

# SiteWizard™

# **Cable and Antenna Analyzer**

# **User Manual**





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# Introduction

### SiteWizard Overview

A large number of abnormal cell site problems are typically caused by the antenna system, cable runs or connectors. It's important to have the right instrument available when either servicing or certifying cell sites for operation. The Miniature cable and antenna analyzer SiteWizard is a lightweight portable diagnostic tool needed to accurately detect operational problems. SiteWizard has all of the measurement functions necessary to accurately verify antenna systems from VSWR to fault location. A 4.3-inch TFT touch screen allows measurements to be easily configured and displayed on the device. Its specific PC software allows users to easily document, compare, analyze measurements and generate reports. One second fast calibration technique implies saving time and efforts in field missions.

## SiteWizard Highlights

#### **Key Measurements**

- VSWR (Voltage Standing Wave Ratio)
- Return Loss
- DTF (Distance to Fault)
- Cable Loss
- Spectrum Analyzer (Optional)

#### **Key Features**

- Built-in worldwide signal standards and frequency channels database
- Superior immunity to RF interference
- Rechargeable battery
- Internal storage (1000 trace)
- External USB storage
- User friendly menu structure
- 4.3-inch TFT touch screen color display viewable in daylight

- Fast one-touch selection of menu items & positioning marker
  - Alphanumeric labeling of saved data
- Built-in cable database
- Up to 4 markers & delta markers, peak & minimum search
- Two Limit Lines.
- Up to 1024 data points per measurement
- A compact lightweight instrument



## Safety Compliances & Precautions

In order to use the SiteWizard in a correct, efficient, safe way, and to avoid damage caused by improper operations, we mandate the following:

- 1. Use only the original accessories to prevent any damage to the device.
- 2. Don't let water or other liquids flow into the device.
- 3. Prohibit approaching the device to flammable or explosive items.
- 4. Don't open the device outside company maintenance branches.
- 5. For the first time usage of the device, the battery should be charged continuously 7 hours before usage.
- Don't disassemble the parts of the instrument; it may cause instrument damage.
  Consultix doesn't take any repair responsibility for the damage or malfunction of the instrument caused by an unauthorized disassembly even during the warranty period.
- 7. Do not apply RF power more than 30 to the RF port of the instrument; that will damage the instrument.
- 8. Do not use solvents or abrasive cleaners to avoid damage to the display or the case.
- 9. Use the touch pin included in the package to avoid scratching the display screen.



# Unpacking SiteWizard

Unpack and inspect the shipping package to ensure that nothing was damaged during shipment.

If the contents are damaged or defective, contact your nearest Consultix service office or agent. Verify that all the parts were included in the shipping container as shown in *table 1*.

| SiteWizard                       |                                       |  |  |
|----------------------------------|---------------------------------------|--|--|
| Touch Pin                        |                                       | Shoulder<br>strap with<br>shock<br>absorbers |  |
| Site Auditor<br>Software         | CLL-SYLARS'S<br>CSLLSSALS'S<br>ISSUES | AC Adapter                                   |  |
| Carrying Case                    |                                       | Calibration<br>Kit<br>(Optional)             |  |
| Precision Adapters<br>(Optional) |                                       | Launch Cable<br>(Optional)                   |  |

Table 1: Packing list



# SiteWizard User Interface

Figure 1, depicts the SiteWizard user interface



Figure 1: SiteWizard User interface

- RF Port: N-Type female 50Ω connector that transmits/receives RF signal to/from DUT (Device Under Test)
  with 33 dBm maximum input power
- o DC Input: DC input port 12 V, 2 A
- USB Client: USB port for interfacing with an application SW on a PC and upgrading the instrument's firmware, if needed
- o USB Host: USB port to export/import measurement data to/from an external memory
- Power switch: Push button to power on/off the SiteWizard with one click
- o Display screen: TFT touchscreen for configuration of displaying measurements
- **Battery compartment:** Battery cover for replacing the battery, if needed, just rotate it counterclockwise and plug the battery into its socket as shown in figure 2



Figure 2: Battery replacement

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## SiteWizard Display Screen

Figure 3, depicts the SiteWizard display screen.



Figure 3: SiteWizard Display screen

- Setup information: displays setup parameters like "Trace Points", "Span", "Average", .... etc. and that depends on the measurement mode
- Measurement mode: displays the selected measurement mode
- Time/Date: indicates the system clock/date information
- Calibration Indicator: indicates the calibration status (Cal. ON/Cal. OFF) of the SiteWizard
- AC-Plug indicator: indicates if the instrument is connected to its AC/DC adapter
- Battery Indicator: indicates the battery status
- Measurement curve: displays the current measurement curve, users can add markers & limit lines, adjust scale and so on
- Trace information: displays the current active traces and captured traces as well
- Marker information: displays the marker values; frequency (in MHz), amplitude (in dB), and distance (in m or ft)
- Main Menu key: a shortcut button to jump to the main menu when touched
- Show/Hide key: shows/hides the current pop-up menu
- Activity status: displays running operations like file saving, error messages...etc



## Figure 4, depicts the SiteWizard display screen in the spectrum analyzer mode



Figure 4: SiteWizard Display screen (Spectrum Analyzer Option)

- Measurement curve: displays the current measurement curve, users can add markers & limit lines, adjust scale and so on.
- Show/Hide key: shows/hides the menu to enable viewing full-screen measurements.
- Main Menu key: a shortcut button to jump to the main menu when touched.
- Marker information: displays the marker values; frequency (in MHz), and amplitude (in dBm).
- Setup information: displays current configuration parameters like reference amplitude level "Ref. Lev.", reference attenuation offset "Offset", sweep time "SWP", and resolution bandwidth "RBW".
- Battery Indicator: indicates the battery status.
- AC-Plug indicator: indicates if the instrument is connected to its AC/DC adapter.
- Time/Date: indicates the system clock/date information.



### SiteWizard Menus

#### Cable and Antenna Analyzer

Always, user can jump to the "Main Menu" by clicking "Main Menu" button at any time. SiteWizard Main Menu is depicted in *figure 5* 



Figure 5: SiteWizard Main Menu

Mode: switches between 5 measurement modes provided by the SiteWizard as depicted in *figure 6* 

| Consultix MTM <sup>4</sup>  | 127          |     |       | 12:00:3<br>2015/12 | 7 Cal. ON<br>/17 Cal. ON |       |
|---|--------------|-----|-------|--------------------|--------------------------|-------|
| VSWR VSWR   | -1.20        |     |       | 1                  |                          |       |
|   | -2.40        |     |       | · ·                |                          |       |
| VSWR RTLS   | -3.60        |     |       |                    |                          |       |
|   | -4.80        |     |       |                    |                          |       |
| DTF RTLS  | -6.00        |     |       |                    |                          |       |
|   | -7.20        |     |       |                    |                          |       |
| DIFVSWR   | -8.40        |     |       |                    |                          |       |
| Cable Loss  | -9.60        |     |       |                    |                          |       |
|   | -10.80       |     |       | - hì               |                          |       |
| < <back< th=""><th>-12.00</th><th></th><th></th><th></th><th></th><th></th></back<> | -12.00       |     |       |                    |                          |       |
|   | 0.00         |     | Dista | ance ( Meter )     | T4                       | 10.00 |
| (Mode)<br>Hide  | Main<br>Menu | M3: |       | M4:                | T2                       | :     |

Figure 6: SiteWizard Mode Menu

Measurements: configures the measurement parameters; like Frequency, Amplitude, and Distance, and in addition to setting and customizing markers. *Figure 7*, depicts the "Measurements" menu in the two main modes (VSWR & DTF).



Figure 7: SiteWizard Measurements Menu

**Frequency:** configures customized frequency band either setting "Start Frequency" & "Stop Frequency" or setting "Center Frequency" & "Span" and other parameters depending on the selected mode (VSWR or DTF) As shown in *figure 8 & 9* respectively.



| Consultix MTM  | 127              | VSWR -             | Return                 | Loss             | 11:38:51<br>2015/12/1 | Cal.                   | ON                      |              | Consultix MTN   | 427              | VSWR               | - Return | Loss   | 11:39:00<br>2015/12/17 | Cal. O | v [                       | ]  |
|--|------------------|--------------------|------------------------|------------------|-----------------------|------------------------|-------------------------|--------------|-----------------|------------------|--------------------|----------|--------|------------------------|--------|---------------------------|----|
| Start Frequency  | -6.00<br>-12.00  |                    |                        |                  |                       | 1 v <sup>2</sup>       | -                       | ¥            | ОК              | -6.00            |                    | Center   | Freque | ncy                    |        | . <del>v</del>            |    |
| Stop Frequency   | -18.00           |                    |                        |                  |                       |                        | ¥⁄                      | $\mathbb{N}$ | Clear           | -18.00           |                    |          | 204    | 5 00                   |        |                           | ļ  |
| Center Freq.   | -30.00           |                    |                        |                  |                       | *:                     | 1                       | 1            | BackSpace       | -24.00           |                    |          | 204    | 5.00                   |        | 1<br>1                    |    |
| Span   | -36.00<br>-42.00 |                    |                        |                  |                       |                        |                         | 1            |                 | -36.00<br>-42.00 | _                  | 7        | 8      | 9                      | 0      |                           |    |
| Band List  | -48.00<br>-54.00 |                    |                        |                  |                       | - i - i<br>- i - i     | 1                       | 1            |                 | -48.00           |                    | 1        | 5      | 6                      |        |                           |    |
| < <back< th=""><th>-60.00</th><th></th><th></th><th>2045</th><th>5.00</th><th></th><th>1</th><th>'<br/>2170.00</th><th>Return</th><th>-60.00</th><th></th><th>4</th><th>5</th><th>0</th><th>•</th><th>2170.0</th><th>10</th></back<> | -60.00           |                    |                        | 2045             | 5.00                  |                        | 1                       | '<br>2170.00 | Return          | -60.00           |                    | 4        | 5      | 0                      | •      | 2170.0                    | 10 |
| (Frequency)<br>Hide  | Main<br>Menu     | M1:2092<br>M3:2119 | 82M/-28.0<br>21M/-18.0 | 8d8 M2<br>8d8 M4 | 2105.36N<br>2141.64N  | 4/-11.4dB<br>4/-10.0dB | T1 : Cu<br>T2 :<br>T3 : | urrent       | (Input)<br>Hide | Main<br>Menu     | M1:2092<br>M3:2119 | 1        | 2      | 3                      | -      | 1 : Current<br>2 :<br>3 : |    |

Figure 8: SiteWizard Frequency Menu in "VSWR" mode

| Consultix MTM   | Itix MTM427 DTF - VSWR |            | WR            | 12:05:47<br>2015/12/17 Cal. |          | Cal. O  | Cal. ON  |  | Consultix MTN | 427   | DTF - V | SWR             | 2            | 12:06:03<br>2015/12/17 | Cal. O  | v [     |      |   |          |
|---|------------------------|------------|---------------|-----------------------------|----------|---------|----------|--|---------------|-------|---------|-----------------|--------------|------------------------|---------|---------|------|---|----------|
| Start Frequency   | 1.90                   |            |               |                             |          |         | 1        |  |               |       |         | ОК              | 1.90         |                        | Stop Fi | requenc | y .  | • | <u> </u> |
| Stop Frequency  | 1.70                   |            |               |                             |          |         |          |  |               |       |         | Clear           | 1.70         |                        |         |         |      |   |          |
| Band List   | 1.60                   |            |               |                             |          |         | ,1       |  |               |       |         | BackSpace       | 1.60         |                        |         | 217     | 0.00 |   |          |
| Cable List  | 1.40                   |            |               |                             | Pa       | ISS     |          |  |               |       |         |                 | 1.40         |                        |         |         |      | 0 |          |
|   | 1.30                   |            |               |                             |          | Ŧ       | $\vdash$ |  | -             |       |         |                 | 1.30         |                        | - (     | 8       | 9    | 0 |          |
| DTF Setting   | 1.10                   |            |               |                             |          | f       |          |  |               |       |         |                 | 1.10         |                        | 4       | 5       | 6    |   |          |
| < <back< th=""><th>1.09/<br/>0.00</th><th></th><th></th><th>1</th><th>Distance</th><th>( Mete</th><th>er)</th><th></th><th>T1 - Cur</th><th>10.00</th><th></th><th>Return</th><th>1.00</th><th></th><th>4</th><th>_</th><th>_</th><th></th><th>10.00</th></back<> | 1.09/<br>0.00          |            |               | 1                           | Distance | ( Mete  | er)      |  | T1 - Cur      | 10.00 |         | Return          | 1.00         |                        | 4       | _       | _    |   | 10.00    |
| (Frequency)<br>Hide   | Mai<br>Men             | n M<br>U M | 1:5.94m<br>3: |                             | Ma<br>Ma | a<br>k: |          |  | T2:<br>T3:    | rent. |         | (Input)<br>Hide | Main<br>Menu | M1:5.94<br>M3:         | 1       | 2       | 3    | - | 2:<br>3: |

Figure 9: SiteWizard Frequency Menu in "DTF" mode

In "DTF" mode, there are relevant sub-bands; users can sweep through each sub-band, but they can't sweep from sub-band to another as depicted below,



Users can choose from ready-configured standard bands by clicking "Band List" and selecting the required band as depicted in *figure 10* below,

| Consultix MTM4      | 27 DTF - VSWR 2             | 12:06:41 Cal. ON [ |
|---------------------|-----------------------------|--------------------|
| Ealast              | 1.90                        |                    |
| Select              | 1.81 Band Name              | Frequency (MHz)    |
|                     | 1 ZI DMP                    | 2592.50 - 2692.50  |
|                     | GSM 900 UP                  | 880 - 915          |
|                     | 1.69 GSM 900 DOWN           | 925 - 960          |
|                     | 1.50GSM 900 FULL            | 880 - 960          |
|                     | 1.44 IEEE 802.11 FH         | 2402 - 2495        |
| Page Up             | IEEE 802.11 DS              | 2412 - 2484        |
|                     | 1.3 IEEE 802.11b/g          | 2400 - 2484        |
| Dago Down           | 1.20 IMT 2000 UMTS WCDMA UP | 1920 - 1980        |
| Page Down           | IMT 2000 UMTS WCDMA DOWN    | 2110 - 2170        |
|                     | IMT 2000 UMTS WCDMA FULL    | 1920 - 2170        |
| Cancel              |                             |                    |
| (Dage 411-1)        | M1-5 94m/1 512 M2           | T1 : Current       |
| (Band List)<br>Hide | Menu M3: M4:                | T2:<br>T3:         |

Figure 10: SiteWizard Band List

In "DTF" mode, users can choose from ready-configured cable types by clicking "Cable List" and configure the DTF required settings (i.e. Velocity, Cable Loss, distance Unit, and windowing) as depicted in *figure 11 & 12* below,



| Consultix MTM4 | 427 DTF - VSW             |           | 12:07:13<br>2015/12/17 | al. ON 🛛 🚺 |
|----------------|---------------------------|-----------|------------------------|------------|
| C-11           | 1.90                      |           |                        |            |
| Select         | 1.80 Cable Name           | Velocity  | Loss @1GHZ             | Loss @2GHZ |
|                | RFF 7/8' -50 GHF          | 0.84      | 0.052                  | 0.078      |
|                | RG142                     | 0.659     | 0.443                  | -          |
|                | <sup>1.60</sup> RG17, 17A | 0.659     | 0.18                   | -          |
|                | 1.5(RG174                 | 0.66      | 1.115                  | -          |
|                | RG178B                    | 0.695     | 1.509                  | -          |
| Page Up        | RG188                     | 0.659     | 1.017                  | -          |
|                | 1.30 RG213                | 0.659     | 0.292                  | -          |
| Dama Dawa      | 1.2(RG214                 | 0.659     | 0.262                  | -          |
| Page Down      | 1,11 RG223                | 0.659     | 0.476                  | -          |
|                | RG55, 55A, 55B            | 0.659     | 0.541                  | -          |
| Cancel         | 1.00                      |           |                        |            |
|                | 0.00 M1-5 04m/1           | Distance  | ( Meter )              | 10.00      |
| (Cable List)   | Main                      | JIC 1-12. |                        | T2:        |
| Hide           | Menu M3:                  | M4:       | 1                      | T3 :       |

Figure 11: SiteWizard Cable List

| Consultix MTM | 427  |          |          | 2   | 12:08:11<br>015/12/17 |    |           | Consultix MT | M427      |                             | 12:08:18<br>2015/12/13 | Cal. ON |         |
|---------------|------|----------|----------|-----|-----------------------|----|-----------|--------------|-----------|-----------------------------|------------------------|---------|---------|
| Apply         | 4.60 |          |          |     | •                     |    |           | Select       | 4.60      |                             |                        |         |         |
|               | 4.20 |          |          |     |                       |    |           |              | 4.2( Will | i <b>dowing</b><br>:angular | _                      |         | - 2     |
| Velocity      | 3.40 |          |          |     |                       |    |           |              | - 3.4     | kman                        |                        |         |         |
| Cable Loss    | 3.00 |          |          |     | 1                     |    |           |              | 3.04      |                             |                        |         |         |
| Unit          | 2.60 |          |          | Fai | Ľ.                    |    |           |              | 2.60      |                             |                        |         |         |
| (Meter) Feet  | 2.20 |          |          |     | _Å                    |    |           |              | 2.20      |                             |                        |         |         |
| Rectangular   | 1.40 |          |          |     |                       |    |           |              |           |                             |                        |         |         |
| Return        | 1.09 |          | <b>-</b> |     |                       |    |           | Return       | 1.00      |                             |                        | _       |         |
| (DTF Setting) | Main | M1:5.94m | /2.614   | M2: | weter (               | 11 | : Current | (Select)     | Main      | M1:5.94m/2.613              | M2:                    | T1:0    | Current |
| Hide          | Menu | M3:      |          | M4: |                       | T  | 3:        | Hide         | Menu      | M3:                         | M4:                    | T3:-    |         |

Figure 12: SiteWizard DTF Setting Menu

In "DTF Setting" Menu, user must click "Apply" key after any configuration or a value entered for Velocity, Cable Loss, etc.

Amplitude: customizes curve profile by setting "Max (TOP)", "Min (BOTTOM)", "Auto Scale" ...extra. and adds limit lines as shown in *figure 13*.

| Consultix MTM  | ix MTM427 VSWR - Return Loss 11:39:43 Cal. ON |                    |             |  |                          |                           | Consultix MTM   | 427 VSWI                 | R - Return        | Loss - | 11:39:53<br>2015/12/17 | Cal. O | N (                       |
|--|---|--------------------|-------------|--|--------------------------|---------------------------|-----------------|--------------------------|-------------------|--------|------------------------|--------|---------------------------|
| Max (TOP)  | -3.42   |                    | عصر فعطر    |  |                          |                           | ОК              | -3.42                    | Min Ar            | np     |                        |        | <u> </u>                  |
| Min (BOTTOM)   | -6.83   |                    |             |  | $\checkmark$             | <b>V</b>                  | Clear           | -10.25                   |                   |        |                        |        | <b>V</b>                  |
| Limit Line   | -13.67  |                    |             |  | $\mathbf{H}$             | $\land$                   | BackSpace       | -13.67                   |                   | -34    | .17                    |        | $\langle A \rangle$       |
| Auto Casla   | -20.50  |                    |             |  |                          |                           |                 | -20.50                   |                   |        |                        |        | /∖                        |
| Auto Scale   | -23.92  |                    |             |  |                          |                           |                 | -23.92                   |                   | 8      | 9                      | 0      |                           |
|  | -30.75  |                    |             |  |                          |                           |                 | -30.75                   | 4                 | 5      | 6                      |        |                           |
| < <back< th=""><th>-34.17<br/>1920.00</th><th></th><th>20</th><th>)45.00</th><th></th><th>'<br/>2170.00</th><th>Return</th><th>-34.17</th><th>· ·</th><th>L.</th><th>-</th><th></th><th>2170.00</th></back<> | -34.17<br>1920.00                             |                    | 20          | )45.00                                     |                          | '<br>2170.00              | Return          | -34.17                   | · ·               | L.     | -                      |        | 2170.00                   |
| (Amplitude)<br>Hide  | Main<br>Menu                                  | M1:2092<br>M3:2119 | 82M/-28.7dB | <b>12:</b> 2105.36M<br><b>14:</b> 2141.64M | /-11.3dB T<br>/-10.0dB T | 1 : Current<br>2 :<br>3 : | (Input)<br>Hide | Main M1:20<br>Menu M3:21 | 92 <b>1</b><br>19 | 2      | 3                      | -      | 1 : Current<br>2 :<br>3 : |

Figure 13: SiteWizard Amplitude Menu



Distance: enters the cable length estimated to measure its DTF as shown in *figure 14*.

| Consultix MTM   | 427 DTF - R                      |         |        | 05:02:53<br>2015/12/19 |   |                        |                |
|-----------------|----------------------------------|---------|--------|------------------------|---|------------------------|----------------|
| ок              | -2.00                            | Distanc | :e (m) | 1                      |   | Í                      | 1              |
| Clear           | -6.00                            |         | 1      | 50                     |   |                        | ¥ <sup>1</sup> |
| BackSpace       | -10.00                           |         |        |                        |   |                        |                |
|                 | -12.00                           | 7       | 8      | 9                      | 0 | $\vdash$               |                |
| Return          | -16.00<br>-18.00<br>-20.00       | 4       | 5      | 6                      |   |                        | 1<br>1         |
| (Input)<br>Hide | 0.00<br>Main M1:5.62<br>Menu M3: | 1       | 2      | 3                      | - | 1 : Curr<br>2 :<br>3 : | 6.00<br>ent    |

Figure 14: Setting distance

Marker: adds and edits markers (up to 4 markers) and changes the marker type between "Normal" and "Delta" markers as shown in *figure 15*.



Figure 15: SiteWizard Marker Menu

Peak: moves through the measurement curve smoothly through using "Peak" soft key as shown in *figure* **16**.

| Consultix MTM   | 427          | VSWR           | - VSWR |              | 05:1 <sup>-</sup><br>2015/ | l:14<br>12/19 | Cal. ON    |                       |          |
|---|--------------|----------------|--------|--------------|----------------------------|---------------|------------|-----------------------|----------|
| Peak Right  | 4.60         |                |        |              | 1                          |               |            |                       | 1        |
| T Cuk Right   | 4.20         |                |        | 1            | 1                          |               |            |                       | 1        |
| Peak Left   | 3.80         |                |        |              |                            |               |            |                       |          |
| -   | 3.40         |                |        | - 1          |                            |               |            |                       |          |
| Max Search  | 3.00         |                |        |              | 1                          |               |            |                       | 1        |
|   | 2.60         |                |        |              | 1                          |               |            |                       |          |
| Min Search  | 2.20         |                |        |              |                            |               |            |                       |          |
|   | 1.80         |                |        |              | 14                         |               | 1          | $\overline{}$         |          |
|   | 1.40         |                |        |              |                            |               |            |                       | 3        |
| < <back< th=""><th>1.00</th><th></th><th></th><th></th><th>V</th><th><math>\sim</math></th><th></th><th></th><th><math>\nabla</math></th></back<> | 1.00         |                |        |              | V                          | $\sim$        |            |                       | $\nabla$ |
|   | 1710.00      |                |        | 179          | 5.00                       |               | -          |                       | 1880.00  |
| (Peak)<br>Hide  | Main<br>Menu | M1:1800<br>M3: |        | :38 M;<br>M( | 2:1868.<br>4:              |               | 1.127<br>T | 1 : Cun<br>2 :<br>3 : |          |

Figure 16: SiteWizard Peak Menu



Trace: adds traces by clicking "Next" from the "Measurements" and customizes up to 3 traces by clicking "Trace" key as shown in *figure 17.* 

| Consultix MTM  | 427              | VSWR - Return Loss                             | 16:20:17<br>2015/12/16                 | Cal. ON AC   | Consultix MTM4   | 27 V             | SWR - Return                       | n Loss 💡               | 16:21:05<br>015/12/16       | Cal. ON                  | AC [[                         |                      |
|--|------------------|--|--|--|--|------------------|------------------------------------|------------------------|-----------------------------|--------------------------|-------------------------------|----------------------|
| Trace  | -2.51            |  |  |  | Trace Select<br>[T3]   | -2.51            |                                    |                        |                             |                          |                               |                      |
| Tracepoints  | -5.02            |  |  |  | Trace Capture  | -5.02            |                                    |                        |                             | $\wedge$                 |                               | $\sum$               |
|  | -10.03<br>-12.54 |  | $\vdash$                               | $\gamma / \gamma $                                   | Trace View   | -10.03<br>-12.54 |                                    |                        |                             | $\land \lor$             | ~                             | $\frac{1}{\sqrt{2}}$ |
|  | -15.05           |  | I III III                              | V Y  | Clear Write  | -15.05           |                                    |                        |                             | ΞY                       |                               |                      |
|  | -20.07           |  |  |  | Next>>   | -20.07           |                                    |                        |                             |                          |                               | V                    |
| < <back< th=""><th>-25.08</th><th>20</th><th>45.00</th><th>2170.00</th><th>&lt;<back< th=""><th>-25.08</th><th></th><th>2045.0</th><th>0</th><th></th><th>21</th><th>70.00</th></back<></th></back<> | -25.08           | 20   | 45.00                                  | 2170.00  | < <back< th=""><th>-25.08</th><th></th><th>2045.0</th><th>0</th><th></th><th>21</th><th>70.00</th></back<> | -25.08           |                                    | 2045.0                 | 0                           |                          | 21                            | 70.00                |
| (Measurements)<br>Hide   | Main<br>Menu     | M1:2092.82M/-20.0dB M<br>M3:2165.38M/-19.8dB M | 12:2119.87M/-15.0<br>14:2084.91M/-5.51 | IdB T1 : Capture<br>T2 : Capture<br>IdB T3 : Current | (Trace)<br>Hide  | Main<br>Menu     | 11:2092.82M/-19<br>13:2165.38M/-19 | .6dB M2:2<br>.3dB M4:2 | 119.87M/-15<br>084.91M/-5.: | .1d8 T1<br>T2<br>37d8 T3 | I:Captu<br>2:Captu<br>3:Curre | re<br>re<br>nt       |

Figure 17: SiteWizard Trace Menu

Trace Points: chooses the curve adequate number of "Trace Points" by clicking "Next" from the "Trace" menu as shown in *figure 18.* 

| Consultix MTM4  | 27           | VSWR -                 | Return | Loss                              | 16:2:<br>2015/                     | 3:51<br>12/16 | Cal. ON          | AC                     |                  |
|---|--------------|------------------------|--------|-----------------------------------|------------------------------------|---------------|------------------|------------------------|------------------|
| 128   | -2.51        |                        |        |                                   |                                    | <b>`</b>      |                  | 1                      | 1                |
| 120   | -5.02        |                        |        |                                   |                                    | _ \ '         |                  | 1                      | 1                |
| 256   | -7.53        |                        |        |                                   |                                    | _\!           |                  | - ¥                    | ļ                |
|   | -10.03       |                        |        |                                   |                                    | <u> </u> 1    | $\wedge$         | - jin                  |                  |
| 512   | -12.54       |                        |        |                                   |                                    | · ·           | $( \land )$      | 2/ •                   | $\sum_{i=1}^{n}$ |
| 1001  | -15.05       |                        |        |                                   |                                    |               |                  |                        | <u>\'</u>        |
| 1024  | -17.56       |                        |        |                                   |                                    |               |                  |                        | - V              |
|   | -20.07       |                        |        |                                   |                                    |               |                  |                        | V                |
|   | -22.58       |                        |        |                                   |                                    |               |                  | 1                      | 1                |
| < <back< th=""><th>-25.08</th><th></th><th></th><th></th><th></th><th>1</th><th></th><th>1</th><th>1</th></back<> | -25.08       |                        |        |                                   |                                    | 1             |                  | 1                      | 1                |
| - iburn   | 1920.00      |                        |        | 204                               | 5.00                               |               |                  | 2                      | 170.00           |
| (Trace Point)<br>Hide   | Main<br>Menu | M1:2091.1<br>M3:2137.1 |        | .5d8 <b>M</b> 2<br>9d8 <b>M</b> 4 | <b>2:</b> 2119.<br><b>4:</b> 2162. |               | i.8dB<br>i.9dB T | 1 : Curr<br>2 :<br>3 : |                  |

Figure 18: SiteWizard Trace Points

System: configures SiteWizard settings; like "Date/Time", "Beep"," Pass Ind.", and "Factory Reset", also user can view device information. As shown in **figure 19**.

| Consultix MTM4  | 27 System                        | 16:25:38<br>2015/12/16 | AC [         |
|---|----------------------------------|------------------------|--------------|
| Date/Time   | Firmware Version :               | Batterv Volt           | age: 8,491   |
| Factory Reset   | UI : 2.6.0.1684<br>RF : 6.2.1620 | Battery Cum            | ent : 0.0010 |
| Beep<br>[ON]  | Hardware Version :               | Battery Leve           | I : 100 %    |
| Pass Ind.<br>[ON]   | RF : V.2                         | Keypad Bee             | p:ON         |
|   | Model : MTM427                   | Cal.Kit :              | 533864       |
| < <back< th=""><th>Serial Number : C11510MTM</th><th>1427D22003</th><th></th></back<> | Serial Number : C11510MTM        | 1427D22003             |              |
| (System)<br>Hide  |                                  |                        |              |

Figure 19: SiteWizard System Menu



Calibration: calibrates the SiteWizard before starting your measurements by clicking "Calibration" key from the "Main Menu". as shown in *figure 20.* 



Figure 20: SiteWizard Calibration Menu

File: saves/loads screenshots or traces to/from internal/external memory.

Save: saves measurements either as .bmp images or .csv traces as shown in *figure 21* 



Figure 21: SiteWizard Save Menu

Load: Loads measurements from the internal memory or from external flash memory as shown in *figure 22* 



Figure 22: SiteWizard Save Menu

Users can copy their measurements (traces or images) from the internal memory to an external flash memory after loading it by using "File Management"



Shortcuts: allows user to execute all common functions fast by using "Shortcuts" menu as shown in *figure* 23.



Figure 23: SiteWizard Shortcuts Menu



## Spectrum Analyzer Mode (Not supported by all models)

go to "Main Menu" > Mode > "Spectrum Analyzer", below are the menus of the spectrum analyzer mode

#### Presetting the spectrum analyzer

On **Main Menu > Shortcuts**, press "**Reset**" button to restore current configurations to a default state as shown in figure 24.



Figure 24: Spectrum Analyzer Configuration Resetting



#### Frequency Settings

On **Main Menu > Measurements > Frequency**, the user can configure measurement frequencies in two ways; either using **"Start Frequency**" & **"Stop Frequency**" or using **"Center Freq."** & **"Span**" as shown in figure 25.



Figure 25: SiteWizards Frequency Menu

For quick frequency configuration, the user can select a frequency band from the ready-made band list made according to the frequency band standard as shown in figure 26.

|               | Consultix MTM- | 427       | Spec        | trum An   | alyzer  | 22:29:0<br>2016/02 | 16<br><i>1</i> 07 | A(        |         |
|---------------|----------------|-----------|-------------|-----------|---------|--------------------|-------------------|-----------|---------|
|               | Select         | Band Na   | ame         |           |         | Frequ              | iency (Mł         | łz)       |         |
|               |                | DMP       |             |           |         | 2592.              | 50 - 2692.        | 50        |         |
|               | 5              | GSM 900   | UP          |           |         | 8                  | 80 - 915          |           |         |
| Press to sele | ect a          | GSM 900   | DOWN        |           |         | 9                  | 25 - 960          |           |         |
| frequency h   | and            | GSM 900   | FULL        |           |         | 8                  | 80 - 960          |           |         |
| in equency b  |                | IEEE 802. | 11 FH       |           |         | 24                 | 02 - 2495         |           |         |
|               |                | IEEE 802. | .11 DS      |           |         | 24                 | 12 - 2484         |           |         |
|               | Page Up        | IEEE 802. | .11b/g      |           |         | 24                 | 00 - 2484         |           |         |
|               |                | IMT 2000  | UMTS WO     | CDMA UP   |         | 19                 | 20 - 1980         |           |         |
|               | Dage Down      | IMT 2000  | UMTS WO     | CDMA DOV  | VN      | 21                 | 10 - 2170         |           | A. JA   |
|               | Page Down      | IMT 2000  | UMTS WO     | CDMA FULI | -       | 19                 | 20 - 2170         |           | W 1     |
|               | Cancel         |           |             |           |         | 1                  |                   |           |         |
|               |                | 50.00 (   | Offset :0.0 | 0 1970    | 0.00 SM | P : 924 ms         | RB\               | N : 100 K | 1980.00 |
|               | (Band List)    | Main      | M1: 19      |           |         | dBm M2:            |                   |           |         |
|               | Hide           | Menu      | M3:         |           |         | M4:                |                   |           |         |

Figure 26: SiteWizard Frequency Band List



#### Amplitude Settings

On **Main Menu > Measurements > Amplitude**, you can adjust scale settings according to the received signal level through using "**Max (TOP)**", "**Min (BOTTOM)**", and setting a "**Ref. Offset**" as shown in figure 27.



Figure 27: Spectrum Analyzer Amplitude Menu

#### Resolution Bandwidth Selections

On **Main Menu > Measurements > RBW**, select the suitable resolution bandwidth (RBW) for your displayed graph (I.e. select a wide RBW for modulated signals regarding its sidebands) as shown in figure 28.



Figure 28: Spectrum Analyzer RBW selection Menu



#### **Capturing Traces**

On Main Menu > Measurements > Trace, you can control three traces; select, capture, Max. Hold, Min.

Hold, and delete traces as shown in figure 29 & 30



Figure 29: Spectrum Analyzer Trace Menu



Figure 30: Spectrum Analyzer Trace Menu – Maximum & Minimum hold



#### Setting Limit Lines

On Main **Menu > Measurements > Amplitude > Limit Line**, set two limit lines to monitor if the signal exceeds certain limits as shown in figure 31.



Figure 31: SiteWizard Limit Lines

With limit line capability, on **Main Menu > System > Next**, the user can enable the Pass/Fail indication of the current signal level by switching on "**Pass Ind**." Button at the system menu.

#### Markers

On **Main Menu > Measurements > Next > Marker**, you can set, edit, and clear up to 4 markers (& Delta Marker) as shown in figure 32 & 33.



Figure 32: SiteWizard Marker Menu

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|                 | Consultix MTM-4 | 27                 | Spe    | ectrum # | Analyzei | 23:0<br>2016/ | 7:08<br>02 <i>1</i> 07                | AC [  |
|-----------------|-----------------|--------------------|--------|----------|----------|---------------|---------------------------------------|---|
|                 | ок –            |                    | Marker | Edit     | Freq.    | (MHz)         |                                       |   |
|                 | Clear           |                    |        | 246      | 0 06     |               |                                       | <sup>2</sup><br>★ 4   |
|                 | BackSpace       |                    | ſ      | 240      | 0.00     |               |                                       |   |
| Set Marker      |                 | 1                  | 7      | 8        | 9        | 0             | mm                                    | - and Malighan  |
| frequency (MHz) | Return          |                    | 4      | 5        | 6        |               |                                       |   |
|                 | (Input)<br>Hide | 0.00<br>Mai<br>Mer | 1      | 2        | 3        | -             | ms RBW<br>2.92 MHz / -<br>2479.58 MH: | : <mark>100 K  2482.00</mark><br>12.1 dBm<br>2 / -81.59 dBm |

Figure 33: SiteWizard - Marker editing

On **Main Menu > Measurements > Next > Peak**, you can set a marker to the peak value, to the maximum search point or to the minimum search point on your current trace as shown in figure 34.

| Consultix MTM  | 427          | Spec             | trum An                | alyzer                    | 23:08:<br>2016/02  | 44<br>2/07 | Â                       |                |
|--|--------------|------------------|------------------------|---------------------------|--------------------|------------|-------------------------|----------------|
| Peak Right   |              |                  | ı<br>ı                 |                           |                    |            |                         | 1 I            |
| Peak Left  |              |                  | 3                      |                           |                    |            |                         | 2              |
| Max Search   |              |                  |                        |                           |                    |            |                         |                |
| Min Search   | A.A          | An AR            | 10 miles               | К. А.                     | in him             |            | لم يا له                | hille.         |
|  | 101-101      | Abres A          |                        | V 7 **                    |                    |            |                         |                |
| < <back< th=""><th>50.00</th><th>Offset :0.</th><th>'<br/>'<br/>00 246</th><th>2.00 SW</th><th>Р:1844 m</th><th>IS RE</th><th>3VV : 100 k</th><th>2482.00</th></back<> | 50.00        | Offset :0.       | '<br>'<br>00 246       | 2.00 SW                   | Р:1844 m           | IS RE      | 3VV : 100 k             | 2482.00        |
| (Peak)<br>Hide   | Main<br>Menu | M1: 24<br>M3: 24 | 81.50 MHz<br>58.20 MHz | :   -104.61<br>:   -76.77 | dBm D2:<br>dBm M4: | -3.67 MF   | lz / 28.63<br>MHz / -81 | dBm<br>.59.dBm |

Figure 34: SiteWizard Peak Menu



#### Shortcuts

On **Main Menu > Shortcuts**, users can do the common functions; like setting markers & traces, holding measurement, and resetting the current configuration as shown in figure 35.



Figure 35: Spectrum Analyzer Shortcuts Menu



# Prepare for your test

## SiteWizard Calibration

Before starting your measurements, user has to calibrate the unit as per the following steps,

- Attach the launch cable to the SiteWizard RF port. (Alternatively, user can mount the SiteWizard directly to test port using an appropriate adapter)
- 2. Main Menu > Mode, select your measurement mode (VSWR, Return Loss...etc.)
- 3. Main Menu > Measurements > Frequency > Band List, select the required band, and click "Select" key
- 4. **Main Menu**, click **"Calibration**" key to start the calibration process, then pop-up menus will appear to confirm each step.
- Connect the OPEN port of the N-Type cal. Kit to the other end terminal of the launch cable and click "Continue" key.

"Open Calibration in progress" message appears

- Connect the SHORT port of the N-Type cal. Kit and click "Continue".
  "Short Calibration in progress" message appears
- Connect the LOAD port of the N-Type cal. Kit and click "Continue".
  "Load Calibration in progress" message appears
- 8. Upon accomplishing calibration, the "Calibration Indicator" status will be changed from Cal. OFF to Cal. ON

Figure 36, depicts the calibration process



Figure 36: SiteWizard Calibration Process



# **Test Scenarios**

## **VSWR Measurements**

After calibrating the SiteWizard, now the unit is ready for real-time VSWR or DTF measurements. The user has to take the following points into consideration,

- After calibration, do not change or modify the connection of the launch cable or the frequency settings; that will result in measurement errors, otherwise, you have to recalibrate the unit
- Do not connect the unit to the DUT (Antenna, cable...etc.) when there is a risk of lightning. It may cause a malfunction or damage the unit

#### Measurement

1. After calibration, connect the other terminal of the launch cable to the DUT (Device Under Test) port such as an antenna, RF cables...etc. As shown in *figure 37.* 



Figure 37: SiteWizard VSWR Measurements

- 2. Main Menu > Mode, select your measurement mode either "VSWR" or "RL"
- 3. VSWR curve appears on the display screen as shown in *figure 38*

| Consultix MTM4                     | 27      |        |        |        |          | 10:3 <sup>,</sup><br>2015/ | 1:37<br>12/17 |        | AC       |                |
|------------------------------------|---------|--------|--------|--------|----------|----------------------------|---------------|--------|----------|----------------|
| Points : 256<br>Spep : 250,00, MHz | -6.00   |        |        |        |          |                            |               |        |          |                |
| Average :                          | -12.00  |        |        | $\sim$ | $ \sim $ | 5                          | ~             | ~      |          | ~              |
| -12.4<br>Band :                    | -18.00  | $\sim$ | $\sim$ | γV     | V        | $\nabla$                   | $\nabla$      | $\sim$ | $\sim$   |                |
| IMT 2000 UMTS                      | -24.00  |        |        |        |          |                            |               |        |          |                |
| VVCDWA FOLL                        | -30.00  |        |        |        |          |                            |               |        |          |                |
|                                    | -36.00  |        |        |        |          |                            |               |        |          |                |
|                                    | -42.00  |        |        |        |          |                            |               |        |          |                |
|                                    | -48.00  |        |        |        |          |                            |               |        |          |                |
|                                    | -54.00  |        |        |        |          |                            |               |        |          |                |
|                                    | -60.00  |        |        |        |          |                            |               |        |          |                |
| Cham                               | 1920.00 | M      | :      |        | 204<br>M | 5.00<br>2:                 |               | T      | 1 : Curr | 2170.00<br>ent |
| Main Menu                          | Menu    | M      | 3:     |        | M        | 4:                         |               | 1      | 2:       |                |

Figure 38: SiteWizard VSWR Curve



4. Main Menu > Shortcuts, click "Auto Scale" for adjusting curve appearance as shown in *figure 39* 



Figure 39 SiteWizard VSWR Curve

5. Main Menu > Measurements > Amplitude, click "Limit Line" key to open "Limit Line" menu, add up to two limit lines, and define their levels - out of these limits, measurements are not accepted and marked in red as shown in *figure 40*.



Figure 40: SiteWizard Limit Line

On "Main Menu" click "System" key and click "Pass Ind." On or Off to show either the measurements are "Pass" or "Fail" according to the limit lines levels as shown in *Figure 41*.



Figure 41: SiteWizard Limit Line in two VSWR modes

During site acceptance process, the SiteWizard field engineer may accept or decline the DUT performance according to the defined limit levels, these levels defer from vendor to others.



#### **DTF Measurements**

- 1. After calibration, connect the other terminal of the launch cable to the DUT (Device Under Test) port such as an antenna, RF cables...etc. As shown in *figure 36* above.
- 2. Main Menu > Mode, select your measurement mode either "DTF RTLS" or "DTF VSWR"
- Main Menu > Measurements > Distance, enter the length of the line system (DUT) as shown in figure 42



Figure 42: Distance setting

4. Main Menu > Measurements > Frequency, click "Cable List" and choose your cable type as shown in *figure 43* 

| Consultix MTM4 | 27 DTF - Retu        | rn Loss  | 10:39:59<br>2015/12/17 C | al. ON 🛛 AC 🚺 |
|----------------|----------------------|----------|--------------------------|---------------|
| Foloct         | -6.00                |          |                          |               |
| Selecc         | -12, Cable Name      | Velocity | Loss @1GHZ               | Loss @2GHZ    |
|                | -18 RG142            | 0.659    | 0.443                    | -             |
|                | RG17, 17A            | 0.659    | 0.18                     | -             |
|                | <sup>-24</sup> RG174 | 0.66     | 1.115                    | -             |
|                | 480.RG178B           | 0.695    | 1.509                    | -             |
|                | RG188                | 0.659    | 1.017                    | -             |
| Page Up        | RG213                | 0.659    | 0.292                    | -             |
|                | -42. RG214           | 0.659    | 0.262                    | -             |
| Dana Dawa      | -48.RG223            | 0.659    | 0.476                    | -             |
| Page Down      | –54 RG55, 55A, 55B   | 0.659    | 0.541                    | -             |
|                | 347                  |          |                          | *****         |
| Cancel         | -60.00               |          |                          |               |
|                | 0.00                 | Distance | (Meter)                  | T1 : Current  |
| (Cable List)   | Main                 | 142      |                          | T2:           |
| Hide           | Menu M3:             | M4:      | :                        | T3:           |

Figure 43: Selecting Cable type

5. **Main Menu > Measurements > Frequency > DTF Setting**, adjust the DTF parameters; like cable loss, windowing (Blackman/Rectangular), distance unit (m/feet) as shown in *figure 44* 

| Consultix MTM   | 1427 DTF             |       | 2    | 10:45:46<br>2015/12/17 |   | AC [                      |
|-----------------|----------------------|-------|------|------------------------|---|---------------------------|
| ОК              | 3.70                 | Cable | Loss |                        |   |                           |
|                 | 3.40                 |       |      |                        |   |                           |
| Clear           | 3.10                 |       | ~    | E A                    |   |                           |
| 2.15            | 2.80                 |       | υ.   | 54                     |   | I                         |
| Васкърасе       | 2.50                 |       |      |                        |   | <mark>/</mark>            |
|                 | 2.20                 | 7     | 0    | 0                      | 0 | A                         |
|                 | 1.90                 |       | 0    | 9                      | 0 | $-\Lambda$                |
|                 | 1.60                 | 1     | E    | ~                      |   | -+                        |
| Dahara          | 1.00                 | 4     | ່ວ   | ю                      | • | -/                        |
| Return          | 0.00                 |       |      | -                      |   | 6.00                      |
| (Input)<br>Hide | Main M1:<br>Menu M3: | 1     | 2    | 3                      | - | 1 : Current<br>2 :<br>3 : |

| Consultix MTN | 1427 DTF - VS    | WR 10:46:0<br>2015/12 | и4<br>И7 Cal. ON AC [ |
|---------------|------------------|-----------------------|-----------------------|
| Falact        | 3.70             |                       |                       |
| Select        | 3.4 Windowing    |                       |                       |
|               | 3.11 Rectangular |                       |                       |
|               | Blackman         |                       |                       |
|               | 0.5              |                       |                       |
|               | 2.0              |                       |                       |
|               | 2.26             |                       |                       |
|               | 1.90             |                       |                       |
|               | 1.60             |                       |                       |
|               | 1.30             |                       | N                     |
| Return        | 1.00             |                       |                       |
|               | 0.00             | Distance ( Meter )    | 6.00                  |
| (Select)      | Main M1:         | M2:                   | T1 : Current          |
| Hide          | Menu M3:         | M4:                   | T2 -                  |

Figure 44: DTF settings



The curve shows peaks at the faulty location; on Main Menu > Measurements, click "Peak" to set a marker at the maximum peak point you can add markers from Main Menu > Measurements > Marker as shown in *figure 45*

| Consultix MTN  | 1427                 | DTF - VSW          | /R 2                           | 10:47:48<br>015/12/17 | Cal. ON        | AC [                   | Consultix MTM4   | 127                 | DTF - VSWR    |                        | 10:48:26<br>2015/12/17 | Cal. ON        | AC [[         |            |
|--|----------------------|--------------------|--------------------------------|-----------------------|----------------|------------------------|--|---------------------|---------------|------------------------|------------------------|----------------|---------------|------------|
| Peak Right   | 3.70                 |                    |                                |                       |                | 1                      | Marker Select<br>[Marker 2]  | 3.70                |               |                        |                        |                |               | ı          |
| Peak Left  | 3.10                 |                    |                                |                       |                | 1                      | Marker View<br>[ON]  | 3.10                |               |                        |                        |                |               | 1          |
| Max Search   | 2.80<br>2.50         |                    |                                |                       |                | <b>\</b>               | Marker Type<br>[Normal]  | 2.80                |               |                        |                        | +              |               |            |
| Min Search   | 2.20                 |                    | <b>— Fai</b>                   |                       |                | <u>A</u>               | Marker Clear All   | 2.20                |               | Fa                     | il —                   |                |               |            |
|  | 1.60                 |                    |                                |                       |                |                        | Marker Edit  | 1.60                | 2             |                        |                        |                |               |            |
| < <back< th=""><th>1.30</th><th>~</th><th></th><th></th><th></th><th><math> \rightarrow</math></th><th>&lt;<back< th=""><th>1.30</th><th>×</th><th></th><th></th><th></th><th><math>\mathcal{I}</math></th><th>÷</th></back<></th></back<> | 1.30                 | ~                  |                                |                       |                | $ \rightarrow$         | < <back< th=""><th>1.30</th><th>×</th><th></th><th></th><th></th><th><math>\mathcal{I}</math></th><th>÷</th></back<> | 1.30                | ×             |                        |                        |                | $\mathcal{I}$ | ÷          |
| (Peak)<br>Hide   | 0.00<br>Main<br>Menu | M1:5.53m/2.<br>M3: | Distance (1<br>.832 M2:<br>M4: | Meter)                | T1<br>T2<br>T3 | 6.00<br>: Current<br>: | (Marker)<br>Hide   | 0.00<br>Maii<br>Men | M1:5.53m/2.82 | Distance<br>9 M2<br>M4 | (Meter)<br>0.89m/1.227 | T1<br>T2<br>T3 | : Currei      | 6.00<br>nt |

Figure 45: Fault detection

Users can capture up to 3 traces of many cable measurements and save it to internal or external memory as shown in *figure 46* 



Figure 46: Capturing Measurement Traces

The user can define limit lines, save, load, and capture traces & screenshots to arrange the site measurements for acceptance packaging



### **Cable Loss Measurements**

- 1. After calibration, connect the other terminal of the launch cable to the measurement cable.
- 2. Main Menu > Mode, select "Cable Loss" mode as shown in *figure 47*

| Consultix MTM  | 427   | VS | SWR - | VSWR |          | 11:02<br>2015/1 | 2:27<br>12/17 | Cal. ON | AC [              |       | Consultix MTM4 | 127    | Ca | able L          | oss        |                  | 11:0<br>2015/ | 2:40<br>12/17 | Cal. ON | AC              |        |
|--|-------|----|-------|------|----------|-----------------|---------------|---------|-------------------|-------|----------------|--------|----|-----------------|------------|------------------|---------------|---------------|---------|-----------------|--------|
| VSWR VSWR  | 58.60 |    |       |      |          |                 |               |         |                   |       | Mode           | -3.00  |    |                 |            |                  |               |               |         |                 |        |
|  | 52.20 |    |       |      |          |                 |               |         |                   |       |                | -6.00  |    |                 | $\wedge l$ | $\uparrow \land$ | h             |               |         | ~ /             |        |
| V5WR RIL5  | 39.40 |    |       |      |          |                 |               |         |                   |       | Measurements   | -12.00 | ΥV | $\uparrow \lor$ | / \f       | ₩ \              | Ł₩            | ₩ \           | $\sim$  | ſ~              | $\sim$ |
| DTF RTLS   | 33.00 |    |       |      |          |                 |               |         |                   |       | System         | -15.00 | 4  |                 |            |                  |               |               |         |                 |        |
| DTF VSWR   | 26.60 |    |       |      |          |                 |               |         |                   |       | Calibration    | -18.00 |    |                 |            |                  | <u> </u>      |               |         |                 |        |
|  | 13.80 |    |       |      |          |                 |               |         |                   |       |                | -21.00 |    |                 |            |                  |               |               |         |                 |        |
| Cable Loss   | 7.40  |    |       |      |          |                 |               |         |                   |       | File           | -27.00 |    |                 |            |                  |               |               |         |                 |        |
| < <back< th=""><th>1.00</th><th>1</th><th></th><th></th><th>204</th><th>5.00</th><th></th><th></th><th></th><th>70.00</th><th>Shortcuts</th><th>-30.00</th><th></th><th></th><th></th><th>20/</th><th>15.00</th><th></th><th></th><th><u> </u></th><th>170.00</th></back<> | 1.00  | 1  |       |      | 204      | 5.00            |               |         |                   | 70.00 | Shortcuts      | -30.00 |    |                 |            | 20/              | 15.00         |               |         | <u> </u>        | 170.00 |
| (Mode)   | Mair  | м  | 1:    |      | 204<br>M | 2:              |               | Ŧ       | 1 : Currer<br>2 : | nt    | Hide           | Mai    | M  | 1:              |            | M                | 2:            |               |         | 1 : Curr<br>2 : | ent    |
| Hide   | Men   | M  | 3:    |      | M        | 4:              |               | T       | 3 :               |       | Main Menu      | Men    | M  | 3:              |            | M                | 4:            |               | 1       | 3:              |        |

Figure 47: Cable Loss Measurement

3. Add markers, define limit lines, and capture many traces of your measurements to accept or decline your site as shown in *figure 48* 

| Consultix MTM  | 427                |       |                  |                     | 11:0<br>2015/ | 3:12<br>12/17 |                | AC [   |            | Consultix MTM   | 427     |            |      |      |   |                | 1<br>20  | 1:04<br>01 <i>5/</i> 1 | k05<br>12/17 |     |      | AC            |               |
|--|--------------------|-------|------------------|---------------------|---------------|---------------|----------------|--------|------------|---|---------|------------|------|------|---|----------------|----------|------------------------|--------------|-----|------|---------------|---------------|
| Limit  | -5.70              |       |                  |                     |               |               |                |        |            | Peak Right  | -5.00   |            |      |      |   | 1              | V        |                        |              |     |      |               |               |
| LONI   | -2:40              | h h r | $\Delta \Lambda$ | $\Lambda / \Lambda$ | $\Lambda I$   | $\Lambda$     | ~              | $\sim$ | <u>_</u>   | ·j  | -6.01   |            |      |      | - | <del>' ^</del> |          |                        | - ^          |     |      |               |               |
| 1st Limit Level  | 1 <sub>11,10</sub> | VV    | γV               | W V                 | V             | V             | $\int \nabla $ | /      |            | Peak Left   | -7.9    | ^          | ~ /  | Λ    | Λ | Л              | $\Gamma$ | _/                     | $\Gamma$     |     |      |               |               |
|  | -13.80             |       | V V              | I V                 |               |               |                |        |            |   | -8.02   | $\wedge 1$ | M    | UH I |   |                | Π.       |                        | Π.           | ١., | .    | $\mathcal{N}$ | $\Lambda >$   |
| Limit<br>[OFF]   | -16.50             |       |                  |                     |               |               |                |        |            | Max Search  | 9.02    | W          | V    | VI   |   | ī Ē            |          |                        | ١Į –         | Vľ  |      |               | $\mathcal{M}$ |
|  | -19.20             |       |                  |                     |               |               |                |        |            |   | -10.03  | •          | V    |      |   | ١              | Ч -      | l –                    | V            | W.  | W    |               | V             |
| 2nd Limit Level  | -21.90             |       |                  |                     |               |               |                |        |            | Min Search  | -11.04  |            |      |      |   | V –            | i i      | V.                     |              | V   | * \  |               |               |
|  | -24.60             |       |                  |                     |               |               |                |        |            |   | -12.04  |            |      |      |   | l –            |          |                        |              |     |      |               |               |
|  | -27.30             |       |                  |                     |               |               |                |        |            |   | -13.05  |            |      |      | T |                | •        |                        |              |     |      |               |               |
| < <back< th=""><th>-30.00</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>&lt;<back< th=""><th>-14.05</th><th></th><th></th><th></th><th></th><th></th><th>1</th><th></th><th></th><th></th><th></th><th></th><th></th></back<></th></back<> | -30.00             |       |                  |                     |               |               |                |        |            | < <back< th=""><th>-14.05</th><th></th><th></th><th></th><th></th><th></th><th>1</th><th></th><th></th><th></th><th></th><th></th><th></th></back<> | -14.05  |            |      |      |   |                | 1        |                        |              |     |      |               |               |
|  | 1920.00            |       |                  | 204                 | 5.00          |               |                | 2170.0 | <u> 00</u> |   | 1920.00 |            |      |      |   | 20             | 45.00    | )                      |              |     |      |               | 2170.00       |
| (Limit Line)   | Main               | M1:   |                  | M                   | 2:            |               |                |        |            | (Peak)  | Main    | M          | 2026 |      |   | 9dB M          | 12:20    |                        |              |     | dB 🕌 | 1 : Curi      |               |
| Hide   | Menu               | M3:   |                  | м                   | 4:            |               | T              | 3:     |            | Hide  | Menu    | M          | 3:   |      |   | M              | 14:      |                        |              |     | Ť    | 3:            |               |



Figure 48: Cable Loss measurement acceptance



# Appendix A: Technical Background

#### Overview

RF energy transmission requires an impedance match which is the most important condition to achieve a maximum power transfer from the BTS radio to the antenna. On the other hand, a mismatch before the antenna will produce a reflective wave in the opposite direction of the incident wave and that implies an interference pattern called "standing wave".

VSWR is the ratio between the power transmitted through the cable or antenna and the amount of the power that is reflected back to the transmitter. In cellular communication, having high VSWR results in dropped calls, poor reception, and unacceptable performance.

DTF (Distance-To-Fault) is a measurement to identify the fault locations by displaying the distance of the reflections from various points in the antenna line system where there are various types of cables, connectors, and functional devices, and that guarantees the whole system performance.

## SWR (STANDING WAVE RATIO)

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.

### **RETURN LOSS**

Return loss is the ratio between the power reflected in a communication link to the incident power.

For example, if a device has 15 dB of return loss, the reflected energy from that device is always 15 dB lower than the transmitted energy. When expressed in dB, larger negative numbers represent larger return losses and thus smaller reflected power. In electrical systems, return losses often occur at junctions between transmission lines and terminating impedances.

Return Loss is a function in VSWR, as outlined in the following equation,

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

## DTF (Distance-to-fault)

Due to impedance mismatching, some of the incident signal power is reflected back to the source, if a matched terminal is connected to the other terminal of the cable or the line system, the signal will be absorbed and no reflection occurs

The resulting reflected signal that is measured and plotted as a function of time and, because of the constant signal speed for a given transmission medium, it can be read as a function of cable length or distance location.

DTF measurement depends on **FDR technology** (Frequency Domain Reflectometer) for testing long cables over several kilometers



# Appendix B: Spectrum Analysis

Spectrum Analyzer is a measurement instrument that measures the amplitude (strength) of an input signal varied by frequency over the full frequency range of the instrument to reveal the frequency and power contents of the input signal based on Fourier transform theory as shown below,



In the frequency domain, a spectrum analyzer can detect complex RF signals, separate its frequency components into a fundamental frequency and other harmonics and the signal amplitude at each frequency is displayed.

There are two main types of spectrum analyzers a fast Fourier transform (FFT) analyzer or a swept-tuned analyzer. The FFT analyzer detects the signal with period T in the time domain, samples it with a frequency  $f_s$  equal to or more than twice the signal bandwidth (based on Nyquist Limit), and applies the Fourier transform mathematics to convert to the frequency domain where all frequency components are displayed from zero to  $\frac{f_s}{2}$ , this requires analog to digital converters and high processing power making the FFT analyzers limited in frequency range.

The swept-tuned analyzer is the most common type of spectrum analyzer; it down-converts a portion of the input signal spectrum to the center frequency of a band-pass filter by sweeping the voltage-controlled oscillator through a range of frequencies across the displayed frequency range and detects all the frequency components. This enables to perform measurements over a large dynamic range.

Both types of spectrum analyzers can be used for a wide range of measurements in most of the field applications spectrum monitoring, spurious emissions, and interference hunting.

The below block diagram simply illustrates the employed technique in the spectrum analyzer mode of SiteWizard.





# Appendix C: Band list

| Band Name                   | Start Freq.<br>(MHz) | Stop Freq.<br>(MHz) | Band Name                        | Start Freq.<br>(MHz) | Stop<br>Freq.<br>(MHz) |
|-----------------------------|----------------------|---------------------|----------------------------------|----------------------|------------------------|
| Bluetooth USA &<br>Europe   | 2,400                | 2,484               | NMT 411 FULL                     | 411                  | 430                    |
| Bluetooth JAPAN             | 2,472                | 2,497               | NMT 451 UP                       | 450                  | 460                    |
| C450 P UP                   | 453                  | 464                 | NMT 451 DOWN                     | 460                  | 470                    |
| C450 P DOWN                 | 463                  | 474                 | NMT 451 FULL                     | 450                  | 470                    |
| C450 P FULL                 | 453                  | 474                 | NMT 451 20kHz CDMA2k<br>UP       | 451                  | 484                    |
| C450 SA UP                  | 465                  | 470                 | 470 NMT 451 20kHz CDMA2k<br>DOWN |                      | 494                    |
| C450 SA DOWN                | 455                  | 460                 | NMT 451 20kHz CDMA2k<br>FULL     | 451                  | 494                    |
| C450 SA FULL                | 455                  | 470                 | 470 NMT 450 20kHz CDMA2k<br>UP   |                      | 458                    |
| CDMA CHINA UP               | 872                  | 915                 | 915 NMT 450 20kHz CDMA2k<br>DOWN |                      | 468                    |
| CDMA CHINA DOWN             | 917                  | 960                 | NMT 450 20kHz CDMA2k<br>FULL     | 411                  | 468                    |
| CDMA CHINA FULL             | 872                  | 960                 | NMT 900 UP                       | 890                  | 915                    |
| CELLULAR UP                 | 824                  | 849                 | NMT 900 DOWN                     | 935                  | 960                    |
| CELLULAR DOWN               | 869                  | 894                 | NMT 900 FULL                     | 890                  | 960                    |
| CELLULAR FULL               | 824                  | 894                 | PCS GSM 1900 UP                  | 1,850                | 1,910                  |
| CELLULAR 700 UP             | 776                  | 794                 | PCS GSM 1900 DOWN                | 1,930                | 1,990                  |
| CELLULAR 700 DOWN           | 746                  | 764                 | PCS GSM 1900 FULL                | 1,850                | 1,990                  |
| CELLULAR 700 FULL           | 746                  | 794                 | PCS KOREA UP                     | 1,750                | 1,780                  |
| DCS GSM 1800 UP             | 1,710                | 1,785               | PCS KOREA DOWN                   | 1,840                | 1,870                  |
| DCS GSM 1800 DOWN           | 1,805                | 1,880               | PCS KOREA FULL                   | 1,750                | 1,870                  |
| DCS GSM 1800 FULL           | 1,710                | 1,880               | PDC 800 UP                       | 898                  | 940                    |
| DMB                         | 2,593                | 2,693               | PDC 800 DOWN                     | 843                  | 885                    |
| GSM 900 UP                  | 880                  | 915                 | PDC 800 FULL                     | 843                  | 940                    |
| GSM 900 DOWN                | 925                  | 960                 | PDC 1500 UP                      | 1,525                | 1,549                  |
| GSM 900 FULL                | 880                  | 960                 | PDC 1500 DOWN                    | 1,477                | 1,501                  |
| IEEE 802.11 FH              | 2,402                | 2,495               | PDC 1500 FULL                    | 1,477                | 1,549                  |
| IEEE 802.11 DS              | 2,412                | 2,484               |                                  | 1,895                | 1,918                  |
| IMT2000 UMTS                | 1,920                | 1,980               | SMR 800 DOWN                     | 851                  | 866                    |
| IMT2000 UMTS<br>WCDMA DOWN  | 2,110                | 2,170               | SMR 800 FULL                     | 806                  | 866                    |
| IMT2000 UMTS<br>WCDMA FULL  | 1,920                | 2,170               | SMR 1500 UP                      | 1,453                | 1,465                  |
| ISM 2.4GHz                  | 2,400                | 2,484               | SMR 1500 DOWN                    | 1,501                | 1,513                  |
| JTACS/NTAC JPN ARIB<br>UP   | 887                  | 925                 | SMR 1500 FULL                    | 1,453                | 1,513                  |
| JTACS/NTAC JPN ARIB<br>DOWN | 832                  | 870                 | TACS/ETACS UP                    | 872                  | 915                    |
| JTACS/NTAC JPN ARIB<br>FULL | 832                  | 925                 | TACS/ETACS DOWN                  | 917                  | 960                    |
| NMT 411 UP                  | 411                  | 420                 | TACS/ETACS FULL                  | 872                  | 960                    |
| NMT 411 DOWN                | 421                  | 430                 | Tetra                            | 380                  | 430                    |

Table 2: Standard band list



# Appendix D: Cable list

| Cable Type     | Relative<br>Propagation<br>Velocity (V <sub>r</sub> ) | Nominal<br>Attenuation dB/m<br>@ 1000MHz | Cable Type         | Relative<br>Propagation<br>Velocity ( V <sub>r</sub> ) | Nominal<br>Attenuation<br>dB/m @<br>1000MHz |  |
|----------------|---|--|--------------------|--|---|--|
| FSJ1-50A       | 0.84  | 0.197                                    | LMR600             | 0.87   | 0.087                                       |  |
| FSJ250         | 0.83  | 0.134                                    | LMR900             | 0.87   | 0.056                                       |  |
| FSJ4-50B       | 0.81  | 0.119                                    | RG142              | 0.69   | 0.443                                       |  |
| HCC 12-50J     | 0.915   | 0.092                                    | RG17, 17A          | 0.659  | 0.18  |  |
| HCC 158-50J    | 0.95  | 0.023                                    | RG174              | 0.66   | 0.984                                       |  |
| HCC 300-50J    | 0.96  | 0.014                                    | RG178B 0.69        |  | 1.509                                       |  |
| HCC 312-50J    | 0.96  | 0.013                                    | RG187, 188 0.69    |  | 1.017                                       |  |
| HCC 78-50J     | 0.915   | 0.042                                    | RG213/U            | 0.66   | 0.292                                       |  |
| HF 4-1/8" Cu2Y | 0.97  | 0.01                                     | RG214              | 0.659  | 0.292                                       |  |
| HF 5" Cu2Y     | 0.96  | 0.007                                    | RG223              | 0.659  | 0.165                                       |  |
| HF 6-1/8"Cu2Y  | 0.97  | 0.006                                    | RG55, 55A, 55B     | 0.659  | 0.541                                       |  |
| HJ4.5-50       | 0.92  | 0.054                                    | RG58, 58B          | 0.659  | 1.574                                       |  |
| HJ4-50         | 0.914   | 0.087                                    | RG58A, 58C         | 0.659  | 0.787                                       |  |
| HJ5-50         | 0.916   | 0.042                                    | RG8, 8A, 10, 10A   | 0.659  | 0.262                                       |  |
| HJ7-50A        | 0.921   | 0.023                                    | RG9, 9A            | 0.659  | 0.289                                       |  |
| LDF12-50       | 0.88  | 0.022                                    | HFSC-12D(1/2")     | 0.81   | 0.112                                       |  |
| LDF4-50A       | 0.88  | 0.077                                    | HFC-12D(1/2")      | 0.88   | 0.072                                       |  |
| LDF5-50A       | 0.89  | 0.043                                    | HFC-22D(7/8") 0.88 |  | 0.041                                       |  |
| LDF6-50        | 0.89  | 0.032                                    | HFC-33D(1_1/4")    | 0.88   | 0.0294                                      |  |
| LDFF7-50A      | 0.88  | 0.027                                    | HFC-42D(1_5/8")    | 0.87   | 0.0243                                      |  |
| LMR100         | 0.8   | 0.792                                    | RFCX-12D(1/2")     | 0.88   | 0.088                                       |  |
| LMR1200        | 0.88  | 0.044                                    | RFCX-22D(7/8")     | 0.88   | 0.049                                       |  |
| LMR1700        | 0.89  | 0.033                                    | RFCX-33D(1_1/4")   | 0.88   | 0.038                                       |  |
| LMR200         | 0.830   | 0.344                                    | RFCX-42D(1_5/8")   | 0.87   | 0.028                                       |  |
| LMR240         | 0.84  | 0.262                                    | RFCL-22D(7/8")     | 0.88   | 0.044                                       |  |
| LMR400         | 0.85  | 0.135                                    | RFCL-33D(1_1/4")   | 0.88   | 0.034                                       |  |
| LMR500         | 0.86  | 0.109                                    | RFCL-42D(1_5/8")   | 0.87   | 0.0315                                      |  |

Table 3: Standard cable list



# Appendix E: VSWR-Return Loss Conversation

|      | Return | Trans. | Volt. | Power | Power |       | Return | Trans. | Volt. | Power | Power |
|------|--------|--------|-------|-------|-------|-------|--------|--------|-------|-------|-------|
| VSWR | Loss   | Loss   | Refl  | Trans | Refl  | VSWR  | Loss   | Loss   | Refl  | Trans | Refl  |
|      | (dB)   | (dB)   | Coeff | (%)   | (%)   |       | (dB    | (dB)   | Coeff | (%)   | (%)   |
| 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  |

Table 4: VSWR-Return Loss table

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# Further Help

- For any support inquiry, kindly contact:
  *Support:* <u>support@consultixwireless.com</u>
  Or contact our distributor covering your region (check <u>www.consultixwireless.com</u>)
- For any information about prices, specifications, future developments, recommendations, customizations, or general question, kindly contact:
  Sales: sales@consultixwireless.com

