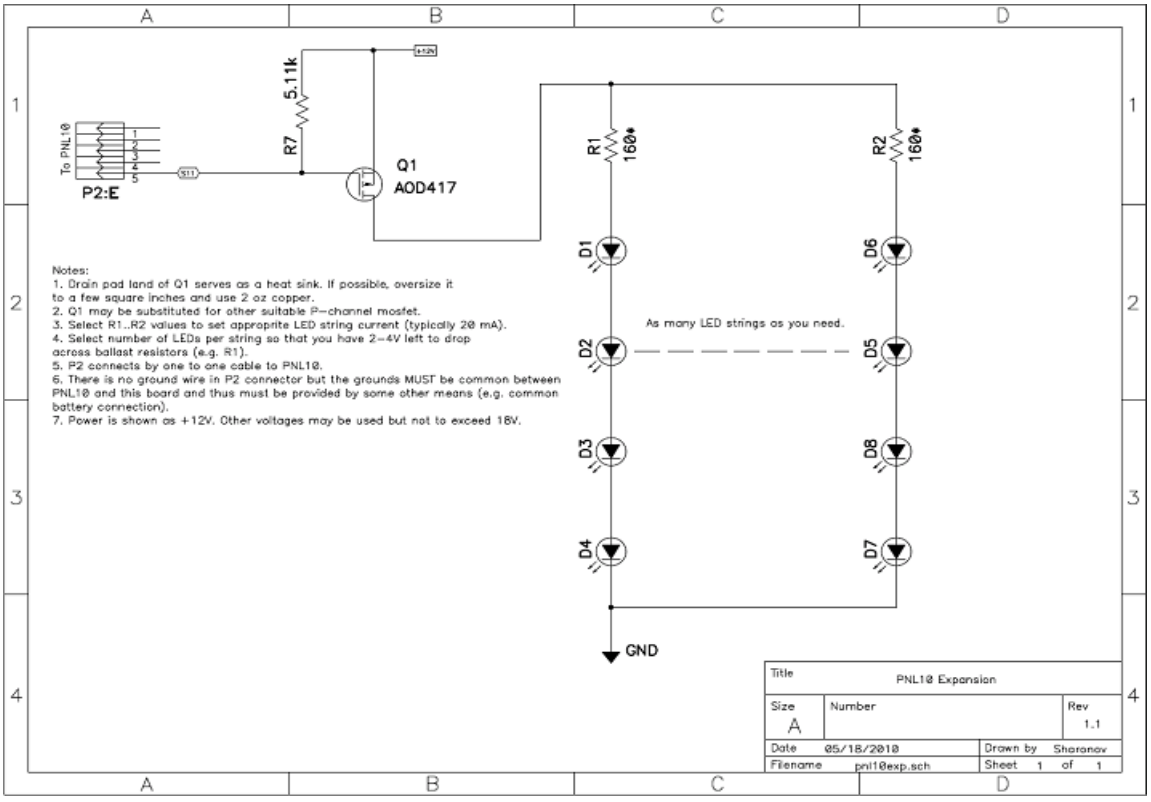


All dims in mm except those shown in inches (marked with a ").

Appendix B: Activate External LED Message(s)

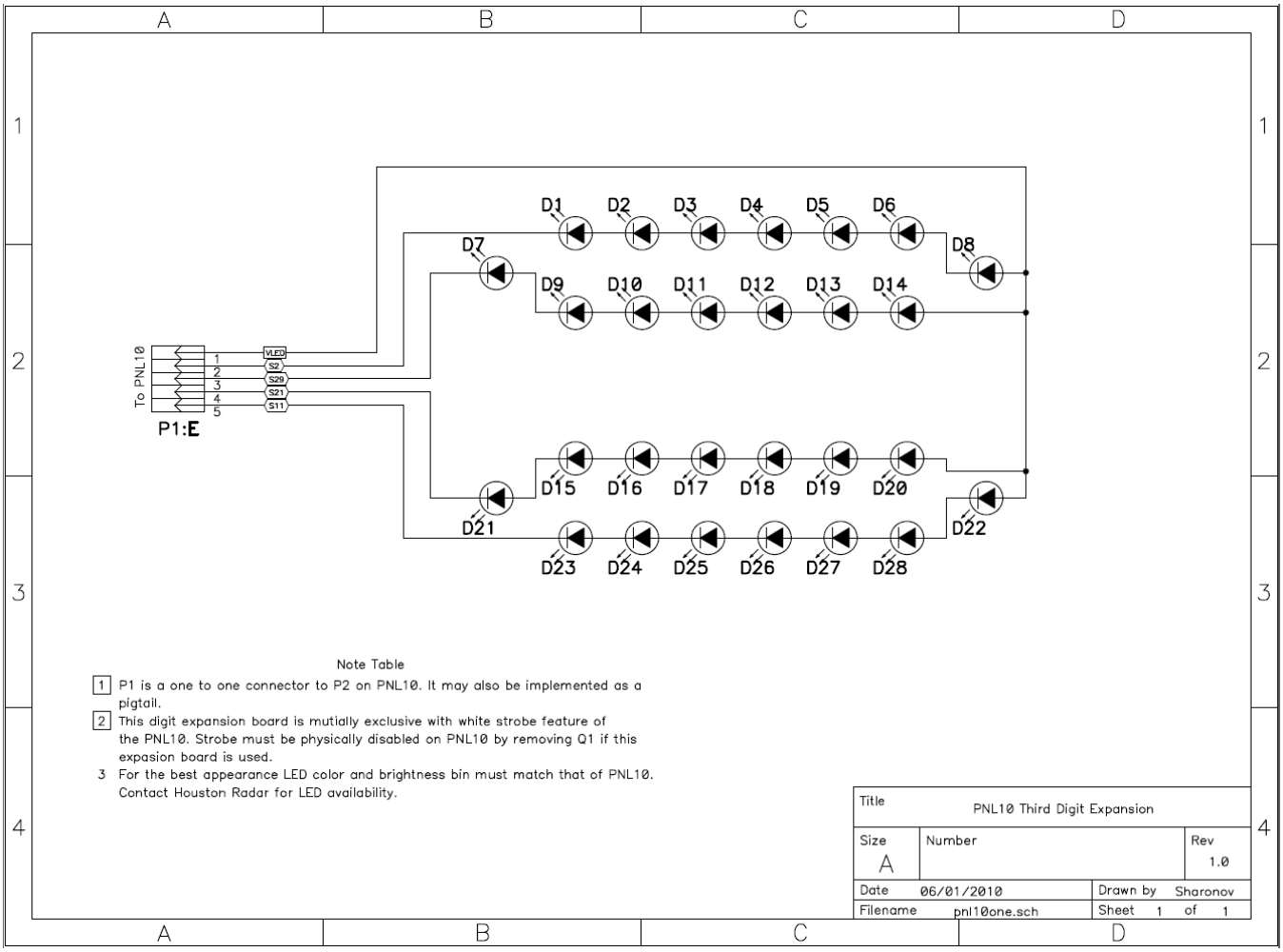
Many speed signs have an external VMS message that gets activated above a preset speed. This message may spell out text like “SLOW DOWN” or any other message in a local language. Emoticons like a “sad face” are also commonly used in certain countries. The schematic below shows how to connect strings of LEDs that can be triggered by the PNL10 above a user set speed limit. The message is activated together with the on-board strobe. Additionally, this message will blink if the user chooses the on-board strobe to blink. The 10Hz strobing effect does not apply to the message.

Connect as many strings of LEDs as required to form a message. For simplification only two strings are shown on the schematic. Then physically arrange the LEDs in the form of the message or emoticon you desire. All LEDs will be lit when the on-board strobe is activated. The message can be programmed to activate above any user-selected speed. Furthermore, this speed can be adjusted in the field through the rotary switch located on the back of PNL10. For most configuration purposes this eliminates the need to connect a computer in the field. If you wish to add a turn-key “SLOW DOWN” message, we have this LED board available for purchase. A second “THANK YOU” message (or a “happy face” emoticon) can be activated below the user-selected speed when connected to pin #2 of P2. Thus you can build a “SLOW DOWN”/”THANK YOU” type of display easily. Please contact us for details if you wish to utilize this feature. Pin 2 can be activated when speeds are detected below the user-selected speed limit, and pin 5 can be activated when speeds are detected above the user-selected speed limit.



Appendix C: Expanding to an Optional 3rd Digit to Make a 3 Digit Speed Sign

You may easily expand the PNL10 to a 3rd digit (to show the 100's place value) via an LED only PCB. All the drivers are already built on the PNL10 PCB.
Note: The expansion connector to drive this 3rd digit is shared with the on-board strobe. Hence you must disable the on-board strobe for this scheme to work. Contact us for details on how to do that or please order your PNL10 without the white strobe populated.



Appendix D: Using External Radar Sensor Mode (SS400 only)

The SS400/PNL10 can be configured to receive and display speeds from an external radar sensor, the Houston Radar DR600. This feature requires SS400 firmware v308 or later. The main purpose of this mode is to increase the pickup range for installations where the additional range is needed. The external radar may also be pointed in either direction, providing more setup versatility. The DR600 can be connected to the RS232/DB9 connector on the PNL10 using a serial crossover cable. By simply bridging the DB9 power traces, the DR600 can also be powered directly from the PNL10.

DB9 RS232 Crossover Cable Pinout:

DB9 Pin # (male)	PNL10 Signal Name	DB9 Pin # (female)	DR600 Signal Name
1	+VCC	1	+VCC
2	RS232 TX	3	RS232 RX
3	RS232 RX	2	RS232 TX
5	GND	5	GND
9	GND	9	GND

The SS400/PNL10 is not accessible and the ASCII output is not available while the DR600 is connected. For this reason, the SS400 and DR600 radars should be configured separately before the DR600 is plugged into the PNL10. A DB9 splitter (Available from Houston Radar) may be used to allow access to the second DR600 serial port while it is connected to the PNL10. The RF transmitter on the SS400 will be disabled when in "External Radar Sensor" mode to prevent any interference with the DR600 radar.

In this mode, the SS400/PNL10 will receive a list of speeds and magnitudes from the DR600 and process them as if collected by the SS400 itself. If no updates are received from the DR600 for several seconds, the PNL10 will display "Er". Some options will no

longer be available on the SS400 in this mode, and will need to be set on the DR600 radar instead. Please refer to the table below for a list of options and behavior descriptions. Statistics is not available on the SS400 while in this mode. If you wish to gather statistics, it will need to be performed by the DR600 radar.

Behavior glossary:

Normal: This setting's behavior is unchanged and can be adjusted according to your requirements.
No effect: The setting for this option/variable is not used in this mode and is ignored.
Not applicable: This option does not exist on the radar or does not apply in the PNL10 configuration.
Not compatible: This option, that would normally be available, will not function in this mode.
Specific setting required: This option must be set correctly for this mode to function properly.

Option	SS400 Behavior	DR600 Behavior
Minimum Display Speed (LO)	Normal	Specific setting required (must be set to 0 to allow SS400 full control)
Maximum Display Speed (SH)	Normal	No effect
Speed Limit (SP)	Normal	No effect
Maximum Speed (HI)	Normal	Specific setting required (must be set to 350 to allow SS400 full control)
Enable Rotary Switch	Normal	No effect
Rotary Switch Speed Increment	Normal	No effect
All strobe related options	Normal	Not applicable
Brightness/Battery Life Optimized	Normal	Not applicable
Speed Units	No effect	Normal
Tracking Mode	Specific setting required (must be set to "External Radar Sensor" mode)	Specific setting required (must be set to Target List output mode)
Detection Sensitivity	No effect	Normal
Detection Direction	No effect	Normal (only incoming direction is received on PNL10 when in bi-directional mode)
Select Fast/Strong Target Speed	Normal	No effect
Slow Speed Targets Filter	No effect	Normal
Enable Speed Output On Primary RS232	Normal	Specific setting required (speed output for serial port connected to PNL10 must be enabled)
Enable Speed Output On Auxiliary RS232	Not applicable	Specific setting required (speed output for serial port connected to PNL10 must be enabled)

Option	SS400 Behavior	DR600 Behavior
Baud Rate	Normal	Specific setting required (settings for the DR600 serial port connected to PNL10 must match that of the SS400, the other DR600 serial port may be configured differently)
Data Bits/Parity/Stop	Normal	Specific setting required (settings for the DR600 serial port connected to PNL10 must match that of the SS400, the other DR600 serial port may be configured differently)
1 Byte Binary	Normal (serial port not accessible)	Not compatible
All ASCII CR/LF Options	Normal (serial port not accessible)	Normal
ASCII with Leading '+'	Normal (serial port not accessible)	No effect
Heartbeat 0's When No Target	Normal (serial output not accessible)	Specific setting required (must be enabled)
Disable Count Up on Startup	Normal	No effect (no effect on PNL10 output, DR600 serial outputs behave normally)
ASCII Speed Output Precision	Normal (same or higher precision must also be set on DR600, serial output not accessible)	Normal
Output ASCII Speed Bin Counts	Not compatible	Not compatible
Display Target Magnitude with Speed	Normal (Serial output not accessible)	Specific setting required (must be enabled)
Speed Measurement Mode	Specific setting required (Must be set to "Output Instantaneous Target Speed")	Specific setting required (must be set to "Output All Targets' Speeds")
PRI RS232 Interface	Normal	Specific setting required (must be set to "Always ON")
AUX RS232 Interface	Not applicable	Normal (either serial port can be used to send data to the PNL10 and the other serial port is available for external serial connections)
Frequency	Not applicable	Normal
All Statistics Options	Not compatible	Normal