



Telewave.io



44D-LX Digital/Analog Broadband RF Wattmeter - User Manual

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Telewave.io 44D-LX User Manual



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Warranty Periods:

- Antennas and antenna mounting hardware - 5 years
- All other products - 1 year



Table of Contents

PRECAUTIONS AND SAFETY INSTRUCTIONS.....	4
INTERNAL BATTERY CHARGING INSTRUCTIONS.....	5
QUICK START GUIDE.....	6
LITHIUM BATTERY MANAGEMENT	7
BATTERY CHARGING AND DISCHARGING.....	7
CHARGING POWER SUPPLY & INTERNATIONAL POWER ADAPTERS.....	8
POWER CONTROL	10
MENU TREE.....	11
HOME SCREEN AND FIELDS DESCRIPTION	11
MAIN MENU	11
<i>Frequency Range Menu</i>	12
<i>Modulation</i>	12
<i>Settings Menu</i>	12
<i>Info & Help Menu</i>	12
SPECIFICATIONS	13
FREQUENCY RANGE.....	13
POWER RANGE (CONSTANT ENVELOPE) MODULATION.....	13
RF AND MEASUREMENT	13
USB CONNECTOR, BATTERY, AND CHARGING.....	14
MECHANICAL.....	14
ENVIRONMENTAL.....	14
MISCELLANEOUS: ACCESSORIES, OPTIONS, MAINTENANCE	15
INCLUDED ACCESSORIES	15
OPTIONAL TC44-RX CARRY CASE.....	15
MAINTENANCE & CALIBRATION	15
STORAGE	16
CLEANING.....	16
APPENDIX: CONNECTING THE 44D-LX TO THE CIRCUIT	17
CONCEPTS	17
44D-LX CONNECTION DIAGRAM	18
CALCULATING THE PRIMARY & SECONDARY CABLE CUT LENGTH.....	18
APPENDIX: RF SAMPLE PORT ISOLATION	19



Precautions and Safety Instructions

1. Read the user manual carefully. All **Warnings** and **Cautions** should be noted.
 - Contact Telewave.io Technical Support with any questions.
 - Keep the user manual(s) for future reference.
2. Keep the 44D-LX away from sources of moisture or excessive humidity.
 - Never pour any liquid into the openings or connectors.
 - Do not immerse in any liquid. The 44D-LX is water resistant, not waterproof.
3. Do not store this 44D-LX in an unconditioned environment for an extended time. Prolonged exposure to extreme heat, cold, or moisture may cause damage.
4. Check the current capacity of the USB charger/power supply before connecting to the 44D-LX.
5. Do not attempt to disassemble the 44D-LX, there are no user-serviceable parts inside.
6. Inspect the 44D-LX if it has been dropped or exposed to excessive vibration.
7. Contact Telewave.io Technical Support if any of the following conditions arise:
 - Are there any obvious signs of damage – case, display, connectors, switches, etc.
 - Any liquid appears to have penetrated the case.
 - The 44D-LX appears to malfunction or is giving incorrect readings.
 - The 44D-LX has been tampered with or opened by anyone other than Telewave.io.
8. Follow all normal Radio Frequency safety rules and High Voltage safety rules.
 - Double-check all connections and configurations before applying power to transmitters.
 - Double-check all connections and configurations before keying any transmitters.
 - Be mindful of short and long-term exposure risks to Radio Frequency Radiation.



WARNING: This symbol alerts you to the risk of personal injury, hardware damage, or irrevocable loss of data.



CAUTION: This symbol denotes situations where instructions must be followed carefully to avoid personal discomfort or to obtain expected results.



Internal Battery Charging Instructions

- Connect the battery charger to the wall outlet.
- Then connect the other end to the charging port on your device.
- Turn the unit battery switch to "INT."
- While charging, the charger indicator light will be red.
- When fully charged, the charger indicator light will turn green.
- Once charged, disconnect the charger.
- Turn on the unit, and the battery indicator on the device should show a full bar, indicating a full charge.

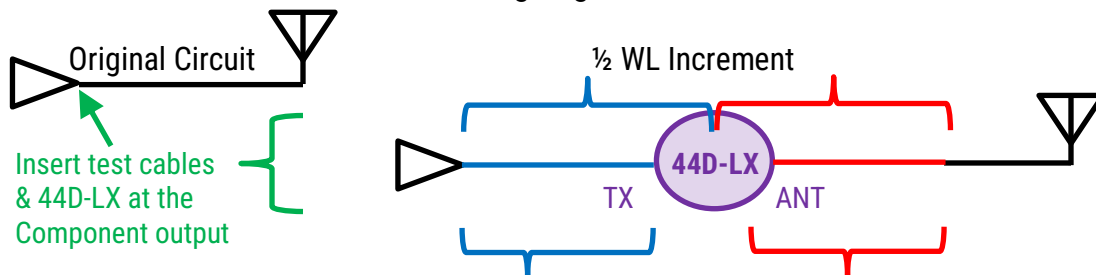


Quick Start Guide

The complete 44D-LX User Manual is available for download at www.telewave.com.

- Unpack the 44D-LX and accessories (8.4V DC charger)
- Check the box and contents for any damage immediately after it arrives
- In case of damage or missing items, contact Telewave.io immediately at 408-929-4400 Opt 1.
- Charge the Batteries (See Page 5)
 - Connect the supplied USB cable to the 44D-LX (connector on the back) and into the supplied AC power supply. Plug the power supply into a 90 to 250 VAC (50 or 60 Hz) wall socket (Charging will begin automatically - when the 44D-LX is turned off the display will flash on for a moment & then go dark, the blue power ring will remain on.)
 - The 44D-LX must be fully charged before turning on for first use.
 - The 44D-LX cannot be switched ON or OFF while charging via the USB. Disconnect the USB cable, toggle the power button, and then re-connect the USB to continue charging.
 - See the section "[Lithium Battery Management](#)" for battery management details.
- Build or procure "Primary Cables" (see "Appendix - Connecting the 44D-LX to the Circuit")
- Press and release the power button. The blue power indication in the switch will illuminate.
- The 44D-LX will be functional in three to five seconds as indicated by:
 - The backlight will be illuminated
 - Frequency and battery indicators are displayed
- The HOME screen & menu tree:
 - Freq Range > Set operating frequency range*
 - Modulation > Selects the modulation type*
 - Settings > Select dB, watts, backlight Adj.
 - Info & Help > Show Version, Telewave.io contact
- *Set the Frequency Range and Modulation before use or measurement will be inaccurate, other settings are optional
- When in any MENU screen other than the HOME Screen, the function buttons will be UP, SELECT/EXIT, and DOWN.
Press SELECT implements the selection & returns HOME
- Once the 44D-LX has been configured, the cables can be connected.
- Connect the primary cable to the port labeled TX on the left side of the 44D-LX (RF input)
- Connect the cable leading to the antenna to the port on the right side of the 44D-LX (RF output)
- The RF Sample port can be connected to any monitor or source test equipment. The sample port is bi-directional, with connectivity to both the Thru Line TX and Thru Line ANT ports.

Wiring Diagram



Primary Cable (1/2 WL increment minus 3") Secondary Cable (Optional = 1/2 WL incr. - 3")



Lithium Battery Management

Lithium-ion batteries are used in the 44D-LX to supply power. The behavior of the 44D-LX batteries is like other devices that use the same battery technology (cell phones, iPads, etc.). Please carefully read this section regarding battery safety and operation details.

Battery charging and discharging

The battery can be charged when the 44D-LX is on or off. The 44D-LX can be charged from any USB source that can support a 2.4-amp load, though we recommend using the supplied power supply and cable (do not charge via a laptop USB port). Charging begins automatically when power is applied to the USB port.



NOTE: Two Power Management Rules

1. Always make sure that there is at least one bar (2 hours) of battery life before using the 44D.
 2. Unplug the charger before operating the power switch (turning the power on or off) and then plug the charger back in if needed for charging or operation.
- When the 44D-LX is powered off, the power switch ring will be blue, and the display will be dark.
 - When the 44D-LX is on, the battery life indicator turns yellow indicating that the batteries are charging.
 - Depleted batteries will require 2-3 hours of charging time to reach a full charge.
 - Fully charged batteries will support about 8 hours (internal only, with optional external battery for extended battery life) of active operation.

NOTE: The 44D-LX can be used when charging, but when the charger is in trickle mode (less than 1-hour battery life) there is not enough current provided to operate the 44D-LX; the batteries will eventually be depleted.



WARNING

- The batteries must be discharged to 1/3 or less capacity before the meter can be shipped by Air. This is a legal and safety requirement for all lithium batteries.
- The 44D-LX can be carried into the cabin of any passenger flight (at any charge level), but it cannot be checked into luggage on any passenger flight.
- The internal batteries are not user serviceable. The 44D-LXm must be returned to Telewave.io for service if the batteries no longer accept or retain a sufficient charge.
- Excessive cold or hot temperatures can damage the batteries or create a fire hazard.



CAUTION

- Fully charge the batteries upon initial receipt, as well as before and after long-term storage.
- Fully charge the batteries at least once a month during long-term storage.
- The batteries may self-deplete and malfunction unless they are periodically re-charged.
- The 44D-LX can be left on the charger for longer than 24 hours, but this is not recommended.
- The 44D-LX is protected by internal fuses. If the USB charging port is shorted, the fuses may blow, requiring factory replacement.



Charging Power Supply & International Power Adapters

The included power supply for charging batteries supports 100 to 240 volts at 50 or 60 hertz and is an IEC international "Plug Type A".

The appropriate type C, G, or I adapters are included for the destination "ship to" country that supports the adapter standard to allow the power supply to be safely connected to the power socket in the designated country.

Visit the International Electro-Technical Commission (IEC) website for a complete list of socket types, and power voltage/frequencies used in various countries: <http://www.iec.ch/worldplugs/>.

Please Note: Type A will be included. The rest of the charging power supply will be based on the customer's location.

Description	Picture	Short list of Areas/Countries where the "Type" is used
Type A Plug on the power supply		North and Central America, Japan Directly compatible with Type B sockets
Type B		USA/Canada
Type C		American Samoa, Antigua & Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Brazil, Cayman Islands, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Liberia, Mexico, Micronesia, Monserrat, Nicaragua, Okinawa, Panama, Peru, Philippines, Puerto Rico, Saint Kitts & Nevis, Tahiti, Taiwan, Thailand, Trinidad and Tobago, USA, Venezuela, Virgin Islands (Exceptions may occur)
Type D		India, Pakistan
Type E/F		France, Germany, South Korea, Europe: Austria, Belgium, Czech Republic, Finland, The Netherlands, Norway, Turkey, Poland, Portugal, Slovakia, Spain, Sweden, Estonia (Exceptions may occur) and Tunisia, Morocco



Type G



Bahrain, Belize, Botswana, Brunei, Cyprus, Dominica, England, Ghana, Gibraltar, Grenada, Hong Kong, Iraq, Ireland, Kenya, Macau, Malta, Malaysia, Nigeria, Northern Ireland, Oman, Qatar, St. Lucia, St. Vincent, Saudi Arabia, Scotland, Singapore, Sri Lanka, Tanzania, Uganda, UAE, United Kingdom, Wales, Yemen, Zimbabwe

Type H



Israel

Type I



Australia, China, New Zealand, Fiji Islands, Solomon Island, Tonga, and Western Samoa.

Type J



Switzerland

Type L



Italy, Uruguay

Type M



S. Africa

Type N



Australia, New Zealand, Papua New Guinea, Argentina, China



Power Control

The 44D-LX has a latching push power button in the lower-left corner of the front panel.

To turn the 44D-LX ON, push the power button until you hear a clicking sound and/or you see that the power switch rim is illuminated with a blue glow. After a few seconds, the display backlight will illuminate, and the power-up sequence will be shown on the display.

The power-up sequence, as is seen in the display, is:

- The screen backlight will illuminate after about two seconds
- Then the HOME screen will display
- After that, the frequency and battery status indications will be displayed
- After the power-up, the user needs to set up the frequency band and modulation type

Once the power-up sequence is complete, the HOME screen will indicate the settings that were selected when the 44D-LX was previously turned off (units of measurement, backlight level, etc.) The power switch will remain partially depressed while the 44D-LX is turned on.

To turn the 44D-LX OFF, push the power button slightly further, and release it. The switch will return to the flush position, the blue rim light will extinguish, the display backlight will turn off and the display will become blank. There are no lights or display activity when the unit is off.

Plugging in the charger when the 44D-LX is powered off

The blue power switch indicator & display backlight will turn on, the 44D-LX is not operational
Push the power switch in to turn the 44D-LX on for use (freq counter & temp indication show)

Turning off the 44D-LX when USB power is applied

The blue power switch indicator & display backlight will remain on, 44D-LX is not operational.
Unplug the 44D-LX for a few seconds and then plug in and/or turn the 44D-LX back on for use.



NOTE: RF signals will flow through the line sensor unimpeded with the 44D-LX power turned On or Off.



Menu Tree

HOME Screen and Fields Description

		Battery Status
FWD (measured forward power)	Measured Value	Avg W / dBm
REFL (measured reflected power)	Measured Value	Avg W / dBm
VSWR (Voltage Standing Wave Ratio)	Calculated Value	Value
Measured Frequency MHz		Frequency Range (Low, Med, High)
	MENU	

After the system has completed the power-up sequence, the default screen configuration is shown.

The top row indicates the Battery Life.

The second and third rows indicate results measured from the main thru-line connectors.

The fourth row indicates the Calculated VSWR value (VSWR is displayed in WATTS or dBm mode.) When the display is set to indicate the measured power in dBm, the Return Loss can be manually calculated by subtracting the reflected power “dBm” from the forward power “dBm”.

The fifth row indicates the measured frequency of the RF signal and the frequency range setting.

! **NOTE:** All measured power indications show a dash “---”dBm or “0.0” Watts until the average forward power detected exceeds 5 watts.

The bottom row indicates the current function of the three buttons located just below the screen. The purpose of each of these buttons changes as needed for easy configuration of the 44D-LX.

The HOME screen function buttons are:

- MENU Setup before measuring - Open the MAIN menu

MAIN Menu

The main MENU allows access to these categories:

- **FREQ RANGE** Configure the frequency range Low, Medium, or High
- **MODULATION** Choose the desired modulation type
- **SETTINGS** Adjust the display parameters
- **INFO & HELP** Read-only attributes and Telewave.io contact information

! **CAUTION:** The frequency range must be set to the proper range before reading the power.

For the main MENU and all Sub-Menus

- Scroll up and down in the options by pressing the UP and DOWN buttons.
- Pressing the SELECT key will select the currently highlighted item.
- Selecting EXIT will return to the HOME screen without making any changes.



Frequency Range Menu

The frequency range sets the search window for locking onto the target signal (Low, Med, High.)

- 88-100 MHz Select for measuring frequencies between 88 and 100 MHz
- 101-400 MHz Select for measuring frequencies between 101 and 400 MHz
- 401-1000 MHz Select for measuring frequencies between 401 and 1000 MHz

! CAUTION: The Frequency Range is a mandatory parameter setting. The 44D-LX may not be able to accurately measure the power of a signal if the range is not set correctly.

! CAUTION: The frequency counter indication is only a reference to validate that the transmitter is close to the expected frequency or that the correct transmitter is transmitting during testing. The 44D-LX counter should not be used to adjust the output frequency of a transmitter. Due to the step size of the 44D-LX counter, there may be occasional toggling between indicated frequencies.

Modulation

The supported list of modulation/radio types is:

Menu Selection	Radio System Type
FM/FSK	CW, FM, DMR-II/III Downlink, P25-P1 (C4FM, Yaesu Fusion), dPMR, NXDN (Kenwood NEXEDGE / ICOM IDAS), D-Star
DMR/P25-P2 UL	DMR-II/III, P25-P2 Uplinks (FSK & TDMA), TETRA Uplink (Quadrature & TDMA)
LSM/P25-P2 DL	LSM, P25-P2, TETRA Downlinks (Quadrature no TDMA)

Settings Menu

This menu is for setting the units of measurement and other behavioral parameters of the 44D-LX:

- Power Units Select forward and reverse power display in Watts or dBm
- Backlight Select the backlight intensity: Low, Medium, High

Info & Help Menu

This menu is for the query of the attributes of the 44D-LX:

- About Display the serial number and firmware version of the 44D-LX
- Help Display the phone number and email address of Telewave.io Technical Support
- EXIT Return to the HOME screen



Specifications

If the 44D-LX is reading a signal that is outside the range of these specifications, the 44D-LX will indicate “---” dBm or “0.0” Watts as the measurement.

The 44D-LX is only certified for use on 50 Ω coax-style cables.

Frequency Range

Calibrated Range 118 MHz to 960 MHz

Power Range (Constant Envelope) Modulation

Forward Power Average (Min to Max) 5 Watt to 500 Watts (37 dBm to 57 dBm)
Reflected Power Average (Min to Max) 1 Watt to 100 Watts (30 dBm to 50 dBm)

RF and Measurement

Thru-Line RF connectors N-Female
Sample RF port connector SMA-Female

RF Impedance of all RF Ports 50 Ω
Mismatch introduced by 44D-LX (50 Ω coax) < 1.2:1 VSWR (> 21.0 dB Return Loss)
RF Coax Termination Range (see Note) < 2.0:1 VSWR (> 9.5 dB Return Loss)
RF Insertion Loss (through main RF connectors) Less than 0.02 dB up to 500 MHz
Less than 0.04 dB up to 1 GHz

RF Sample Port Insertion Loss -50 dB +/- 2 dB from 200 MHz to 1 GHz
-50 dB +0/-12 dB from 30 MHz to 200 MHz

See “[Appendix – RF Sample Port Isolation](#)” for isolation by frequency details.

Frequency Counter Accuracy +/-200 KHz at all frequencies
Typical Settling Time 3 to 5 Seconds (FM Analog / FSK Digital)
Thru Line Coupler Directivity >20 dB
RMS RF Power Measurement Accuracy \pm 0.4 dB



USB Connector, Battery, and Charging

Battery Life	8 hours (internal only) on time for fully charged batteries
Battery Charge Time	2-3 hours to fully charge depleted batteries
8.4 DC Charger	100 to 240 VAC at 50 or 60 Hz
The Universal Power Plug Adapter Kit, IEC (International Electrotechnical Commission)	Charger comes with an IEC Type A plug. Adapter kit converts to Type C, G or I plug Compatible Type B, E, F, J, K, & N socket

Mechanical

44D-LX weight	3.5 lb (1.6 kg)
44D-LX dimensions (LWH) inches (CM) Incl. Knobs/feet/connectors - not incl. the handle	6.75" x 5.5" x 4.0" (17.14 x 13.97 x 10.16 cm)
Shipping weight 44D-LX only	4 lb (1.8 kg)
Shipping weight with optional case	8 lb. (3.6 kg)
Shipping dimensions (LWH) inches (cm)	14.0" x 12.0" x 7.0" (35.56 x 30.48 x 17.78 cm)

Environmental

Humidity Range (Operating / Storage)	35% to 85% non-condensing
Temperature Range Operating (Charger Connected)	+32°F to +113°F (0°C to +45°C)
Temperature Range Operating (Charger Disconnected)	-4°F to +122°F (-20°C to +50°C)
Temp Range Storage (Long)	+68°F to +86°F (+20°C to +30°C)



Miscellaneous: Accessories, Options, Maintenance


Included Accessories

The 44D-LX comes with:

- Universal power supply
- 8.4V DC Charger
- For meters shipped outside the United States, an appropriate type C, G, or I Male to US Female power adapter will be included (per the destination country plug configuration.)

Note: USB-C cable is not included.

Visit the International Electro-Technical Commission (IEC) website for a complete list of socket types, and power voltage/frequencies used in various countries: <http://www.iec.ch/worldplugs/>.

 NOTE: It is recommended to use the Telewave.io-supplied power supply and charging cable.

Optional TC44-RX Carry Case

Contact Telewave.io sales for a quote or to order a carry case.

Maintenance & Calibration

There are no user-serviceable parts inside the 44D-LX. Opening the cover voids the calibration.

Telewave.io recommends returning the 44D-LX to the factory every year for inspection & calibration. Calibration must be done at Telewave.io, contact Telewave.io sales for a quote.

Before each 44D-LX is calibrated, it will be inspected. A report will be provided detailing any issues found (including a battery health test report.) Any deficiencies found will be repaired (warranty for free, non-warranty if customer authorized) and then the 44D-LX will be calibrated. Unrepaired deficiencies may cause a calibration failure. The firmware version will be updated to the latest, at no charge.

To return a 44D-LX to Telewave.io for calibration or repair; complete the RMA request form located on our website at <https://www.telewave.com/rma-request-form/>.

For Sales / RMA request assistance contact sales@telewave.com or call 408-929-4400 Option 1.

For Technical Support assistance contact support@telewave.com or call 408-929-4400 Option 2.



Storage

The 44D-LX can be stored for long periods in a climate-controlled (cool & dry) environment with no damage. It is recommended to store the 44D-LX in the TC44-R Case, or it can be wrapped in a cloth and placed into a box or other container.

If the 44D-LX is accidentally left on or turned on when placed into storage, the power controller will eventually turn off the 44D-LX. Even when turned off, the batteries will discharge during storage. The 44D-LX should be removed from storage once a month & fully charged before return to storage.



WARNING:

- Excessive cold or hot temperatures can damage the batteries or create a fire hazard.
- Verify that the 44D-LX is completely dry before long-term storage inside any container.



CAUTION:

- Fully charge the batteries upon initial receipt, as well as before and after long-term storage.
- Fully charge the batteries at least once a month during long-term storage
- The batteries may self-deplete and malfunction unless they are periodically re-charged.

Cleaning

The 44D-LX will not be damaged by wiping with a wet cloth, fog, mist, or light rain; when positioned with the display facing to the side or up (either set of rubber feet is facing down).

To clean the 44D-LX, put some mild liquid soap onto a soft but moist cloth or towel. Wipe the dirt from the 44D-LX with a light touch. Use a rinsed moist towel to clean any residual soap from the 44D-LX. The 44D-LX can air dry or be towel dried.

The optional TC44-RX case can be cleaned using the same procedure.



WARNING:

- Make sure the power supply is dry before connecting to AC power. An electrical shock hazard exists if the components are wet when plugged into a main outlet.
- Do not use more than a few drops of water or soap when cleaning the 44D-LX
- Excessive water or soap could leak into the 44D-LX and may cause damage or a malfunction.
- The USB connector on the back of the 44D-LX is vulnerable to water intrusion if the 44D-LX is positioned display down.



CAUTION:

- Do not use powder or abrasive soap. These soaps may scratch the case or display cover glass. Scratches or similar damage to the display cover glass are not warranted.



Appendix: Connecting the 44D-LX to the Circuit

Concepts

RF power will transfer from the source to the destination with the most efficiency when:

- The source and load impedance are the same
- The source and the load are separated from each other by a cable that has been cut so that the electrical length of that cable is a $\frac{1}{2}$ wavelength increment.

When the cables are $\frac{1}{2}$ electrical wavelength increments long, any reflected energy from a load or source mismatch will arrive at the source 180 degrees out of phase compared to the energy emanating from that source. The reflected energy will cancel a portion of the source energy.

Cutting the cables to the proper length in the LMR environment has the following advantages:

- Energy reflected by mismatches is dissipated, rather than bouncing back and forth
- Power amplifiers and other components will run cooler (less energy to dissipate)
- Power meters can more accurately measure forward vs. reflected power in the circuit
- Impedance mismatches at an antenna/feed interface are less likely to be masked by the losses encountered with long feed lines.
- Inserting a meter into the circuit has less impact on the behavior of the circuit.

To properly connect the 44D-LX to the circuit to be tested, the cables used to insert the 44D-LX into the circuit should be of a close length (within 10%) to an increment of $\frac{1}{2}$ wavelength. These cables are a “Primary Cable” (always needed) and a “Secondary Cable” (sometimes needed).

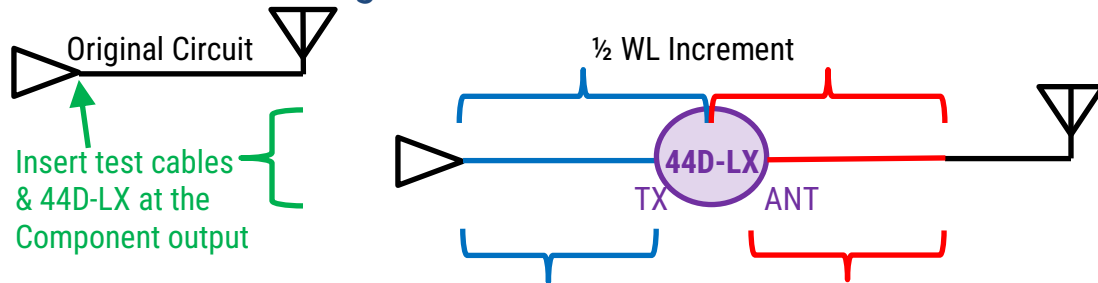
When calculating the length of the “Primary” (sometimes called a “Launch”) or “Secondary” cable, subtract 3 inches (7.6 cm) from the length of the cable to allow for the insertion of the 44D-LX.

It is suggested to have one or two test cables built for each band that needs to be tested. For example, a cable built to 159 MHz would cover 144 MHz to 174 MHz. Another cable built for 455 MHz would cover 440 to 470 MHz. The key is to use the same cables consistently so that the test results are repeatable, thus any system changes will be noticed during maintenance.

! **CAUTION:** The formulas for calculating the cut length of the test cable do not consider the length of any lead wire inside a radio, amplifier, or other device in the RF system. In some situations, the length of the primary and secondary cables should be shortened to compensate.



44D-LX Connection Diagram



Primary Cable (1/2 WL increment minus 3") Secondary Cable (Optional = 1/2 WL incr. - 3")

Calculating the Primary & Secondary Cable Cut Length

The steps to calculate the length of the cables are:

Find the base cable length:

(Speed of Light in a vacuum (299,792,458 Meters/Second) divided by (Frequency in Hertz))
Times (Velocity Factor of the cable in %) Times (wavelength required... 0.5 for 1/2 etc.)

Speed of Light M/S / Frequency Hz (445 MHz)
Math = ((299792458 / 445000000) * 0.85 * 0.5) = 0.286 meters or 28.6 cm

Subtract 2 cm for the 2 N Male connectors (one on the end of the cable):
Sample = 28.6 cm minus 2 cm (for two each N Male connectors) = 26.6 cm

Subtract 7.6 cm (3") for the 44D-LX:
Sample = 26.6 cm minus 7.6 cm (the distance across the thru line sensor) = 19.0 cm

In this example, the final cut length for the cable would be 19.0 cm (7.5")

If a cable is required after the 44D-LX to reach back to the feed line, that cable should be built to the same specifications as the "Primary" or "Launch" cable.

The samples above are for a 1/2 wavelength cable. The cables can be made longer as needed in lengths at a 1/2 wavelength increment: 1.0, 1.5, 2.0, etc.

! CAUTION: The formulas for calculating the cut length of the test cable do not consider the length of any lead wire inside a radio, amplifier, or other device in the RF system. In some situations, the length of the primary and secondary cables should be shortened to compensate.



Appendix: RF Sample Port Isolation

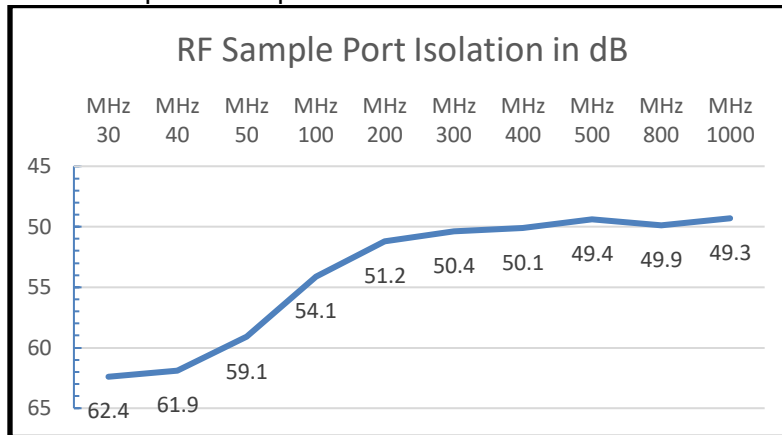
The “RF Sample Port” provides a simple and safe path to connect test equipment to the circuit under test. The port is bi-directional, meaning that a signal from either direction of the thru line coupler can be monitored, or a signal can be injected into both directions of the thru line coupler.

The Sample Port is passive and has a usable bandwidth from 30 to 960 MHz. The active components of the 44D-LX have a narrower bandwidth of 118 to 960 MHz.

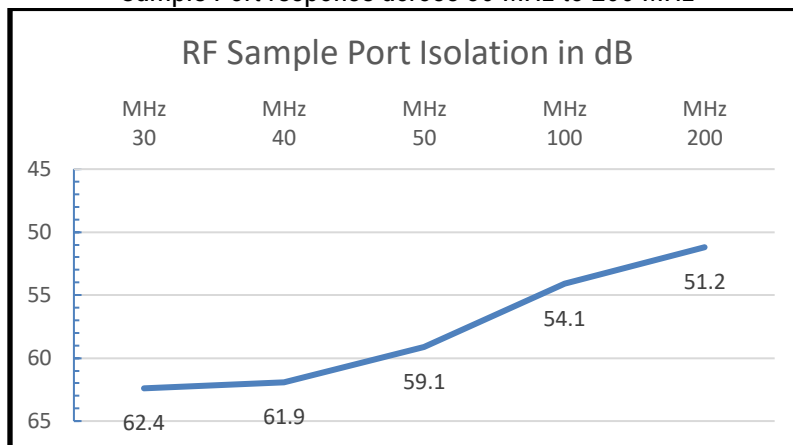
The isolation provided by the sample port is consistent at 50 dB +/- 2 dB from 200 MHz up to 960 MHz (the highest frequency supported by the 44D-LX.)

Below 200 MHz the isolation begins to increase as shown in the tables below until it reaches a maximum of ~62.5 dB at 30 MHz. The response is detailed below for situations where absolute power levels need to be measured (from the circuit under test) or injected (into the circuit).

Sample Port response across the full 30 to 1000 MHz



Sample Port response across 30 MHz to 200 MHz



NOTE: RF signals will flow through the sample port unimpeded with the 44D-LX power turned On or Off.