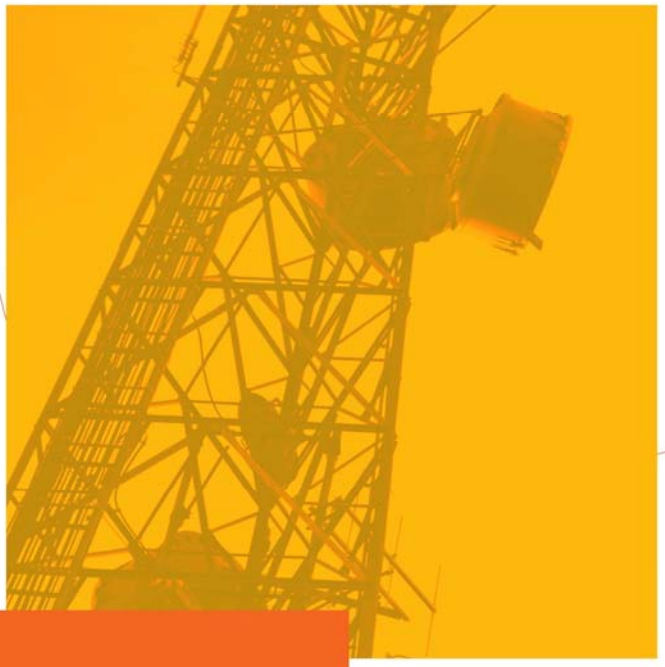


GC723A/GC724B

Cable and Antenna Analyzer

User's Manual

www.gctm.net

innertron

GenComm

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

This page intentionally left blank.

CH 1

1.0 INTRODUCTION

In this chapter

CH 1

OVERVIEW

GC723A/GC724B

A large number of abnormal cell site problems are typically caused by the antenna system, cable and connectors, or both. It's important to have the right instrument available when either servicing or certifying cell sites for operation.

The GC723A/GC724B Cable and Antenna Analyzer is a lightweight portable diagnostic tool needed to accurately detect operational problems.

The GC723A/GC724B has all of the measurement functions necessary to accurately verify antenna systems from VSWR to power measurements.

In addition, the GC723A/GC724B makes distance-to-fault measurements to accurately pinpoint the fault's location.

Touch panel operation and a 7 inch wide TFT color display allows measurements to be easily made and displayed on the GC723A/GC724B.

Its application specific software allows for the user to easily compare and analyze measurements and generate reports.

A rechargeable and field installable lithium-ion battery offers a continuous field operation of the GC723A/GC724B for up to three hours.

GC723A/GC724B HIGHLIGHTS

KEY MEASUREMENTS

The Cable and Antenna Analyzer's key measurements are:

- VSWR
- Distance to Fault
- Cable Loss
- Power (average and peak)

KEY FEATURES

The Cable and Antenna Analyzer key features are:

- Rechargeable and infield replaceable lithium-ion battery
- A portable lightweight instrument <2.0 Kg (4.4 lbs) including the battery
- Built-in worldwide signal standards and frequency channels database
- 7 inch TFT color display viewable in daylight
- Easy front keypad operation
- Superior immunity to RF interference
- Up to 1001 data points to locate long range problems
- Built-in cable database containing > 90 cables' characteristics
- User friendly menu structure
- Saves up to 20 user setups
- Saves up to 400 measurement traces
- Saves up to 100 measurement screens
- Alphanumeric labeling of saved data
- Automatic Time/Date stamp of saved data
- Up to 6 trace markers
- RS-232 interface
- USB Port (USB 1.1)
- Remote firmware upgrade capability
- Fast one-touch selection of menu item or positioning marker

APPLICATION SOFTWARE

The GC723A/GC724B Application Software, GCViewer, provides all the necessary tools to operate the instrument more conveniently including:

- Smith Chart conversion
- VSWR-DTF conversion
- Captures saved plots from the GC723A/GC724B
- Registers or edits user definable RF bands into a Custom bands list
- Registers or edits user definable cables into a Custom cable list
- Edits measurement charts
- Generates and prints reports

SUPPLEMENTARY FUNCTIONS

- Captures up to 4 traces
- Displays up to 4 traces in one screen
- Supports up to 6 markers simultaneously

SAFETY INFORMATION

SAFETY SYMBOL

The following safety symbols are used in this document to avoid personal injuries and any damage to the instrument

Warning

WARNING denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond WARNING sign until the indicated conditions are fully understood and met.

Caution

CAUTION denotes a caution. It calls for attention to a procedure or practice which, if not performed correctly could result in a partial or totally damage of the instrument. Do not proceed beyond a CAUTION indication until all the conditions are fully understood and met.

Notice

NOTICE denotes additional information or direction of operation of the instrument.

.

CH 1

INPUT POWER & OTHER INFORMATION

The allowable line input voltage is AC 110V to 250V. There is no need to select the input line voltage. No separate safety fuse is provided with the instrument.

Item		Specification
AC Adaptor	Regulated Input	100 ~ 250V AC, 50 ~ 60 Hz
	Regulated Output	15VDC, 3.3A (49.5W)
Instrument Power Consumption		15VDC, 1.2A (18W) Max

Table 1 – Input Power Requirements

When using the AC adapter, only connect the plug to a properly grounded receptacle. Serious injury or death can occur if grounding is not properly installed.

Always use the AC adapter supplied with the instrument; GenComm doesn't assume any responsibility for incidents caused by using other power supplies.

Disassembly of the electric parts inside or outside of the instrument may cause instrument damage. GenComm doesn't take any repair responsibility for the damage or malfunction of the instrument caused by an unauthorized disassembly even in the warranty period

Do not apply RF power exceeding +25dBm to the RF Out/Reflection port of the instrument. Exceeding the maximum input will damage the instrument.

To avoid damage to the display or the case, do not use solvents or abrasive cleaners.

Incorrect connection of the internal Li-Ion battery may cause explosion. Use only the same or compatible type of battery supplied by the manufacturer. Dispose the battery according to the safety guide

ELECTROSTATIC DISCHARGE PRECAUTIONS

This product was manufactured in an ESD protected environment. Semiconductor devices used in this product are susceptible to damage by static discharge. Depending on the magnitude of discharge, semiconductor devices may be damaged by direct contact or mere proximity of a static charge. This result can cause the degradation of the performance, early failure or immediate destruction. Please use the following guideline to prevent ESD damage.

- Before connecting the cable to the GC723A/GC724B terminal, short circuit the center of the cable with outside metal shield.
- Before connecting or disconnecting cables, wear a wrist strap with 1 MΩ resistor connected to ground.
- All equipment must be connected to ground in order to avoid accumulation of static charges.

2.0 GETTING STARTED

In this chapter

UNPACKING THE GC723A/GC724B

Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment.

If the contents are damaged or defective, contact your nearest GenComm sales and service office. Keep the shipping materials for carrier's inspection.

Verify that all the parts were included in the shipping container. The basic test set package for the GC723A/GC724B includes:

- GC723A/GC724B, Cable and Antenna Analyzer
- Soft Carrying Case
- AC-DC Adapter
- Crossover LAN Cable (1.5m)
- 1GByte USB Memory
- Automotive Cigarette Lighter/12V DC Adapter
- Stylus Pen
- User's Manual (CD ROM)
- Application Software (CD ROM)
- Rechargeable Li-ion Battery

GC723A/GC724B ACCESSORIES

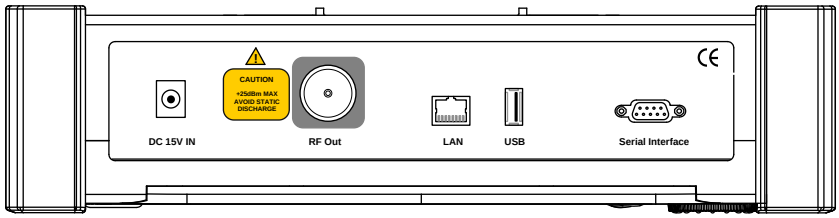
Description	Picture	Specification
Soft Carrying Case (Part No: GC723-50541)		Soft Carrying Case
AC-DC Adapter (Part No: GC724-50522)		Input: 100 ~ 250V AC, 1.2A Output: 15V, 3.3A DC
Cross LAN Cable (1.5m) (Part No: G7105-50335)		Cross LAN Cable (1.5m)
Stylus Pen (Part No: G7105-50316)		Stylus Pen
USB Memory (Part No: GC724-50517)		1GByte, USB2.0
Automotive Cigarette Lighter/12V DC Adapter (Part No: GC724-50523)		DC Adapter for Cigarette Lighter
Li-ion Battery (Part No: GC724-50321)		LI201SX Output: DC11.1V, 4800mAh
User's Manual & Application Software (Part No: GC725-50561)		User's Manual and Application Software CD

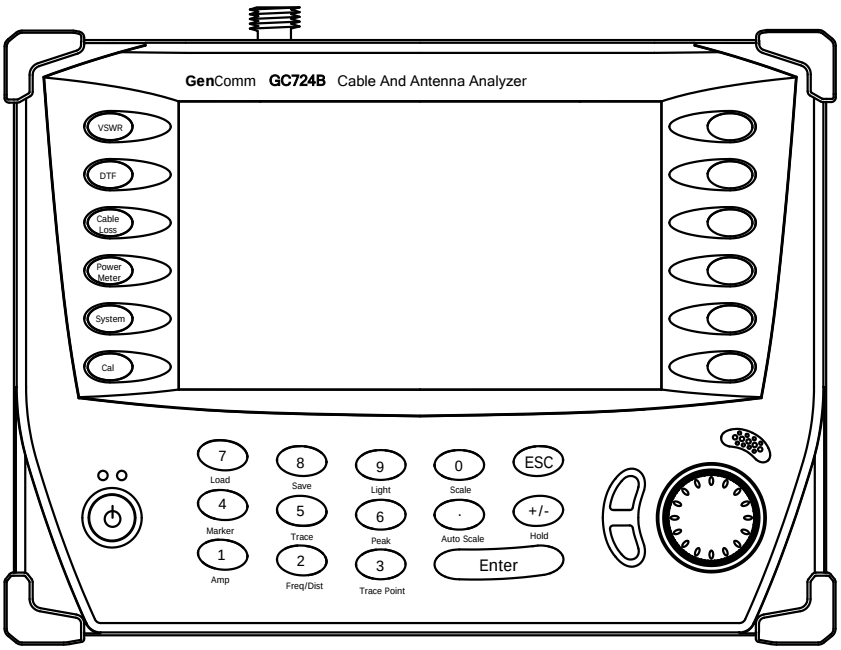
Table 2 – GC723A/GC724B Accessory List

LAYOUT & HARD/SOFT KEYS

LAYOUT

CH 2





FRONT VIEW

VSWR
Measures impedance matching

DTF
Measures distance to fault location

CABLE LOSS
Measures cable insertion loss

POWER METER
Measures transmission power

SYSTEM
Identify and/or revise system information or upgrade firmware

CAL
Performs calibration for VSWR, DTF, and Cable Loss measurements

Power & LED
Power ON/OFF
Green LED: Power On status
Red LED: External power

LOAD
Recalls saved traces to compare with current or other saved traces

MARKER
Supports six markers for each trace

AMP
Sets Y-axis Min/Max, Limit and Limit Level

SAVE
Saves Current, Screen, Trace, and Setup

FREQ / DIST
Sets frequency range or selects a standard or custom frequency band. Sets distance and selects standard or custom cables

TRACE
Captures up to 4 traces
Assign saved trace to Trace CH

LIGHT
Sets LCD Brightness

PEAK
Identifies the highest peak of the trace

TRACE POINT
Selects trace points among 126, 251, 501 or 1001

SCALE
Changes Y-axis scale, VSWR & Return Loss

AUTO SCALE
Adjusts Y scale on screen for optimal display of trace

ENTER
Inputs numeric values

HOLD
Pauses current measurement display

KNOB & UP/DOWN
Moves marker positions of items on the table list

ESC
Cancels latest selection or moves to previous menu

SPEAKER
Generates audio, if enabled, for alarms and key selections

Soft Key
Selects the options displayed in the screen

Screen Menu
Selects menu displayed on the screen

7 " Color LCD
Daylight viewable high resolution LCD Display

POWER SWITCH

A red LED indicates that an external power supply is connected and a green LED indicates that the instrument is turned on. There is no red indication when the instrument is powered by the internal battery.

FUNCTION KEYS

The Hard Keys perform the function uniquely assigned to each key.

- **VSWR**: Activates the VSWR measurement mode.
- **DTF**: Activates DTF measurement mode.
- **Cable Loss**: Activates Cable Loss measurement mode.
- **Power Meter**: Activates RF Power measurement mode. An optional power sensor must be connected to the instrument before using this function.
- **System**: Opens the system screen with the information of the instrument.
- **CAL**: Opens the calibration screen procedure.

SCREEN KEYS

Refers to the menu displayed at the right side of the screen. The menu shown on the display varies depending on the selection of Hard Keys or Multifunction Keys.

ESC KEY

Stops an active function or goes back to the previous menu level or exits data entry without changing the value.

ENTER KEY

Selects the highlighted item in the list or exits data entry, changing the value for test parameters.

KNOB, ARROW KEYS

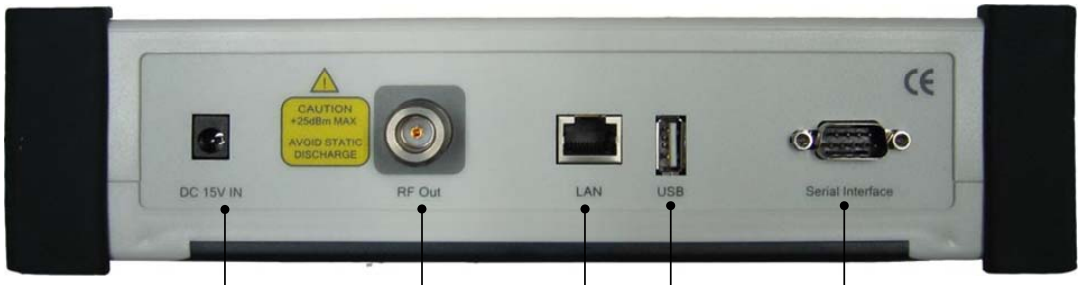
KNOB is used to change step values defined for limit level or to move the marker on the trace. Rotating the knob clockwise will increase the value or move the marker to the right and rotating it counterclockwise will decrease the values or move the marker to the left. Incremental step values are set differently for each function.

ARROW key increases or decreases an active function values. It works almost the same as the knob, but allows more precise control.

MULTI KEYS

Enters values shown on the keys for input pop-up windows prompted on the screen. Opens a menu linked with the functions in blue or directly performs the specified function.

UPPER VIEW



DC 15V IN
External DC input port

RF OUT
50ohm N-type RF Connector, maximum allowable input is +25dBm

LAN
Ethernet Communication port to connect a PC with the application software

USB
USB Memory Stick port, used for either saving measurement data or upgrading the instrument's firmware

RS-232C
D-sub serial interface port to connect optional external power sensors

RF OUT

RF-Out/Reflection is an N-type Female 50Ω connector that perform the RF measurements of VSWR, DTF and One-port Cable Loss.

The maximum power for **RF Out/Reflection** port is +25dBm. If input power exceeds the maximum allowable limit, it will degrade the product performance and in worst case can damage the product. Do not connect output of the power amplifier exceeding 1W directly to the RF Out/Reflection port of the GC723A/GC724B.

RF IN

50Ω N-type Female connector, in conjunction with the RF Out/Reflection port, measures Gain and Insertion Loss.

DC15V

DC power input port

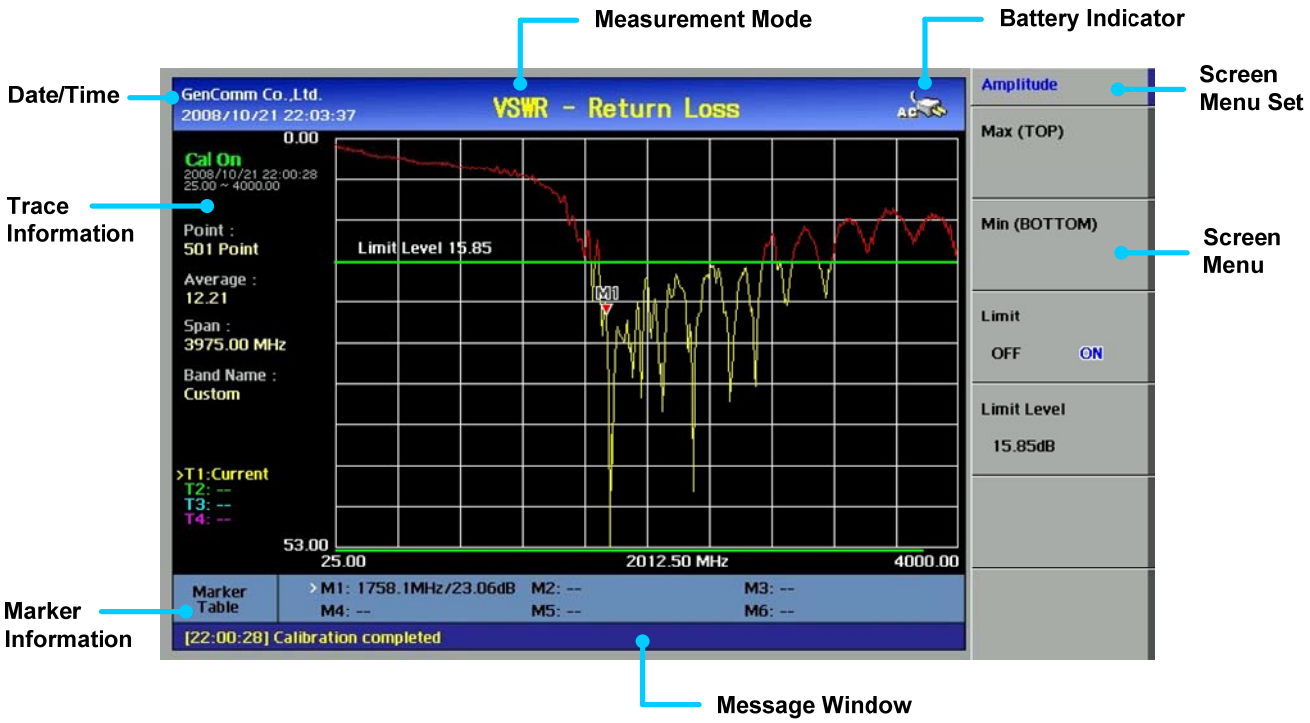
USER INTERFACE

LAN: Ethernet communication port to connect a PC with the application software.

RS232C: Serial interface port to connect an optional external power sensor.

USB: USB1.1 master port for external storage devices or to upgrade firmware through the memory stick. It supports most USB memory sticks and 32bit file systems.

DISPLAY SCREEN OVERVIEW



BATTERY INDICATOR

Indicates the status of the internal battery.

 Indicates the instrument is using an external power supply. The internal battery is charged when an external power supply is connected.

 Indicates the instrument is using the internal battery and shows the remaining battery capacity.

 This warning message appears when a battery is not installed in the instrument.

MEASUREMENT MODE

Indicates the current measurement mode. The selected mode is displayed in yellow

DATE AND TIME

Indicates the system clock information.

SCREEN MENU SET

Indicates the selectable screen menu. Selection of the menu can be made by pressing the soft key or touching the screen menu directly.

TRACE INFORMATION

- Calibration On/Off Status
- Calibration Information: Calibrated frequency band and timing
- Trace Points
- Trace Average (applicable to VSWR and Cable Loss measurement mode only)
- Span
- Band Name
- Cable Name (applicable to DTF measurement mode only)
- Max D: Maximum measurement distance limited by the defined frequency setting (DTF measurement mode only)
- VT (Relative Propagation Velocity), CL (Cable Loss) – applicable to DTF measurement mode only
- Trace Information
- Marker Position

MARKER INFORMATION

Displays the Marker Table when Marker is set.

MESSAGE WINDOW

Displays the result of performed functions or error messages

FUNCTION & HARD KEYS

Function hard keys on the front panel of the instrument are used to select measurement modes or perform specified functions. Refer to the following sections for the key structure to be used in each measurement modes.

SYSTEM SCREEN MENU

System screen menu is used to change the basic settings of the instrument and consists of the following sub-menus.

Function Key	Screen Menu			
	1st Layer	2nd Layer	3rd Layer	4th Layer
SYSTEM	Upgrade			
	Beep	On		
		Off		
	Sweep Mode	Continue		
		Single		
	Instrument Setting	Language	English	
			Korean	
			Spanish	
		Date/Time	Date Format	YMD
				MDY
				DMY
			Set Date	
			Set Time	
		LAN	Apply	
			Mode	Static
				DHCP
			IP Address	
			Net Mask	
			Gateway	
		Touch Screen	Enable	
			Disable	
		Sleep Time		
	License	Register License		

Table 3 – Menu structure in System mode

COMMON MENU

The menu structure is common to all the measurement modes except for the Power Meter mode as shown in the following table.

Function Key	Multi Key	Screen Menu		
		1st Layer	2nd Layer	3rd Layer
CAL		Open		
		Short		
		Load		
VSWR DTF Cable Loss	Amplitude	Max (Top)		
		Min (Bottom)		
		Limit	ON / OFF	
		Limit Type	Single / Multiple*	
		Limit Level		
	Auto Scale			
	Marker	Marker Select	M1 / M2 / M3 / M4 / M5 / M6	
		Marker View	ON / OFF	
		Marker Clear All		
		Marker Edit		
		Marker Type	Normal / Delta	
	Trace	Trace Select	T1/ T2/ T3/ T4	
		Trace Capture		
		Trace View	ON / OFF	
		Clear Write		
		Trace Clear		
		Trace Clear All		
	Peak	Peak Right		
		Peak Left		
		Max Search		
		Min Search		

Function Key	Multi Key	Screen Menu		
		1st Layer	2nd Layer	3rd Layer
VSWR DTF Cable Loss	Load	Load Trace / Load Screen / Load Setup /	Select	
			Page Up	
			Page Down	
			File Manager	Delete / Delete All / Copy to USB / Copy All to USB
			Destination	T1 / T2 / T3 / T4 / Screen
		Load from	Internal / USB	
	Save	Save Trace	T1 / T2 / T3 / T4*	
		Save Screen / Save Setup	Done	
			Select	
			Clear	
			Back Space	
			Cancel	
		Save to	Internal / USB	
	Light	Enter / Cancel		
PM / SG	Load	Load Screen / Load Setup /	Select	
			Page Up	
			Page Down	
			File Manager	Delete / Delete All / Copy to USB / Copy All to USB
		Load From	Internal / USB	
	Save	Save Trace	T1 / T2 / T3 / T4*	
		Save Screen / Save Setup	Done	
			Select	
			Clear	
			Back Space	
			Cancel	
		Save to	Internal / USB	
	Light	Enter / Cancel		

Table 4 – Menu Structure Common to all measurement modes

** Selected Trace number will be highlighted*

VSWR MENU

The following is the VSWR hard key and soft key menu structure.

Function Key	Multi Key	Screen Menu		
		1st Layer	2nd Layer	3rd Layer
VSWR	Freq / Dist	Start Freq		
		Stop Freq		
		Center Freq		
		Span		
		Band List	Standard Band	Select
				Add to Custom
				Page Up
				Page Down
			Custom Band	Select
				Delete
				Delete All
				Page Up
				Page Down
	Trace Point	126		
		251		
		501		
		1001		
	Scale	VSWR / R.L		

Table 5 – Menu Structure Used for VSWR Measurement mode

DTF MENU

The following is the DTF hard key and soft key menu structure.

Function Key	Multi Key	Screen Menu		
		1st Layer	2nd Layer	3rd Layer
DTF	Freq / Dist	Start Freq		
		Stop Freq		
		Distance		
		Band List	Standard Band	Select
				Add to Custom
				Page Up
				Page Down
			Custom Band	Select
				Delete
				Delete All
				Page Up
				Page Down
		Cable List	Standard Cable	Select
				Add to Custom
				Page Up
				Page Down
			Custom Cable	Select
				Delete
				Delete All
				Page Up
				Page Down
		DTF Setting	Apply	
			Velocity	
			Cable Loss	
			Unit	Meter / Feet
			Windowing	Rectangular / Blackman

Table 6 – Menu Structure Used for DTF Measurement Mode

CABLE LOSS MENU

The following is the Cable Loss (One-Port) hard key and soft key menu structure.

Function Key	Multi Key	Screen Menu		
		1st Layer	2nd Layer	3rd Layer
Gain / Loss → Cable Loss	Freq / Dist	Start Freq		
		Stop Freq		
		Center Freq		
		Span		
		Band List	Standard Band	Select
				Add to Custom
				Page Up
				Page Down
			Custom Band	Select
				Delete
				Delete All
				Page Up
				Page Down
	Trace Point	126		
		251		
		501		
		1001		

Table 7 – Menu Structure Used for Cable Loss Measurement Mode

POWER METER MENU

The menu structure of the Power Meter or Signal Generator hard function key and multi keys are shown below.

Function Key	Multi Key	Screen Menu		
		1st Layer	2nd Layer	3rd Layer
POWER METER		Initialize		
		Frequency		
		Display Setup	Display	Abs / Rel
			Set Ref	
			Disp Max	
			Disp Min	
			External Offset	
		Limit Setup	Limits	ON / OFF
			High Limit	
			Low Limit	
		Reset		

Table 8 – Menu Structure Used in Power Meter Mode

SYSTEM KEYS

Provides information about the system or changes the instrument's settings. Selecting the system key shows the following information:

- Firmware Version
- Device Version
- Display Brightness
- Keypad beep On/Off
- Sleep Mode setting: time to sleep mode
- Battery charge indicator
- Selected language
- System temperature

Figure 1 – System Screen

The System key opens the following screen menu:

- **Upgrade**: Upgrades the instrument's firmware. For detailed upgrade procedure, refer to the section "Firmware Upgrade".
- **Beep**: Activates or deactivates the beep sound of alarms or when keys are pressed.
- **Sweep Mode**: Sets the sweep mode either single or continuous in VSWR, DTF, or Cable Loss measurements. If Sweep Mode is set to Single, the message "Hold On" is displayed at the completion of a single sweep. Every time the Hold key is pressed, a new sweep is done once.
- **Instrument Setting**
  - **Language**: Changes the language used in menus, messages and information on the screen. For details, refer to "Language Setting".
  - **Time/Date**: Sets the time of the system clock.
  - **LAN**: Sets the Ethernet communication setting.
  - **Touch Screen**: Enable or Disable touch screen.
  - **Sleep Time**: Sets the time to enter into power saving mode. Power saving mode is automatically activated when no key entry occurs during the Sleep Time.

  → Sleep Time setting range: 1~200 minutes.

  → Power saving mode is turned off when Sleep Time is set to 0.
- **License**: Used to select optional modules, which are activated by entering the corresponding license number.

UPGRADING FIRMWARE

It is recommended to upgrade the firmware to the latest version in order to achieve the best performance of the instrument. Users can easily upgrade the firmware of the instrument by using an USB memory drive.

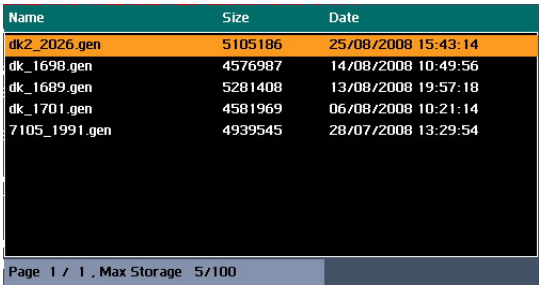
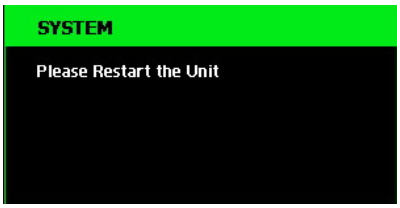
Action	Note
1. Check the firmware version	Check the latest firmware at GenComm's website www.gctm.net
2. Download the firmware to an USB memory drive	
3. Turn on the instrument	Plug the USB memory stick into the instrument USB port after the system initialization.
4. Press the **SYSTEM** key	
5. Select the ***Upgrade*** screen menu 	The file list will be displayed
6. Select the ***Upgrade source file (*.gen)*** from the list, then press **Select**.	
Once the upgrade starts, the progressing state is displayed on the screen. After successful completion of the upgrade, then reboot the instrument followed by "Please Restart Unit" message. 	

Table 9 – Firmware Upgrade Procedure with USB Memory Drive

If the instrument is power down during the upgrading process, the instrument may not operate properly. Make sure the power is not interrupted during the upgrading process.

There should be at least 30Mbytes spaces available on the USB in order to perform the upgrade.

The zip file should be unzipped and the *.gen file should be placed on a USB in the root directory. Otherwise the instrument may not be able to read the firmware file from the USB.

LANGUAGE SELECTION

The instrument supports multiple languages. The following procedure changes the language setting.

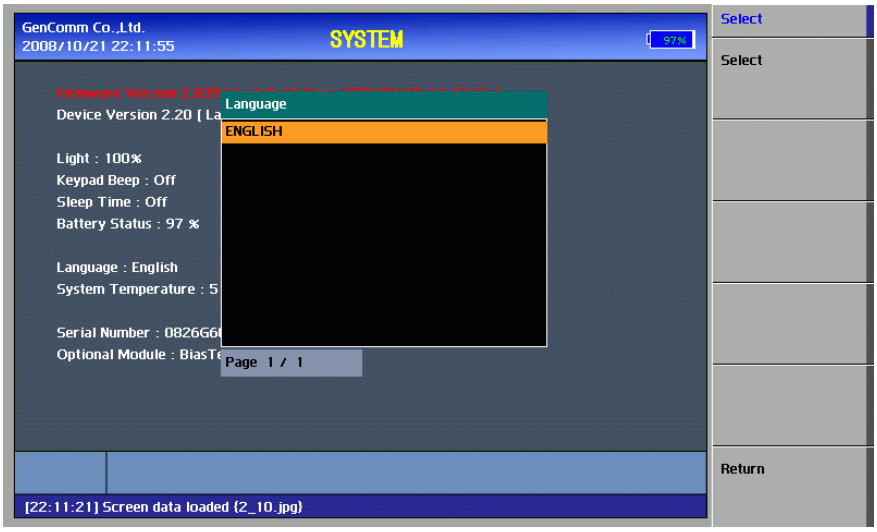


Figure 2 – Language Selection Screen

Action	Note
1. Press the **SYSTEM** key	Function hard key
2. Select the ***Instrument Setting*** menu	Soft key
3. Select the ***Language*** screen menu	Soft key
4. Select the language by pressing the **Up/Down Arrow** key	Hard key
5. Press the **ENTER** key or **Select**	Hard key or Soft key

Table 10 – Language Selection Procedure

Language changes apply to menus, messages and information displayed on the screen after restarting the instrument.

SYSTEM TIME

The instrument provides real time clock powered up by a separate internal battery to maintain the timing information even when the battery is fully discharged or the system power is disconnected. The default time setting at the factory is (GMT+9:00).

Action	Note
1. Press the **SYSTEM** key	Function hard key
2. Select the ***Instrument Setting*** menu	Soft key
3. Select the ***Date/Time*** screen menu	Soft key
4. Set ***Date Format (YMD,MDY,DMY)***	Soft key
5. Set ***Date / Time***	Selecting screen menu prompts a pop-up window. Enter numbers, and press the **ENTER** key.

Table 11 – System Time Setting

APPLICATION I/F

This function provides the user with the option of two different Application Software programs to communicate with the instrument:

- The selection of GenComm in the APP I/F (Application Program Interface) configuration option allow the user to communicate with the instrument via GenComm's Application Software, GCViewer.

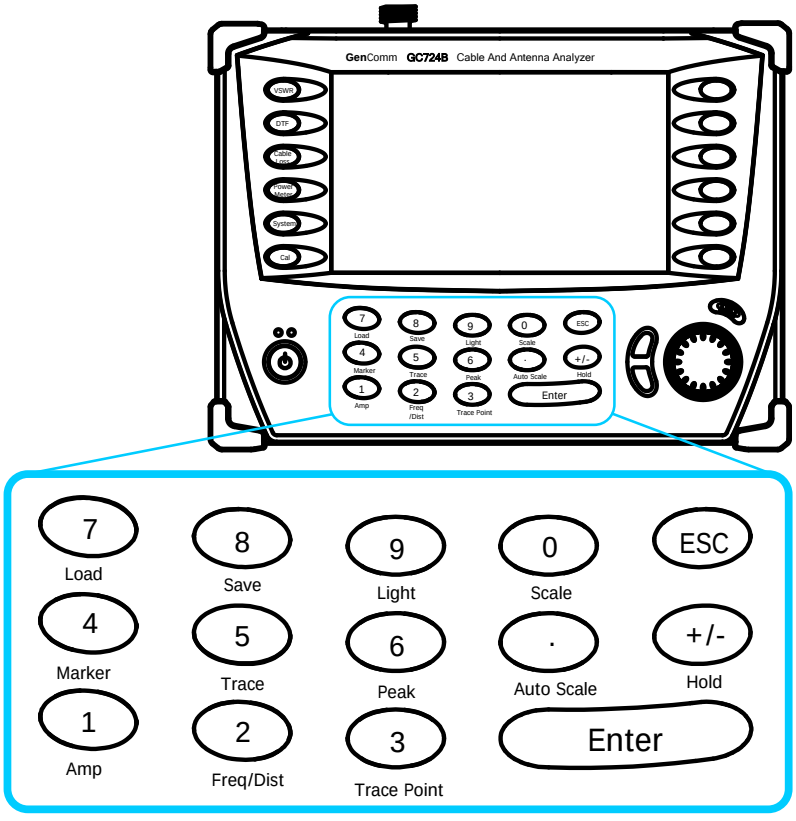
Refer to "Application Software Program" for instruction on how to use GenComm's Application Software.

MULTI KEYS

Twelve multi keys are located under the LCD display. The Multi keys serve multiple functions depending on the operation mode. The dual purpose keys are indicated in black color, and the specific functions in blue color.

The keys are used to enter a numeric data when a user is prompted to input values. In all other cases, the keys are used to perform the specific function.

The function and operating procedure for each multi keys are described in the following sections.



NUMERIC DATA ENTRY

Multi keys operate as follows when a user is prompted to input values by pop-up windows.

- Numeric keys from 0 to 9 are used to input numeric values.
- The plus/minus (+/-) key is used to assign positive or negative values to numbers.
- The period key (.) is used to input numbers with decimal points.

SPECIFIC FUNCTION KEYS

Keys are used in VSWR, DTF and Cable Loss measurement mode. Unless otherwise specified, multi keys are not supported in Power Meter mode.

Auto Scale

The instrument can automatically set the scale to the minimum and maximum values of a measurement on the Y-axis of the graph for optimum display of the traces. Every time the AUTO SCALE key is pressed, the top and bottom scales are set to the minimum and maximum values with margin on the Y-axis of the screen display.

Amp

AMP (amplitude) defines a manual setting for the scale on the Y-axis of the graph. It can be selected in VSWR, DTF, and Cable Loss measurement mode. Depending on the choice of an amplitude unit, allowable input value is limited to the following:

- **VSWR Y-scale:**

  Max (Top): Entry values can be from 1.01 to 65.00 and it cannot be equal to or smaller than the Min (Bottom) setting value. Adjustment can be made in steps of 0.01.

  Min (Bottom): Entry values can be from 1.0 to 64.99 and it cannot be equal to or larger than the Max (Top) setting value. Adjustment can be made in steps of 0.01.

- **Return Loss Y-Scale:**

  Max (Top): Entry values can be from 0.0 to 59.99dB and it cannot be equal to or smaller than the Min (Bottom) setting value. Adjustment can be made in steps of 0.01.

Amp (cont'd)

Min (Bottom): Entry values can be from 0.01 to 60.00dB and it cannot be equal to or larger than the Max (Top) setting value. Adjustment can be made in steps of 0.01.

- **Limit:** Turns On and Off the limit line on the display. If a measurement exceeds the limit line, the trace above the limit line is displayed in red color and an audible beep sound is generated.

- **Limit Type:** Selects between single and multiple limit lines.
- **Limit level**: Sets the position of a limit line. Depending on the Y-scale of a graph, the input units are set automatically as none for VSWR or dB for Return Loss. The value of limit level is displayed on the limit line.

The instrument takes into account the negative values of Return Loss, therefore is not needed to add a minus (-) sign in a value entry. The Y-axis of a graph doesn't show the minus sign.

Freq/Dist

Freq/Dist key causes different screen menu to be displayed depending on a measurement mode. In VSWR or Cable Loss measurement modes it opens a frequency screen menu and in DTF measurement mode it opens a distance screen menu.

- **VSWR/ Cable Loss Measurement Mode**
  - **Start Freq:** Sets a start frequency of the measurement to be made.
  - **Stop Freq:** Sets a stop frequency of the measurement to be made.
  - **Center Freq:** Sets a center frequency of the measurement to be made.
  - **Span:** Sets a user-defined frequency span.
  - **Band List:** Opens standard or custom frequency band stored in the instrument:

    Standard Band: Opens the world-wide standard Band List stored in the instrument.

    → Select: Selects the Band from the list.

Freq/Dist (cont'd)

→ Add to Custom: Copies a frequency band stored in the Standard Band List to the Custom Band.
→ Page Up: Moves to the previous page.
→ Page Down: Moves to the next page.

Custom Band: Opens the customized Band List stored in the instrument.

→ Select: Selects the Band from the list.
→ Delete: Deletes the selected frequency band from the Custom Band.
→ Delete All: Deletes all files in the Custom Band list.
→ Page Up: Moves to the previous page.
→ Page Down: Moves to the next page.

- **DTF Measurement Mode**
  - **Start Freq:** Sets the starting frequency to measure DTF
  - **Stop Freq:** Sets the stop frequency to measure DTF
  - **Distance:** Sets a distance to measure. The maximum measurable distance is 1250m (4125ft).
  - **Band List:** Opens standard or custom frequency bands stored in the instrument:

Standard Band: Opens the world-wide standard Band List registered in the instrument.

→ Select: Selects the Band from the list.
→ Add to Custom: Copies a frequency band stored in the Standard Band List to the Custom Band.
→ Page Up: Moves to the previous page.
→ Page Down: Moves to the next page.

Custom Band: Opens the customized Band List stored in the instrument.

→ Select: Selects the Band from the list.
→ Delete: Deletes the selected frequency band from the Custom Band List.
→ Delete All: Deletes all files in the Custom Band List.
→ Page Up: Moves to the previous page.
→ Page Down: Moves to the next page.

Freq/Dist (cont'd)

- **Cable List:** Opens a list of coaxial cables stored in the instrument. About 110 different kinds of cables are stored in the standard cable list. The user can store additional cables to the instrument by using the application software GCViewer provided with the instrument.

  Standard Cable: Opens the Cable List stored in the instrument.

  → Select: Selects the Cable from the list.

  → Add to Custom: Copies a cable stored in the Standard Cable List to the Custom Cable List.

  → Page Up: Moves to the previous page.

  → Page Down: Moves to the next page.

  Custom Cable: Opens a Custom Cable List stored in the instrument.

  → Select: Selects the Band from the list.

  → Delete: Deletes the selected cable from the Custom Cable List.

  → Delete All: Deletes all files in the Custom Cable list.

  → Page Up: Moves to the previous page.

  → Page Down: Moves to the next page.

- **DTF Setting:** Opens a list of DTF measurement settings.

  - **Apply:** Applies the setting and exits the menu.
  - **Velocity:** Sets the Propagation Velocity of the cable to be tested. The velocity will affect the distance of DTF measurement so that it is important to set the propagation velocity for the type of transmission line being tested.
  - **Cable Loss:** Sets the Cable Loss of the cable to be tested. The cable loss will affect the peak (amplitude) of DTF measurement so that it is important to set the propagation velocity for the type of transmission line being tested.
  - **Unit:** Selects the unit of X-axis scale to display the measurement results in Meter or Feet.

- **Windowing:** Applies video filtering to the display of the trace. If the video filter is activated by selecting Rectangular or Blackman filter types, traces are filtered by smoothing out the sharp transitions, thereby enabling users easy to discriminate noises and peaks.

Trace (Data) Point

Trace point is used to select the number of data points to take during a VSWR and Cable Loss measurement. There are 4 different data points available: 126, 251, 501 and 1001. The default number of trace points is 251.

Marker

A marker is used to get the data on the specific point of a trace. A total of 6 markers can be displayed on the screen and each maker can be assigned independently. Placing a maker on the trace displays the marker's Y coordinates next to the marker's position. If the maker table is turned on, both X and Y coordinates of all activated markers are displayed.

- **MARKER**
  - **Marker Select:** Selects an active marker which its position can be changed with the knob or the arrow keys. The assigned number of active markers is displayed in red color on the Select screen menu and the marker's number is also displayed next to the marker on the trace.
  - **Marker View:** Hides or displays the selected marker on the screen. In the same measurement mode markers appear at the previous positions when the Marker View is turned off and on. If a measurement mode has been changed, markers are not restored to their previous positions but moved to the left end of the trace.
  - **Marker Type:** Selects the type of Marker to be displayed, Normal marker provide the reading of its position and Delta marker provides the differences between two sets of marker points.
  - **Marker Clear All:** Turns all markers off the screen. Markers are redisplayed on the previous position if markers are turned back on. If a measurement mode is changed, current settings are not restored.
  - **Marker Edit:** Sets the marker position manually. A pop-up window appears for users to set the frequency and the marker position is moved to the defined frequency.

Marker (cont'd)

- **Moving Markers**
  - **Knob:** Turning the knob clockwise moves a marker to the right and counter clockwise moves it to the left. The knob is used to move the marker's position fast.
  - **Arrow Keys:** Pressing the up arrow key (↑) moves a marker's position one point to the right and pressing the down arrow key (↓) moves a marker's position one point to the left. Arrow keys are used to move a marker's position more precisely.

As the instrument is equipped with a touch panel screen, a marker can be placed to the desired position by simply touching the screen. The touch screen will quickly move an activated marker to the desired position and then knob or up/down arrow keys can be use to make fine adjustments.

Trace

Captures a trace for comparison with other traces or saves traces.

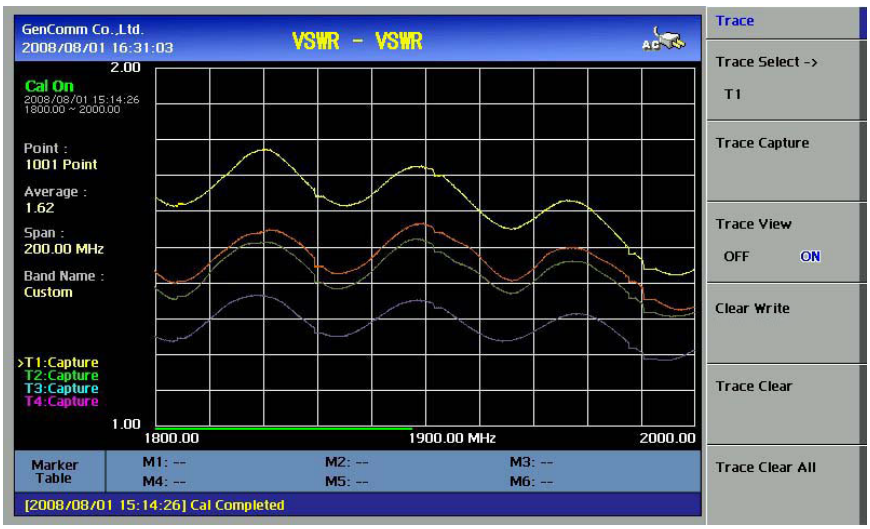


Figure 3 – Trace Screen Display

- **Trace Select:** Selects an active trace. Every time Select screen menu is pressed, the active trace changes. Trace numbers are assigned to each captured traces or loaded traces. Refer to "Save & Load" for procedures to load traces.
- **Trace Capture:** Captures a current trace on the screen and assigns a Trace number. Refer to "Save & Load" for procedures to save traces.

Trace (cont'd)

- **Trace View:** Hides or displays the Trace number on the screen. Press the Select screen menu key to choose the Trace number. Traces with View set OFF are hidden from the screen. The information about hidden traces is also cleared from the information window shown on the upper right of the screen. Setting View On restores hidden traces and information on the window.
- **Clear Write:** Clear selected Trace and Write (Assign) current Trace
- **Trace Clear:** Deletes an active trace channel from the screen. The cleared channel is not restored. It is used to select and delete a trace channel one by one when multiple channels are displayed on the screen. Verify the channels to delete with Trace View ON/OFF function in advance settings as cleared channels cannot be restored.
- **Trace Clear All:** Deletes all channels from the instrument and initialize the trace settings.

Peak

This key is used to find the peak value of a trace. Pressing this key leads to the activation of Marker CH1 and places the marker to the peak point of the trace.

- **Peak Right**: Moves a marker to the nearest peak on the right.
- **Peak Left**: Moves a marker to the nearest peak on the left.
- **Max Search**: Moves a marker to the highest point of the trace.
- **Min Search**: Moves a marker to the lowest point of the trace.

Light

The Light key is used to adjust the brightness of the LCD display. Adjustment can be made from 1 to 100% and the default setting is 100%.

Scale

The Scale key is used to select a unit of Y-axis of the graph in VSWR and DTF measurement modes. Either VSWR or Return Loss can be selected. In Cable Loss measurement mode, Return Loss only can be selected.

Hold

The Hold key is used to pause a sweep in all measurement modes. The Hold state is activated by pressing the HOLD key, and it is maintained even if users change the measurement mode. The sweep resumes when the HOLD key is pressed again.

When Sweep Mode is set to Single in the System screen menu, a Hold message is displayed on the screen in red color and the measurement stops at the completion of a single sweep. Pressing the HOLD key triggers another single sweep.

INITIALIZATION

Initialization

The following initialization screen appears when the instrument is started with the indication “System Initialization”. After a successful initialization, data loading and self test, the VSWR measurement screen appears.

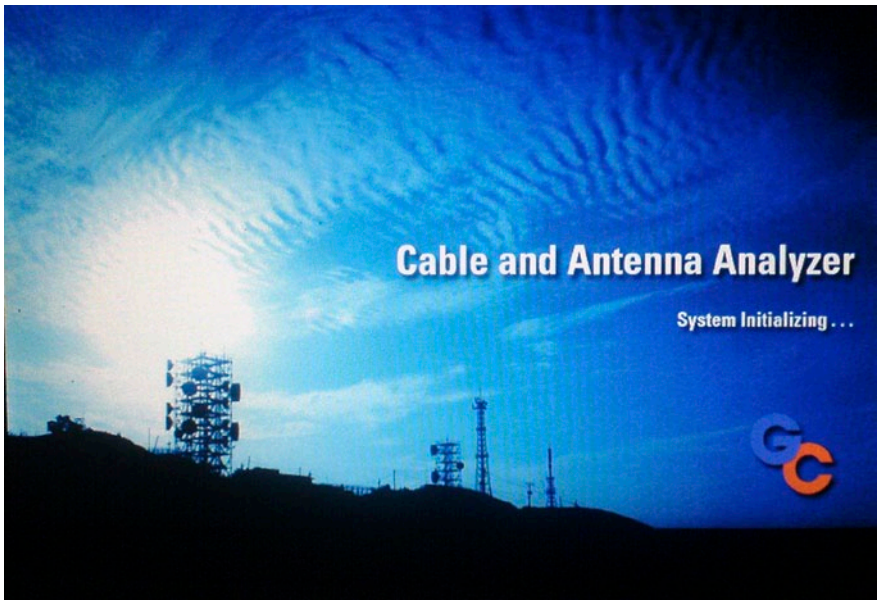


Figure 4 – Initialization Screen

SYSTEM INFORMATION

Before using the instrument, verify the firmware's version and status of the instrument.

- Firmware version: For the instrument's best performance, make sure the latest firmware version has been installed. Contact GenComm's sales representative to obtain the latest firmware version released.
- Verify the system's temperature is within the operating range. Depending on the storage condition, the temperature of the instrument at power up may be out of normal operating range in winter or summer season. Measurements over the operating temperature range may be out of resolution.

Figure 5 – System Screen

3.0 VSWR

In this chapter

INTRODUCTION

A proper RF emission in cell sites is achieved with a maximum power transfer from the radio to the antenna, where all the transmission media should have an impedance match. A mismatch at the antenna system produces a reflective 'traveling wave' which goes in the opposite direction from the incident wave. As the two traveling waves cross each other in opposite direction, it is produce an interference pattern called a "standing wave". VSWR is the ratio between the power that is sent forward to the cable and/or antenna and the amount of the power that is reflected back to the transmitter.

Some of the consequences of having a high VSWR condition in cellular services are: dropped calls, poor reception, and an overall unacceptable performance in the cell (or section of cell) covered by the base station antenna. Therefore, the VSWR of the antenna system including the feed line is one of the most critical factors in the service and maintenance of the RF transmitter systems.

STANDING WAVE RATIO

In telecommunications, standing wave ratio (SWR) is the ratio of the amplitude of a partial standing wave at its maximum amplitude and at its minimum, in an electrical transmission line.

The SWR is usually defined as a voltage ratio called the VSWR, for voltage standing wave ratio. For example, the VSWR value 1.2:1 denotes a maximum standing wave amplitude that is 1.2 times greater than the minimum standing wave value. It is also possible to define the SWR in terms of current, resulting in the ISWR, which has the same numerical relationship. The power standing wave ratio (PSWR) is defined as the square of the VSWR.

PRACTICAL IMPLICATIONS OF SWR

SWR has a number of implications that are directly applicable to RF radios.

- SWR is an indicator of reflected waves bouncing back and forth within the transmission line, and as such, an increase in SWR corresponds to an increase in power in the line beyond the actual transmitted power. This increased power will increase RF losses, as increased voltage increases dielectric losses, and increased current increases resistive losses.
- Matched impedances give an ideal power transfer; mismatched impedances give high SWR and reduced power transfer.
- Higher power in the transmission line also leaks back into the RF radio, which causes it to overheat.
- The higher voltages associated with a sufficiently high SWR could damage the transmitter. Solid state radios which have a lower tolerance for high voltages may automatically reduce its output power to prevent damage. The high voltages may also cause transmission line dielectric to break down and/or to burn.
- VSWR measurements may be taken to ensure that a waveguide is contiguous and has no leaks or sharp bends. If such bends or holes are present in the waveguide surface, they may diminish the performance of transmitter and receiver equipment strings.
- Another cause of bad VSWR in a waveguide is moisture build-up, which can typically be prevented with silica gel or pressurization of the waveguide with dry gas.

PRACTICAL IMPLICATIONS OF SWR (cont'd)

- A very long run of coaxial cable especially at a frequency where the cable itself is loose can appear to a radio as a matched load. The power coming back is, in these cases, partially or almost completely lost in the cable run.

RETURN LOSS

In telecommunications, return loss is a measure of power reflected from imperfections in an electrical or optical communication link. The ratio (P_R / P_T), represents the wave power reflected from the imperfection (P_R) to that of the incident, or transmitted, wave, (P_T). For maximum transmitted power, the return loss should be as small as possible, meaning the ratio P_R / P_T should be as small as possible.

Return loss is usually expressed in dB, the return loss value describes the reduction in the amplitude of the reflected energy, as compared to the forward energy. It will always be a loss, and therefore a negative dB. However one can write -3 dB as simply 3 dB of loss, dropping the negative sign and adding loss. For example, if a device has 15 dB of return loss, the reflected energy from that device (P_R), is always 15 dB lower than the transmitted energy (P_T). When expressed in dB, larger (in magnitude) negative numbers represent larger return losses and thus smaller reflected power (P_R).

In electrical systems, return losses often occur at junctions between transmission lines and terminating impedances. It is a measure of the dissimilarity between impedances in metallic transmission lines and loads. For devices that are not perfect transmission lines or purely resistive loads, the return loss value varies with the frequency of the transmitted signal.

VSWR DISPLAY

Display Overview

The following figure is a screen example when VSWR measurement mode is selected. Various kinds of information related to the VSWR measurement are shown on the screen.

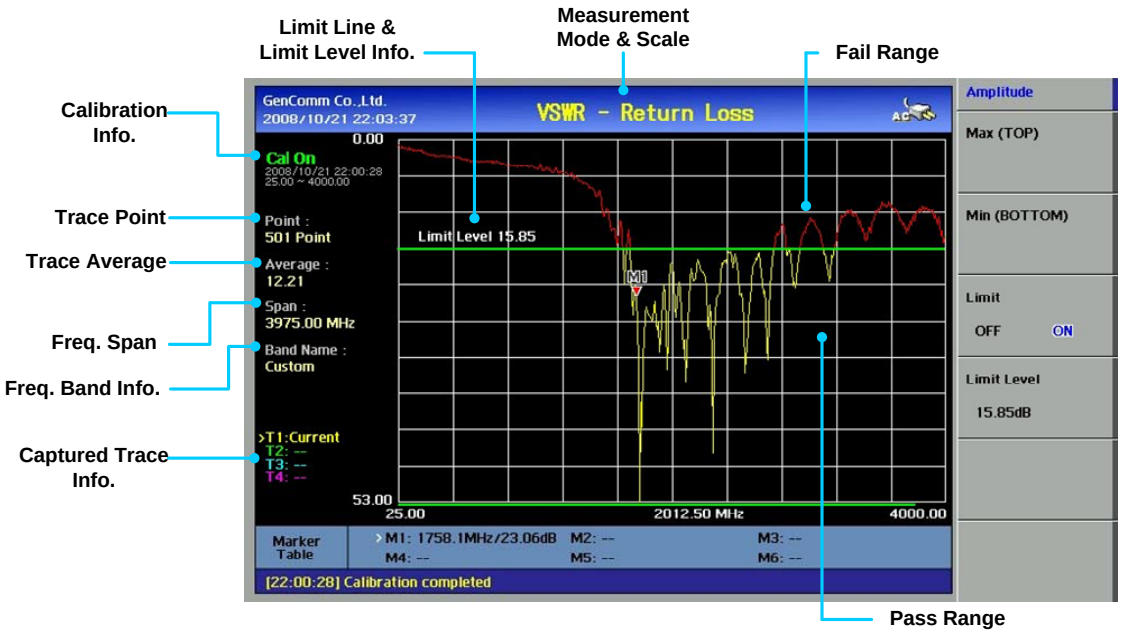


Figure 6 – VSWR Measurement Display

- **Calibration Info**: Displays a calibration state on the measurement frequency band that a user has selected. When the instrument is first turned on, the state is “CAL OFF”. The symbol “CAL ON” is displayed along with the execution time and frequency band after the calibration is successfully completed.
- **Trace Point**: Sets the number of data points to take during a measurement mode. The Trace Pont sets available are the following:
  - 126, 251, 501, and 1001
  - Selecting 501 data points provides twice as many measurement points as 251, but it takes approximately twice as long for the trace to sweep and display.

VSWR DISPLAY (cont'd)

Selecting trace points larger than needed for the measurement will result in longer sweep times. It is recommended to select high resolution trace points only when measuring wide frequency bands or a precise measurement is required. The calibration is effective even after the trace points are changed.

- **Measurement Mode & Scale**: It is the measurement mode and the display unit of the Y-axis displayed for the trace.
  - Return Loss (dB)
  - VSWR
- **Trace Average:** Indicates the average value of a single sweep over the user setting frequency band.
- **Freq. Span:** It is a user-defined frequency band. Changing the frequency band doesn't affect the sweep time, but affects the calibration. Recalibration is required if the frequency setting is changed.
- **Freq Band Info:** The band name is displayed if the band is selected from the band list stored in the instrument. If the user sets the start, stop, center or span frequency manually, the band name will show "CUSTOM".
- **Limit Line & Level:** Sets the upper limit value of the trace. The portion of the trace that exceeds the limit line is displayed in red color. Captured traces will not display the exceeded portion of the trace in different color.

SETTING FREQUENCY

Frequencies can be set manually or selected from a band list stored in the instrument. It is desirable to set the frequency to a value that covers the normal range of the measurement with enough margins.

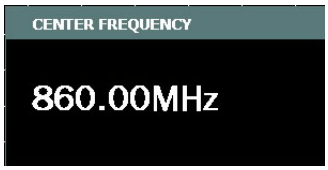
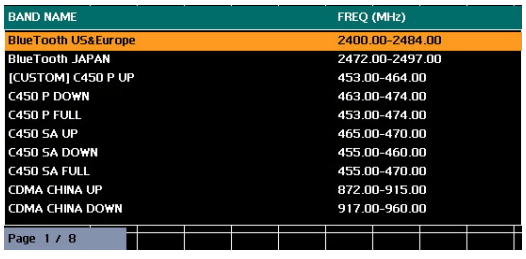
Action	Note
Setting Center Freq and Span	
1. Press the **FREQ/DIST** key.	Multi key
2. Select the ***Center Freq*** screen menu.	▪ The current setting is displayed on the window.
3. Enter a center frequency value.	
4. Press the **ENTER** key.	
5. Select the ***Span*** screen menu.	
6. Enter a span value.	
7. Press the **ENTER** key.	
Setting Start/ Stop Frequency	
1. Press the **FREQ/DIST** key.	▪ The current setting is cleared when a new value is entered. ▪ The frequency input unit is in MHz and the minimum input steps is 0.01MHz
2. Select the ***Start Freq*** screen menu	
3. Enter a start frequency value.	
4. Press the **ENTER** key.	
5. Select the ***Stop Freq*** screen menu.	
6. Enter a stop frequency value.	
7. Press the **ENTER** key.	
Selection from the band list stored in the instrument	
1. Press the **FREQ/DIST** key.	▪ Press the Up/Down arrow keys or rotate the dial knob to select a band from the list. ▪ Select the ***Page Up/Down*** screen menu for searching bands not shown in the screen.
2. Select the ***Band List*** screen menu.	
3. Select the band from the list and press the **Enter** key or choose **Select**	

Table 12 – Frequency Setting Procedure

Changing the frequency settings will automatically turn calibration OFF with the indication “CAL OFF” displayed on the screen. Always set the frequency before calibrating the instrument. Changing the trace points during the measurement doesn’t affect the calibration.

CALIBRATION

The instrument must be calibrated to get a reliable measurement result. For best results, set the frequency and calibrate the instrument immediately before taking a measurement.

- Calibration accessories (optional).
- Calibration Kit, which contains a 50 ohm load, one open standard and one short standard.
- Test cable: Use a phase stable cable for reliable and consistent measurement results.

To minimize measurement errors, connect the port extension cable to the ***RF Out*** port on the instrument and then connect the Calibration Kit to the end of the extension cable.

If temperature changes by +/-10C or more from the temperature registered during calibration then, the calibration status will not be valid and “CAL OFF (T)” will be displayed. This means that it is required to re-calibrate the instrument for accurate results.

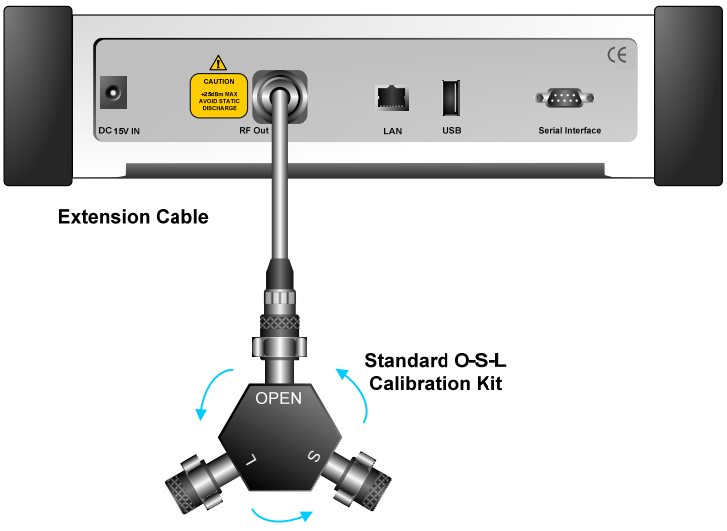


Figure 7 – Calibration for VSWR measurement

Bending or moving the phase unstable cable while making a measurement may cause errors in the measurement. The test cable used for port extension must be phase stable in the measurement frequencies.

At the successful completion of each calibration step, the message is displayed with a beep sound.

Figure 7 illustrates the connection method when a port extension cable is used for calibration. To compensate for errors caused by a port extension cable or adapters, it is required to perform an Open-Short-Load calibration including the port extension cable.

Action	Note
Performs Calibration after the frequency setting and test cable connections.	
1. Press the **CAL** key.	Hard function key
2. Connect an Open standard then press Enter	▪ Connect CAL Kit "Open" connector to the test cable. ▪ When the Open screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Open CAL Complete***", is displayed at its completion.
3. Connect a ***Short*** standard then press Enter	▪ Connect CAL Kit "***Short***" connector to the test cable. ▪ When the ***Short*** screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Short CAL Complete***", is displayed at its completion.
4. Connect the 50ohm ***Load*** standard then press Enter	▪ Connect CAL Kit "***Load***" connector to the test cable. ▪ When the ***Load*** screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Load CAL Complete***", is displayed at its completion.
Calibration state is changed to "***CAL ON"*** after the Open-Short-Load calibration.	

Table 13 – Calibration Procedure

MAKING VSWR MEASUREMENT

The instrument is ready to make VSWR measurements after completing the Open-Short-Load calibration using a port extension cable.

The end of the port extension cable must be connected to the device (antenna or feed line) for VSWR measurements as shown in the following figure. The result of the VSWR measurement is displayed on the screen in real time.

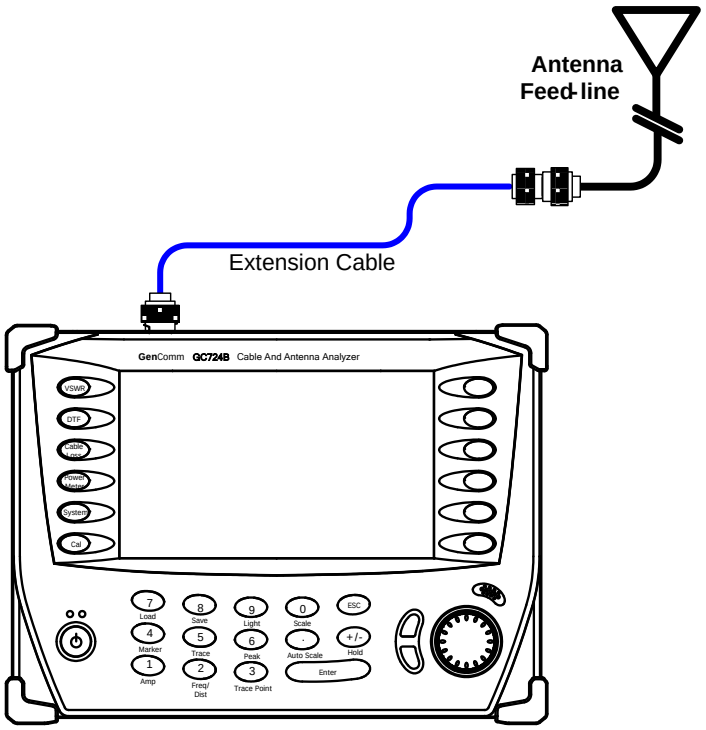


Figure 8 – Connection for VSWR Measurement

After calibration, do not change the connection of the port extension cable or the frequency setting. It can cause an error in the measurement.

When the frequency setting is changed, a warning alarm will sound and the calibration state will change to “CAL OFF”. In this case, recalibrate the instrument using the Open-Short-Load standard.

The maximum allowable input level of the instrument is +25dBm. Do not connect the ***RF Out*** port of the instrument directly to the output port of the system. An over power input degrades the performance of the instrument and may cause a malfunction of the instrument.

Do not connect the instrument to the antenna when there is a risk of lightning. Electric shock may cause a malfunction or damage the instrument.

SETTING TRACE POINT

Adjust a trace point to change the resolution of the VSWR measurement. Changing the Trace Point doesn’t affect the calibration state.

SCALE ADJUSTMENT

- Press the AUTO SCALE key to optimize the Y-scale and display the entire trace.
- Press the AMP key to set the maximum and minimum values on the Y-scale manually.
- Press the SCALE key to select the display unit of the Y-scale.
- Scale adjustment doesn’t affect the calibration state.

USING MARKERS

Markers can be set on the trace(s) to indicate the location. All the information such as X and Y-axis are provided in the marker table at the bottom of the screen.

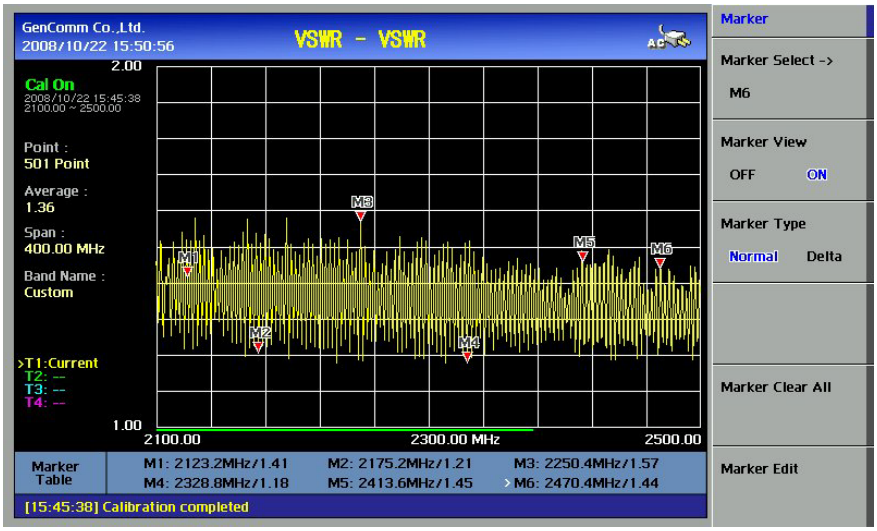


Figure 9 – Using Markers in VSWR Measurement Mode

USING LIMIT LINE

By setting a limit line, it is easy to verify if a measurement exceeds a specified limit. A limit lines appear as a horizontal line at the set value. An alarm sound is generated when a trace exceeds the limit line and the exceeded portion is displayed in red color.

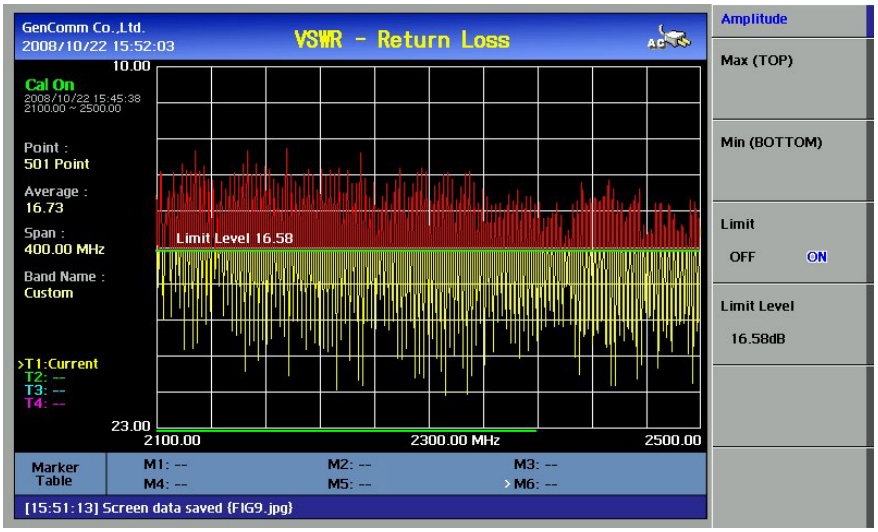


Figure 10 – Limit Line Application

4.0 DTF

In this chapter

INTRODUCTION

While VSWR is an indicator to express the efficiency of the cell site energy transmission, DTF is a measurement to identify the fault locations in the antenna line system. Most of the antenna line system consists of various types of coaxial cables, connectors and devices such as dividers and surge arrestors.

Since VSWR is a measurement to verify the impedance discontinuity of the total feed line system, it is necessary to perform DTF measurement to identify the exact component that is contributing to the performance of the line system. The DTF measurement makes it easy to identify the fault location by displaying the relative distance of the signal reflections or discontinuities from various points of the transmission system.

DTF MEASUREMENT CONCEPT

In DTF measurements, the instrument transmits a test signal along the conductor or transmission medium. If the conductor is of an uniform impedance and properly terminated, the entire transmitted pulse will be absorbed in the far-end termination and no signal will be reflected toward the instrument. Any impedance discontinuities will cause some of the incident signal to be sent back towards the source.

A higher impedance create a reflection that reinforces the original signal whilst a lower impedance create a reflection that opposes the original signal.

The resulting reflected signal that is measured at the output/input to the instrument is displayed or plotted as a function of time and, because the speed of signal propagation is relatively constant for a given transmission medium, it can be read as a function of cable length, or distance location.

Because of this sensitivity to impedance variations, the instrument may be used to verify cable impedance characteristics, splice and connector locations and associated losses, and estimate cable lengths or faulty location.

FREQUENCY DOMAIN REFLECTOMETER

Frequency domain reflectometer, are commonly used for testing long cable runs, where it is impractical to dig up or remove what may be over a kilometer cable length. They are indispensable for preventive maintenance of telecommunication lines, as they can reveal growing resistance levels on joints and connectors as they corrode, and increasing insulation leakage as it degrades and absorbs moisture long before either leads to catastrophic failures. Using a DTF, it is possible to precisely identify the fault location.

DTF DISPLAY

Display Overview

The screen shown in the following figure is displayed when DTF measurement mode is selected. The distance from the instrument is shown in the X-axis, while the relative magnitude of the discontinuity is shown in the Y-axis. The information related to the DTF measurement is shown on the screen.

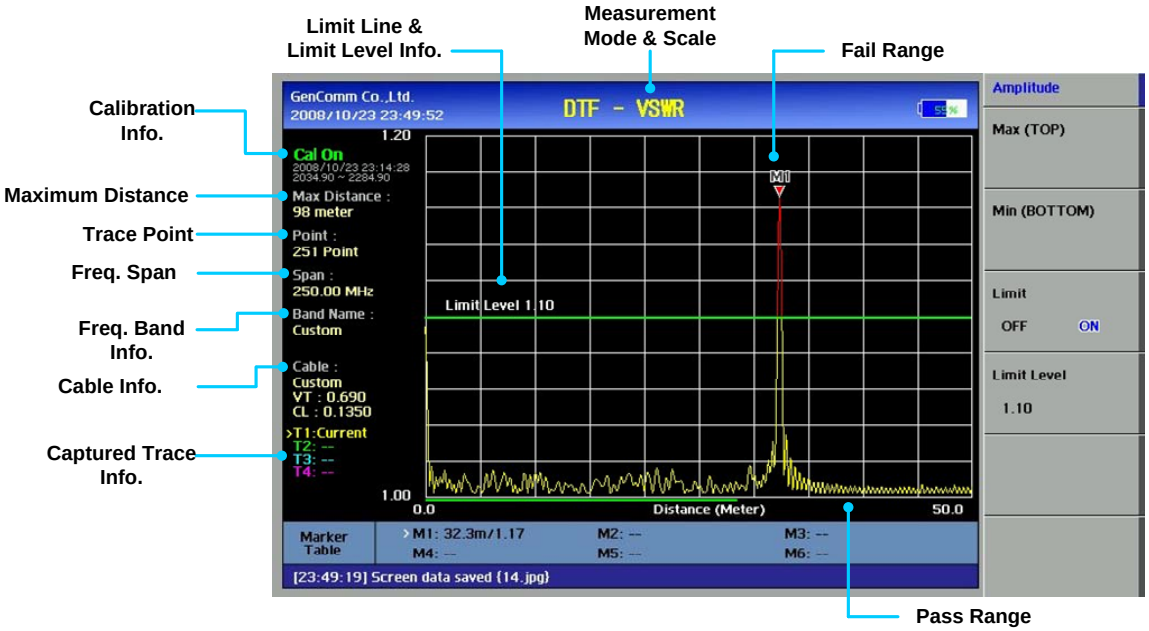


Figure 11 – DTF Measurement Display

- **Limit Line & Limit Level Info:** Sets the upper limit value of a trace. The portion of the trace that exceeds the limit line is displayed in red color. However, the captured trace by using TRACE function doesn't discriminate the color even if the trace exceeds the limit line.
- **Calibration Info:** Displays a calibration state on the measurement frequency band that a user has selected. When the instrument is first turned on, the state is "CAL OFF". The indication "CAL ON" is displayed along with the execution time and frequency band after the calibration is successfully completed.
- **Maximum Distance:** Displays the maximum measurable distance within the user setting frequency band. Setting a narrow frequency band will increase the measurable distance while setting a wide frequency band will decrease the distance.

- **Measurement Mode & Scale Unit**: Is the measurement unit of the Y-axis that the trace is displayed.
  - Return Loss (dB)
  - VSWR
- **Freq. Span**: Is the user-defined frequency band. Changing the frequency band doesn't affect the sweep time, but affects the calibration. Recalibration is required if the frequency setting is changed.
- **Freq Band Info**: The band name is displayed if the band is selected from the band list stored in the instrument. If the user sets the start, stop, center or span frequency manually, the band name will show "CUSTOM".
- **Cable Info**: The name of user selected cable is displayed on the screen. A cable name is displayed if the cable is selected from a Cable List stored in the instrument. If the user sets the Velocity and Cable Loss manually, the band name will show "CUSTOM". The following information is also displayed.
  - Rel. Propagation Velocity: The relative propagation velocity for the cable type selected by the user from the Cable List or manually set by selecting the Velocity key.
  - Nominal Attenuation: The loss per distance of the cable selected from the Cable List or manually set by the Cable Loss key.

By using the application program supplied with the instrument, users can store custom cable characteristics into the instrument. For details, refer to the Application Program, GCViewer.

DTF SETUP

Set the parameters for DTF measurements. The following is the user setting parameters for DTF measurements:

- **Frequency Setting**: Sets the start and stop frequency to make a measurement. If a specific frequency band has been set in VSWR measurement mode, it can be applied to DTF measurement. To change the maximum measurement distance or increase the measurement resolution, is necessary to change the frequency setting.
- **Distance Setting**: The maximum measurable distance is displayed on the left side of the screen depending on the frequency setting. Any value within the maximum measurable distance can be set. Optimum resolution is achieved when the user setting distance is the same as the maximum measurable distance.
- **Cable Setting**: Selects a cable type of the feed line. By using this key, users can select the cable stored in the instrument without setting the detailed parameters of the cable.
- **Setup**: Used to change the setting of the cable parameters or change the distance unit. It consists of the following sub menus:
  - Velocity: Sets the relative propagation delay of a cable. It affects the calculation of the distance in the DTF measurement.
  - Cable Loss: Sets the loss per distance unit of a cable. It affects the peak level of the discontinuity in the DTF measurement.

After calibration, do not change the connection of the port extension cable or the frequency setting. It can cause a measurement error. When the frequency setting is changed, a warning alarm will sound and the calibration state will change to “CAL OFF”. After changing the frequency setting, recalibrate the instrument using the Open-Short-Load standard.

A detailed procedure for DTF setup is as follows:

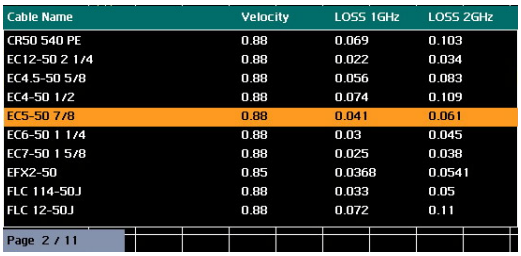
Action	Note
Frequency Setting	
Press the **FREQ/DIST** key ▪ Select the ***Start Freq*** screen menu - {Enter start frequency value} - Press the **ENTER** key ▪ Select the Stop Freq screen menu - {Enter stop frequency value} - Press the **ENTER** key	▪ Additional calibration is not necessary if a Freq. Band has been set and a calibration has been performed for the band in VSWR measurement, and the same Freq. band is used in the DTF measurement.
Distance Setting	
Select the ***Distance*** screen menu ▪ {Enter measuring distance} ▪ Press the ENTER key	▪ The ending point can only be set in distance setting. ▪ The maximum measurable distance is 1,250m (4,125ft).
Cable Setting	
Select the ***Cable List*** screen menu ▪ [Standard Cable/Custom Cable] - {Select a cable by using Knob or arrow key} ▪ Press the **Select** key	
DTF Setting	
Select the ***DTF Setting*** screen menu Setting Relative Propagation Velocity ▪ Select the **Velocity** screen menu ▪ {Enter user setting value} Setting Cable Loss ▪ Select the **Cable Loss** screen menu ▪ {Enter user setting value} ▪ Press the ENTER key Setting the X axis **Unit** ▪ [Meter]/[Feet] Setting **Windowing** ▪ [Rectangular]/[Blackman] Press ***Apply*** to save changes	▪ Exit without pressing “Apply” button will not save any changes.

Table 14 – DTF Setup Procedure

CALIBRATION

The instrument must be calibrated to get reliable measurement results. The instrument must be calibrated to get the DTF measurement results compatible with VSWR measurement results.

- Calibration accessories (optional)
- Calibration Kit which contains one 50 ohm load, one Open standard and one Short standard
- Test cable: Use a phase stable cable for reliable and consistent measurement results

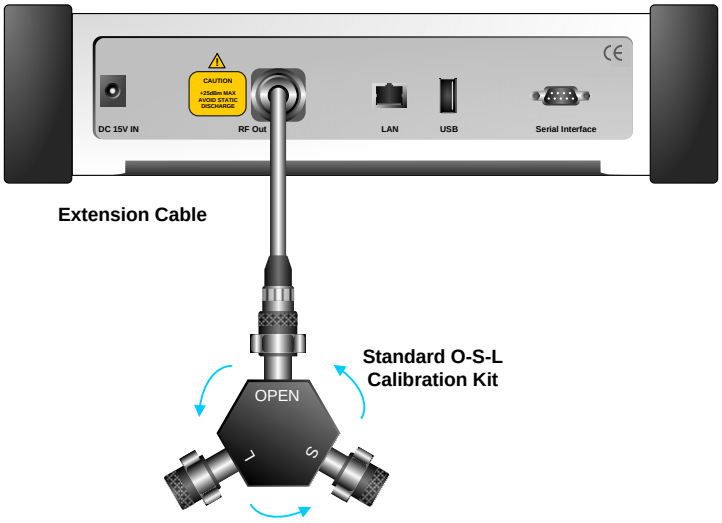


Figure 12 – Calibration for DTF measurement

To minimize measurement errors, connect the port extension cable to the ***RF Out*** port on the instrument and then connect the Cal Kit to the end of the extension cable.

If temperature changes by +/-10C or more from the temperature registered during calibration then, the calibration status will not be valid and “CAL OFF (T)” will be displayed. This means that it is required to re-calibrate the instrument for accurate results.

Figure 12 shows the connection diagram for calibration using a test cable. To compensate measurement errors due to the test cable or adapters, perform the Open-Short-Load (O-S-L) calibration including the test cable.

For detailed calibration procedure, refer to the Calibration Procedure.

Bending or moving the phase unstable cable while making a measurement may cause errors in the measurement. The test cable used for port extension must be phase stable in the measurement frequencies.

At the successful completion of each calibration step, a message is displayed with a beep sound.

Following is the calibration procedure for DTF measurement.

Action	Note
Performs Calibration after the frequency setting and test cable connections.	
1. Press the **CAL** key.	Hard function key
2. Connect an ***Open*** standard then press Enter	▪ Connect CAL Kit "***Open***" connector to the test cable. ▪ When the ***Open*** screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Open CAL Complete***", is displayed at its completion.
3. Connect a ***Short*** standard then press Enter	▪ Connect CAL Kit "***Short***" connector to the test cable. ▪ When the ***Short*** screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Short CAL Complete***", is displayed at its completion.
4. Connect the 50ohm ***Load*** standard then press Enter	▪ Connect CAL Kit "Load" connector to the test cable. ▪ When the Load screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "Load CAL Complete", is displayed at its completion.
Calibration state is changed to "***CAL ON"*** after the Open-Short-Load calibration.	

Table 15 – Calibration Procedure

If a port extension cable is used to interconnect the instrument with the transmission line, a measurement error can happen due to the sum of the port extension cable length. By performing the O-S-L calibration at the end of the port extension cable, the extension cable length will be compensated and the fault location can be more accurately measurable.

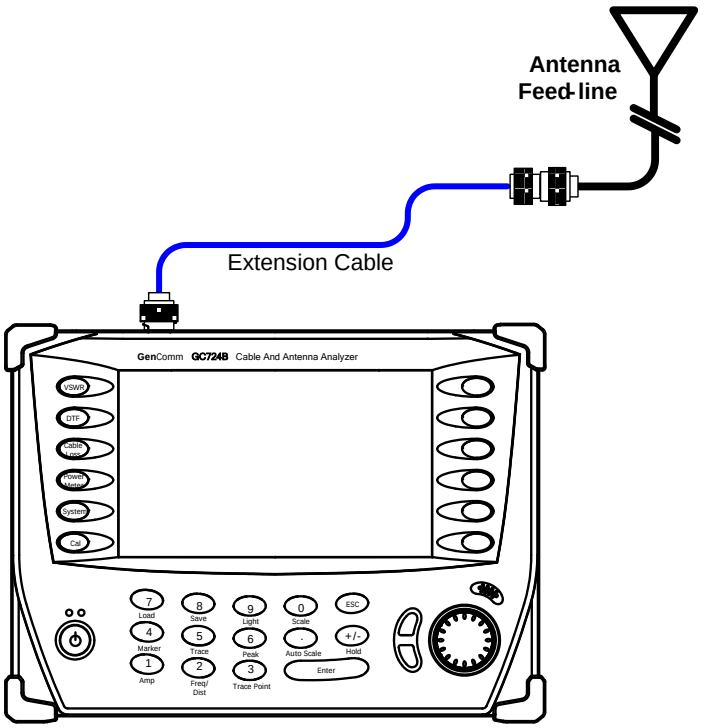


Figure 13 – Connection Diagram for DTF Measurement

The maximum allowable input level of the instrument is +25dBm. Do not connect the ***RF Out/Reflection*** port directly to the system output port. Exposure to the overpowered input may degrade the performance of the or damage the instrument.

Do not connect the instrument to the antenna when there is a risk of lightning. Electric shock may cause the malfunction or breakdown of the instrument.

If O-S-L calibration has been done at the end of the port extension cable for DTF measurement, the length of the port extension cable is compensated automatically and is not included in the distance to the point of discontinuity.

SCALE ADJUSTMENT

- Press the AUTO SCALE key to optimize the Y-scale and display an entire trace.
- Press the AMP key to set the maximum and minimum values on the Y-scale manually.
- Press the SCALE key to select a display unit of the Y scale.

USING MARKERS

Six markers can be used simultaneously. Markers can be set on the trace(s) to indicate the location. All the necessary information such as X and Y-axis are provided in the marker table at the bottom of screen.

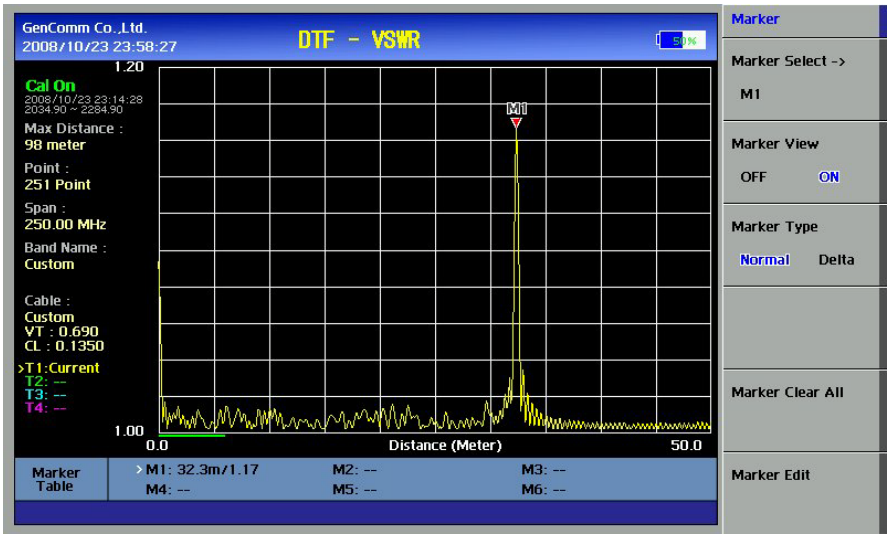


Figure 14 – Using Markers in DTF Measurement Mode

USING LIMIT LINE

By setting a limit line, it is easy to verify if a measurement exceeds a specified limit. A limit lines appear as a horizontal line at the set value. An alarm sound is generated when a trace exceeds the limit line and the exceeded portion is displayed in red color.

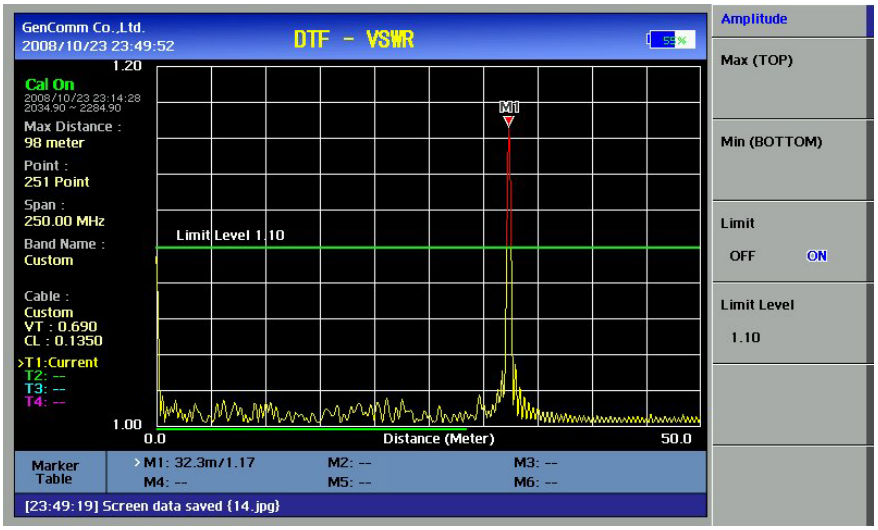


Figure 15 – Limit Line Application

WINDOWING

If the video filter is activated by selecting the different types of Windowing filters, Rectangular or Blackman, the overshoots of the trace are reduced by smoothing out the sharp transitions thereby enabling users easy to discriminate noises and peaks. Figure 17 is the result of applying Blackman window to the trace on Figure 16 (Rectangular filter – default). Noises around peaks are reduced and distance to the fault location is clearly verified.

Figure 16 – Measurement Display applying Rectangular Window

Figure 17 – Measurement Display applying Blackman Window

5.0 CABLE LOSS

In this chapter

INTRODUCTION

The cable loss measurement feature checks the signal attenuation level of the cable system. The frequency band to measure the characteristics of a cable must be calibrated before performing the cable loss measurement.

INSERTION GAIN

In electronics, the gain is the ability of a circuit (often an amplifier) to increase the power or amplitude of a signal. It is usually defined as the mean ratio of the signal output of a system to the signal input of the same system. It may also be defined as the decimal logarithm of the same ratio.

In telecommunication, insertion gain is the gain resulting from the insertion of a device in a transmission line, expressed as the ratio of the signal power delivered to that part of the line following the device to the signal power delivered to that same part before insertion.

INSERTION LOSS

Insertion loss is the loss of transmitted signal power resulting from the insertion of a device in a transmission line. It is usually expressed relative to the signal power delivered to that same part before insertion.

The insertion loss of a device (which may be a whole line) may also be referred to as attenuation. Line terminations play an important part in insertion loss because they reflect some of the power. Apart from this it is clear that not all of the power which is sent into the line at one end appears at the other. This is because of radiation losses, resistive losses in the conductor as well as losses in the surrounding dielectric. The loss which results from inserting a transmission line between a source and a load is called the insertion loss of the line.

If the power transmitted by the source is P_T and the power received by the load is P_R, then the insertion loss is given by P_R divided by P_T. For maximum power transfer the insertion loss should be as small as possible. In other words, the ratio P_R / P_T should be as close to 1 as possible, which in decibels means as close to 0dB as possible.

In most systems, insertion loss is introduced by things such as connectors, splitters, or couplers.

CABLE LOSS DISPLAY

Display Overview

The screen shown in the following figure is displayed when Cable Loss measurement mode is selected. The frequency range is shown on the X-axis, while the power loss is shown on the Y-axis.

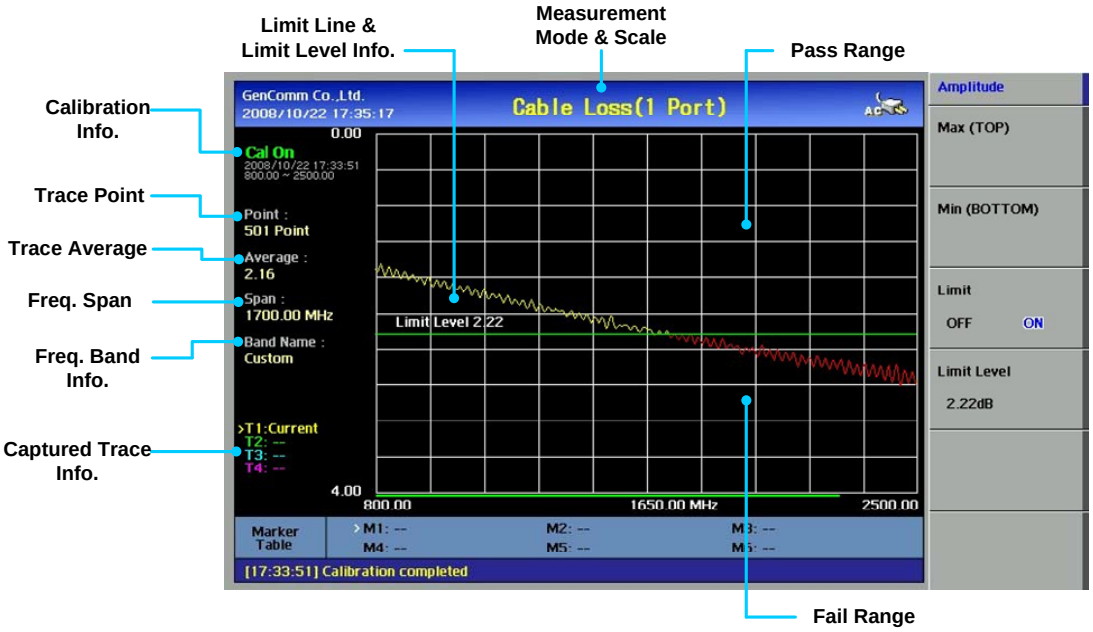


Figure 18 – Cable Loss Measurement Display

- **Calibration Info**: Displays the calibration state of the measurement frequency band that a user has selected. When the instrument is first turned on, the status is “CAL OFF”. The indication “CAL ON” is displayed along with the calibration time and frequency band after successful completion of calibration.
- **Trace Point**: Sets the data points or resolution to measure the trace. The following trace point sets can be selected:
  - 126, 251, 501, 1001
- **Trace Average**: Indicates the average value of a single sweep over the user setting frequency band.
- **Freq. Span**: User-defined frequency band. Changing the frequency band doesn’t affect the sweep time, but affects the calibration. Recalibration is required if the frequency setting is changed.
- **Freq Band Info**: The band name is displayed if the band is selected from the band list stored in the instrument. If the user sets the start, stop, center or span frequency manually, the band name will indicate “CUSTOM”

SETTING FREQUENCY

The user must set the frequency band to make a Cable Loss measurement. Frequencies can be set manually or chosen from a band list stored in the instrument.

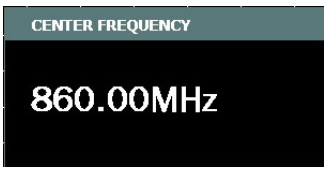
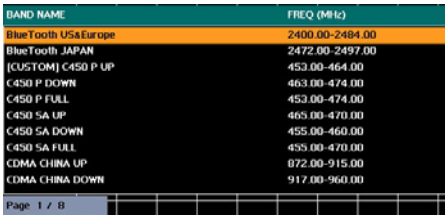
Action	Note
Setting Center Freq and Span	
1. Press the **FREQ/DIST** screen menu.	Multi Key
2. Select the ***Center*** screen menu.	▪ Current setting is displayed as default on the screen
3. Enter a center frequency value.	
4. Press the **ENTER** key.	
5. Select the ***Span*** screen menu.	
6. Enter a span value.	
7. Press the **ENTER** key.	
Setting Start/Stop Frequency	
1. Press the FREQ/DIST key.	▪ Current setting is cleared when a new value is entered. ▪ Input unit is MHz and minimum input step is 0.01MHz
2. Select the Start screen menu	
3. Enter a start frequency value.	
4. Press the ENTER key.	
5. Select the Stop screen menu	
6. Enter a stop frequency value.	
7. Press the ENTER key.	
Selection from the band list registered in the instrument	
1. Press the FREQ/DIST key.	
2. Select the Band List screen menu.	
3. Select the band from the and then press the Enter key or choose Select.	▪ Press Up/Down arrow key or rotate the knob to select a band from the list ▪ Select the Page Up/Page Down screen menu for searching the band that doesn't show up on the current page.

Table 16 – Frequency Setting Procedure

Changing the frequency settings will automatically turn calibration OFF with the symbol "CAL OFF" to be displayed on the screen along with an alarm sound. In this case, recalibrate the instrument with the Open-Short-Load Calibration kit.

CALIBRATION

The instrument must be calibrated to get reliable Cable Loss measurement results. For best results, set the frequency and calibrate the instrument immediately before taking measurements.

- Calibration accessories (optional).
- Calibration kit which contains one 50 ohm load, one Open standard, and one Short standard

To minimize measurement errors in One-port Cable Loss measurement, do not use unnecessary extension cables or adapters while performing calibration. The following figure illustrates the recommended calibration method for One-port Cable Loss measurement.

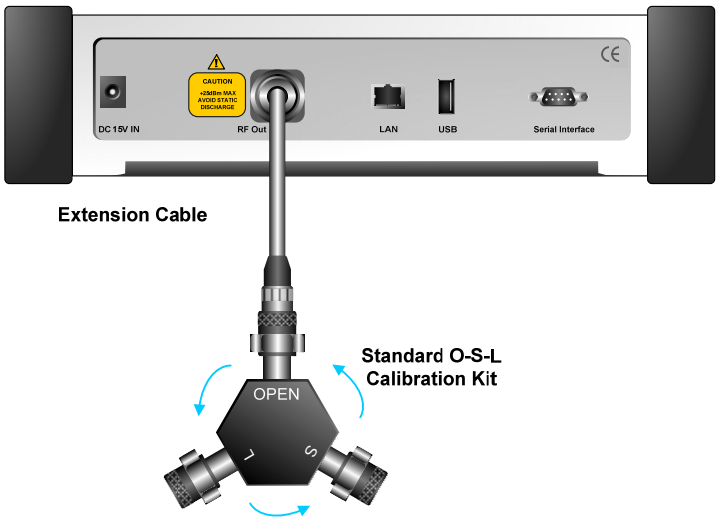


Figure 19 – Calibration Diagram

If temperature changes by +/-10C or more from the temperature registered during calibration then, the calibration status will not be valid and “CAL OFF (T)” will be displayed. This means that it is required to re-calibrate the instrument for accurate results.

The calibration procedure for Cable Loss measurements is as follows.

Action	Note
Performs Calibration after the frequency setting and test cable connections.	
1. Press the CAL key.	Hard function key
▪ Connect an ***Open*** standard then press Enter	▪ Connect CAL Kit "***Open***" connector to the test cable. ▪ When the ***Open*** screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Open CAL Complete***", is displayed at its completion.
▪ Connect a ***Short*** standard then press Enter	▪ Connect CAL Kit "***Short***" connector to the test cable. ▪ When the ***Short*** screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Short CAL Complete***", is displayed at its completion.
▪ Connect the 50ohm ***Load*** standard then press Enter	▪ Connect CAL Kit "***Load***" connector to the test cable. ▪ When the Lo***a***d screen menu is selected, a progress bar is displayed to show the progress. ▪ The message, "***Load CAL Complete***", is displayed at its completion.
Calibration state is changed to "***CAL ON"*** after the Open-Short-Load calibration.	

Table 17 – Calibration Procedure

MAKING CABLE LOSS MEASUREMENT

The instrument is ready to perform Cable Loss measurement after completion of Open-Short-Load calibration.

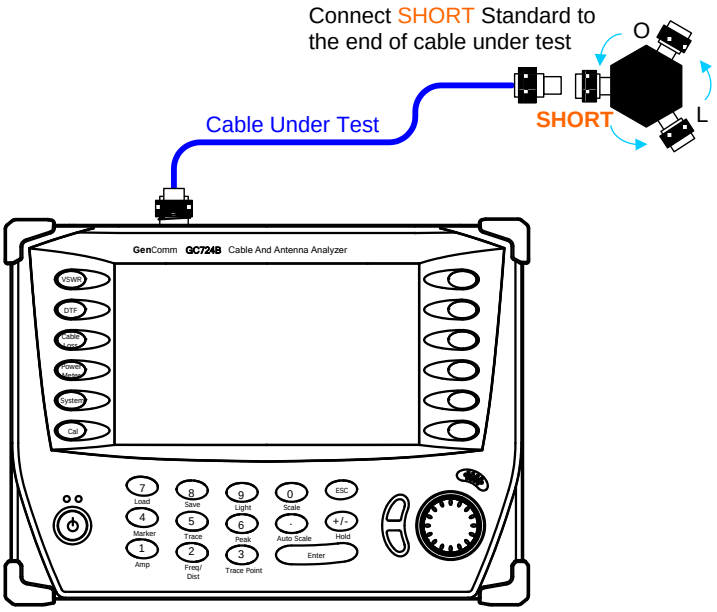


Figure 20 – Cable Loss Measurement Connection Diagram

The following is the procedure for Cable Loss measurement.

Action	Note
Make a measurement after completion of O-S-L calibration.	
1. Connect the cable to measure its loss to the RF Out/Reflection port of the instrument.	
2. Connect the Short standard of the Cal Kit to the end of the cable to be tested	Cable Loss measurement result is displayed on the screen.

Table 18 – Cable Loss Measurement Procedure

SCALE ADJUSTMENT

Press the AMP key to set the maximum and minimum values on the Y-scale manually.

USING MARKERS

Six markers can be used simultaneously. Markers can be set on the trace(s) to indicate the location. All the necessary information such as X and Y-axis are provided in the marker table at the bottom of screen. A marker can be moved to a specific frequency by using the Marker Edit.

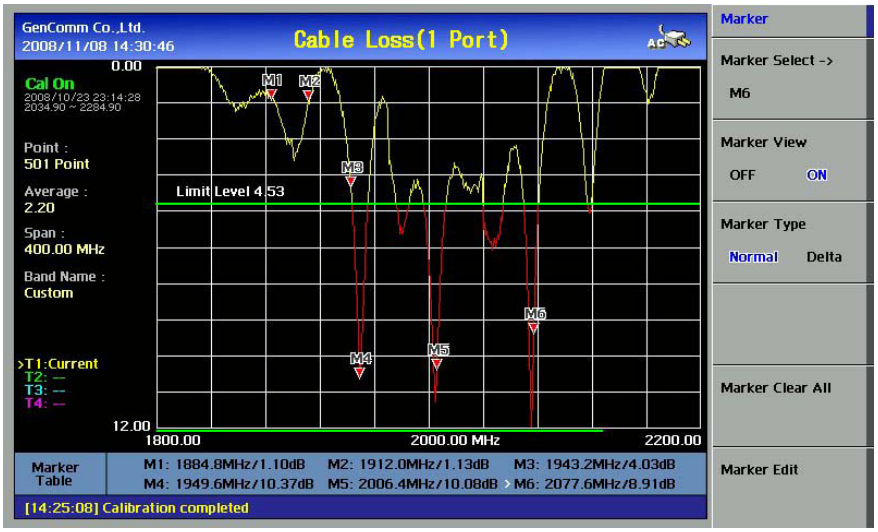


Figure 21 – Using Markers in Cable Loss Measurement Mode

USING LIMIT LINE

By setting a limit line, it is easy to verify if a measurement exceeds a specified limit. A limit lines appear as a horizontal line at the set value. An alarm sound is generated when a trace exceeds the limit line and the exceeded portion is displayed in red color.

Figure 22 – Limit Line Application

6.0 POWER METER & RF SOURCE

In this chapter

INTRODUCTION

The Power Meter function measures the transmission power of the system. This function can be used only with optional external power sensors. Two kinds of power sensors are available, Directional Power Sensors, or Terminating Power Sensors, its application depends on the type of transmission power signals to be measured. The specification of each sensor is shown in the following table.

Part No	Description	Frequency Range	Power Range
GC731A	Directional Power Sensor	300 ~ 3800MHz	Average : +21.76 ~ +51.76dBm (0.15 ~ 150W)
			Peak : +36.02 ~ +56.02dBm (4 ~ 400W)
GC732A	Terminating Power Sensor	20 ~ 3800MHz	Average : -30 ~ +20dBm (1uW ~ 100mW)
GC733A	Directional Power Sensor	150 ~ 3500MHz	+24dBm ~ 43dBm (0.25W ~ 20W)
GC724A-001	Average Power Sensor (Terminating type)	20 ~ 3000MHz	0 ~ -30dBm
GC724A-002	Peak Power Sensor (Terminating type)	20 ~ 4000MHz	0 ~ -40dBm

Table 19 – Types of Power Sensors

NOTE:

Specifications listed above subject to change.

SETTING POWER METER

All the keys used to set the power measurement are displayed as screen menu keys. No hard keys on the front panel are used. The following is a description of the screen menu and its functions:

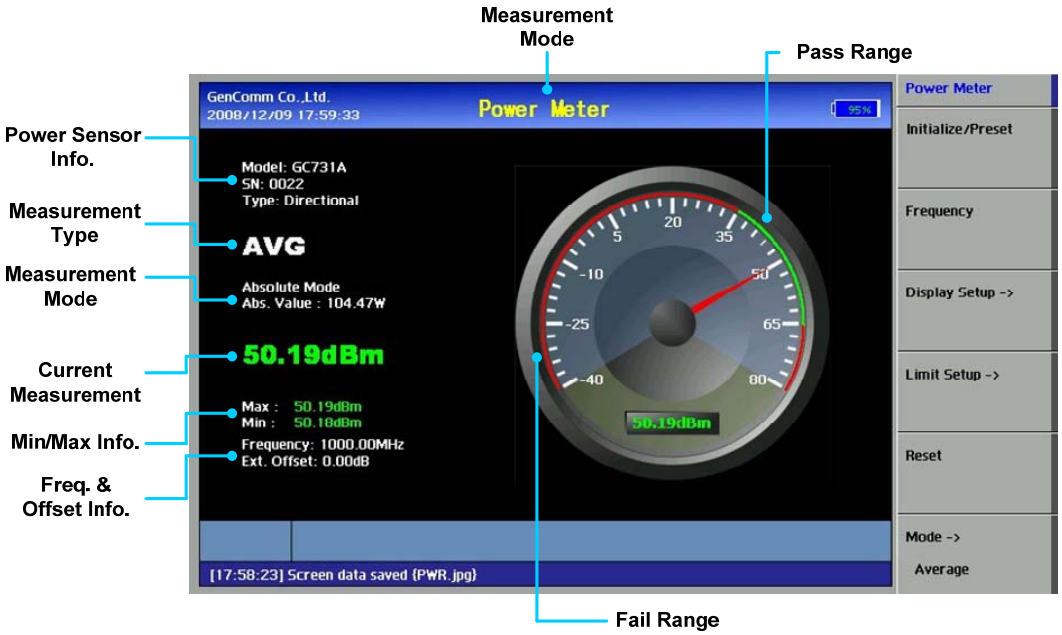


Figure 23 – Power Sensor Measurement Display

- **Power Sensor Info:** Types of power sensor connected, Terminating or Directional, and its Model Information.
- **Measurement Type:** Current measurement type information, AVG or PEAK.
- **Measurement Mode:** Display current measurement mode, Relative or Absolute.
- **Current Measurement:** Display current measured value.
- **Min/Max Info:** Display Min and Max value of the measurement.
- **Frequency & Offset:** Display current frequency setting and External offset setting information.
- **Initialize**: Initializes the power sensor and downloads the calibration data from the sensor.
- **Frequency**: Sets the frequency of signals to measure. As the frequency setting affects the calibration data, be sure to set the accurate center frequency for reliable measurement results.
- **Display Setup**: Sets the following items.

- Sets Display Value in Absolute or Relative
- Sets Reference Level to be used in Relative display mode
- Sets Display Minimum and Maximum Range
- Setting External Offset (Enters the value of Gain or Loss when an attenuator or an amplifier is used before the power sensor. As the default setting is Loss, enter the level of Loss in positive values when an attenuator is used and in negative values when an amplifier is used)

- **Reset**: Clears all user settings and returns to the factory settings.
- **Mode**: Selects display mode, Average, Peak and VSWR.

CONNECTING POWER SENSOR

Selecting the Power Meter function after power up the instrument will display the Power Meter measurement screen without power sensor information, dashed line of Model, S/N, Type, etc.

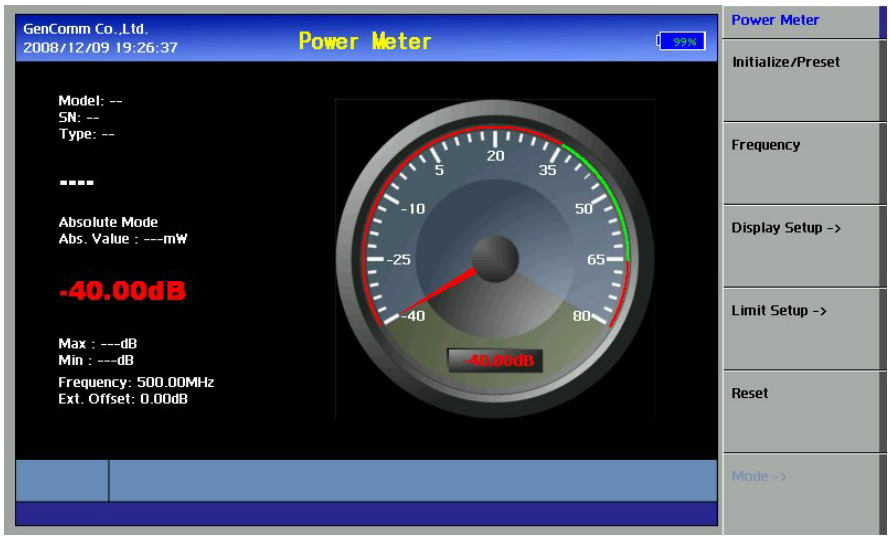


Figure 24 – Power Meter Screen before Connecting Sensor

Connect a power sensor to the RS-232C interface port of the instrument using the provided cable as shown in the following figure. Do not connect a power sensor directly to the LPA or HPA.

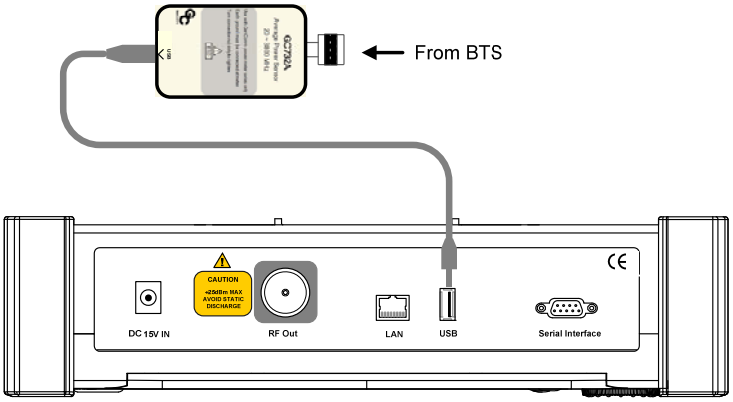


Figure 25 – Terminating Power Sensor Connection Diagram

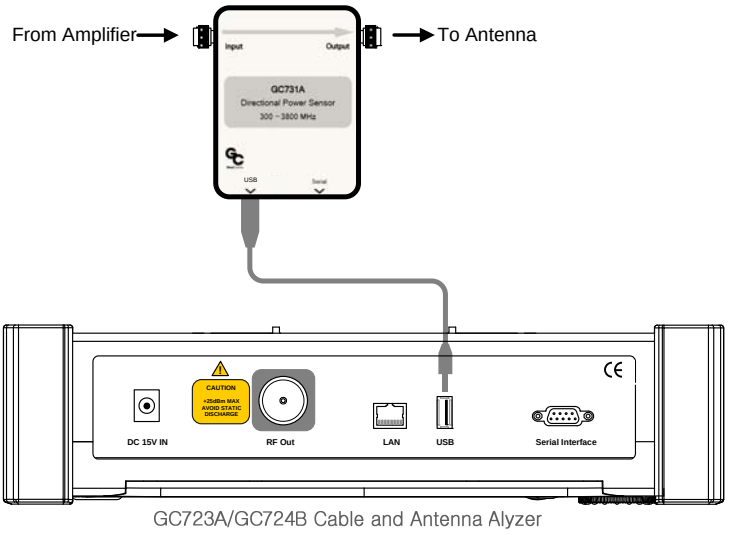


Figure 26 – Directional (Through Line) Power Sensor Connection Diagram

After connecting a power sensor, select the Initialize/Preset screen menu key for the instrument to recognize the sensor. After successful recognition of the power sensor, the sensor type is displayed on the screen as shown in the following figure.

No sensor type is displayed on the screen if the instrument is not able to recognize a sensor type during the initialization process.

Figure 27 – Power Sensor Initial Screen

MAKING POWER MEASUREMENT

After the connection and initialization of a power sensor, connect the power sensor to the output port of the device.

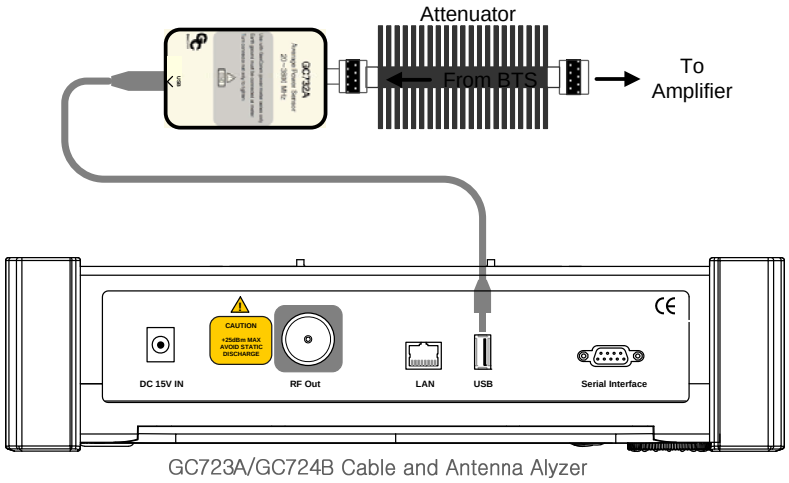


Figure 28 – HPA (High Power Amplifier) Output Power Measurement w/Terminating power sensor

Do not connect the Terminating type of power sensor directly to the output of the HPA. The power sensor will be damaged if output power greater than +20dBm is supplied directly.

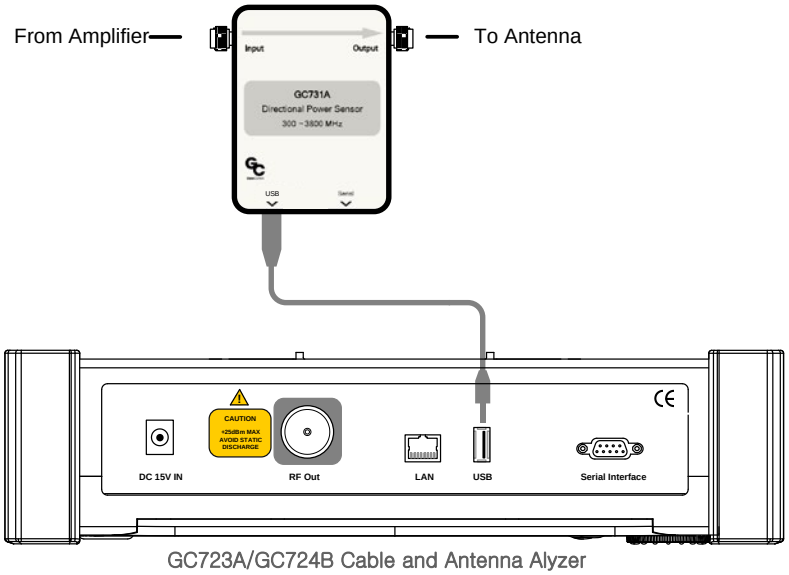


Figure 29 – HPA (High Power Amplifier) Output Power Measurement w/Directional power sensor

Action	Note	
Make a measurement after completion of Power Sensor initialization.		
1. Connect the DUT to the RF In of the power sensor.		
2. ***Initialize/Preset***	Initialize the power sensor	
3. ***Frequency***	Set the frequency to be measured	
4. ***Display Setup***	Display	Sets display method in Abs / Rel
	Set Ref	Reference level setting information when Relative mode is selected
	Disp Max / Min	Sets display range
	External Offset	Sets external offsets
5. ***Limit Setup***	Limits	Turns limit line On/Off
	High Limit	Sets high limit value
	Low Limit	Sets low limit value
6. ***Reset***	Retrieve current measurements	
7. ***Mode***	Sets display mode in Average, Peak and VSWR (this menu will only be activated when Directional Power Sensor is identified)	

Table 20 – Power Measurement Procedure

7.0 SAVE & LOAD

In this chapter

INTRODUCTION

Measurement results and setups can be saved to or loaded from the non-volatile memory in the instrument or an external USB memory.

The instrument can save a measurement result in a data file and recall the file later for the purpose of comparison or analysis. The display screen can be saved as a graphic file format. Also a user setup configuration can be saved. The LOAD function is used to recall data files, display screens or user setups.

SAVE

The instrument provides the following save functions:

- **Save Trace:** Saves a captured trace in a data file. The file name extension is *.tra.
- **Save Screen:** Saves a current display screen in a JPEG file format.
- **Save Setup:** Saves a user setup configuration.

SAVE TRACE

This function is to save a captured trace using the TRACE function. Trace Saving procedure is as follows.

Action	Note
This function is available in VSWR, DTF, and Cable Loss measurement mode.	
1. Press the **SAVE** key.	Multi key
2. Select the ***Memory Type***. ***Internal/ USB***	Select either an internal memory or an external USB memory.
3. Select the ***Save Trace*** screen menu.	Screen menu key
4. Select the ***Trace*** number (T1 ~ T4)	Select a trace number to be saved.
5. Assign the ***File Name***	▪ User enters the file name manually using the keyboard on the screen. ▪ To delete all of previous entered name, press “Clear”. ▪ To delete previous entered name one by one, press “Back Space”.
6. Press the **Done** key	▪ Press Done for save changes. ▪ Press Cancel to exit without save changes.

Table 21 – Trace Saving Procedure

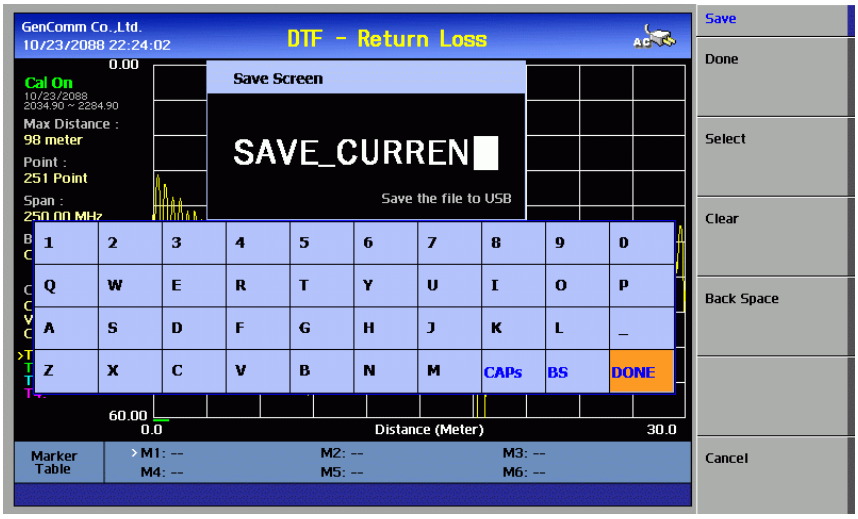


Figure 30 – Save Screen to Enter File Name

When a user assigns the file name manually, the ENTER key on the screen keyboard or Done key on the screen menu key must be entered after finishing the entry of a file name.

SAVE SCREEN

This function is to save the measurement display screen in the graphic file format. Following is the procedure for screen saving.

Action	Note
This function is available in VSWR, DTF, and Cable Loss measurement mode.	
1. Press the **SAVE** key.	Multi key
2. Select the ***Memory Type***. ***Internal/ USB***	Select either an internal memory or an external USB memory.
3. Select the ***Save Screen*** screen menu.	Screen menu key
4. Assign the ***File Name***	▪ User enters the file name manually using the keyboard on the screen. ▪ To delete all of previous entered name, press “Clear”. ▪ To delete previous entered name one by one, press “Back Space”.
5. Press the **Done** key	▪ Press Done for save changes. ▪ Press Cancel to exit without save changes.

Table 22 – Screen Saving Procedure

SAVE SETUP

This function is to save the user setup configuration and the calibration data. Up to 20 setups can be saved in the internal memory.

Action	Note
This function is available in VSWR, DTF, and Cable Loss measurement mode.	
1. Press the **SAVE** key.	Multi key
2. Select the ***Memory Type***. ***Internal/ USB***	Select either an internal memory or an external USB memory.
3. Select the ***Save Setup*** screen menu.	Screen menu key
4. Assign the ***File Name***	▪ User enters the file name manually using the keyboard on the screen. ▪ To delete all of previous entered name, press “Clear”. ▪ To delete previous entered name one by one, press “Back Space”.
5. Press the **Done** key	▪ Press Done for save changes. ▪ Press Cancel to exit without save changes.

Table 23 – Setup Saving Procedure

Saving a setup is based on the procedure shown in the above table. The instrument setting can be configured by loading saved setups.

The following table summarizes the parameters saved in setup.

Measurement Mode	Parameters	Remarks
VSWR Cable Loss	CAL On/ Off status	
	CAL Data	Recall preceding calibration data.
	Frequency	Start, Stop, Center Freq and Span
	Trace Point	126, 251, 501, 1001points,
	Y-scale	Top, Bottom
	Y-scale unit	VSWR, Return Loss
	Band	Frequency band name
	Marker	Type/Position
	Limit	On/Off status and Limit Line
DTF	Distance Setting	0 ~ 1250m (4125feet)
	Cable Setting	Cable name and its characteristics
	Y-scale Setting	Top, Bottom
	Y-scale unit Setting	VSWR, Return Loss
	Custom Cable Parameter Setting	User setting Propagation Velocity and Cable Loss value
	Unit	Meter/Feet
	Windowing	Rectangular/Blackman
	Marker	Type/Position
	Limit	On/Off status and Limit Line
Cable Loss	CAL On/Off Status	
	CAL Data	Two port CAL data
	Bias Tee	On/Off status and Voltage
	Y-scale	Top, Bottom
	Limit	Status/Type/Limit Line
	RF In Atten	Recalling previous RF In Attenuation setting
	Marker	Type/Position
Power Meter	Frequency	Start, Stop, Center Freq and Span
	Display Mode	Average/Relative setting
	Set Ref	Reference level setting
	Display Min/Max	Display range setting
	External Offset	External offset setting
	Limit	Status/High/Low settings

Table 24 – Saved Parameters in each Measurement Mode

LOAD

The instrument provides the following save functions:

- **Load Trace:** Loads a captured trace from a data file. The file name extension is *.tra.
- **Load Screen:** Loads a display screen.
- **Load Setup:** Loads a user setup configuration.

Loading data can be either done from the internal memory or from the external USB memory.

File manager provides following menu to copy or delete the data of the instrument.

- **Delete**: Delete the selected file.
- **Delete All**: Delete all files saved in the instrument.
- **Copy to USB**: Copy the selected file to USB memory stick.
- **Copy All to USB**: Copy all files from the instrument to USB memory stick.

LOAD TRACE

This function is used to recall multiple traces for comparison purposes. The following changes happen automatically when a saved trace is recalled:

- The trace with the different Y-scale unit may not be seen on the screen.
  - Frequency or distance setting of the instrument must be matched to trace to be loaded.
  - Mode of the instrument must be matched to trace file to be loaded.
- The Y-scale unit is adjusted automatically to fit into the Y-scale of the recalled trace.

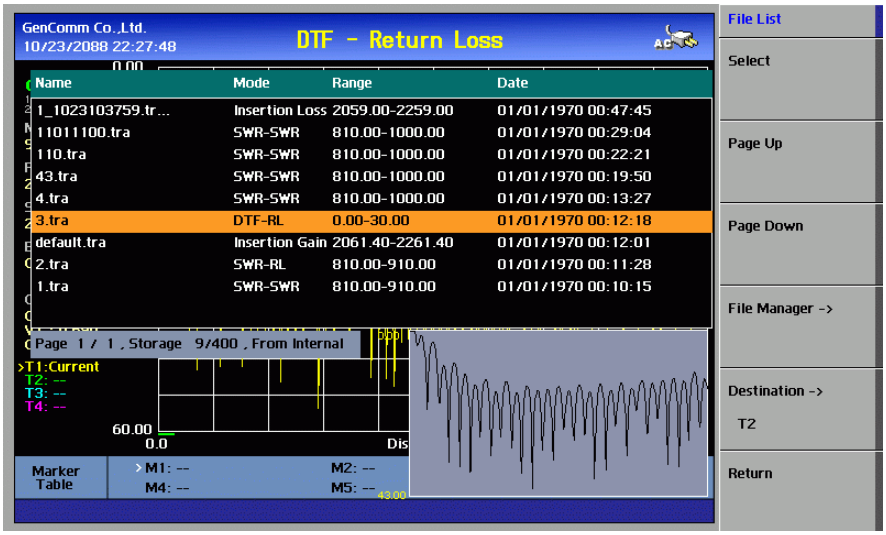


Figure 31 – Trace Loading Screen

When the Load Trace function is selected, the preview of the selected trace from the list is displayed on the lower right corner of the screen.

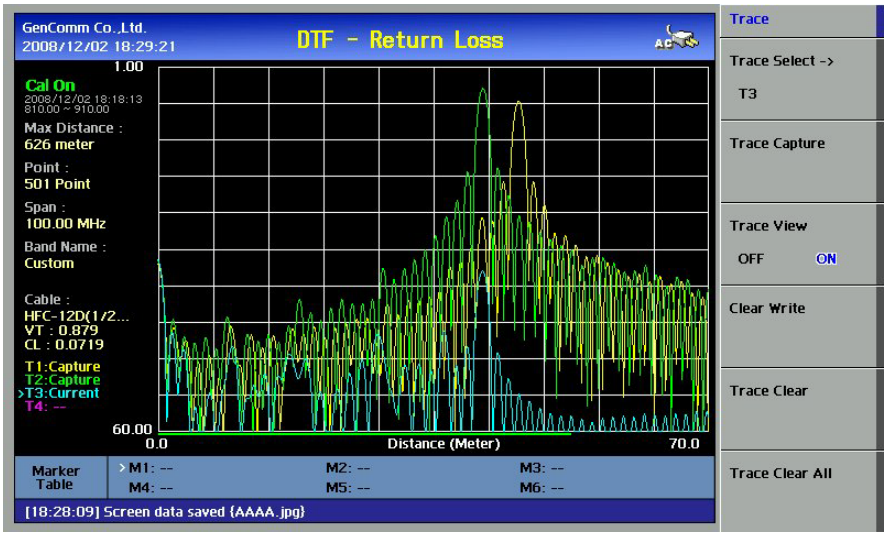


Figure 32 – Screen with Multiple Traces

Action	Note
This function is available in VSWR, DTF, and Cable Loss measurement mode.	
1. Press the **LOAD** *key*	Multi key
2. Select the ***Load Trace*** *screen menu*	Saved file list shows up when ***Load Trace*** is selected. Use dial knob or Up/Down Arrow key to select the file to load from the list.
3. Press the **Select** key	Load a selected trace.

Table 25 – Trace Loading Procedure

Loaded traces can be deleted from the screen according to the above procedure. Unlike the loaded traces, captured traces cannot be restored once they are deleted. Be cautious in deleting traces so that you do not lose any necessary information.

Action	Note
Available in VSWR, DTF, and Cable Loss measurement mode.	
1. Press the **TRACE** key	Multi key
2. Select the ***Trace Number (T1 ~ T4)*** screen menu	Select Trace number to be cleared, arrow mark indicate current trace
3. Select the ***Trace Clear*** screen menu	Delete the selected Channel from the screen
4. Select the ***Clear Write*** screen menu	By selecting Clear Write, current selected trace, which marker indicates will be assigned to current trace
All traces except the current trace are deleted from the screen when ***Trace Clear All*** is selected.	

Table 26 – Trace Unloading Procedure

USING MARKERS ON LOADED TRACES

Each marker can be set on the individual trace among multiple traces. Active marker will be set on the active trace. By changing the active trace, the active marker will be set on the active trace.

Six markers can be used simultaneously. Markers can be set on the trace(s) to indicate the location. All the necessary information such as X and Y-axis are provided in the marker table at the bottom of screen. A marker can be moved to a specific frequency by using the Marker Edit.

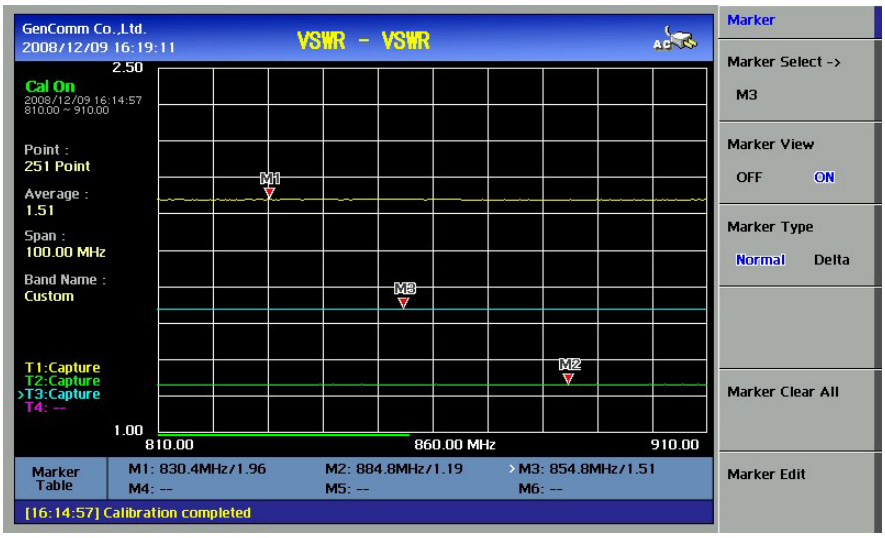


Figure 33 – Marker Display Screen with Multiple Traces

LOAD SCREEN

This function recalls and displays a saved screen. The measurement currently under processing is continued in the background, but it is not displayed on the screen. Pressing any key removes the loaded screen and the measurement screen being processed in the background shows up.

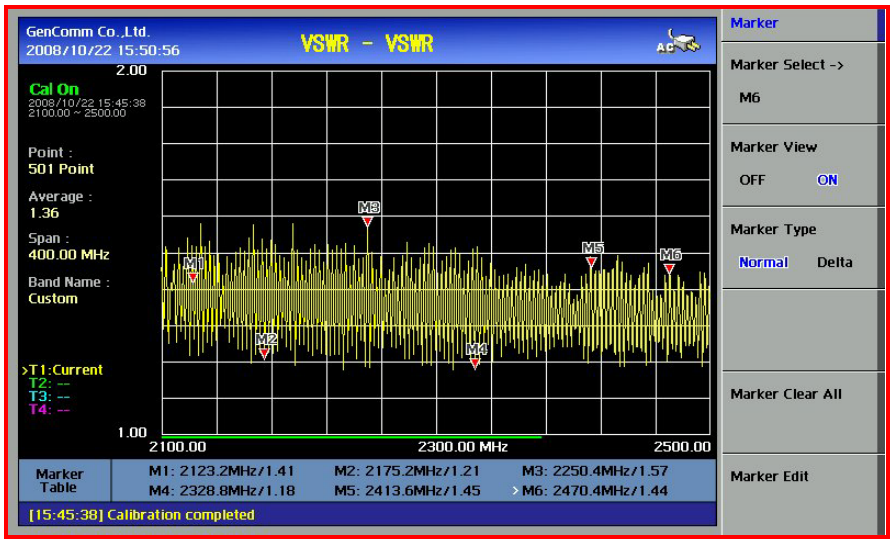


Figure 34 – Load Screen

CH 7

MEMORY TYPE

This menu designates the area used to recall Trace, Screen, and Setup. Two types of storage areas are available as follows.

- **Internal:** Selects the files stored in the internal memory of the instrument. A list of files stored in the internal memory is displayed when Load Trace, Load Screen or Load Setup is selected while the memory type is set to “Internal”. In case the user selected file is not available, an error message is displayed on the messaging window and the file list is not shown.
- **USB:** Selects the files stored in external USB memory. A list of files stored in the external USB memory is displayed when Load Trace, Load Screen or Load Setup is selected while memory type is set to “USB”. In case the user selected file is not available, an error message is displayed on the messaging window and the file list is not shown.

8.0 APPENDIX

In this chapter

APPENDIX A. BAND LIST

Band Name	Start Freq (MHz)	Stop Freq (MHz)
BlueTooth USA & Europe	2,400	2,484
BlueTooth JAPAN	2,472	2,497
C450 P UP	453	464
C450 P DOWN	463	474
C450 P FULL	453	474
C450 SA UP	465	470
C450 SA DOWN	455	460
C450 SA FULL	455	470
CDMA CHINA UP	872	915
CDMA CHINA DOWN	917	960
CDMA CHINA FULL	872	960
CELLULAR UP	824	849
CELLULAR DOWN	869	894
CELLULAR FULL	824	894
CELLULAR 700 UP	776	794
CELLULAR 700 DOWN	746	764
CELLULAR 700 FULL	746	794
DCS GSM 1800 UP	1,710	1,785
DCS GSM 1800 DOWN	1,805	1,880
DCS GSM 1800 FULL	1,710	1,880
DMB	2,593	2,693
GSM 900 UP	880	915
GSM 900 DOWN	925	960
GSM 900 FULL	880	960
IEEE 802.11 FH	2,402	2,495
IEEE 802.11 DS	2,412	2,484
IEEE 802.11b/g	2,400	2,484
IMT2000 UMTS WCDMA UP	1,920	1,980
IMT2000 UMTS WCDMA DOWN	2,110	2,170
IMT2000 UMTS WCDMA FULL	1,920	2,170
ISM 2.4GHz	2,400	2,484
JTACS/NTAC JPN ARIB UP	887	925
JTACS/NTAC JPN ARIB DOWN	832	870
JTACS/NTAC JPN ARIB FULL	832	925
NMT 411 UP	411	420
NMT 411 DOWN	421	430
NMT 411 FULL	411	430
NMT 451 UP	450	460
NMT 451 DOWN	460	470
NMT 451 FULL	450	470
NMT 451 20kHz CDMA2k UP	451	484
NMT 451 20kHz CDMA2k DOWN	461	494
NMT 451 20kHz CDMA2k FULL	451	494
NMT 450 20kHz CDMA2k UP	411	458
NMT 450 20kHz CDMA2k DOWN	421	468
NMT 450 20kHz CDMA2k FULL	411	468
NMT 900 UP	890	915
NMT 900 DOWN	935	960
NMT 900 FULL	890	960
PCS GSM 1900 UP	1,850	1,910
PCS GSM 1900 DOWN	1,930	1,990
PCS GSM 1900 FULL	1,850	1,990
PCS KOREA UP	1,750	1,780
PCS KOREA DOWN	1,840	1,870
PCS KOREA FULL	1,750	1,870
PDC 800 UP	898	940
PDC 800 DOWN	843	885
PDC 800 FULL	843	940
PDC 1500 UP	1,525	1,549
PDC 1500 DOWN	1,477	1,501
PDC 1500 FULL	1,477	1,549
PHS	1,895	1,918
SMR 800 UP	806	821

Band Name	Start Freq (MHz)	Stop Freq (MHz)
SMR 800 DOWN	851	866
SMR 800 FULL	806	866
SMR 1500 UP	1,453	1,465
SMR 1500 DOWN	1,501	1,513
SMR 1500 FULL	1,453	1,513
TACS/ETACS UP	872	915
TACS/ETACS DOWN	917	960
TACS/ETACS FULL	872	960
Tetra	380	430

APPENDIX B. CABLE LIST

Cable Type	Relative Propagation Velocity (V¦)	Nominal Attenuation dB/m @ 1000MHz
FSJ1-50A	0.84	0.197
FSJ250	0.83	0.134
FSJ4-50B	0.81	0.119
HCC 12-50J	0.915	0.092
HCC 158-50J	0.95	0.023
HCC 300-50J	0.96	0.014
HCC 312-50J	0.96	0.013
HCC 78-50J	0.915	0.042
HF 4-1/8" Cu2Y	0.97	0.01
HF 5" Cu2Y	0.96	0.007
HF 6-1/8"Cu2Y	0.97	0.006
HJ4.5-50	0.92	0.054
HJ4-50	0.914	0.087
HJ5-50	0.916	0.042
HJ7-50A	0.921	0.023
LDF12-50	0.88	0.022
LDF4-50A	0.88	0.077
LDF5-50A	0.89	0.043
LDF6-50	0.89	0.032
LDFF7-50A	0.88	0.027
LMR100	0.8	0.792
LMR1200	0.88	0.044
LMR1700	0.89	0.033
LMR200	O.830	0.344
LMR240	0.84	0.262
LMR400	0.85	0.135
LMR500	0.86	0.109
LMR600	0.87	0.087
LMR900	0.87	0.056
RG142	0.69	0.443
RG17, 17A	0.659	0.18
RG174	0.66	0.984
RG178B	0.69	1.509
RG187, 188	0.69	1.017
RG213/U	0.66	0.292
RG214	0.659	0.292
RG223	0.659	0.165
RG55, 55A, 55B	0.659	0.541
RG58, 58B	0.659	1.574
RG58A, 58C	0.659	0.787
RG8, 8A, 10, 10A	0.659	0.262
RG9, 9A	0.659	0.289
HFSC-12D(1/2")	0.81	0.112
HFC-12D(1/2")	0.88	0.072
HFC-22D(7/8")	0.88	0.041
HFC-33D(1_1/4")	0.88	0.0294
HFC-42D(1_5/8")	0.87	0.0243
RFCX-12D(1/2")	0.88	0.088
RFCX-22D(7/8")	0.88	0.049
RFCX-33D(1_1/4")	0.88	0.038
RFCX-42D(1_5/8")	0.87	0.028
RFCL-22D(7/8")	0.88	0.044
RFCL-33D(1_1/4")	0.88	0.034
RFCL-42D(1_5/8")	0.87	0.0315

APPENDIX

APPENDIX C. SPECIFICATION

General		Directional Power Sensors	
Max Input Power	+25dBm	GC731A	
Frequency Accuracy	< 5ppm	Sensor Type	Average and Peak
Frequency Resolution	100KHz	Frequency Range	300 ~ 3800MHz
Impedance	50Ω	Resolution	0.01dB or 0.1xW
Test Port	Type N, Female	Measurement Range	
Trace Storage	Up to 400	Average:	21.76 ~ 51.76dBm (0.15 ~ 150W)
Screen Storage	Up to 100	Peak:	36.02 ~ 56.02dBm (4 ~ 400W)
Setup Storage	Up to 20	Measurement Uncertainty	±4% of reading +0.05W[1]
VSWR		Input Return Loss	27 dB Min
Frequency Range	25 ~ 4000MHz (GC724B)	Directivity	27 dB Min
	100 ~ 2700MHz (GC723A)	Connector Type	N-Female on both ends
Data points	126, 251, 501, 1001	GC733A	
Return Loss	0 ~ 60dB	Senor Type	Average and Peak
VSWR Range	1 ~ 65	Frequency Range	150 ~ 3500MHz
Measurement Speed	1, 1.3, 2.5, 5sec for each data points	Measurement Range	
		Average:	24dBm ~ 43dBm (0.25 ~ 20W)
Cable Loss		Peak:	24dBm ~ 43dBm (0.25 ~ 20W)
Frequency Range	25 ~ 4000MHz (GC724B)	Measurement Uncertainty	±4% of reading +0.05W[1]
	100 ~ 2700MHz (GC723A)	Input Return Loss	27 dB Min
Cable Loss Range	0 ~ 30dB	Directivity	27 dB Min
Resolution	0.01dB	Connector Type	N-Female on both ends
DTF (Distance to Fault)		Terminating Power Sensors	
Frequency Range	25 ~ 4000MHz (GC724B)	GC732A	
	100 ~ 2700MHz (for GC723A)	Sensor Type	Average
Distance	0 ~ 1250m (4125ft)	Frequency Range	20 ~ 3800MHz
Horizontal Range	(#of Data Points-1)x(Resolution-1)/2	Measurement Range	-30 ~ +20dBm (1uW ~ 100mW)
		Measurement Uncertainty	±7% of reading[1]
Resolution	$\frac{(1.5\times10^{8})(Vp)}{(Delta)(Z.F)}$ Vp = Cable's relative propagation velocity Delta (Hz) = Stop Freq. - Start Freq. $Z.F\ (Zoom\ Factor) = \frac{Setup\ Dist.}{Max\ Dist.}$	Connector Type	N-Male
		GC724-50551	
		Sensor Type	Average
		Frequency Range	40 ~ 3000MHz
		Measurement Range	-30 ~ 0dBm (1uW ~ 1mW)
Return Loss	0 ~ 60dB	Measurement Uncertainty	±10% of reading2
VSWR	1 ~ 65	Connector Type	N-Male
Immunity to Interfering Signals		GC724-50552	
On Frequency	+5dBm	Sensor Type	Peak
On Channel	+17dBm	Frequency Range	40 ~ 4000MHz
RF Power Meter (Requires Power Sensors)		Measurement Range	-30 ~ 0dBm (1uW ~ 1mW)
Display Range	-80 ~ +80dBm	Measurement Uncertainty	±10% of reading[1]
Offset Range	-100 ~ +100dB	Connector Type	N-Male
Resolution	0.01dB (W)		
Miscellaneous			
Dimension	260mm x 190mm x 60mm (10.2"x7.5"x2.3")	Operation Temperature	0 ~ +50°C (+32 ~ +122°F)
Weight	< 2.0kg (4.4lbs) includes battery	Storage Temperature	-40 ~ +80°C (-40 ~ +176°F)
Battery	Li-ion (>3hrs continuous operating)	Humidity	95% No Condensation

[1] The specification provided at a temperature of 25℃ ± 10℃.
*All Specifications based on calibrating at 25℃ after 5 minute warm-up.
**Specification and product description are subject to change without notice.

APPENDIX D. VSWR-RETURN LOSS CONVERSION TABLE

· Return Loss=$20\log_{10}$(VSWR+1/VSWR-1) (dB)

· VSWR=($10^{R.L./20}$+1/$10^{R.L./20}$-1)

VSWR	Return Loss (dB)	Trans. Loss (dB)	Volt. Refl Coeff	Power Trans (%)	Power Refl (%)	VSWR	Return Loss (dB)	Trans. Loss (dB)	Volt. Refl Coeff	Power Trans (%)	Power Refl (%)
1.00	--	0.000	0.00	100.0	0.0	1.64	12.3	0.263	0.24	94.1	5.9
1.01	46.1	0.000	0.00	100.0	0.0	1.66	12.1	0.276	0.25	93.8	6.2
1.02	40.1	0.000	0.01	100.0	0.0	1.68	11.9	0.289	0.25	93.6	6.4
1.03	36.6	0.001	0.01	100.0	0.0	1.70	11.7	0.302	0.26	93.3	6.7
1.04	34.2	0.002	0.02	100.0	0.0	1.72	11.5	0.315	0.26	93.0	7.0
1.05	32.3	0.003	0.02	99.9	0.1	1.74	11.4	0.329	0.27	92.7	7.3
1.06	30.7	0.004	0.03	99.9	0.1	1.76	11.2	0.342	0.28	92.4	7.6
1.07	29.4	0.005	0.03	99.9	0.1	1.78	11.0	0.356	0.28	92.1	7.9
1.08	28.3	0.006	0.04	99.9	0.1	1.80	10.9	0.370	0.29	91.8	8.2
1.09	27.3	0.008	0.04	99.8	0.2	1.82	10.7	0.384	0.29	91.5	8.5
1.10	26.4	0.010	0.05	99.8	0.2	1.84	10.6	0.398	0.30	91.3	8.7
1.11	25.7	0.012	0.05	99.7	0.3	1.86	10.4	0.412	0.30	91.0	9.0
1.12	24.9	0.014	0.06	99.7	0.3	1.88	10.3	0.426	0.31	90.7	9.3
1.13	24.3	0.016	0.06	99.6	0.4	1.90	10.2	0.440	0.31	90.4	9.6
1.14	23.7	0.019	0.07	99.6	0.4	1.92	10.0	0.454	0.32	90.1	9.9
1.15	23.1	0.021	0.07	99.5	0.5	1.94	9.9	0.468	0.32	89.8	10.2
1.16	22.6	0.024	0.07	99.5	0.5	1.96	9.8	0.483	0.32	89.5	10.5
1.17	22.1	0.027	0.08	99.4	0.6	1.98	9.7	0.497	0.33	89.2	10.8
1.18	21.7	0.030	0.08	99.3	0.7	2.00	9.5	0.512	0.33	88.9	11.1
1.19	21.2	0.033	0.09	99.2	0.8	2.50	7.4	0.881	0.43	81.6	18.4
1.20	20.8	0.036	0.09	99.2	0.8	3.00	6.0	1.249	0.50	75.0	25.0
1.21	20.4	0.039	0.10	99.1	0.9	3.50	5.1	1.603	0.56	69.1	30.9
1.22	20.1	0.043	0.10	99.0	1.0	4.00	4.4	1.938	0.60	64.0	36.0
1.23	19.7	0.046	0.10	98.9	1.1	4.50	3.9	2.255	0.64	59.5	40.5
1.24	19.4	0.050	0.11	98.9	1.1	5.00	3.5	2.553	0.67	55.6	44.4
1.25	19.1	0.054	0.11	98.8	1.2	5.50	3.2	2.834	0.69	52.1	47.9
1.26	18.8	0.058	0.12	98.7	1.3	6.00	2.9	3.100	0.71	49.0	51.0
1.27	18.5	0.062	0.12	98.6	1.4	6.50	2.7	3.351	0.73	46.2	53.8
1.28	18.2	0.066	0.12	98.5	1.5	7.00	2.5	3.590	0.75	43.7	56.3
1.29	17.9	0.070	0.13	98.4	1.6	7.50	2.3	3.817	0.76	41.5	58.5
1.30	17.7	0.075	0.13	98.3	1.7	8.00	2.2	4.033	0.78	39.5	60.5
1.32	17.2	0.083	0.14	98.1	1.9	8.50	2.1	4.240	0.79	37.7	62.3
1.34	16.8	0.093	0.15	97.9	2.1	9.00	1.9	4.437	0.80	36.0	64.0
1.36	16.3	0.102	0.15	97.7	2.3	9.50	1.8	4.626	0.81	34.5	65.5
1.38	15.9	0.112	0.16	97.5	2.5	10.00	1.7	4.807	0.82	33.1	66.9
1.40	15.8	0.122	0.17	97.2	2.8	11.00	1.6	5.149	0.83	30.6	69.4
1.42	15.2	0.133	0.17	97.0	3.0	12.00	1.5	5.466	0.85	28.4	71.6
1.44	14.9	0.144	0.18	96.7	3.3	13.00	1.3	5.762	0.86	26.5	73.5
1.46	14.6	0.155	0.19	96.5	3.5	14.00	1.2	6.040	0.87	24.9	75.1
1.48	14.3	0.166	0.19	96.3	3.7	15.00	1.2	6.301	0.88	23.4	76.6
1.50	14.0	0.177	0.20	96.0	4.0	16.00	1.1	6.547	0.88	22.1	77.9
1.52	13.7	0.189	0.21	95.7	4.3	17.00	1.0	6.780	0.89	21.0	79.0
1.54	13.4	0.201	0.21	95.5	4.5	18.00	1.0	7.002	0.89	19.9	80.1
1.56	13.2	0.213	0.22	95.2	4.8	19.00	0.9	7.212	0.90	19.0	81.0
1.58	13.0	0.225	0.22	94.9	5.1	20.00	0.9	7.413	0.90	18.1	81.9
1.60	12.7	0.238	0.23	94.7	5.3	25.00	0.7	8.299	0.92	14.8	85.2
1.62	12.5	0.250	0.24	94.4	5.6	30.00	0.6	9.035	0.94	12.5	87.5

ORDERING INFORMATION

Basic Model

- GC723A Cable and Antenna Analyzer (100 ~ 2700MHz)
- GC724B Cable and Antenna Analyzer (25 ~ 4000MHz)

Standard Accessories

- GC723-50541 : Soft Carrying Case
- GC724-50522 : AC-DC Adapter
- G7105-50335 : Cross LAN Cable (1.5m)
- GC724-50517 : 1GByte USB Memory
- GC724-50523 : Automotive Cigarette Lighter/12V DC Adapter
- GC724-50321 : Lithium-Ion Battery
- G7105-50316 : Stylus Pen
- GC723-50561 : User's Manual and Application Software CD

Optional Accessories

- GC725-50509 : Calibration Kit (N), 40dB 4GHz
- GC724-50531 : RF Cable, 1.5m N(m)-N(f)
- GC724-50532 : RF Cable, 3.0m N(m)-N(f)
- GC723-50542 : Hard Case
- GC723-50562 : GC723A/GC724B User's Manual- Printed Version
- G7000-50571 : Adapter N(m) to DIN(f), DC to 4GHz, 50Ω
- G7000-50572 : Adapter DIN(m) to DIN(m) , DC to 4GHz, 50Ω
- G7000-50573 : Adapter N(m) to SMA(f) , DC to 18GHz, 50Ω
- G7000-50574 : Adapter N(m) to BNC(f) , DC to 1.5GHz, 50Ω

Power Meter Accessories

- GC731A : Directional Power Sensor, 300 ~ 3800MHz, Average 0.15 ~ 150W, Peak 4 ~ 400W
- GC733A : Directional Power Sensor, 150 ~ 3500MHz, Average/Peak 0.25 ~ 20W
- GC732A : Terminating Average Power Sensor, 20 ~ 3800MHz, -30 ~ +20dBm
- GC724-50551 : Terminating Average Power Sensor, 40 ~ 3000MHz, -30 ~ 0dBm
- GC724-50552 : Terminating Peak Power Sensor, 40 ~ 4000MHz, -40 ~ 0dBm

Cable and Antenna Analyzer

innertron

GenComm

Corporate Office
14 Floor E&C Dream Tower VII,
60-44 Gasan-Dong, Kumchun-Gu,
Seoul 153-803, Korea
Tel: 82-2-6676-7070
Fax: 82-2-6676-7040
Web: www.gencomm.co.kr

Customer Support
Tel: 82-2-6676-7090
Email: support@gencomm.co.kr

Sales (Korea)
Tel: 82-2-6676-7080
Email: sales@gencomm.co.kr

International Sales/Marketing Office
1190 Saratoga Ave, Suite 180
San Jose, CA 95129, USA
Tel: 1-408-679-1002
Email: sales@gctm.net
Web: www.gctm.net

For the most recent specifications, visit www.gctm.net. Document Release. 1.3