

protoTx

USER MANUAL

INSTALLATION AND OPERATION



Version 1.1

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Warranty

Polyphase Microwave Inc. warrants this product to be free from defects in material and workmanship for one year from the date of delivery. Damage due to accident, abuse, or signal levels beyond absolute maximum ratings are not covered by this warranty. Polyphase Microwave Inc. will repair or replace, at its option, any components of this product which prove to be defective during the warranty period, provided the entire unit is returned to Polyphase Microwave Inc. or an authorized service facility. In-warranty units will be returned freight prepaid; out-of warranty units will be returned freight collect. No warranty other than the above is expressed or implied.

1. QuickStart Guide

The protoTx series of RF upconverters are programmed over the USB 2.0 interface by a software front panel running on a Windows-based personal computer (PC). This manual describes the installation of the USB drivers and the installation/operation of the protoTx Interface software. The protoTx drivers are compatible with 32-bit and 64-bit versions of Windows XP, Windows Vista, and Windows 7.

For a PC running Windows 7 with an internet connection:

1. Connect the protoTx to your PC using the supplied USB cable. It is not necessary to apply the +/- 5V DC supplies to the protoTx at this time.
2. Windows 7 automatically detects and installs the protoTx USB drivers.
3. Insert the protoTx Installation CD into your PC and run "setup.exe".
4. Follow the installation prompts to install the protoTx Interface software.
5. Restart your computer (if prompted).
6. Apply +/- 5V DC supplies and ground to the protoTx, ensure USB cable is connected to your PC, and run **Programs>>Polyphase Microwave>>protoTx Interface**.
7. If installation succeeds and USB communication is established, the protoTx device's serial number should appear in the upper left field of the protoTx Interface software.

If Windows 7 fails to install the protoTx USB drivers automatically, please follow the instructions in section 2 for installing the USB drivers in Windows 7.

For Windows XP, please refer to section 3 for instructions on installing the USB drivers.

2. Installing USB Drivers in Windows 7

When the protoTx is first connected to a Windows 7 PC with an internet connection, the USB drivers should install automatically. If the drivers do not install correctly, the protoTx status will be “Needs troubleshooting” under **Control Panel>>Devices and Printers** as shown in Figure 1.

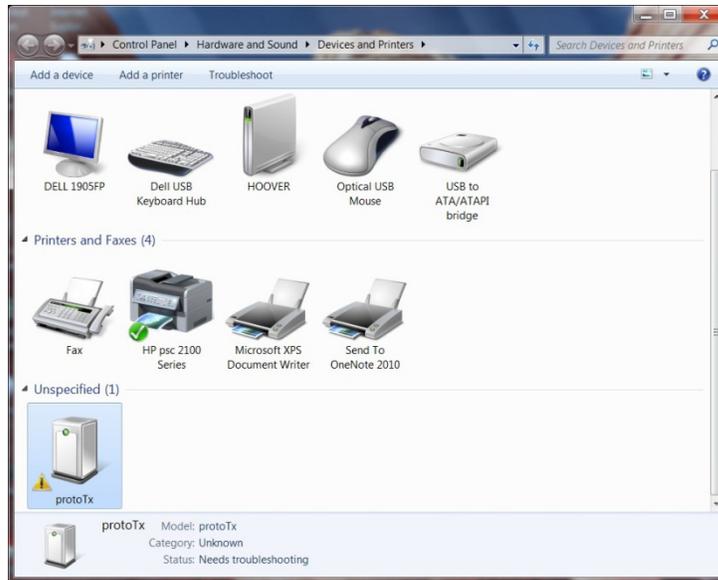


Figure 1. protoTx status “Needs Troubleshooting”

There are two USB drivers to install. Begin the process by right clicking on the protoTx icon in the **Devices and Printers** display and select **Properties**. The protoTx Properties dialog window will open as shown in Figure 2. Select “Change settings” to enable the “Update Driver ...” button. Select “Update Driver ...”

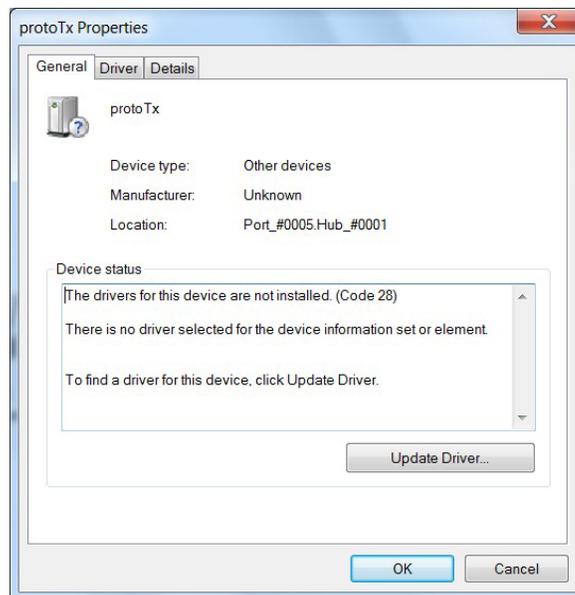


Figure 2. protoTx Properties

Tell Windows 7 to “Browse my computer for driver software” as shown in Figure 3.

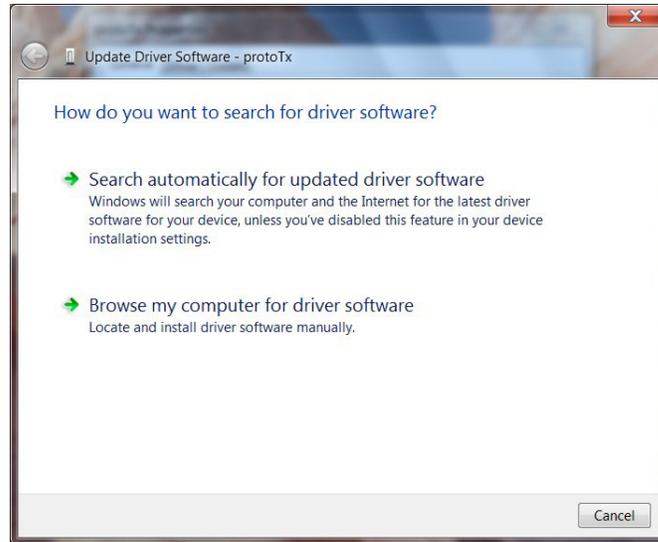


Figure 3. “Update Driver ...” Dialog Box

Insert the protoTx Installation CD and browse for the CD drive. Select “Next” in Figure 4.



Figure 4. Browse for the protoTx Installation CD

Wait for the USB driver to install. You should see the notification in Figure 5 that Windows has successfully updated your driver software. Select “Close”.

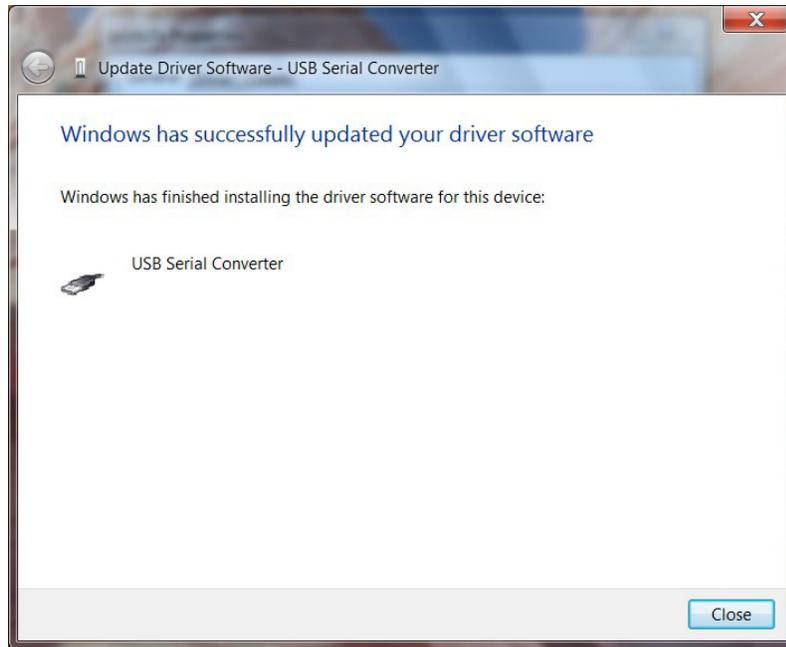


Figure 5. USB Serial Converter Driver Installed

The second USB driver can now be installed. Right click the protoTx icon under **Control Panel>>Devices and Printers** as shown in Figure 6 and select “Properties”.

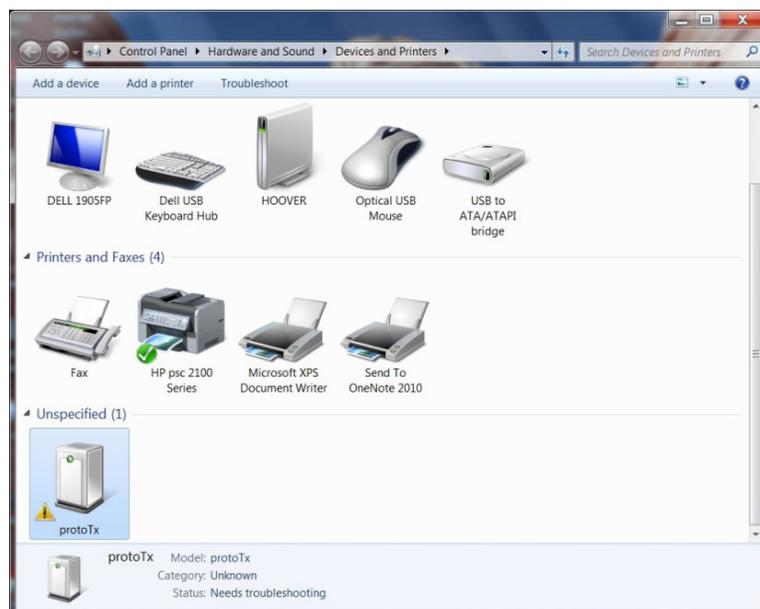


Figure 6. protoTx status “Needs Troubleshooting”

Under the Hardware tab in the “protoTx Properties” window, select “Properties”.

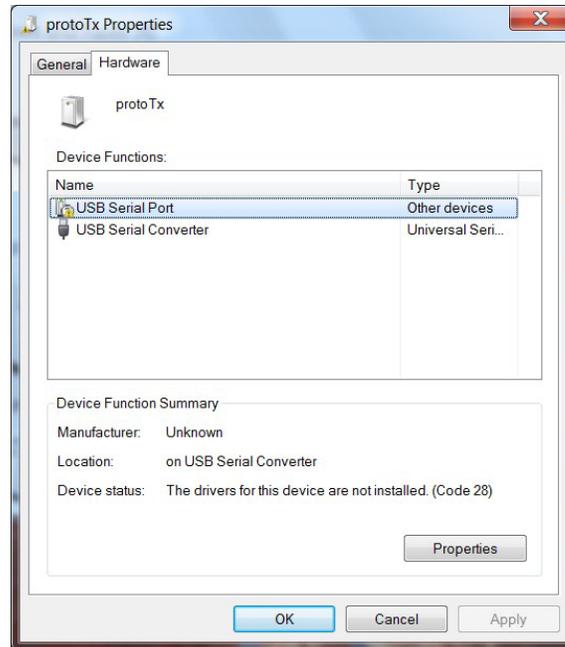


Figure 7. Install protoTx Serial Port Driver

The USB Serial Port Properties window will appear. Select “Change settings” to enable the “Update Driver ...” button. Select the “Update Driver ...” button as shown in Figure 8.

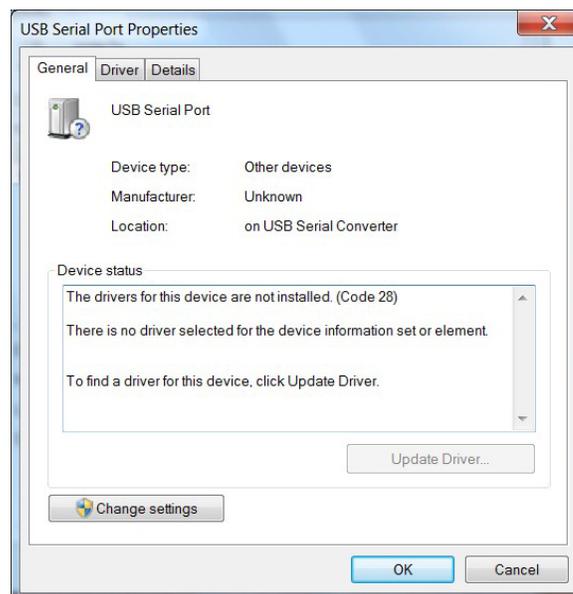


Figure 8. Install protoTx Serial Port Driver

Tell Windows 7 to “Browse my computer for driver software”.

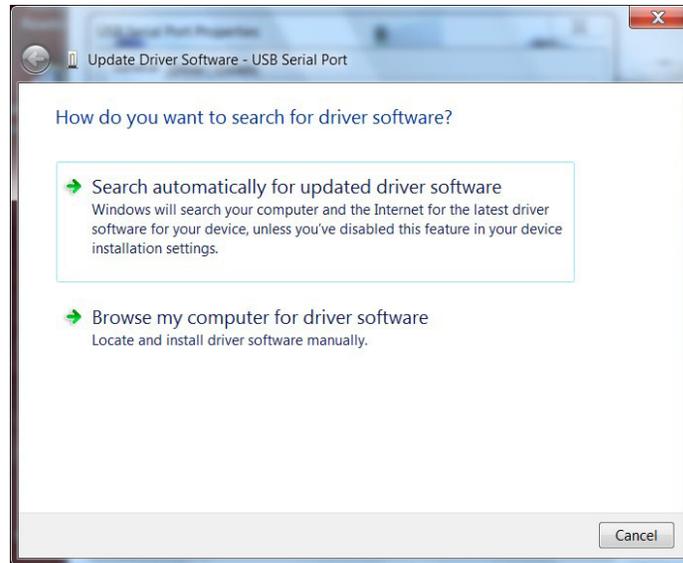


Figure 9. Update Driver Dialog

Select the protoTx Installation CD drive letter and click “Next”.



Figure 10. Browse for the protoTx Installation CD

Wait for the USB Serial Port driver to install. Windows will show a confirmation window when the driver installation is complete. Click “Close”.

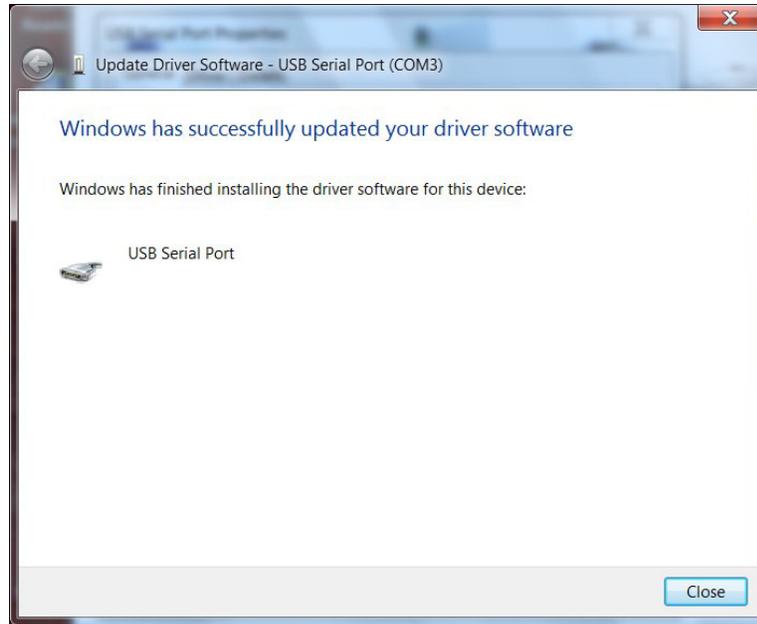


Figure 11. USB Serial Port driver installation complete

If the USB driver installation was successful, the protoTx device should appear without warnings under **Control Panel>>Devices and Printers**.

3. Installing USB Drivers in Windows XP

Connect the protoTx to your PC with the supplied USB cable. The protoTx does not require DC power for installation of the USB drivers. Windows XP should detect the protoTx as shown in Figure 12.



Figure 12. Found New Hardware

The Found New Hardware Wizard will ask if you want to connect to Windows Update to search for a driver. Select “No, not this time” and then “Next”.



Figure 13. Found New Hardware Wizard

Select “Install from a list or specific location (Advanced)” and click “Next”.



Figure 14. Found New Hardware Wizard

Insert the protoTx Installation CD and browse for the drive letter. Click “Next” to install the USB Serial Converter Driver.

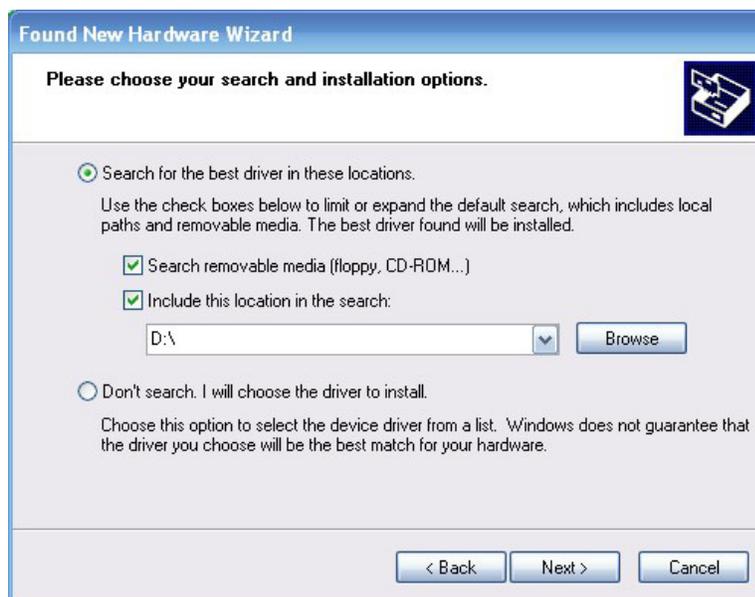


Figure 15. Browse for the protoTx Installation CD

Wait for Windows XP to install the driver. A confirmation dialog will appear when the driver is installed. Click “Finish”.



Figure 16. USB Serial Converter Driver Installed

Windows XP will now detect the new USB Serial Port hardware and request a connection to Windows Update. Select “No, not this time” and click “Next”.



Figure 17. Found New Hardware Wizard

Select “Install from a list or specific location (Advanced)” and click “Next”.



Figure 18. USB Serial Port Driver Installation

Browse for the protoTx Installation CD drive letter and click “Next” to install the USB Serial Port driver.

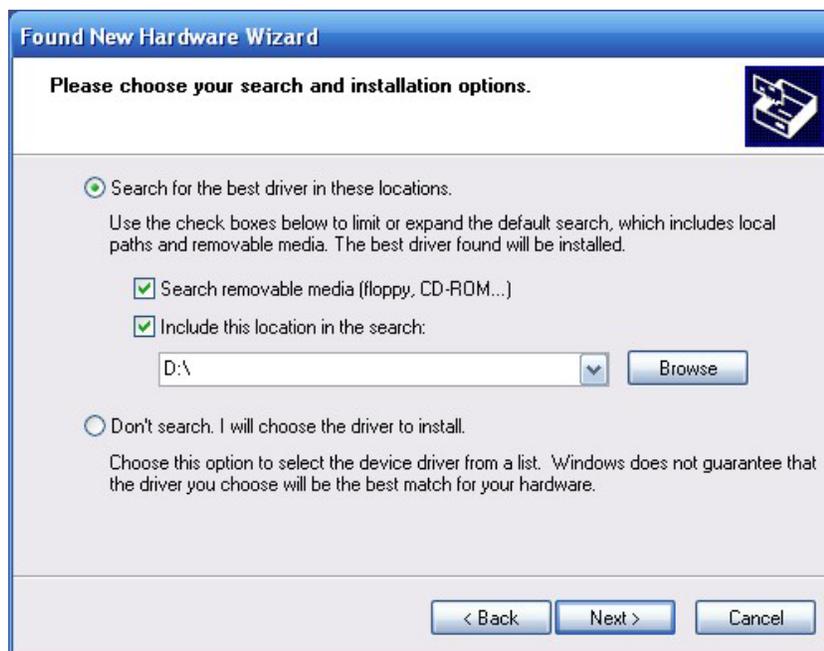


Figure 19. Browse for the protoTx Installation CD

Wait for the driver to install. A confirmation dialog will appear when the driver has installed correctly. Click "Finish".



Figure 20. USB Drivers Successfully Installed

4. Installing the protoTx Interface Software

After the protoTx USB drivers have been installed, run the “setup.exe” file located in the protoTx Installation CD. The protoTx Installer will display the welcome screen. Click “Next”.

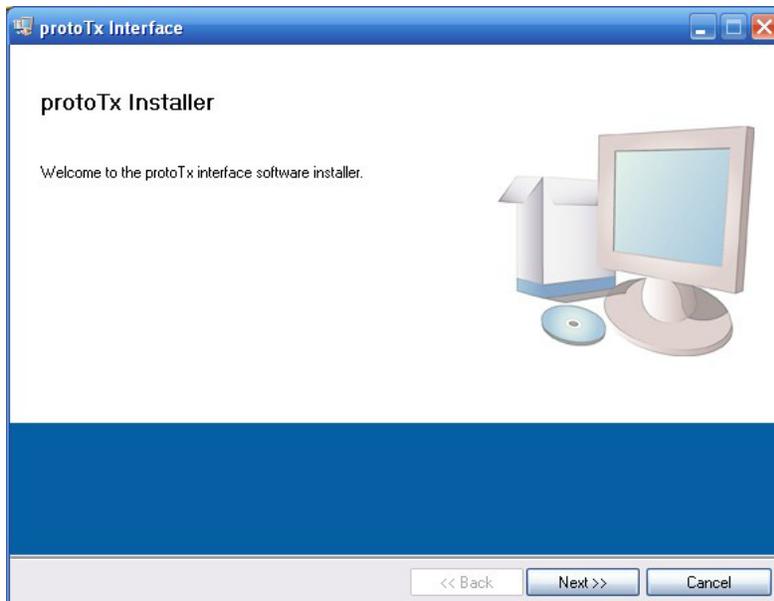


Figure 21. protoTx Installer Welcome

If the default installation directories are acceptable, click “Next”.



Figure 22. Default Installation Directories

Select “I accept the License Agreement” to install the National Instruments LabView Runtime Engine v8.6. Click “Next”.

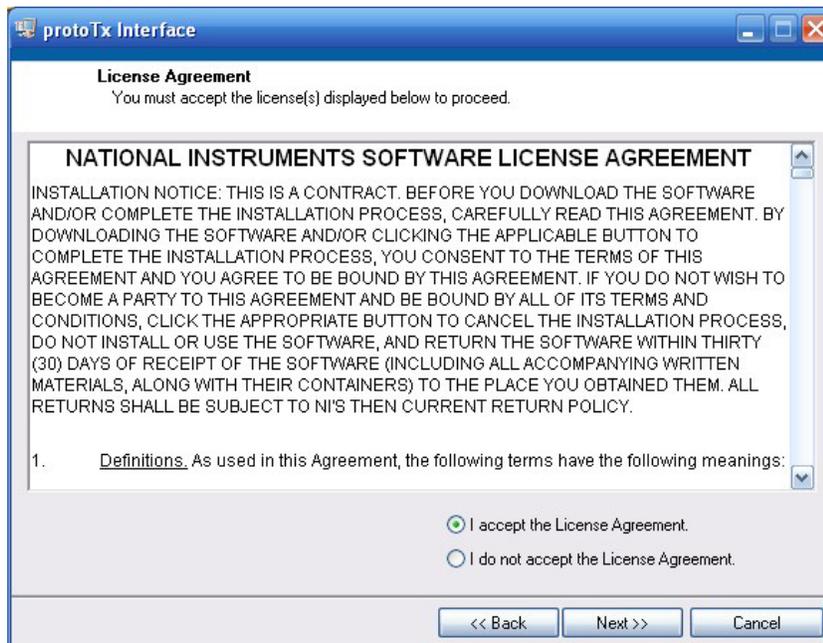


Figure 23. Default Installation Directories

A confirmation dialog appears that lists the installation tasks. Click “Next” to begin installing the protoTx Interface Software files.

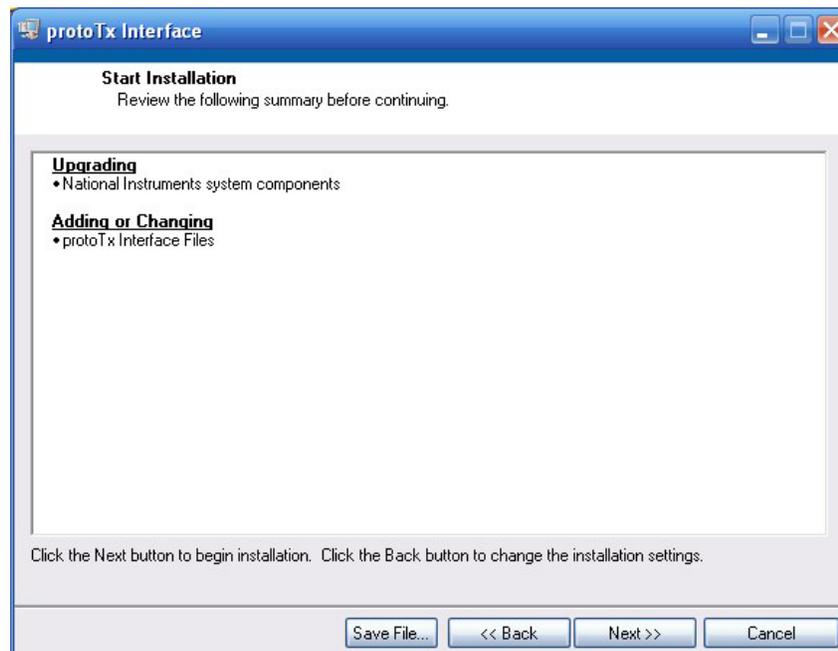


Figure 24. Confirm Installation Tasks

Wait for the installation to complete. If errors or warnings appear, do not quit or exit the installation. Most errors or warnings do not affect the proper operation of the protoTx Interface Software. Click “Next” when the installation is complete.

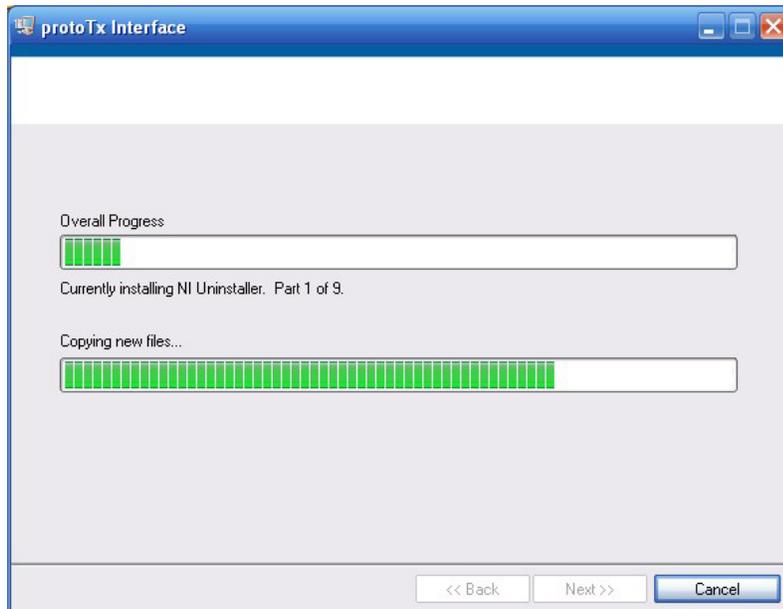


Figure 25. Installing protoTx Interface Software

When the installation completes, click “Finish”. The protoTx Interface Software is added to the list of installed programs at **Programs>>Polyphase Microwave>>protoTx Interface**.



Figure 26. Installation Complete

5. Setup protoTx Hardware

Before starting the protoTx Interface Software, first apply +5 V, -5 V, and ground to power up the protoTx. The +5 V supply draws approximately 575 mA and the -5 V supply draws 45 mA. Ensure the +5 V supply voltage is in the range of +4.95 V minimum to +5.25 V maximum. The -5 V supply should be in the range of -5.25 V minimum to -4.95 V maximum. The protoTx will not be damaged by short periods of reverse polarity and/or overvoltage conditions up to +/- 12V.

The USB cable should be connected between the protoTx and your PC. DC voltages and the USB cable can be connected or disconnected in any order.

When the protoTx is powered up for the first time it will default to the Factory Preset configuration:

- Synthesizer Mode
- 1000.000000 MHz RF Output Frequency
- +0 dBm RF Output Power
- RF Output On
- Internal 10 MHz Reference

Hardware functionality can be verified by connecting the protoTx RF output port to a spectrum analyzer or other instrumentation. Please note the protoTx is capable of producing up to +24 dBm output power and can cause damage to some power sensors. Exercise caution when connecting instrumentation directly to the protoTx RF output port.

6. protoTx Interface Software

Launch the software by running **Programs>>Polyphase Microwave>>protoTx Interface**. The protoTx Interface soft front panel displays the current settings of the protoTx as seen in Figure 27.

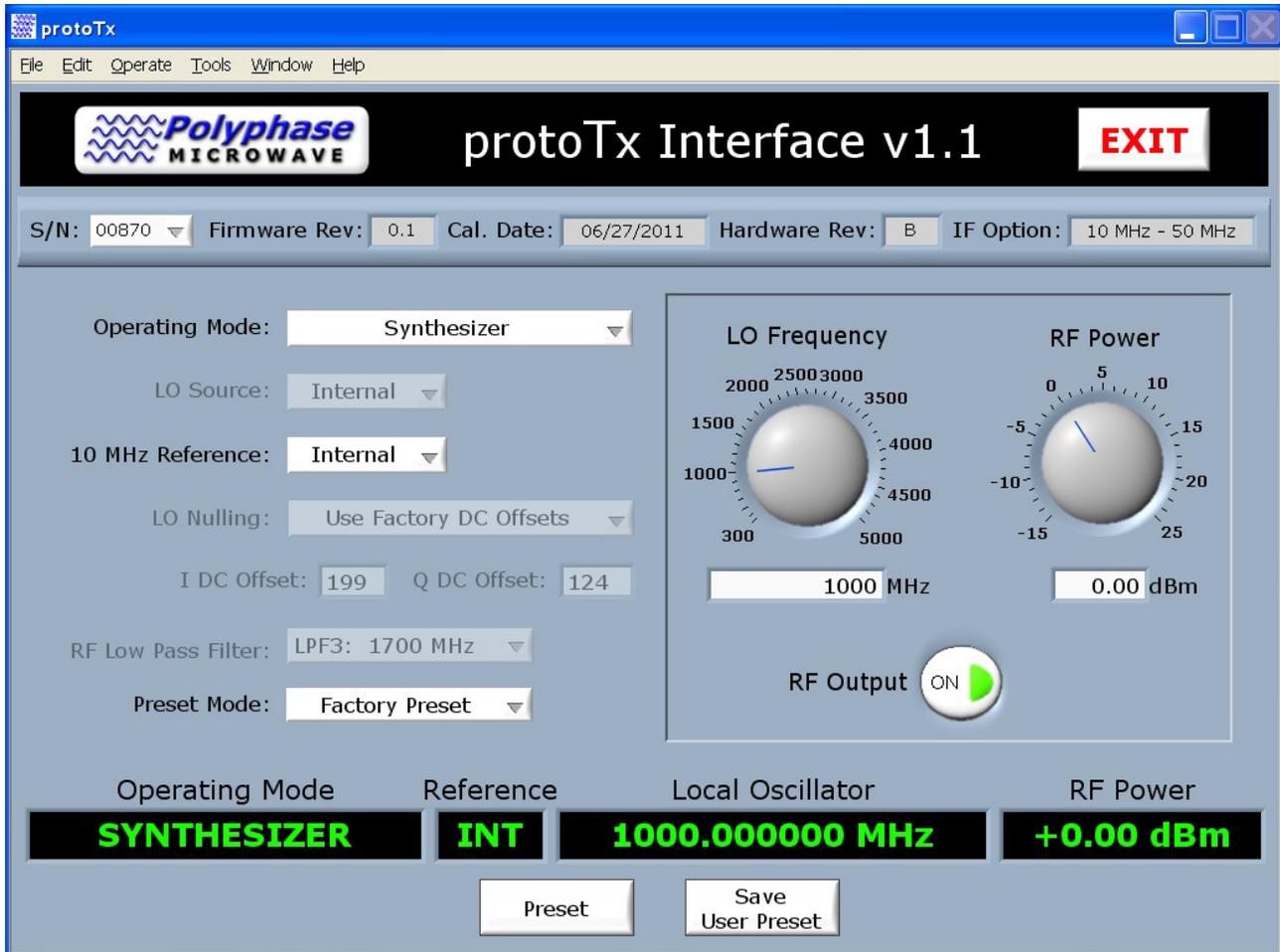


Figure 27. protoTx Soft Front Panel

When USB communication is established, the protoTx serial number will appear in the upper left “S/N:” drop down list. If multiple protoTx units are connected, the active protoTx can be selected from the “S/N:” drop down list. If USB communication with the protoTx fails, an error window will provide instructions for repairing the protoTx USB connection.

Firmware Rev, Cal. Date, Hardware Rev, IF Option

These fields are informational only and cannot be changed.

Operating Mode: This control selects between the four operating modes. Depending on the mode selected, some controls are enabled or disabled. The four operating modes are:

- **I/Q Upconverter** The protoTx is configured to accept I and Q baseband inputs for direct modulation of the LO. The user's I and Q signal sources should be DC coupled with 50Ω source impedance.
- **RF=LO+IF Upconverter** The protoTx will upconvert the IF input to the upper RF sideband. The lower RF sideband is rejected and the LO leakage is nulled. The I and Q input ports should be left open for best LO leakage performance.
- **RF=LO-IF Upconverter** The protoTx will upconvert the IF input to the lower RF sideband with spectral inversion (the highest IF frequency component will be upconverted to the lowest RF frequency). The upper RF sideband is rejected and the LO leakage is nulled. The I and Q input ports should be left open for best LO leakage performance.
- **Synthesizer** The internal LO synthesizer is available at the RF output. I, Q, and IF inputs should be left disconnected to prevent unwanted modulation.

LO Source: When **External** is selected, the user should apply an LO signal with -5 dBm nominal power to the LO port of the protoTx. When **Internal** is selected, the protoTx uses the internal fractional/integer-N PLL synthesizer as the LO source.

10 MHz Reference: When **External** is selected, the user should connect a 10 MHz reference to the REF port. The 10 MHz signal should be 1 Vp-p nominal amplitude into 50Ω with no spurious tones out to 100 kHz offset from the carrier. When **Internal** is selected, the protoTx LO synthesizer locks to the internal TCXO and outputs the buffered 1 Vp-p 10 MHz reference signal at the REF port.

LO Nulling: When **Use Factory DC Offsets** is selected, the protoTx uses the factory calibration to calculate the optimum I and Q DC offsets that null (minimize) the LO leakage at the RF port. The I and Q DC offsets are 8-bit unsigned integers with values in the range of 0-255 that control internal I and Q

DC current sources. By selecting **Enter DC Offsets Manually** the LO leakage can be nulled by the user. First adjust the **I DC Offset** to minimize the LO leakage, then adjust the **Q DC offset** for minimum LO leakage, and then repeat until the desired level of LO nulling is achieved.

RF Low Pass Filter: Selects between the 5 internal RF low pass filters: 500 MHz, 950 MHz, 1700 MHz, 3250 MHz, and 5500 MHz. The filter's frequency indicates the -1 dB passband frequency of the filter. An RF filter should be selected that rejects the x2 and higher harmonics of the RF frequency while avoiding group delay variation effects near the filter's cutoff frequency.

Preset Mode: When **Factory Preset** is selected, the protoTx will power up with the following settings: Synthesizer Mode, 1000.000000 MHz RF Output Frequency, +0 dBm RF Output Power, RF Output On, and Internal 10 MHz Reference. When **User Preset** is selected, the protoTx will power up to the most recently saved User Preset settings.

LO Frequency: Selects the frequency of the internal LO synthesizer. When the selected frequency is an integer multiple of 10 MHz, the LO synthesizer operates in integer-N mode and is an exact integer multiple of the 10 MHz reference. LO frequencies that are non-integer multiples of 10 MHz are generated using fractional mode and are accurate to within +/- 0.5 Hz up to 2400 MHz and +/- 1.0 Hz from 2400 MHz to 5000 MHz. When an external LO is used, the internal LO synthesizer is disabled, but the LO Frequency control can still be used to calculate the Factory Calibration I and Q DC Offsets for optimum LO nulling.

RF Attenuator: Active in I/Q Upconverter, $RF=LO+IF$, and $RF=LO-IF$ operating modes. The RF attenuator has a range of 0 dB minimum to 31.75 dB maximum attenuation. Step size is 0.25 dB.

RF Power: Controls the RF power level in Synthesizer operating mode. The leveled power range varies with LO frequency, with a typical range of -5 dBm minimum to +20 dBm maximum. Refer to the protoTx datasheet for a plot

of the leveled output power vs. LO frequency. If the **RF Power** is set above the maximum leveled power, a red “**Unleveled**” indicator warning will display in the lower right corner of the front panel. Absolute power level accuracy is +/- 2.0 dB typical over frequency and temperature.

RF Output: Selecting **OFF** disables the output amplifier and disables the internal LO synthesizer.

The **Status Indicators** shown in Figure 28 summarize the protoTx status. If the internal LO is locked, the actual output frequency will be displayed. If the LO is unlocked, “UNLOCKED” will be displayed. If an external LO is selected, “EXTERNAL” is displayed.



Figure 28. protoTx Status Indicators

Note: The internal LO lock/unlock status is NOT continuously polled. The LO status is read and updated once on software start and immediately after any control’s value is updated. Any change in lock status will be displayed only after a front panel control’s value is updated. For example, if an external 10 MHz reference is removed and the internal LO loses phase lock, the UNLOCKED status will not be displayed until after the user updates any control’s value (or restarts the software).

Preset: Pressing this button forces an immediate preset. If **Preset Mode** is set to **User Preset**, the User Preset settings will be recalled and displayed. If **Preset Mode** is set to **Factory Preset**, the protoTx will recall the following settings: Synthesizer Mode, 1000.000000 MHz RF Output Frequency, +0 dBm RF Output Power, RF Output On, and Internal 10 MHz Reference.

Save User Preset: Pressing this button saves the control settings to the protoTx User Preset non-volatile memory.