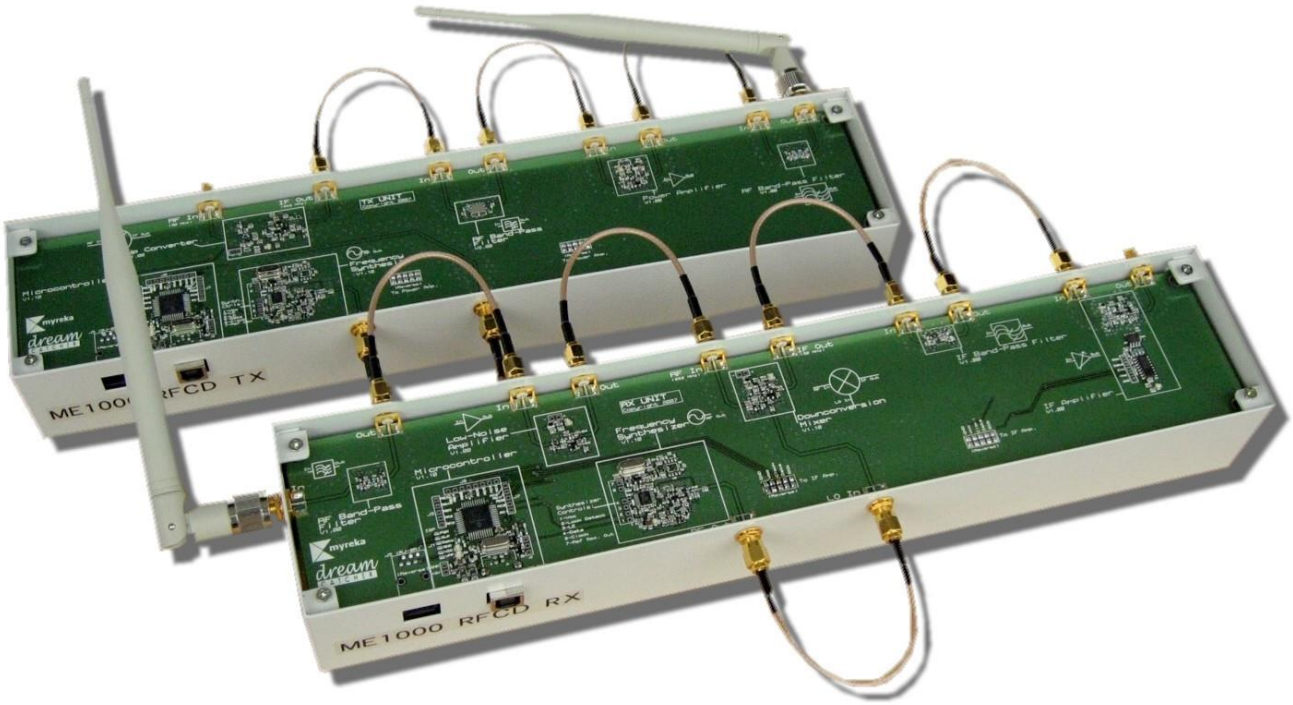
dream CATCHER

ME1000 RF Circuit Design Courseware

Out-of-Box Teaching Solution for the RF Circuit Design

Quick Start Guide

revision 3.02
Printed on 12 August 2023



NOTE:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference. (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for Class B digital devices under Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, it may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. Suppose this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on. In that case, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving unit.*
- *Increase the separation between the equipment and the receiver unit.*
- *Connect the equipment to an outlet on a different electrical circuit from the Receiver.*
- *Consult the dealer and/or an experienced radio/TV technician for help.*

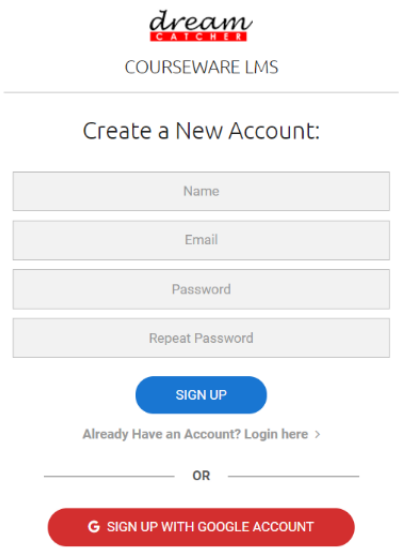
WARNING:

CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE WITH THE FCC RULES (THE FCC' GRANTEE') COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

Table of Contents

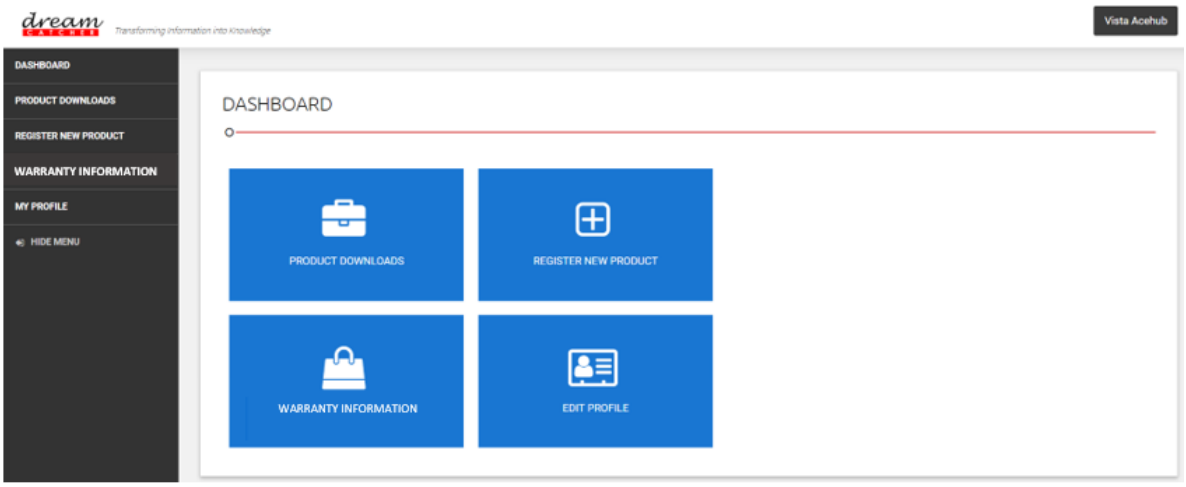
DreamCatcher Courseware Customer Login Guide

1. Go to the DreamCatcher Courseware website at http://dreamcatcher.asia/cw/
2. Click the **Product Registration / Download** link at the bottom left corner of the page.
3. If you are a new customer, skip to step 5. If you are a returning customer, proceed to step 4.
4. If you are a returning customer, click **Continue** under the LOGIN section to log in.
   NOTE: If you have created your DreamCatcher account before 1 September 2017, you will receive an email request to reset your password. If you do not receive the password reset email within a few minutes of logging in, please check your Junk Email folder just in case the password reset email got delivered there instead of your inbox. Follow the password reset instructions to reset your password and continue logging in.
   Skip to step 6 to complete the login procedure.
5. If you are a new customer, click **Continue** under the CREATE ACCOUNT section to create a new account.



Fill in the New Account form and click **SIGN UP** to submit your registration.

6. After successfully logging in, your DASHBOARD page appears.



A. EDIT PROFILE

Update your user profile.

B. REGISTER NEW PRODUCT

Register a new product with the given product key.

NOTE: Contact your local sales representative if you need further assistance.

C. PRODUCTS DOWNLOADS

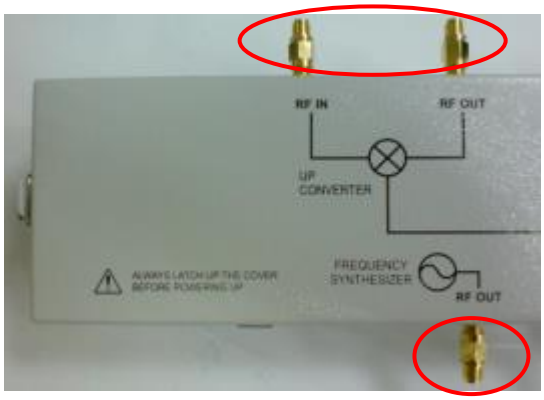
Download the registered product's contents and materials.

NOTE: Downloads are made available only for registered products. Click **REGISTER NEW PRODUCT** to register your product first.

D. WARRANTY INFORMATION

View your product's warranty expiry date.

1. Quick Setup and Verification



The N(m)-to-SMA(f) adapters are always connected to all SMA connectors of the training kit to prevent the SMA connectors from wearing out due to regular connection and disconnection of the SMA cables. If the adapters are worn out, they can be easily replaced with new ones. This measure is taken to simplify part replacement since the SMA connectors of the training kit is soldered to the PCB board.

1.1 The following steps demonstrate the setup and verification of the entire system:

Step 1: Installing the RF Trainer Control Panel Software

Step 2: Powering Up the Transmitter Unit and Receiver Unit

Step 3: Verifying the Transmitter Unit

Step 4: Verifying the Receiver Unit

Step 5: Verifying the final end-to-end System

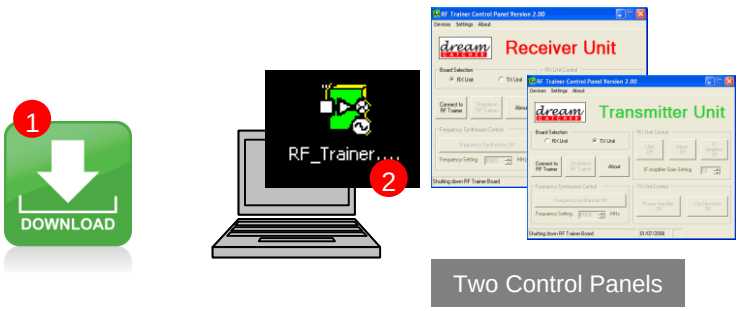
IMPORTANT

- *Excessive power levels from the instruments can damage the transmitter and receiver units. Please adhere strictly to the power levels recommended in the instructions.*
- *Turn off the training kit when not in use.*
- *Always ensure the casing is grounded and the cover latched before powering up the device.*

Step 1: Installing the RF Trainer Control Panel Software

1. Install the **RF Trainer Control Panel** downloaded from the DreamCatcher website. Click YES to install the Microsoft .NET Framework when prompted.

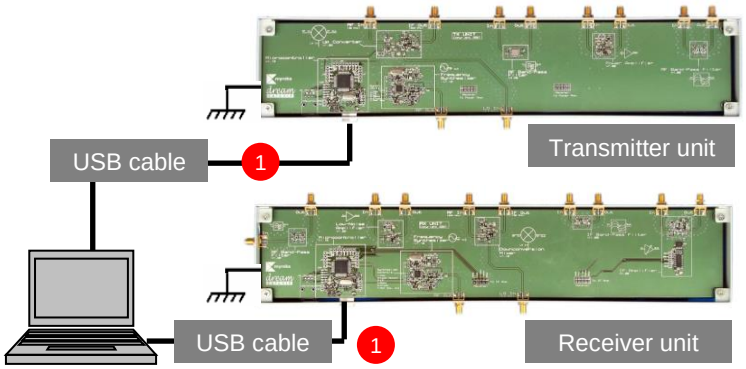
2. Launch two control panels by clicking the **RF_Trainer** icon twice. One Control Panel will control the transmitter unit, while the other will control the receiver unit.



Two Control Panels

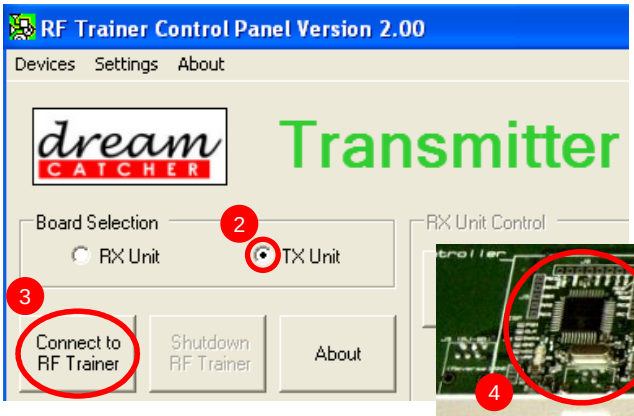
Step 2: Powering Up the Transmitter Unit and Receiver Unit

1. Connect the transmitter and receiver units to the PC using the USB cables.

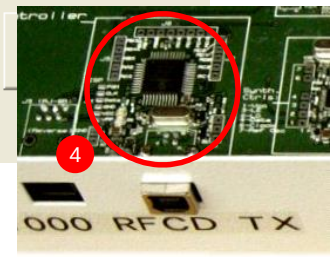


Powering Up the Transmitter Unit

2. Select **TX Unit** from Control Panel 1.
3. Click **Connect to RF Trainer**.
4. The green **LED** on the control unit of the transmitter will blink once, indicating a successful connection.



Control Panel 1

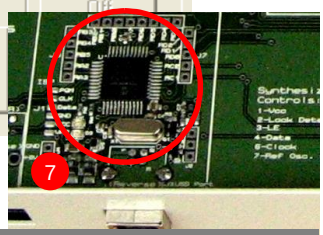


Control unit of the transmitter

Powering Up the Receiver Unit

5. Select **RX Unit** from Control Panel 2.
6. Click **Connect to RF Trainer**.
7. The green **LED** on the control unit of the Receiver will blink once, indicating a successful connection.

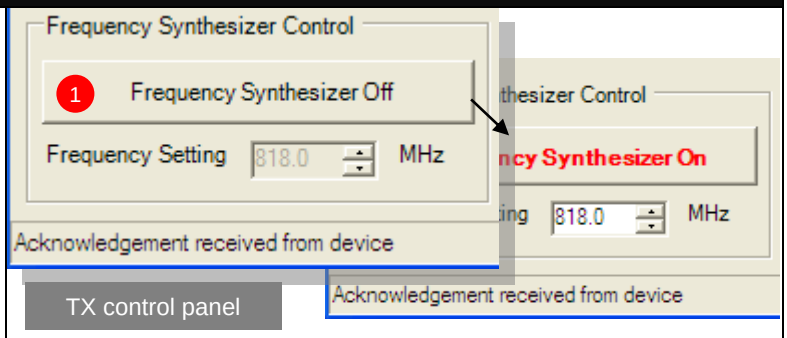
Control Panel 2



Control unit of the receiver

Step 3: Verifying the Transmitter Unit

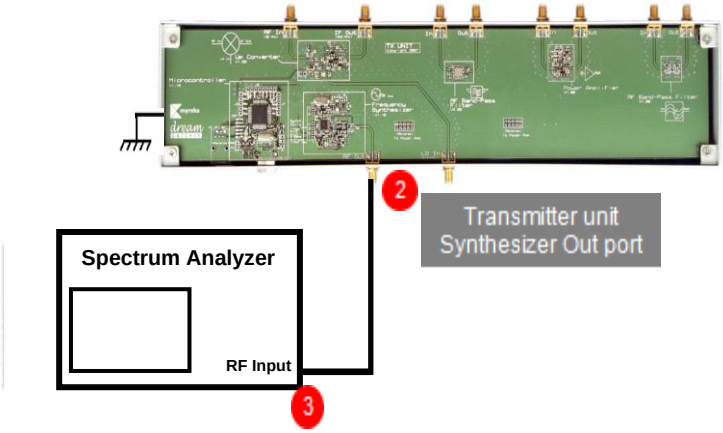
1. Click **Frequency Synthesizer Off** to turn it on. Set the frequency to **818 MHz**.



Verifying the Synthesizer

2. Connect the spectrum analyzer to the Synthesizer Out port of the transmitter unit.

3. Check if the output signal from the synthesizer is correct.

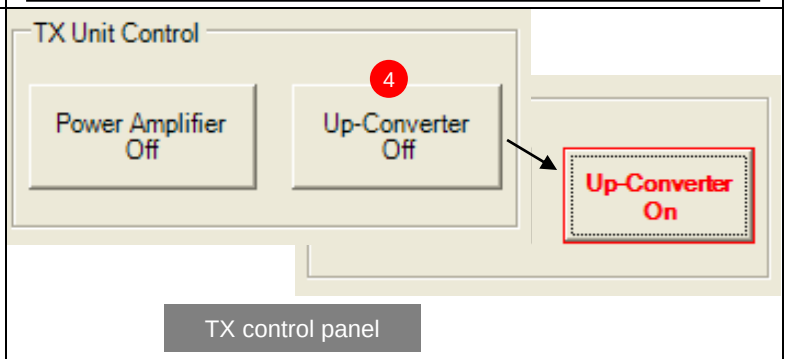


Spectrum Analyzer setting:

Center Freq: 818 MHz
Span: 10 MHz

Verifying the Mixer

4. Click **Up-Converter Off** to turn on the Mixer.



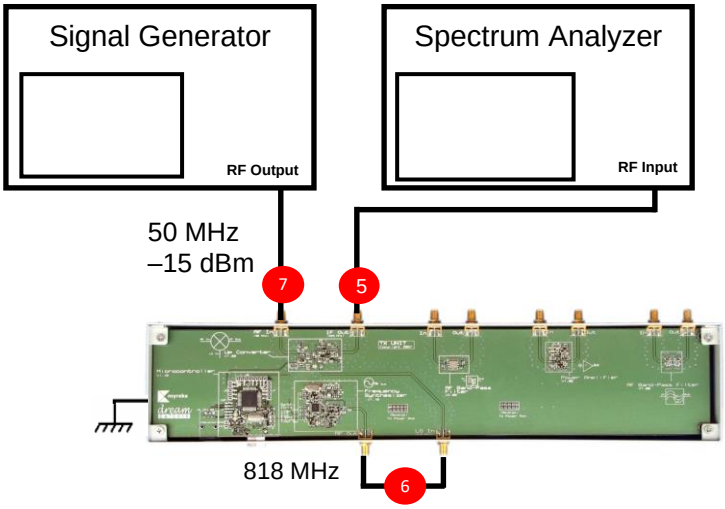
	Signal Generator Setting:	**Spectrum Analyzer Setting:**
	Frequency: 50 MHz **Amplitude: –15 dBm** **Turn off Mod.**: **Turn on RF Out**:	**Center Freq: 818 MHz** **Span: 500 MHz** Note: Reduce the SPAN value to get a more accurate frequency measurement

5 Reconnect the spectrum analyzer to the IF Out port.

6 Use the jumper cable to connect the Synthesizer Out port to the Mixer LO In port.

7 Connect the signal generator (50 MHz, –15 dBm) to the Mixer RF In port.

8 Check the spectrum analyzer to see if the Mixer produces intermodulation products such as (**±n818 ± m50) MHz**.



Spectrum Analyzer setting:
Locate signal with Marker: [Peak Search]

Next Peak search: {Next Peak}

<u>Verifying the end-to-end transmitter</u>

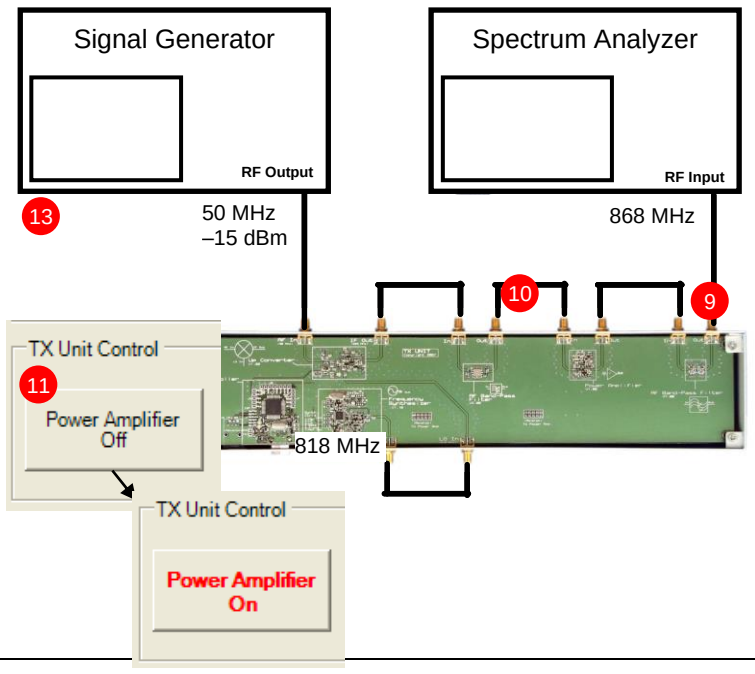
9 Reconnect the spectrum analyzer to the Bandpass Filter Out port.

10 Use the jumper cables to connect all the ports, as shown on the right.

11 Click **Power Amplifier Off** to turn on the power amplifier.

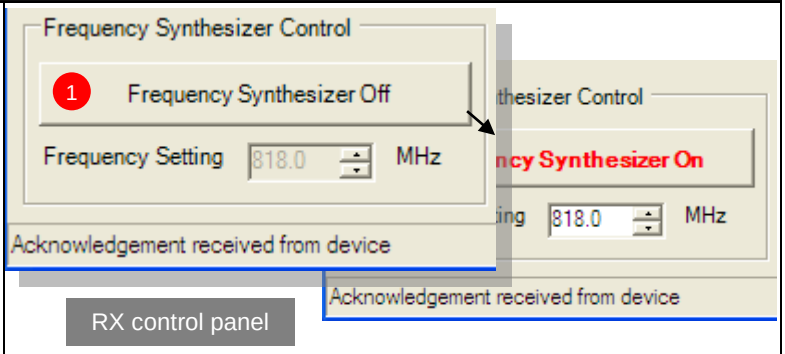
12 Check the spectrum analyzer to see whether the signal generator output is up-converted from **50 MHz** to **868 MHz**.

13 Power of the signal generator.



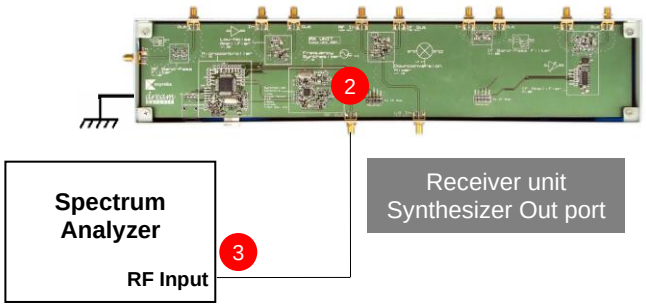
Step 4: Verifying the Receiver Unit

1. Click **Frequency Synthesizer Off** to turn it on. Set the frequency to **818 MHz**.



Verifying the Synthesizer

2. Connect the spectrum analyzer to the Synthesizer Out port.
3. Check if the output signal from the frequency synthesizer is correct.

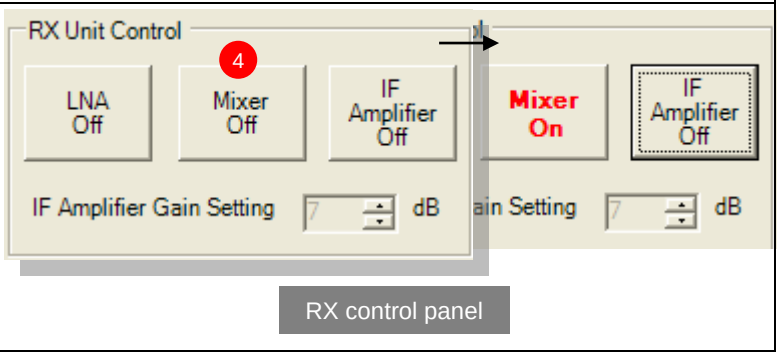


Spectrum Analyzer setting:

Center Freq: 818 MHz
Span: 10 MHz

Verifying the Mixer

4. Click **Mixer Off** to turn on the Mixer.



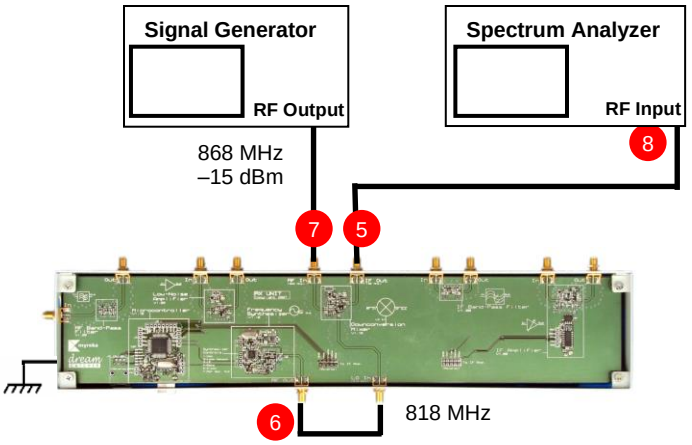
	Signal Generator setting: **Frequency: 868 MHz** **Amplitude: –15 dBm** **Turn off Mod.:** [MOD On/Off] **Turn on RF Out:** [RF On/Off]	**N9320B Spectrum Analyzer setting:** **Start Freq: 0 MHz** **Stop Freq: 3 GHz** Note: Set the stop frequency to 100 MHz to get a more accurate 50 MHz frequency measurement.

5 Reconnect the spectrum analyzer to the IF Out port.

6 A jumper cable connects the Synthesizer Out port to the Mixer LO In port.

7 Reconnect the signal generator (868 MHz, –15 dBm) to the Mixer RF In port.

8 Check the spectrum analyzer to see whether the Mixer produces intermodulation products, such as (**±n818 ± m868)** MHz.



Verifying the end-to-end Receiver

9 Reconnect the spectrum analyzer to the Bandpass Filter Out port.

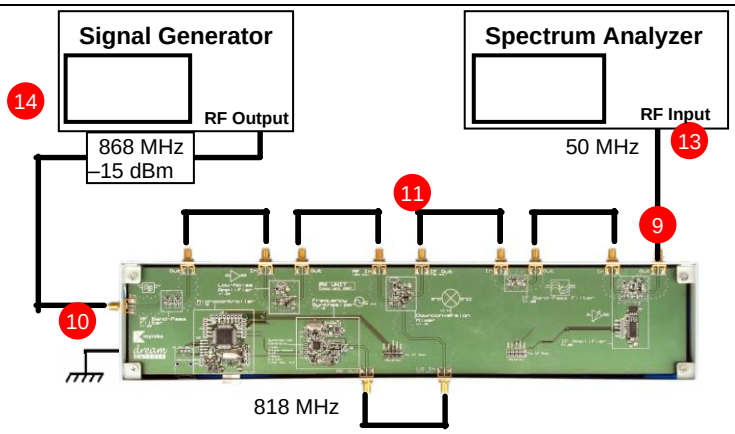
10 Reconnect the signal generator to the Bandpass Filter In port.

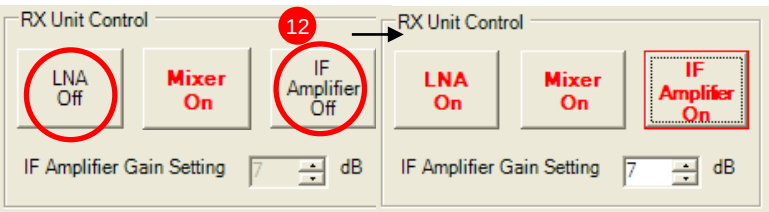
11 Use jumper cables to connect all the ports shown on the right.

12 Click **LNA Off** and **IF Amplifier Off** to turn on the LNA and IF Amp.

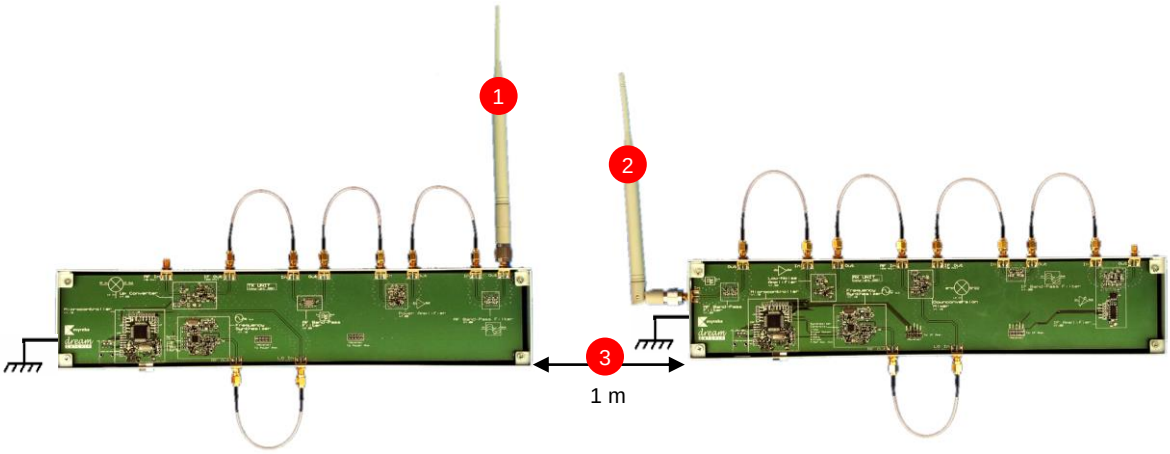
13 Check the spectrum analyzer to see whether the signal generator output is down-converted from **868 MHz** to **50 MHz**.

14 Power off the signal generator.

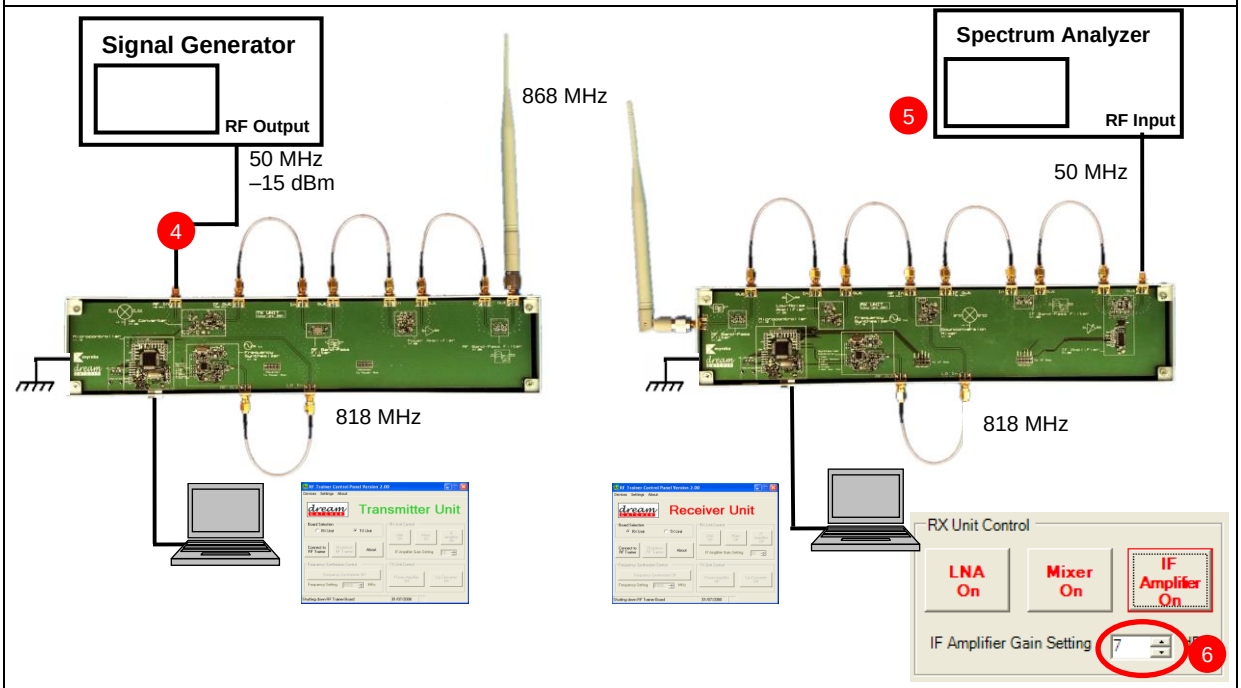




Step 5: Verifying the final end-to-end System



1. Connect the antenna to the transmitter unit.
2. Connect the antenna to the receiver unit.
3. Separate the units about 1 meter apart.



4. Reconnect and power up the signal generator, as shown above.
5. Check the spectrum analyzer to see whether the signal generator output from the transmitter unit is received at the receiver unit.
6. The received signal is in the region of –50 dBm. Ensure that the noise floor of your spectrum analyzer is below this level. You might need to change the **IF Amplifier gain** (for example, to Level 13) if the received signal is too weak or your spectrum analyzer noise floor is too high.

2. Support and Warranty

2.1 Terms and Conditions

This courseware contains scholarly and technical information protected by copyright laws and international treaties. No part of this publication may be reproduced by any means, be it transmitted, transcribed, photocopied, stored in a retrieval system, or translated into any language in any form without the prior written permission of *Acehub Vista Sdn. Bhd.*

The use of the courseware product and all other products developed and/or distributed by *Acehub Vista Sdn. Bhd.* are subject to the applicable License Agreement.

For further information, see the Courseware Product License Agreement.

To retrieve the password for installation of the provided materials and software and the model answers and solutions for lab sheets, please register yourself at http://dreamcatcher.asia/cw under the Product Registration menu using the product key provided with the education courseware.

2.2 Product Warranty

- *Acehub Vista Sdn. Bhd.* warrants that its products sold will, at the time of shipment, be free from defects in material and workmanship and will conform to *Acehub Vista Sdn. Bhd. 's* applicable specifications.

- If *Acehub Vista Sdn. Bhd.* receives notice of a defect or non-conformance during the **one-year warranty** period, *Acehub Vista Sdn. Bhd.* will, at its option, repair or replace the affected product. Buyer will pay shipping expenses for the return of such product to *Acehub Vista Sdn. Bhd.* or its authorized reseller. *Acehub Vista Sdn. Bhd.* or its authorized reseller will pay the repair or replacement product shipment expenses.

- This warranty shall not apply to any products *Acehub Vista Sdn. Bhd.* determines have been, by Buyer or otherwise, subject to operating environmental conditions above the maximum values established in applicable specifications or have been subjected to mishandling, misuse, neglect, improper testing, repair, alteration, damage, assembly, or processing that alters physical or electrical properties.

- In no event will *Acehub Vista Sdn. Bhd.* be liable for any incidental or consequential damages.

- This warranty extends to the Buyer only and not to the Buyer's customers or users of the Buyer's products and is in lieu of all other warranties, whether expressed, implied, or statutory, including implied warranties of merchantability of fitness.

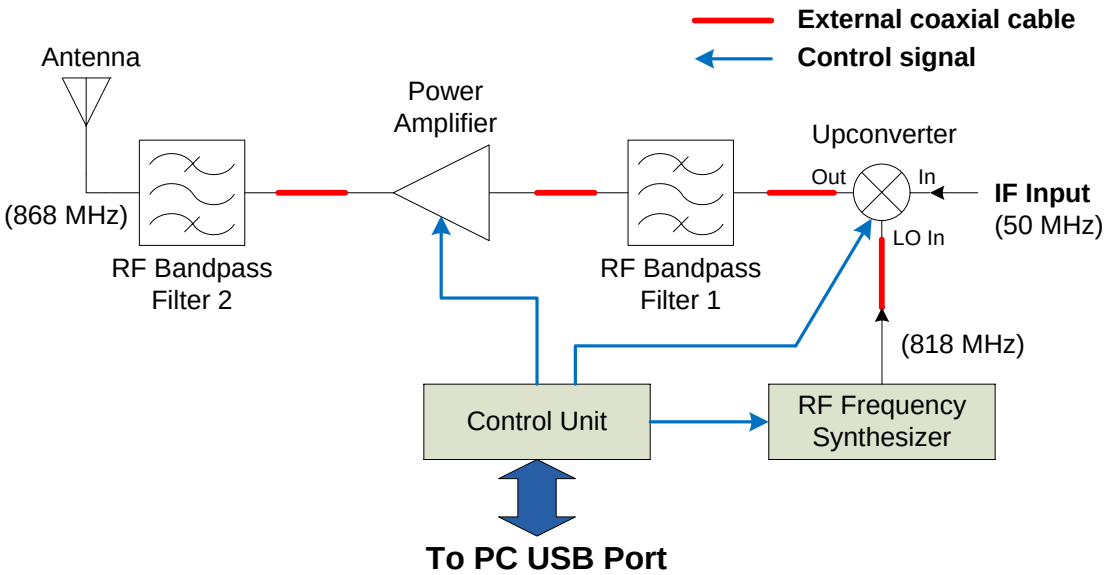
- For technical support and warranty, email cw.support@dreamcatcher.asia.

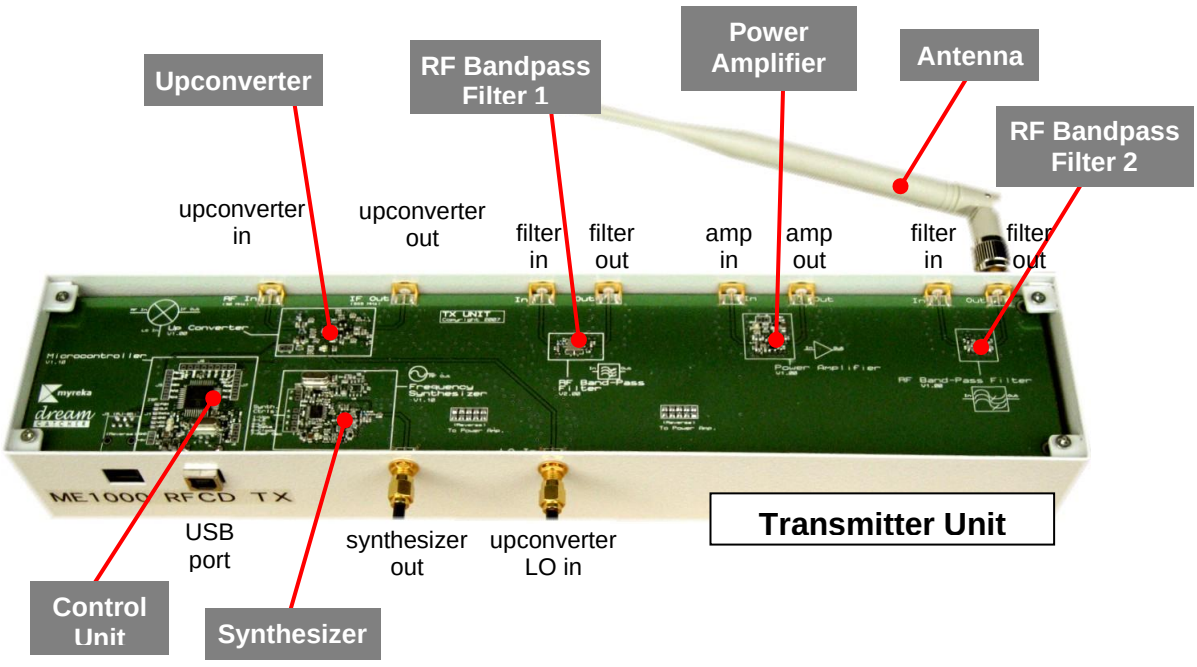
Appendix A: ME1000 Transmitter Unit

The Transmitter Unit (TX) contains the basic blocks of a typical RF front-end system as follows:

- RF Frequency Synthesizer
- Bandpass Filters
- Upconverter
- Power Amplifier

The block diagram of the TX is shown below. The TX accepts a modulated 50 MHz intermediate frequency (IF) signal with a maximum bandwidth of 1 MHz. This is then upconverted to 868 MHz by the Upconverter. The Bandpass Filters suppress unwanted frequency components while the Power Amplifier boosts the signal power to a maximum of 1 mW (into a 50 Ω load) before being fed to the antenna. The Control Unit controls the active circuits of the Power Amplifier, Upconverter, and Frequency Synthesizer. The Control Unit receives commands from the personal computer (PC) via the universal serial bus (USB) port. Applications running on the PC intercept the user's instructions and send the appropriate commands to the Control Unit of the TX. The Control Unit, in turn, provides the necessary power and control signals to the active circuits.



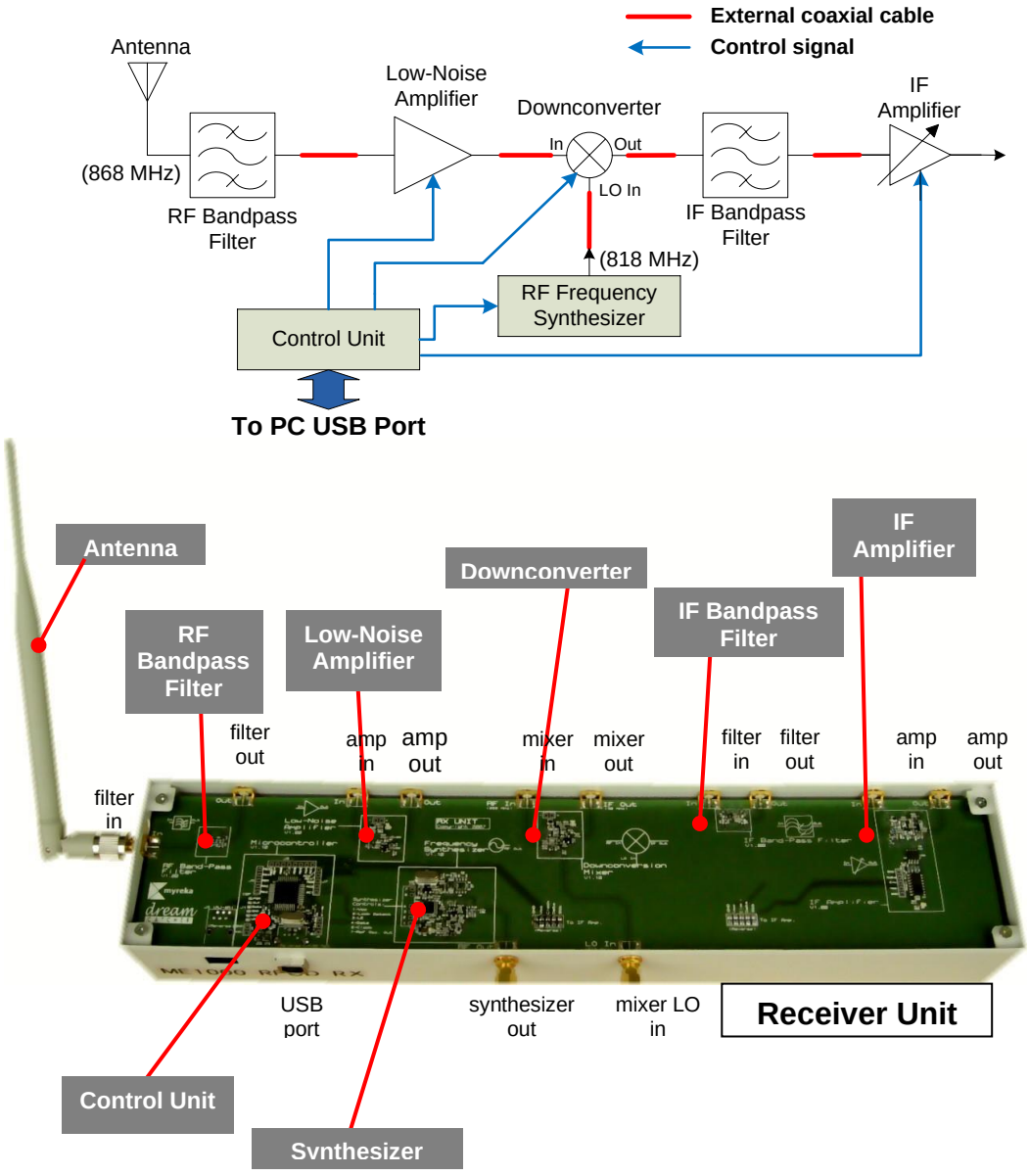


Appendix B: ME1000 Receiver Unit

The Receiver Unit (RX) contains the basic blocks of a typical RF front-end system as follows:

- RF Frequency Synthesizer.
- Bandpass Filters.
- Downconverter.
- Low-Noise Amplifier.
- Intermediate Frequency (IF) Amplifier.

The block diagram of the RX is shown below. The antenna on the RX accepts a modulated 868 MHz RF signal with a maximum bandwidth of 1 MHz. The Low-Noise Amplifier amplifies the RF signal and is subsequently down-converted to a 50 MHz IF signal by the Downconverter. The variable gain IF Amplifier amplifies the IF signal to a maximum of 3 mW (into a 50 Ω load). The RF and IF Bandpass Filters suppress unwanted frequency components. The Control Unit controls the Low-Noise Amplifier, Downconverter, Frequency Synthesizer, and IF Amplifier. The Control Unit receives commands from the personal computer (PC) via the universal serial bus (USB) port. Applications running on the PC intercept the user's instructions and send appropriate commands to the Control Unit of the RX. The Control Unit provides the active circuits with the necessary power and control signals.



Appendix C: Technical Specifications

Low-Noise Amplifier	Min	Typical	Max	Unit	Remarks / Descriptions
Power supply voltage	3	3.3	3.6	V	
Small-signal gain @ 868 MHz	9	11	15	dB	
Input return loss	9	14	18	dB	
Output return loss	9	13	15	dB	
Isolation	15	20	22	dB	
Noise figure	-	-	5	dB	at T= 23 °C
Frequency Synthesizer	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Power supply voltage	3	3.3	3.6	V	
Output frequency	816	-	880	MHz	
Output power	–6	–4.5	–2	dBm	into a 50 Ω load
1st harmonic suppression	15	-	45	dB	
2nd harmonic suppression	20	-	50	dB	
Frequency resolution	-	0.1	-	MHz	
Power Amplifier	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Power supply voltage	3	3.3	3.6	V	
Small-signal gain @ 868 MHz	13	15	16	dB	
Input return loss	13	18	29	dB	
Output return loss	7	12	15	dB	
Output 1 dB compression power	8	10	11	dBm	into a 50 Ω load
Input P1 dB compression power	–7	–5	–3	dBm	
Output 3rd order intercept power	15	17	25	dBm	1 MHz separation into a 50 Ω load
Isolation	20	21	23	dB	
RF Bandpass Filter (V1.01)	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Lower 3 dB frequency	800	-	-	MHz	Only min limit is required
Upper 3 dB frequency	-	-	1300	MHz	Only max limit is required
Insertion loss @ 868 MHz	-	2.5	4	dB	
Insertion loss @ 600 MHz	-	25	30	dB	200 MHz from 3 dB limit
Insertion loss @ 1500 MHz	-	22	32	dB	200 MHz from 3 dB limit
Input return loss @ 868 MHz	8	15	21	dB	
Output return loss @ 868 MHz	8	21	23	dB	
RF Bandpass Filter (V2.00)	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Lower 3 dB frequency	867.5	-	-	MHz	Only min limit is required
Upper 3 dB frequency	-	-	869.3	MHz	Only max limit is required
Insertion loss @ 868 MHz	-	4	6.5	dB	
Input return loss @ 868 MHz	10	12	15	dB	
Output return loss @ 868 MHz	10	12	15	dB	

IF Bandpass Filter (V1.00)	Min	Typical	Max	Unit	Remarks / Descriptions
Lower 3 dB frequency	41	-	-	MHz	Only min limit is required
Upper 3 dB frequency	-	-	57	MHz	Only max limit is required
Insertion loss @ 50 MHz	-	3	5	dB	
Insertion loss @ 43 MHz	-	5	7	dB	
Insertion loss @ 57 MHz	-	5	7	dB	
Input return loss @ 50 MHz	10	17	19	dB	
Output return loss @ 50 MHz	10	14	17	dB	
Downconverter Mixer	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Power supply voltage	3	3.3	3.6	V	
LO to RF isolation @ 818 MHz	5	7	9	dB	into 50 a Ω load
LO to IF isolation @ 818 MHz	13	15.5	18	dB	into 50 a Ω load
Input return loss @ 868 MHz	2	3	5.5	dB	RF
Input return loss @ 818 MHz	1.5	2.5	4	dB	LO
Input return loss @ 50 MHz	2	4	6	dB	IF
RF feedthrough	14	15	17	dB	
Conversion loss @ 868 MHz	0.5	2	3.5	dB	RF@ –15 dBm, 868 MHz; LO @ –4 dBm, 818 MHz
Upconverter Mixer	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Power supply voltage	3	3.3	3.6	V	
LO to RF isolation @ 818 MHz	6	8	11	dB	into a 50 Ω load
LO to IF isolation @ 818 MHz	7	10.5	12	dB	into a 50 Ω load
Input return loss @ 868 MHz	3	5	8	dB	IF
Input return loss @ 818 MHz	8	10	12	dB	LO
Input return loss @ 50 MHz	1.5	2.5	4	dB	RF
RF feedthrough @ 50 MHz	7	12	16	dB	
Conversion loss @ 868 MHz	3	5	-	dB	RF @ –15 dBm, 50 MHz; LO @ –3 dBm, 818 MHz
IF Amplifier	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Power supply voltage	3	3.3	3.6	V	
Small-signal gain @ 50 MHz (Gain Level = 10)	7	9	12	dB	
Small-signal gain @ 50 MHz (Gain Level = 12)	11	12.5	16	dB	
Small-signal gain @ 50 MHz (Gain Level = 15)	14	16	20	dB	
Input return loss	10	12.5	17	dB	
Antenna	**Min**	**Typical**	**Max**	**Unit**	**Remarks / Descriptions**
Frequency range	806	-	960	MHz	
Gain at operating range	-	2.5	-	dBi	
VSWR	-	<2	-	-	
Polarization	-	Vertical	-	-	
Length	-	210	-	mm	

Revision History

Revisions	Notes
3.01	Initial document.
3.02	Added: DreamCatcher Courseware Customer Login Guide

Contact Us

Contact Us

Acehub Vista Sdn Bhd (785702-P)
A member of the DreamCatcher group
70-03-79,D'Piazza Mall, Jalan
Mahsuri, Bayan Lepas, 11900
Penang, Malaysia.