Instruction Manual

Model 2650 3.3GHz Spectrum Analyzer

General Safety Information

This portion provides general information for your safety. Before using this unit, please read all Warning notes on the back of the unit

- This Instrument must be used only by qualified personal that are aware of the risks of exposure to electric shock while performing electrical measurements on open circuits.
- Never use unit under severe whether conditions especially thunder storms.
- Never work in extremely close proximity from Hi-Power transmitting antennas without taking proper safety precautions listed by FCC.
- Always ground the unit to insure static electricity protection in stationary applications. Not properly grounded unit can damage tested circuits and in some cases expose user to the electric shock.
- In the case unit starts producing abnormal sounds, smell or smoke, immediately turn off the unit, disconnect AC adapter and remove the battery. Contact authorized repair center to arrange service.
- Any adjustments, calibrations, maintenance or repair work could be performed only by authorized repair center.
- Never use an AC adapter other than the one specified. Using unspecified adapter might damage the unit and avoid manufacture warranty.
- Never use a battery other than the one specified, because doing so it might damage the unit and avoid manufacture warranty. When removing or installing the battery, turn off the unit and disconnect the AC adapter first.
- For fuse replacement, disconnect the AC adapter first, open the battery compartment and remove the battery. Fuse located under battery in the battery compartment. Use only 5A/120V slow-blow fuse. Always use specified fuse. Using unspecified fuse might damage the unit and avoid manufacture warranty.

Warm-up time

To ensure the 100% specified measurement accuracy the 2650 needs to have at list 10 minutes of warm-up time, before performing any crucial measurements in the field. Always perform 10 min warm-up if unit is going to work in any stationary applications.

Table of Contents:

1. Overview

1.1 Product Introduction

2650 is ideal hand held spectrum analyzer capable to deliver performance and functions comparable to bench stationary analyzers.

1. Compact and light

The external dimensions are (W×H×D) 6.4×2.8×10.2" (162×70×260 mm). Weight is 3.7lb. (1.7 kg) including the battery. That alone make 2650 versatile hand healed unit for field use alone with stationary applications.

2. Frequency range 50kHz to 3.3GHz

This bandwidth is cover W-CDMA, CDMA, PDC, PHS, GSM, 2.4GHz band wireless LAN, Bluetooth, etc.

3. Operation time on battery power up to 100 min

2650 will work approximately 100 Min on fully charged battery (with display back light off).

4. Bench type, stationary analyzer capabilities

2650 guarantees a highly stable frequency axis by PLL synthesizer system. Center frequency step setup resolution is 100kHz. Displayed average noise level -110dBm or less. Turns, a broad dynamic range is secured and the reference level can be set in 1 dB steps.

5. Functions

- Measuring functions: Channel power measurement, channel leakage measurement, Occupied frequency bandwidth measurement, Electric field strength measurement, and Magnetic field strength measurement.
- Electric field strength measurement:
- Optimum for measurement of cellular phone and wireless LAN working environment.
- Magnetic field strength measurement:
- Optimum for EMI design verification and evaluation of printed circuit boards.
- Calculation functions: MAX HOLD, MIN HOLD, AVERAGE, OVER WRITE
- Marker * peak search.
- Save/load

6. Auto tuning

The center frequency is set at the spectrum of the maximum level in the 3.3GHz band, and in addition, optimum reference level, resolution bandwidth, video bandwidth and sweep time are set when the AUTO TUNE key is pressed.

7. Auto range

The resolution bandwidth, video bandwidth and sweep time are set automatically based on the frequency span settings. It is also possible to set auto range motion only one out of resolution bandwidth, video bandwidth and sweep time.

8. Printing capability

Then PT2650 (optional printer) is connected to the analyzer, user could use print command to get screen image printout. PT2605 printer operates on both AC adapter and alkaline standard AA batteries. Battery-powered, printer operates for approximately 30 min (printing time).

9. Display resolution.

Trace resolution could be as high as 1,001 points (in the horizontal axis) then it is displayed on PC screen by using 2650 optional PC Software.

1.2 Standard accessories

1) AC adaptor BC 2650
2) Soft carrying case
3) Accessory pouch.
4) Fuse (It has been installed in the inside)
5) Operating manual
6) Ni-MH Battery BP 2650 (Refer to "6.4 Installing the battery" for details.)

1.3 Optional accessories

1.) Dipole antenna AN 301, AN 302, AN 303, AN 304
(Refer to "19.4 Electric field strength measurement" for details.)

2.) Magnetic field probe PR 26M with a dedicated double-shielded coaxial cable.
(Refer to "19.5 Magnetic field strength measurement" for details.)

3.) PC software AK 2650 (Refer to "24. PC Software" for details.)

4.) Printer with AC adaptor. 4pcs of AA batteries, a roll paper.
(Refer to "21. Printing" for details.)

5.) Roll paper for optional printer PX 2650 (with 10 rolls)

6.) SMA coaxial cable CC 301(50cm), CC 302(1m), CC 303(1.5m)

Bandwidth is DC to 10GHz (VSWR< 1.5) performance could change by bending and deteriorate by repeating the insertion and extraction.

2 Specifications

Frequency

Frequency range	50kHz to 3,3GHz
Center frequency	
Setting resolution	100kHz (Allows rotary encoder, numeric key and function key)
Accuracy T : Sweep time (s)	within ± (30+100T) kHz±1dot (frequency span : 200kHz to 10MHz, RBW : 30kHz, 23 ±5°C) within ± (100+700T) kHz±1dot (frequency span : 20MHz to 3.3GHz, RBW : 100kHz, 23 ±5°C)
RBW frequency error	within ± 6% of RBW (RBW : 3kHz, 30kHz) within ± 30% of RBW (RBW : 100kHz to 3MHz)
Frequency span	
Setting range	0Hz (zero span), 200kHz to 2GHz (1-2-5step) and 3.3GHz (full span)
Accuracy	within ± 3% ± 20TkHz ± 1dot (Frequency span: 200kHz to 10MHz, 23 ±5°C)
T: Sweep time (s)	within ±3% ±200TkHz ±1dot (Frequency span : 20MHz to 3.3GHz, 23 ±5°C)
Display resolution	Frequency span/250 Frequency span/1000 (only the measurement by RS-232C communication)
Display dot number	251dots, 1001dots (only the measurement by RS-232C communication) (The unit displays data in 251 horizontal dots, but it internally captures the trace in 1001 dots)
Resolution bandwidth	3dB bandwidth
Setting range	3kHz to 3MHz (1-3step) and AUTO
Accuracy	within ±20%
Selectivity	1 : 12 (typical, 3dB : 60dB)
Video bandwidth	100Hz to 300Hz (1-3step), OFF and AUTO
SSB Phase noise	-90dBc / Hz (typical, 100kHz offset, RBW : 3kHz, VBW : 100Hz, Sweep time : 0.3s)
Spurious response	less than -60dBc
Harmonics	less than -40dBc (50kHz to100MHz) less than -45dBc (100MHz to 3.3GHz)

Amplitude

Reference level	
Setting range	+10 to -40dBm (1dB step)
Accuracy	within ±0.8dB ±1dot (center frequency : 100MHz, RBW : 3MHz, VBW : OFF, ATT : 0dB, 23 ±5°C)
Unit	dBm, dBV, dBmV, dBµV, dBµV/m, dBµA/m (dBµV/m and dBµA/m is used the measuring function)
Average noise level	-110dBm (typical, center frequency : 100MHz RBW : 3kHz, VBW : 100Hz)
Freq. Characteristic	within ±2.0dB ±1dot (50kHz to100MHz) within ±1.0dB ±1dot (100MHz to 3.3GHz)
Input impedance	50ohm
Input VSWR	less than 2.0
Input attenuator	
Operating range	0 to 25dB (1dB step), coupled with reference level
Switching error	within ±0.6dB
RBW switching error	within ±0.6dB
Display resolution	0.4dB (10dB/div), 0.08(2dB/div)
Display dot number	200dot
Display scale	10dB / div, 2dB / div
Scale	within ±0.2dB / 2dB ±1dot
Accuracy	within ±0.8dB / 10dB ±1dot within ±1.6dB / 70dB ±1dot
Input damage level	+20dBm (CW average power), 25VDC
Input connector	SMA (J)

Sweep

Sweep time	
Range	10ms to 30s (1-3step, frequency span: 0 to 2GHz) and AUTO 30ms to 30s (1-3step, frequency span: full span) and AUTO
Accuracy	within ±0.1% ±1dot (frequency span: 0 to 2GHz) within ±1.5% ±1dot (frequency span: full span)
Trigger mode	AUTO (frequency span : zero span)
Detection mode	Positive peak, Negative peak, Sample (when sweep time is 10ms or 30ms, only Sample can be set)

Functions

Marker	NORM: displays frequency (7 digits max) and level (4 digits max) at marker point.

		DELTA: displays difference frequency and level between 2 markers.
Peak search		NORM: searches a peak point within 10div. Available NEXT peak (10max).
		ZONE: searches a peak point within a zone designated by center and width. Marker moves to a peak point each sweep.
Calculation		NORM, MAX HOLD, MIN HOLD, AVERAGE, OVER WRITE MAX/MIN HOLD: 2 to 1024 times, AVERAGE: 2 to 256
Measuring		Channel power, Adjacent channel power, occupied frequency bandwidth, Electric field strength (needs optional antenna), Magnetic field strength (needs optional magnetic field probe) measurement.
AUTO tuning		When pressing AUTO TUNE key, the maximum level spectrum within 3.3GHz bandwidth is adjusted to center, and reference level, RBW, VBW and sweep time are adjusted to optimum values.
Save / Load		
	Save	Saves 100 traces and 100 setups
	Load	Loads 1 trace and 1 setup

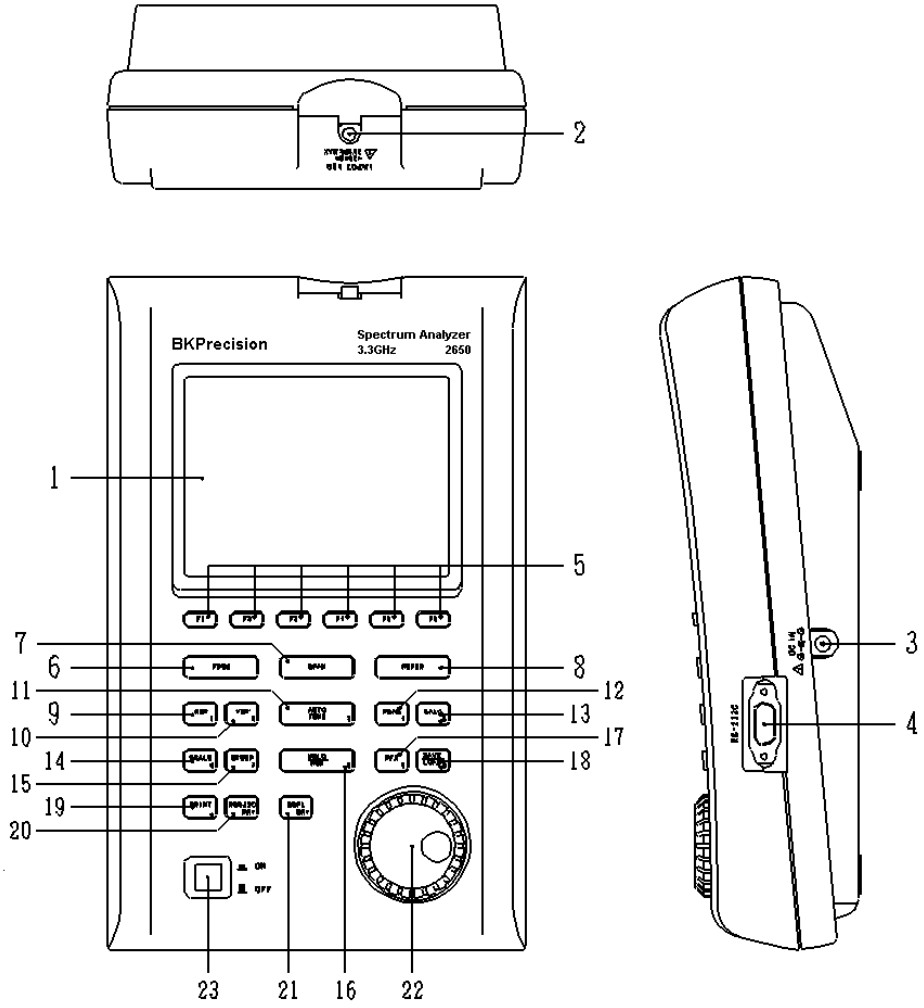
General

Communication		
	Interface	RS-232C
	Baud rate	2,400 to 38,400bps
Hard copy		allows direct hard copy with an optional printer
Display		
	Display	LCD
	Backlight	CFL backlight
	Resolution	320 (H) × 240 (V) dots
Power source		
	Battery	Ni-MH Battery (included)
	External DC	Pin jack, DC5V / 4A (BC 2650 included)
Operating temperature		0 to 40°C (Guaranteed at 23 ±10°C, without soft carrying case)
Operating humidity		less than 40°C / 80%RH (Guaranteed at less than 33°C / 70%RH, without soft carrying case)
Storage temperature		-20 to 60°C, less than 60°C / 70%RH
Dimensions (WxHxD)		6.4 x 2.75 x 10.25 (162 × 70 × 260 mm)
Weight (approx.)		3.75 lb. (1.7kg) included battery
		3.3 lb (1.5kg) without battery

2.1 Front panel view.

BK Precision Corporation reserves the right to make changes in design, specification and other information without prior notice.

3 2650 Front Panel at a Glance



1) LCD display

High-resolution 320×240 liquid crystal display. It simultaneously displays traces (10×8 div), various setting values, measured values, etc.

2) Input connector

SMA J type input connector.

3) External power connector

Power connector. In use for external BC 2650 AC power adapter.

4) RS-232 connector

RS-232C port.

5) Function keys (F1 to F6)

Flexible, function key.

6) Center frequency key

This key is used to set the center frequency. Center frequency can be set in range from 0 to 3.3GHz (100kHz step).

7) Frequency span key

Use this key to set the frequency span. It can set between 200kHz to 2GHz, ZERO SPAN and FULL SPAN (3.3GHz).

8) Reference level key

Set the reference level. It can set between +10dBm to -40dBm (1dB step).

9) Resolution bandwidth key

Use this key to set the Resolution bandwidth. It can set between 3kHz to 3MHz.

10) Video bandwidth key

Use this key to set the video bandwidth between 100Hz to 300kHz or OFF.

11) AUTO tuning key

Automatic tunes measured signal spectrum within 3.3GHz bandwidth. This does not operate normally when the signal level is -40 dBm or lower and the input frequency is 50 MHz or lower and the frequency span is ZERO SPAN and FULL SPAN.

12) Measuring function key

Available for Channel power, channel leakage, occupied frequency bandwidth, Electric field strength and Magnetic field strength measurement.

13) Calculation function key

Available for Max hold, Min hold, Average and Over write.

14) Display scale key

Use this key is used to select the display scale of amplitude from 2dB/div or 10dB/div.

15) Sweep key

This key is used to set sweep time between 10ms to 30s or set the detection mode.

16) Hold/Run key

Stops or restarts the measurement.

17) Marker - Peak search key

Use this key to set and move a marker.

18) Save/Load key

Saves 100traces and 100setups, and loads 1trace and 1setup.

19) Print key

Print screen key, if optional printer is connected.

20) RS-323C key

Sets baud rate and transfers a current or saved trace.

21) Display control key

Control's contrast, backlight ON/OFF, brightness of backlight, invert display and buzzer ON/OFF functions.

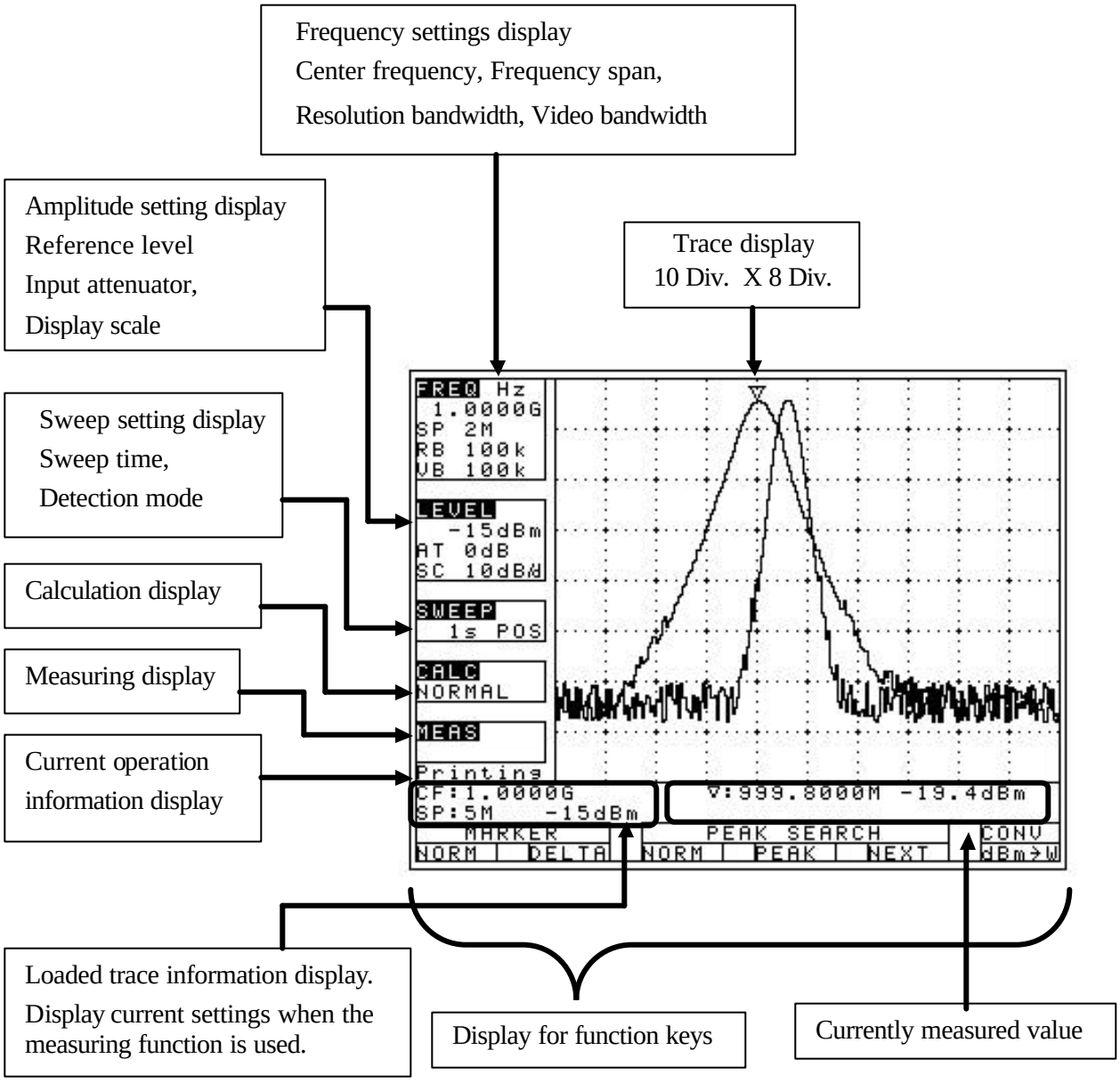
22) Rotary encoder

Universal encoder

23) Power switch

Power switch

4 Description Of Screen



5 Function Key Menu

5.1 List of the Function key menus

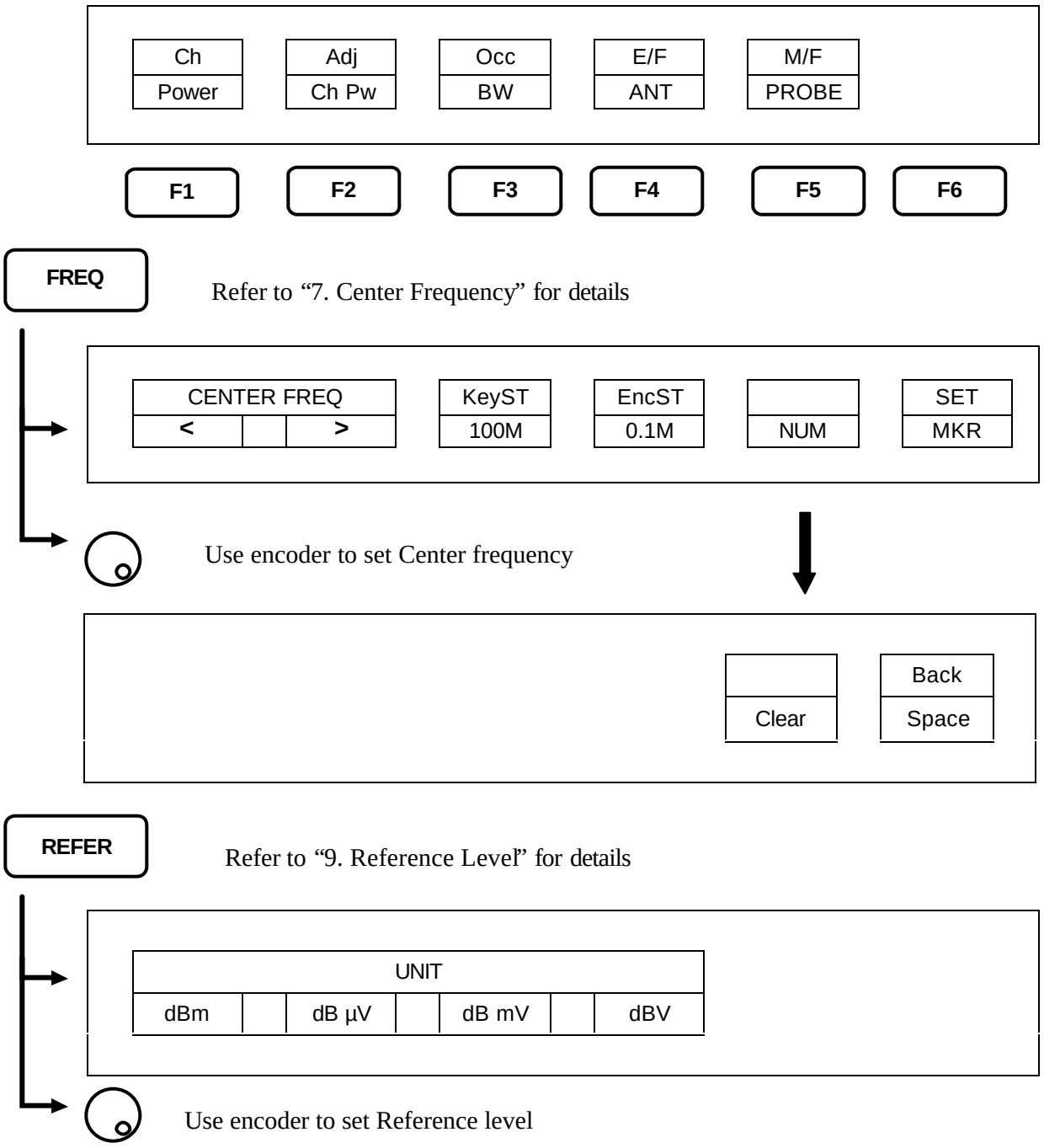
The List of all function keys is shown in the table below. For description of each function, please see the detailed pages. For the flow of change in the function key display, refer to 5.2 Menu tree.

	Function key menus	Key flow	Detailed page
A)	Adj Ch OFS	MEAS>(F6)>(F2)>(F2)>F2	38
	Adj. Ch Pw	MEAS>(F6)>F2	38
	Adj. Ch WIDTH	MEAS>(F6)>(F2)>F3	38
	ANT	MEAS>(F6)>(F5)>F1	39
	AVER	CALC>F4	32
B)	B.L. (back light)	DSPL>F2	44
	BACK SPACE	FREQ>F5>F6	25
	BAND CNTR	MEAS>(F6)>(F1)>(F1)>F2	37
	BAND WIDTH	MEAS>(F6)>(F1)>(F1)>F3	37
	BAUD	RS232>F2	46
	BLCTR (display brightness)	DISPL>F3	44
	BUZZR (beep sound)	DISPL>F5	44
C)	CENTER FREQ **<**	FREQ>F1	25
	CENTER FREQ **>**	FREQ>F2	25
	Ch. Power	MEAS>(F6)>F1	37
	CLEAR	FREQ>F5>F5	25
	CONV	MKR>F6	34
	CTRS (display contrast)	DSPL>F1	44
D)	DET (sweep auto detection)	SWEEP>F4	31
E)	E/F ANT	MEAS>(F6)>(F3)>F4	39
	EncST	FREQ>F4	25
	EXEC	RS232>F3	46
	EXECUTE DEL	SAVE/LOAD>F5	36
	EXECUTE LOAD	SAVE/LOAD>F4	35
	EXECUTE SAVE	SAVE/LOAD>F3	35
I)	INVT (display inverter)	DSPL>F4	44
K)	KeyST	FREQ>F3	25
M)	M/F PROBE	MEAS>(F6)>F5	43
	MAXHD	CALC>F2	32
	MEAS OFF	MEAS>(F1~5)>F6	37
	MINHD	CALC>F3	33
	MKR DELTA	MKR>F2	34
	MKR NORM	MKR>F1	34
	MODE	MEAS>(F6)>(F1~3)>F1	36

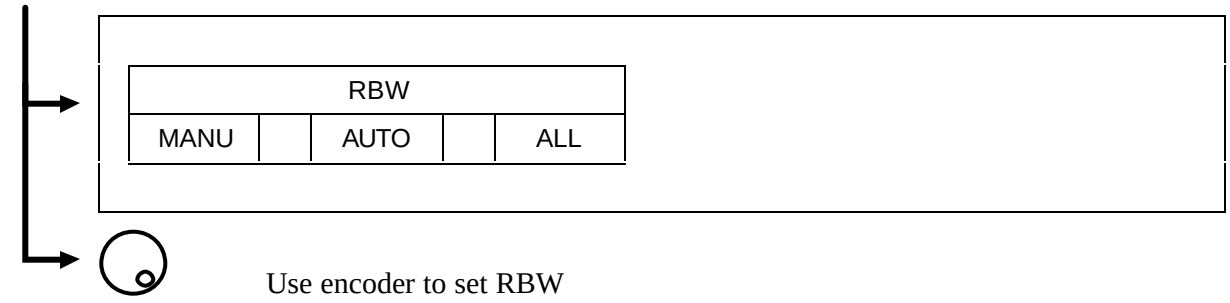
N)	NORM	CALC>F1	32
	NUM	FREQ>F5	25
O)	Occ BW	MEAS>(F6)>F3	39
	OVPWR	CALC>F5	33
P)	PARM (location)	SAVE/LOAD>F2	35
	PEAK SEARCH CNTR	MKR>(F3)>F4	34
	PEAK SEARCH NEXT	MKR>(F3)>F5	34
	PEAK SEARCH NORM	MKR>(F3)>F3	34
	PEAK SEARCH PEAK	MKR>(F3)>F4	34
	PEAK SEARCH WIDTH	MKR>(F3)>F5	34
	PEAK SEARCH ZONE	MKR>(F3)>F3	34
	PRE SET	SAVE/LOAD>F6	36
	PROBE	MEAS>(F6)>(F5)>F1	43
R)	RATIO	MEAS>(F6)>(F3)>F2	39
	RBW ALL	RBW>F3	29
	RBW AUTO	RBW>F2	29
	RBW MANU	RBW>F1	29
	PREFERENCE CNTR	MEAS>(F6)>(F2)>F4	38
	PREFERENCE WIDTH	MEAS>(F6)>(F2)>F5	38
S)	SCALE 10dB	SCALE>F1	29
	SCALE 2dB	SCALE>F2	29
	SET MKR	FREQ>F6	26
	SWEEP ALL	SWEEP>F3	31
	SWEEP AUTO	SWEEP>F2	31
	SWEEP MANU	SWEEP>F1	31
T)	TRACE	SAVE/LOAD>F1	35
	TRACE	RS232C>F1	46
U)	UNIT dBm	REFER>F1	27
	UNIT dBmV	REFER>F3	27
	UNIT dBV	REFER>F4	27
	UNIT dBµV	REFER>F2	27
V)	VBW ALL	VBW>F3	30
	VBW AUTO	VBW>F2	30
	VBW MANU	VBW>F1	30

5.2 Menu tree

Icons displayed on the bottom of the screen correspond to the function keys under them, as shown in the figure below:

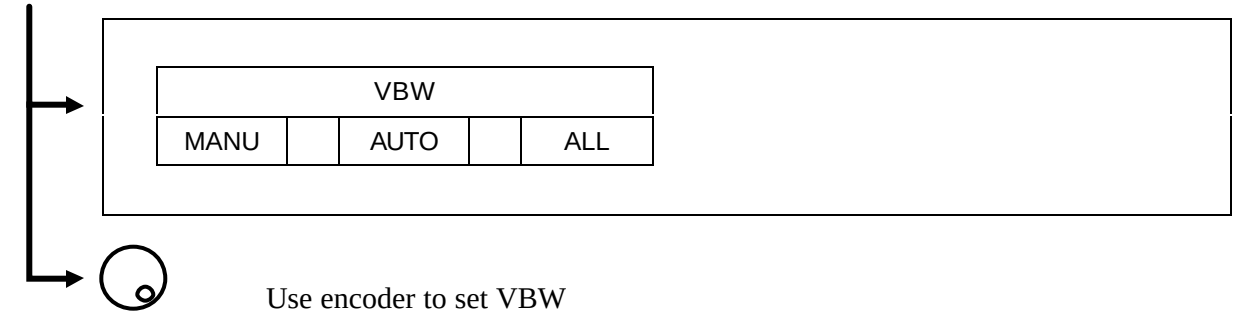


RBW Refer to “11. Resolution Bandwidth” for details



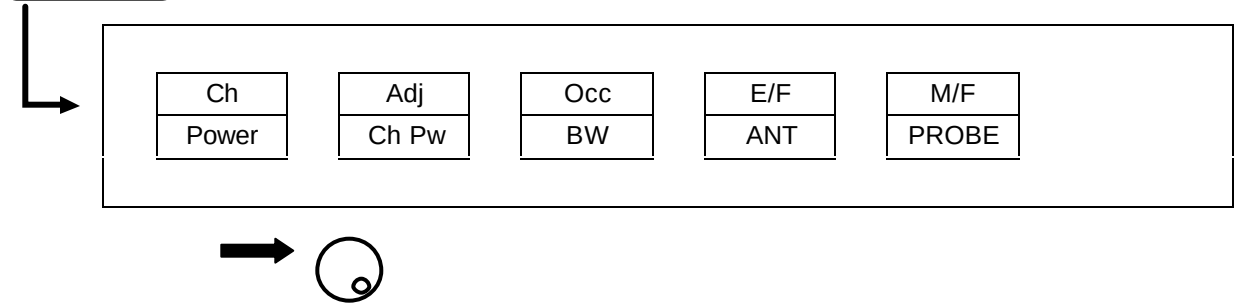
Use encoder to set RBW

VBW Refer to “12. Video Bandwidth” for details

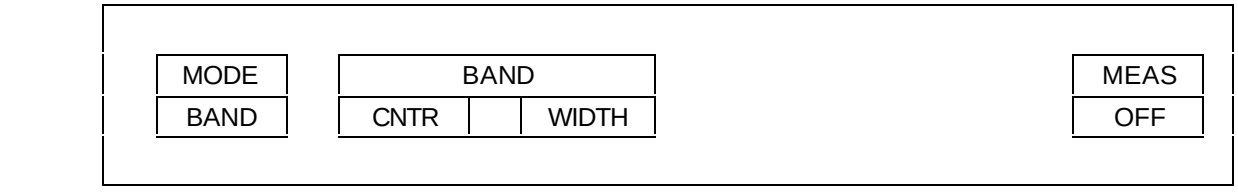


Use encoder to set VBW

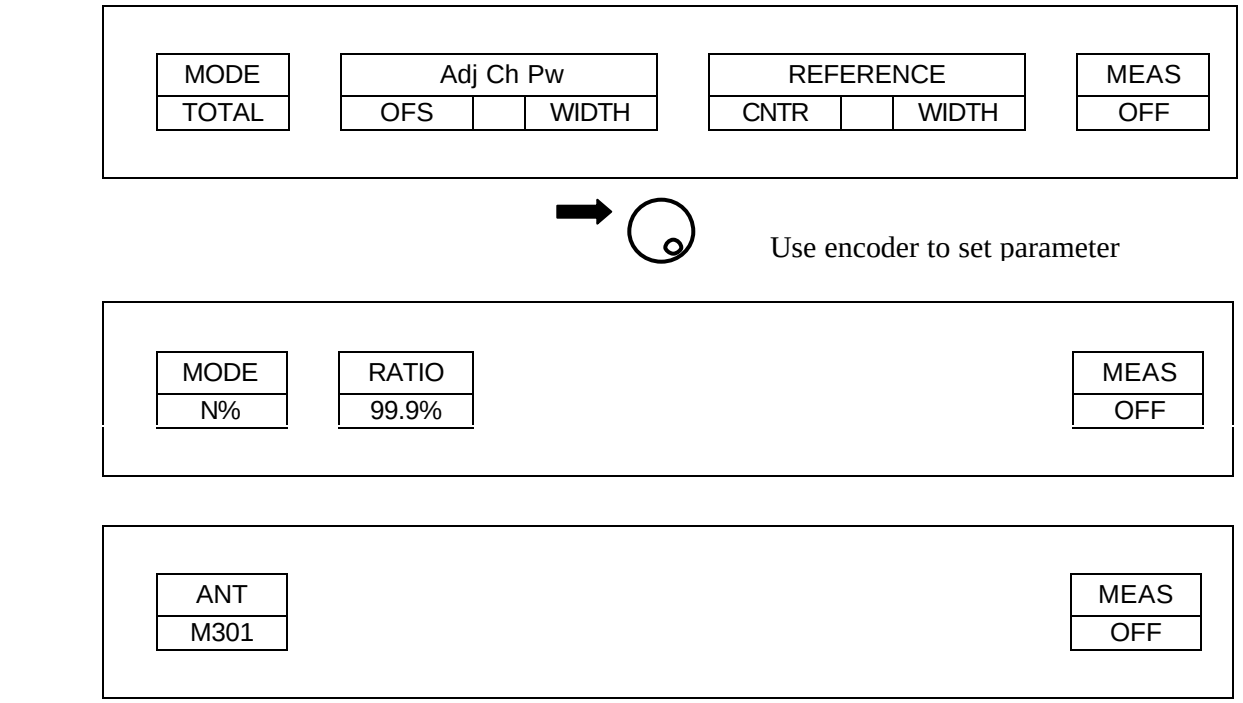
MEAS Refer to “19. Measuring Function” for details



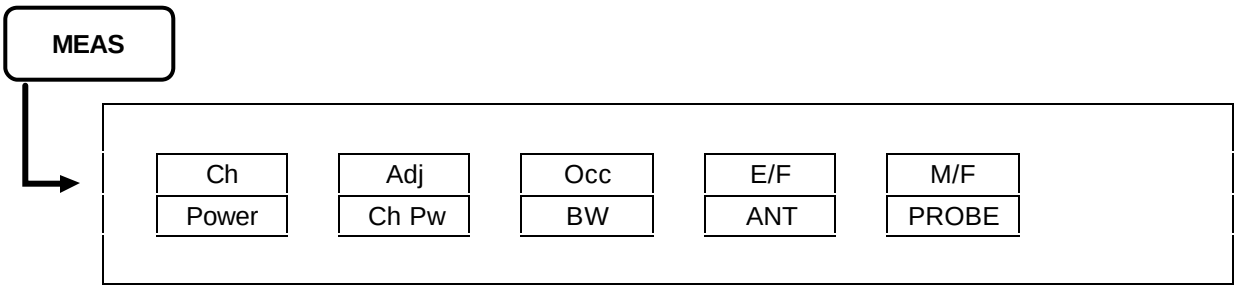
Use encoder to set parameter



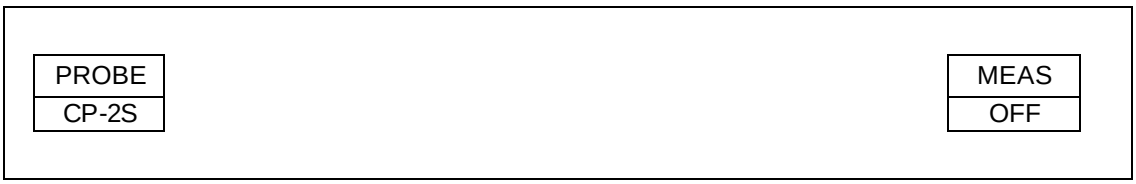
Use encoder to set parameter



Use encoder to set parameter

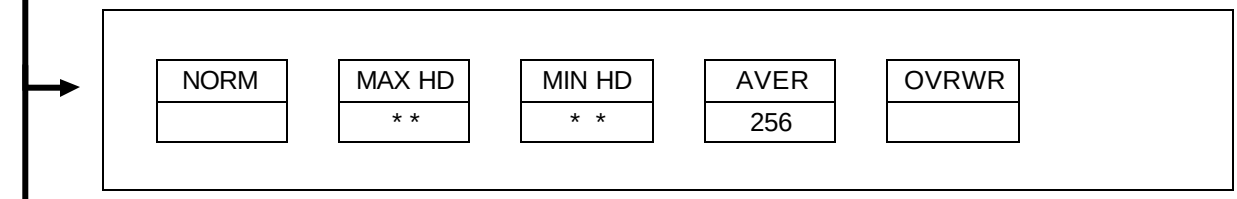


Input the probe ID (first time only)

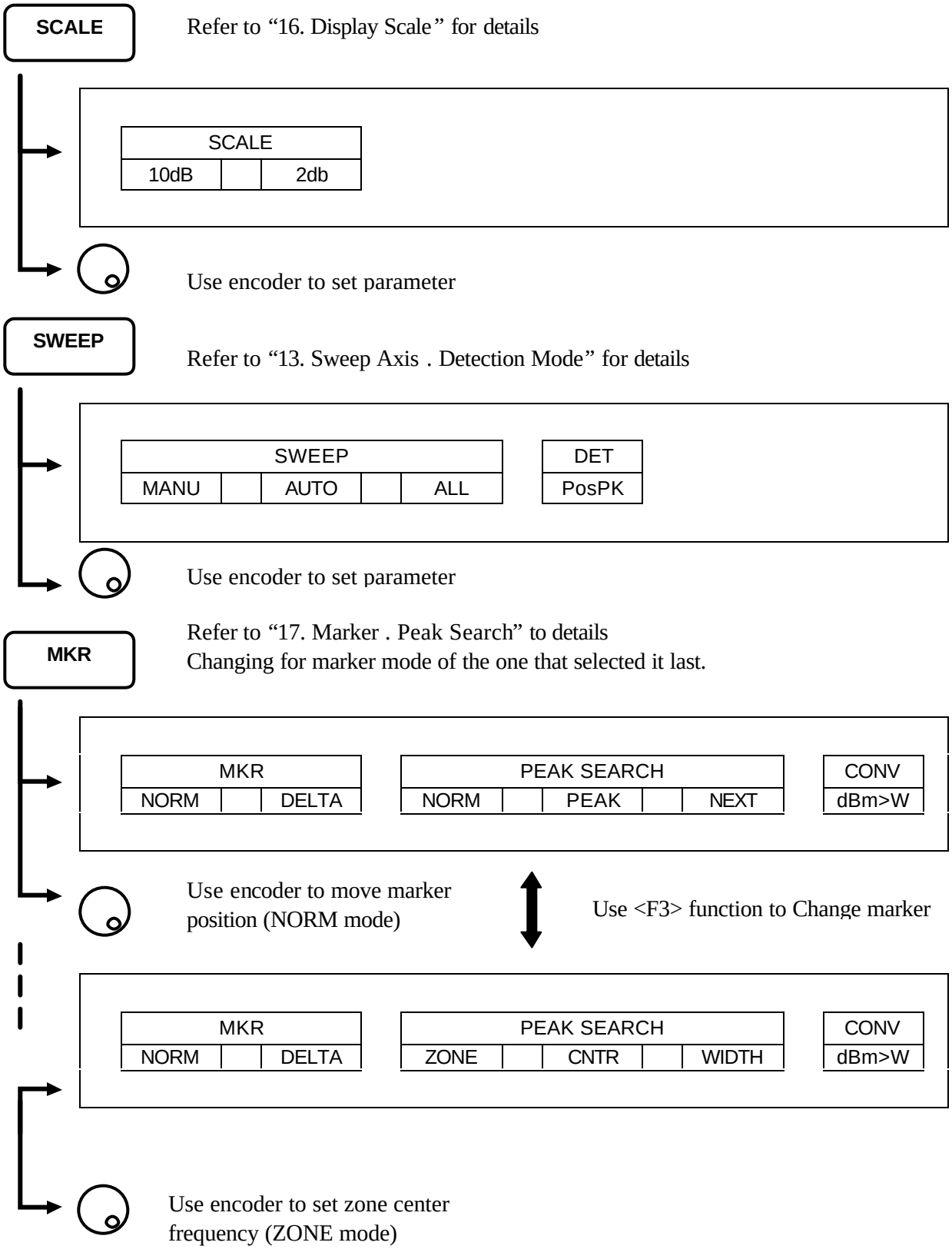


CALC

Refer to "16. Calculation Function" for details .

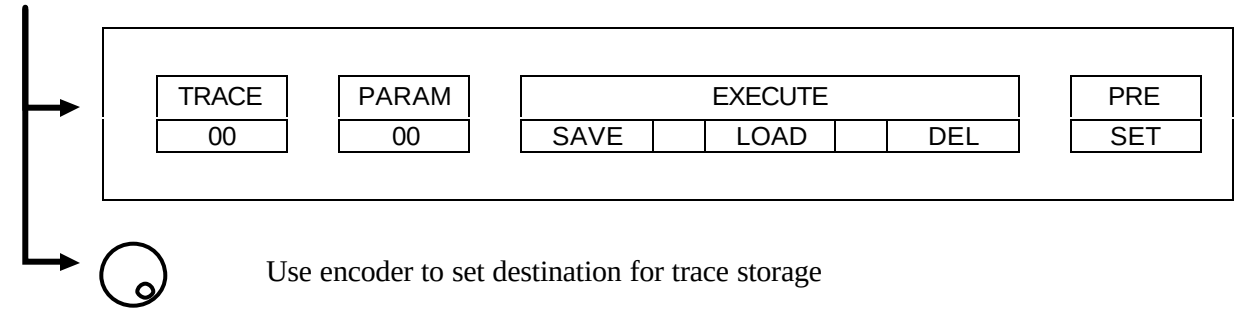


Use encoder to set parameter


SCALE
Refer to “16. Display Scale” for details
SCALE
10dB
2db
Use encoder to set parameter
SWEEP
Refer to “13. Sweep Axis . Detection Mode” for details
SWEEP
MANU
AUTO
ALL
DET
PosPK
Use encoder to set parameter
MKR
Refer to “17. Marker . Peak Search” to details
Changing for marker mode of the one that selected it last.
MKR
NORM
DELTA
PEAK SEARCH
NORM
PEAK
NEXT
CONV
dBm>W
Use encoder to move marker position (NORM mode)
Use <F3> function to Change marker
MKR
NORM
DELTA
PEAK SEARCH
ZONE
CNTR
WIDTH
CONV
dBm>W
Use encoder to set zone center frequency (ZONE mode)

SAVE/LOAD

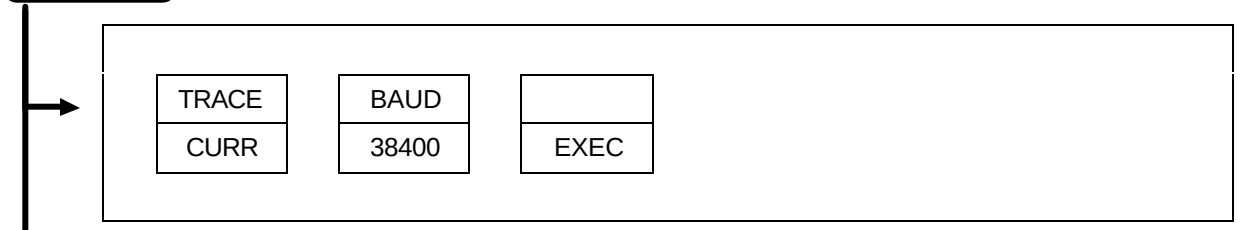
Refer to “18. Save/Load” for details



Use encoder to set destination for trace storage

RS232C

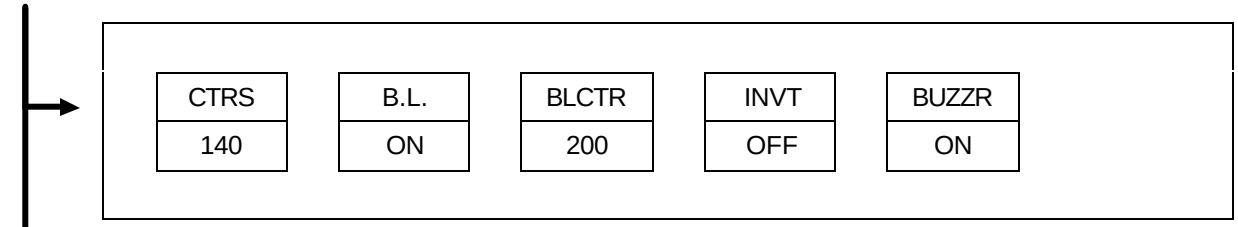
Refer to “22. Data Output” for details



Use encoder to set port transfer

DISPL

Refer to “20. Screen Control” for details

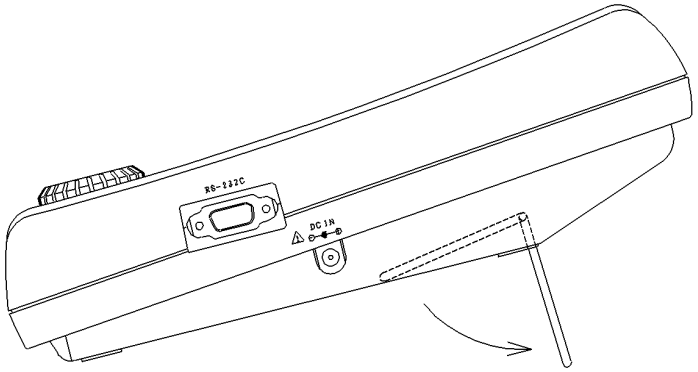


Use encoder to set screen contrast level

6 Preparing For Operation

6.1 Support stand

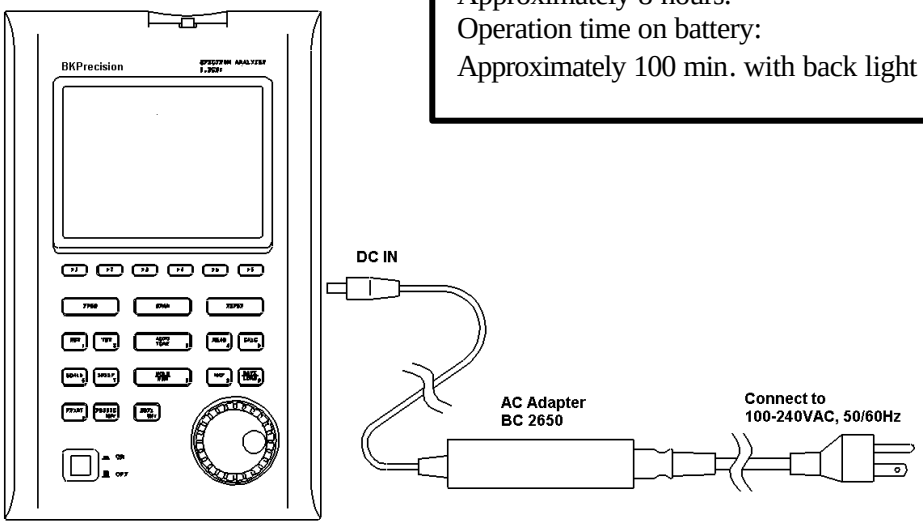
Build-in support stand could be used to provide better screen view angle then 2650 is use as desktop, stationary analyzer.



6.2 Connection to power supply

The BC 2650 AC adapter is both for the use with AC power supply and for charging the BP 2650 built-in battery. Connect the adapter as in the figure below and connect the AC plug to the power line (100-240 VAC, 50/60 Hz). For static electricity protection, unit has to be grounded correctly by connecting the three cores if possible. Not grounding the unit can damage it and the object measured. Do not use an AC adapter other than the BC 2650 supplied with the unit. Using an AC adapter other than the BC 2650 may cause damage to the unit.

Battery charge time:
Approximately 8 hours.
Operation time on battery:
Approximately 100 min. with back light off.



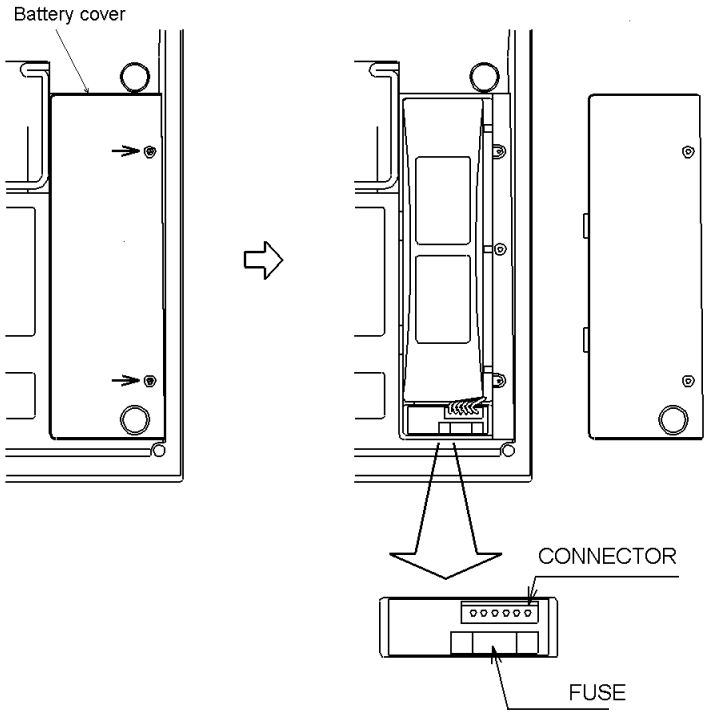
6.3 Replacing the fuse

The fuse 5A/250V (slow-blow type) is used for the 2650 protection. To replace the fuse, turn the power off first, disconnect the AC adapter, remove the battery cover and on the back as shown in the figure below, remove the battery, and then take sufficient care to perform the replacement. Be sure to use the fuse supplied with the unit, or specified one.

6.4 Installing the battery

To install or replace the battery, turn off power first, disconnect the AC adapter, open the battery compartment on the back of the unit after removing two screws as shown in the figure below.
For replacement use only approved BP 2650 battery.

CAUTION! Use of other non-specified battery could damage the unit.



6.5 Soft carrying case

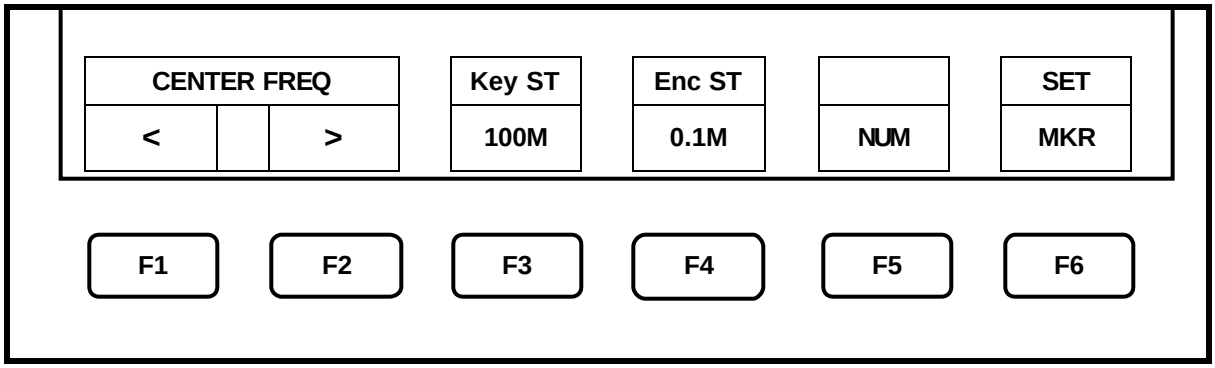
2650 comes with soft carry/store protective case. Carry case is design to carry 2650 unit alone with AC adapter, printer and cables, antennas in accessory pouch.

CAUTION!

Do not temporary locate 2650 unit, in the carry case, on direct sunlight.
Leaving the unit in carry case on the direct sunlight will easily heat the unit above operating temperature of 40ºC.

7 Center Frequency

Press <**FREQ**> key to switch over to the function screen shown below:

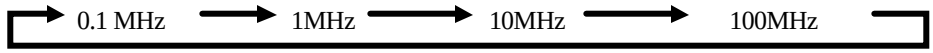


NOTE: Center frequency can be set between 0 to 3.3GHz.

7.1 Setting with the step keys <F1, F2, F3>

1. Each time <**F1**> key is pressed center frequency decreases in one step.
2. Each time <**F2**> key is pressed; the center frequency increases in one step.
3. Setting the step size by <**F3**>:

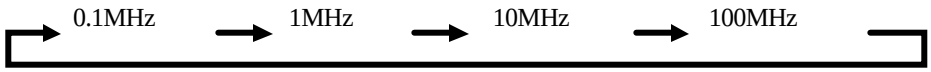
Each time <**F3**> key is pressed, step size it is changes in the following order:



7.2 Setting with the encoder <Enc ST>

1. When encoder is used, the center frequency setting is changes on one step at the time.
2. Setting the step size:

Each time <**F4**> key is pressed, step size it is changes in the following order:



7.3 Setting with the numeric keys

1. Press the <**F5**> key go to numeric key input mode. **F5** functions as the <**CLEAR**> key. **F6** functions as the <**BACK SPACE**> key.

NOTE: In this mode, setting with **F1**, **F2** or the encoder is not accepted.

2. The center frequency can be set according to the "Numeric Key Mapping Diagram".
3. Use the unit key to set new value, <MHz (RS232C)> or <GHz (DSPL)>.

NOTE: Any figures below the resolution (100 kHz) will be discarded.

4. Changing the settings:

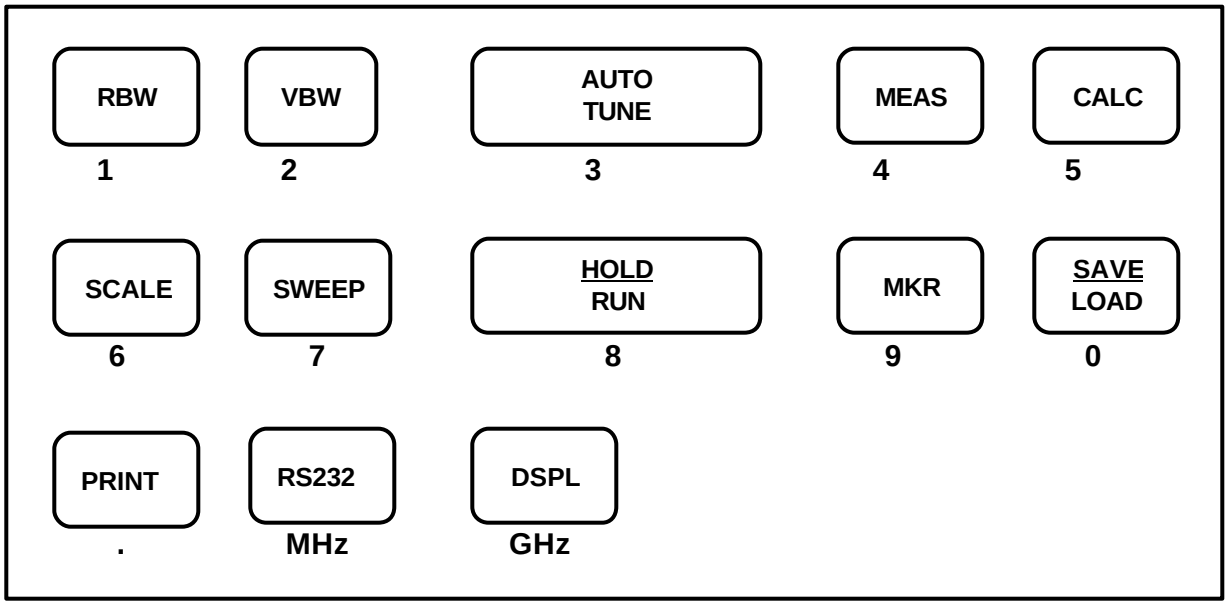
<**F5**> key deletes the entire value and allows you to input one from the beginning.

<F6> key deletes the last input figure.

5. Canceling the numeric key mode:

<FREQ> key enables setting with step keys **<F1>**, **<F2>** or the encoder again.

Numeric Key Mapping Diagram



7.4 Marker position.

By pressing the **<F6>** key, the center frequency will be set to the current marker position.

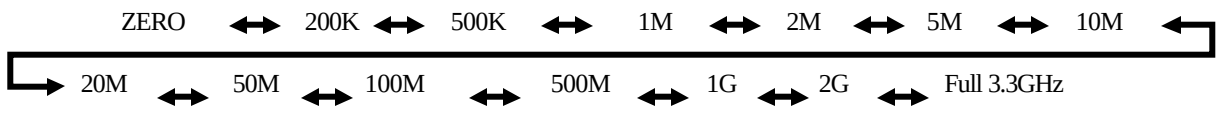
NOTE: Any figures below the resolution (100 kHz) will be discarded. This does not operate when the marker is not displayed. (And the function display disappears.)

8 Frequency Span

Press **<SPAN>** key, then use encoder to set desired frequency span.

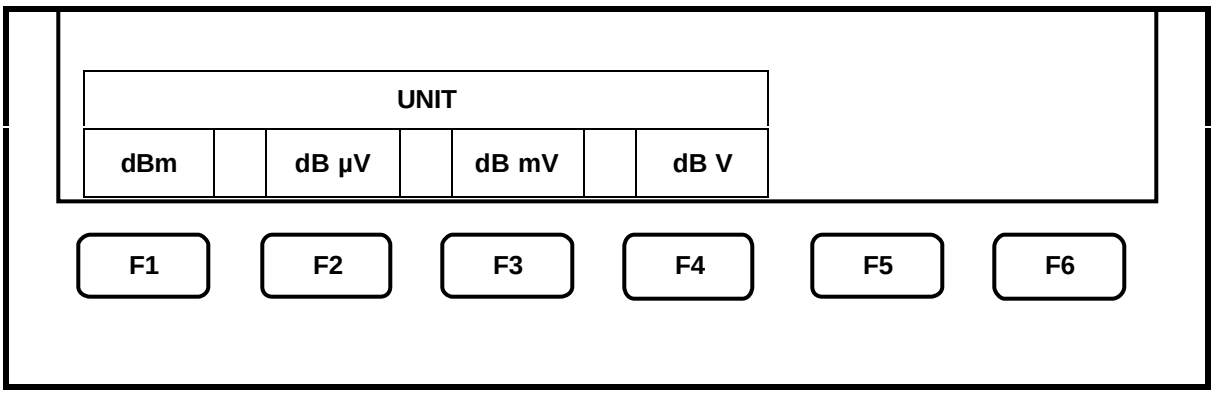
NOTE: Frequency span can be set only by using encoder. Function keys are not available for this operation.

1. When encoder is turned, the frequency span changes in the specified step.



9 Reference Level

Press <**REFER**> key to switch over to the function screen shown below:



9.1 Setting the Reference level

1. Use encoder to change reference level.
(Refer to "9.3 Reference level setting range for each unit" for details.)

9.2 Switching units of amplitude axis

dBµV/m and dBµA/m are optional. Refer to "19.4 Electric field strength measurement" and "19.5 Magnetic field strength measurement" for details.

1. Press the <**F1**> to switching units to dBm.
2. Press the <**F2**> to switching units to dBµV
3. Press the <**F3**> to switching units to dBmV
4. Press the <**F4**> to switching units to dBV

9.3 Reference level setting range for each unit

UNIT	DBm	dBµV	DBmV	dBV
MAXIMUM	10	117	57	-3
MINIMUM	-40	67	7	-53

"Unit that is able to use it with the measuring function"

UNIT	dBµV/m (Electric filed strength measurement)				dBµA/m (Magnetic field strength measurement)
Setting	AN 301	AN302	AN303	AN304	PR 26M
MAXIMUM	146	150	153	154	159 to 178
MINIMUM	96	100	103	104	109 to 128

Calculation expression (conversion formula to and from dBm)

- ? X[dBm]=107+X[dBμV] B[dBm]=47+B[dBmV] C[dBm]=-13+C[dBV]
- ? Y[dBm]=68.8/? ×v (Y/Gar)[dBμV/m] ? : Wavelength[m] Gar: Antenna absolute gain
- ? Z[dBm]=180+Z+A[dBμ A/m] A: probe calibration coefficient may changes by frequency

9.4 Relation between the reference level and ATT, AMP (in dBm indication)

The programmable attenuator (ATT) and the reference amplifier (AMP) inside 2650 are automatically set according to the setting value of the reference level (REFER). (ATT cannot be set independently.)

Refer (dBm)	ATT (dB)	AMP (dB)
10	25	0
9	24	0
8	23	0
7	22	0
6	21	0
5	20	0
4	19	0
3	18	0
2	17	0
1	16	0
0	15	0
-1	14	0
-2	13	0

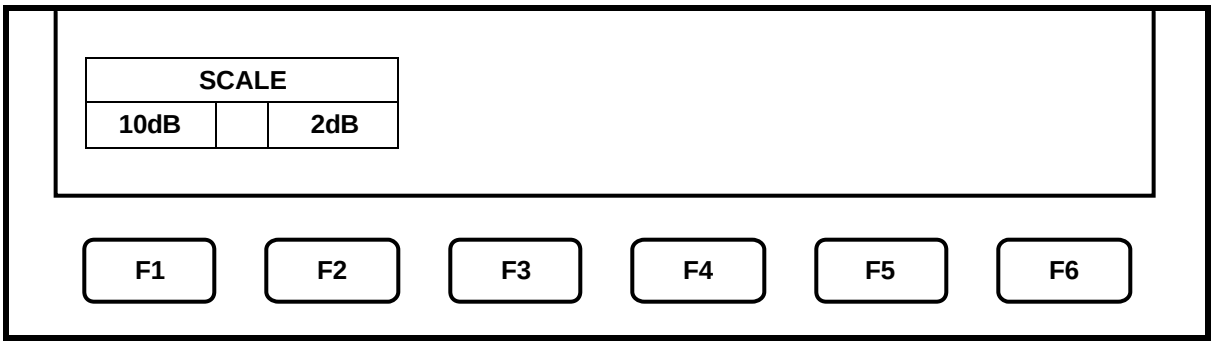
Refer (dBm)	ATT (dB)	AMP (dB)
-3	12	0
-4	11	0
-5	10	0
-6	9	0
-7	8	0
-8	7	0
-9	6	0
-10	5	0
-11	4	0
-12	3	0
-13	2	0
-14	1	0
-15	0	0

Refer (dBm)	ATT (dB)	AMP (dB)
-16	22	28
-17	21	28
-18	20	28
-19	19	28
-20	18	28
-21	17	28
-22	16	28
-23	15	28
-24	14	28
-25	13	28
-26	12	28
-27	11	28
-28	10	28

Refer (dBm)	ATT (dB)	AMP (dB)
-29	9	28
-30	8	28
-31	7	28
-32	6	28
-33	5	28
-34	4	28
-35	3	28
-36	7	28
-37	6	28
-38	5	28
-39	4	28
-40	3	28

10 Display Scale

Press <**SCALE**> key to switch over to the function screen shown below:



10.1 Setting by using the F1, F2 keys

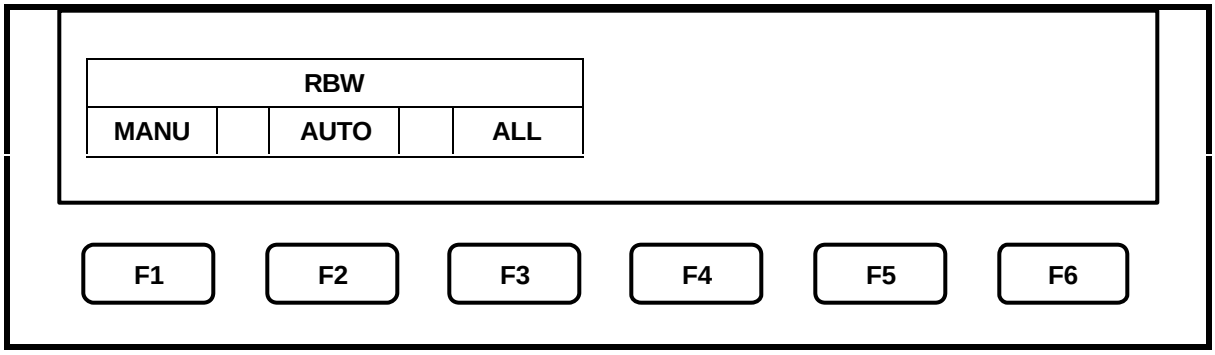
1. Press the **<F1>** key to set the 10dB/div display scale.
2. Press the **<F2>** key to set the 2dB/div display scale.

10.2 Setting by using the encoder

1. Turn the encoder to switch between 10dB/div and 2dB/div display scale.

11 Resolution Bandwidth

Press **<RBW>** key to switch over to the function screen shown below:



11.1 MANUAL mode

1. Press the **<F1>** key or turn encoder to enter MANUAL mode. Use encoder to set RBW.

3kHz ↔ 10kHz ↔ 30kHz ↔ 100kHz ↔ 300kHz ↔ 1MHz ↔ 3MHz

11.2 AUTO mode

1. When the **<F2>** key is pressed, optimum RBW is set according to the settings of SPAN and SWEEP.

NOTE: When the AUTO mode is set, it can be confirmed by the asterisk (*) that is displayed on the right end of the RBW setting value display area on the screen.

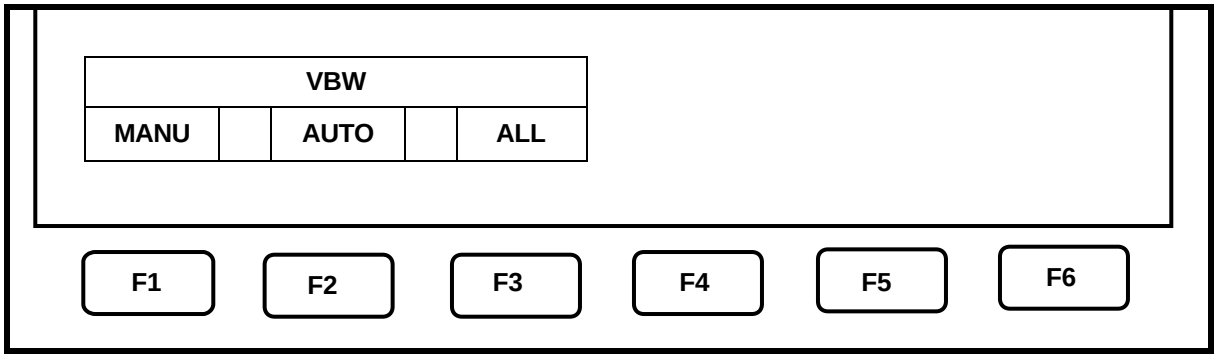
11.3 ALL auto mode

1. When is engaged, optimum RBW, VBW and SWEEP are sets according to the setting of SPAN.

NOTE: When the ALL AUTO mode is set, in the right end of the RBW, VBW and SWEEP display area on the screen the <*> will be displayed. Selectivity (-60dBc width) becomes bigger than actual values by SSB phase noise when 3kHz and 10kHz.

12 Video Bandwidth <VBW>

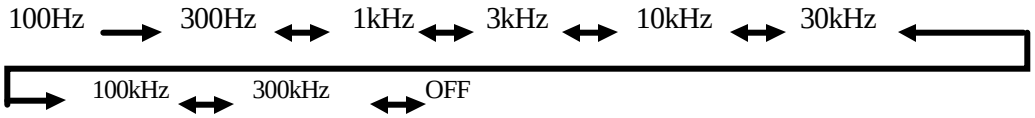
Press the **<VBW>** key to switch over to the function screen shown below:



NOTE: Any selected parts of MANU, AUTO and ALL become inverted display

12.1 MANUAL mode

1. Press the **<F1>** or use the encoder to enter MANUAL mode. Use encoder to set VBW.



12.1 AUTO mode

1. When the **<F2>** key is pressed, VBW is set according to the settings of SPAN and SWEEP.

NOTE: When the AUTO mode is set, in the right end of the VBW display area on the screen the <*> will be displayed.

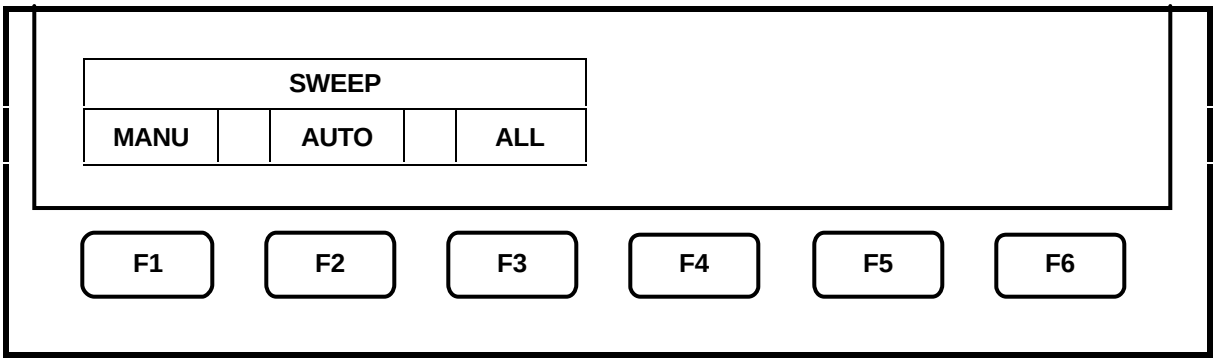
12.2 ALL auto mode

1. When the **<F3>** key pressed, RBW, VBW and SWEEP are set according to the setting of SPAN.

NOTE: When the ALL AUTO mode is set, in the right end of the RBW, VBW and SWEEP display area on the screen the <*> will be displayed.

13 Sweep Axis · Detection Mode <SWEEP>

Press the **<SWEEP>** key to switch over to the function screen shown below:



13.1 MANUAL mode

1. Press the **<F1>** or turn the encoder to enter MANUAL mode. Also use encoder to set the SWEEP.

10ms ↔ 30ms ↔ 0.1s ↔ 0.3s ↔ 1s ↔ 3s ↔ 10s ↔ 30s

NOTE: FULL SPAN cannot be set to10msin this mode.

13.2 AUTO mode

1. When the **<F2>** key is pressed, SWEEP is set according to the settings of SPAN and RBW.

NOTE: When the AUTO mode is set, in the right end of the SWEEP display area on the screen the <*> will be displayed.

13.3 ALL auto mode

1. When the **<F3>** key is pressed, RBW, VBW and SWEEP are set according to the setting of SPAN.

NOTE: When the ALL AUTO mode is set, in the right end of the RBW, VBW and SWEEP display area on the screen the <*> will be displayed.

13.4 Setting the Detection mode

Pressing **<F4>** key allows you to change the method to capture the trace.

PosPK → PMPL → NegPK →

- PosPK (Positive Peak) : Traces the maximum value of the sample point
- SMPL (Sample) : Traces the momentary value of the sample point.
- NegPK (Negative Peak) : Traces the minimum value of the sample point

.

NOTE: SMPL could be set only when sweep time set to10ms or 30ms.

14 AUTO Tuning <AUTO TUNE>

When **<AUTO TUNE>** key is pressed, the peak spectrum of the input signal is searched and centered on the screen. Optimum RBW, VBW and SWEEP are set according to the setting of SPAN.

- Please set up frequency span before auto tuning.
- This operates only with the keypad, with no function indication.
- This does not operate normally when the signal level is -40 dBm or lower, the input frequency is 50 MHz or lower, or the frequency span is ZERO SPAN or FULL SPAN.

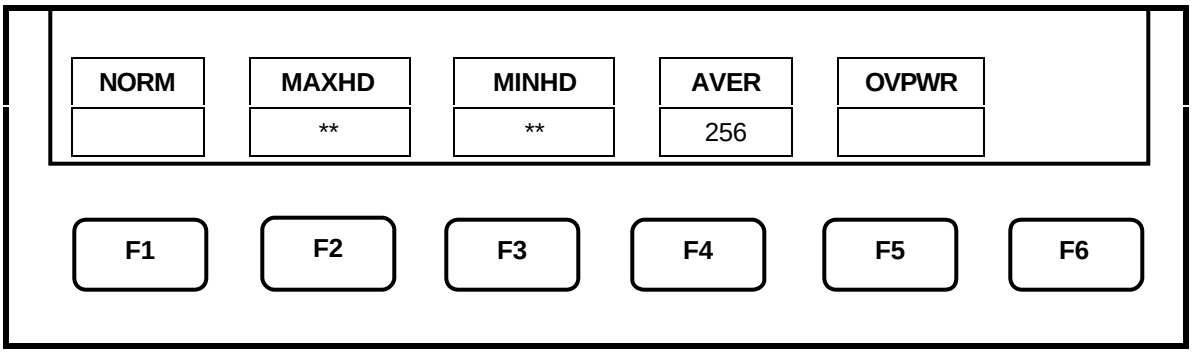
15 Hold/Run <HOLD/RUN>

Press the **<HOLD/RUN>** key to switch to between sweep halt and continuous sweep.

NOTE: This operates only with the key press, with no function indication.

16 Calculation Function <CALC>

Press the **<CALC>** key to go to the function menu screen shown below.



- Press the **<HOLD/RUN>** key to stop and restart sweep.
- Press the **<F1>** to **<F5>** key to set CALC mode.
- Use encoder to select number of sweeps.

16.1 NORM mode

1. Press the **<F1>** key. Calculation is available in this mode, the number of sweeps is always unlimited.

NOTE: "NORMAL" is displayed in the CALC area on the LCD screen. (Refer to "4. Description Of Display" for details)

16.2 MAX HOLD mode

1. Press the **<F2>** key then use the encoder to set the number of sweeps.
2. Sweeps are performed the set number of times, the maximum value of each point of trace data is displayed as a trace, at the end sweep is will be stop.

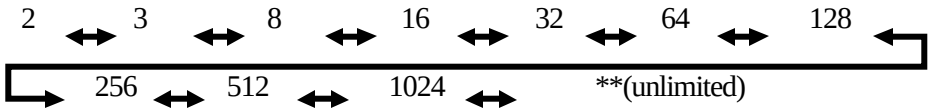
2 ↔ 4 ↔ 8 ↔ 16 ↔ 32 ↔ 64 ↔ 128 ↔ 256 ↔ 512 ↔ 1024 ↔ ** (Unlimited)

NOTE: “MAX --- (number of sweeps)” is displayed in the CALC area on the LCD screen.
(Refer to “4. Description Of Display” for details)

16.3 MIN HOLD mode

1. Press the <**F3**> key, then use encoder to set the number of sweeps.

3. Sweeps are performed the set number of times, the minimum value of each point of trace data is displayed as a trace, and then sweep is stop.



NOTE: “MIN --- (number of sweeps)” is displayed in the CALC area on the LCD screen.
(Refer to “4. Description Of Display” for details)

16.4 AVERAGE mode

1. Press the <**F4**> key, then use encoder to set the number of sweeps.
2. Sweeps are performed the set number of times, average value of each point of trace data is displayed as a trace, and then sweep is stop.

NOTE: “AVG --- (number of sweeps)” is displayed in the CALC area on the LCD screen.
(Refer to “4. Description Of Display” for details)

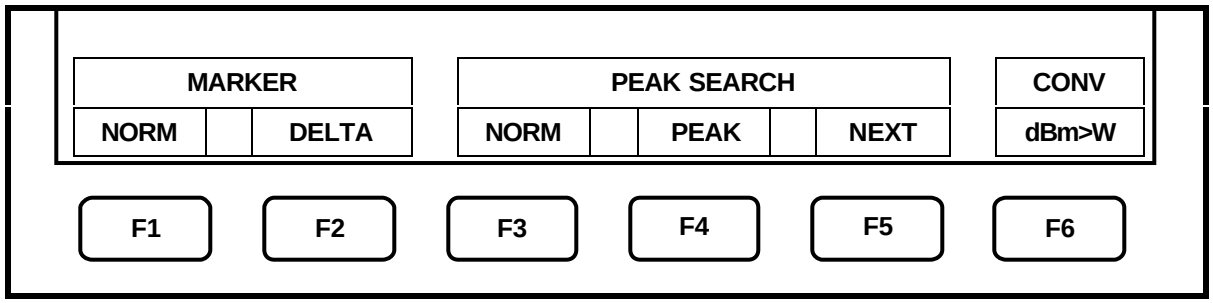
16.5 OVER WRITE mode

1. Press the <**F5**> key to enter into the OVER WRITE mode. In this mode new trace will overwrite previous one.

NOTE:“OVER WR” is displayed in the CALC area on the LCD screen. (Refer to “4. Description Of Display” for details) only the last trace could be saved in this mode.

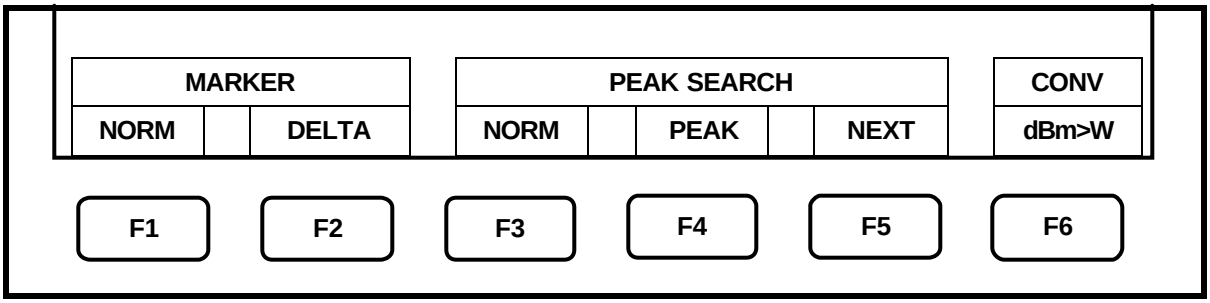
17 Marker <MKR>

Press <**MKR**> key to switch over to the function screen shown below:



- This screen is displayed when NORM marker is selected.
  Marker could be manually moved in NORM mode. Peak search function, NEXT peak with search functions are available in this mode.

- When a ZONE marker is selected, marker could be moved to the biggest peak position automatically at ZONE mode, inside specified zone.



17.1 Moving the marker

Use the **<F1>** key, then use encoder to move the marker.

Use the **<F2>** key to put DELTA REF at the current marker position.

17.2 Setting the peak search <PEAK SEARCH>

- NORM mode (Use **<F3>** key to select NORM.)
- Use the **<F4>** key to move the marker to the maximum peak position.
- Use the **<F5>** key to move the marker successively from higher to lower peak positions other than the maximum peak. (The marker moves to 10 peaks.)

NOTE: When you move the marker to the 10th peak or moving the marker, the NEXT peak search function stops and the function display disappears.

- ZONE mode (Use **<F3>** key to select ZONE.)
  Use the **<F4>** key, then encoder to move the center position.
  Use the **<F5>** key, then encoder to change the width.

17.3 Changing marker point reference level <CONV>

Press the **<F6>** key, to change marker conversion reference level.

When unit of reference level is dBm, the unit is changed from [dBm] to [W].

When unit of reference level is dBµV, the unit is changed from [dBµV] to [V].

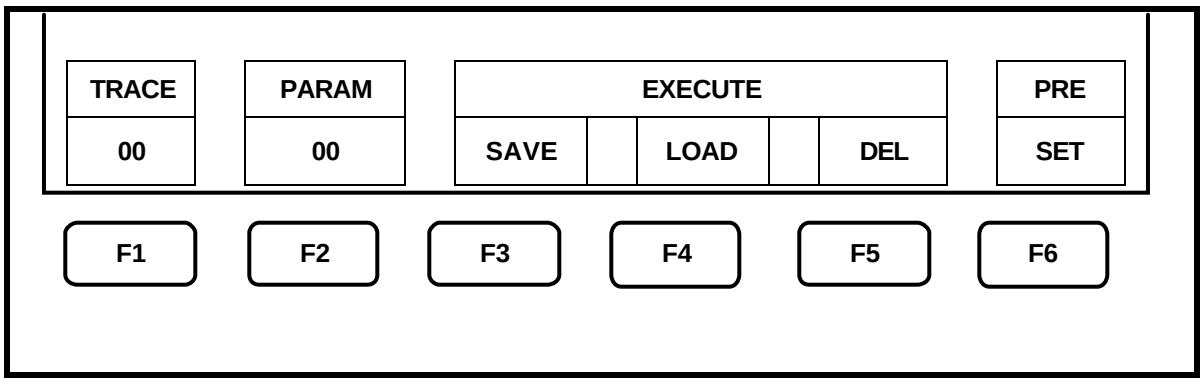
When unit of reference level is dBmV, the unit is changed from [dBmV] to [V].

When unit of reference level is dBV, the unit is changed from [dBV] to [V].

When unit of reference level is dBµV/m, the unit is changed from [dBµV/m] to [V/m].

18 Save/Load <SAVE/LOAD>

Press the **<SAVE/LOAD>** key to switch over to the function screen shown below:



18.1 Setting location for trace storage.

1. Pressing **<F1>** key allows you to set the number of location to store the trace.
2. Use encoder to set the number of location.

00 ↔ 01 ↔ 02 ↔ 03 ↔ 04 ↔ … ↔ 98 ↔ 99

NOTE: The part of TRACE becomes inverted display after it is selected.

18.2 Setting the location to store the parameter

1. Pressing **<F2>** key allows you to set the number of location to store the parameter.
2. Use encoder to set the number of location.

00 ↔ 01 ↔ 02 ↔ 03 ↔ 04 ↔ … ↔ 98 ↔ 99

NOTE: The part of PARAM becomes inverted display after it is selected.

18.3 Saving the data

1. Press the **<F3>** key to save the data at the set number. The trace will be saved only if TRACE is selected, or the parameters PARAM function selected.

NOTE: SAVE operation will be confirmed by lid asterisk (*) on the right end of the main display.

18.4 Loading the data

1. Press the **<F4>** key to read out the data at the set number.

- This reads the trace when TRACE function selected. The setting parameter of the loaded trace is displayed in the loaded trace information display area.
- (Refer to "4. Description Of Display" for details)
- This reads out the setting parameters when PARAM is selected.
- When you load a trace, the current trace disappears, the HOLD state is set, and the loaded trace is displayed. For the loaded trace, you can use the marker, but cannot use a measuring function.
- When you press the HOLD/RUN key, the loaded and the current traces are displayed overlapping each other.

- SAVE operation will be confirmed by lid asterisk (*) on the right end of the main display.
- When you search the trace or setting parameters to be read out, repeat by using **<F4>,** encoder, **<F4> …** , and load the trace or setting parameters in turn.

18.5 Clearing the loaded trace

1. Press the **<F5>** key to clear the loaded trace that has been displayed.

18.6 Presetting (Initialization)

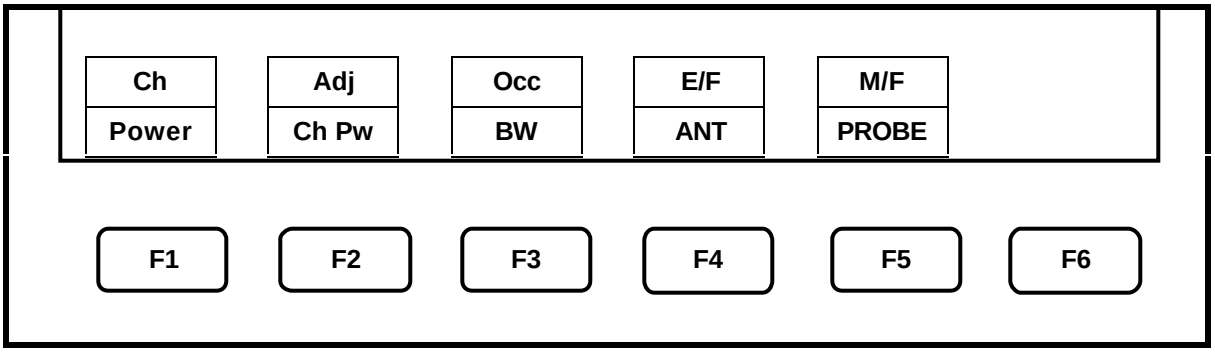
1. Press the **<F6>** key to preset the setting parameters as the Initialization shown below:

"Initialization"

Setting Item	Setting parameter
Center frequency	1GHz
Frequency span	20MHz
Reference level	10dBm
Sweep time	0.3s
Detection mode	Positive peak mode
RBW	300kHz
VBW	OFF
Display scale	10dB/div

19 Measuring Function <MEAS>

Press **<MEAS>** key to switch over to the function screen shown below:



Select the measuring function:

F1 Ch. Power – Channel power measurement.

F2 Adj. Ch. Pw – Adjacent channel leakage power measurement.

F3 Occ BW – Occupied frequency bandwidth measurement.

F4 E/F ANT – Electric field strength measurement.

F5 M/F Probe – Magnetic field strength measurement (optional)

NOTE: The adjacent channel power measurement allows the user to measure the amount of (or ratio of) power leakage into adjacent radio channels.

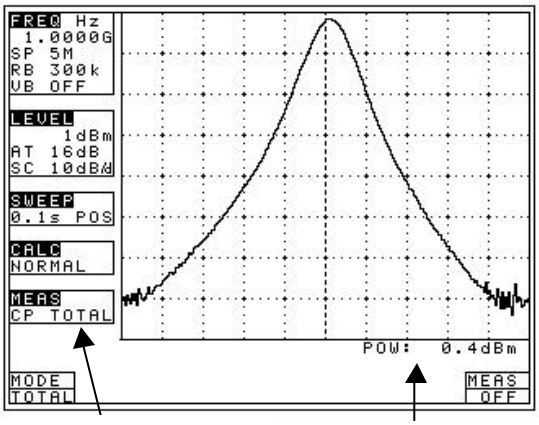
Once you select the measuring function, pressing **<MEAS>** next time will directly bring up the function screen for the function you selected the last time. If you want to stop the measuring function, or if you want to select another measuring function, press **<F6>** (MEAS OFF).

This stops the measuring function and switches to the above screen, which allows you to select the measuring function. The measuring function is stops, when push <MKR> key while these 3 functions (Channel power measurement, Adjacent channel leakage power measurement, Occupied frequency bandwidth measurement) are selected. Because these 3 functions and marker are cannot be used simultaneously. Similar, to the function of the marker stops, when the functions of these 3 measurements are selected while using the marker.

The unit displays data in 251 horizontal dots, but it internally captures the trace and calculates the measured value (Channel power measurement, Adjacent channel leakage power measurement and Occupied frequency bandwidth measurement) in 1001 dots.

19.1 Channel power measurement <Ch Power>

Measures the sum of the power in the zone specified. Two modes, TOTAL and BAND, are available. TOTAL mode. Use **<MODE>** key to select TOTAL mode. Measure the sum of the power in the zone specified by the center frequency and frequency span (whole range of the screen).



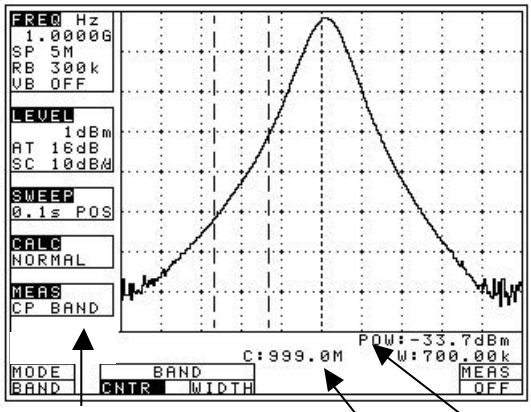
Channel power measurement mode.

Measured value.

- It is shown on MEAS area of LCD as "CP TOTAL"
- The measured value is displayed at the right lower corner on the screen.

- BAND mode. Use the **<F1>** key (MODE) to select BAND.

Measure the sum of the power in the zone specified by the zone center frequency and zone width.



Channel power measurement mode.

Setting Parameter

Measured Value

It is shown on MEAS area of LCD as "CP BAND". The measured value and setting parameter are displayed at the right lower corner on the screen.

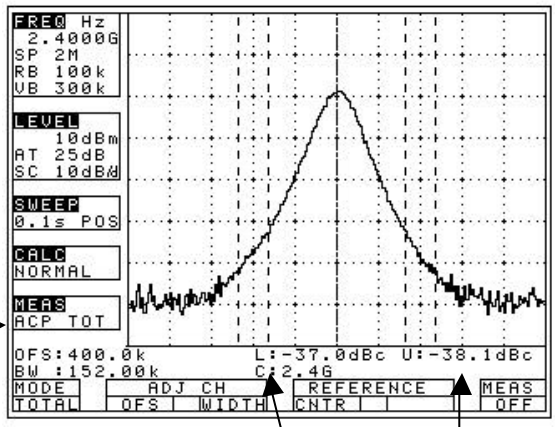
1. Use the **<F2>** key (CNTR) and encoder to set the zone center frequency.
2. Use the **<F3>** key (WIDTH) and encoder to set the zone width.

19.2 Adjacent channel leakage power measurement <Adj Ch Pw> <F2>

Measures the adjacent channel leakage power as the ratio of the power in the range specified by the offset frequency against the reference frequency (reference carrier frequency) and the bandwidth, to the carrier wave power. Two channels of adjacent waves on the upper and lower sides of the same offset frequency are measured. In addition, you can select from three modes, TOTAL (total power method), REF BAND (in-band method) and PEAK (reference level method), according to the classification of definitions of carrier wave.

Mode selection and measurement. Use the **<F1>** key to select mode: TOTAL, BAND or PEAK.

- It is each shown on MEAS area of LCD as “ACP TOT”, “ACP BAND” or “ACP PK”.
- The measured value and parameter are displayed at the right lower corner of the screen.



Adjacent channel Leakage power measurement mode.

Setting parameter

Measured value

1. Use the **<F2>** key (Adj Ch OFS) with encoder to set offset frequency of adjacent channel. The offset is from the center of the reference carrier wave.

2. Use the **<F3>** key (Adj Ch WIDTH) with encoder to set bandwidth of adjacent channel.

3. Use the **<F4>** key (REFERENCE CNTR) with encoder to set center frequency of reference carrier.

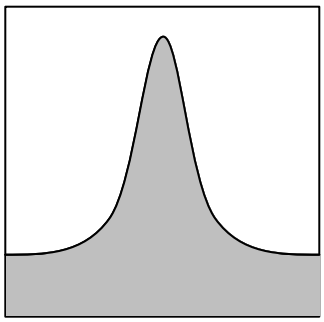
<F4> is only for the TOTAL and BAND mode.

4. Use the **<F5>** key (REFERENCE WIDTH) with encoder to set bandwidth for reference carrier.

<F5> is only for the BAND mode.

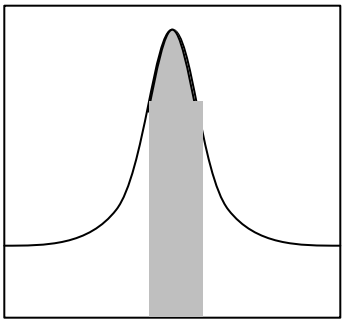
- **Definition of the reference carrier for each mode**

TOTAL (total power method)



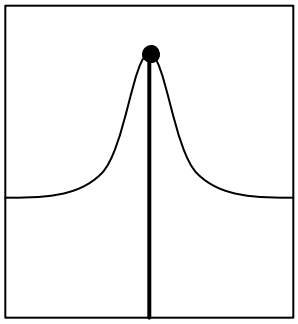
This is based on the sum total of the power of whole range on the screen. Use **<F4>** to set center frequency of the reference carrier wave.

BAND (in-band method)



This is based on the sum total of the power within the set bandwidth. Use **<F4>** to set center frequency of the reference carrier wave.

PEAK (reference level method)

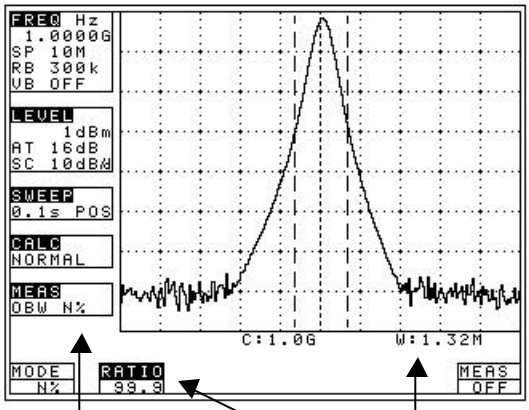


This is based on the power of the peak on the screen. Center frequency of the reference carrier wave is set up to the peak inside the screen automatically.

19.3 Occupied frequency bandwidth measurement <Occ BW> <F3>

Measures the bandwidth at the point of N [%] of total power (N% POWER) or the bandwidth at the point X [dB] down from the peak, level (XdB DOWN). Two modes are available.

- **N% POWER mode** Use **<F1>** key (MODE) to select N%.
  Measures the bandwidth at the point of N [%] of total power displayed on the screen.



Occupied frequency bandwidth measurement mode.

Setting parameter

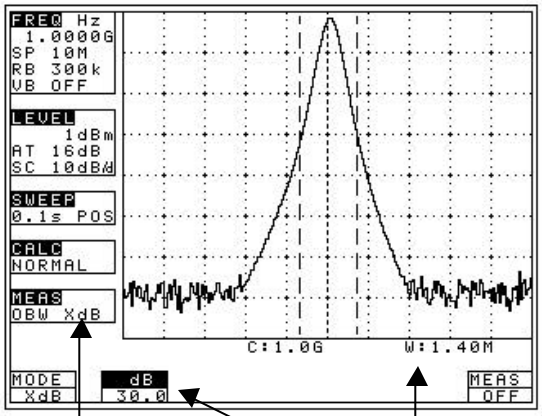
Measured value

- It is shown on MEAS area of LCD as "OBW N%"
- The measured value is displayed at the right lower corner on the screen.

Use the **<F2>** key (RATIO) with encoder to set the percentage to total power.

- Setting range : 80.0 to 99.9%

- XdB DOWN mode Use the **<F1>** key (MODE) to select XdB.
  Measures the bandwidth at the point X [dB] down from the peak level,



Occupied frequency bandwidth measurement mode.

Setting parameter

Measured value

- It is shown on MEAS area of LCD as "OBW XdB"
- The measured value is displayed at the right lower corner on the screen.

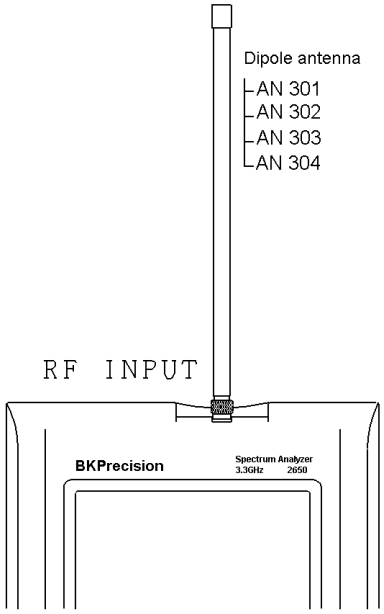
Use the **<F2>** key (dB) with encoder to set down level from peak level.

- Setting range : 0.1 to 80.0dB

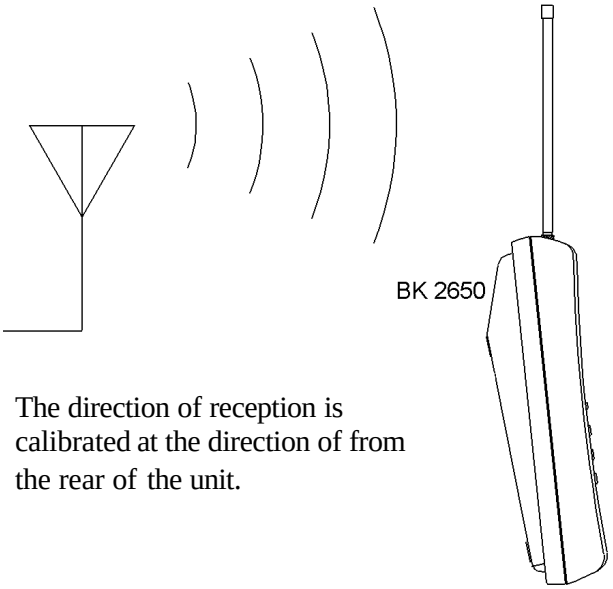
19.4 Electric field strength measurement <E/F ANT> <F4>

Measures electric field strength with an optional dipole antenna. Allows using antenna other than options by creating and inputting the original calibration table.

Antenna connection.



Measurement environment.



The direction of reception is calibrated at the direction of from the rear of the unit.

Dipole antenna specifications. (antenna gain and VSWR are specified at the center frequency range).

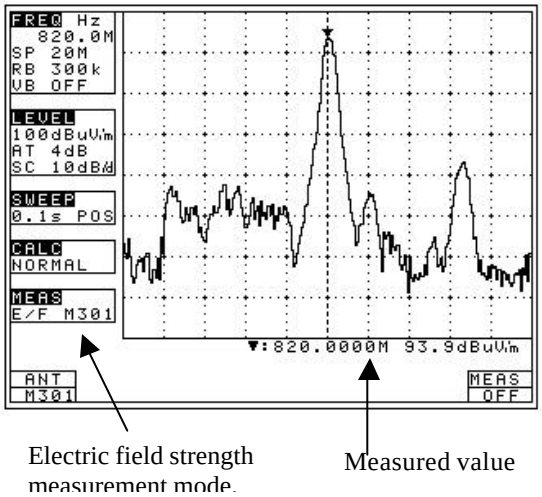
Items	AN 301	AN 302	AN 303	AN 304
Frequency range	0.8 to 1.0GHz	1.25 to 1.65GHz	1.70 to 2.20 GHz	2.25 to 2.65GHz
Antenna gain	+1dBi or higher	+1dBi or higher	+1dBi or higher	+1dBi or higher
VSWR	1.5 or lower	1.5 or lower	1.5 or lower	1.5 or lower
Dimensions	7.5f x250mm	7.5f x250mm	7.5f x180mm	7.5f x180mm
Weight	approx. 20g	approx. 20g	approx. 20g	approx. 20g
Reference level setting range	96 to 146dBμ V/m	100 to 150dBμ V/m	103 to 153dBμ V/m	104 to 154dBμV/m

- Mode selection and measurement

Use the **<F1>** (ANT) to select an antenna, AN 301, AN 302, AN 303, AN 304 or USER. As soon as the antenna is entered, the measurement is taken.

- It is each shown on MEAS area of LCD as “M/F AN 301”, “M/F AN 302”, “M/F AN 303”,“M/F AN 304” or “M/F USER”.
- USER settings, is custom calibration table and there fore could be created by user.

(Refer to “23.1 Command description” for details.)



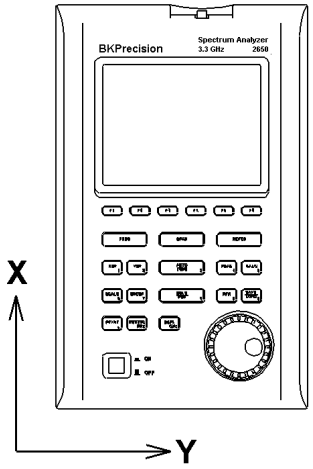
- Amplitude could me measured in [dBmV/m]
- Optimum center frequency and frequency span are set according to the antenna.
- In addition, a trace is not displayed for frequencies outside those supported by the antenna.

(Example) case of AN 301

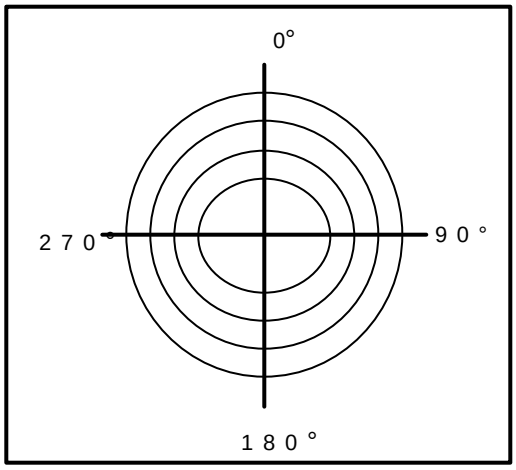
Center frequency: 900MHz

Frequency span: 200MHz

- Antenna directivity (reference data)

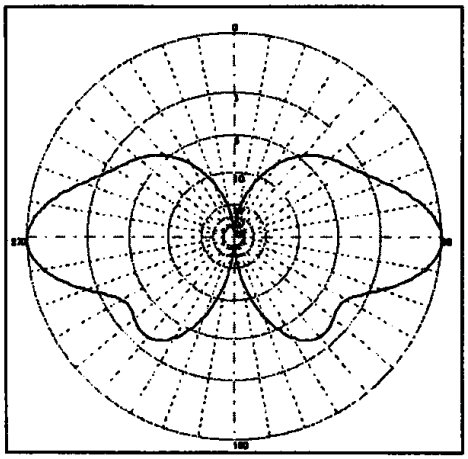


E plane: X-Y axis (X direction=0°)

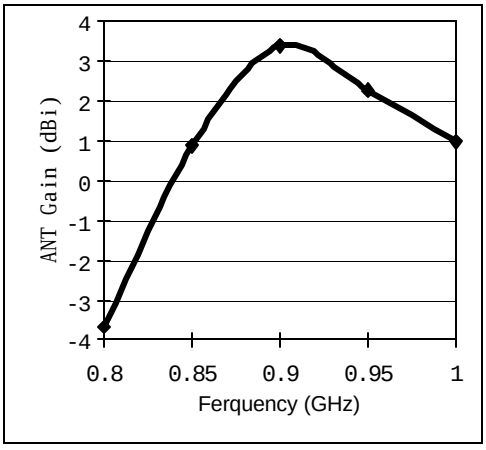


NOTE: All represented examples here with External RF antenna, and undistorted horizon.

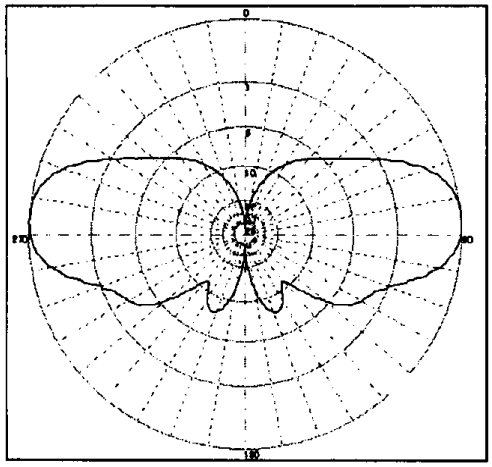
AN301 (900MHz, E plane)

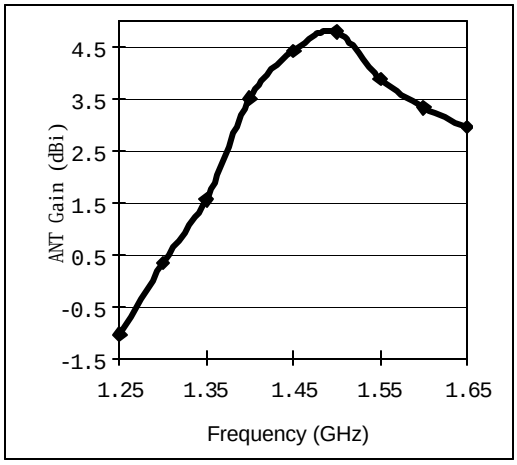


Antenna gain vs. Frequency

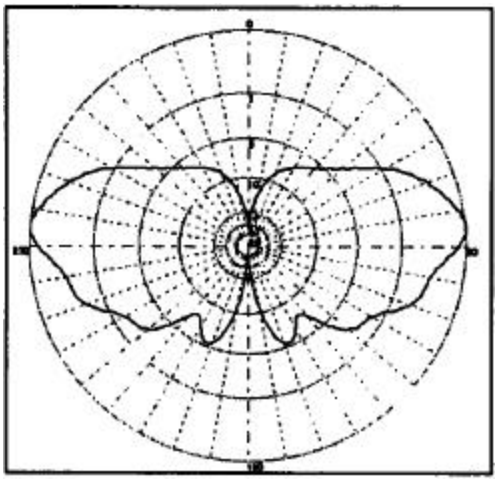


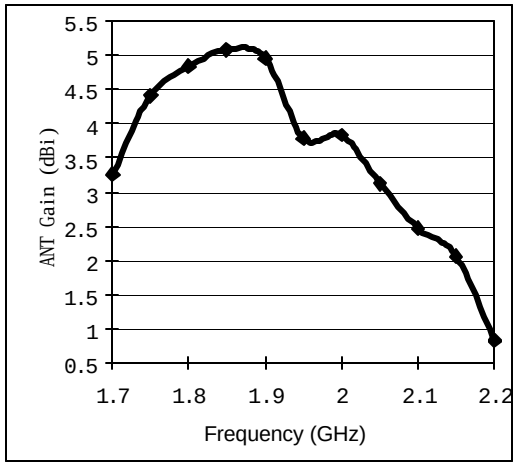
AN302 (1.5GHz, E plane) Antenna gain vs. Frequency



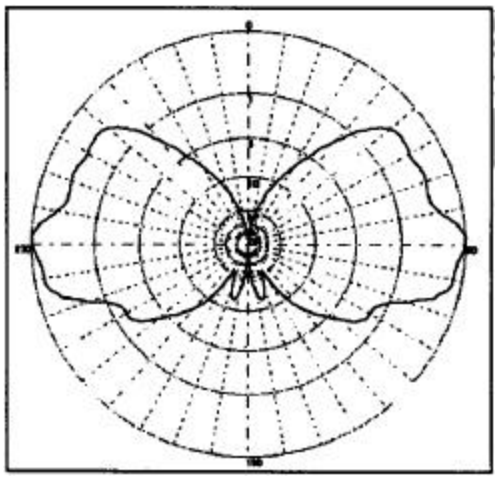


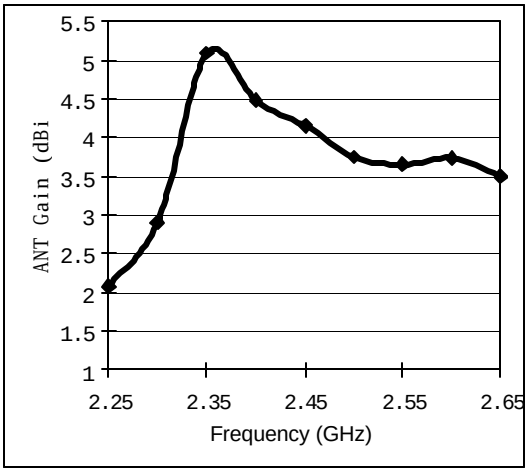
AN303 (2.0GHz, E plane) Antenna gain vs. Frequency





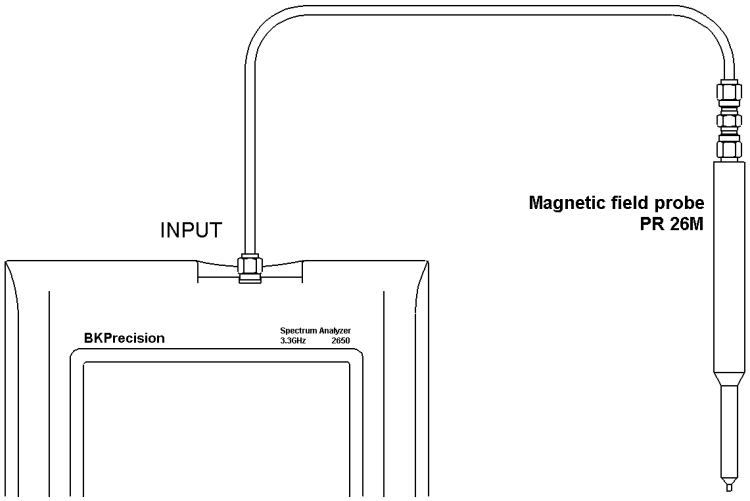
AN304 (2.4GHz, E plane) Antenna gain vs. Frequency





19.5 Magnetic field strength measurement <M/F PROBE> (optional) <F5>

Measures the magnetic field strength using the optional magnetic field probe PR 26M.



Specifications of magnetic field probe PR 26M

Items	Specifications
Frequency range	10MHz to 3GHz
Space resolution	approx. 0.25 mm (Depending on objects)
Dimensions	Outside: 12f ×135mm probe tip: 2mm(W)×1mm(T)
Connector	SMA (P)
Reference level setting range (maximum)	159 to 178dBμ A /m
Reference level setting range (minimum)	109 to 128dBμ A /m
Measurement error	approx. ±1dB

Caution!
Ceramic magnetic field probe PR 26M is fragile. Handle with care.

(Refer to the operating manual for PR 26M for details.)

? Registration of the probe ID

Before use PR26M probe first time, it is needed get registered with analyzer first. Registration is one time procedure, probe don't need registered in future, except if 2650 has been repaired or user try to use different probe.

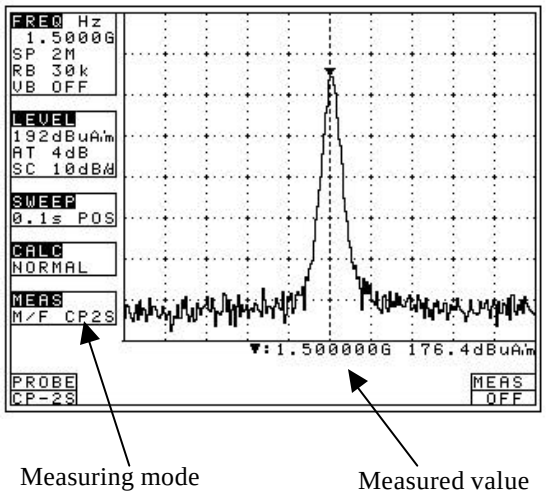
To start registration process push <**MEAS**> then <**F6**> key first. "Input PROBE ID" will appear in the measured value display area on the screen. Second, locate on the probe and input in to 2650 the 14-digit Probe ID from main keypad. Press the <**F4**> (ENTER) to confirm, press <**F5**> (CLEAR) to delete the entire value and allow reentering new one, press the <**F6**> (BACK SPACE) to delete the last digit. Press the <**F3**> key if you wish to cancel the probe ID registration.

- **Mode selection and measurement**

Use the **<F1>** key to select a probe type (PR 26M or USER). As soon as the probe type is set, the measurements will be taken.

- It is each shown on MEAS area of LCD as “M/F CP2S” or “M/F USER”.
- “USER” is an original calibration table the user creates.

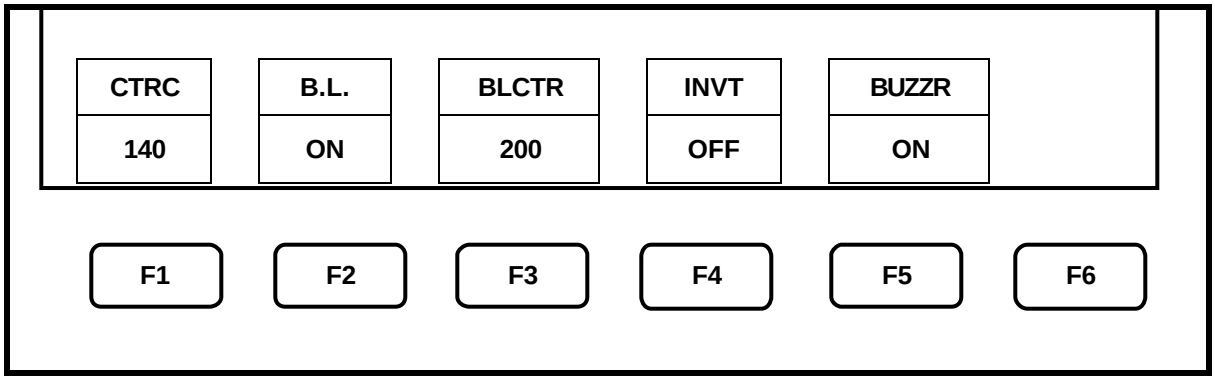
(Refer to “23.1 Command description” for details.)



- Magnetic field strength measurements will be shown in [dBµA/m]
- Trace will be available only in range supported by probe in this mode.

20 Screen Control <DSPL>

Press the **<F6>** key to switch over to the function screen shown below:



20.1 Adjusting the contrast

Use the **<F1>** key with encoder for display contrast adjustment.

20.2 Switching ON and OFF the LCD backlight

Use the **<F2>** key to switch on and off display back light on 2650

20.3 Adjusting the brightness of the LCD backlight

Use the **<F3>** key with encoder to set display brightness level.

20.4 Inverting the display

Press the **<F4>** key to invert the display.

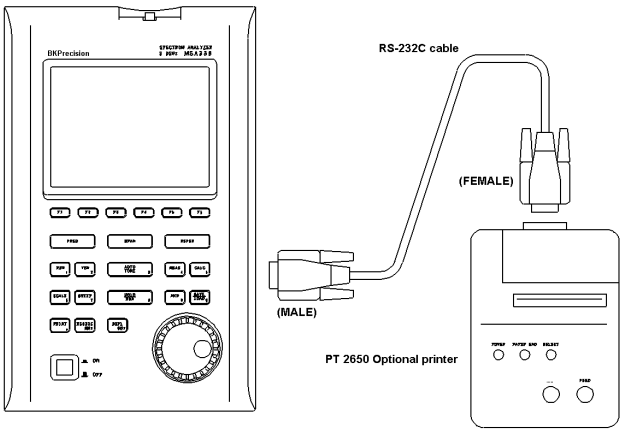
20.5 Enabling or disabling the beep

The **<F5>** key allows you to disable/enable the keypad and encoder beep sounds.

21 Printing <PRINT>

21.1 How to connect

2650 is fully capable to work with PT 2650 external printer (Optional). Connect optional printer to 2650 external printer port with RS-232C cable as shown in the figure below.



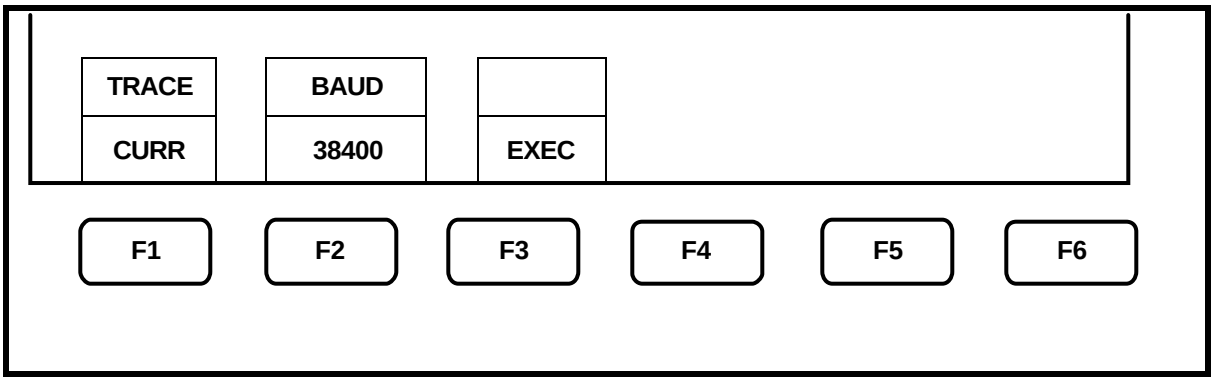
21.2 Print screen

When PT 2650 is connected to the unit and **<PRINT>** button was pressed once, 2650 is goes to the HOLD state and starts printing display image. It will remains in the HOLD state after the printing is finished. In order to stop current print operation - press **<PRINT>** button again. PT2605 printer could be operated on either the AC adapter or on four alkaline standard AA batteries.

On battery printer will operates for approximately 30 minutes (printing time), allowing you to produce about 80 hard copies of the screen image.

22 Data Output <RS232C>

Press the **<F6>** key to switch over to the function screen shown below:



Refer to “23. RS-232C Interface” for how to connect to PC serial port.

22.1 Selecting the trace to transfer

Use the **<F1>** with encoder to select a trace.

CURR ↔ 00 ↔ 01 ↔ 02 ↔ 03 ↔ … ↔ 98 ↔ 99 ↔

An asterisk (*) appears when there is a saved trace at the selected number as well as "SAVE/LOAD".

22.2 Selecting the communication speed (baud rate)

Use the **<F2>** key to select a baud rate.

2400 ↔ 4800 ↔ 9600 ↔ 19200 ↔ 38400

22.3 Transfer the data <EXEC>

Press the **<F3>** key to initiate data transfer.

The data are transmitted in ASCII character strings.

- Contents of data

Character strings	Description	Example
PARAM	This means that the data from the next line are "setting parameters".	PARAM
CF **	Center frequency	CF 2.514G
SP **	Frequency span	SP 20M
RF **	Reference level	RF 10dBm
ST ** ##	Sweep time and detection mode	ST 30mS SMP
RB **	Resolution bandwidth	RB 300k
VB **	Video bandwidth	VB OFF
SC **	Display scale (* * = 0dB/d/2dB/d)	SC 10dB/d
TRACE	This means that the data from the next line are "trace data".	TRACE
**, **, …	These are trace data. Ten two-digit hexadecimal characters separated by commas make a line, and there are 26 lines (251data) of data in total. For Trace 1001 data transfer, there are 101 lines (1001 data) of data in total.	24, 20, 1f, 1f, 1e, **…** **…** 23

NOTE: CR (0D[HEX]) + LF (0A[HEX]) is added to the tail of every data.

1. Center frequency

   CF ** [=0.0M/0.1M ~999.9M (0.1step) /0.0001G~3.3G(0.0001 step)]

2. Frequency span

   SP ** [** =

   ZERO/200k/500k/1M/2M/5M/10M/20M/50M/100M/200M/500M/1G/2G/FULL]

3. Reference level

   RF** [**= -40~10dBm/67~117dBµV/7~57dBmV/-53~-3dBV/96~154dBµV/m/109~178dBµA/m (all 1step)

4. Sweep time and Detection mode.

ST ** ## [** =10ms/30ms/0.1s/0.3s/1s/3s/01s/30s/] [## = POG/NEG/SMP]

5. Resolution Bandwidth

RB ** [** = 3K/10K/30k/100k/300K/1M/3M]

6.Video Bandwidth

VB ** [**= 100/300/1k/3k/ 10k/30k/100k/300k/off]

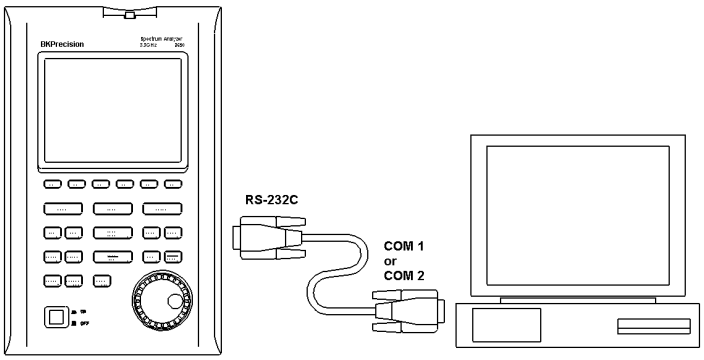
23 RS-232C Interface

23.1 RS-232C specifications

- Transfer rate — 2400/4800/9600/19200/3800bps
- Date bit length — 8bit
- Stop bit — 1bit
- Parity check — None

23.2 How to connect

When using the RS-232C interface, connect the RS-232C cable as shown in the figure below. Refer to "22. Data Output" for RS232 baud rate change.



RS232C (9pin, male)
Use the conversion connector, in the case that is 25pin (male)

23.3 Command description

- "CR (0D[HEX])+ LF (0A[HEX])" is added to the tail of every command. When you send a command from your PC, 2650 returns a response. Responses include "OK" + CR + LF, "ERR" + CR + LF and "(response to command)" + CR + LF.
- By inputting "?" instead of "* *" for each command, the current setting parameters are returned. Except for "… Request" command and command for inputting corrected data.

1) Set the center frequency

Command: FREQ *******

(******* = Refer to [23.4 Input the frequency])

2) Request the marker settings

Command: FREQSETMKR

NOTE: Center frequency is set according to the frequency of current marker position.

3) Set the span

Command: SPAN ****

(****= ZERO/200K/500K/1M/2M/5M/10M/20M/50M/100M/500M/1G/2G/FULL [unit:Hz])

4) Set reference level

Command: REF ****

(*** = - 40~10[1step, unit: dBm])

NOTE: For other, non-dBm units use conversion formulas convert them into dBm before enter the new value. See 9.3 Reference level settings range for each unit.

5) Set the reference unit

Command: UNIT ***

(*** = DBM/DBVU/DBMV/DBV)

Command	Unit
DBM	dBm
DBUV	dBμV
DBMV	dBmV
DBV	dBV

6) Set the RBW

Command: RBW ****

(**** =3K/10K/30K/100K/300K/1M/3M/AUTO/ALL [unit: Hz])

7) Set the VBW

Command: VBW ****

(****=100/1K/3K/10K/30K/100K/300K/OFF/AUTO/ALL [unit: Hz])

8) Start/Stop the measuring function

Command: MEAS ***

(****=CP/ACP/OBW/EF/MF/OFF)

Command	Measuring function
CP	Channel power measurement
ACP	Adjacent channel leakage power measurement
OBW	Occupied frequency bandwidth measurement
EF	Electric field strength measurement
MF	Magnetic field strength measurement
OFF	OFF

9) Request the result of measuring function

Command: MEASRES

Data example:

Case of channel power measurement… POW:-25.5dBm

Case of adjacent channel power measurement… L: -44.7dBc U:-48.3dBc

Case of occupied bandwidth measurement… C: 1.45G W20. 00k

10) Set the mode of channel power measurement

Command: CPMODE *****

(***** = TOTAL/BAND)

Command	Mode
TOTAL	Measure the power of whole range on the screen
BAND	Measure the power within zone set

11) Set the zone center frequency of channel power measurement

Command: CPCNTR *****

(******= Refer to [24.3 input frequency])

12) Set the zone width of channel power measurement

Command: CPWIDTH*******

(*********= Refer to [23.4 input frequency)

13) Set the mode of adjacent channel power mesurement

Command: ACPMOODE*****

(***** = TOTAL/REF/PEAK)

Command	Mode
TOTAL	TOTAL (total power method)
BAND	BAND (in-band method)
PEAK	PEAK (reference level method)

14) Set the band offset of adjacent channel power mesurement

Command: ACPOFS***

(******* = Refer to [23.4 Input the frequency])

15) Set the bandwidth of adjacent channel power mesurement

Command: ASPCHBW ****

(******* = Refer to [23.4 Input the frequency])

16) Set the reference band center frequency of adjacent channel power mesurement

Command: ACPREF****

(******* = Refer to [23.4 Input the frequency])

17) Set the reference bandwidth of adjacent channel power measurement

Command: ACPREFBW****

(******* = Refer to [23.4 Input the frequency])

18) Set the mode of occupied bandwidth measurement

Command: OBWMODE **

(** = N%/DB)

Command	Mode
N%	N% POWER mode
DB	XdB DOWN mode

19) Set the N% ratio of occupied bandwidth mesurement

Command: OBWRATIO***

(*** = 80.0~99.9 [0.1 step unit %])

20) Set the XdB down of occupied bandwidth mesurement

Command: OBWDB***

(***= 0.1~40.0[0.1 step, unit: dB])

21) Set type of external antenna

Command: EFANT****

(****=AN301/AN302/AN303/AN304/USER)

Command	Antenna
M301	Setting date for AN 301
M302	Setting date for AN 302
M303	Setting date for AN 303
M304	Setting date for AN 304
USER	Setting date for user's original antenna

22) Set the user correction-settings for the electric field strength measurement

Command: EFUSER***

Example of the correction entry: *** = 2.25G: 2.08DBI, … 2.65G: 3.5DBI

NOTE: If the correction coefficient is –0.3dBi at 2.5GHz, the correction data is "2.5G:-0.3DBI " Set apart by "," between data and input from lower frequency 10 data entry is available.

23) Set the probe of magnetic field strength measurement

Command: MFPROBE ***

(**** = CP2S/USER)

Command	Probe
CP2S	Setting data for PR 26M
USER	Setting data for user's original probe

24) Set the user correction-settings for magnetic field strength measurement

Command: MFUSER***

Example of the correction entry: *** = 10M:86. 7DB, 100M:69. 2DB, … 3G:40DB

NOTE: If the correction coefficient is 86.7dB at 10MHz, the correction data is "10M:86.7DB" Set apart by "," between data and input from lower frequency. 10data entry is available.

25) Start/Stop Calculation

Command: CALC***

(*** = OFF/MAX/MIN/AVE/OVR)

Command	Calculation
OFF	OFF
MAX	MAX HOLD
MIN	MIN HOLD
AVE	AVERAGE
OVR	OVER WRITE

26) Set the number of MAX HOLD

Command: MAXNO ****

(**** = 2/4/8/16/32/64/128/256/512/1024/0)

NOTE: Value 0 is for unlimited hold.

27) Set the number of MIN HOLD

Command: MINNO ****

(**** = 2/4/8/16/32/64/128/256/512/1024/0)

NOTE: Value 0 is for unlimited hold.

28) Set the number of AVERAGE

Command: AVENO***

(*** = 2/4/8/16/32/64/128/256)

29) Set the display amplitude scale.

Command: SCALE

(** = 2/10)

Command	Display scale
2	2dB/div
10	10dB/div

30) Set the sweep time

Command: SWEEP****

(**** = 10M/30M/0.1S/0.3S/1S/3S/10S/30S/AUTO/ALL)

Command	Sweep time
10M	10ms
30M	30ms
0.1S	0.1s
0.3S	0.3s
1S	1s

Command	Sweep time
3S	3s
10S	10s
30S	30s
AUTO	AUTO
ALL	ALL AUTO

31) Set the detection mode

Command: DET ***

(*** = POS/NEG/SMP)

Command	Detection mode
POS	Positive peak mode
NEG	Negative peak mode
SMP	Sample mode

32) Request the AUTOTUNE

Command: AUTO

NOTE: Returns the response after tuning.

33) Request the action

Command: HOLD/RUN

34) Request the marker information

Command: MKRRES

NOTE: Example of return data: 1.4G-15dBm

35) Set the marker mode

Command: MKR*****

(***** = NORM/DELTA)

Command	Marker mode
NORM	Normal marker
DELTA	Delta marker

36) Set the marker position

Command: NORMMKR*****

(***** = Refer to [23.4 input the frequency])

37) Set the peak search mode

Command: PEAK****

(**** = NORM/ZONE)

Command	Peak search mode
NORM	Normal peak search
ZONE	Zone peak search

38) Request the peak search

Command: PKSEARCH**

(** = 01/01/03/04/05/06/07/08/09/10/11)

Command	Position to where the marker moves
01	Position of the maximum peak on the screen
02	Position of the 2nd highest peak on the screen
…	…
11	Position of the 11th highest peak on the screen

39) Set the zone center frequency of peak search

Command: PKCNTR *****

(******* = Refer to [23.4 Input the frequency])

40) Set the zone width of peak search

Command: PKWIDTH *****

(****** = Refer to [32.4 Input the frequency])

41) Set the input marker

Command: CONV ***

(*** = DBM/W/DBV/V/DBVUM)

Command	Unit of marker
DBM	dBm
W	W
DBV	dBV
V	V
DBVUM	dBμV/m
VM	V/m

42) Print screen

Command: PRT

NOTE: Screen image will be printed on optional printer.

43) Request to transfer trace

Command: SRC ****

(**** = CURR/00 ~ 99)

Command	Trace that is transferred
CURR	Trace of Current
00	Trace of save data 1
…	…
99	Trace of save data 100

44) Request to transfer 1001 date of trace

Command: SRSF

(Refer to [22.3 Transfer the data about returned data])

45) Request the preset

Command: PRESET

46) Set the remote control

Command: REMOTE***

(**** = ON/OFF)

NOTE: When 2650 remote control is ON, "REMOTE" sine will appears on the display.

Command	Remote control
ON	Any operation from the keys or encoder of the main body will not be accepted. Control the unit with RS-232C commands.
OFF	The operation from the keys or encoder of the main body and RS-232C commands will be accepted.

47) Confirmation of capturing situation

Command: CAPT

NOTE: Only after capturing is finished, data can be transferred "COMP". If the capturing is in progress and the data cannot be transferred, or if the data has not been updated, "BUSY" message will be returned.

23.4 Input the frequency

For all privies references enter frequency as follows:

******* = 0.0k~999.9k [0.1step, unit: Hz]

0.0M~999.9M[0.0001 step, unit: Hz]

0.0001G~3G[0.0001 step, unit: Hz]

NOTE: The offset frequency and zone width can be input only in range decided by the center frequency and frequency span. If entered value is out of the range, error will be generated. Values of the offset frequency and the zone width will change as you alter the frequency span.

23.5 Sample of remote program

This is an example of remote program for 2650. Program is designed to send following setting over RS-232C to 2650 shown below:

Setting: Center frequency 1GHz

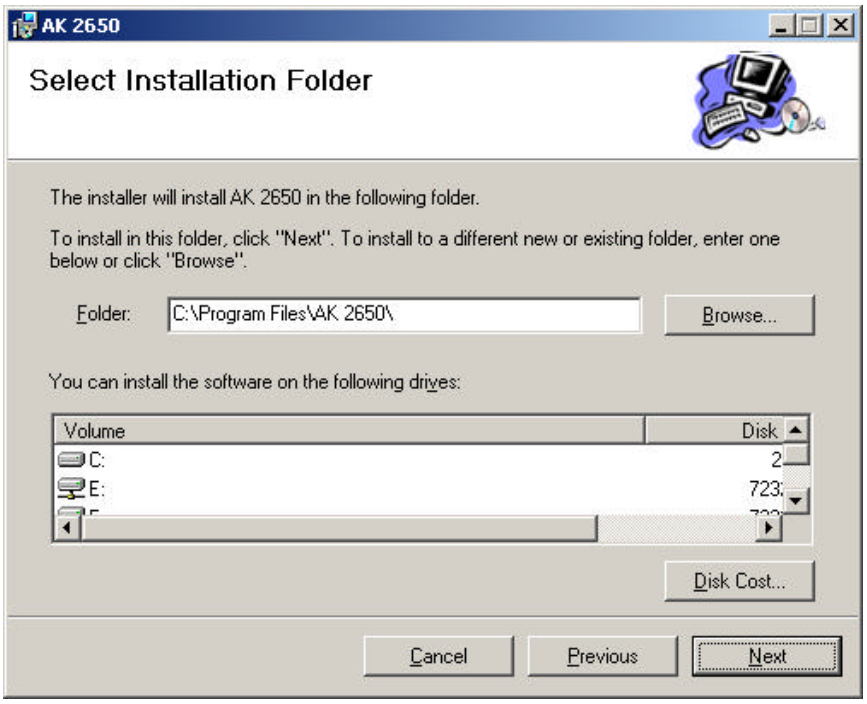
```
10                                  FREQ SETTING
20  OPEN "COM1:N81N" AS #1
30 PRINT #1 "FREQ 1G"               "FREQ 1G" OUTPUT
40 INPUT #1 A$                      "OK" READ
50 CLOSE #1
```

24 PC Software Model AK 2650

2650 Analyzer is capable to be controlled by PC analyzer software, AK2650 (optional) when connected to PC over serial RS232C interface. AK2650 package is containing Software CD and RS232C interface cable. Software is supported in Windows 95, Windows 98, Windows 2000, Windows Me, Windows NT operating system's.

24.1 Installation/Uninstallation procedure

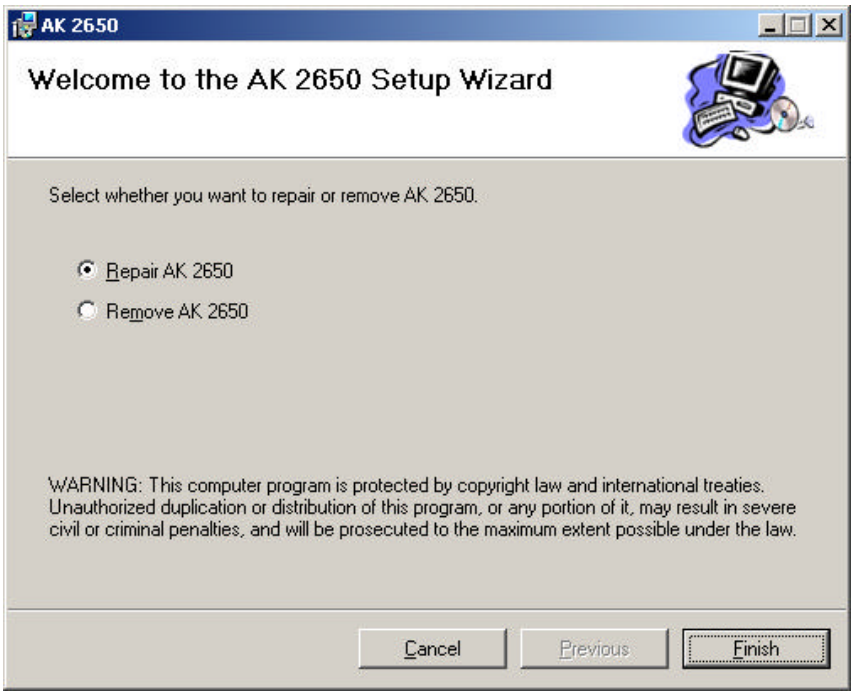
Insert the AK 2650 software CD into the CD-ROM drive. CD browser will open the first screen automatically; If CD auto run option is disabled on your PC lunch CD browser from Microsoft Explorer. To preside with software installation, go to the Software install submenu. The setup will start automatically and the initial screen will appear. Follow the instructions on the screen; enter the destination for AK2650 software. Then click NEXT to complete the installation.
Choose new location in the start menu if needed. (Recommend keeping default)
Click NEXT to continue installation.



At this point installation is complete.

UNINSTALLATION

For complete Uninstallation of AK2650 software insert AK2650 software CD in to CD-ROM, go to Install portion of the menu. Click Install button., Install repair screen will appear.



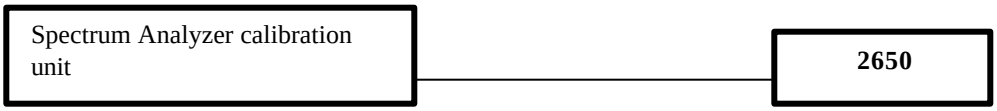
At this point choose Repair for repair existing installation or Remove for complete uninstalling all AK 2650 software components, then click finish.

NOTE. Due to simplicity of 2650 software it cannot interfered with other software on client PC due to it design, it not require any system files be updated or re-new system dll library's. Analyzer software use's only Windows port recourses there fore it can't be any system software problem at all if AK2650 software going to be uninstalled correctly.

25 Calibration procedures.

To insure 2650 accuracy, regular calibration check is recommended. This section describes a methodology and specification for annual calibration check. All equipment is used in this procedure has to be calibrated or check prior to use. If a problem or reading inaccuracy was found in process of performing calibration procedures, full stationary recalibration is required. Contact BK Precision Service department to arrange necessary repair/calibration.

[Connection diagram]



25.1 Frequency characteristics check

Adjust the output level of the spectrum analyzer calibration unit (thereafter, "calibration unit") so that the displayed power value is -15dBm at each frequency for this unit, and measure the absolute value with a receiver for calibration (microwave power meter, etc.).

Setting of 2650			Specifications	Measurement value	Judgment
Center frequency	Frequency span	RBW			
50kHz	200kHz	10kHz	Within Reference±2.6dB±1dot		
100kHz	200kHz	30kHz	Within Reference±2.6dB±1dot		
1MHz	2MHz	100kHz	Within Reference±1.6dB±1dot		
10MHz	10MHz	3MHz	Within Reference±1.0dB±1 dot		
100MHz	10MHz	3MHz	Reference		
1GHz	10MHz	3MHz	Within Reference±1.0dB±1 dot		
2GHz	10MHz	3MHz	Within Reference±1.0dB±1 dot		
3.3MHz	10MHz	3MHz	Within Reference±1.0dB±1 dot		

NOTE: RBW switching error is included at RBW other than 3MHz.

? Setting of 2650

Reference level : -15dBm
VBW : OFF
Sweep time : 1s
Detection mode : SMPL
Display scale : 2dB/div

? Setting of calibration unit

Frequency : Same as a center frequency of 2650. However, no outputs for 0 Hz
Output power : Adjust the power indication of 2650 to -15dBm.

25.2 Reference level accuracy check

Adjust the output level of the calibration unit so that the displayed value of this unit is the 0th div from the top, and calibrate the absolute value with the receiver for calibration (microwave power meter, etc.).

Setting of 2650 Reference level	Specifications	Measurement value	Judgment
+10dBm	Within ± 1.4 dB ± 1 dot		
0 dBm	Within ± 1.4 dB ± 1 dot		
-10 dBm	Within ± 1.4 dB ± 1 dot		
-15 dBm	Within ± 0.8 dB ± 1 dot		
-20dBm	Within ± 1.4 dB ± 1 dot		
-30dBm	Within ± 1.4 dB ± 1 dot		
-40dBm	Within ± 1.4 dB ± 1 dot		

NOTE: Input attenuator switching error is included at the reference level other than –15dBm.

Setting of 2650

Center frequency : 100MHz
Frequency span : 10MHz
RBW : 3MHz
VBW : OFF
Sweep time : 1s
Detection mode : SMPL
Display scale : 2dB/div

Setting of calibration unit

Frequency : 100MHz
Output power : Adjust it so that the indicated value of 2650 is at the 0^{th} div from the top.

25.3 Center frequency display check

Measure the frequency with the peak search function of 2650.

Setting of 2650			Specifications	Measurement value	Judgment
Center frequency	Frequency span	RBW			
100MHz	200kHz	3kHz	Within ± 130kHz ±1dot ±1		
100MHz	10MHz	30kHz	Within ± 130kHz ±1dot ±1		
100MHz	20MHz	100kHz	Within ± 800kHz ±1dot ±1		
100MHz	200MHz	100kHz	Within ± 800kHz ±1dot ±1		
1GHz	500MHz	100kHz	Within ± 800kHz ±1dot ±1		
1GHz	2GHz	3MHz	Within ± 800kHz ±1dot ±1		
1.65Hz	FULL (3.3GHz)	3MHz	Within ± 800kHz ±1dot ±1		

Setting of 2650

Reference level : -15dBm
VBW : AUTO
Sweep time : 1s
Detection mode : SMPL
Display scale : 10dB/div

Setting of calibration unit

Output power : -15dBm

25.4 The display accuracy of the Frequency span

Adjust the frequency on calibrator that peaks are at the positions of f_1 and f_9, and measure the frequencies set to f_1 and f_9. Calculate from f_1 and f_9 the accuracy of the frequency span indication.

Setting of 2650			Specifications	f_1 value	f_9 value	$(f_9 - f_1)$ x1.25	Judgment
Frequency span	Center Frequency	RBW					
200kHz	100MHz	3kHz	within ±26kHz ± 1dot				
10MHz	100MHz	100kHz	within ±320kHz ± 1dot				
20MHz	100MHz	300kHz	within ±0.8MHz ± 1dot				
200MHz	100MHz	3MHz	within ±6.2MHz ± 1dot				
500MHz	1GHz	3MHz	within ±15.2MHz ± 1dot				
2GHz	1GHz	3MHz	within ±60.2MHz ± 1dot				
Full 3.3GHz	1.65GHz	3MHz	within ±99.2MHz ± 1dot				

NOTE: f_1 1st div from the left on the trace screen
f_9 9th div from the left on the trace screen

Setting of 2650 ? Setting of calibration unit

Reference level	:	-15dBm	Frequency	:	Adjust it to the positions of f_1 and f_9.
VBW	:	AUTO			
Sweep time	:	1s	Output power	:	-15dBm
Detection mode	:	SMPL			

25.5 Linearity of the amplitude axis

Adjust the level of the calibration unit so that the peak is at the top of the amplitude axis (0th div), and regard the point set at that time as the reference. Gradually lower the output, starting from the reference, and measure the amplitude value of 2650.

Setting of 2650 Display scales	Output of calibration unit	Specifications	Measurement value	Judgment
10dB/div	**X** dBm (Adjust to the 0th div)	Reference (-15dBm)	(-15dBm)	
	X-10dB	Within –25dBm± 0.8dB ± 1 dot		
	X-70dB	Within –85dBm± 1.6dB ± 1 dot		
2dB/div	**X** dBm (Adjust it to the 0th div)	Reference (- 15dBm)	(-15dBm)	
	X - 2 d B	Within –17dBm± 0.2dB ± 1 dot		
	X - 1 0 d B	Within –25dBm± 0.8dB ± 1 dot		

Setting of 2650			Setting of calibration unit		
Center frequency	:	100MHz	Frequency	:	100MHz
Reference level	:	-15dBm			
Frequency span	:	10MHZ			
RBW	:	3MHz			
VBW	:	OFF			
Sweep time	:	1s			
Detection mode	:	SMPL			

26 Service Information

Warranty Service: Please return the product in the original packaging with proof of purchase to the below address. Clearly state in writing the performance problem and return any leads, connectors and accessories that you are using with the device.

Non-Warranty Service: Return the product in the original packaging to the below address. Clearly state in writing the performance problem and return any leads, connectors and accessories that you are using with the device. Customers not on open account must include payment in the form of a money order or credit card. For the most current repair charges contact the factory before shipping the product.

Return all merchandise to B&K Precision Corp. with pre-paid shipping. The flat-rate repair charge includes return shipping to locations in North America. For overnight shipments and non-North America shipping fees contact B&K Precision Corp.

B&K Precision Corp.
22820 Savi Ranch Parkway
Yorba Linda, CA 92887

Email: service@bkprecision.com

Include with the instrument your complete return shipping address, contact name, phone number and description of problem.

Two-year limited warranty

B&K Precision Corp. warrants to the original purchaser that its product and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the data of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its' option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty card to B&K Precision Corp., 22820 Savi Ranch Parkway, Yorba Linda, CA 92887 within fifteen (15) days from proof of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alternations or repairs. It is void if the serial number is alternated, defaced or removed. B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

Model Number: _____ **Date Purchased: _____**

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