

# **WE-030B Antenna Analyzer Manual and Supplementary Information**

## **1.0 Description**

This product is designed to perform graphical SWR and Return loss measurements to enable easy and proper adjustment of HF antennas. It is lightweight, small, and portable.

The design is based on stable DDS signal sources, an SWR bridge, and a precision RF signal processing IC.

The BNC socket is secured to the PCB, and the PCB secured to the case in the immediate vicinity of the connector by four screws. Care was taken in the design to make sure this mechanical interface was robust.

Centre frequency and sweep width are entered via the keypad and the resultant SWR and return loss information is obtained from the graphical LCD display using a marker.

The fine frequency resolution of 200 Hz (10 kHz span) allows analysis of systems with a high Q, e.g. magnetic loop antenna.

The effects of changes to the antenna dimensions, matching networks, loading coils etc can be quickly seen to guide adjustments for minimum SWR.

The incorporation of an accurate  $\pm 180$  degree phase detector and appropriate software routines enables measurement of the phase as well as the magnitude of the reflection coefficient. From this complex impedance  $Z = R + jX$ ,  $|Z|$ , L, C, magnitude of the reflection coefficient  $|\Gamma|$ , and phase of the reflection coefficient  $\theta$  of the load are calculated and can be displayed at the marker frequency.

Measurement reference plane is also adjustable. This means impedance can be measured at the end of an intermediate coaxial cable directly.

A secondary RF level measurement mode is included. This is useful for signal strength measurements etc.

The product may also be used as a fixed level signal source.

The product is factory calibrated with open circuit, short circuit and 50 ohm load terminations. This enables three-term error correction for enhanced accuracy.

These correction coefficients are permanently stored. They are overwritten when the product is re-calibrated.

The product is rechargeable and features auto power down to maximise operational time.

## 2.0 Specification

### Electrical

#### 1) Reflection measurement mode

Centre frequency range:	300 kHz – 30 MHz
Centre frequency accuracy:	+/- 30 PPM @ 25 deg C
Sweep widths:	10kHz to 10 MHz in 1,2,5 sequence and CW
Sweep time:	approx. 1 second repetitive
Frequency Resolution:	51 points per sweep
Output level:	4 dBm +/- 3 dB
Harmonics:	< -36 dBc
Reflection measurement range:	Return Loss: 0 to 45 dB SWR: 99 to 1.0
Measurement resolution:	0.1 dB
Directivity:	> 45 dB
Source Match:	> 22 dB
Marker functions:	Normal, Marker to frequency of minimum SWR, Centre frequency to marker.
Complex Measurements:	$Z=R+jX$ , C, L, $ Z $ , $ \Gamma $ , $\theta$
Measurement range:	$R<999$ , $ X <999$ , $C<999999\text{pF}$ , $L<999999\text{nH}$ , $ Z <999$ , $ \Gamma <1$ , $-180<\theta<180$
Port Extension:	10 metres max. (RG58 Cable)

#### 2) RF level measurement mode

Frequency range:	300 kHz – 30 MHz
Level range:	+7 dBm to - 35 dBm
Level variation with frequency:	within +/- 1 dB

#### 3) Signal Generator Mode

Frequency range:	300 kHz – 30 MHz
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Frequency accuracy:	+/- 30 PPM @ 25 deg C
Output level:	4 dBm +/- 3 dB

### General

System Impedance:	50 ohm
Connector:	BNC
Display:	Graphical 64 x 128 LCD Monochrome backlit
Supply:	Internal 2xAA 1300mAH NiMh
Battery life:	> 2.5 Hrs continuous operation
Charging:	3 hr fast charge with supplied PSU adapter. Input: 90 – 264V AC Output: 5V, 1A UK: 3 pin, Euro: 2 pin Universal type supplied for North America, Australia, etc
Auto power off:	Switches off 5 minutes after last key press

### Mechanical

Size:	155mm x 96 mm x 30mm approx.
Weight:	250g approx.
Case:	Black ABS plastic

### Environmental

Operating temperature range:	0 – 50 degrees Celsius
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### Standards

CE Compliant ( EN61010-1, EN61326-1, EN61326-2-1)

## **3.0 Operation Instructions**

### **SWR/Return Loss/ Impedance Measurement**

Hold down PWR key for about four seconds until unit powers up. There are three main display modes, Parameter Set (centre frequency and span), Marker and Impedance Measurement. Pressing the E key will toggle between the three modes.

On first use Parameter set mode is entered. Otherwise the last used mode will display. Return loss versus frequency displays on the left half of the screen. The vertical axis is marked in 10 dB steps.

The following functions are available in this mode:

→ Move the cursor clockwise to select different digits for the centre frequency or the span width.

← Move the cursor anti-clockwise to select different digits for the centre frequency or the span width.

↑ Scroll the digit up.

↓ Scroll the digit down.

### **Marker Display Mode**

In this mode the values of SWR and return loss are displayed at the marker frequency.

The following functions are available in this mode:

→ Move the marker to the right.

← Move the marker to the left.

↓ Move the marker to the centre of the resonance dip.

↑ Change the centre frequency to the marker frequency.

To set the centre frequency to the dip use first ↓ and then ↑. To return to Parameter set mode, press E key again. This enables the Span or CF to be re-adjusted if desired.

If the span and centre frequency combination result in the sweep exceeding the frequency limits of 300 kHz and 30 MHz, 'Invalid Entry' is displayed.

When measuring a high Q antenna e.g. magnetic loop, make sure the resonance dip is not missed by setting the span sufficiently small.

### **Impedance Measurement Mode**

Impedance is measured at the marker frequencies set within the frequency span width by using the ← → keys.

If  $|z| > 999$  then the parameters displayed are  $|Z| > 999$  and the magnitude and phase of the reflection coefficient.

If  $|Z| < 999$  then the parameters displayed are:  $Z=R+jX$ , the value of L or C computed from X, and the magnitude and phase of the reflection coefficient.

The measurement plane can be altered by adjusting parameter D with the ↓ and ↑ keys.

I.e. to measure the impedance at the end of a length of coaxial cable, with the cable open circuited at the end, adjust D until a reflection coefficient phase of 0 degrees is measured, then connect the load to be measured. (E.g. the base of a vertical antenna) D approximately corresponds to the length of the cable in cm for RG58.

The product is turned off by momentarily pressing the PWR key.

## **Calibration**

With nothing connected to the RF port, the displayed Return loss level should typically be  $< \pm 0.25\text{dB}$ . Also the measured reflection coefficient phase should typically be  $< \pm 1$  degree.

If the displayed parameters are significantly greater than this, then consider re-calibration.

To do this power off unit. Power on whilst holding down the E key. This brings up the Utilities Menu. With nothing connected to the RF port, press  $\uparrow$  key for Cal. Press  $\downarrow$  key to calibrate the internal phase and amplitude detector. Press the  $\rightarrow$  key to perform short, open and load calibration. Connect short, open and load standards as directed.

Do not proceed through the calibration utility menu without these terminations, or the existing stored calibration data will be lost!

Good quality BNC short and load terminations are adequate for this. The BNC socket can simply be left open for the open circuit calibration.

The unit will then return to the Utilities menu. Press  $\leftarrow$  key to return to normal operation.

## **RF Level Mode**

To select RF level mode, power off unit. Power on whilst holding down the E key. This brings up the Utilities Menu. Press  $\rightarrow$  for RF Functions, Then select RF Level mode with the  $\uparrow$  key.

Press E to exit back to Utilities Menu. Then  $\leftarrow$  to return to frequency and span setting mode.

## **Signal Generator Mode**

To select RF Signal Generator mode, power off unit. Power on whilst holding down the E key. This brings up the Utilities Menu. Press  $\rightarrow$  for RF Functions, Then select signal generator mode with the  $\uparrow$  key.

Press E to exit back to Utilities Menu. Then ← to return to frequency and span setting mode.

## **Battery Charging**

Use supplied 5V 1A regulated adapter only for charging. Momentarily pressing the PWR key during charging will display “ Battery Charging” When the battery has finished charging pressing the PWR key will show the usual PWR up display instead.

The unit can not be operated with the charger connected.

Battery life is not guaranteed. If internal batteries need replacing, then replace with 1300mAH NiMh AA. Replacing with higher capacity will cause battery charging to operate incorrectly.

Do not interrupt the charging supply during charging. This may result in overcharging the battery, reducing battery life.

Only charge the battery when the ambient temperature is between 10 and 35 deg C  
Do not charge the unit in a confined space or near naked flame.

## **Reset**

Holding down the PWR key and ↓ key together for 3 seconds restores the default settings of the instrument. Calibration data is unaltered.

## **4.0 Limitations**

This product, similar to most products of this type is susceptible to strong interference within HF band. If this occurs, then try operating at a different time of day.

Do not expose the product to water. Light splash resistant.

Due to the ABS case moulding process, some slight cosmetic defects may be visible under certain lighting conditions.

## **5.0 Precautions**

This product, similar to all products of this type, emits a low power radio frequency signal.

When connected to an antenna, it may cause interference to neighbouring radio communication systems. Connect for only as long as is necessary.

The user is responsible for the consequences of any interference caused.

The antenna port connector is ESD protected. However, excessive static build up on an antenna may cause damage to the product when connected. As a precaution, discharge antenna before connecting.

## **6.0 Servicing and Repairs**

The product may be returned to Waterbeach Electronics Ltd for servicing and repairs.

## **7.0 Warranty**

The warranty covers defects in material and manufacture under normal use for one year (excludes batteries).

**! Avoid touching internal electronic circuitry- Static sensitive!**

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