Agilent N4880A

Reference Clock Multiplier

User's Guide

Agilent Technologies

Notices

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Safety Summary

General Safety Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

General

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

Environment Conditions

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

Ground the Instrument

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Safety Symbols on Instruments

Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.

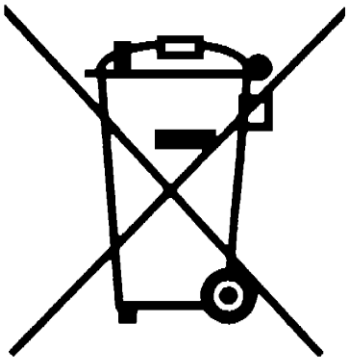
Safety requirements for electrical equipment for measurement, control, and laboratory use CAN/CSA C22.2 No. 1010.1 (1993) UL 3101, 3111 (First Editions). This equipment has also been evaluated to IEC 61010 edition 1 including amendments 1 and 2.

Notice for European Community: This product complies with the relevant European legal Directives: EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC.

Conformity Mark of the Australian ACA for EMC compliance.

General Recycling Mark for plastic parts used in the product.

Environmental Information



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Contents

Contents 5

1 Introduction 6

1.1 Front Panel 8

1.2 Rear Panel 10

1.3 N4880A Installation 11

1.3.1 Pre-Requisites 11

1.3.2 Installation Process 11

1.4 Firmware Update 16

2 N4880A User Interface 17

2.1 Operating Modes 19

2.2 Clock Source 21

2.3 N4880A Output Frequency 22

2.4 BERT Output Clock Frequency and Clock Divider Values 23

2.5 Indicators 24

2.6 Help/About 25

3 Operating Modes and Specifications 27

3.1 PCI Express 27

3.2 MIPI M-PHY 28

3.3 UHS-II 29

4 Programming Interface 31

4.1 Command Line Programming Interface 31

4.1.1 Available Parameters 31

4.1.2 Return Code 34

4.2 J-BERT SCPI Interface Extension 35

4.2.1 Setup 35

5 Troubleshooting 39

1 Introduction

Agilent Technologies' N4880A Reference Clock Multiplier

The N4880A is a reference clock multiplier. It extends the J-BERTs and ParBERTs capability to allow jitter pass through from the reference clock to the BERTs data out. The supported operating modes are PCI Express 1 to 3, MIPI M-PHY and UHS-II standards.

Features and Benefits

- Flexible usage as front-end for J-BERT N4903B, ParBERT 81250A or other pattern generators
- Small size
- Remote programmable via J-BERT N4903B or PC
- USB connectivity

What's inside this Manual

This manual provides detailed information about the following:

- N4880A Front and Rear Ports
- N4880A Graphical User Interface
- Operating Modes and Specifications
- Programming Interface
- Troubleshooting

Purpose of this Manual

The purpose of this manual is to enable you to install, initialize, and start the N4880A.

Who should read this Manual

This manual is intended for testers and engineers who will be using the N4880A to test other devices with or without connecting the N4880A to a N4903B

Terms and conventions used in this manual

The following table lists the terms and conventions used in this manual:

Conventions

The icon...	Indicates...
	A note or important information
	A tip
	A caution or warning
	Notes within a table

Acronyms used in this manual

The following table lists the acronyms and abbreviations used in this manual:

Acronyms used in this Document

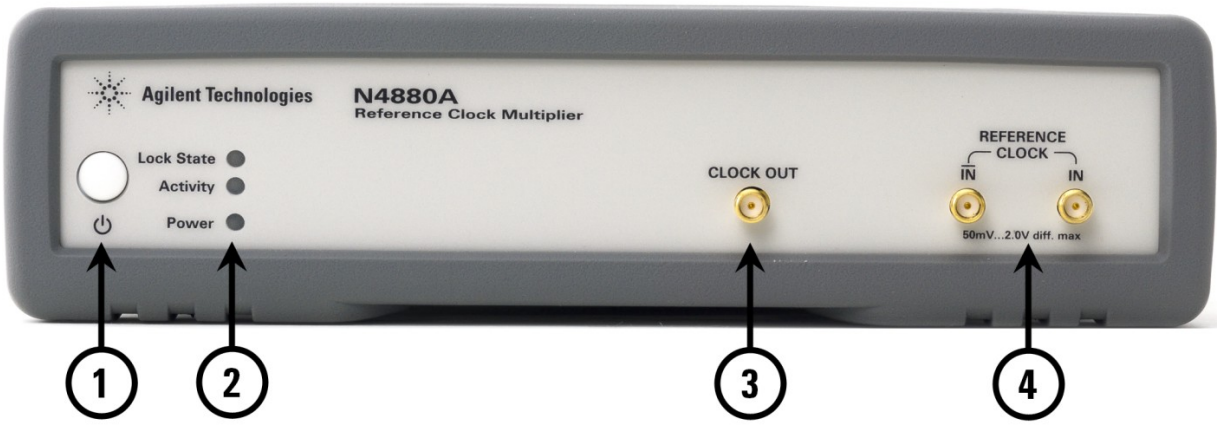
Acronym	Explanation
LED	Light Emitting Diode
MIPI	Mobile Industry Processor Interface
M-PHY	M Physical Layer
PCIe	Peripheral Component Interconnect Express
PLL	Phase Locked Loop
RCM	Reference Clock Multiplier
UHS-II	Ultra High Speed 2
USB	Universal Serial Bus

1.1 Front Panel

Introduction

The N4880A is only operated remotely.

This section explains the Key, LEDs, Inputs and Output seen on the Front Panel of the N4880A.



1 Power Switch

2 Status LEDs

Lock State	Signals the lock state of the PLL Green when the PLL is locked Red when the PLL is unlocked
Activity	Flashes green when the instrument is connected to the graphical user-interface Constantly green when device is up and running Red when there is a selftest error
POWER	Constantly green when instrument is ON (powered) Red when instrument is OFF (in power standby mode)

3 CLOCK OUT Clock Output

Electrical specification:

- Amplitude typical 300 - 600 mVpp (not adjustable)
- Offset AC coupled
- Termination 50 Ω into 0 Vdc
- Transition Times Typical <25 ps (20%/80%) (not adjustable)

4 REFERENCE CLOCK IN Non-Inverted data input

/REFERENCE CLOCK IN Inverted data input

Required input voltages for REFERENCE CLOCK IN and /REFERENCE CLOCK IN:

- Amplitude min 100 mVpp differential
- Amplitude max 2 Vpp differential
- Offset AC Coupled
- Absolute max Voltage +3 V
- Absolute min Voltage -3 V
- Clock Input Transition Times < 7.7 ns 20% - 80%

Unused inputs and outputs have to be terminated with 50 Ω.

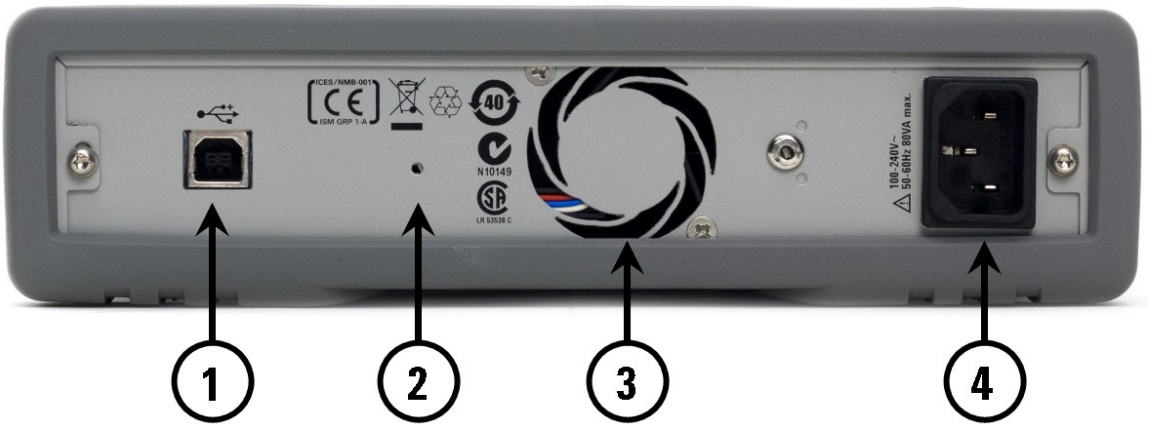
1.2 Rear Panel

Introduction

The rear panel contains:

- USB interface connector for remote control of the instrument.
- Firmware update button to update the firmware in case of server error.
- Fan outlet for cooling the instrument
- Power Connection

The following figure shows the rear panel view of the N4880A.



1 USB Interface Connector (device type for remote access)

2 Firmware update button

Pressing this button during device power up will put the device into firmware update mode. When activated the Lock State LED will flash. Restarting the device without pressing this button will resume normal operation

3 FAN outlet

4 Power Connector (100 – 240V~ 50/60Hz 80VA max.)

1.3 N4880A Installation

This section will show you the steps required to install the M4880A software package.

1.3.1 Pre-Requisites

Pre-requisites for installing the Agilent N4880A software:

- The supported Operating Systems are:
  - Windows XP SP3 English (32 bit)
  - Windows Vista SP2 English (32 bit)
  - Windows Vista SP2 English (64 bit)
  - Windows 7 SP1 English (32 bit)
  - Windows 7 SP1 English (64 bit)
- Ensure that you have .NET 2.0 with Service Pack 2 installed on your system.
- For using the J-BERT SCPI remote extension J-BERT firmware version 7.20 is necessary.

1.3.2 Installation Process

This section will show you the steps required to install the N4880A software package.

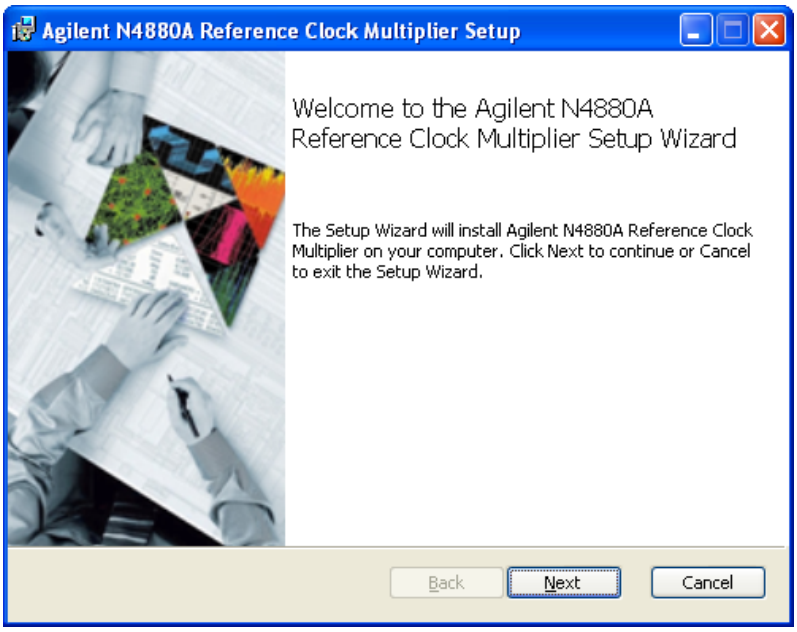
Install the N4880A software package before connecting the device with the computer otherwise there can be problems finding the device.

Follow the given steps to install **Agilent N4880A** software on your system.

---

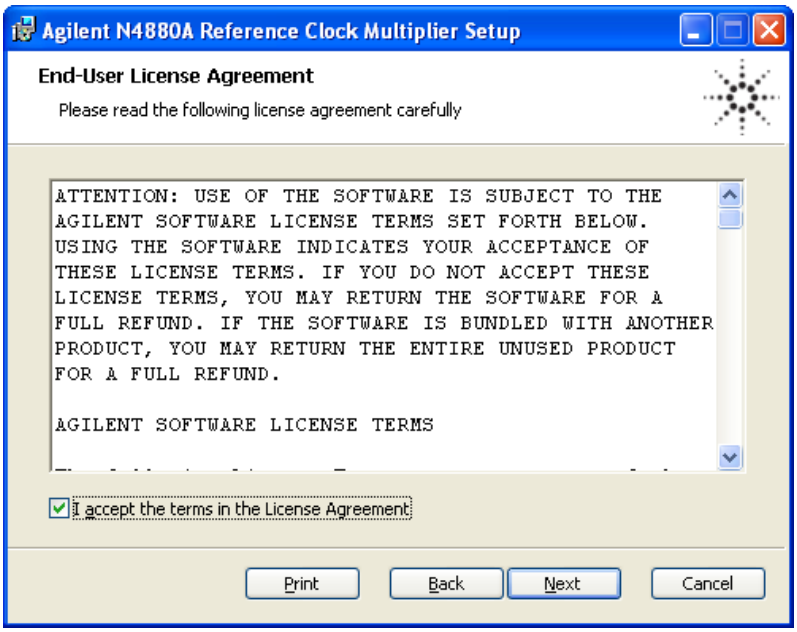
1. Double-click the executable (N4880A_Installer.msi). This executable file will be available either on CD, USB drive or Web.

The following welcome window will appear.

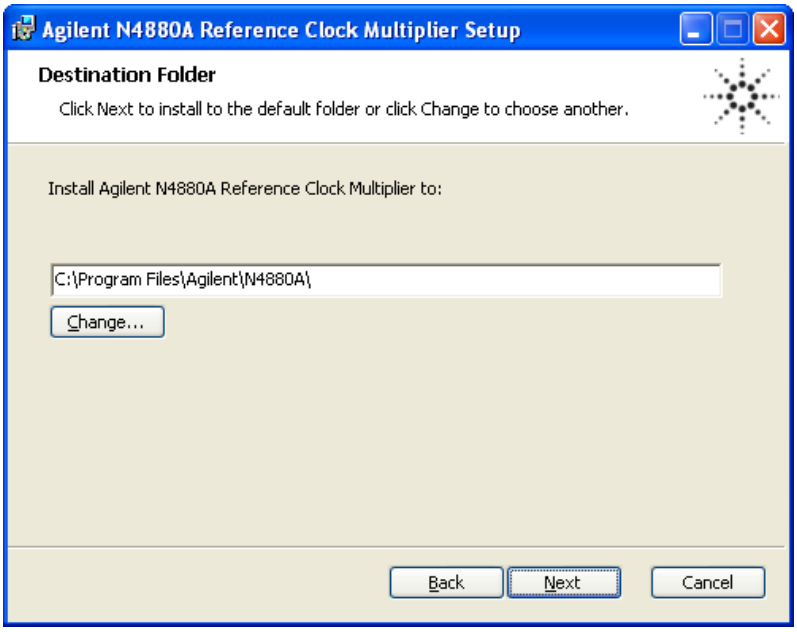


Click “Next” to continue.

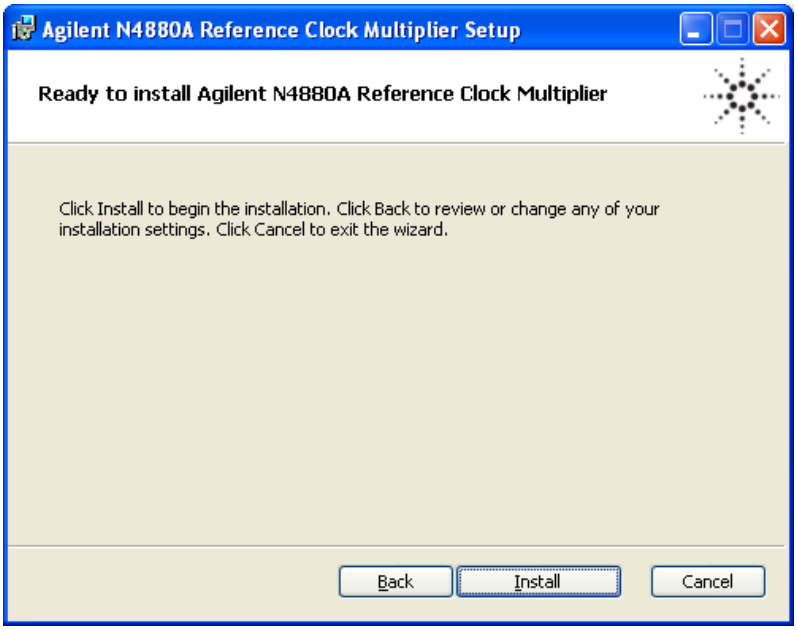
2. Accept the terms of license agreement. Click “Next” to continue.



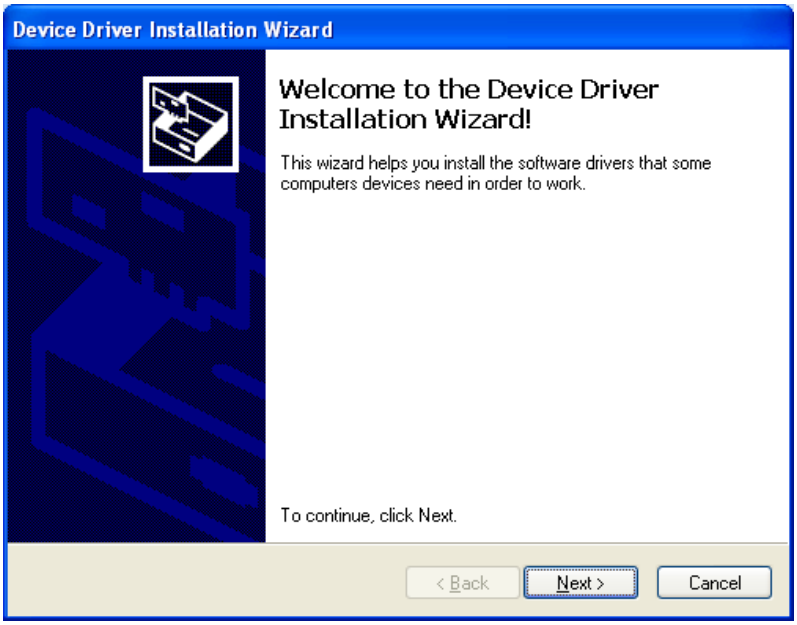
3. Click “Change” if you wish to change the install directory to a different location. Click “Next” to continue.



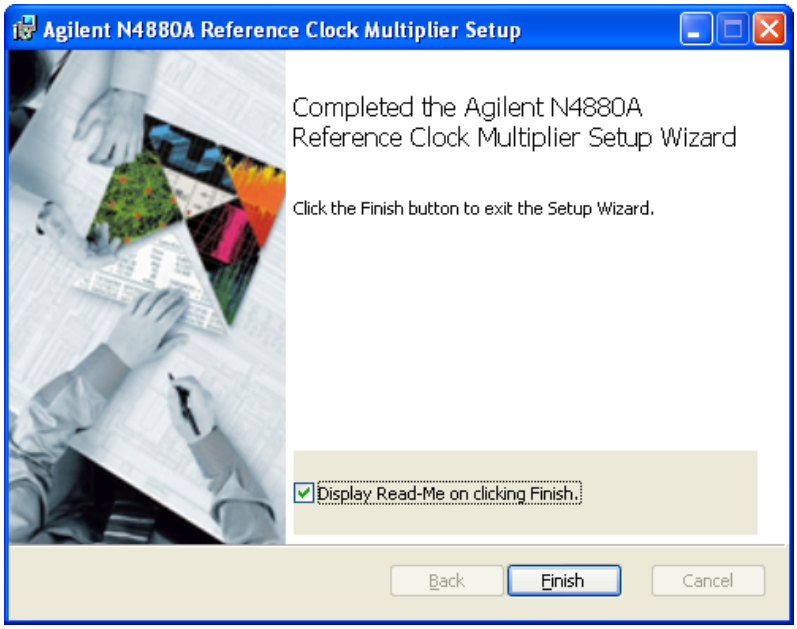
4. Click “Next” to begin the installation.



5. The “Device Driver Installation Wizard” window will appear. Click “Next” to install the software drivers.



6. The following window will appear. This completes the N4880A software installation process. Click “Finish” to exit the Agilent N4880A Reference Clock Multiplier Wizard.



7. Once installation is finished depending on your system a reboot may be necessary. Otherwise the Reference Clock Multiplier may not be found when plugged in.

8. Connect the N4880A via USB to the corresponding J-BERT or PC.

The device driver is installed via the installation program and can also be found in the “Driver” folder inside the installation directory.

1.4 Firmware Update

The graphical user interface only operates when the RCM device is programmed with the corresponding version of its firmware. If the RCM device version is not correct a prompt shows up to guide through the update process.

Click “Update” to start the update process.

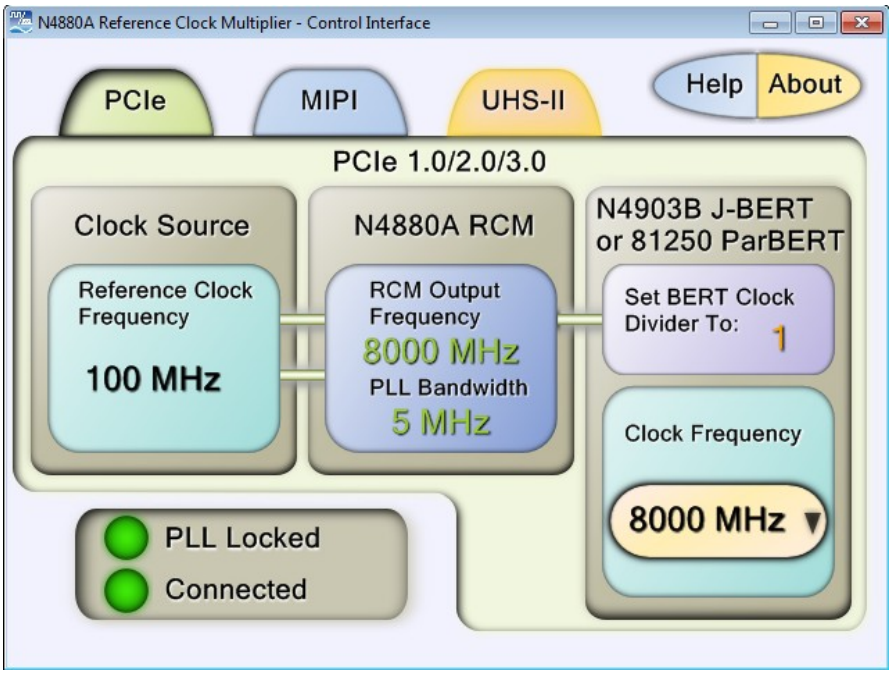
Be sure not to power off the N4880A or the PC while running the update process. Otherwise, your device might get damaged. When using the updater for the first time it may take about one minute after pushing the update button before any progress is shown.

2 N4880A User Interface

Introduction

This chapter describes the graphical user interface of the N4880A.

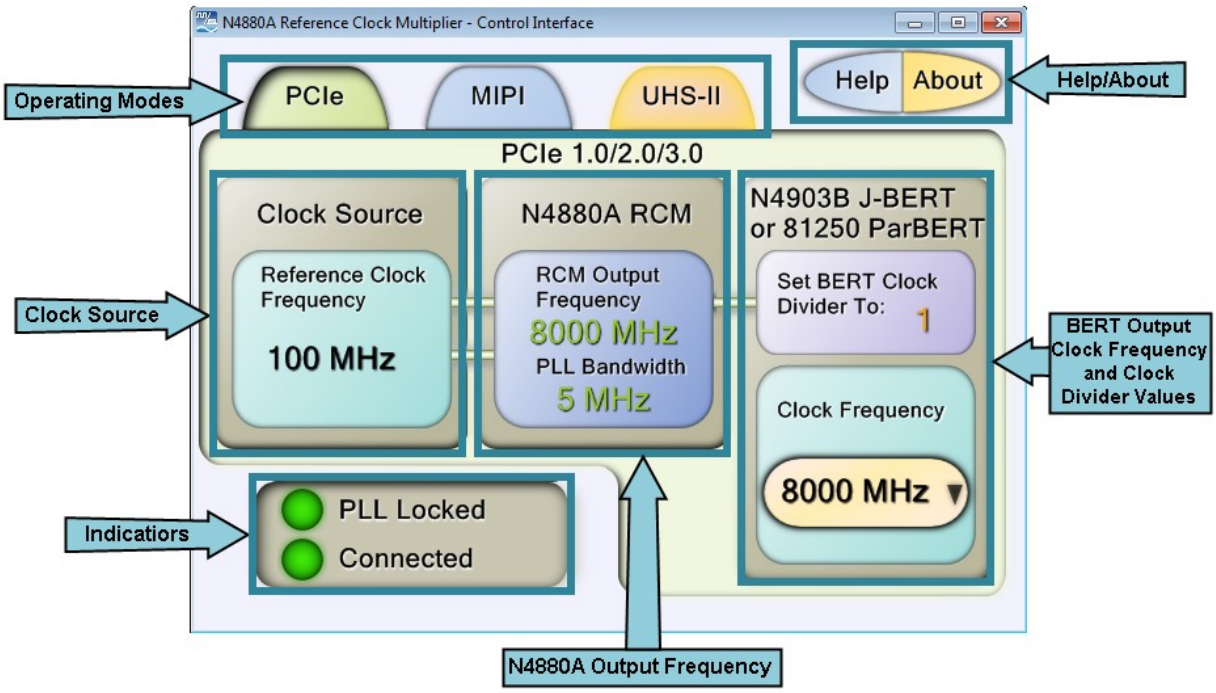
The graphical user interface controls and monitors the connected N4880A Reference Clock Multiplier. It is shown in the figure below.



- The remote GUI automatically prompts the user for a firmware update if necessary and opens the firmware updater program
- It does not accept any other firmware version than the one that is installed together with the Remote GUI

Only one device per PC is supported and only one Remote GUI running at once is allowed.

The highlighted elements of the graphical user interface of the N4880A are described in the section that follows.



2.1 Operating Modes

Operating Modes

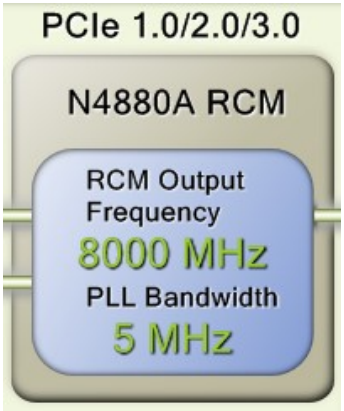
At the top of the main screen the three operating modes PCIe, MIPI M-PHY and UHS-II are selected.

You can simply click the respective tab to select the desired operating mode.

PLL Bandwidth

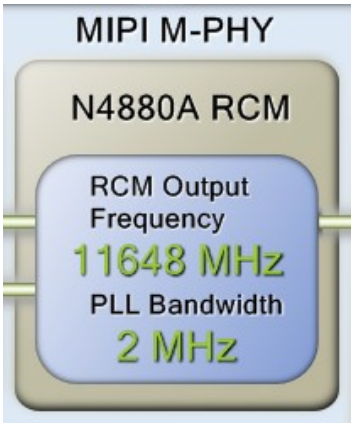
PLL Bandwidth is chosen by the firmware. It depends on the selected standard and the reference clock multiplier.

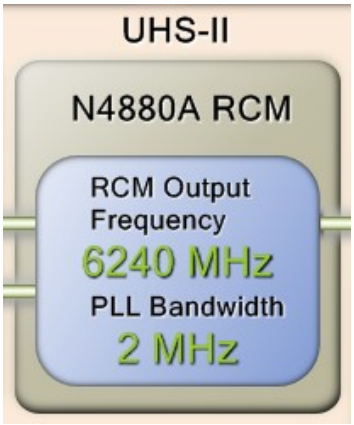
For example:



PCIe uses the 5 MHz bandwidth filter

MIPI M-PHY and UHS-II use a 2 MHz bandwidth filter.



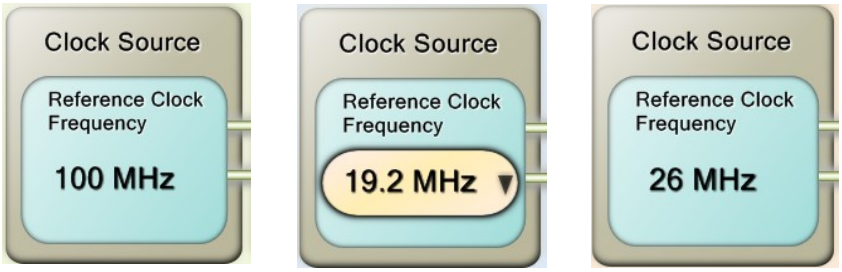


2.2 Clock Source

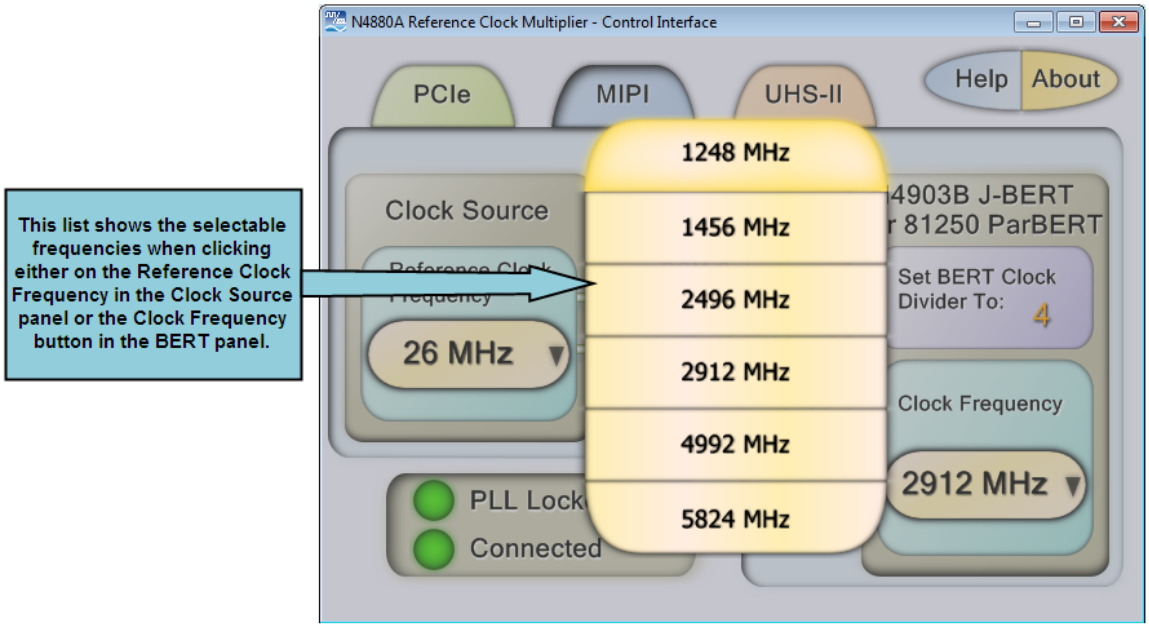
Clock Source

The Clock Source configures the input frequency supplied to the REFERENCE CLOCK IN terminal. For PCIe this value is restricted to 100 MHz and for UHS-II it is derived from the selected BERT Clock Frequency. In MIPI M-PHY mode the Reference Clock Frequency values defined in the MIPI M-PHY standard are selectable.

To set the Reference Clock Frequency (if applicable) or the BERT Clock Frequency, push the corresponding yellow button.



PCIe **MIPI M-PHY** **UHS-II**



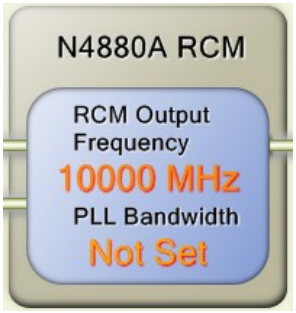
In MIPI M-PHY mode the available settings will show up.

Be aware that in MIPI M-PHY mode changing the Reference Clock Frequency can lead to a change in the BERT Clock Frequency (visible on the right side).

2.3 N4880A Output Frequency

N4880A Output Frequency

The center shows the frequency generated by the Reference Clock Multiplier output at its CLOCK OUT terminal (provided the Reference Clock Frequency is selected correctly and the PLL of the N4880A is locked). Green coloring indicates that everything is set correctly; orange coloring indicates unset values or erroneous settings.

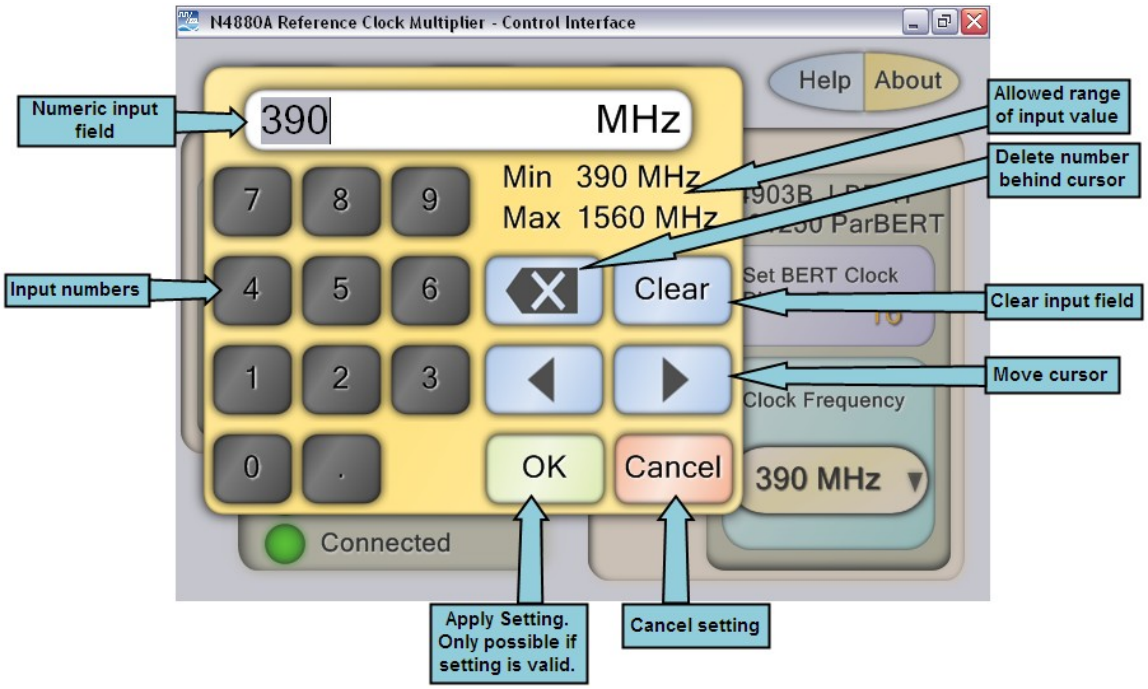


2.4 BERT Output Clock Frequency and Clock Divider Values

BERT Output Clock Frequency and Clock Divider Values

The middle right shows the BERT Clock Divider, this value divides the Output Frequency of the RCM down to the selected BERT Clock Frequency. Below that is the Clock Frequency, this value represents the desired output which is generated by the connected J-BERT or ParBERT after setting the correct BERT Clock Divider.

Pressing the Clock Frequency button in UHS-II mode shows the numeric input dialog.

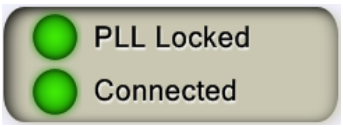


2.5 Indicators

Indicators

The following indicators are present on the graphical user interface:

- **PLL Locked:**
  Displays if the internal N4880A PLL (Phase Locked Loop) is locked onto the supplied reference clock.
- **Connected:**
  Indicates if the Remote GUI found a N4880A device and is connected to it.



2.6 Help/About

Help Click to open the help file (PDF document).

About Click to display the hardware information.

3 Operating Modes and Specifications

Overview

The Reference Clock Multiplier N4880A supports the following operating modes:

1. PCI Express version 1.0, 2.0 and 3.0
2. MIPI M-PHY
3. UHS-II

These tables give an overview of all supported operating modes and the corresponding divider which needs to be selected in the J-BERT or ParBERT Pattern Generator.

3.1 PCI Express

All three modes need a reference clock of 100 MHz at REFERENCE CLOCK IN.

Standard	N4880A REFERENCE CLOCK IN	N4880A CLOCK OUT	BERT Clock Out	BERT Clock Divider	N4880A PLL Loop Bandwidth
PCIe 1	100 MHz	10 GHz	2.5 GHz	4	5 MHz
PCIe 2	100 MHz	10 GHz	5 GHz	2	5 MHz
PCIe 3	100 MHz	8 GHz	8 GHz	1	5 MHz

3.2 MIPI M-PHY

Available REFERENCE CLOCK IN values and their BERT Clock Out values:

N4880A REFERENCE CLOCK IN	N4880A CLOCK OUT	BERT Clock Out	BERT Clock Divider	N4880A PLL Loop Bandwidth
19.2 MHz	9.984 GHz	1.248 GHz	8	2 MHz
19.2 MHz	11.6736 GHz	1.4592 GHz	8	2 MHz
19.2 MHz	9.984 GHz	2.496 GHz	4	2 MHz
19.2 MHz	11.6736 GHz	2.9184 GHz	4	2 MHz
19.2 MHz	9.984 GHz	4.992 GHz	2	2 MHz
19.2 MHz	11.6736 GHz	5.8368 GHz	2	2 MHz
26 MHz	9.984 GHz	1.248 GHz	8	2 MHz
26 MHz	11.648 GHz	1.456 GHz	8	2 MHz
26 MHz	9.984 GHz	2.496 GHz	4	2 MHz
26 MHz	11.648 GHz	2.912 GHz	4	2 MHz
26 MHz	9.984 GHz	4.992 GHz	2	2 MHz
26 MHz	11.648 GHz	5.824GHz	2	2 MHz
38.4 MHz	9.984 GHz	1.248 GHz	8	2 MHz
38.4 MHz	11.6736 GHz	1.4592 GHz	8	2 MHz
38.4 MHz	9.984 GHz	2.496 GHz	4	2 MHz
38.4 MHz	11.6736 GHz	2.9184 GHz	4	2 MHz
38.4 MHz	9.984 GHz	4.992 GHz	2	2 MHz
38.4 MHz	11.6736 GHz	5.8368 GHz	2	2 MHz
52 MHz	9.984 GHz	1.248 GHz	8	2 MHz
52 MHz	11.648 GHz	1.456 GHz	8	2 MHz
52 MHz	9.984 GHz	2.496 GHz	4	2 MHz
52 MHz	11.648 GHz	2.912 GHz	4	2 MHz
52 MHz	9.984 GHz	4.992 GHz	2	2 MHz
52 MHz	11.648 GHz	5.824GHz	2	2 MHz

3.3 UHS-II

Necessary REFERENCE CLOCK IN frequency that needs to be provided:

REFERENCE CLOCK IN frequency = BERT Clock Out/15 for values up to 0.780 GHz and

REFERENCE CLOCK IN frequency = BERT Clock Out/30 for values above 0.780 GHz.

Available BERT Clock Out values:

N4880A REFERENCE CLOCK IN	**N4880A CLOCK OUT**	**BERT Clock Out**	**BERT Clock Divider**	**N4880A PLL Loop Bandwidth**
26 MHz To 52 MHz	6.24 GHz to 12.48 GHz	0.390 GHz To 0.780 GHz	16	2 MHz
> 26 MHz To 52 MHz	> 6.24 GHz to 12.48 GHz	> 0.780 GHz To 1.560 GHz	8	2 MHz

4 Programming Interface

This chapter provides general information on command line and SCPI programming for the N4880A.

4.1 Command Line Programming Interface

The Reference Clock Multiplier can be programmed using batch scripts or the command line.

Usage: "RCM_GUI.exe" {Parameter1} Parameter2 {[Value1] [Value2]}

4.1.1 Available Parameters

Parameter1: NoGUI

This Parameter is optional and closes the GUI after the via command line supplied commands have been applied. If not supplied, the GUI will open up and apply the given settings.

When the Control Interface is already running and it is called again from the command line without "NoGUI" command it will bring the Control Interface window to the front and apply the passed settings.

Calling the GUI via command line while it is already running with the "NoGUI" command the program will not apply the passed settings and nothing will happen to the device.

4.1.1.1 PCI Express Operating Mode

Parameter2: PCIe1 or PCIe2 or PCIe3

Value1: Not used

Value2: Not used

All three modes need a reference clock of 100 MHz at REFERENCE CLOCK IN.

Parameter2	Effective BERT Clock out	Necessary BERT Clock Divider setting
PCIe1	2500 MHz	4
PCIe2	5000 MHz	2
PCIe3	8000 MHz	1

4.1.1.2 MIPI M-PHY Operating Mode

Parameter2: MIPI

Value 1: User provided REFERENCE CLOCK IN value

Value 2: Desired BERT Clock Out value

Example Usage: "RCM_GUI.exe" NoGUI MIPI 19.2 2918.4

Available REFERENCE CLOCK IN values and their BERT Clock Out values:

Parameter2	Value1	Value2	Effective BERT Clock out	Necessary BERT Clock Divider setting
MIPI	19.2	1248	1248 MHz	8
MIPI	19.2	1459.2	1459.2 MHz	8
MIPI	19.2	2496	2496 MHz	4
MIPI	19.2	2918.4	2918.4 MHz	4
MIPI	19.2	4992	4992 MHz	2
MIPI	19.2	5836.8	5836.8 MHz	2
MIPI	26	1248	1248 MHz	8
MIPI	26	1456	1456 MHz	8
MIPI	26	2496	2496 MHz	4
MIPI	26	2912	2912 MHz	4
MIPI	26	4992	4992 MHz	2
MIPI	26	5824	5824 MHz	2
MIPI	38.4	1248	1248 MHz	8
MIPI	38.4	1459.2	1459.2 MHz	8

MIPI	38.4	2496	2496 MHz	4
MIPI	38.4	2918.4	2918.4 MHz	4
MIPI	38.4	4992	4992 MHz	2
MIPI	38.4	5836.8	5836.8 MHz	2
MIPI	52	1248	1248 MHz	8
MIPI	52	1456	1456 MHz	8
MIPI	52	2496	2496 MHz	4
MIPI	52	2912	2912 MHz	4
MIPI	52	4992	4992 MHz	2
MIPI	52	5824	5824 MHz	2

4.1.1.3 UHS-II Operating Mode

Parameter2: UHS2
Value 1: Desired BERT Clock Out value
Example Usage: "RCM_GUI.exe" NoGUI UHS2 1320.4

Available BERT Clock Out values
BERT Clock Out = floating point value between 390 and 1560 [MHz]

Necessary REFERENCE CLOCK IN frequency that needs to be provided:
REFERENCE CLOCK IN frequency = BERT Clock Out/15 for BERT Clock Out values up to 780 [MHz] and REFERENCE CLOCK IN frequency = BERT Clock Out/30 for BERT Clock Out values over 780 [MHz].

The BERT clock divider value in this mode is always 8.

Parameter2	Value1	Effective BERT Clock out	Necessary BERT Clock Divider setting
UHS2	390	390 MHz	16
UHS2	...	...	16
UHS2	571.874	571.874 MHz	16
UHS2	...	...	16
UHS2	780	780 MHz	16
UHS2	780.01	780.01 MHz	8
UHS2	...	...	8
UHS2	879.784	879.9 MHz	8
UHS2	...	...	8
UHS2	1560	1560 MHz	8

4.1.2 Return Code

When calling the Control Interface inside a batch job with the "NoGUI" parameter the following error codes are returned after the executable applied the settings and closed itself.

0 No error
1 Necessary DLLs are missing, reinstall application
2 There was an error in the command line
3 Device is not connected/Driver not installed correctly
4 Invalid setting in command line parameters
5 Power up selftest error
6 Another GUI is already running while calling it with the "NoGUI" command/Other error

Sample batch code:

```
@echo off
REM execute the Control Interface
"RCM_GUI.exe" NoGUI PCIe1
REM return the error code
echo %errorlevel%
exit /B
```

4.2 J-BERT SCPI Interface Extension

To use this command it is necessary to have the J-BERT Software Release V7.20 installed.

The N4880A itself provides no dedicated SCPI interface but when installed on a J-BERT it extends the J-BERT SCPI interface making it possible to utilize the N4880A via SCPI. For further information on SCPI remote control take a look inside the Programming Guide for the J-BERT N4903.

4.2.1 Setup

1. Install the N4880A software package on the J-BERT you want to use.
2. Use the remote controlling PC via SCPI to set the N4880A device. (How to setup a SCPI connection refer to the J-BERT Getting Started/User Guide)

Commands Description

Command	`:SYST:EXEC "RCM","[CommandLine]",[Execution]`
Long	:SYSTem:EXECute "RCM","[CommandLine]",[Execution]
Parameters	[CommandLine] = See Command Line Programming Reference (Optional) **Important: The [CommandLine] parameter needs a leading space.** [Execution]={NOWAIT|WAIT} (Optional)
Parameter Suffix	–
Description	This command starts the N4880A executable when installed on the remote controlled J-BERT. Depending on the given [CommandLine] parameters the graphical user interface is opened and the supplied optional command line parameters are set. When using the NoGUI parameter the chosen settings are applied to the N4880A without opening the graphical user interface. The [Execution] parameter determines if the J-BERT firmware should halt until execution of the N4880A software finishes. Take care that if the [CommandLine] does not contain the NoGUI keyword and the [Execution] parameter is set to WAIT, the J-BERT Firmware will not respond until the N4880A Graphical User Interface is manually closed.

Example

:SYST:EXEC "RCM"

Starts up the graphical user interface of the N4880A device.

:SYST:EXEC "RCM","NoGUI PCIe3"

Disables startup of the graphical user interface. Sets the connected N4880A device to PCIe3 operating mode. Take care to select the correct multiplication factor in your J-BERT. Do not forget the leading space in the command line parameter.

:SYST:EXEC "RCM","NoGUI MIPI 19.2 2918.4"

Disables startup of the graphical user interface. Sets to the connected N4880A device to MIPI M-PHY mode with a reference clock frequency of 19.2 MHz and a desired BERT output frequency of 2918.4 MHz. Take care to select the correct multiplication factor in your J-BERT. Do not forget the leading space in the command line parameter.

5 Troubleshooting

("RCM_GUI.exe") and/or the Firmware Updater ("RCM_Updater.exe") cannot find N4880A / Hardware driver is not correctly loaded.

In case the N4880A is not detected after connecting it to the PC or J-BERT after installing the N4880A Software.

1. Restart your PC/J-BERT and the N4880A.
2. Check the USB connection (cable) between N4880A and PC. If this does not help, proceed with the next step.
3. Check if the software is installed and try to uninstall and reinstall it, if this does not help, proceed with the next step.
4. Go to the "Windows Control Panel", select "System", navigate to the "Hardware Panel" and select "Device Manager".
5. There look out for the "N4880A Reference Clock Multiplier", probably located under "Other Devices" and double click it.
6. Select "Reinstall Driver..." and follow the Wizzard. After it finished successfully the N4880A should be found by the user interface.
7. If the previous steps did not help follow the steps for "Firmware update failed".

Firmware update failed

1. In case of a failed software update, there might be the problem that the flash memory of the N4880A does no longer contain a valid firmware image. In this case the N4880A will not boot after power-on and will remain in an inoperable state.
2. To recover the N4880A from an interrupted software update, you need to power-down the N4880A and connect it via USB to a PC in case it is not yet connected.
3. Make sure there is no other N4880A peripheral connected to your PC while updating.
4. Power-up the device while pressing the firmware update button (See N4880A User Guide) on the rear side of the device. If the firmware update mode is entered correctly the Lock State LED will flash. Otherwise retry from step 1.
5. Navigate to the software installation folder. Depending on your Windows version this folder is on standard either C:\Program Files (x86)\Agilent\N4880A or C:\Program Files\Agilent\N4880A.
6. Execute the “RCM_Updater.exe” file located in the software installation folder, if the N4880A is found the serial number and device firmware revision is displayed.
7. Now press the “Update” button. Restart the N4880A.

Power Up Selftest Error Occurred

There was an error reading out the system voltages. When this error occurs restart the N4880A. If it keeps coming up the hardware is not working correctly anymore.

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