

The **Deeter** Group®

Wireless Site Survey Tool



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1 Introduction

The Wireless Site Survey Tool provides a quick and simple means of determining the radio signal strength between two points. This information is invaluable when specifying the equipment needed for a wireless sensor system based on the IEEE 802.15.4 protocol using the 2.4GHz ISM radio frequency band.

When assessing a site, it is not always possible to know just by observation or by mapping distances, where to place antennas for optimum communications reliability and whether routers are required. Although manufacturer's figures will state a communications range, this is usually a maximum figure achievable under the most favourable conditions. In a real installation it may not be possible to place antennas at the required height, and there will be absorption and complex interference effects, not only from objects directly between antennas, but also from the surroundings. Signal attenuation is often difficult to judge, even for a simple line-of-sight installation, and actual range will almost certainly be shorter than the published figures. The Wireless Site Survey Tool provides an empirical means to assess a site, helping to decide whether signal routers are required, how many might be needed, and determining the best position for antennas.

Attenuation will fluctuate with changes in weather, with growth and moisture content of nearby vegetation, and with the movement of obstacles or radio reflective surfaces. When assessing a site, a margin needs to be added to the signal strength to be sure that communications will be reliable under worst-case conditions. The Wireless Site Survey Tool provides an indication of the signal strength, and by ensuring all links between nodes in the network are above a lower limit, confidence can be gained in the future reliability of the proposed network.

2 Deeter Wireless Sensor System Devices

The basic Deeter Wireless Sensor System consists of a network coordinator (**Base Station**) and a single sensor node (**Sender** or **LVCS-RF**). To help bridge the gap between sensor and Base Station or to enable an alternative path for the signal, up to four **Routers** can be added to form a network.

3 Wireless Site Survey Tool Devices

The Wireless Site Survey Tool consists of two devices: a network coordinator (labelled '**Base Station**'), and a sensor node (labelled '**Sender**'). These are portable, battery-powered devices, with an LCD display and a keypad consisting of three push-buttons. They do not have the process outputs of the normal Deeter Base Station or the inputs of a Deeter Sender, but for communication purposes, behave in the same manner.

Routers are not part of the Site Survey Tool because these may boost a signal and hide the signal-strength information we are trying to measure. The survey may discover that one or more Routers are required in the final installation to give reliable signal reception over longer distances. In that case, the Survey Tool can be used to discover the best positions for the Routers and then continuing the survey from point-to-point.

4 Network Parameters

4.1 LQI

The signal strength will appear as a number between 0 and 255. This number is called the Link Quality Indicator (LQI) and is an indication of the amplifier gain required to receive the signal. It is not a true measure of signal strength with recognisable units, but provides a useful means to quantify relative strengths.

4.2 Channel

The Industrial, Scientific and Medical (ISM) radio band based at 2.4GHz has 16 available channels, numbered 11 to 26.

The presence of other radio equipment in the area may affect communications reliability. The standard Deeter wireless network devices will change channel automatically to find a better signal if communication becomes unreliable, so channel choice is less important for the final installation, but for the purposes of a site survey, a channel should be found that is relatively free from interference to give comparable results.

Note: Channel 26 is no longer recommended because typical frequency deviation can result in transmitting beyond the permitted ISM frequency band.

4.3 Node

The Base Station can communicate with up to 8 Senders in a 'star' network and each registered Sender has a node number.

The site surveying process can be performed more efficiently by using additional Senders. Placing Senders at various locations will allow comparisons to be made of the signal strengths without having to repeatedly move Senders between measurements.

4.4 MAC Address

Every network device has a unique identifier called the Media Access Control (MAC) address. A registration process is required to allow devices to join a network and during this process MAC addresses are exchanged between devices. After registration devices will only communicate with other devices assigned to their network, hence several networks can operate in the same vicinity.

4.5 Transmit Power

The transmitter power is expressed in decibels referenced to 1mW (+6dBm = 4mW, 0dBm = 1mW, -6dBm = ¼mW).

The default transmit power is set to +6dBm. Lower levels can be selected to simulate worse-case conditions of signal attenuation.

In the USA, Canada and other places where local radio communications regulations permit higher power transmissions the maximum transmit power is +18dBm. This is implemented by a special software build. This high power setting is particularly useful when an antenna extension cable is needed in order to mount the antenna higher above the ground.

5 Site Survey Tool Sender

The following descriptions refer to the buttons as labelled in Figure 1:



Figure 1

On power-up the Sender display will briefly show the message 'Deeter Wireless Survey Sender' followed by a firmware version number and the MAC address of the Sender. The word 'Scanning' will then appear while the Sender tries to communicate with a Base Station.

If previously registered with a Base Station that is in range and powered on, the default display will soon appear showing channel number and LQI as in Figure 2. The transmit interval is fixed at 1 second, so the LQI may fluctuate with that frequency.



Figure 2

Pressing SW2 will show the MAC address of the Base Station – see Figure 3. Press SW3 to return to channel number and LQI.



Figure 3

The words 'Lost connection' will appear if communication with the Base Station stops.

To clear registration with the Base Station, hold down SW1 while powering-on the Sender.

To register with a Base Station, power on the Sender while performing the registration menu options at the Base Station (described below).

6 Site Survey Tool Base Station

On power-up the Base Station display will briefly show the message 'Deeter Wireless Survey Tool' followed by 'Starting Network'. The default Base Station display will then appear, similar to Figure 4.

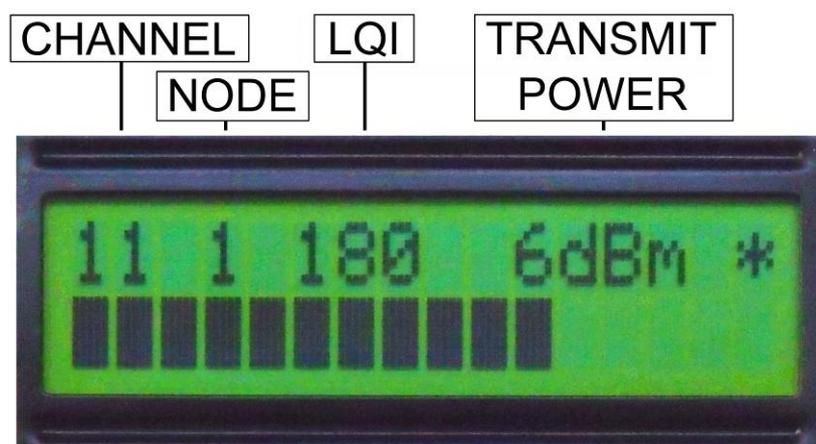


Figure 4

LQI is shown as a number on the top row and is also represented by a bar graph along the bottom row.

The three buttons on the Base Station can be used to access menus to view or change network parameters:

6.1 Changing Channel

- From the default screen, press SW2 twice to enter Setup
- Press SW1 twice to reach the 'Survey Tool Channel' screen
- Press SW2 to select a new channel, incrementing from 11 to 26, followed by 'Auto' and then wrapping back to 11
- If the channel is changed, then pressing SW1 twice will reach a 'Settings Changed' screen. Press SW2 to save changes or SW3 to cancel. No response at any menu screen will eventually time-out and return to the default display without change – equivalent to cancel.

6.2 Changing Transmit Power

- From the default screen, press SW2 twice to enter Setup
- Press SW1 three times to reach the 'Survey Tool dBm' screen

- Press SW2 to select a transmit power. The default is 6dBm, with options of -12dBm, -6dBm and 0dBm
- If the setting is changed, '<SET>' will appear below SW3. Press SW3 to reach the 'Settings Changed' screen or alternatively press SW1 to reach this screen. Press SW2 to save changes.

6.3 Registering a Sender

- From the default screen, press SW2 twice to enter Setup
- Press SW1 four times to reach the 'Register' screen
- Press SW2 to start a search for new devices. Power-on the Sender to be registered while the 'Allow join' countdown takes place.
- If registration is successful, the Base Station display will show the MAC address of the new device and the Sender will be assigned the next available node number. Press SW3 to exit

6.4 Clearing Registration

This function will not normally be needed as the Survey Tool is shipped in pre-registered Base Station / Sender pairs.

- From the default screen, press SW2 twice to enter Setup
- Press SW1 five times to reach the 'Reset System' screen
- Press SW2 to clear all registered devices

6.5 Viewing Nodes

- From the default screen, press SW1 to enter the 'Node #' screen
- Press SW2 to select the next node. Numbers cycle from 1 to 8 and wrap back to 1
- Press SW3 to return to the default display. The LQI shown will be for the Sender node number now selected

7 Operational Guide

Before starting a survey, make sure the batteries in all devices are fresh.

Check that all Senders are registered with the Base Station. If a Sender has previously been used with another Base Station, it may refuse to join the network. In this case, clear the Sender registration first by powering it on with SW1 held down, and then try the registration process again.

If there are other sources of 2.4GHz in the area (other IEEE802.15.4 networks, WiFi or Bluetooth), the initial choice of channel should be made by selecting 'Auto' at the Base Station. This will cause a scan of all channels and one with the least background activity will be chosen. If left in Auto the channel may change again following loss of communications, so after using Auto, go back to the channel menu and save again. All measurements will then be performed using the same channel.

For most sites, the position of the Base Station and the sensor (Sender or LVCS-RF) will be determined by the equipment they must attach to. A logical starting point for assessing a site might therefore be either of these end positions. However, extensions kits are available that allow the antennas to be placed up to 3m away from the devices, and these might be an option to consider. The extension cable will attenuate the signal slightly but much stronger signals can be achieved from a well placed antenna.

Sensor node transmitters and receivers are able to enter a low-power sleep state, thus using little power and are capable of running from internal batteries. Receivers at the Base Station and Routers must be on at all times and require more power. Although they could be supplied by large external batteries, these devices are

usually powered from the mains supply and come with a main adapter. When surveying a site using the battery-powered site survey tool, remember that a power source will be needed at all but the sensor nodes.

An LQI less than 60 will indicate a poor signal, on the borderline of break-up, and will almost certainly lead to unreliable communications. Below 100 and there could be a reliability problem if the site is susceptible to wide fluctuations in conditions. A Router or additional Routers should be considered where LQI falls below 100 in a network.

Standard Deeter network devices sold in Europe have a maximum transmit power of +6dBm. Regulations in other parts of the world permit greater transmit power and the Deeter products sold elsewhere may transmit up to +18dBm. When using the Site Survey Tool for assessing these installations, a lower threshold of LQI should be considered.

An important feature of IEEE802.15.4 networks is their self-healing capability. If a link between two nodes fails, new links are automatically formed to try and complete the route from sensor to Base Station. Therefore, as well as bridging a gap, Routers might also be added to provide an alternative path for the signal. This would be particularly suited to installations where the direct path is susceptible to interference.

8 Specifications

Dimensions Height: 150mm (body) + 110mm (antenna) = 260mm
 Width: 90mm
 Depth: 26mm

Radio Frequency	2.4GHz ISM band	Communications Protocol	IEEE 802.15.4
Antenna Type	Half-wave dipole	Receiver Sensitivity	-96dBm
Batteries	2 x AA 1.5v	Operating Temperature	-20°C to +50°C

9 Regulations

Antenna

The system must only be used with the antennas supplied.

CE Marking

The models approved for use within the European Union have a CE mark to show compliance with EU Directives and European regulations. In particular the maximum RF transmission power is limited to +6dBm in order to comply with ETSI regulations.

FCC Part 15 Compliance

The system uses an RF Transceiver module that complies with US Federal Communications Commission Part 15 Regulations for intended RF emissions.

Each device is permanently labelled with either of the following statement:

*Contains:
 FCC ID TYOJN5139M4
 IC 7438A-CY0512M4*

*Contains
 DCC ID TYOJN5148M4
 IC 7438A CY05148M4*

Modular Approval for mobile RF Exposure conditions require that the antenna used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Repair and Servicing

Do not attempt to repair this product yourself. Contact the Deeter Group for product servicing or repairs.

Disposal and Recycling

At the end of the equipment life these products should be recycled according to the European Directive on Waste Electronic Equipment.

Outside the EU dispose of this product according to local recycling or waste disposal regulations.

This equipment is expected to have a long service life and the regulations will most likely change during that time.

This product must not be disposed in household waste.