D2030

30 GHz Downconverter
User Guide
Version 1.4

HARDWARE WARRANTY AND LIMITATION OF LIABILITY

Read this warranty carefully before you use the product.

D2030 30 GHz Downconverters are warranted for workmanship and materials for a period of one (1) year from the date of shipment as identified by the Customer's packing slip or carrier waybill. ThinkRF reserves the right to void the warranty on any equipment that has been altered or damaged due to Customer negligence, unauthorized repair, misuse of equipment, evidence of physical or environmental damage, transportation abuse or removal of any ThinkRF identification labels or serial numbers.

It will remain the responsibility of the Customer, having obtained a Return Material Authorization (RMA) and shipping instructions from ThinkRF, to return, at the Customer's expense, the defective unit to ThinkRF's repair facilities. ThinkRF will incur shipping charges for the return of warranty repaired equipment. The RMA number can be secured by contacting ThinkRF Customer Service and Support (support@thinkrf.com). If the product does not fall within ThinkRF's warranty period or the product is found to be functioning as designed, then under the terms of ThinkRF's warranty policy, all costs of repairs and shipping will be charged directly to the Customer. ThinkRF will warrant repaired units for a period of 90 days from date of shipment from ThinkRF to the Customer. If the remaining period on the original hardware warranty is greater than 30 days, then ThinkRF will honor this remaining warranty period.

THINKRF EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES AND CONDITIONS, WHETHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, WARRANTIES, CONDITIONS OR REPRESENTATIONS OF WORKMANSHIP, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, DURABILITY, OR THAT THE OPERATION OF THE HARDWARE OR LICENSED SOFTWARE WILL BE ERROR FREE. IN NO EVENT WILL THINKRF BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

USE OF PRODUCTS IN HIGH RISK ACTIVITIES

THINKRF PRODUCTS ARE INTENDED FOR STANDARD INDOOR COMMERCIAL USE. WITHOUT THE APPROPRIATE NETWORK DESIGN ENGINEERING, THEY MUST NOT BE USED FOR ANY "HIGH RISK ACTIVITY", as described in this paragraph. Customer acknowledges and agrees that the products supplied hereunder are not fault-tolerant and are not designed, manufactured or intended for use or resale as on-line control equipment in hazardous environments requiring fail safe performance including but not limited to the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of products could lead directly to death, personal injury, or severe physical or environmental damage, all of which are examples of "High Risk Activity". THINKRF AND ITS SUPPLIERS EXPRESSLY DISCLAIM ANY EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR HIGH RISK ACTIVITIES.

Table of Contents

Preface

This preface describes the audience for, the organization of, and conventions used in this document. It also identifies related documentation and explains how to access electronic documentation.

Audience

This document is written for technical people who have basic understanding, familiarity and experience with network test and measurement equipment.

Conventions

This section describes the conventions used in this document.

Grayed-out Font

Indicates a command or a feature is not yet available in the current release.

Courier Font

Illustrates this is an example for a command or a concept.

Light Blue Font

Contains hyperlink to the referenced source that can be clicked on.

Normal Bold Font

When used within a sentence or a paragraph, it emphasizes an idea to be paid attention to particularly.

Red Font

Conveys special information of that section.

Note: This symbol means **take note**. Notes contain helpful suggestions or references to additional information and material.

Caution: This symbol means **be careful**. In this situation, you might do something that could result in equipment damage or loss of data.

> **Warning:** This symbol means **danger**. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with the standard practices for preventing accidents.

Obtaining the Latest Documentation and Software

Please visit our website's resource page at http://www.thinkrf.com/resources/ to obtain the latest documentation and releases of new firmware and software.

Document Feedback

Please send your comments about this document or our other documentation to support@thinkrf.com.

Thank you, we appreciate your comments.

Obtaining Technical Assistance

For all customers who hold a valid end-user license, ThinkRF provides technical assistance 9 AM to 5 PM Eastern Time, Monday to Friday. Contact us by filling out the form listed on http://www.thinkrf.com/support/.

Before contacting Support, please have the following information available:

- D2030 serial number, product version (and options if available), which are located on the identification label on The Underside of the D2030.
- The firmware version running on the D2030 (use *IDN? command).
- If applicable, the versions of ThinkRF software you are using or any third-party applications.
- The operating system and version you are using.

For any other information, contact ThinkRF at:

ThinkRF Corporation
390 March Road
Kanata, ON K2K 0G7
+1.613.369-5104
info@thinkrf.com or sales@thinkrf.com
www.thinkrf.com

Overview of the D2030

Note: This is a living and evolving document. We welcome your feedback.

The features and functionality described in this section **may** exist in the current product or are scheduled for a future product release.

D2030 30 GHz Downconverter is used to convert RF signals in the range of 27-30 GHz down to an intermediate frequency (IF) of 3.55 GHz. This is designed to extend the functionality of existing spectrum analyzers that can operate at 3.55 GHz to measure and analyze 5G signals in the range of 27-30 GHz band.

Getting Familiar with the D2030

This section provides information about the front and rear panels, connection ports and identification label of the D2030 Downconverter.

Note: The type and placement of connectors and components on the panels and the case may vary depending upon the product version.

The Front Panel

The front panel of the D2030 contains, from left to right:

- STS - Status LED
- RJ-45 Ethernet port
- +12 VDC 0.5A Max, female BNC power connector

- RF IN port, 2.92 mm female flange connector
- IF OUT port, female bulkhead SMA connector
- 10 MHz IN port, female bulkhead SMA connector
- 10 MHz OUT port, female bulkhead SMA connector

The Rear Panel

The rear panel of the D2030 contains a small hole, which is the access point for factory reset.

The Underside

The underside of the D2030 provides an identification label, as illustrated in below. The label on your product may vary depending on your product variant and version.

The product "Version" number is important for identifying which firmware can be used to update your product. The "Options" number is to identify which product model you have, see D2030's datasheet.
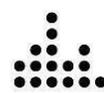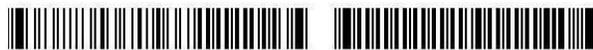
Precautions and Operation Consideration

Ensure that you read and understand the following information about safety and electrostatic discharge before you unpack and set up the D2030.

Warning: Only trained and qualified personnel should be allowed to install or replace this equipment. Read the installation instructions before you connect the system to its power source.

Preventing Electrostatic Discharge Damage

Electrostatic Discharge (ESD) is a single-event, rapid transfer of electrostatic charge between two objects, such as an operator and a piece of electrical equipment. ESD can occur when a high electrostatic field develops between two objects in close proximity. ESD occurs when electronic components are improperly handled and is one of the major causes of device failures in the semiconductor industry.

Electrostatic discharge is more likely to occur with the combination of synthetic fibers and dry atmosphere. Always follow these steps to prevent ESD.

Warning: Never open the front or rear panels of the D2030 as personal injury may result and opening the chassis will void the warranty. There are no user-serviceable parts inside. Always contact ThinkRF support for service through the online support form at **http://www.thinkrf.com/support/.**

Caution: To prevent ESD, wear an ESD-preventive wrist strap that you provide, ensuring that it makes good skin contact.

Caution: Do not touch any exposed contact pins or connector shells of interface ports that do not have a cable attached. If cables are connected at one end only, do not touch the exposed pins at the unconnected end of the cable.

Preventing RF Connector Damage

When connecting to an RF connector, whether it is BNC, SMA or Flange connector, it is important that proper care and connector connection practice is used to prevent irreversible damage to the connector and its port.

Caution: When mating/demating the connectors,
- **Do:** align the mating connectors properly to prevent damaging the center pin, make preliminary connection lightly, use correct torque spanner for the final connection
- **Do not:** apply bending force to connection, over-tighten to a connector on the jack or overturn point of the torque wrench. Using incorrect torque wrench, wrench, pliers or even your hand to over-tighten a connector can cause permanent damage to a D2030.

2.92 mm Flange Female Connector

Caution: Use only 2.92 mm Flange Male connector as the mating part to the D2030's RF IN port. **DO NOT** connect a SMA connector to this port.

Use only a proper torque wrench with torque setting intended for a 2.92 mm Male connector (not the same one for a SMA connector). The recommended torque setting is 100 N.cm (8.9lbs.in). An example of a torque wrench that can be used for this is Huber-Suhner P/N 74 Z-0-0-21.

SMA Connectors

The recommended torque setting for all SMA connectors is 45 N.cm (4lbs.in). An example of a torque wrench that can be used for this is Huber-Suhner P/N 74 Z-0-0-79.

Operation Consideration and Maintenance

The D2030 should be operated only within its specified operation temperature and specification of 14°F to 131°F (-10°C to 55°C). The ideal operating temperature for optimum performance is between 68°F to 77°F (20°C to 25°C).

Caution: Do not expose the device to direct sunlight or radiation from other sources of heat.

Some regular maintenance is needed to maintain the unit in its good working state. This includes

- cleaning the box with a slightly damp cloth from time to time to eliminate any dust or debris that could get into the box via any holes
- inspect and keep all the connectors clean, especially the threads, with a soft cloth

Setting Up the D2030

Unpacking the Box

The following table lists the items that come with your D2030. If any of the items are missing or damaged, please contact your ThinkRF customer service representative.

D2030 Shipping Box Contents:

- D2030 Downconverter
- Power adapter and cable
- BNC-male to 2.55mm-female power adaptor
- Precautions & Quickstart Guide

Connecting the Ethernet and Cables

Follow the steps below to connect up the D2030 ports. The diagram bellow illustrates the setup steps.
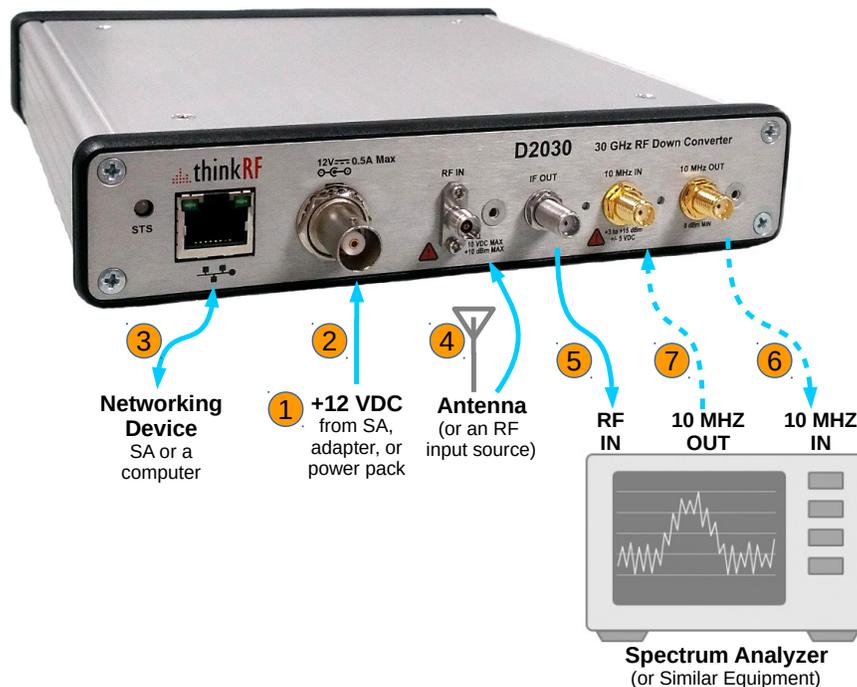
1. Before connecting D2030 to a spectrum analyzer (SA), if instead of the provided +12VDC (0.5A Max) power adapter, a power source is supplied from an SA (especially through a SA's Bias-Tee Voltage setting) or power pack, then first power up the power source device and set the voltage to +12VDC.

2. Connect the power supply source to D2030's BNC power connector.

Caution: Do not supply a power source exceeding **+15VDC** to the D2030. It can cause permanent damage to the device.

3. Connect one end of the Ethernet cable to the D2030's Ethernet port and the other end to an Ethernet port on the SA.

Caution: For the following RF connectors, see Preventing RF Connector Damage section for important cautions and torque suggestion.

4. Connect the Antenna or an RF input source to the D2030's RF IN port.

5. Connect the SMA connector end of the cable coming from SA's RF IN port to the D2030's IF OUT SMA port.

6. Connect the SMA connector end of the cable coming from D2030's 10 MHz OUT port to the SA's External IN port. Important to see Preventing RF Connector Damage and its SMA Connectors section for caution and torque suggestion.

7. Connecting to D2030's 10 MHz IN port is optional or on per needed basis for clock synchronization. See Use of D2030 with External 10 MHz Reference for more information and important cautions.

Use of D2030 with External 10 MHz Reference

The ThinkRF D2030 can be synchronized with the use of an external 10 MHz reference, for example, from an external oscillator or from the digitizer section of the data acquisition system.

As well, this 10 MHz is redistributed within the D2030 and sent to the 10 MHz OUT SMA connector for use by external equipment that needs a 10 MHz reference source.

To set the D2030 to use the external 10 MHz reference, send the SCPI command `[:SENSE]:REFERENCE:PLL EXT` (Refer the D2030 Programmer's Guide for more details).

Cautions:
- When the external 10 MHz IN reference is used, its reference level must be between **+3 dBm** and **+15 dBm**.
- The maximum power level to the D2030's 10 MHz IN is +15 dBm. Exceeding this value might degrade the product performance.
- The 10 MHz reference source to the 10 MHZ IN port must be powered down prior to powering down the D2030.
- See Preventing RF Connector Damage and its SMA Connectors section for important caution and torque suggestion.

Interfacing with the D2030

This section provides instruction for different methods of accessing the D2030 via its Ethernet port and obtaining its IP address.

The D2030's Downconverters are network ready devices conveying SCPI (Standard Commands for Programmable Instruments) commands and data using the TCP/IP protocol via a Gigabit Ethernet connection. Network application access is via SCPI Raw or SCPI Telnet.

Note: The SCPI commands consist of network configuration, device status checking, input filter selection, frequency settings, bandwidth and attenuation values, etc. To see a complete SCPI command list for D2030, please refers to the D2030 Programmer's Guide.

The D2030 also supports different methods of obtaining its IP address including:

- Dynamic IP address allocation via the Dynamic Host Configuration Protocol (DHCP), which is applicable to a routed network topology that has a DHCP server;
- Static IP address allocation, which is applicable to any network topology.

Note: The D2030's default factory configuration at the first power up or after a factory reset is set to STATIC type with IP 192.168.1.2.
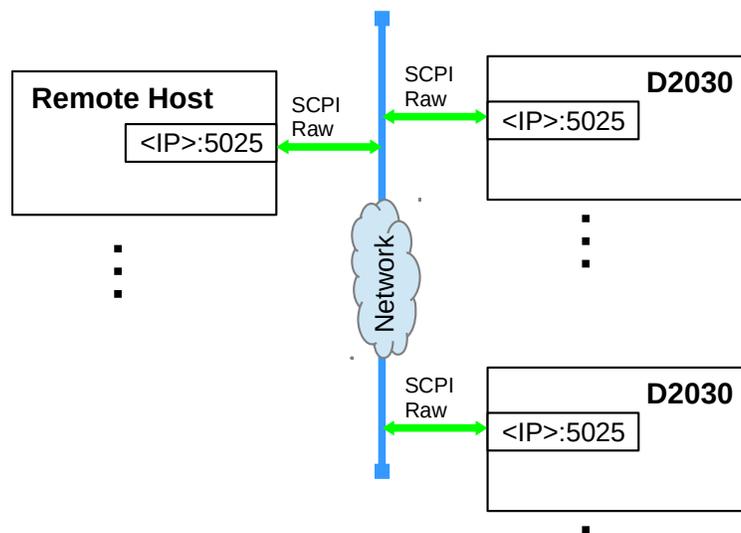
Network Application Access Methods

SCPI Raw

SCPI Raw uses a TCP/IP connection to establish a bidirectional link with minimal overhead. Although it can be used as a command line interface, it is better suited for use with an application.
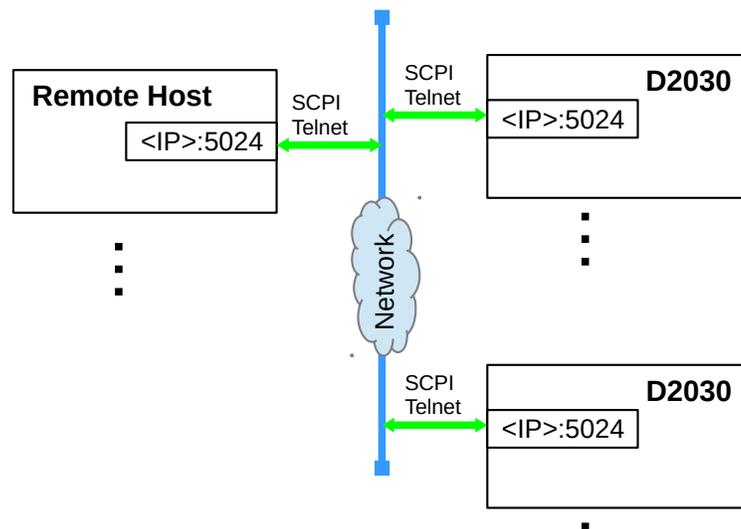
SCPI Raw is accessible via TCP port 5025, see the following figure.

SCPI Telnet

SCPI Telnet is similar to SCPI Raw but it is meant to be used as an interactive user interface as it echoes typed characters back to the user. A standard Telnet client may be used to communicate with the D2030 directly.

SCPI Telnet is accessible via TCP port 5024, see the following figure.

Establishing Ethernet Connection with D2030

This section provides instruction on connecting the D2030 directly to a SA via their Ethernet ports using an Ethernet cable.

To connect the D2030 directly to your SA:

1. If this is not the very first time connecting to the D2030, skip to the next step. Otherwise, your SA's Ethernet interface must be configured first to use static IP mode in order to work with the D2030's factory default IP of 192.168.1.2. This

involves setting your SA to have an IP address of 192.168.1.x (x cannot be 2) with a subnet mask 255.255.255.x and a gateway 192.168.1.x. If still not sure of the setting, please contact your network administration for valid settings.

2. Connect the Ethernet cable to both your SA's and the D2030 Ethernet ports.

3. Power up the D2030 if haven't done so and wait until the status LED turns green.

4. Check to ensure that either your SA's or the D2030 Ethernet's jack LINK indicator is illuminated. If it is not, then your SA may not support automatic crossover on its Ethernet connection and you may require an RJ-45 crossover Ethernet cable.

5. Choose one of the methods mentioned in Network Application Access Methods to verify the established connection with the D2030.

6. With an assigned IP, the D2030 could now be controlled through SCPI commands described in the D2030 Programmer's Guide document.

7. If necessary, after establishing a successful connection, configure the D2030 to your chosen method of IP allocation following the instruction in the Changing the Method of IP Address Allocation for D2030 section.

Changing the Method of IP Address Allocation for D2030

This section provides instruction for re-configuring one IP address allocation type to another for a D2030.

Notes:
- The D2030 is configured to STATIC IP 192.168.1.2 by factory default.
- Decide on whether you will be using static or dynamic IP allocation. Regardless of which method you choose, **both** your SA's and the D2030's Ethernet interface must be configured for the same method of IP allocation.

If your D2030 is configured for static IP allocation, then it may be reconfigured for dynamic IP address allocation using the `:SYSTem:COMMunicate:LAN` command set (see D2030 Programmer's Guide document).

If your D2030 is configured for dynamic IP allocation, then it may be reconfigured for static IP address allocation either using the `:SYSTem:COMMunicate:LAN` command set (see D2030 Programmer's Guide) or via a hardware factory reset. Using the hardware factory reset to reconfigure to static IP allocation is the simplest method and is described in the Device Reset section.

Device Reset

Reset to Factory Settings

If for any reason you cannot connect to the D2030 via the Ethernet, then performing this following procedure will reset the D2030 network configuration to the factory installed static IP configuration with IP address of 192.168.1.2.

Follow the steps below to reset your box.

1. Power off the D2030

2. Use a small pin to access the reset button locating in The Rear Panel of the D2030

3. Press and hold while powering on the unit

4. Power on the unit

5. Follow Establishing Ethernet Connection with D2030 section to setup the connection

Status Indicator LED

The D2030 has a status (STS) indicator LED located on The Front Panel.

Using different colours and blink codes, the STS LED indicates the following device conditions.

STS Indicator LED	Internal Status
Green	All internal power conditions are good and the device is ready
Yellow	The device is busy, PLL lock failure or not receiving 10 MHz reference source
Red	Insufficient or the power source is no good
3 fast yellow blinks	No network activity
2 fast, 1 slow yellow blinks	Waiting or no DHCP connection
Long short long yellow blinks	A warning. Device is operating **up to** 41°F (5°C) beyond the specified operational temperature range (see System Specifications)
Long short long red blinks	An error. Device is operating 41°F (5°C) **or more beyond** the specified operational temperature range (see System Specifications)
3 slow red	Hardware failure
Off	Not receiving power from the power source

Fast blink is defined as 0.25 second long and **slow** blink is 0.75 second.

Hardware Reference

This section provides physical and performance specifications, and port and cable pinouts for the D2030.

System Specifications

The following table outlines the physical and electrical specifications for the D2030.

Description	Design Specification
Dimensions (W x L x H)	6.67 x 7.3 x 1.36 in. (16.94 x 18.54 x 3.45 cm)
Weight (approximately)	< 1 Kg (2.2lb)
Digital interface ports	Ethernet 10/100/1000
Analog interface ports	RF IN, IF OUT, 10 MHz IN and OUT
Input supply voltage	12 VDC +/- 5%
Input supply current	< 0.5 A at 12V
Power Consumption	< 6 Watts
Operating temperature	14 to 131°F (-10 to 55°C)
Storage temperature	-40 to 160°F (-40 to 71°C)

Flange 2.92 mm and SMA Connectors

The Flange 2.92 mm and SMA connectors on the front panel are all female jacks. The SMAs are with 50Ω nominal impedance. The following table outline the maximum and minimum power level restrictions on these connectors.

Caution: Injecting signal levels that exceed the specifications described in the following table will result in permanent damage to the downconverter.

Connector Name	Direction	Max Power Level	Min Power Level
RF IN[1]	in	+10 dBm[4], 10 Vdc[4]	---
10 MHz IN[2,3]	in	+15 dBm[4]	+3 dBm[4]
10 MHz OUT	out	---	0 dBm[5]

[1] It is recommended that the output of a signal source be verified with the use of a power meter prior to connecting the source directly to the RF IN connector. It is best to inject signals equal to or lower than -20 dBm; otherwise, an external attenuator should be considered to prevent damaging the D2030. Additionally, any external signal sources connected to RF IN must be turned on only after powering on the D2030 and turned off prior to powering down the D2030.
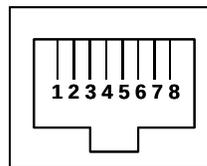
[2] The 10 MHz reference input must be powered down prior to powering down the D2030. See also the Caution Note of Use of D2030 with External 10 MHz Reference section on page 18.

[3] To set the D2030 to use the external 10 MHz reference, apply a [:SENSE]:REF:PLL EXT command, see the D2030 Programmer's Guide.
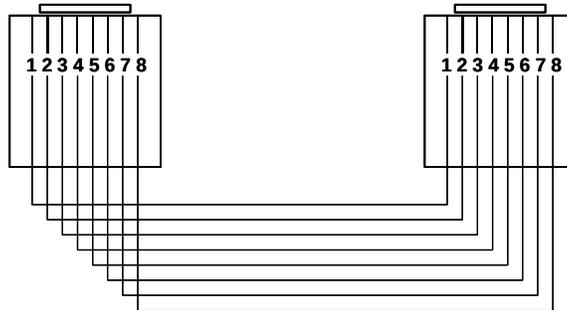
[4] By design.

[5] Tested in production.
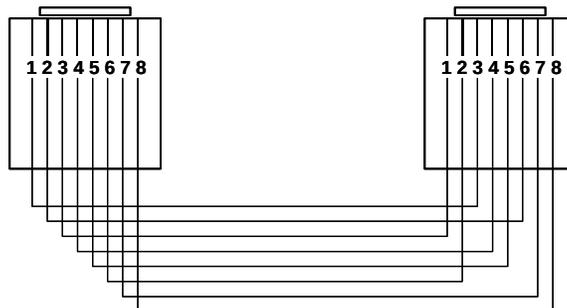
RJ-45 Ethernet Port Pinout

Pin	Signal
1	BI_DA+
2	BI_DA-
3	BI_DB+
4	BI_DC+
5	BI_DC-
6	BI_DB-
7	BI_DD+
8	BI_DD-

RJ-45 Straight-Through Ethernet Cable

RJ-45 Crossover Ethernet Cable

Document Revision History

This section summarizes document revision history.

Document Version	Release Date	Revisions and Notes
v1.0	Sept 14, 2017	First release
v1.1	Nov. 01, 2017	Added Operation Consideration and Maintenance section
v1.2	Nov. 15, 2017	- Updated device images to have 0.5A Max specification - Updated the product's label - Added a connection diagram

v1.3	Jan. 15, 2018	- Reorganized sections and changed some headings
		- Added:
		  + Preventing RF Connector Damage section with torque wrench recommendation for SMA and 2.92 mm connectors
		  + Use of D2030 with External 10 MHz Reference section with caution note on 10 MHz IN port usage
		- Cleaned up Connecting the Ethernet and Cables section

v1.4	June 13, 2018	- Added 2 new LED indicator codes relating to temperature for the Status Indicator LED section - Added information to the torque setting of 2.92 mm Flange Female Connector and SMA Connectors - Minor correction through out the document