WBo2 **2Y2** User Manual (update coming Oct 2012)

This is the **user manual** for the latest **2Y2 DIY** wideband controller series. Go to the main page for more background on the 2Y range of DIY controllers. The ***Tech Edge*** 2Y2 incorporates an *optional* on-board display.

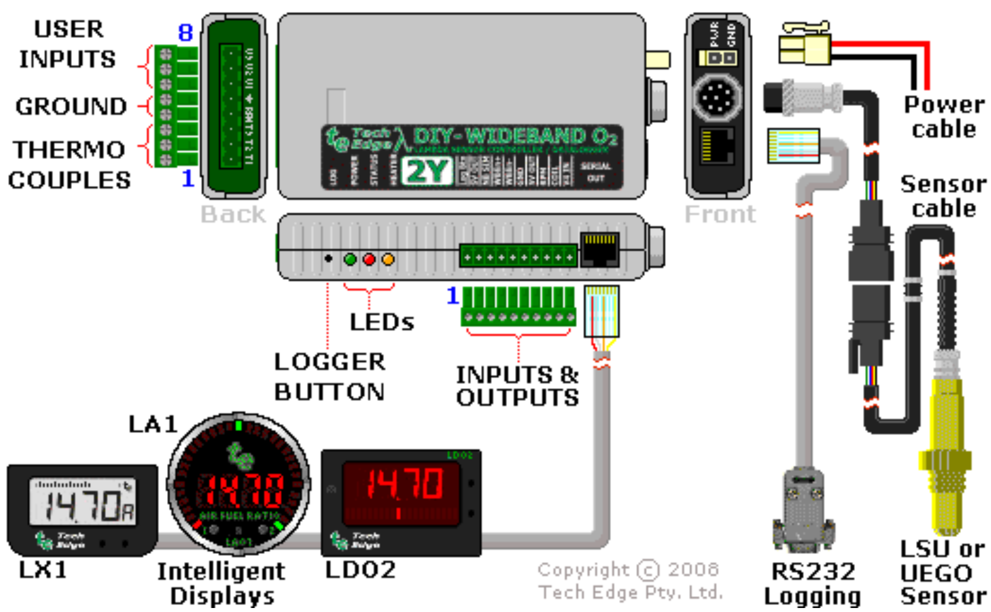
Tech Edge sells the **2Y** controller **ONLY** in **DIY** (*do-it-yourself*) form. If you're after a *factory pre-built* unit then we have the **2J economy range** or, if you want a unit with equivalent wideband performance as the **2Y**, then the **2C professional range** is where you should start.

Below is the **User Manual menu bar** showing sections of this guide. It's repeated throughout this document.

2Y Manual- **Overview** RS232 Outputs Inputs Sensor LEDs Logging Display

2Y Connection Overview

The 2Y unit provides an **RS232** data stream (in the form of logging frames) which provides digitally precise information on sensed lambda/AFR and all logged inputs. Additionally, three software configurable 0 to 5 volt outputs (**WBlin**, **SVout** & **NBsim**) can be mapped to lambda/AFR. All **2Y** connectors and their inputs & outputs are described in detail below. Also see the connector summary.



The image at left shows how a 2Y unit is connected to other WBo2 wideband components. Please note, there are some *Popup* images (JavaScript needed) on this web page.

Clockwise from top right, the 2Y's power is provided by the two pin **power cable**. Then the *Bosch LSU* **sensor** is connected via the **Controller-to-Sensor cable** *(available in various lengths)*. (The *NTK L1H1* sensor may possibly be supported in the future.) The Controller-to-Sensor *cable's* circular *8-pin* connector plugs into the **2Y unit**.

On the front and end of the case are two **8-pin (RJ45)** connectors for the **RS232** serial port, which is in the unit. A ***Tech Edge*** display or an RS232 (COM) port of a PC may be plugged in to either RS232 connector on the unit. Then the PC may display the data from the unit. Also the data may be logged for later display or analysis.

The **10-way green pluggable header connector** is used for configurable voltage outputs, a **5 volt 500mA** supply for powering external sensors (MAP, TPS etc.), an **RPM** and **COIL** input, and a connection for an external logger button (labelled "Log Btn").

The three **LED**s are for *power present (GREEN)*, *operational status reporting (RED)* and *sensor heater operation (AMBER)*. The **logger button** is used to control on-board logging, for units with a logger module installed.

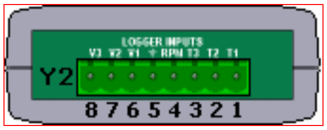
The green endplate has an **8-way green pluggable header connector** that provides the input connections for the three user **0-5 Volt** analog input channels, as well as the three **Type K** thermocouple inputs.

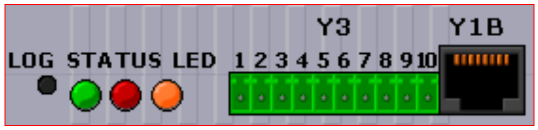
Pin Numbers — *A notation like: **Y3p4** would refer to pin 4 on connector Y3*.

The **2Y** unit, without cables, weighs just over **200 grams**, and the case measures **150 x 80 mm** with height of **30 mm**. The connectors at the ends combined protrude a further **80 mm**. Sensor, power and display cables are compatible with other ***Tech Edge*** Wideband units. The connectors are shown in the images below.

Schematic View of Connectors

Green endplate | **10-way green connector** | **Black endplate**

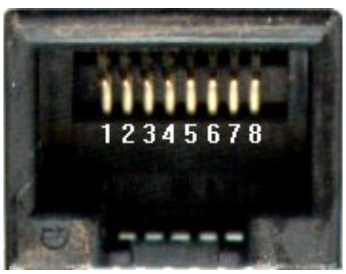


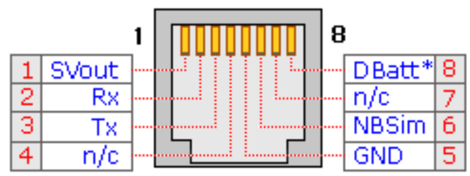


Click on each image to obtain a *schematic view* of the connectors or see the brief connector summary.

2Y Manual- Overview **RS232** Outputs Inputs Sensor LEDs Logging Display

RS232 Connectors



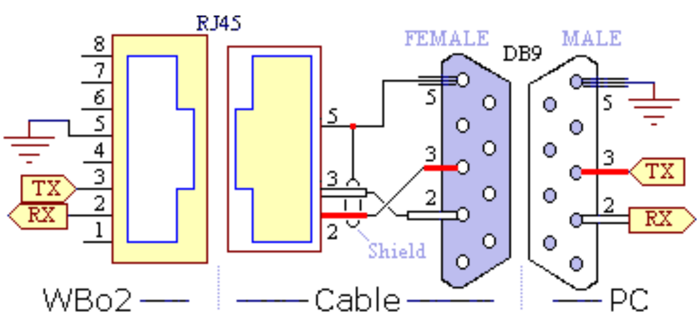


The image on the left shows the exterior appearance of an RJ45 connector for the unit's RS232 serial port (Y1A and Y1B), complete with pin numbers. On both connectors, the RS232 signals are on **R_x** **[pin 2]** & **T_x** **[pin 3]**. The unit transmits RS232 data on both **Tx** pins (logging frames, etc.) and receives RS232 data (commands from PC or display, code updates from a PC, etc.) on either **Rx** pin. The ground reference (**GND**) for the RS232 signals is on **pin 5**. There are two RS232 connectors but they are connected to the one RS232 port in the unit. Tx is just connected to both pins 3 in parallel. The two Rx pins go to a simple diode steering circuit which allows either Rx pin to send data to the unit's microcontroller. Thus, both a display and a PC can be plugged in at the same time and either device may send commands to the unit (but not both at the exact same time).

GND also serves as the power supply return pin for **D_{batt}**, which is is a fused, protected and partially filtered **display battery** voltage, on **pin 8**. **D_{batt}** powers connected ***Tech Edge*** displays, such as the LX1 display, LA1 display or the LD02. Thus the display only needs one cable, it gets data and power from the RS232 port. **D_{batt}** should only be connected to devices that draw small currents; typically less than 100 milliAmps. Excessive current consumption will cause heating of (and possible damage to) an internal protection resistor designed to limit short circuit current.

On both RJ45 connectors, there are also two configurable **analog output** voltages, **SVout [each pin 1]** & **NBsim [each pin 6]**. These two outputs, as well as **WBlin**, are also available on the 10-way green connector. That 10-way connector would normally be used to access all three voltages.

RS232 Cable

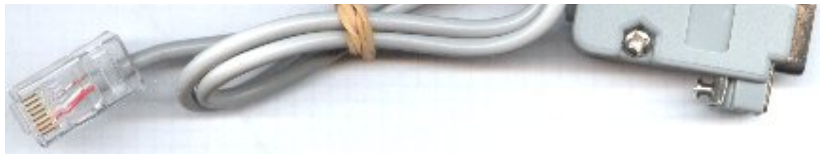


The diagram at left shows the wiring for the RS232 serial cable, which goes from the unit to an attached PC. The cable is used for logging to the PC, display of the unit's data on the PC, re-flashing the unit's firmware (under the control of the PC), or sending a variety of other commands to the unit.

Note that the pin names change from left to right - the unit's **Tx** pin transmits to the PC's **Rx** pin (and vice versa). **Pin 5** is the shield for the Rx and Tx data lines as well as being the return data path.

Here's a picture of an RS232 cable (at right). If you need to extend the cable, then a standard **straight through** male-female DB9 extension cable should be used (that is, **not** a

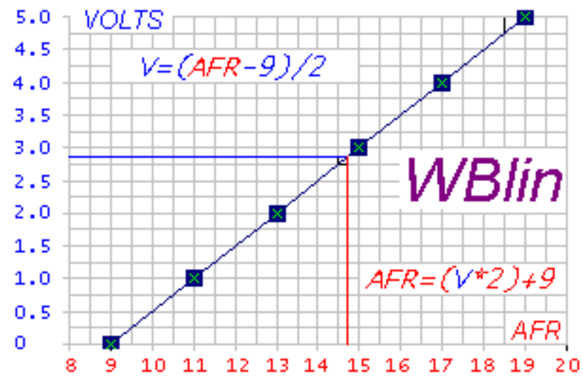
cross-over or null modem cable).



If you're having problems with your RS232 serial connection, please refer to the common problems guide in the FAQ section.

2Y Manual- Overview RS232 **Outputs** Inputs Sensor LEDs Logging Display

Wideband Output WB_{lin}



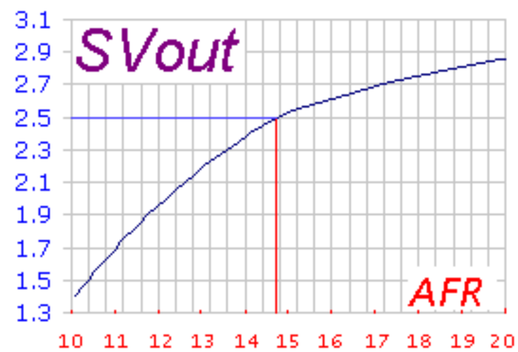
On the 10-way green connector is the most accurate of the three analog voltage outputs, **WBlin**, which is generated by a precision 12-bit DAC (Digital to Analog Converter) using a 65-word lookup table (with linear interpolation). Compared to the old 2A0 unit, the **2Y**'s WBlin output buffer has been upgraded to the superior differential output.

The default linear wideband output mapping is shown in the image at right. To convert the default WBlin voltage to an AFR simply multiply the measured voltage by 2 and add 9. The formulas are shown in the image. The advantage of a linear output is that it's easy to write a conversion function from the wideband voltage to AFR.

WBlin can be re-programmed using the WButil configuration utility to cover any part of the AFR range from Lambda = 0.6 to free-air and 0 to 5 Volt output.

As well as **WBlin** the **SVout** & **NBsim** outputs are available. They use a 10-bit PWM circuit which is less accurate (WBlin is 12 bits) and slightly noisier too. We sometimes call these the 9.5 bit outputs to indicate their relative accuracy. All outputs can be re-programmed using WButil's WB Tables section.

Configurable Output SV_{out}



SVout (Simulated Voltage out) is an analog voltage output. It is on the 10-way green connector (**Y3p2**) and the RJ45 sockets (**Y1Ap1** and **Y1Bp1**). By default, it is set to suit the old ***Tech Edge*** analog display LD01 (see image at right).

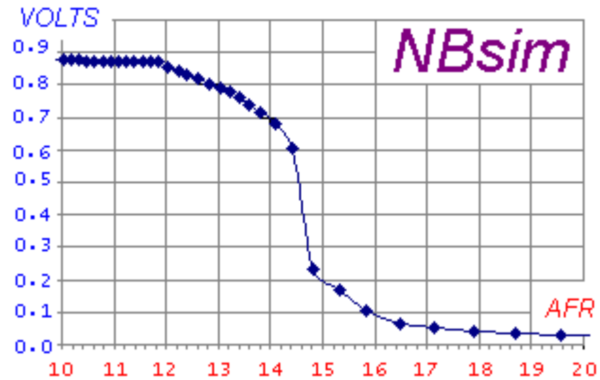
SVout is produced by the unit's microcontroller using an internal 10-bit A/D (Analog to Digital) PWM (Pulse Width Modulation) converter, followed by a simple low-pass filter and an op-amp buffer. To generate the data, the microcontroller uses a 65-word lookup table with linear interpolation. It converts the normalised pump current (Ipx) into a 10-bit value representing **SVout**. We say SVout has about 9.5 bits of relative accuracy.

SVout is compatible with the **Vout** signal from the original oz-diy-wb unit (and the 1.5 unit's **Vwb**). By changing the connector on the display cable, SVout will also drive the older ***Tech Edge*** 5301 display. Note that the 12-bit **WBlin** can be re-programmed to use the **SVout** table, so if you're not using **WBlin** and you want a more accurate **SVout** voltage, you should consider reprogramming **WBlin**. Remember however that the default SVout signal is non-linear, covers the full range of very rich (Lambda=0.6) to free air, and the voltage range is small (less than 3 Volts). So, measuring resolution is reduced compared to using a smaller AFR range over a larger voltage range.

The default SVout table, shown at right, varies between about **1.0 Volt** for a very rich mixture (Lambda=0.6 or AFR=9), to **2.50 Volts** for a stoich mixture, and on to **3.1 Volts** for a lean mixture (AFR=25). In free air, the SVout should be exactly 4.00 Volts when the unit has been free-air calibrated correctly.

The default AFR vs SVout relationship is shown in the Vout table/graph page. SVout is a continuously available signal that may be logged with an analog logger. We recommend at least a 10-bit input converter for best accuracy.

Configurable Output NB_{sim}



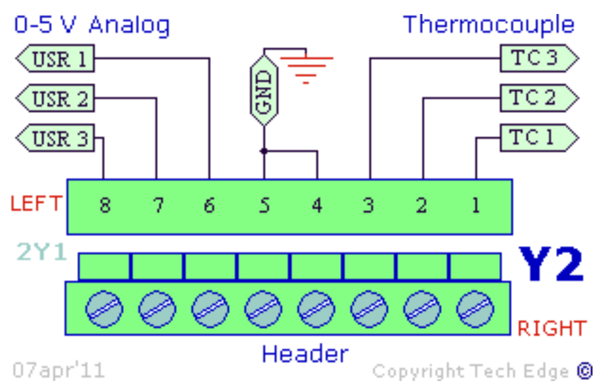
NBsim (NarrowBand simulate) is another analog voltage output. It is also on the 10-way green connector (**Y3p3**) and the RJ45 sockets (**Y1Ap6** and **Y1Bp6**). By default, it is set to simulate the output voltage from an old narrowband sensor (see image at right).

NBsim is produced the same way as SVout, with identical hardware, but using a different 65-word lookup table with linear interpolation. NBsim also has about 9.5 bits of relative accuracy. The full 0 to 5 Volt output is available (by changing the lookup table), but restricting the output to 0 to 1 volt (as needed for narrowband simulation) reduces the number of possible steps to around 200 (~5 mV per step).

The NBsim output is designed to be compatible with the raw output of a Bosch LSM-11 sensor. Refer to this Excel spreadsheet for the graph of the default NBsim vs AFR.

As NBsim can be re-programmed, it is possible to do a number of interesting things, such as fooling the engine's ECU (if equipped with a narrowband sensor) into running richer or leaner than it would do otherwise.

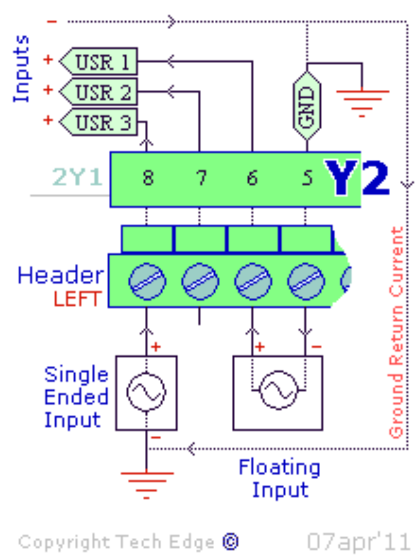
Analog Inputs



2Y wideband units have a green 8-way *pluggable connector* (Y2) on the green endplate. The inputs are shown in the diagram at right. The inputs, counting from **pin 8** at the left to **pin 1** at the right are:

- **USR$_{3,2,1}$** - User input voltages, 0 to 5 Volt range.
- **GND** - Common ground (earth) return for all inputs.
- **TC$_{1,2,3}$** - Thermocouple inputs.

User Inputs



The **left** three pins of 8-way green connector **Y2** are the three 0-5 Volts *single ended* **analog inputs** USR1 (**Y2p6**), USR2 (**Y2p7**) and USR3 (**y2p8**). They are marked on the green endplate as V1, V2 and V3, respectively. Remember that pin 1 is on the **right** of connector Y2, pin 8 is at the **left**. They can be used for sampling voltages such as TPS (Throttle Position Sensor) and MAP (Manifold Absolute Pressure), but remember that the measured voltage should not exceed 5 Volts. They are not suitable for measuring pulse inputs unless the pulses have been processed by an external circuit.

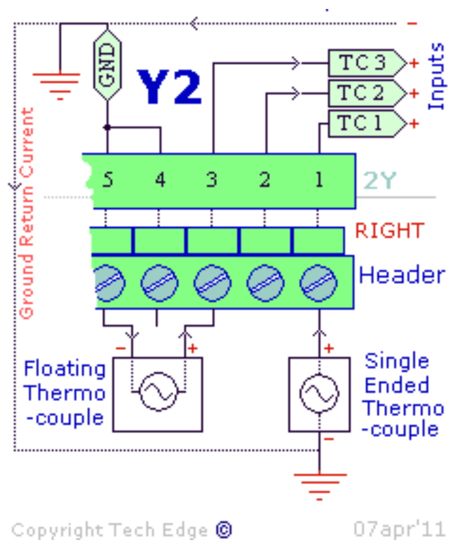
The USER voltages are sampled at a resolution of 10 bits at a rate determined by logging configuration parameters (default 10 sample/sec). The 3 channels have at least a 10k Ohm input impedance. The 10-bit resolution means variations as small as 5 milliVolts can be detected, but in practice the noise limit sets the resolution to as low as 15 to 20 milliVolts.

The diagram at left shows how to connect the two possible types of inputs to the USER inputs. The **Single Ended Input** positive signal wire (**+**) goes to one of the input pins (Pin 8 = USR 3 in this case), and the return path for the signal is via the vehicle's wiring. The **Floating Input** positive signal wire goes to another input pin (pin 6 = USR1 in this case) and the return path for the signal is via the GROUND pin (pin 5) rather than vehicle's wiring.

Note that unterminated inputs will **float** and may show a voltage level when not being used. Either ignore this effect or physically connect all unterminated inputs to GND (pin 5) with short pieces of wire.

Unused Input Pin — On the 10-way green connector, there is a pin labelled "**V4 IN**". It turns out that this pin goes to a not-connected point inside the unit, so this pin is surplus to requirements.

Thermocouple Inputs



The right-most three pins of Y2 are three *single ended* **thermocouple inputs**. There is a single thermocouple amplifier (with a 3-input multiplexer) that amplifies the very low level thermocouple signals (voltage gain is **101** times). The **Type K thermocouples** used allow a temperature range of **ambient** to just over **1,200 °C** (The actual voltage input is in the range 0->49.5 milliVolts). The unit also has an internal **thermistor** that is used to measure ambient temperature so that *ice-point compensation* can be applied to the raw thermocouple data to give better accuracy.

There are two types of thermocouples; ones with two terminals and one with a single terminal that is used with a ground return. Both types can be used although only the double ended (or floating) one will give noise-free results in an automotive environment. The floating thermocouple is attached between ground and the signal input (see image at right). Some thermocouples have screw or bolt attachments and use a single wire. These will work but they will be noisier than a two wire thermocouple.

We don't necessarily recommend these people, but http://www.exhaustgas.com should be consulted to give you an idea of what's available. Check their part number **4018-48-R-W** (48 inch long wire, weld on bung, stinger model). Or for their probes look at the bottom of the page for the products they make to suit Westach instruments. All of these probes are manufactured with terminals which suit the green connector really well. The tabs on the *EGT probe's end wires* have been "streamlined" to prevent hitting each other during operation. The K-type thermocouples are made in either a clamp-on style, a weld-on style, a high quality bullet probe, or the stinger probes (2 year warranty). Their bullet probes work on 1000 hp/cylinder top fuel cars and need to last 100 passes.

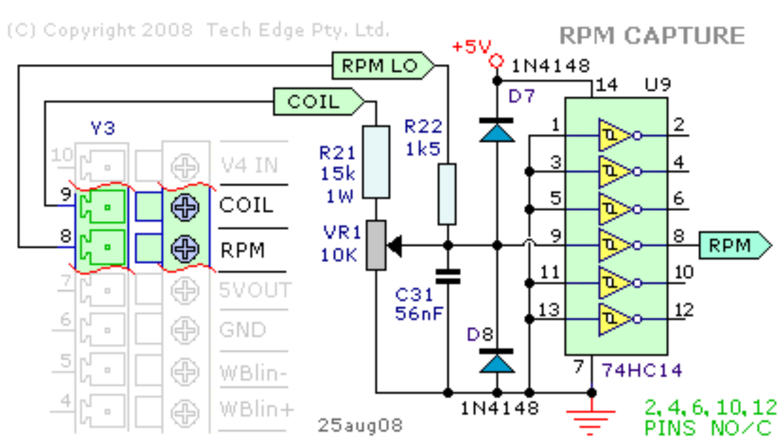
Here's a pop-up image of a hose-clamp style *EGT clamp*.

Thermocouples generate a voltage that depends on the difference between the "hot" junction where two dissimilar metals are joined, and the "cold" junction. Basic data for Type K thermocouples is available from NIST at http://srdata.nist.gov/its90/main/its90_main_page.html.

Conversion of Thermocouple Inputs to Analog

Converting all three thermocouple inputs into **analog (0 to 5 Volt) inputs** can be done, but it's not possible to have a mix of thermocouple and analog - it's all or none! Open up your **2Y** unit's case and move jumper J1 from the X101 position to the X1 position, then reassemble the case. See Section 12 "Jumper-Shunts" in your 2Y1 Assembly Guide for more details. Refer to the 2Y1 DIY Wideband Kit Assembly page for how to get your 2Y1 Assembly Guide. Logging software will also have to be told of the change by reconfiguring it.

Tachometer RPM Input



A tachometer is an instrument which measures RPM (Revolutions Per Minute). The unit has a single **RPM channel** that is captured for logging, although there are two input pins provided to capture your RPM signal. Refer to the image at right.

- **COIL** (on **Y3p9**, 10-way green connector) for direct connection to a **COIL** (or a **Tach** signal as generated by some vehicles). The COIL input normally connects to the wire going between the **points and the COIL.** On vehicles that have electronic ignition and a distributor you would connect to the point between the transistor switch (or *ignition amplifier*) and the coil.
- **RPM** (on **Y3p8**, 10-way green connector) for a lower voltage "**logic level**" signal as is generated by some sensors or produced as a low voltage output by an ECU (possibly the input to a *transistor ignition amplifier*). The **5 volt pulse** will be at some small multiple of the engine's revs. Unfortunately, the loading (low input impedance) of the **RPM** input sometimes makes it infeasible to connect to sensitive circuits such as an inductive crank angle sensor.

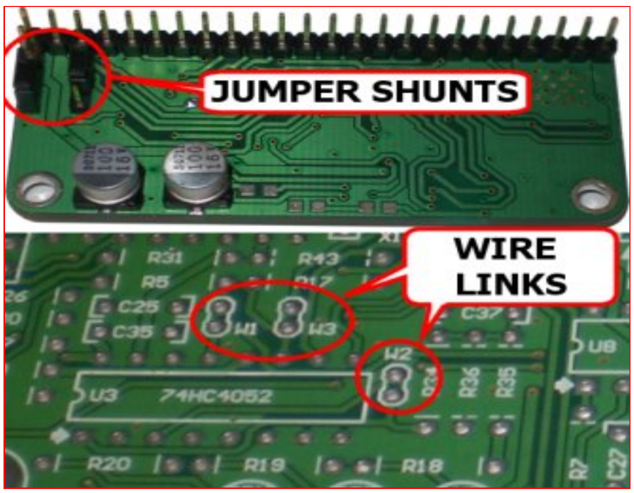
RPM Noise Filtering

Notice the components **C31** (56 nF capacitor), and **VR1** (10k preset variable resistor). Their physical location (bottom left of the main PCB, beside the 10-way green connector) is *shown here*.

Capacitor C31 is a low-pass filter component. C31 is supplied as a 56 nF capacitor (or 0.056 uF) and is marked as **563**, and is usually a large green capacitor. On some vehicles (when using the COIL input) C31 may limit the maximum RPM that can be logged. C31 can be removed entirely or replaced with a smaller value.

2Y Manual- Overview RS232 Outputs Inputs **Sensor** LEDs Logging Display

Sensor Type



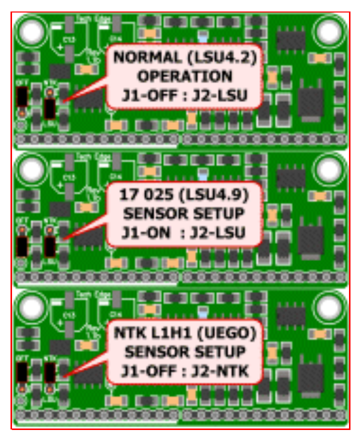
The 2Y unit has hardware support for both the **Bosch LSU** sensors (all LSU 4.0, 4.2 & 4.9 types) as well as the **NTK UEGO** sensor (L1H1, L2H2 & related models). Note carefully, hardware support is one thing, there must also be suitable firmware. There is presently (2011) no 2Y firmware available for NTK sensors, so they cannot be used. Go here for more information on sensors in general.

The sensor type is set using **jumpers** (sometimes called *jumper-shunts*) on the lambda module. The jumpers are on the underneath of the module. They are marked with white lettering on the top of the module. These jumpers are:

- **NTK/LSU** - Jumper **LSU** for Bosch LSU 4.0/4.2/4.9 sensors. Jumper **NTK** for NTK UEGO sensors. *Note: Check for the correct firmware support, for the sensor type you are selecting.*
- **Vs Bias** - Normally in the **OFF** position (NTK and LSU 4.0/4.2). Change to **ON** when using an LSU 4.9 sensor. *Note: Check for LSU 4.9 firmware support.*

Click on the image or *here* for an enlarged popup of the jumper locations.

Changing The Sensor Type



Before changing the sensor type, always verify that there is suitable firmware available to suit both the unit and the proposed sensor. Go here for more information on what firmware is available for which wideband unit and sensor combination.

To change the sensor type, three things must be done:

- Change the jumper settings: Remove the cover from your 2Y unit, remove the lambda module. Put the NTK/LSU jumper and the Vs Bias jumper in the correct positions. Click on the image at right for a *popup image* of the jumper settings. Reassemble your 2Y unit. **Label** your unit with the sensor type it is now set for.
- Get hold of the latest firmware for that sensor type from here on the WBo2 website. Make sure the sensor is **not plugged in**. Plug your unit into your PC's RS232 port, using the RS232 cable. (Go here if you do not presently have an RS232 port on your PC.) Find a suitable 12 Volt DC power supply, capable of delivering 3 Amps without excessive voltage droop. A fully charged car battery or an old computer power supply would do. Car battery chargers are generally unsuitable because they have no regulation and an unfiltered output, delivering current in the form of pulses, not the nice steady supply needed for the unit. Plug your unit into the power supply (using the unit's power cable, be careful with polarity), power it up. Start WButil. (Go here if you do not have WButil loaded.) Change the firmware in the unit by re-flashing it. **Verify** that you have the correct firmware loaded in the unit by checking the version number. That can be done by clicking the Terminal tab in WButil, then power the unit off, click CLS, then power the unit on. The unit will report its model nuimber and revision number. Then logging frames will begin. Power off.
- Change the Controller-to-Sensor cable to match the new sensor. The sensor's connector is different between different sensor types, but stays the same for different sensor model numbers within the same type. See more cable information here.

Once you have successfully changed the sensor type, plug the new sensor into the unit, using the correct Controller-to-Sensor cable. Plug in your display, if you have one. Keep your PC plugged in and WButil running. Conduct a basic sensor and controller test. If that test passes, you are done, your changed unit and sensor are ready for use.

Be very careful to set the **NTK/LSU** jumper's position correctly, since using the NTK setting with an LSU sensor, or vice versa, *may* ***damage the sensor*** *or the* ***2Y unit***. This warning is particularly relevant if you swap from LSU to NTK.

Jumper Functions

The Vs Bias jumper applies a small current bias to the Vs pin (from the sensor) via a 150 kOhm resistor. When it is ON, the unit can correctly drive Bosch LSU 4.9 (models 17025 and 17123) sensors, provided the firmware is also correct. It is OFF for all other sensor types.

The NTK/LSU jumper alters the impedance between the microcontroller pin VsDRIVE and the sensor's Vs pin. NTK and LSU sensors use different techniques to control their internal temperature. The LSU sensor needs the lower impedance.

2Y Manual- Overview RS232 Outputs Inputs Sensor **LEDs** Logging Display

LEDs

The unit has three LEDs (Light Emitting Diodes). Their *Normal* operational status is described below. From left to right the LEDs are:

- **GREEN** = ***Power LED*** indicates power is connected. It should **never** be flashing.
- **RED** = ***Status LED*** flashes while the sensor is warming up, to indicate error conditions, and to indicate on-board logging status. The status LED is driven by a pin on the microcontroller.
- **AMBER** = ***Heater Power LED*** shows the level of power being supplied to the sensor's heater. The heater LED is simply connected in parallel with the sensor heater element, so it is a good guide to what is happening with the sensor heater. It should flicker reasonably brightly at **30 Hz**.

Diagnostics from the RED & AMBER LEDs

Normal Operation : The unit should always have a steady **RED LED** showing (unless on-board logging is active - see below). The **AMBER LED** is **brightly LIT** but will flicker at 30 Hz (just perceptible). The intensity of the **AMBER** flicker will give some idea of how much power is being used to maintain the heater's temperature.

Please note: Unfortunately, a 2Y unit running firmware Rev 8062 will incorrectly turn off its status LED during normal operation. This has now been fixed! Please make sure you know your sensor type, then go here to get the latest firmware, then re-flash your 2Y unit and enjoy correct Status LED operation.

Normal - Heating : Just after the unit has been turned on the normal heating cycle will cause the **RED LED** to flash about *once a second* with a short **sharp** ON time, and **longer** OFF time. The **AMBER LED** will produce a small amount of flicker (30 Hz), but should be brightly lit. This should last **20 to 30 seconds** for a cold sensor. If the time is much over 30 seconds then either the battery voltage may be low or the sensor is placed where it is being excessively cooled by the gas flowing past it. A cool sensor position may result in reduced sensor life and inaccurate measurements.

Error - No Heating : If the sensor **cable is disconnected or damaged**, the **battery voltage too low or too high**, or some other problem with the heater circuit occurs, the **Status LED** will flash with a **fast regular** ON - OFF beat *twice a second* While these conditions remain, the **Heater LED** will be mostly **dim** but will flicker at a rate of about ten times a second (the unit is looking for a sensor or sampling battery voltage). This condition can occur during starting or when there is excessive battery drain during idle. It may be an indication of a poor battery or alternator/regulator, or connection to the wrong point of the vehicle's wiring.

Unlocked Heater PID : The Heater PID is a Proportional Integral Differential controller inside the unit firmware, which controls the sensor temperature. When the **Heater PID** is unlocked (lost control), a sharp **single OFF** flash is shown. This condition may indicate that the sensor is positioned where it is either too hot or too cool. (Prior to firmware Rev-48 this single OFF flash was also used to indicate a **Wideband PID** unlock too.)

It's possible for transient conditions to cause the **Status LED** to flash off briefly. As long as the **Heater LED** and **Power LED** remain on, then this is an indication of a **Heater PID unlock** condition.

A **Heater PID unlock** is not necessarily an error, but it does indicate either very rapid changes in heating or cooling of the sensor, and/or rapid changes in the ambient air-fuel ratio. If this occurs without an explanation (such as rapid changes in throttle position) then it may be an indication of an intermittent somewhere in the wiring, or an ageing sensor. Both ***Tech Edge*** displays and the [TEWBlog/WinLog logger software] indicate this condition.

Unlocked Wideband PID is now indicated by a sharp **double OFF** flash as shown here. The Wideband PID is another PID controller which controls the Nernst cell voltage Vs by varying the pump current Ip. Both PIDs must be locked for accurate sensor measurements. If you have earlier firmware and need to differentiate between the two conditions, then download the latest [HXF flash files] and re-flash your firmware.

2Y Manual- Overview RS232 Outputs Inputs Sensor LEDs **Logging** Display

Logging

The normal power-up mode of **2Y** series units is sending **logging frames** out through the RS232 port (as a serial data stream), to be displayed or logged to a PC or other RS232 device. Units with a **logger module** installed (model **2Y1M**) can store logging data **on-board**, for later retrieval by a PC. The unit can be commanded to save data in **on-board** mode by operating the **logger button** shown at left. All inputs, *analog*, *thermocouple* and *RPM*, as well as *lambda/AFR* are logged. When logging is enabled, the **Status LED** serves double duty, by indicating the current logging mode .

On-Board Logging : The logger module memory is a **1M** byte **non-volatile flash memory** that can store over 37000 frames of 28 bytes each. At a logging rate of 10 frames/sec (the default) that's over an hour. The Logging rate can be varied up to around 50 frames/sec (12 minutes of logging) or down to less than a frame every 2 seconds (about 5 hours). Logging [software] can retrieve logged data and send it out the unit's RS232 port (at 19,200 bit/s). It would take over 8 minutes to download the maximum data that could be stored.

PC Logging Software : Direct and unlimited logging from the RS232 port to the PC is performed by default. This allows the PC to store a virtually unlimited quantity of logging information. Win32 and other platform [Logging software] is available right now.

On-board logging can also be controlled by all recent ***Tech Edge*** displays. These displays have a button that turns on-board logging on or off with a single press. The display shows you logging status by showing "L on" or "LoFF" as appropriate, for about a second or so. This is a good deal more convenient than using the logger button on the unit

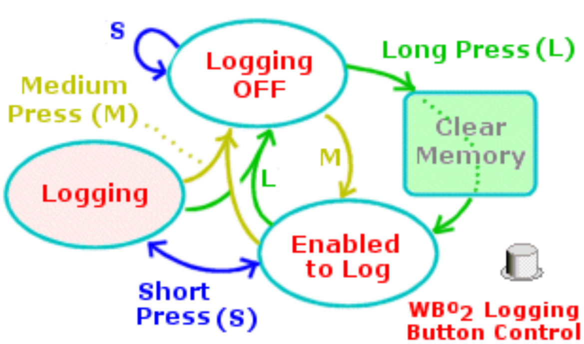
Logger Button Operation

A combination of **short**, **medium**, and **long** button presses commands the ***on-board logger*** to enter one of three states - **Stopped**, **Enabled** and **Logging**. The red **Status LED** shows you the current logging status.

- ***S****hort* press is from **0.2** to **1.5** seconds.
- ***M****edium* press is from **1.5** to **4** seconds.
- ***L****ong* press is greater than **4** seconds.

slow flash (on-off every 2 seconds) **= enabled for logging**.

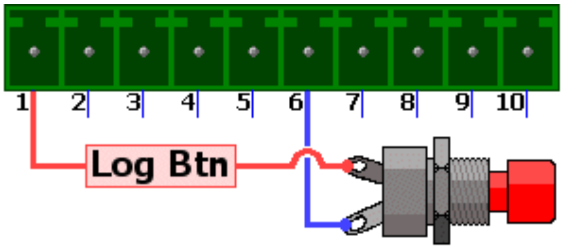
double flash (two flashes every second) **= logging**.



Here are the simple steps to using on-board logging - refer to the state diagram at left for the complete scheme :

1. a *medium* press puts the unit into *enabled* state, then ..
2. a *short* press **starts** or **stops** *logging* - multiple **sessions** are possible.
3. a *medium* press returns to the *stopped* state.
4. a *long* press from the *stopped* state enters the *enabled* state **AND clears all recorded data** (use before a new recording session).

External Logger Button



The **Log Btn** terminal of the **10-way green connector** may be wired to an external logger button, with the other terminal of the pushbutton connected back to the **GND** terminal. Please see the schematic at the right. Inside the unit, the external logger button is simply wired in parallel with the normal logger button, so both are used in the same manner.

The unit contains a pull-up resistor to keep the **Log Btn** terminal at 5 Volts while the button is not closed. The resistor only supplies a very small amount of current. The unit may be damaged by high voltages applied to the **Log Btn** terminal, It should only be left floating, or grounded to activate logging. Be careful never to connect this terminal to **12 Volts**.

A normally-open momentary pushbutton should be used. A large red panel mount version is shown here, suitable for the instrument panel of a drag car, but any ordinary pushbutton should work.

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2Y2 4-digit Display

The 2Y2 adds a functional on-board 4-digit 7-segment display. The original 2Y1 was supposed to have the same display, but we could not source a part we designed the PCB for.

In its basic form the 4-digit display shows AFR.

More information coming soon - we are hoping to update the display firmware before we publish this information

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