XoomSpeed Wireless Probe

What's in the box

In the shipping box, you should find the following items

- The base station
- The wireless probe adapter. This contains the LiPo battery, but the battery will be disconnected for shipping.
- A 5 pin DIN to 5 pin DIN lead
- A small bag containing wires used to connect to your probe and a jumper link

Initial testing

The simplest and fastest way to establish that the wireless setup is working is to connect both the base station and the probe adapter to a USB power source. This could be your PC or a phone charger. You will need two micro USB cables to do this.

Plug the base station in first – the micro USB connector is on the end of the case, next to the 'Output' connector. If you're using a PC, ignore any messages about needing device drivers, you won't need them at this stage. The display on the base station will come alive and after a few seconds will display the message 'Searching'. At the same time, the LED next to the 'Output' connector will be flashing red and green alternately. This means the base station is alive and well and is waiting for the probe adapter to start communicating.

With that done, it's time to power up the probe adapter. Again, the quickest way is to plug in a USB power source. Remove the small rubber cover on the end of the adapter housing to reveal the connector. Plug in the USB power source. It typically takes around 7 or 8s for the adapter and base station to recognise one another. The display on the base station will change to 'Running' and the LED on the base station will change to steady green.

If that all works, then you've successfully tested >95% of the electronics.

Now momentarily press the button on the end of the base station case between the 'Auxin 1' and 'Auxin 2' connectors. The display will change to show you the following pieces of information for 3s before returning to the normal operating display.

WARNING Don't press this button while the machine is actually probing as the probe is disabled while the info is on the screen.

1. VBatt. This is the probe's battery voltage. This should be 4.2V for a fully charged battery. When the battery discharges to 3.6V, the system goes into low power mode and cannot be used again until the battery is charged. With the battery disconnected and running on USB power, the battery voltage is not meaningful and is generally reported as 4.2V
2. RSSI. This is an indication of the received signal strength of the last message received by the base station from the probe. In general, this number should be greater than -90 to give reliable operation. If you see numbers of around -60 or -70, that's perfect.

3. SNR. The signal to noise ratio of the last received message. This is actually more important than RSSI and is an indication of the quality of the signal for the last received message rather than the signal strength. You'd like to see numbers of +4dB or better for this value. If it gets down to -6dB, then the system will likely still work, but the chances of an error occurring are significant.
4. Ferr. The frequency error between the probe and the base station. This is really an indication of the tolerances of the quartz crystals that provide the reference frequency to each radio module. Errors of up to 2.5kHz are perfectly normal and satisfactory.

Installing the base station on the mill

Installing the base station is very simple. Just connect the supplied 5 pin DIN cable between the 'Output' connector on the base station and the accessory port of your mill. For the PCNC440, you will need to retain the USB power source, but for all the other Tormach mills, the accessory port provides the power required to run the base station, so you can remove the USB connection. Just turn the mill on, and the base station will come alive. To operate correctly with the default configuration of the base station, the accessory port on your mill should be set to 'Passive probe'

Modifying your probe

Firstly remove the 4 screws holding on the lid of the probe adapter. These screws are M2.5 x 16mm, so you'll need a 1.5mm Allen key.

Once the lid is off, the electronics board simply lifts out to reveal the battery underneath. Once the battery is plugged in, the module runs under its own power. The battery is charged by plugging in the USB power source as in initial testing. The yellow LED on the PCB indicates that the battery is charging and it goes out once the battery is fully charged.

You should also see a loop of wire connected to a pair of pins on the pcb. This is where the probe connects.

If you have the base station connected to your mill and the battery plugged in, then once you see the 'Running' message on the base station, you can simulate the operation of the probe by removing and replacing the wire loop. When you remove the loop, you should see that a red LED on the probe board lights up, the LED on the end of the base station turns red and your mill's controller will indicate that the probe input is active.

Replace the wire link and the red led goes out, the led on the base station returns to green and the mill controller will indicate that the probe is in the normal state.

At this point, you have successfully tested all the components in the wireless system and all that remains to be done is to connect the probe's cables to the 2 pins where the wire loop is currently connected. Polarity's not important, so you may connect the wires either way round. You won't need the wire loop again, so use that and the additional wires supplied to make the connections.

One of the trickiest parts of the conversion is just removing the existing cable gland from the probe body. The Tormach SPU40 has thread locking compound on the gland which makes removal pretty difficult. The key thing is to notice that the inside of the gland body accepts a hex key and you

should use that to remove the gland. Whatever you do, don't try to remove any other way. That'll leave you with a mangled mess.

General use and battery life

Normal use of the wireless probe is no different from using a conventional wired probe. There are no switches on the probe and nothing you have to set up or configure in order to use it. The probe will wake up and start working within a few seconds of you turning your mill on and it will go back into its lowest power state within a minute of the mill being turned off.

If the battery runs flat or for any other reason the base station is unable to communicate with the probe, the probe signal to the accessory port on your mill will go to the active state, preventing any further probing operations from taking place. If it's a battery low condition, the base station will also sound an alarm buzzer to get your attention.

In its operating state, the probe's battery life is expected to be around 4 days. With the base station turned off and the probe in its low power state, the battery life is in excess of 1 month.

Charging time from a standard USB port is 3 to 4 hours to fully charged, so if the battery's low when you start work in the morning, 20 to 30 minutes on charge should be enough to last until the end of the day. Then leave it on charge overnight and it'll be fully charged in the morning.

The on board battery management circuitry is smart enough that the probe can be left connected to a USB power source permanently and charging will stop once the battery is fully charged. If the battery discharges below 3.5V, then the processor and radio module will be turned off. Power consumption in this state is not 0, so if the probe is going to be unused for more than a month, it's still recommended that it be left connected to a USB power source or that the battery is disconnected.

Running the PC setup App

The probe adapter and base station each have a number of configurable parameters. Most users won't need to alter them, but if you want to use the Aux In connectors to use an ETS at the same time as the probe or you want to run 2 probe systems within range of ne another, then you will have to change the configuration.

The configuration editor is available to download from

https://daleksw.com:8005/!/#xoomspeed/view/head/Machining/WirelessProbing/trunk

You will be asked to enter a username and password. Give the username as

tormach

and the password as

fusion360

The files available for download are

WirelessProbeConfig.msi – the configuration app
adafruit_drivers_2.3.4.0.exe
BaseStation.hex
Probe.hex

WirelessProbeConfig.msi is the installer for the configuration app. Download and run it.

If you got a message from Windows requesting a device driver when you first plugged in the base station, then download the adafruit_drivers package. That will install the correct device drivers and Windows should identify and connect to the base station.

The two .hex files are the firmware files for the probe and base station. Your wireless system will have been shipped with the latest version already installed, but any future updates will be available to download via these links. The configuration app is used to update the firmware.

The first thing to know about the app is that exactly the same configuration information is stored in both the base station and the probe. This means that if you ever replace one of the components, you can use the app to read the configuration from the remaining component and then write it to the replacement. In fact, as a general rule, it is good practice to write any changes you make to both components so they are always configured identically.

For a brief tutorial on how to use the app, see the video at

https://autode.sk/2UnIJBQ

This describes configuring the base station. The only difference with the probe adapter is how you go about getting it into 'Comms mode'.

In the video you can see that the COM port appears as soon as the USB connector is plugged in, but that you have to hold the push button in for 3s until the display shows 'Comms mode' before you can read or write the configuration.

For the probe adapter, the USB port is normally kept turned off to save on battery power. As a result, your computer won't connect when the cable is plugged in – although the probe battery will start to charge.

To put the probe into 'Comms mode' remove the rubber cover on the lid of the housing to reveal 2 pins underneath. Install the jumper that was included with the wireless probing system on those pins. The probe electronics periodically checks for the jumper and when it detects it, it goes into 'Comms mode' and the PC will recognise and detect the USB devce. This should take not more than 10s and will be much faster if the probe was already awake and communicating with the base station.

The probe and base station use the same device driver, so once you have one of them connected and working, the other should follow automatically.

Configurable parameters

Radio frequency (MHz)

Obvious enough, this is the frequency the radio module transmits on. The module is capable of working anywhere from 433 MHz up to 470 MHz, but the legal range varies from country to country. The default value for this parameter is 433.5 MHz which is fine in the UK and also USA. If you wish to run 2 wireless systems close enough that picking up one another's signal would be a problem, then make sure their frequencies are set at least 0.2 MHz apart.

RF power

Allowed range is 5 .. 23 with the larger values corresponding to higher powers. Obviously higher power will increase the range but at the cost of reducing battery life. Almost all of the testing of the wireless probe setup was performed at the lowest power '5', but increasing it to 10 for an increased safety margin is not unreasonable. The thing to look at is the RSSI and SNR reported by the base station when you press the button momentarily. If SNR is consistently showing +4dB or better, then the power is plenty. If SNR starts to drop to 0dB or below and RSSI is reading -90 or below, then it's time to consider increasing the RF power.

Base Station address

Probe address

These two values should be different and in the range 1 to 254. They allow the probe and the base station to identify messages from one another. If you had one wireless pair with addresses 1 and 2 and a second pair with addresses 3 and 4, the even on the same RF frequency each base station would only respond to signals from its own paired probe.

Enable Wireless probe

Generally this will be set to true, but if you ever want to use the auxiliary inputs on the base station on their own without the probe being present, then turn set this parameter to false. The base station will stop looking for the probe and monitoring its battery voltage and you can use a probe or ETS connected to the auxiliary inputs.

Probe polarity

The probe is expected to operate as a switch between the 2 pins on the probe circuit board. Most probes are normally closed and open when they make contact, but this parameter allows you to convert a probe with the opposite characteristic.

Output polarity

The base station's output is a switch to ground. This parameter allows you to select whether it's normally closed and opens when one of the inputs is activated or the other way round. To use with the accessory input on a Tormach mill, the normal configuration would be to set PathPilot for a passive probe and set this parameter to normally closed.

Auxin 1 disconnected state

When the auxiliary input is enabled, this parameter determines how the input will be read if the probe or ETS is disconnected. For a Tormach passive probe or an ITTP, the attached device is a switch to ground, so this parameter should be set to 'Float high'.

Auxin 1 polarity

Sets the polarity of the auxiliary input. Most passive probes (like the Tormach SPU40 or ITTP) are normally closed switches to ground. For that type of device, the correct configuration is to have the disconnected state set to 'Float high' and this parameter set to 'Normally low/High when tripped'. Active probes on the other hand may be the other way round.

Enable Auxin 1

Set to 'Enabled' if you wish to use Auxin 1, otherwise leave it 'Disabled'.

Auxin 2 disconnected state

Auxin 2 polarity

Enable Auxin 2

These parameters are the same as the above 3 except that they control the function of AuxIn 2.

Ping period (ms)

Sleep period (ms)

High alert period (ms)

Message repeats

The above 4 parameters control the behaviour of the radio link and the power saving features of the wireless system. Please don't change them from their default values.

Low battery hysteresis

Low battery voltage

These control when the system decides the probe's battery is too low to continue. If the probe battery voltage drops below 'Low battery voltage' the base station will sound an alarm and set its output to the triggered state. This will prevent any subsequent probing operations. The base station will not allow normal operation to resume until the probe battery voltage rises above 'Low battery voltage' + 'Low battery hysteresis'.

The default values of these parameters are 3.6V and 0.1V respectively.