

F5701

24.25GHz to 29.5GHz RF, 2.5GHz to 6GHz IF Upconverter/Downconverter

The F5701 evaluation kit (EVK) is designed to help users evaluate the F5701 RF upconverter/downconverter device. This document provides the necessary information and a brief overview of the associated control software Graphical User Interface (GUI). Renesas recommends that you review the corresponding device datasheets and use them as a reference to supplement the information provided in this document.

Features

- RF range: 24.25GHz to 29.5GHz (n257/n258)
- IF range: 2.5GHz to 6GHz
- Two integrated LO frequency doublers
- Analog supply voltage: +2.4V to +2.6V
- Dedicated PA supply voltage: selectable between +2.4V to +2.6V and +3.0V to +3.3V

Evaluation Kit Contents

- F5701 evaluation board (Figure 1, item 1)
- FT2232HL interface board (Figure 1, item 2)
- USB-to-Micro USB cable (Figure 1, item 3)
- 16-pin supply cable (Figure 1, item 4)

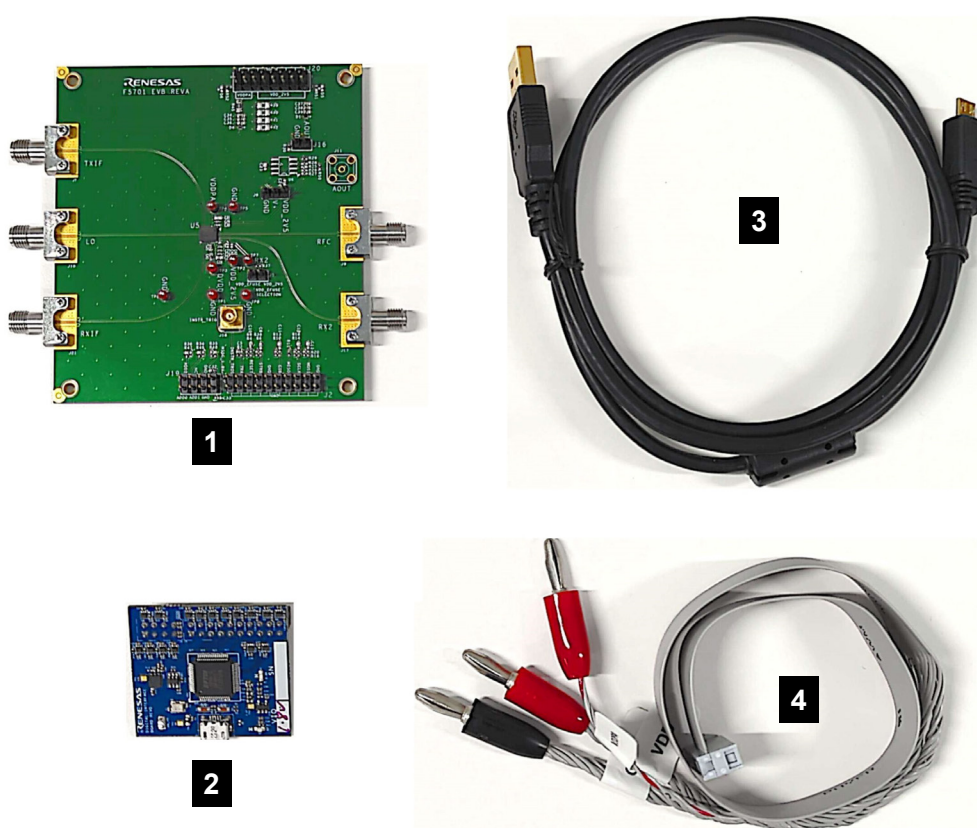


Figure 1. Evaluation Kit Contents

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1. Hardware Overview

1.1 Evaluation Board

Figure 2 identifies the locations of RF I/O ports, digital interface and power supply headers, and sensing test points.

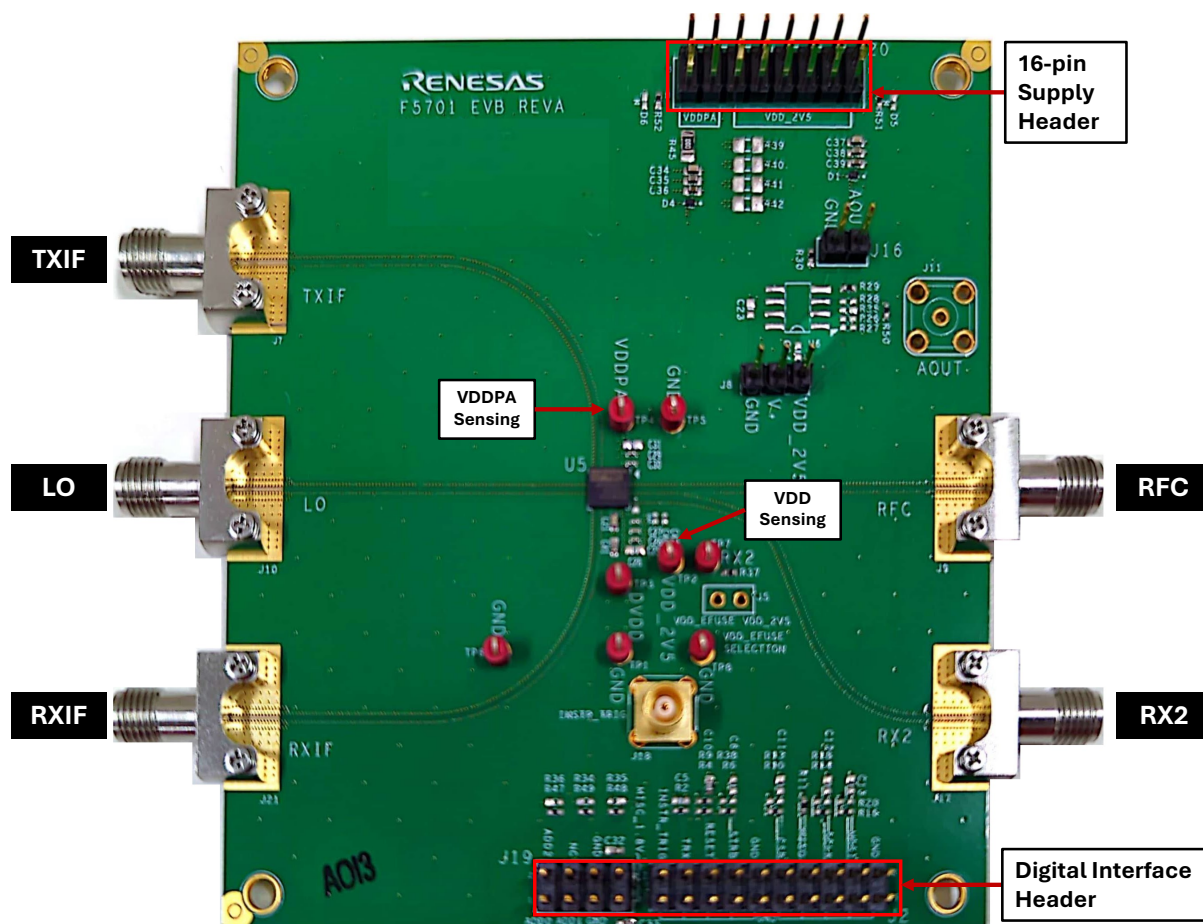


Figure 2. F5701 Evaluation Board Ports and Connectors

Table 1. Connector Descriptions

Connector	Description
J2	Digital interface header (2 × 10) 1, 3, 5, 7 – No connection 2 – Instrument Trigger 4 – TRX control 6 – RESETB control 8 – STRB control 9, 11, 13, 15, 17, 19 – GND 10, 20 – GND 12 – CSB control 14 – MISO control 16 – SCLK control 18 – MOSI control
J7	TXIF port
J9	RFC port
J10	LO port
J17	RX2 port

Connector	Description
J19	Digital interface header (2 × 4) 1 – ADD0 2 – ADD2 3 – ADD1 4 – No connection 5, 6 – GND 7, 8 – MISC_1.8V
J20	16-pin supply header 1, 3, 5, 7, 9, 11, 13, 15 – GND 2, 4, 6, 8, 10, 12 – VDD (Analog) 14, 16 – VDDPA
J21	RXIF port

Table 2. Selector Descriptions

Selector Block	Description	Factory Setting
J5	2-pin EFUSE header 1 – VDD_2V5 2 – VDD_EFUSE	Not connected
J8	AOUT buffer VDD jumper 1 – GND 2 – OPA356 VDD pin (connect to J8.3 to power OPA356) 3 – VDD	Not connected
J16	AOUT reference resistor connection jumper 1 – U6 Op-amp positive signal input 2 – R30 resistor to ground	Not connected

Table 3. Test Point Descriptions

Test Point	Description
TP1, TP5	GND test point
TP2	VDD test point
TP3	DVDD test point
TP4	VDDPA test point

1.2 THRU Reference Fixture

The THRU reference fixture (optional part of the evaluation kit) is used to generate test equipment de-embed files for removing the effects of the EVB RF traces and connectors. AFR (Automatic Fixture Removal) is a commercial product available from test and measurement suppliers to create the de-embed files (.s2p) using measurements from the THRU Reference Fixture traces (2x half-fixture lines). The THRU board is laid out symmetrically so that the AFR process can generate two half-fixture s-parameter files. The S-parameter de-embed files are available from the Renesas Application Support or your local field engineer. For information on purchasing the THRU Reference Fixture board in order to create your own de-embed files, contact the Renesas [Sales](#) department.

1.3 FT2232HL Digital Interface Board

The FT2232HL digital interface board connects your computer to the F5701 EVB through a USB-to-Micro USB cable.

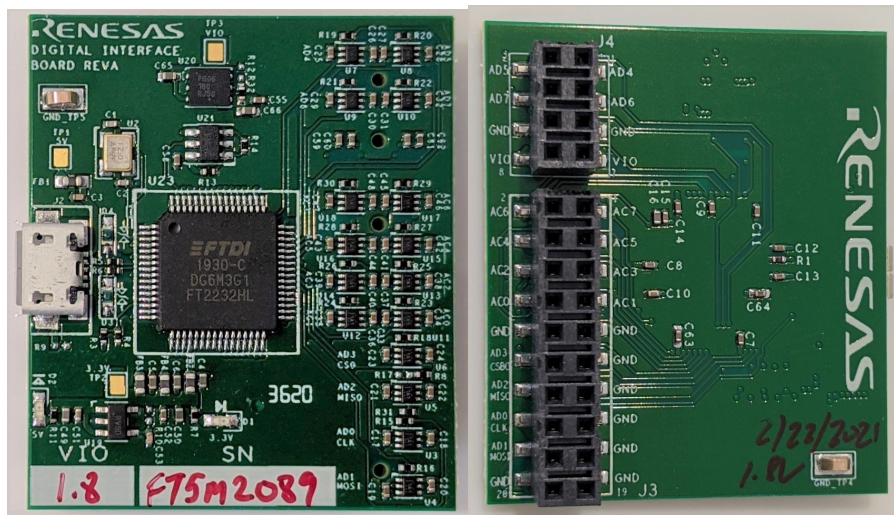


Figure 3. FT2232HL Digital Interface Board – Top (left) and Bottom (right)

2. Quick Start

2.1 Required or Recommended Test Equipment

- Power supplies with banana jack outputs capable of at least 2.5V and 1000mA rating. It is recommended to use a 4-wire remote sensing power supply for V_{DD} and V_{DDPA} when making any measurements for correlation with datasheet parameters. Removing all voltage drops introduced by the conductors and connectors is critical to achieving the datasheet specified performance.
- Vector network analyzer capable of measuring up to 30GHz.

2.2 Computer Requirements and Setup

2.2.1 Computer Requirements

- Renesas F5701 Evaluation System Software installed
- USB 2.0 or 3.0 Interface
- Windows XP SP3 or later
- Processor: Minimum 1GHz
- Memory: Minimum 512MB; recommended 1GB
- Available hard disk space: Minimum 600MB (32-bit OS), 1.5GB (64-bit OS); recommended 1GB (32-bit OS), 2GB (64-bit OS)
- Internet access during installation if the .NET framework (4.6.1 or later) is not currently installed on the system

2.2.2 Software Installation and Setup

1. Download the Renesas F5701 Evaluation Software (EVS) from the F5701 [webpage](#). Contact a Renesas field engineer if experiencing any difficulty with the download.
2. Launch the software installation application (**setup.exe**).
Note: Your account must have administrator privileges to complete the installation.
3. Follow the on-screen prompts to complete the installation.

2.3 EVB Hardware Setup

Connect the EVB as displayed in Figure 4 using the provided power supply cable and USB-to-Micro USB cable. The digital interface board can be attached directly to the F5701 EVB. The typical V_{DD} and V_{DDPA} power supplies are 2.5V. For details on other recommended power supply operating voltages, refer to the [F5701 datasheet](#).

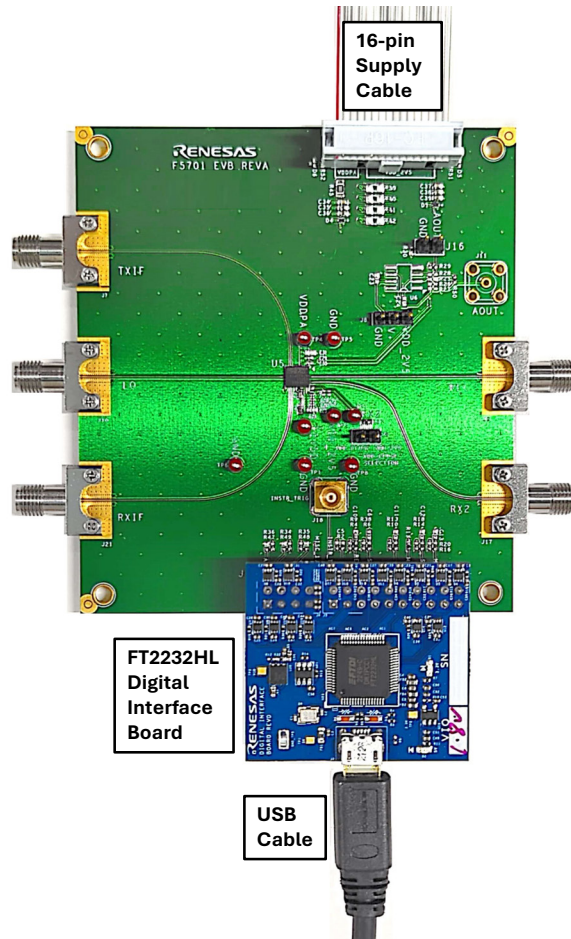


Figure 4. F5701 EVB Hardware Setup

2.4 Software Start-up and Presets

1. Open the application through the Windows Start menu or click on the application icon if saved on the desktop. The application appears as shown in Figure 5. The USB Interface Serial Number (Figure 5, item 1) should be auto-detected if the FT2232HL digital interface board is connected and recognized.
2. Select write speed, read speed, and chip address (Figure 5, item 2), then select **Detect** (Figure 5, item 4) to start the communication with the device. The **Device Selection** drop-down menu (Figure 5, item 3) is automatically selected with the correct device variant (ZL or Y). A subsequent pop-up window will ask if the user would like to program the device with the recommended default values (Figure 6). Click **Yes** to program the default values or click **No** to reset the device.
3. For each device variant, there are five recommended settings to choose from: H8 (5GHz IF / 28GHz RF), H6 (5GHz IF / 26GHz RF), H6H (5GHz IF / 26GHz RF, high linearity), L8 (3GHz IF / 28GHz RF), and L6 (3GHz IF / 26GHz RF). By default, H8 is initially selected and programmed. To program the device to other settings, use the **Device Selection** drop-down menu (Figure 5, item 3) and follow the pop-up window.
4. Users can also program the device with the recommended default values at any time afterward by clicking the *Program Defaults* button (Figure 5, item 8). After the programming, the GUI settings will be in sync with the hardware settings and the device can be controlled in real time.

5. Users can quickly enable/disable the master bias, enable/disable signal paths, set the device standby mode, switch between transmit and receive modes, and control the strobe pin by using the high-level chip control checkboxes at the bottom of the main panel (Figure 5, item 5).
6. To read all bitfield and register values at any given time, click the *Read Values* button (Figure 5, item 6) and the results will be displayed on both **BitField Log** and **Register Log** panels. To view the results, click on either **BitField Log** or **Register Log** panel tabs (Figure 5, item 10).

Important: The **Enable BitField Log** and **Enable Register Log** checkboxes (Figure 7, items 1 and 2) must be selected beforehand. The **BitField Log** and **Register Log** panels will also keep track of all the SPI write commands.

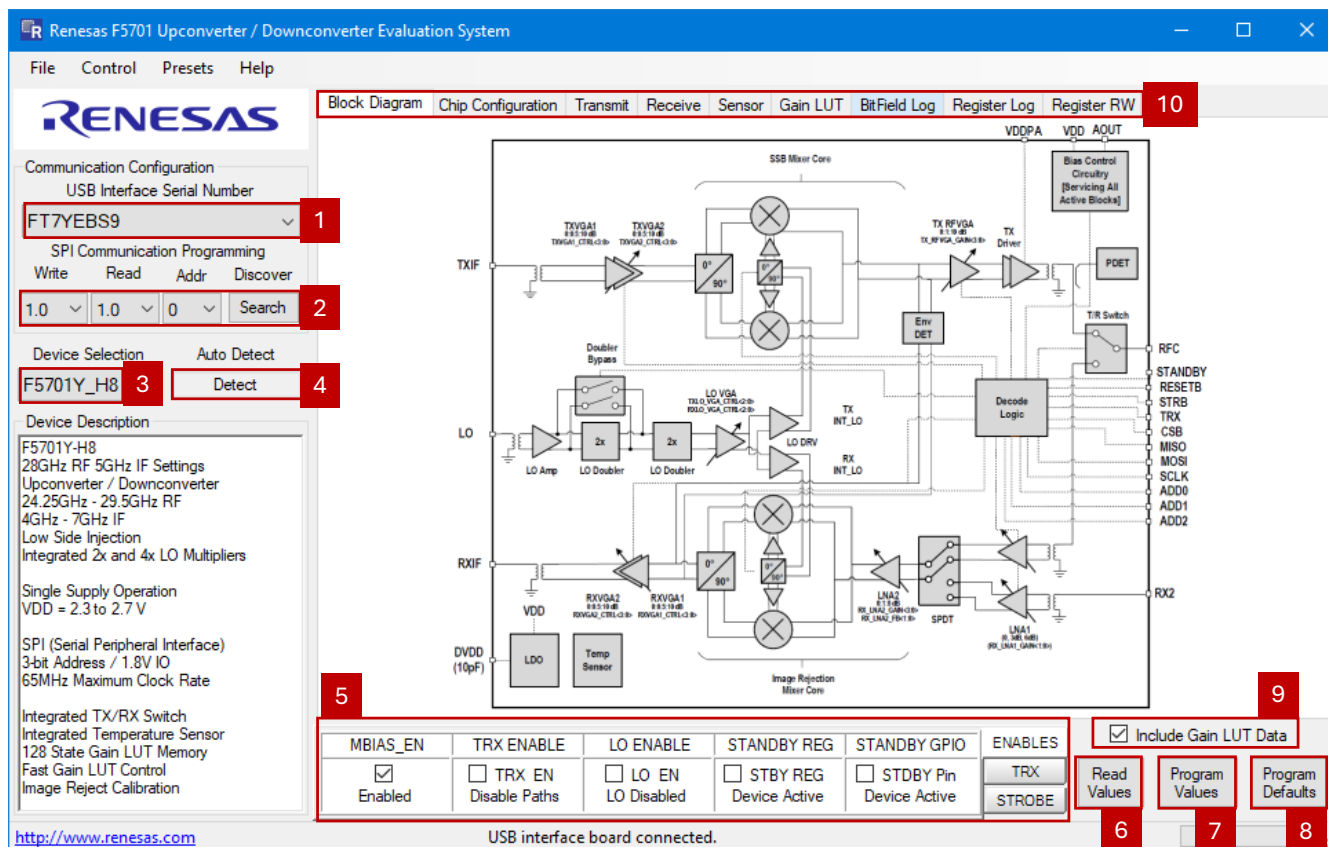


Figure 5. Application Control Panel at Start-up

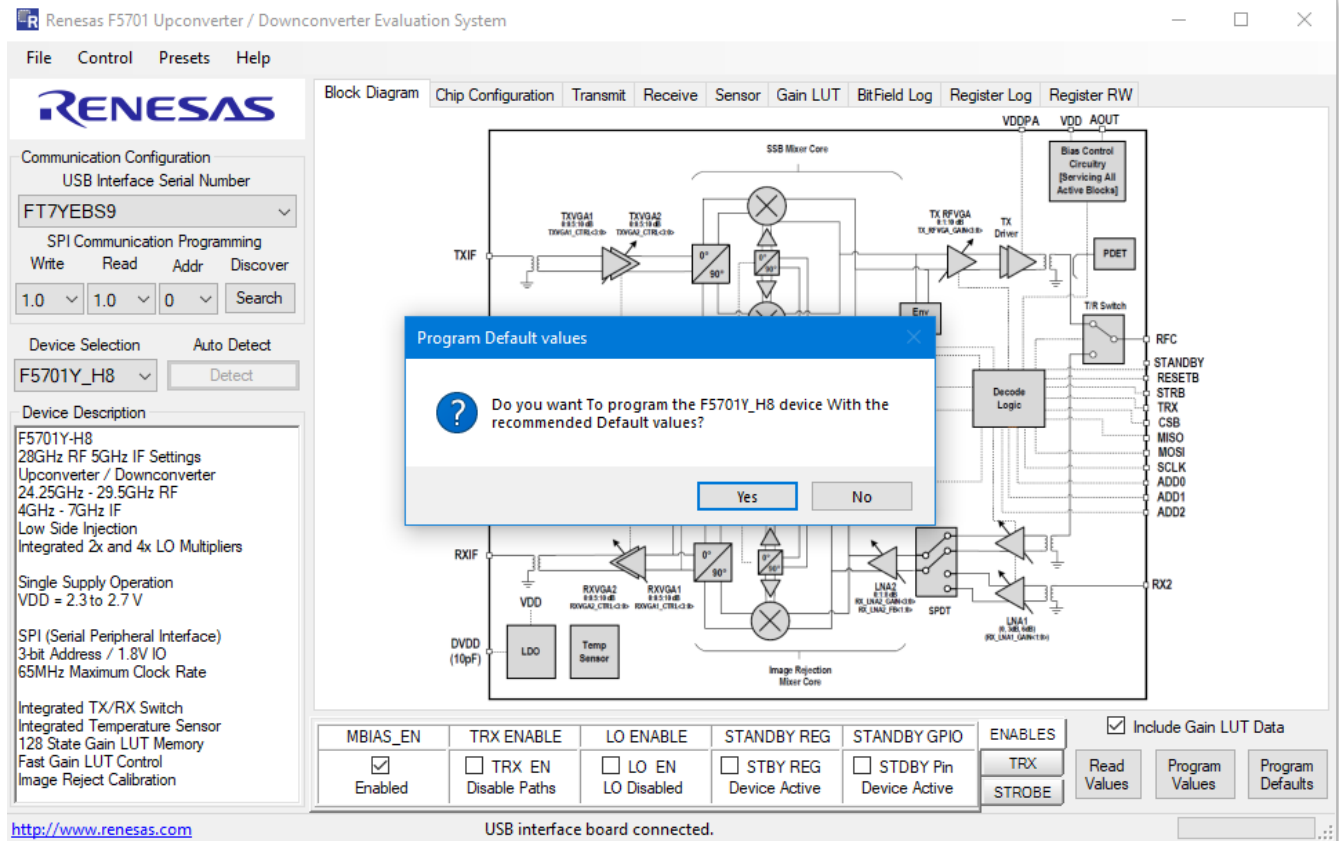


Figure 6. Pop-up Window to Program Default Values

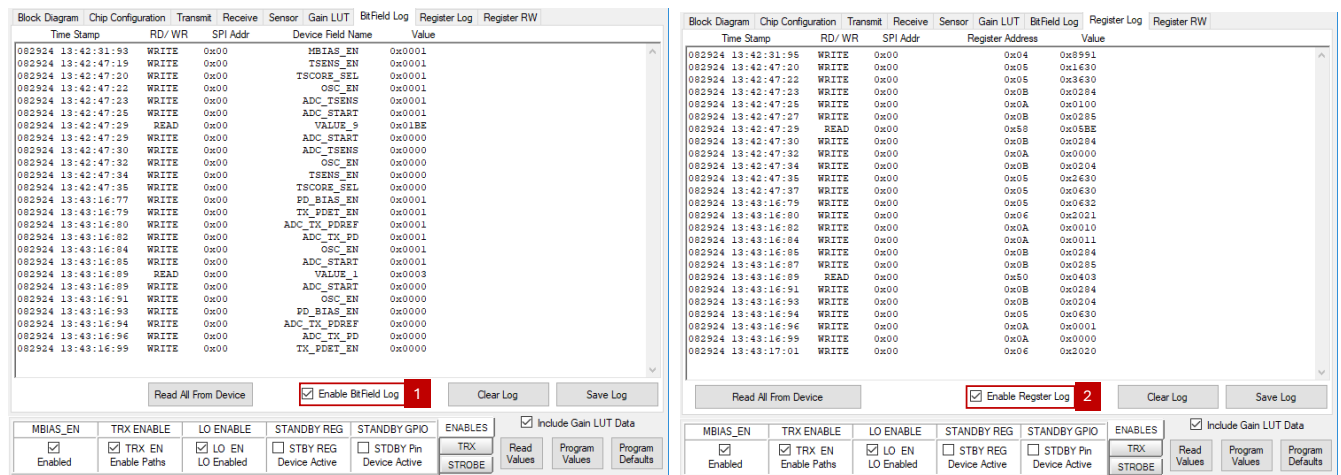


Figure 7. BitField Log and Register Log Panels

7. The File menu shown in Figure 8 provides options to load or save device settings (Figure 8, item 1). Device bitfield settings can be saved to an XML file and loaded back to the software at any given time. To use a Gain Lookup Table (LUT), **Load Gain Lookup Table** (Figure 8, item 2) to load a gain LUT file, then select **Program Gain Lookup Table** (Figure 9, item 3) in the Control menu to program it to the device.

Note: To use gain LUT, the **Include Gain LUT Data** checkbox (Figure 5, item 9) must be checked. The Control menu also allows users to reset the device (Figure 9, item 1). The software will read back the written register after every SPI write command if item 2 in Figure 9 is selected.

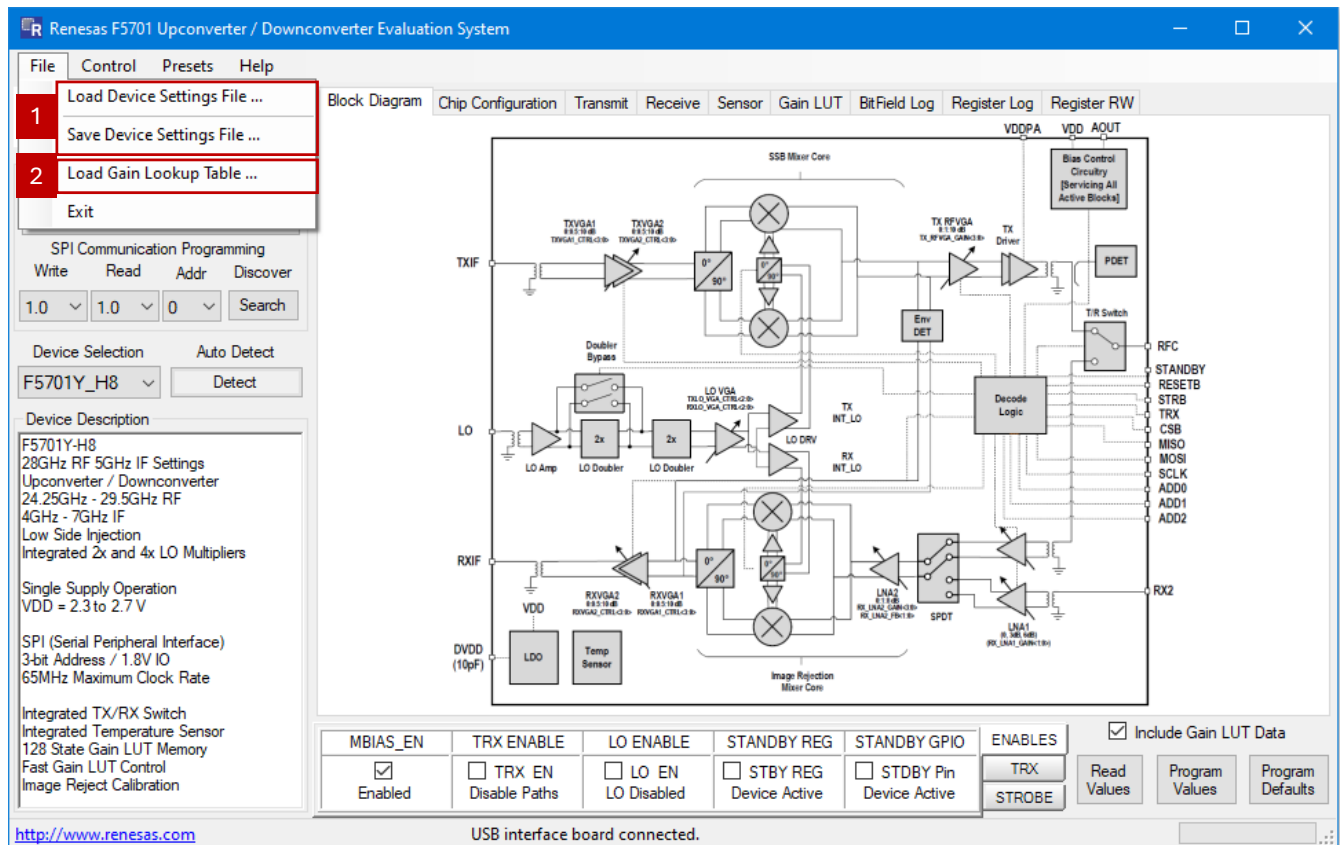


Figure 8. File Menu

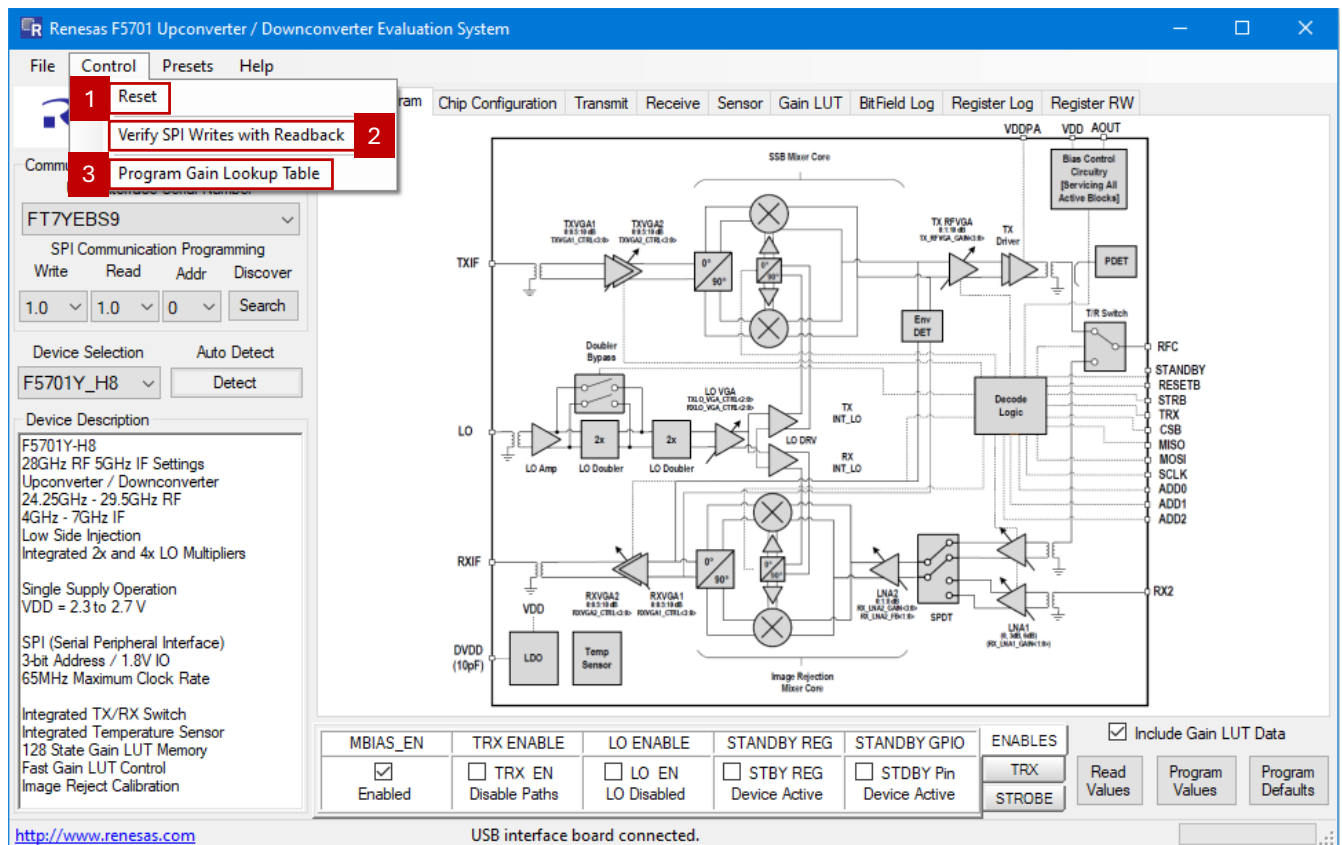


Figure 9. Control Menu

8. For convenience, the Presets menu (see Figure 10) is provided in this software for users to quickly program the device to one of the predefined states for the standby mode, transmit modes, receive modes, and receive-2 modes (RX2 path). For example, by selecting the **Transmit: Transmit LO2X** option, both TRX and LO signal paths will be enabled in the transmit mode with LO_SEL set to 0 for LOx2.

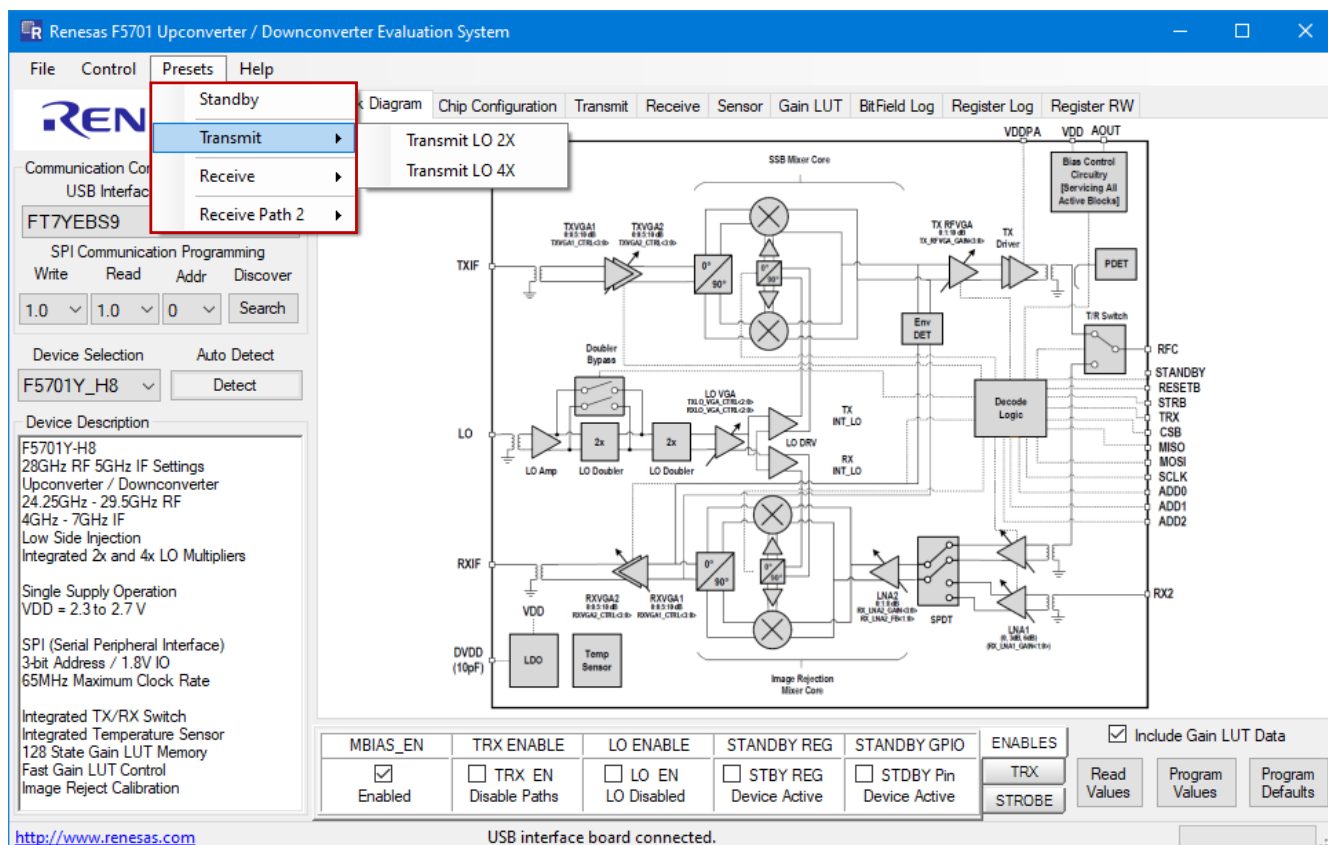


Figure 10. Presets Menu

9. The main configuration control panel can be seen by clicking on the **Chip Configuration** panel tab (Figure 5, item 10). Users can select the corresponding subpanel tab to read chip information (Figure 11), set general device configuration (Figure 12), set/enable master bias (Figure 13), and test the SRAM (Figure 14).

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

CHIP ID Config Master Bias BIST

Field Name	Control	Register	Description
CHIP_ID_REGISTER	0x5200	CHIP_ID	CHIP_ID Register Value
ID_CLASS	0x1	CHIP_ID	ID Class of connected device. 0 = Beamformer 1 = Up-Down Converter
ID_FREQ	0x1	CHIP_ID	Frequency of connected device. 0 = 26GHz 1 = 28GHz 2 = 39GHz
BASE_REV	0x2	CHIP_ID	Base revision of connected device. 1 = V1XY 2 = V2XY
METAL_REV	0x0	CHIP_ID	Metal revision of connected device. X in V1XY
VARIANTS	0x0	CHIP_ID	Variant of connected device. Y in V1XY
Read Chip ID			

☒ MBIAS_EN
 ☒ TRX ENABLE
 ☒ LO ENABLE
 ☐ STANDBY REG
 ☐ STANDBY GPIO
 ENABLES
☒ Include Gain LUT Data

☒ Enabled
☒ TRX EN
☒ LO EN
☐ STBY REG
☐ STDBY Pin
 TRX
 Read Values
 Program Values
 Program Defaults

Enable Paths
 LO Enabled
 Device Active
 Device Active
 STROBE

Figure 11. Chip ID Panel

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

CHIP ID Config Master Bias BIST

Field Name	Control	Register	Description
RESET	RESET	CTRL_CFG	Software RESET of the chip
STANDBY	☐ Operation	CTRL_CFG	Standby Control 0: Normal Operation 1: STANDBY irrespective of STANDBY_SEL
SA_IDX	0	CTRL_CFG	Sub-array Index
STROBE PROG	000: Latch Buf	CTRL_CFG	Strobe Pin Functionality
LO_SEL	☐ LO 2X	CTRL_CFG	LO Select 0: LO 2X 1: LO 4X
LO_EN	☒ LO Enabled	CTRL_CFG	LO Path Enable
TRX_SEL	☐ Internal Signal	CTRL_CFG	TRX Select 0: Uses internal signal for TRX toggle 1: Uses external TRX pin for TRX toggle
TRn	☐ RX Enabled	CTRL_CFG	TR Select 0: RX Enabled 1: TX Enabled
TRX_EN	☒ Enable Sig Paths	CTRL_CFG	TRX Enable 0: Disable Signal Paths 1: Enable Signal Paths

☒ MBIAS_EN
 ☒ TRX ENABLE
 ☒ LO ENABLE
 ☐ STANDBY REG
 ☐ STANDBY GPIO
 ENABLES
☒ Include Gain LUT Data

☒ Enabled
☒ TRX EN
☒ LO EN
☐ STBY REG
☐ STDBY Pin
 TRX
 Read Values
 Program Values
 Program Defaults

Enable Paths
 LO Enabled
 Device Active
 Device Active
 STROBE

Figure 12. Configuration Panel

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

CHIP ID Config Master Bias BIST

Field Name	Control	Register	Description
SCTAT_CTRL	8	MBIAS	Super CTAT Bias control
SCTAT_TRIM	4	MBIAS	Super CTAT Bias Trim
SCTAT_EN	☒ Enabled	MBIAS	Super CTAT Bias Enable
PTAT2_SLOPE	4	MBIAS	PTAT2 slope control
PTADJ	4	MBIAS	Internal reference current generator level control. +/- 30% reference current control adjustment.
VBG_SEL	☐ PTAT	MBIAS	Master Bias VBG source select 0 = PTAT 1 = BG
MBIAS_EN	☒ Enabled	MBIAS	Master Bias Enable

☒ Include Gain LUT Data
 MBIAS_EN ☒ Enabled
 TRX ENABLE ☒ TRX EN Enable Paths
 LO ENABLE ☒ LO EN LO Enabled
 STANDBY REG ☐ STBY REG Device Active
 STANDBY GPIO ☐ STDBY Pin Device Active
 ENABLES

Figure 13. Master Bias Panel

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

CHIP ID Config Master Bias BIST

Field Name	Control	Register	Description
OSC_EN	☐ Disabled	BIST	Oscillator Enable
SRAM_INIT	☐ Idle	BIST	Initialize SRAM to Zeros
SRAM_BIST	☐ Idle	BIST	Request SRAM Built In Self Test (BIST)
SRAM_CRC	☐ Idle	BIST	Request SRAM CRC Check Request
SRAM_ERR	Read 0	BIST	Number of SRAM BIST Errors (Max 7 reported)
SRAM_DONE	Read 0	BIST	SRAM Access Status (INIT, BIST, or CRC) 0 = REQUESTED 1 = DONE
CRC_RESULT	Read 0	BIST	SRAM CRC Result

NOTE: ENABLE OSC, THE CHECK SRAM_INIT, SRAM_BIST, or SRAM_CRC, THEN READ SRAM_DONE, FINALLY CLEAR THE CONTROL.

☒ Include Gain LUT Data
 MBIAS_EN ☒ Enabled
 TRX ENABLE ☒ TRX EN Enable Paths
 LO ENABLE ☒ LO EN LO Enabled
 STANDBY REG ☐ STBY REG Device Active
 STANDBY GPIO ☐ STDBY Pin Device Active
 ENABLES

Figure 14. BIST Panel

10. In transmit mode, individual transmit building blocks and their warmup states can be configured by selecting **Transmit** panel tab (Figure 5, item 10) and **Enable / Warmup** subpanel tab as shown in Figure 15.

Field Name	Warmup	Register	Field Name	Enable	Register
	All On			All On	
TX_BIAS_WU	☐	TRX_WARMUP	TX_BIAS_EN	☒	TRX_ENABLE
TX_PA_WU	☐	TRX_WARMUP	TX_PA_EN	☒	TRX_ENABLE
TX_DRV_WU	☐	TRX_WARMUP	TX_DRV_EN	☒	TRX_ENABLE
TX_MXR_WU	☐	TRX_WARMUP	TX_MXR_EN	☒	TRX_ENABLE
TX_LO_DRV_WU	☐	TRX_WARMUP	TX_LO_DRV	☒	TRX_ENABLE
TXVGA_BIAS_WU	☐	TRX_WARMUP	TXVGA_BIAS	☒	TRX_ENABLE
TXVGA2_WU	☐	TRX_WARMUP	TXVGA2_EN	☒	TRX_ENABLE
TXVGA1_WU	☐	TRX_WARMUP	TXVGA1_EN	☒	TRX_ENABLE
	All Off			All Off	

MBIAS_EN

☒ Enabled

TRX ENABLE

☒ TRX EN Enable Paths

LO ENABLE

☒ LO EN LO Enabled

STANDBY REG

☐ STBY REG Device Active

STANDBY GPIO

☐ STDBY Pin Device Active

ENABLES

TRX

STROBE

☒ Include Gain LUT Data

Read Values

Program Values

Program Defaults

Figure 15. Transmit: Enable / Warmup Panel

11. The **VGA / Front End** panel (Figure 16) allows users to manually adjust TX VGA/FE gain settings. Users can also manually adjust bias settings for individual TX building blocks and calibration parameters by selecting **Bias** and **Calibration** subpanel tabs.

Important: To manually adjust VGA/FE gain settings (both transmit and receive modes), the **Include Gain LUT Data** checkbox (Figure 5, item 9) must be unchecked, otherwise, the gain settings will be dictated by the gain LUT control feature.

Field Name	Control	Register	Description
TX_RFVGA_GAIN	<input type="range"/> 15	TX_FE_SET	TX RFVGA Gain Setting
TXVGA2_PT_PT2	☒ PTAT ²	TX_FE_SET	TX VGA2 PTAT / PTAT ² Setting
TXVGA2_BIAS	<input type="range"/> 4	TX_FE_SET	TX VGA2 Bias Current Setting
TXVGA1_BIAS	<input type="range"/> 4	TX_FE_SET	TX VGA1 Bias Current Setting
TXVGA1_RTUNE	<input type="range"/> 1	TX_VGA_SET	TX VGA1 Resistance Setting
TXVGA1_PT_PT2	☒ PTAT ²	TX_VGA_SET	TX VGA1 PTAT / PTAT ² Setting
TXVGA2_CTRL	<input type="range"/> 31	TX_VGA_SET	TX VGA2 Amplifier Gain Setting
TXVGA1_CTRL	<input type="range"/> 31	TX_VGA_SET	TX VGA1 Amplifier Gain Setting
TXVGA_SW_3p5	☒ Atten Disabled (High Gain)	TX_VGA_SET	Removes 3.5dB Attenuator
TXVGA_SW_0p25	☒ Atten Disabled (High Gain)	TX_VGA_SET	Removes 0.25dB Attenuator

MBIAS_EN	TRX ENABLE	LO ENABLE	STANDBY REG	STANDBY GPIO	ENABLES	☒ Include Gain LUT Data		
☒ Enabled	☒ TRX EN Enable Paths	☒ LO EN LO Enabled	☐ STBY REG Device Active	☐ STDBY Pin Device Active	TRX STROBE	Read Values	Program Values	Program Defaults

Figure 16. Transmit: VGA / Front End Panel

12. Similarly, in receive mode, individual receive building blocks and their warmup states can be configured by selecting **Receive** panel tab (Figure 5, item 10) and **Enable / Warmup** subpanel tab as shown in Figure 17.

Field Name	Warmup	Register	Field Name	Enable	Register
	All On			All On	
RX_BIAS_WU	☐	TRX_WARMUP	RX_BIAS_EN	☒	TRX_ENABLE
RX_LNA1_WU	☐	TRX_WARMUP	RX_LNA1_EN	☒	TRX_ENABLE
RX_LNA2_WU	☐	TRX_WARMUP	RX_LNA2_EN	☒	TRX_ENABLE
RX_MXR_WU	☐	TRX_WARMUP	RX_MXR_EN	☒	TRX_ENABLE
RX_LO_DRV_WU	☐	TRX_WARMUP	RX_LO_DRV_EN	☒	TRX_ENABLE
RXVGA_BIAS_WU	☐	TRX_WARMUP	RXVGA_BIAS_EN	☒	TRX_ENABLE
RXVGA2_WU	☐	TRX_WARMUP	RXVGA2_EN	☒	TRX_ENABLE
RXVGA1_WU	☐	TRX_WARMUP	RXVGA1_EN	☒	TRX_ENABLE
	All Off			All Off	

MBIAS_EN	TRX ENABLE	LO ENABLE	STANDBY REG	STANDBY GPIO	ENABLES	☒ Include Gain LUT Data		
☒ Enabled	☒ TRX EN Enable Paths	☒ LO EN LO Enabled	☐ STBY REG Device Active	☐ STDBY Pin Device Active	TRX STROBE	Read Values	Program Values	Program Defaults

USB interface board connected.

Figure 17. Receive: Enable / Warmup Panel

13. The **VGA / Front End** panel (Figure 18) allows users to manually adjust RX VGA/FE gain settings. Users can also manually adjust bias settings for individual RX building blocks and calibration parameters by selecting **Bias** and **Calibration** subpanel tabs.

The screenshot displays the 'Receive: VGA / Front End' panel of the F5701 Evaluation Kit software. The panel is divided into several sections:

- Top Tabs:** Block Diagram, Chip Configuration, Transmit, Receive (selected), Sensor, Gain LUT, BitField Log, Register Log, Register RW.
- Subpanel Tabs:** Enable / Warmup, VGA / Front End (selected), Bias, Calibration.
- Main Table:**

Field Name	Control	Register	Description
RX_LNA2_FB	3	RX_FE_SET	LNA2 Feedback Control
RX_LNA2_GAIN	Slider (15)	RX_FE_SET	Adjust Gain of the LNA2 Amplifier
RX_LNA1_GAIN	11: 0dB	RX_FE_SET	Adjust Gain of the LNA1 Amplifier
RXVGA2_BIAS	Slider (4)	RX_FE_SET	RX VGA2 Bias Current Setting
RXVGA1_BIAS	Slider (4)	RX_FE_SET	RX VGA1 Bias Current Setting
RX_VGA2_CTRL	Slider (15)	RX_VGA_SET	Adjust Gain of the VGA2 Amplifier
RXVGA1_CTRL	Slider (15)	RX_VGA_SET	Adjust Gain of the VGA1 Amplifier
RX_VGASW_3p5	☒ Atten Disabled (High Gain)	RX_VGA_SET	Enables 3.5dB Attenuator
RXVGA_SW_0p25	☒ Atten Disabled (High Gain)	RX_VGA_SET	Enables 0.25dB Attenuator
- Bottom Section:**
 - MBIAS_EN:** ☒ Enabled
 - TRX ENABLE:** ☒ TRX EN Enable Paths
 - LO ENABLE:** ☒ LO EN LO Enabled
 - STANDBY REG:** ☐ STBY REG Device Active
 - STANDBY GPIO:** ☐ STDBY Pin Device Active
 - ENABLES:** TRX, STROBE
 - Include Gain LUT Data:** ☒
 - Buttons:** Read Values, Program Values, Program Defaults
- Status Bar:** USB interface board connected.

Figure 18. Receive: VGA / Front End Panel

14. Sensor control panel can be accessed by selecting **Sensor** panel tab (Figure 5, item 10). While individual settings relating to temperature sensor and power detector (PDET) can be controlled, a **Macros** panel (Figure 19) is provided for quick evaluation.

Chan	Start	HW AVG	SW Repeat Count	SW Avg Type	Raw ADC	Slope	Offset	Calibrated	Unit
Temp	Measure	0: No AVG	1	☒ Median ☐ Avg	446	0.7715	-263	81.09	°C

Chan	Start	HW AVG	SW Repeat Count	SW Avg Type	Raw ADC	P0	C0	Calibrated	Unit
PDet	Measure	0: No AVG	1	☒ Median ☐ Avg	3	14.89	1.0152	-10.82	dBm

MBIAS_EN	TRX ENABLE	LO ENABLE	STANDBY REG	STANDBY GPIO	ENABLES	☒ Include Gain LUT Data		
☒ Enabled	☒ TRX EN Enable Paths	☒ LO EN LO Enabled	☐ STBY REG Device Active	☐ STDBY Pin Device Active	TRX STROBE	Read Values	Program Values	Program Defaults

Figure 19. Sensor: Macros Panel

15. TX/RX VGA/FE gain can be controlled by a predefined gain LUT. For gain control mapping and typical performance at nominal settings, please consult the datasheet. An example gain LUT CSV file is included with the evaluation software and can be loaded and programmed (Figure 8, item 2 to load and Figure 9, item 3 to program). The **Include Gain LUT Data** checkbox (Figure 5, item 9) must be checked beforehand. Select **Gain LUT** panel tab (Figure 5, item 10) to see the LUT control panels.

16. Figure 20 shows the **SRAM LUT Entry Select** panel. Use the slider to select any gain LUT index loaded on the SRAM, or similarly on the **Direct LUT Entry Select** panel (Figure 22) without accessing the SRAM.

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

SRAM LUT Entry Select LUT Editor Direct LUT Entry Select LUT Register

Programming Mode		Display Update		SPI Programming	
☒ Local ☐ Global		☒ Auto Read SRAM		☒ Auto Update Update SRAM	

Gain LUT Index Slider Selection

< [Slider] > 0

VGA Field Name	Value	FE Field Name	Value
TX / RX (FROM LUT FILE)	RECEIVE	RX_LNA2_FB	3
VGA2_CTRL	12	RX_LNA2_GAIN	8
VGA1_CTRL	14	RX_LNA1_GAIN	3
VGA_SW_0P25	☐ Atten Enabled (Low Gain)	VGA2_BIAS	7
VGA_SW_3P5	☐ Atten Enabled (Low Gain)	VGA1_BIAS	5
TX VGA1_RTUNE	0	TX_RF_VGA_GAIN	0
VGA1_PT_PT2	☐ PTAT	TX_VGA2_PT_PT2	☐ PTAT

MBIAS_EN	TRX ENABLE	LO ENABLE	STANDBY REG	STANDBY GPIO	ENABLES	Include Gain LUT Data			
☒ Enabled	☒ TRX EN Enable Paths	☒ LO EN LO Enabled	☐ STBY REG Device Active	☐ STDBY Pin Device Active	TRX STROBE	☒	Read Values	Program Values	Program Defaults

Figure 20. Gain LUT: SRAM LUT Entry Select

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

SRAM LUT Entry Select LUT Editor Direct LUT Entry Select LUT Register

< [Slider] > 0

☐ Transmit
☒ Receive
☒ Immediate
☐ Enable Edit

VGA Field Name	Value	FE Field Name	Value
TX / RX (FROM LUT FILE)	RECEIVE	RX LNA2_FB	3
VGA2_CTRL	31	RX LNA2_GAIN	15
VGA1_CTRL	31	RX LNA1_GAIN	3
VGA_SW_0P25	☒ Atten Disabled (High Gain)	VGA2_BIAS	4
VGA_SW_3P5	☒ Atten Disabled (High Gain)	VGA1_BIAS	4
TX VGA1_RTUNE	0	TX RF VGA GAIN	0
VGA1PT_PT2	☐ PTAT	TX VGA2 PT_PT2	☐ PTAT

MBIAS_EN	TRX ENABLE	LO ENABLE	STANDBY REG	STANDBY GPIO	ENABLES	Include Gain LUT Data			
☒ Enabled	☒ TRX EN Enable Paths	☒ LO EN LO Enabled	☐ STBY REG Device Active	☐ STDBY Pin Device Active	TRX STROBE	☒	Read Values	Program Values	Program Defaults

Figure 21. Gain LUT: LUT Editor

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

SRAM LUT Entry Select LUT Editor Direct LUT Entry Select LUT Register

Direct Gain LUT (Non-SRAM) Index Slider Selection

< [Slider] > 0

VGA Field Name	Value	FE Field Name	Value
TX / RX (FROM LUT FILE)	TRANSMIT	RX_LNA2_FB	3
VGA2_CTRL	31	RX_LNA2_GAIN	15
VGA1_CTRL	31	RX_LNA1_GAIN	3
VGA_SW_3P5	☒ Atten Disabled (High Gain)	VGA2_BIAS	4
VGA_SW_0P25	☒ Atten Disabled (High Gain)	VGA1_BIAS	4
TX VGA1_RTUNE	0	TX_RF_VGA_GAIN	0
VGA1_PT_PT2	☐ PTAT	TX_VGA2_PT_PT2	☐ PTAT
		☒ Auto Update	Update

MBIAS_EN ☒ Enabled
 TRX ENABLE ☒ TRX EN Enable Paths
 LO ENABLE ☒ LO EN LO Enabled
 STANDBY REG ☐ STBY REG Device Active
 STANDBY GPIO ☐ STDBY Pin Device Active
 ENABLES
☒ Include Gain LUT Data

Figure 22. Gain LUT: Direct LUT Entry Select

Block Diagram Chip Configuration Transmit Receive Sensor Gain LUT BitField Log Register Log Register RW

SRAM LUT Entry Select LUT Editor Direct LUT Entry Select LUT Register

Field Name	Control	Register	Description
TRn	☐ TRn RX Enabled	LUT	TR Select 0: RX Enabled 1: TX Enabled
LUT_PTR	0	LUT	Updates when Global or Local FBS command is issued. When written to, channel SET reg buffers are loaded with the LUT data.
	Read		

MBIAS_EN ☒ Enabled
 TRX ENABLE ☒ TRX EN Enable Paths
 LO ENABLE ☒ LO EN LO Enabled
 STANDBY REG ☐ STBY REG Device Active
 STANDBY GPIO ☐ STDBY Pin Device Active
 ENABLES
☒ Include Gain LUT Data

Figure 23. Gain LUT: LUT Register

17. Users can read or write directly to any writable register using the **Register RW** panel shown in Figure 24. Select the register name from the drop-down menu (Figure 24, item 1). The register address (Figure 24, item 2) will be automatically updated. Click *Read* to read the register value. To write to the register, enter the new value in the **Register Value (0x)** box and click *Write*.

The Register RW Panel interface includes the following components:

- Register Names:** A dropdown menu (item 1) listing registers such as CHIP_ID, ADC_CLK, ADC_CTRL, ADC_SEL, BIST, CRC_RESULT, CTRL_CFG, and various DATA_ADC_CHN registers.
- Register Addr (0x):** A numeric input field (item 2) showing the address 7.
- Register Value (0x):** A hex input field (item 3) showing the value FC4.
- Action Buttons:** Read, Read All, Write, and Clear buttons.
- Register Data Table:**

Register Name	Operation	Address (0x)	Field Name	Value (0x)
CHIP_ID	READ	0x00	MBIAS	0x8991
	READ	0x00	TRX_ENABLE	0xFFFF
	READ	0x00	TX_VGA_SET	0x3FFF
	READ	0x00	TX_FE_SET	0x0FC4
- Configuration Section:** Includes checkboxes for MBIAS_EN, TRX EN, LO EN, STBY REG, and STDBY Pin, along with ENABLES buttons (TRX, STROBE) and a checkbox for Include Gain LUT Data.

Figure 24. Register RW Panel

3. Board Design

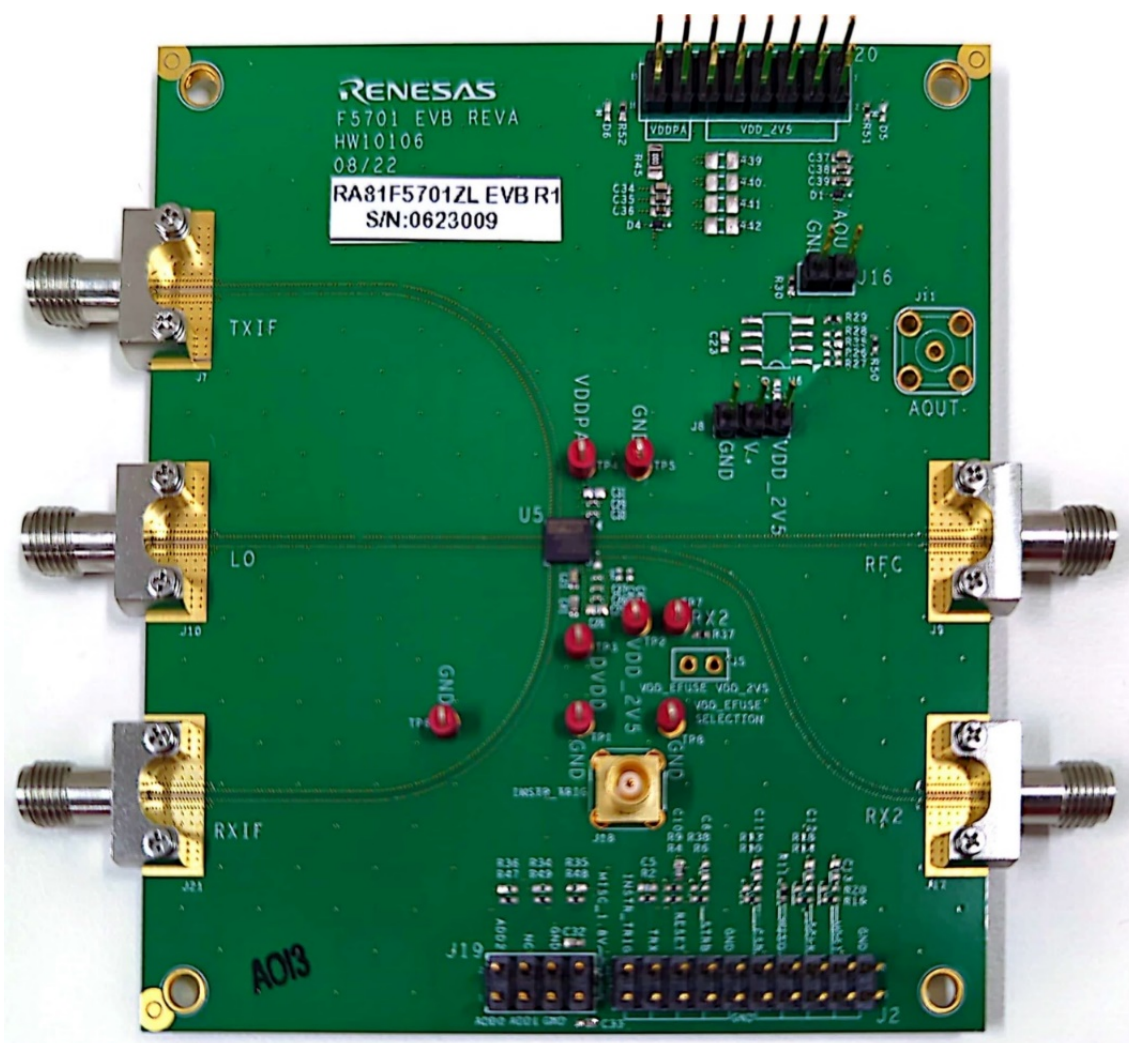


Figure 25. F5701 Evaluation Board Image (Top)

3.1 Schematic Diagrams

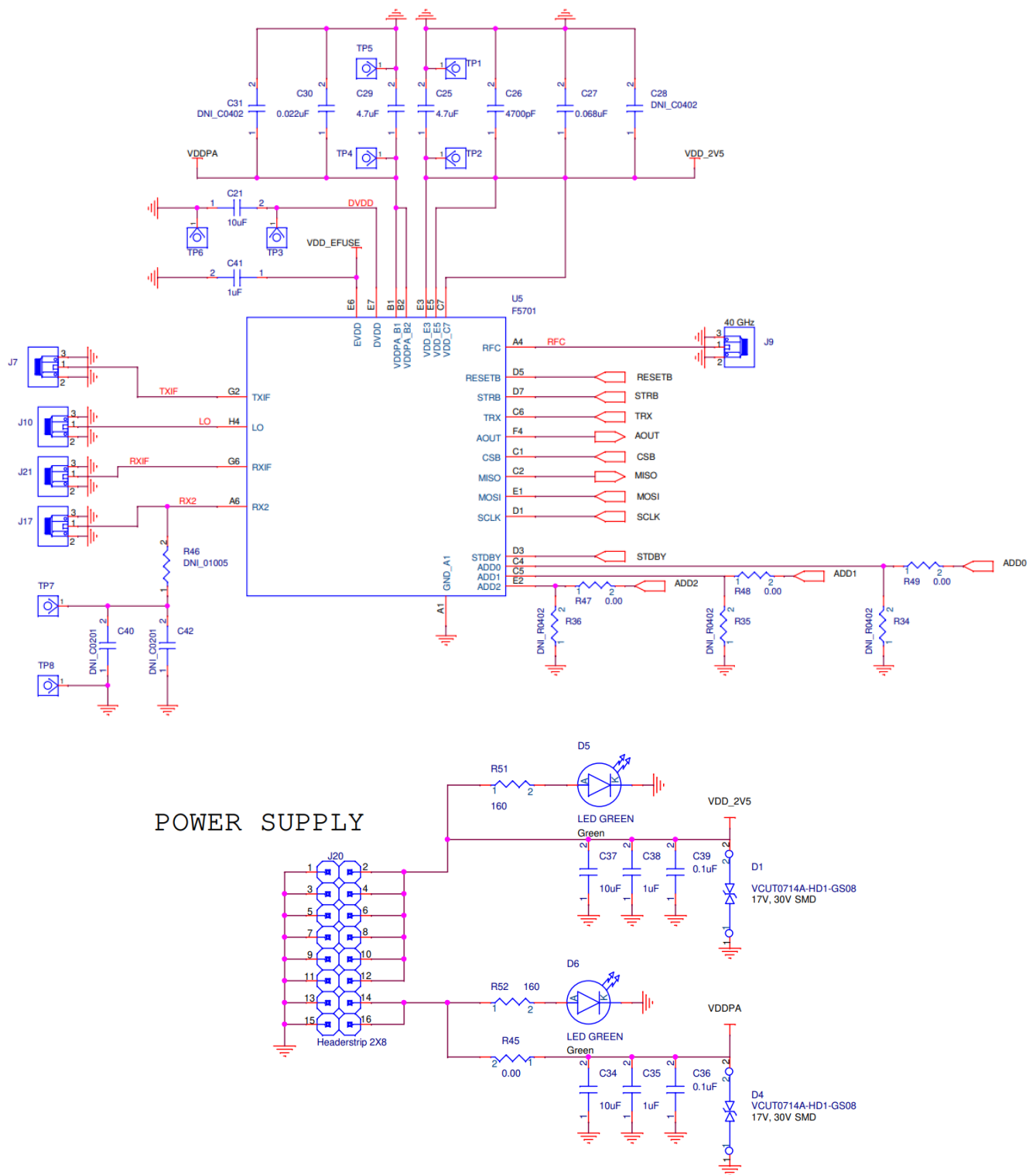


Figure 26. F5701 Evaluation Board Schematic – Part 1

3.2 Bill of Materials (BOM)

Part Reference	Qty	Description	Manufacturer Part #	Manufacturer
C5, C6, C11, C12, C13, C23, C24, C28, C31	9	TBD Surface Mount Capacitor	DNI	
C10	1	COG Surface Mount Capacitor, 1000pF	GRM1555C1E102J	Murata
C21, C34, C37	3	X5R Surface Mount Capacitor, 10μF	GRM155R60J106M	Murata
C25, C29	2	X5R Surface Mount Capacitor, 4.7uF	GRM035R60J475ME15D	Murata
C26	1	X7R Surface Mount Capacitor, 4700pF	GRM033R71E472K	Murata
C27	1	X5R Surface Mount Capacitor, 0.068μF	GRM033R61C683K	Murata
C30	1	X5R Surface Mount Capacitor, 0.022μF	GRM033R61C223K	Murata
C32, C33, C36, C39	4	X7R Surface Mount Capacitor, 0.1μF	GRM155R71C104KA88D	Murata
C35, C38, C41	3	X5R Surface Mount Capacitor, 1μF	CL05A105KA5NQNC	Samsung
C40, C42	2	TBD Surface Mount Capacitor	DNI	
D1, D4	2	Surface Mount Diode	VCUT0714A-HD1-GS08	Vishay
D5, D6	2	Green LED, SMD	APHHS1005CGCK	Kingbright
J2	1	Header Dual, Gold, Unshrouded, Breakaway, 100mil pitch, 0.240-inch contact mating length	10-89-7200	Molex
J5	1	Header, 2 × 10 Vertical	DNI	
J7, J9, J10, J17, J21	5	2.92mm edge launch, Female Standard Profile	ELF40-002	Signal Microwave
J8	1	Header, Gold, Unshrouded, Breakaway, 100mil pitch, 0.240-inch contact mating length	22-28-4033	Molex
J11	1	SMB Connector Jack, Male Pin 50Ω Through Snap Connect	1-1337482-0	TE Connectivity
J16	5	Header, Gold, Unshrouded, Breakaway, 100mil pitch, 0.240-inch contact mating length	22-28-4023	Molex
J18	1	MCX Connector Jack, Female Socket 50Ω Through Hole Solder	0733660061	Molex
J19	1	C-Grid Header Dual, Gold, Unshrouded, Breakaway, 100mil pitch	10-89-7080	Molex
J20	1	Header Dual, Gold, Unshrouded, 100mil pitch, 0.062-inch contact mating length	68602-116HLF	Amphenol FCI
R2, R4, R6, R9, R10, R11, R14, R16, R29, R47, R48, R49, R50	13	Surface Mount Resistor	ERJ-2GE0R00	Panasonic
R13, R18, R20, R25, R26, R27, R28, R34, R35, R36, R38	11	Surface Mount Resistor	DNI	-

Part Reference	Qty	Description	Manufacturer Part #	Manufacturer
R30	1	Surface Mount Resistor	RCG040220K0FK	Vishay
R37	1	Surface Mount Resistor	ERJ-2GE0R00	Panasonic
R39, R40, R41, R42	4	Surface Mount Resistor	DNI	-
R45	1	Surface Mount Resistor	CRCW08050000Z0EA	Vishay
R46	1	Surface Mount Resistor	DNI	-
R51, R52	2	Surface Mount Resistor	CRCW0402160RFK	Vishay
SO1, SO2, SO3, SO4	4	Hex Standoff Threaded M3 Nylon 0.984" (25.00mm) Natural	25506	Keystone Electronics
TP1, TP2, TP3, TP4, TP5, TP6	4	Phosphor Bronze Wire Loop	5000	Keystone Electronics
U5	1	mmWave Upconverter/Downconverter 24.25GHz to 29.5GHz RF, 2.5GHz to 7GHz IF	F5701	Renesas
U6	1	Voltage Feedback Amplifier 1 Circuit Rail-to-Rail SOIC8	OPA356AID	TI

4. Ordering Information

Part Number	Description
RTKA81F5701000RU	F5701 24GHz to 30GHz Evaluation Board

5. Revision History

Revision	Date	Description
1.00	Sep 4, 2024	Initial release.