Freescale Semiconductor
User's Guide

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KITRADAR2001EVM Radar Starter Kit

Figure 1. KITRADAR2001EVM

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This evaluation kit is intended for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY. It is provided as a sample IC pre-soldered to a printed circuit board to make it easier to access inputs, outputs, and supply terminals. This evaluation board may be used with any development system or other source of I/O signals by simply connecting it to the host MCU or computer board via off-the-shelf cables. This evaluation board is not a Reference Design and is not intended to represent a final design recommendation for any particular application. Final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

The goods provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end product incorporating the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. In order to minimize risks associated with the customers applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact Freescale sales and technical support services.

Should this evaluation kit not meet the specifications indicated in the kit, it may be returned within 30 days from the date of delivery and will be replaced by a new kit.

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2 Getting Started

2.1 Kit Contents/Packing List

The KITRADAR2001EVM contents include:

- Assembled and tested evaluation board/module in an anti-static bag
- Quick Start Guide
- Warranty card

2.2 Required Equipment and Software

To use this kit, you need:

- 6.0 V AC/DC Adaptor or 5.5 V from DC power supply with 2.0 A current limit
- Ethernet cable
- Ethernet enabled Win32 PC with Windows® XP or higher

2.3 System Requirements

The kit requirements are as follows:

- The kit is bundled with a graphical front end which supports simple control and analysis of the radar data. This software (Radar Control Panel V01_04.exe or higher) requires Win32 operating systems and has been tested under Windows XP and Windows 7
- The connection between KITRADAR2001EVM and the PC must be established via a 100 Mbit/s ethernet cable
- The TCP/IP address on the PC must be manually set to IP address: 192.168.100.47, subnet mask: 255.255.255.0

3 Understanding the Hardware

3.1 Overview

The KITRADAR2001EVM starter kit is a small, cost-effective demonstration and evaluation system for 76 GHz - 77 GHz fast Frequency-Modulated Continuous-Wave (FMCW) modulation radar applications. The kit uses the MR2001 chip set and a special Freescale 32-bit MPC577xK. The Freescale KITRADAR2001EVM starter kit is designed for engineering purposes only, not for customer production.

The Freescale KITRADAR2001EVM starter kit facilitates the evaluation of Freescale products. The kit supports 76 GHz - 77 GHz MR2001 chipsets and microcontroller solutions. Freescale products offer smaller form factors, lower component counts, greater ease of design, lower system costs and improved performance. They support long-, mid-, and short-range radar applications over a broad spectrum of vehicle radar systems.

3.2 Kit Features

The kit consists of multiple hardware and software components:

- Radar processor board based on MPC577xK MCU
- RF front-end board
- Mechanical waveguide adapter board
- RO3003 patch antenna board
- Graphical control software and radar data analysis software for Win32 operating systems

Key features of the radar kit are as follows:

- Soldered MPC577xK 32-bit microcontroller
- Single power supply input of 6.0 V
- Joint Test Action Group (JTAG) port to debug the microcontroller which can be supplied by third party companies
- Nexus Aurora interface for real time trace of RAM and ΣΔ (SD) Analog-to-Digital conversion (ADC) data
- Ethernet to output the results of the Fast Fourier Transform (FFT) and detection algorithm by MPC577xK via User Datagram Protocol (UDP) to the PC via ethernet for radar demonstration
- Fast FMCW modulation
- High output power in the range from 76 GHz - 77 GHz of approximately 8 dBm at waveguide port
- Antenna board can be easily exchanged
- Standard waveguide interface

3.3 Block Diagram

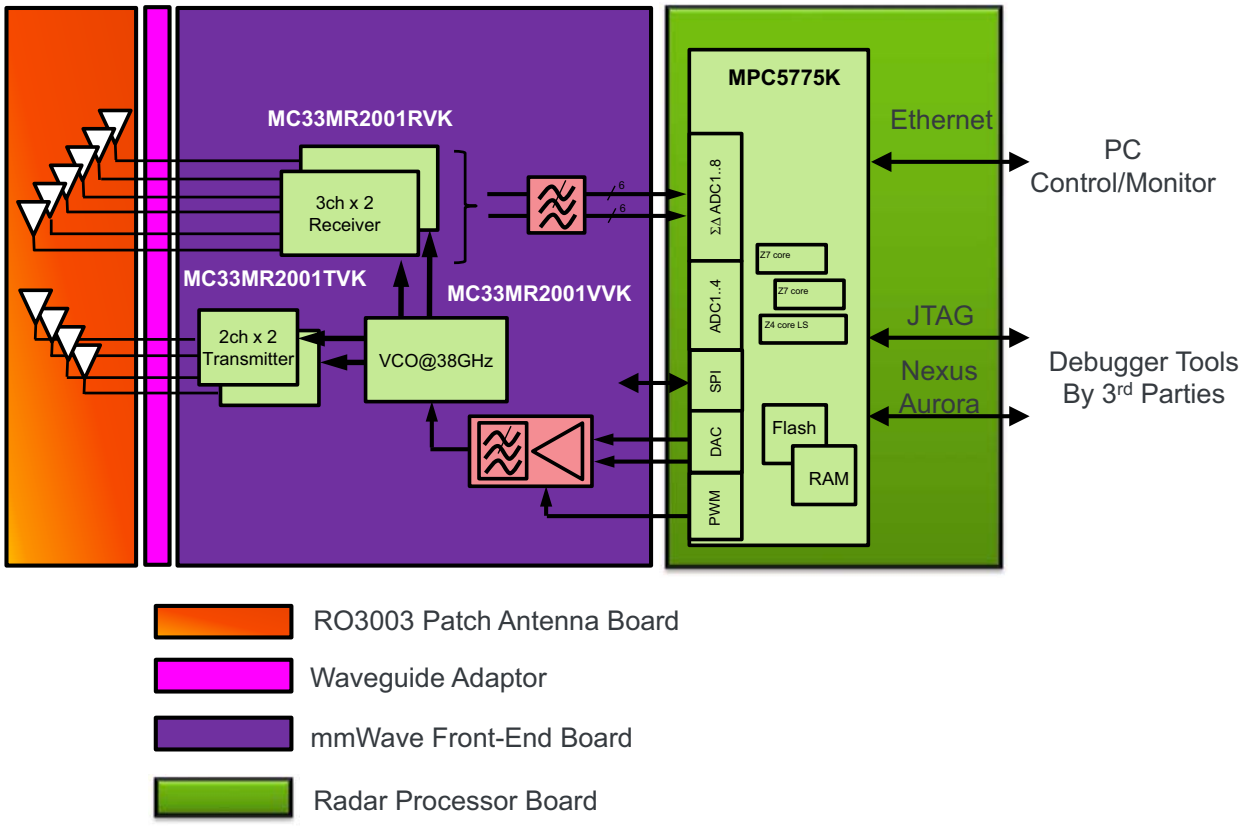

Figure 2. Block Diagram

3.3.1 Device Features

This starter kit board features the following Freescale products:

Table 1: KITRADAR2001EVM Device Features

Device	Description	Features
MC33MR2001TVK	MR2001 power amplifier	• Scalable radar chip set • Integrated frequency doublers and 2-channel outputs at 76 GHz – 77 GHz
MC33MR2001RVK	MR2001 receiver	• Scalable radar chip set • 3-channel receiver integrating baseband filters
MC33MR2001VVK	MR2001 Voltage Controlled Oscillator (VCO)	• Scalable radar chip set • 3-channel outputs at 38 GHz – 38.5 GHz
MPC577xK	32-bit microcontroller	• 2x Z7 (266 MHz), 1x Z4 LS (133 MHz) • 4 MB Flash, 1.5 MB SRAM • 8x SD ADC, 4 SAR ADC, DAC, SPT (FFT Accelerator, DMA), Ethernet, Integrated Safety

4 Radar Starter Kit Overview

4.1 Overview

The Freescale Radar Starter Kit is a complete demonstration and evaluation platform. It supports both automotive and industrial radar systems. The kit enhances rapid prototyping for any radar system using Freescale MR2001 chipsets and the 32-bit microcontroller.

4.2 Antenna Board Features

Key features of the antenna are as follows:

- Support for 4-channel transmitters and 6-channel receivers
- A patch antenna array manufactured on Rogers RO3003 material with a substrate thickness of 127 um
- TX3 (typically used with long range applications) and TX4 (typically used with short range applications)

The following combinations are recommended:

- Transmit antenna: TX1, TX2, Receive antenna: RX1, RX2, RX3
- Transmit antenna: TX3, TX4, Receive antenna: RX4, RX5, RX6

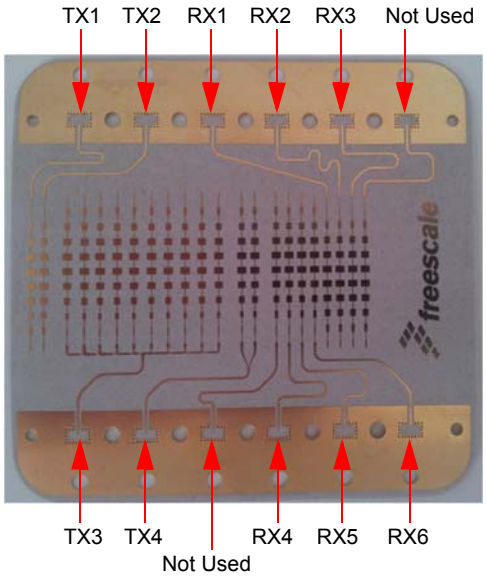

Figure 3. Top View of Antenna

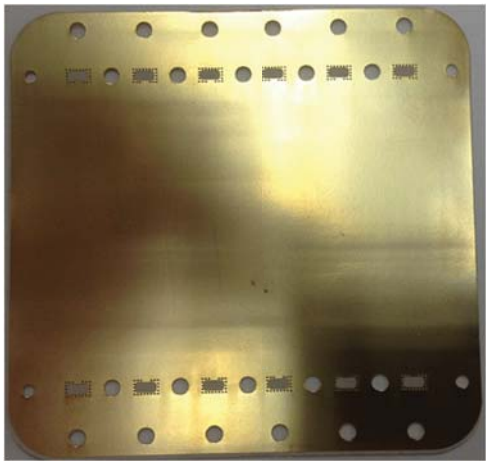

Figure 4. Bottom View of Antenna

Key feature of the mechanical waveguide transition adaptor:

- The adapter provides the mechanical transition from the RF board to the waveguide adapter

Figure 5. Mechanical Waveguide Transition Adapter (Antenna Side)

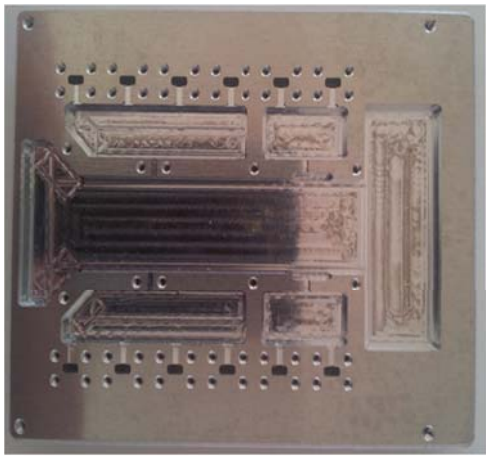

Figure 6. Mechanical Waveguide Transition Adapter (Chip Side)

4.3 MR2001 Features

Key feature of MR2001 board:

- Soldered MR2001 chip set consisting of two pieces of MC33MR2001TVK, two pieces of MC33MR2001RVK, one piece of MC33MR2001VVK, and Intermediate Frequency (IF) amplifiers directly connected to MPC577xK microcontroller

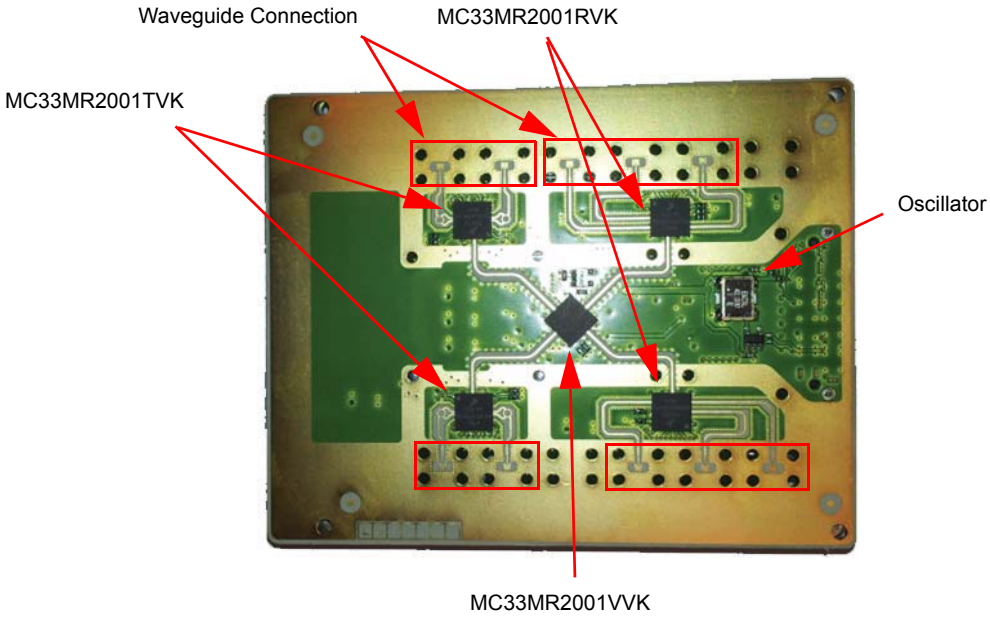

Figure 7. Top View of MR2001 Board

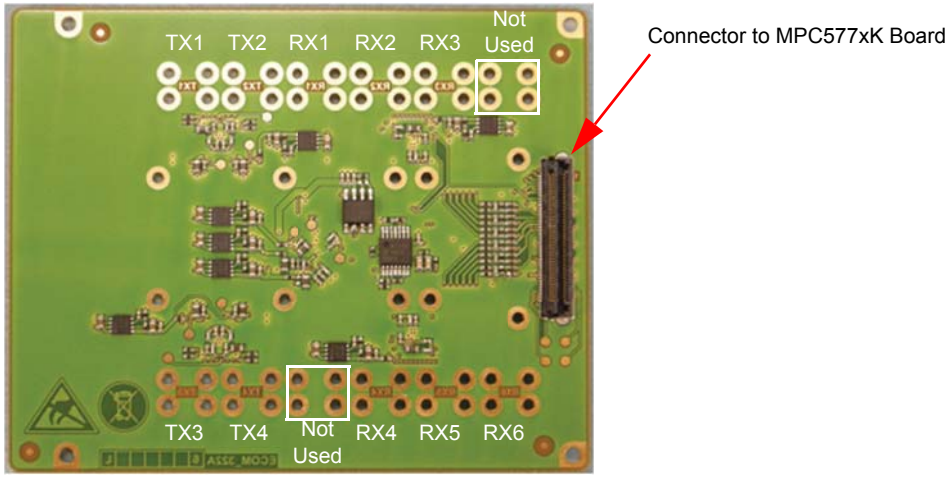

Figure 8. Bottom View of MR2001 Board

4.4 MPC577xK Features

The board features of MPC577xK (Radar Demo) Board are as follows:

- Soldered MPC577xK 32-bit microcontroller
- 6.0 V DC jack power cable or 5.5 V from DC power supply with 2.0 A current limit
- JTAG port to debug the microcontroller and can be supplied by third party companies
- Nexus Aurora for real time trace of RAM and SD ADC data

- Ethernet to output the results of the FFT and detection algorithm by MPC577xK via UDP to the PC via ethernet for radar demonstration

4.5 MPC577xK Board Description

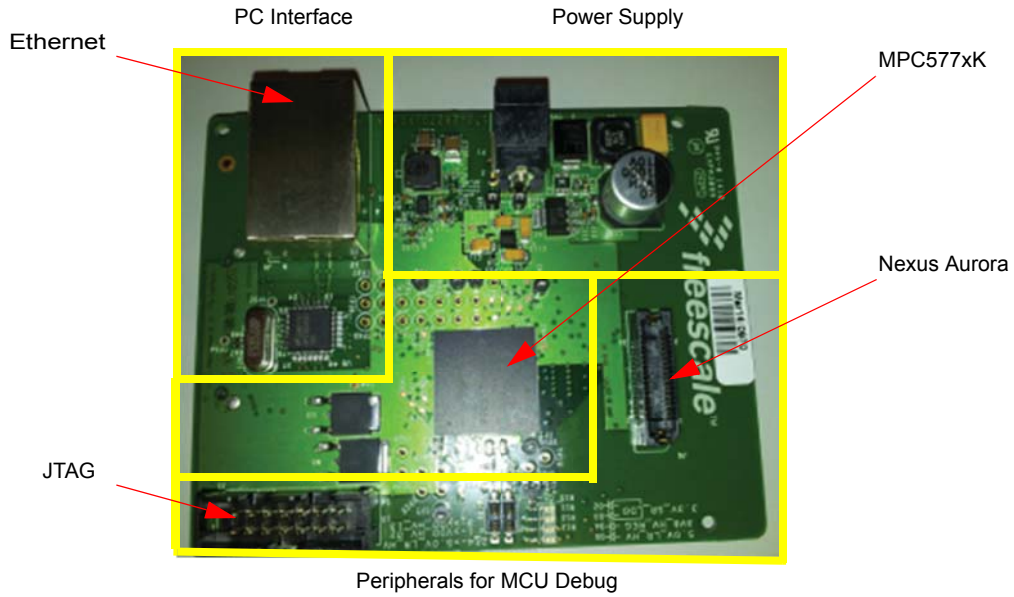

Figure 9. MPC577xK Microcontroller Board

Table 2. Board Description

Name	Description
PC Interface	Ethernet to PC
Ethernet	Output the results of the FFT and detection algorithm by MPC577xK via UDP to the PC via ethernet for radar demonstration
JTAG	Debug the microcontroller and can be supplied by 3rd party companies
Peripherals for MCU Debug	Peripherals for MCU debug consists of JTAG and Nexus Aurora
Nexus Aurora	Real time trace of RAM and SD ADC data
MPC577xK	32-bit microcontroller
Power Supply	6.0 V AC/DC adaptor

4.6 JTAG, Nexus Aurora, Waveguide, and Other Connectors

Table 3. JTAG Connector Pin Assignment

Pin Number	Name	Description
1	TDI	Test Data Input
2	VSS	GND
3	TDO	Test Data Output
4	VSS	GND
5	TCK	Test Clock
6	VSS	GND
7	EVTI	Event In

Table 3. JTAG Connector Pin Assignment (continued)

Pin Number	Name	Description
8	N/C	No Connection
9	RESET_B	Reset
10	TMS	Test Mode Select
11	VDD	3.3 V
12	VSS	GND
13	RDY_B	Read/Write Ready
14	JCOMP	JTAG Compliance

Table 4: Nexus Aurora Connector Pin Assignment

Pin Number	Name	Description
1	TXP_0	NAP T+ Data for Lane 0
2	3.3V_SR_LDO	3.3 V
3	TXN_0	NAP T- Data for Lane 0
4	TCK	Test Clock
5	VSS	GND
6	TMS	Test Mode Select
7	TXP_1	NAP T+ Data for Lane 1
8	TDI	Test Data Input
9	TXN_1	NAP T- Data for Lane 1
10	TDO	Test Data Output
11	VSS	GND
12	JCOMP	Reset
13	TXP_2	NAP T+ Data for Lane 2
14	N/C	No Connection
15	TXN_2	NAP T- Data for Lane 2
16	EVTI	Event In
17	VSS	GND
18	EVTO	Event Out
19	TXP_3	NAP T+ Data for Lane 3
20	N/C	No Connection
21	TXN_3	NAP T- Data for Lane 3
22	RESET_B	No Connection
23	VSS	GND
24	VSS	GND
25	N/C	No Connection

Table 4: Nexus Aurora Connector Pin Assignment (continued)

Pin Number	Name	Description
26	CLKP0	NAP Clock
27	N/C	No Connection
28	CLKN0	NAP Clock
29	VSS	GND
30	VSS	GND
31	N/C	No Connection
32	RDY_B	Read/Write Ready
33	N/C	No Connection
34	N/C	No Connection
SH1	VSS	GND
SH2	VSS	GND

Table 5. Microcontroller and MR2001 Board Connector Pin Assignment

Pin Number	Microcontroller Board	MR2001 Board	Description
1	DSPI0_SIN	MOSI	SPI
2	DSPI0_SOUT	MISO	SPI
3	DSPI0_SCK	SCLK	SPI
4	DSPI0_CS0	SEB	SPI
5	RESETB_AFE	RESET_B	SPI
6	CTE_OUT0	TX1_PA	Enable Transmitter 1 (TX1)
7	CTE_OUT1	TX2_PA	Enable Transmitter 1 (TX2)
8	CTE_OUT2	TX3_PA	Enable Transmitter 1 (TX3)
9	CTE_OUT3	TX4_PA	Enable Transmitter 1 (TX4)
10	CTE_OUT4	TX1_Mod	Enable Bi-Phase modulator in Transmitter 1
11	CTE_OUT5	TX2_Mod	Enable Bi-Phase modulator in Transmitter 2
12	CTE_OUT6	TX3_Mod	Enable Bi-Phase modulator in Transmitter 3
13	CTE_OUT7	TX4_Mod	Enable Bi-Phase modulator in Transmitter 4
14	FLEXPWM0_X0	Voffset	VCO Vtune offset
15	GND	GND	GND
16	ADC0_AN0	Sens	Sensor output
17	ETIMER1_ETC1	Saturation_RX	RX Saturation detector
18	ADC0_AN1	RX1_Vtemp	Not Used
19	ADC0_AN2	RX2_Vtemp	Not Used
20	GND	GND	GND
21	FLEXPWM0_A0	Test_IN	IQ or differential test signal inputs

Table 5. Microcontroller and MR2001 Board Connector Pin Assignment (continued)

Pin Number	Microcontroller Board	MR2001 Board	Description
22	FLEXPWM0_B0	Test_INx	IQ or differential test signal inputs
23	GND	GND	GND
24	GND	GND	GND
25	SD_0_ADCP	IF1	Receiver 1 (RX1) IF output
26	SD_0_ADCN	IF1x	Receiver 1 (RX1) IF output
27	SD_1_ADCP	IF2	Receiver 2 (RX2) IF output
28	SD_1_ADCN	IF2x	Receiver 2(RX2) IF output
29	SD_2_ADCP	IF3	Receiver 3 (RX3) IF output
30	SD_2_ADCN	IF3x	Receiver 3 (RX3) IF output
31	SD_3_ADCP	IF4	Receiver 4 (RX4) IF output
32	SD_3_ADCN	IF4x	Receiver 4 (RX4) IF output
33	GND	GND	GND
34	GND	GND	GND
35	SD_4_ADCP	IF5	Receiver 5 (RX5) IF output
36	SD_4_ADCN	IF5x	Receiver 5 (RX5) IF output
37	SD_5_ADCP	IF6	Receiver 6 (RX6) IF output
38	SD_5_ADCN	IF6x	Receiver 6 (RX6) IF output
39	SD_6_ADCP	IF7	Not used
40	SD_6_ADCN	IF7x	Not used
41	SD_7_ADCP	IF8	Not used
42	SD_7_ADCN	IF8x	Not used
43	GND	GND	GND
44	GND	GND	GND
45	RX1_EN	RX1_EN	Not used
46	RX2_EN	RX2_EN	Not used
47	RX3_EN	RX3_EN	Not used
48	RX4_EN	RX4_EN	Not used
49	RX5_EN	RX5_EN	Not used
50	RX6_EN	RX6_EN	Not used
51	RX7_EN	RX7_EN	Not used
52	RX8_EN	RX8_EN	Not used
53	GND	GND	GND
54	DAC_AP	Vtune	VCO Vtune
55	FLEXPWM1_A1	GPIO4	Not used
56	GND	GND	GND

Table 5. Microcontroller and MR2001 Board Connector Pin Assignment (continued)

Pin Number	Microcontroller Board	MR2001 Board	Description
57	ETIMER1_ETC0	DivOut	Divider output
58	CTE_RCS	TRIG_ADC	Not used
59	CTE_RFS	TRIG_FRAME	Not used
60	GPIO[50]	RAMPDIRIN	Not used
61	GND	GND	GND
62	GND	GND	GND
63	XOSCLK	XOSCLK	Reference clock
64	XOSCLKx	XOSCLKx	Reference clock
65	GND	GND	GND
66	GND	GND	GND
67	N/C	TX_Testout	Not used
68	N/C	RF_Testout	Not used
69	N/C	Testout	Not used
70	N/C	TempOut2	Not used
71	GPIO[48]	GPIO0	Test pin 100
72	GPIO[47]	GPIO1	Test pin 101
73	GPIO[51]	GPIO2	Test pin 102
74	GPIO[52]	GPIO3	Test pin 103
75	GND	GND	GND
76	5.0V LR HV	VCC5V	5.0 V
77	5.0V LR HV	VCC5V	5.0 V
78	5.0V LR HV	VCC5V	5.0 V
79	5.0V LR HV	VCC5V	5.0 V
80	5.0V LR HV	VCC5V	5.0 V
S2	GND	GND	GND
S1	GND	GND	GND

Table 6. Mechanical Waveguide Adaptor

Pin Number	Name	Description
TX1	TX1	Antenna board or Waveguide connection
TX2	TX2	Antenna board or Waveguide connection
TX3	TX3	Antenna board or Waveguide connection
TX4	TX4	Antenna board or Waveguide connection
RX1	RX1_IN1	Antenna board or Waveguide connection
RX2	RX1_IN2	Antenna board or Waveguide connection

Table 6. Mechanical Waveguide Adaptor (continued)

RX3	RX1_IN3	Antenna board or Waveguide connection
RX4	RX2_IN1	Antenna board or Waveguide connection
RX5	RX2_IN2	Antenna board or Waveguide connection
RX6	RX2_IN3	Antenna board or Waveguide connection

5 Installing the Software and Setting up the Hardware

5.1 Configuring the Hardware

The KITRADAR2001EVM is connected to a PC through an ethernet port. The power for the kit is supplied by a 6.0 V AC/DC adaptor or 5.5 V from DC power supply with 2.0 A current limit

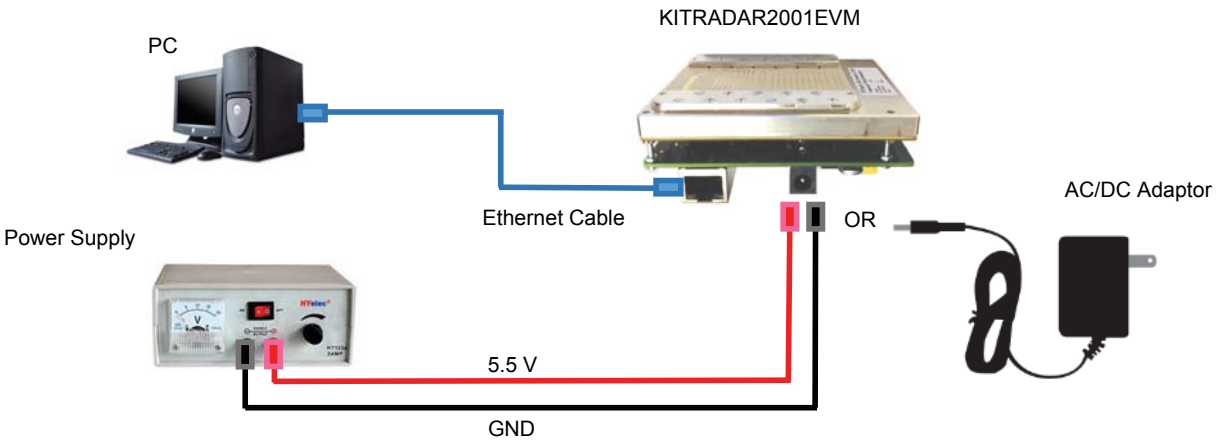

Figure 10. KITRADAR2001EVM and Setup

5.2 Installing the Radar Control Panel on Your Computer

The latest version of the Radar Control Panel software is designed to run on any Windows 7 or XP-based 32-bit operating system. To get the software, go to http://compass.freescale.net/livelink/livelink?func=ll&objid=232904627&objaction=browse and download "Radar Control Panel V0x_xx_xx.exe" to your computer desktop.

5.3 Connect the Ethernet Cable and Run the Radar Control Panel

Connect one end of the Ethernet cable to the PC and the other end to the KITRADAR2001EVM. Power up the hardware (6.0 V supply) before starting the software on the PC. After a few seconds, the current draw should be approximately 0.7 A. The current should continue increasing until it reaches approximately 1.7 A.

WARNING

The temperature of the waveguide adapter can easily exceed 60 °C during normal operation.

Run the program from your desktop. The **Radar Control Panel** window opens (see Figure 11). The Graphical User Interface (GUI) options are separated into five categorized sections related to the PC interface configuration: Telnet and UDP Configuration, Target Control, Graphic Selection, Graphic Setting, and Chip Set Control.

5.3.1 Radar Control Panel GUI

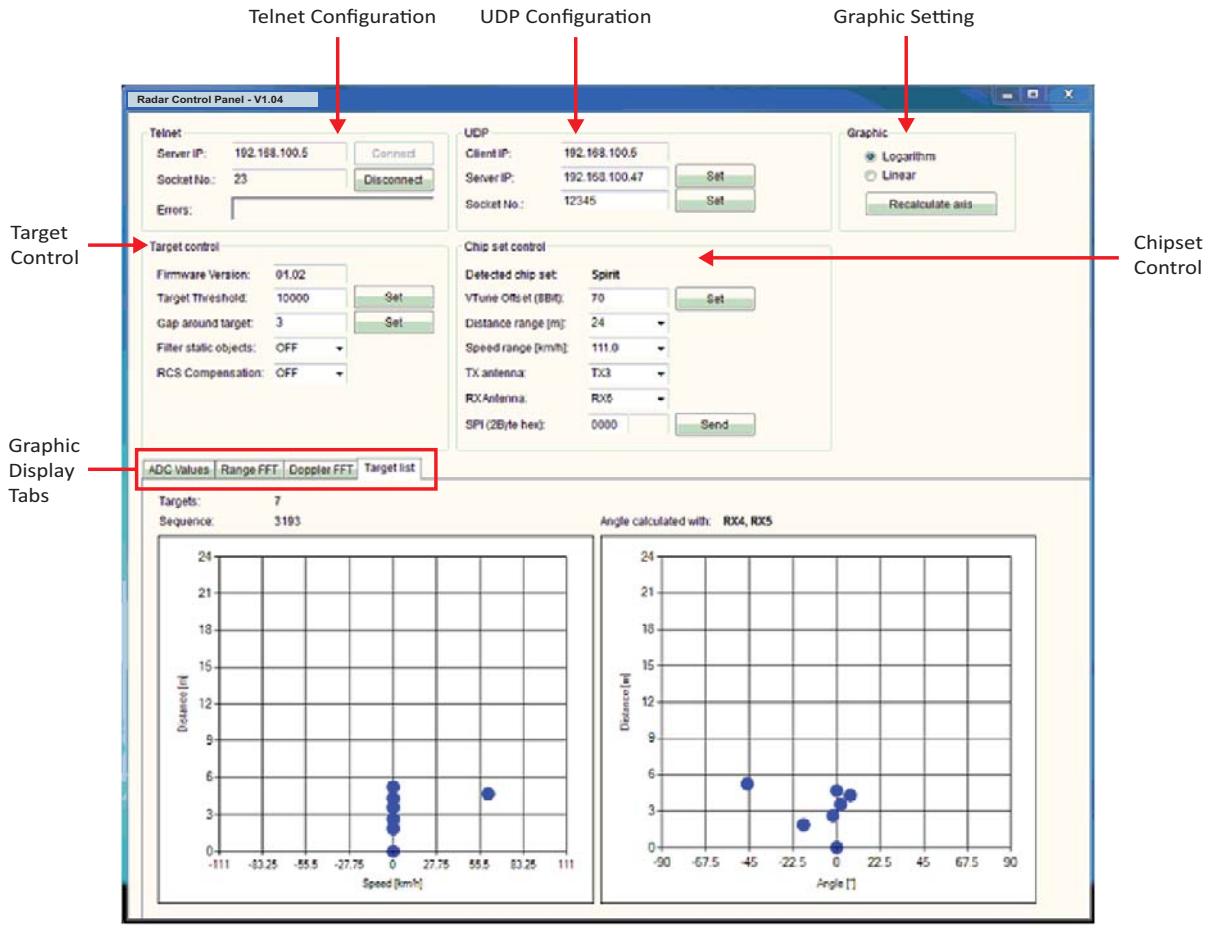

Figure 11. Radar Control Panel Main Window

5.3.2 Telnet and UDP Configuration Section

Notes: You must manually set the IP address: 192.168.100.47 and Subnet mask: 255.255.255.0 in the PC before connecting it to the KITRADAR2001EVM. Otherwise, the Radar Control Panel cannot recognize the KITRADAR2001EVM. See Figure 12.

This section shows the configuration with the PC connected via Ethernet. The Server IP and Socket numbers seen in Figure 11 are configured when the PC is correctly connected to the KITRADAR2001EVM.

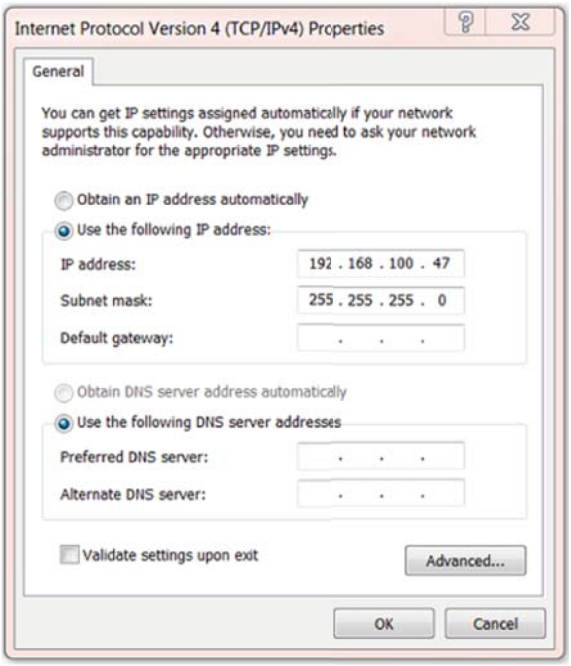

Figure 12. IP Address Setting

5.3.3 Target Control Section

Sets target detection parameters.

- Firmware Version: Automatically shows the software version being used
- Target Threshold: Threshold of the Radar Cross Section (RCS) value. Any target larger than the RCS threshold value is detected. For a person the value is between 15000 and 35000
- Gap around target: Gap around a detected target where all lower targets are deleted. A real target such as a car or person may yield multiple RCS peaks in this target map. The firmware searches for the highest RCS peak and deletes all the other peaks around it. The target gap defines the gap between a high RCS peak and the next allowable peak. Increasing this value reduces the number of targets detected for a car or person. Decreasing the value results in a cloud of targets for a car or person. Values between 0–7 are reasonable.
- Filter static objects: When activated at 1, all stationary objects are removed. 0=Disabled, 1=Enabled
- RCS Compensation: Compensates for the distance of far away targets. This compensation is also known as Far-Field Compensation

5.3.4 Chip Set Control Section

Sets MR2001 chipset and radar performance configurations.

- Detected chip set: Spirit is shown if the kit functions correctly
- VTune Offset (8 bit): Shift up/down the center frequency of the Voltage Control Oscillator (VCO.) Recommend to use the default value. (0–255)
- Distance range (m): The maximum distance setting for target detection. Selectable from 16.0 m, 24.0 m, 32.0 m, and 48.0 m. The value of this setting is used for Y-Axis in the Target list tab in the Graphics display tabs section
- Speed range (km/h): The speed range for target detection. Selectable from 16.0 km/h, 32.0 km/h, 61.0 km/h, 111.0 km/h The speed range setting for the x-axis of the left graph in the Target list tab (graphic display tabs section)
- TX antenna: Switch to different transmit antenna. Selectable for TX antenna 1, 2, 3, or 4
- RX antenna: Switch to different receive antenna. Selectable for RX antenna 1, 2, 3, 4, 5, or 6
- SPI (2Byte hex): This allows the user to send the register setting manually to MR2001 chip set

5.3.5 Graphic Setting Section

Changes the scale to logarithm or linear.

5.3.6 Graphics Display Tabs Section

Offers four types of graphical display windows: ADC Values, Range FFT, Doppler FFT, and Target list.

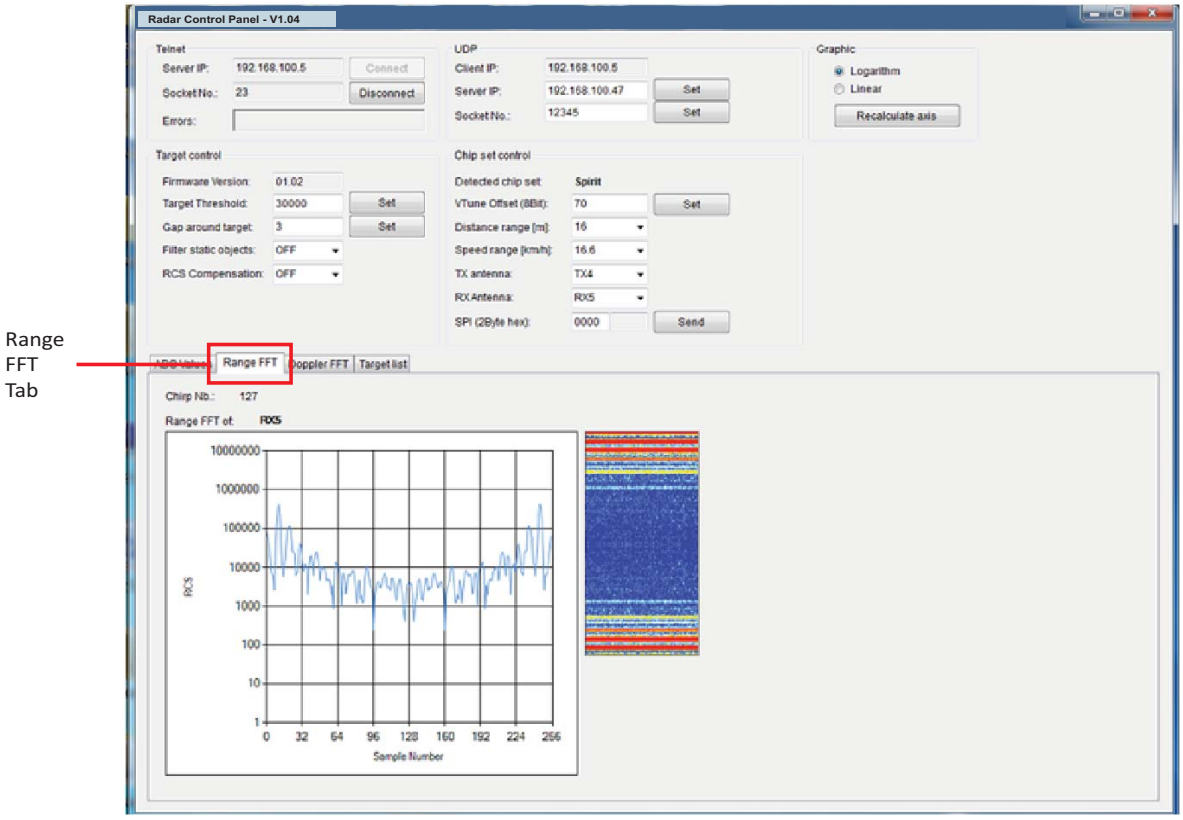

Figure 13. ADC Values Tab

ADC Values tab in Figure 13 shows the voltages on IF output levels of RXs which are 256-sampled by the ADC on one FMCW chirp. One frame has 128 chirps.

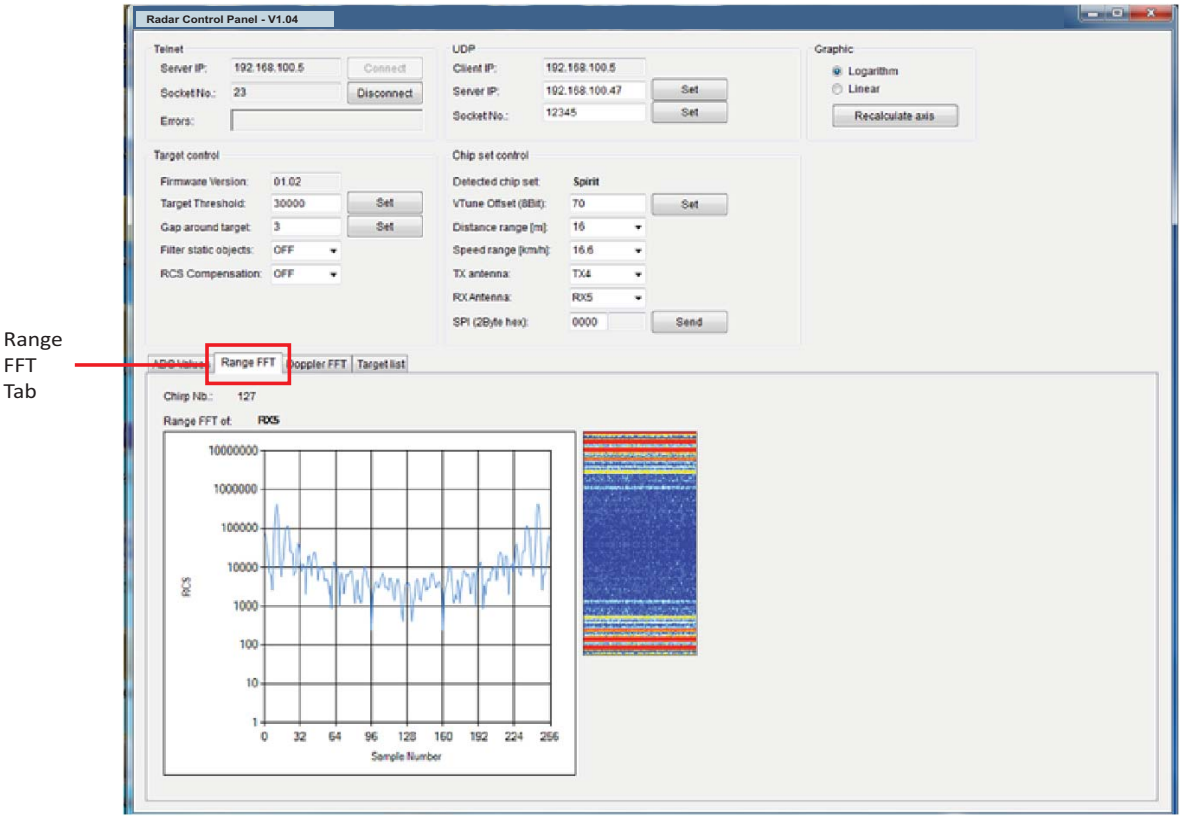

Figure 14. Range FFT Tab

Range FFT tab in Figure 14 shows RCS-to-sample numbers performed by FFT on each chirp. The tab includes information on the distance and RCS of the targets. A peak at a lower sample number indicates the existence of closer objects.

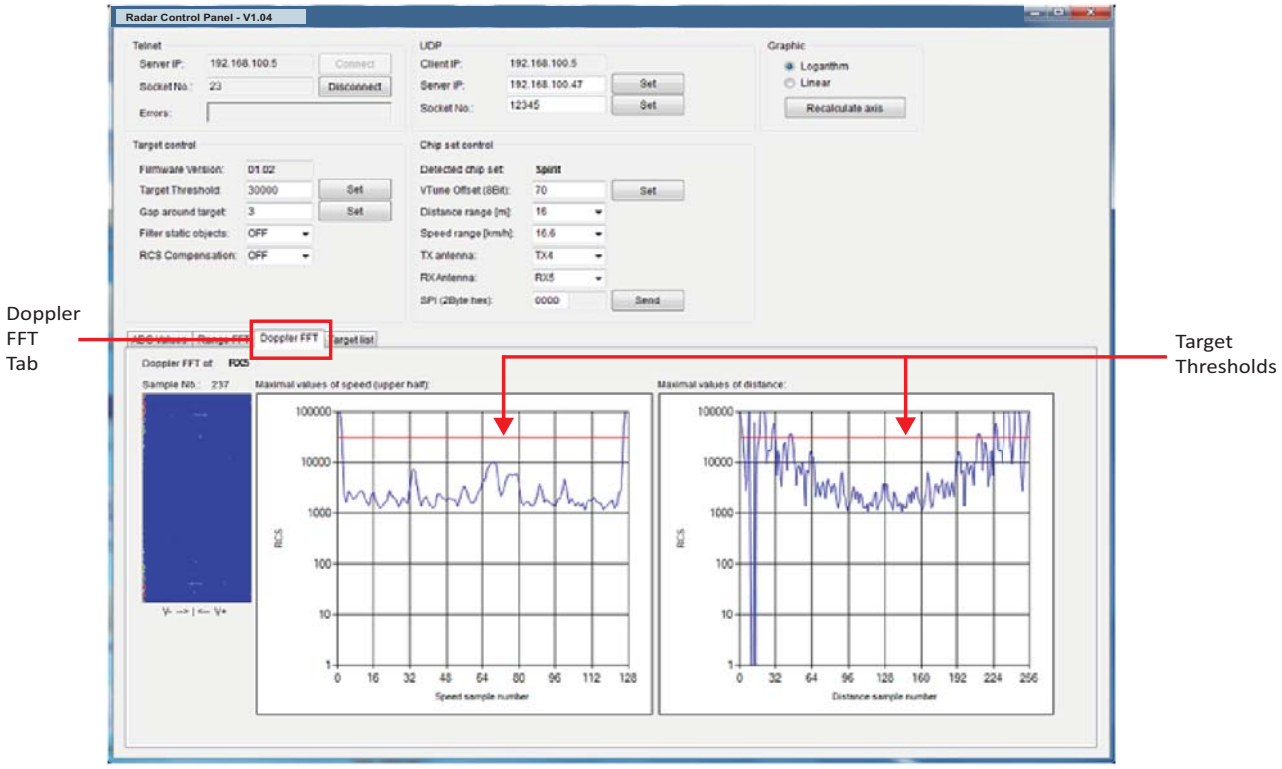

Figure 15. Doppler FFT Tab

The Doppler FFT tab in Figure 15 shows the Speed-Sample-Numbers-to-RCS calculations performed by 128 range FFTs. The tab also generates 255 Doppler FFTs. The color graph on the lower left of the tab shows the sensor targets in red. Targets that appear in the left half of the graph are moving away from the sensor (negative speed detected.) Targets that appear in the right half of the graph are moving toward the sensor (positive speed detected.) Targets that appear along the left border of the graph are stationary (no speed detected.) A target's relative distance from the sensor is indicated by its vertical position in the graph: Targets close to the upper border of the graph are nearer to the sensor than targets lower down in the graph. The red line in the Speed Sample Number graph and the Distance Sample Number graph indicates the target threshold.

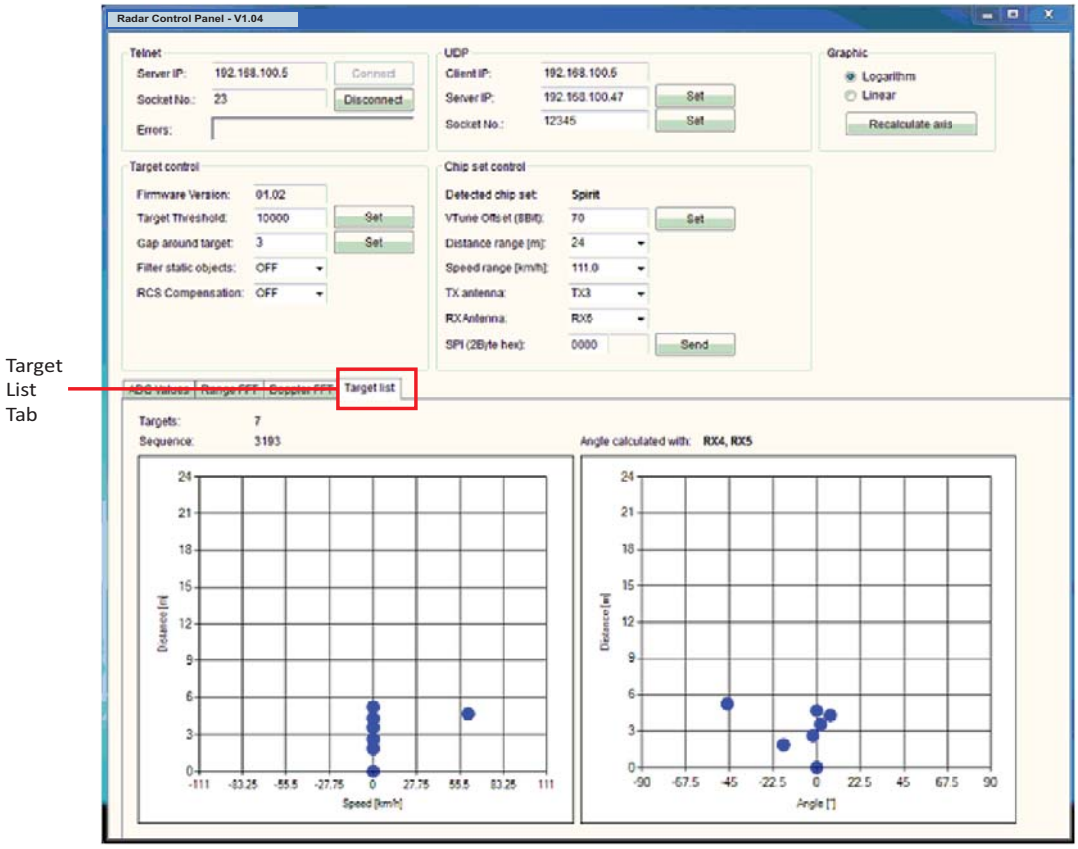

Figure 16. Target List Tab

The Target list tab in Figure 16 shows the distance, speed, and angle of single or multiple targets.

6 IF Interface Board

The IF interface board allows you to directly access the MR2001 chip set without the microcontroller board. The SPI connector is compatible with Cheetah (http://www.totalphase.com/products/cheetah-spi/) USB to SPI cable. To directly measure the analog IF outputs, use a spectrum analyzer and an oscilloscope.

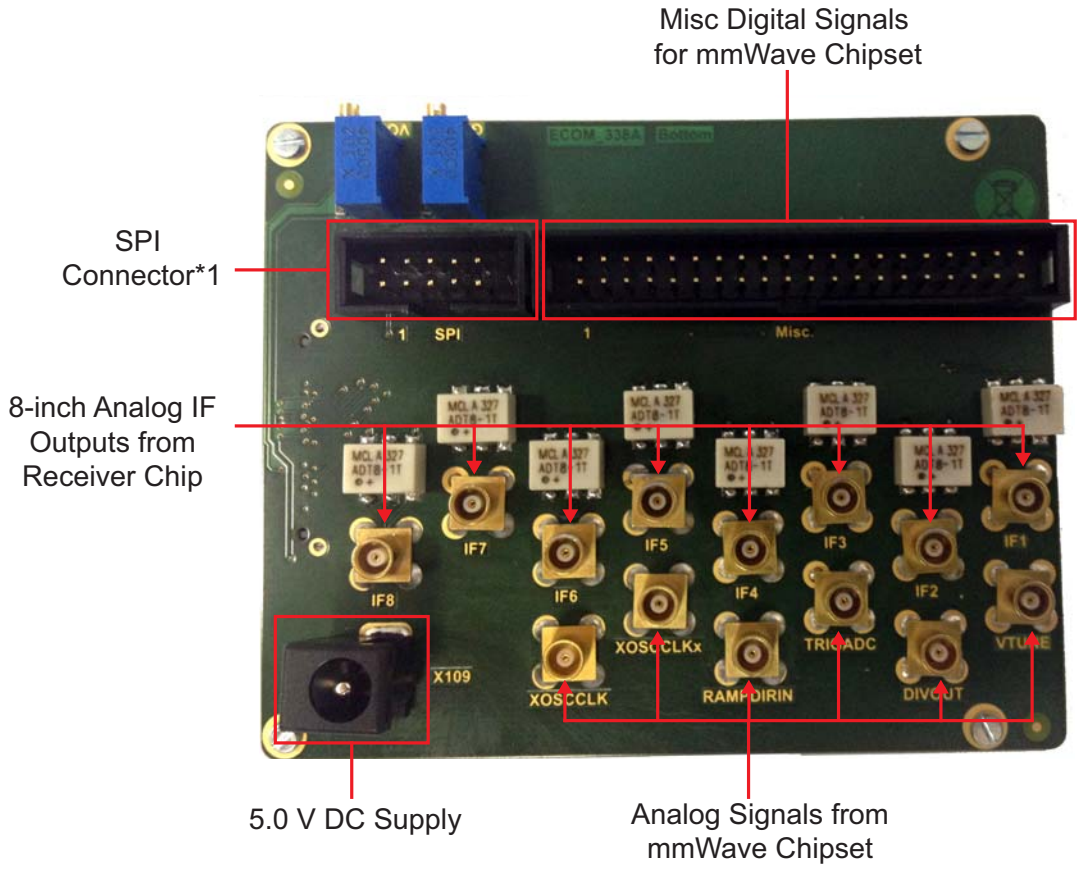

Figure 17. IF Interface Board, Top View

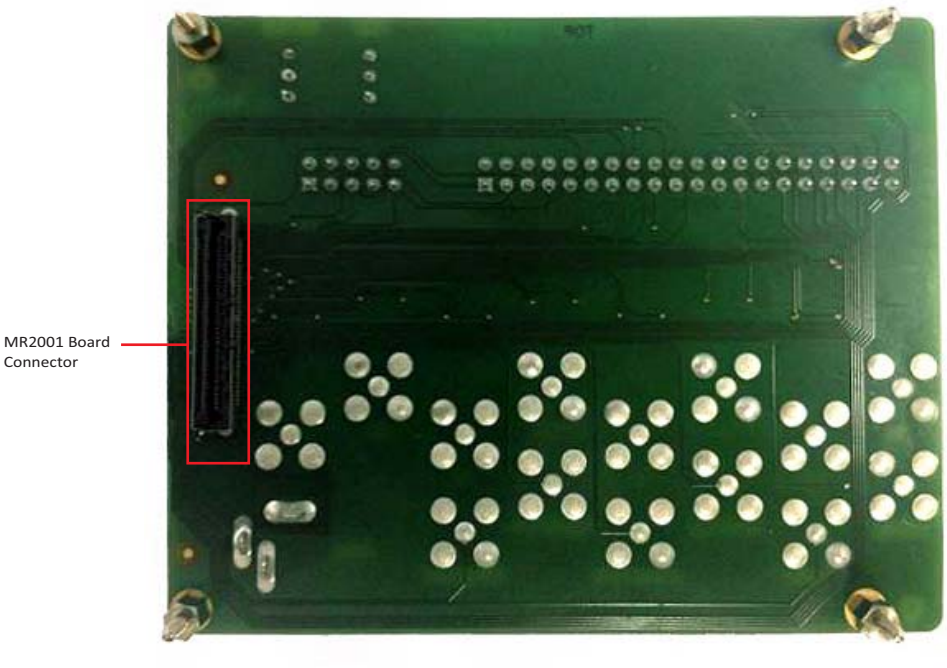

Figure 18. IF Interface Board, Bottom View

7 Schematic

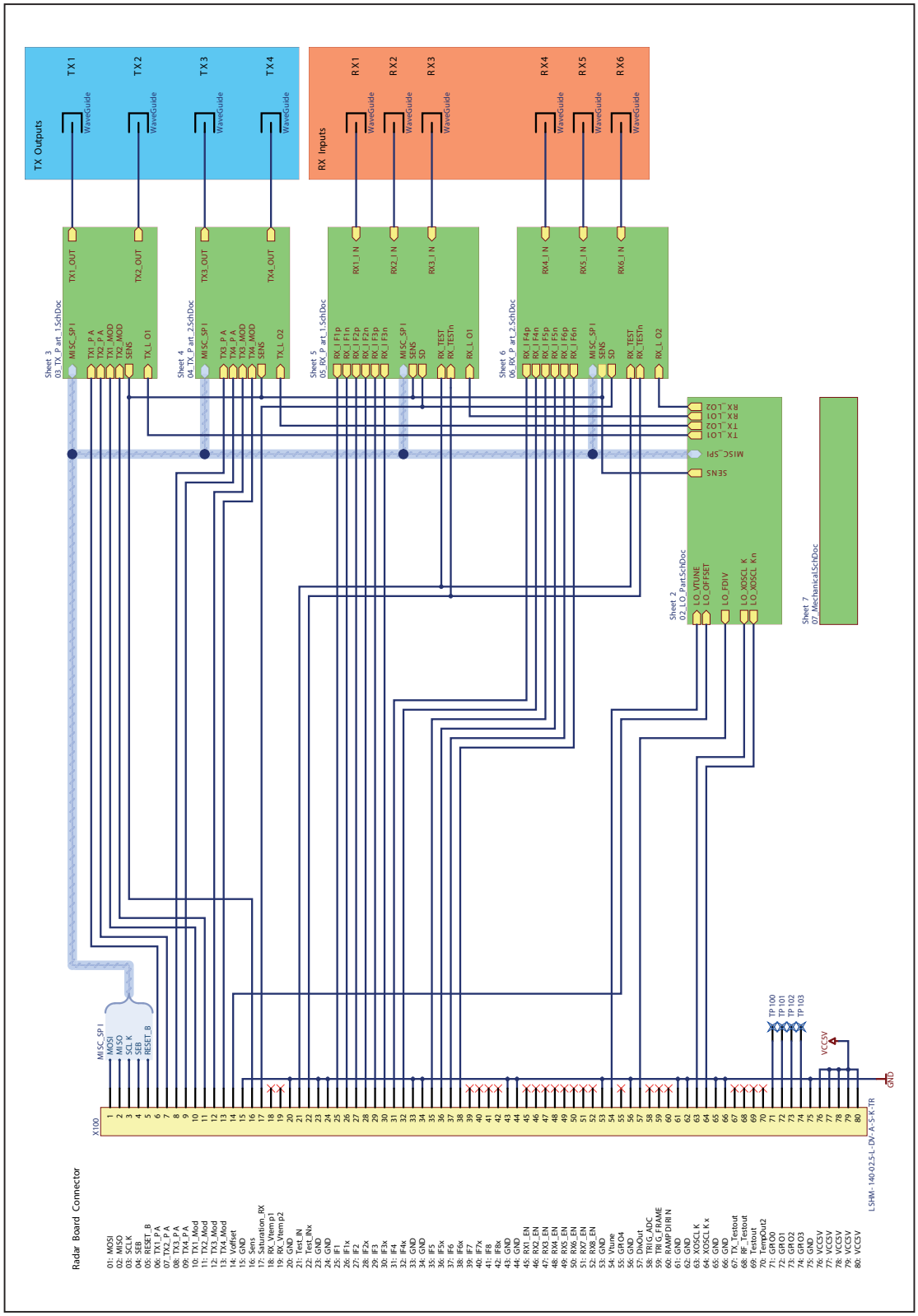

Figure 19. MR2001 Board Schematic, Part 1

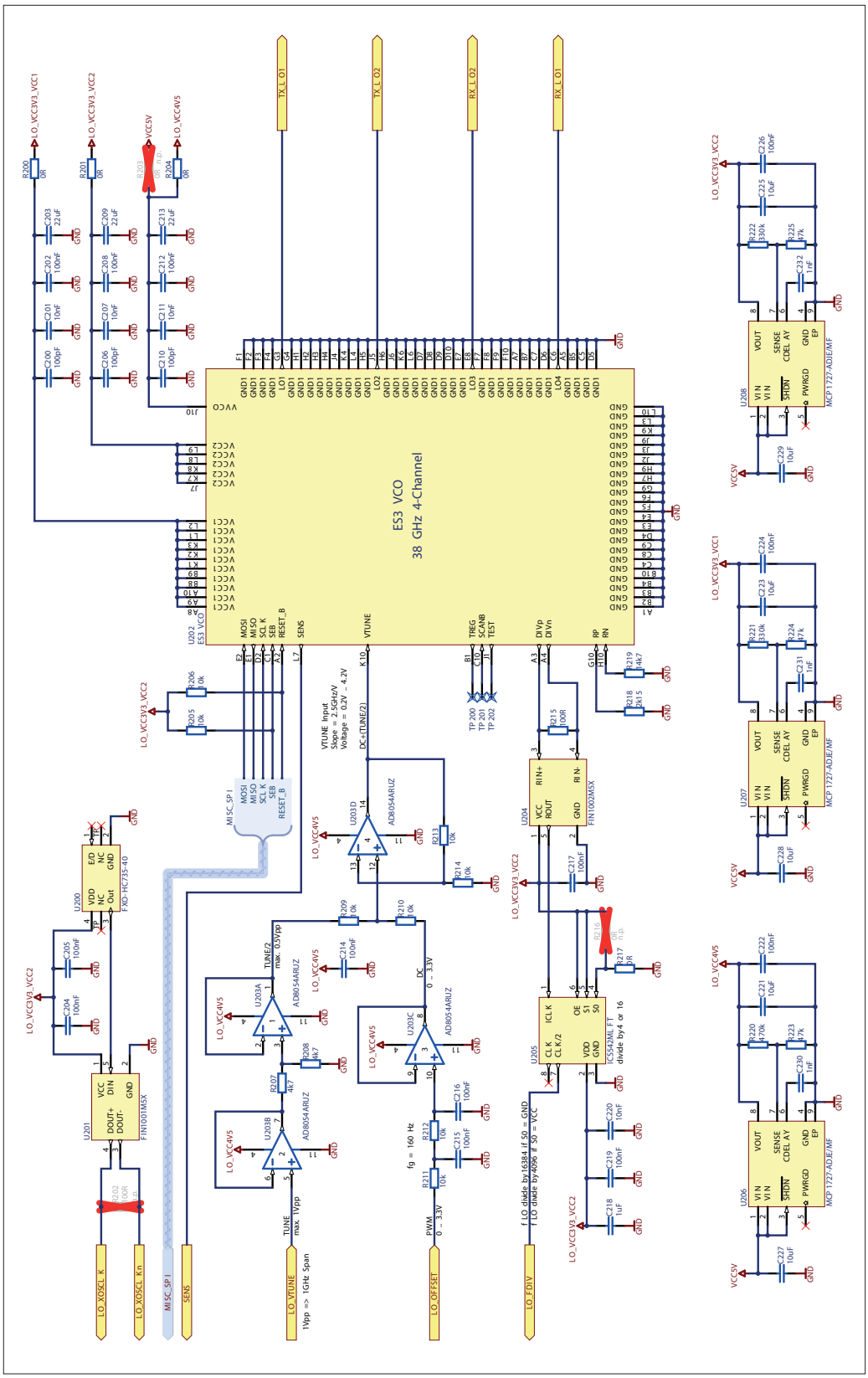

Figure 20. MR2001 Board Schematic, LO Part

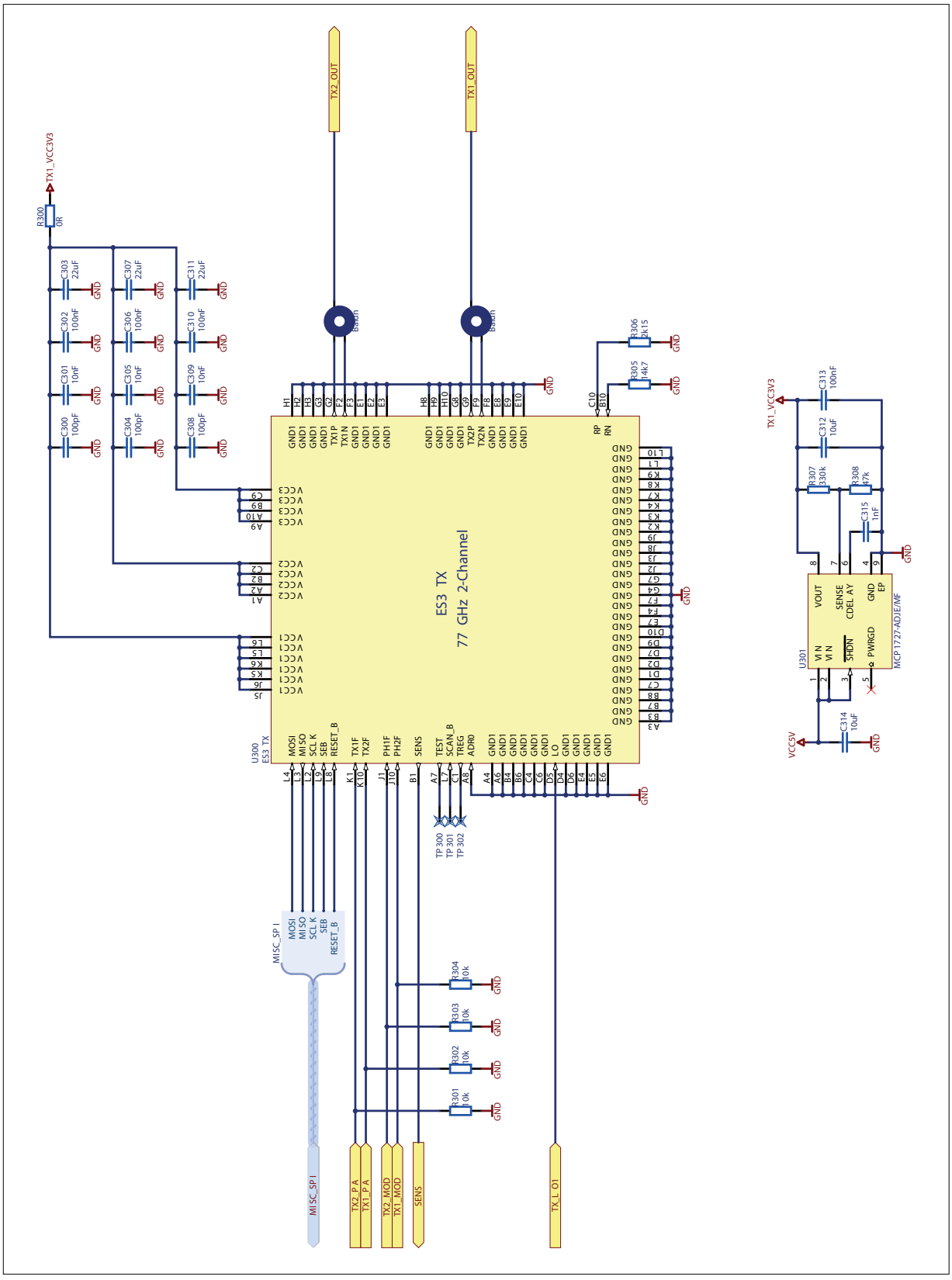

Figure 21. MR2001 Board Schematic, TX Part 1

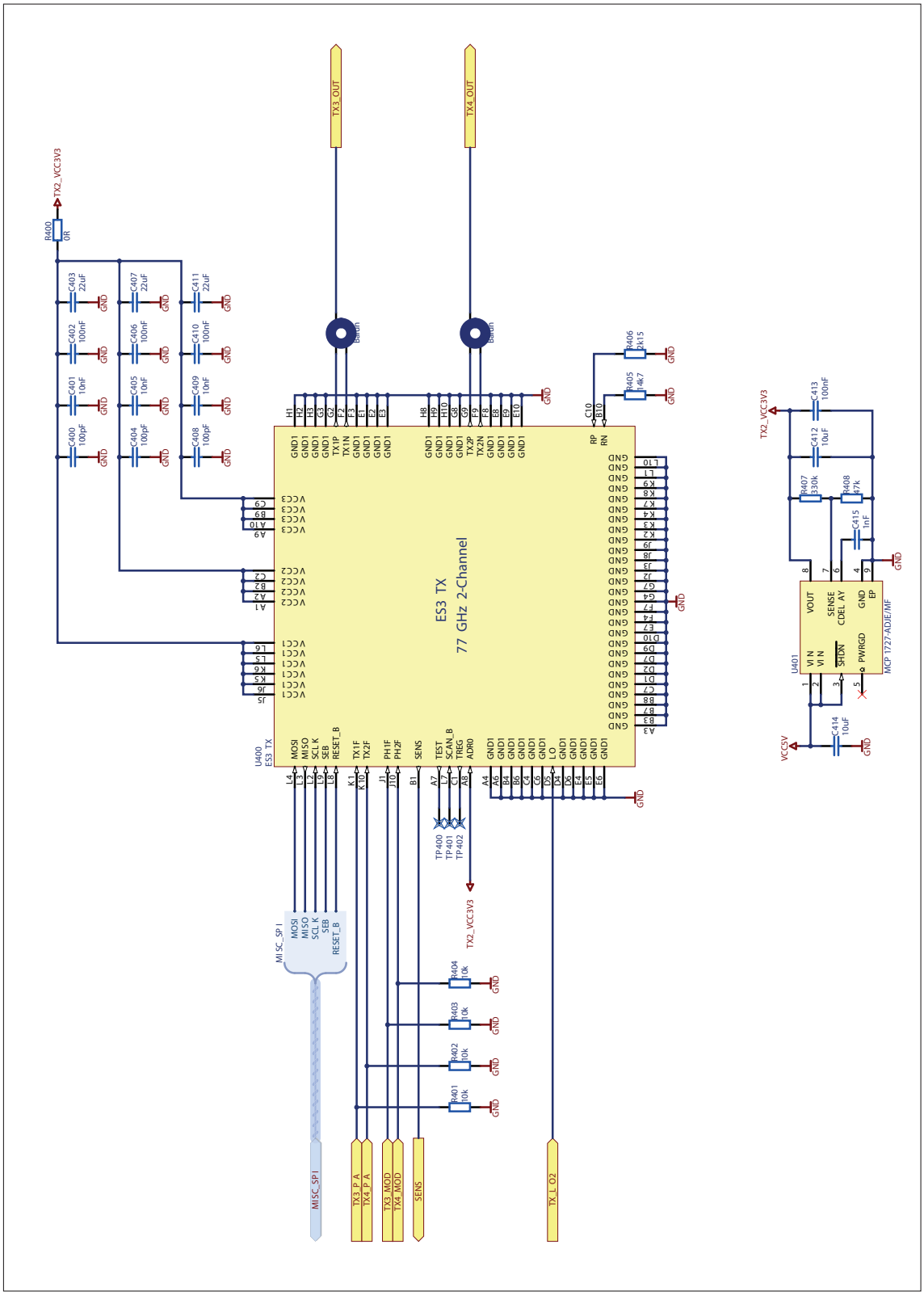

Figure 22. MR2001 Board Schematic, TX Part 2

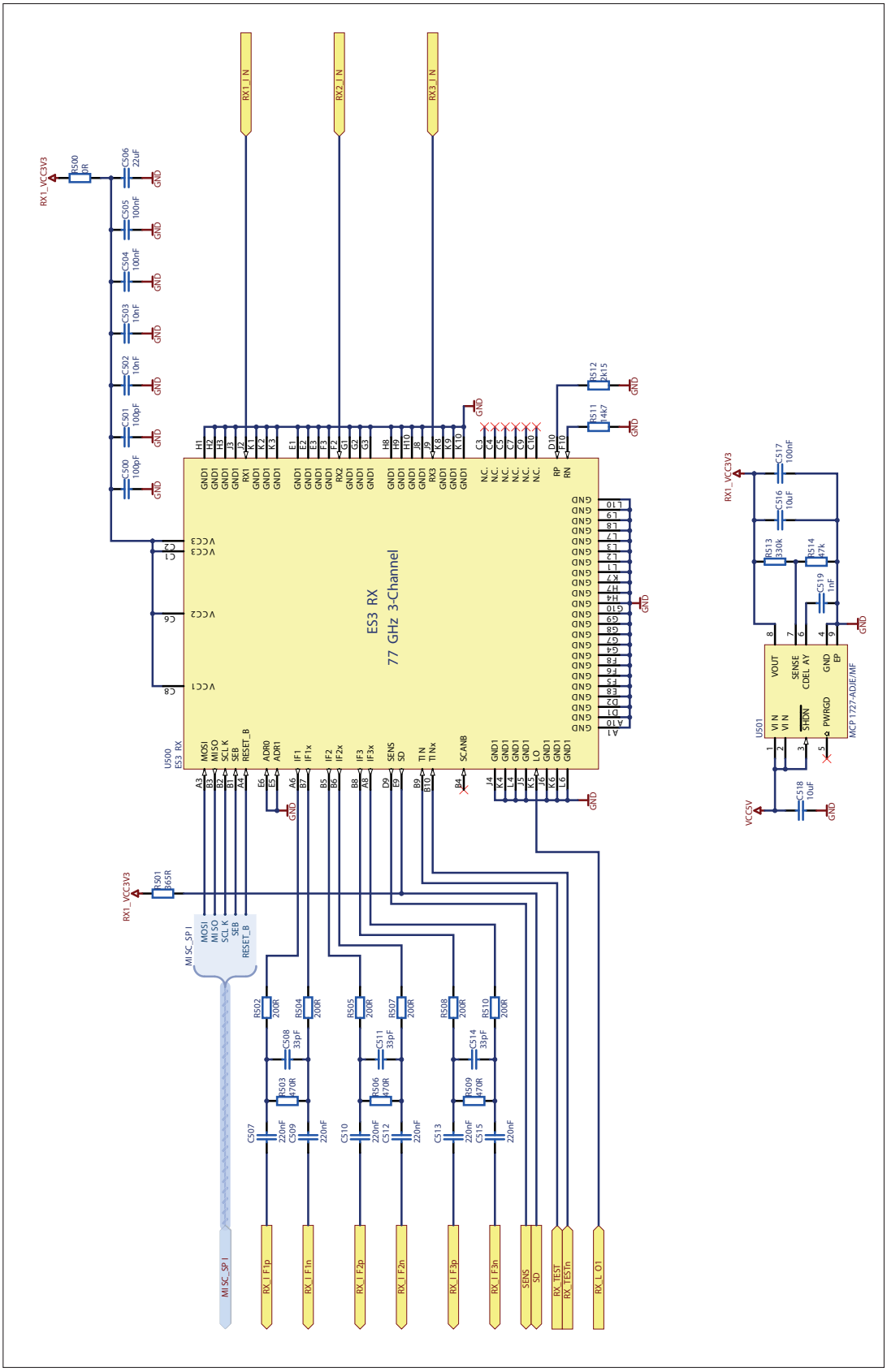

Figure 23. MR2001 Board Schematic, RX Part 1

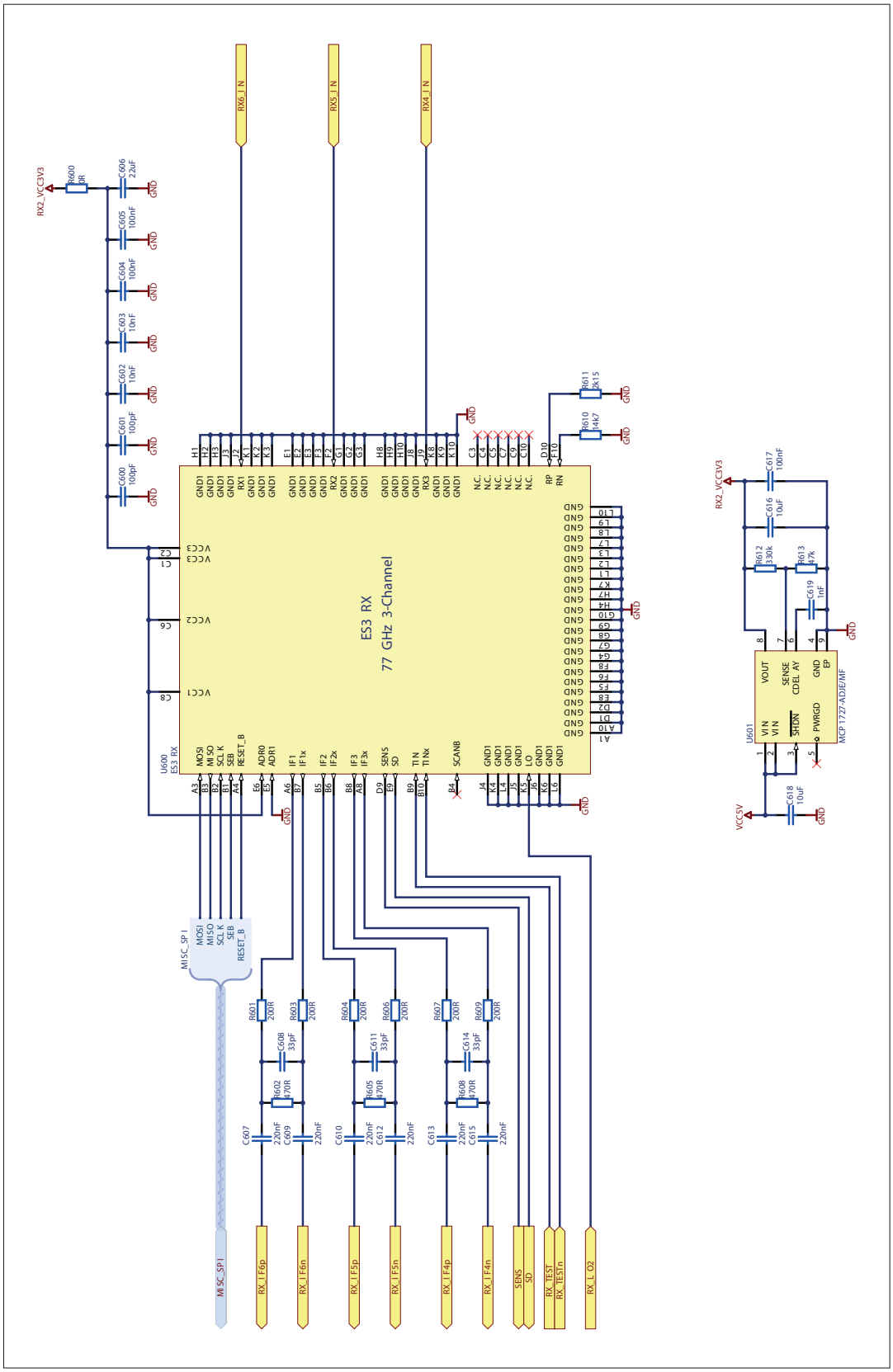

Figure 24. MR2001 Board Schematic, RX Part 2

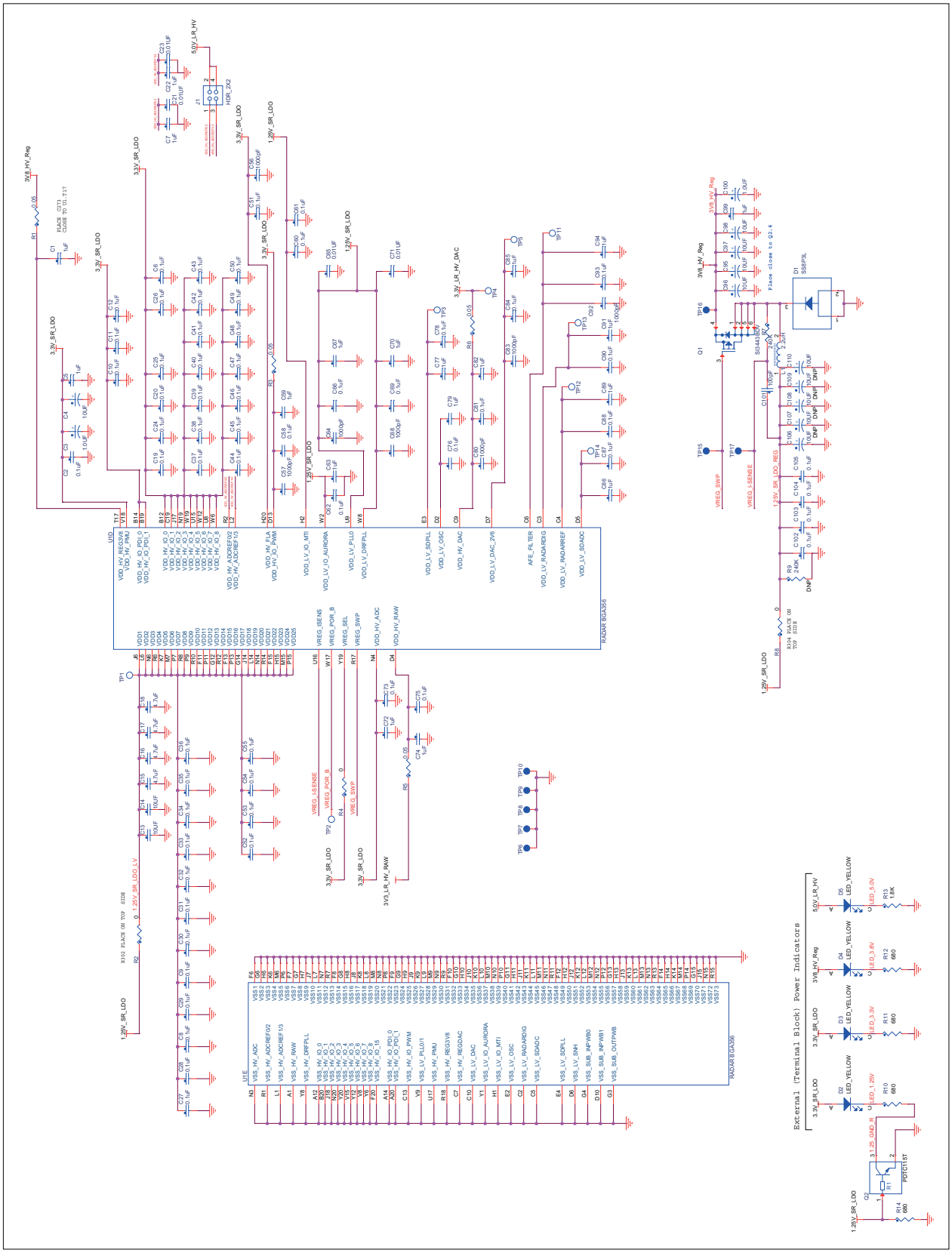

Figure 25. Microcontroller Board Schematic, Part 1

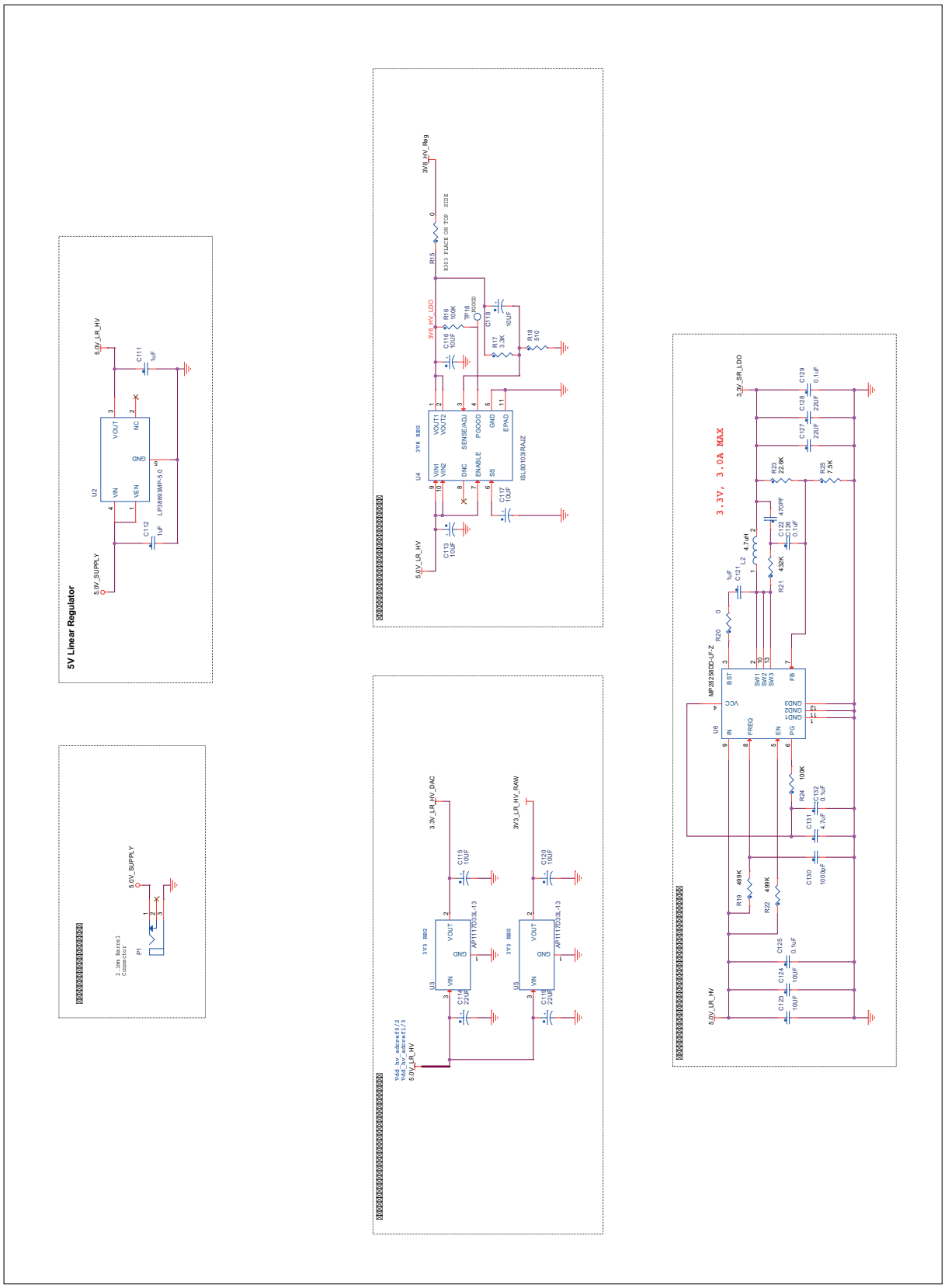

Figure 26. Microcontroller Board Schematic, Part 2

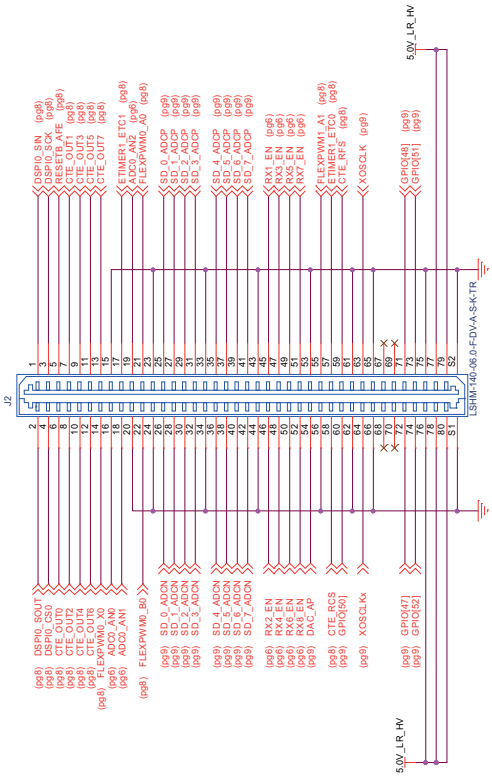

Figure 27. Microcontroller Board Schematic, Part 3

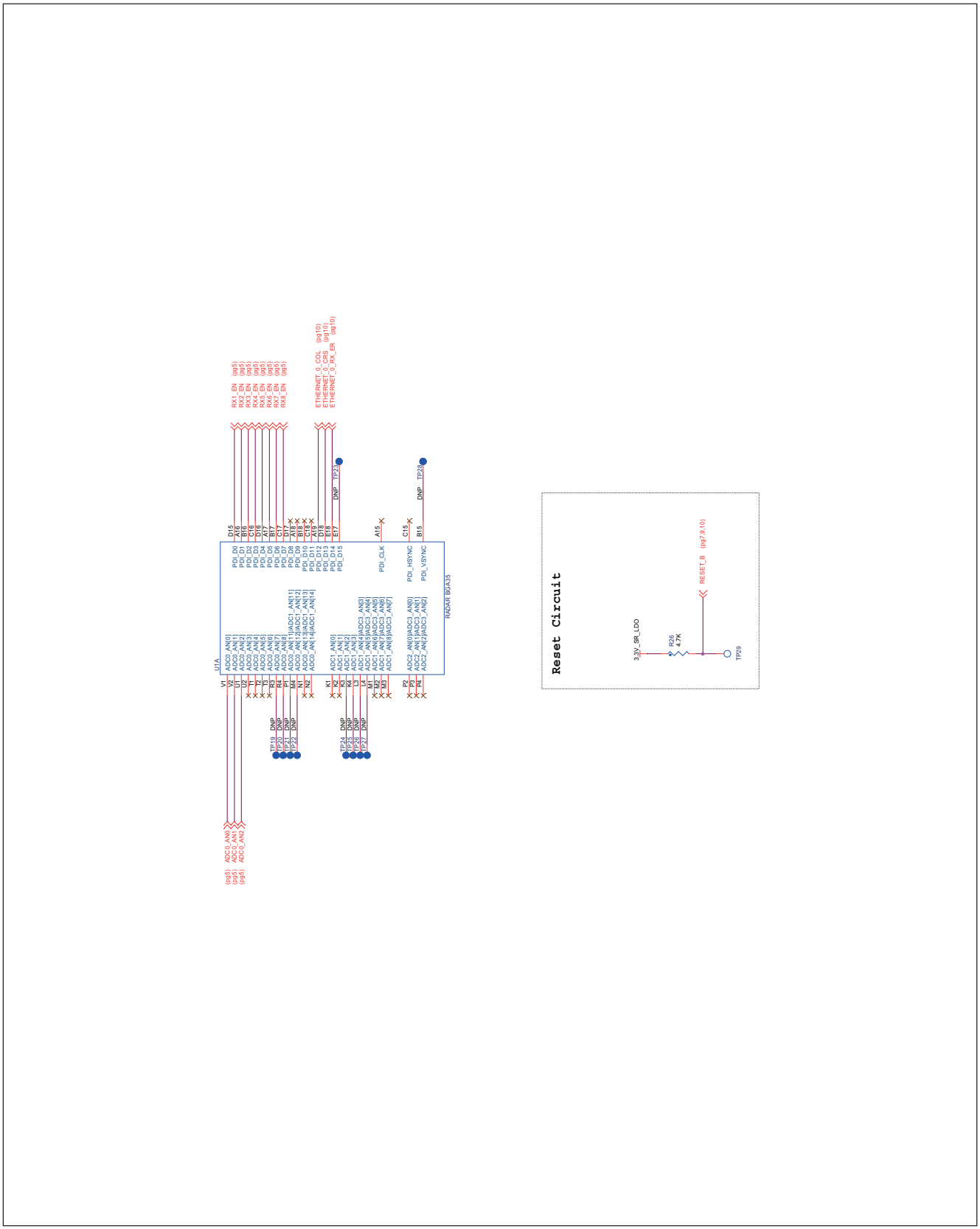

Figure 28. Microcontroller Board Schematic, Part 4

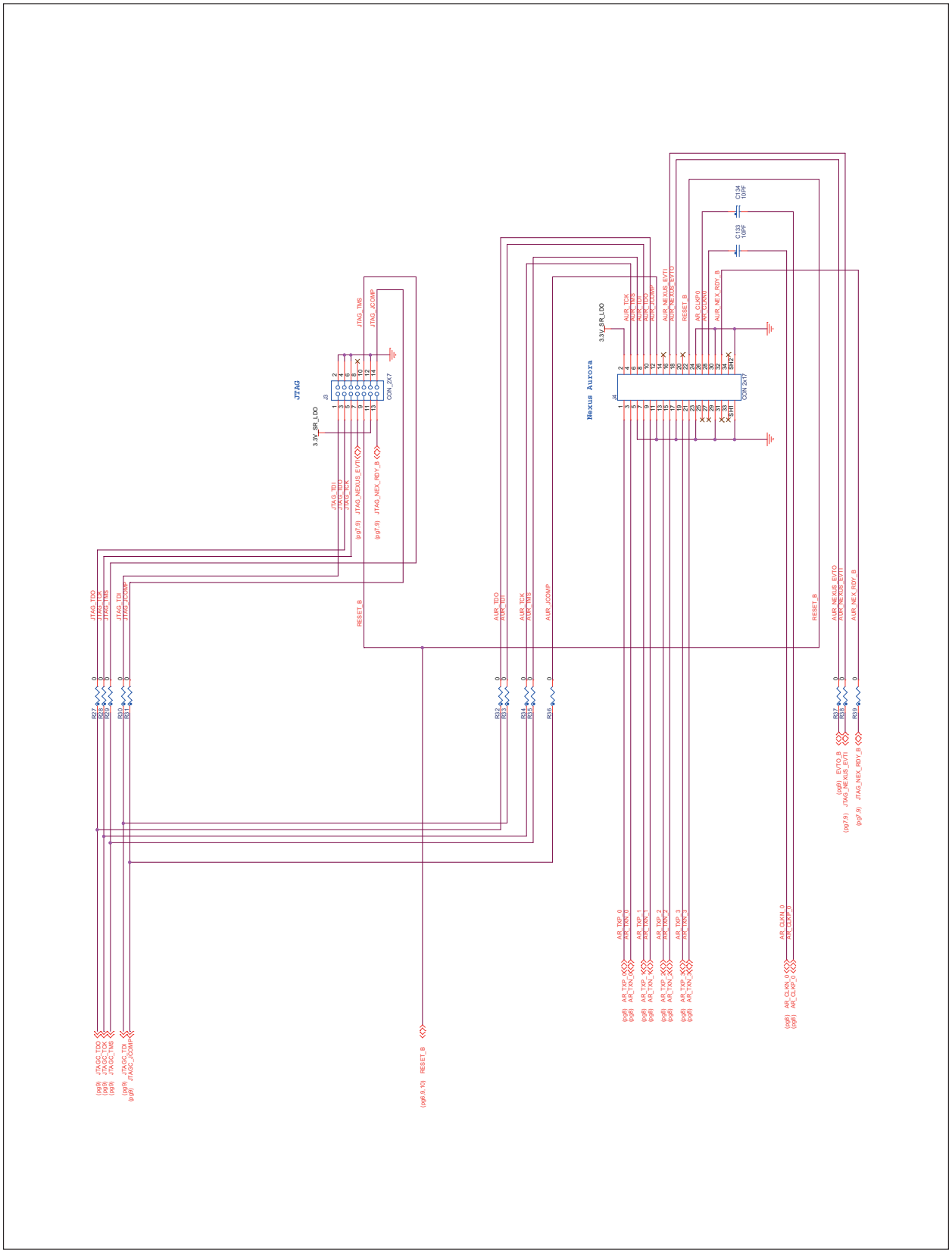

Figure 29. Microcontroller Board Schematic, Part 5

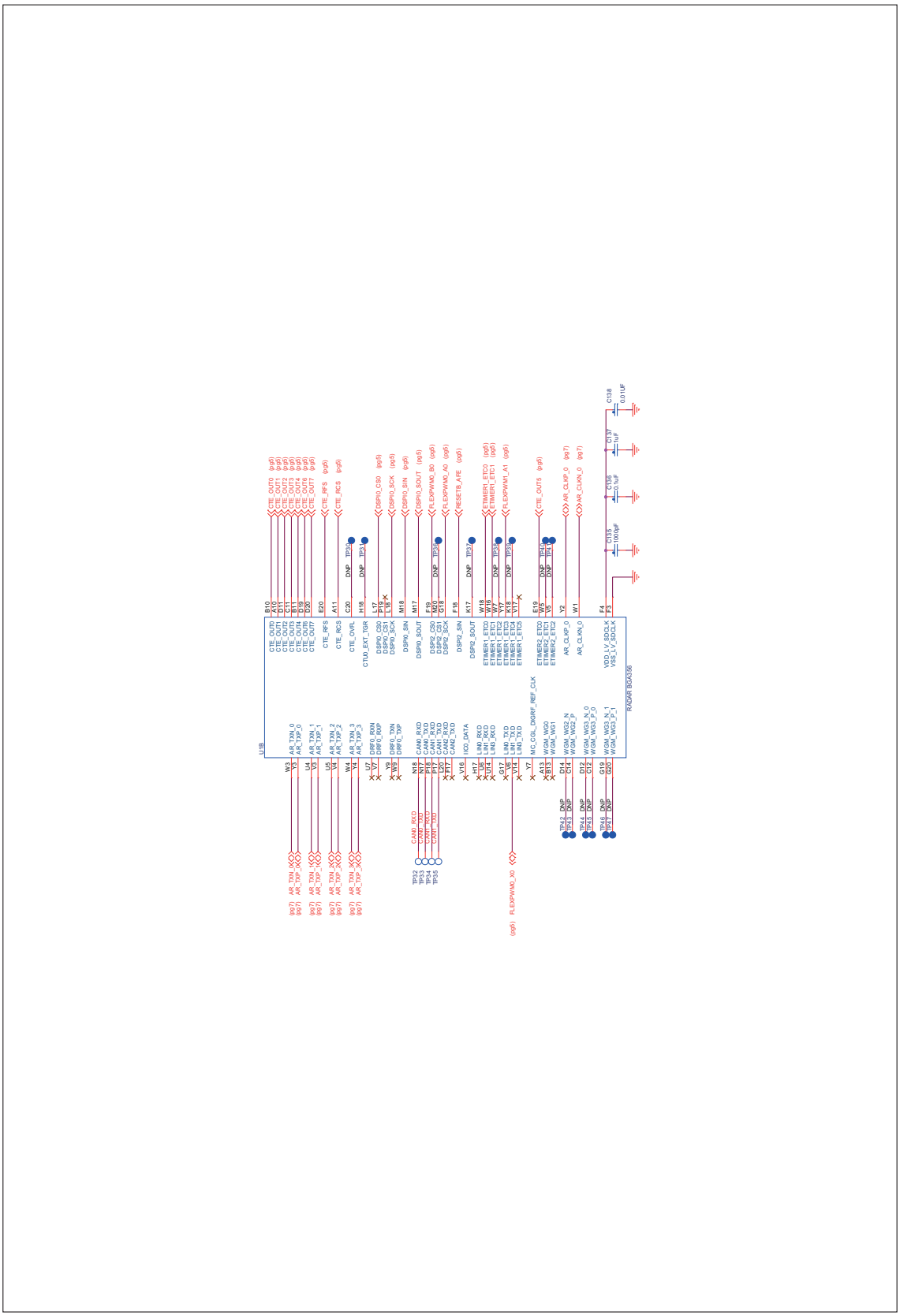

Figure 30. Microcontroller Board Schematic, Part 6

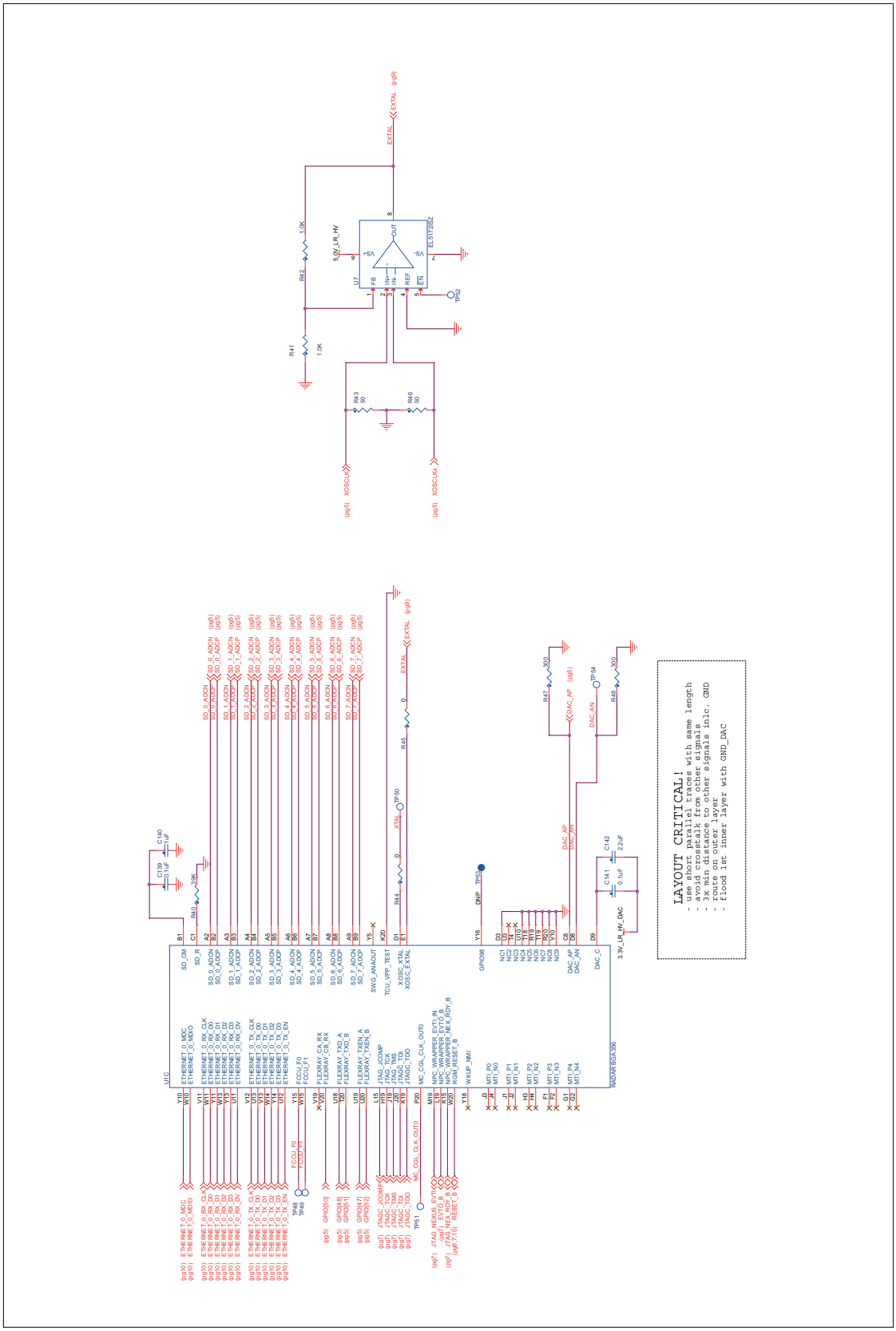

Figure 31. Microcontroller Board Schematic, Part 7

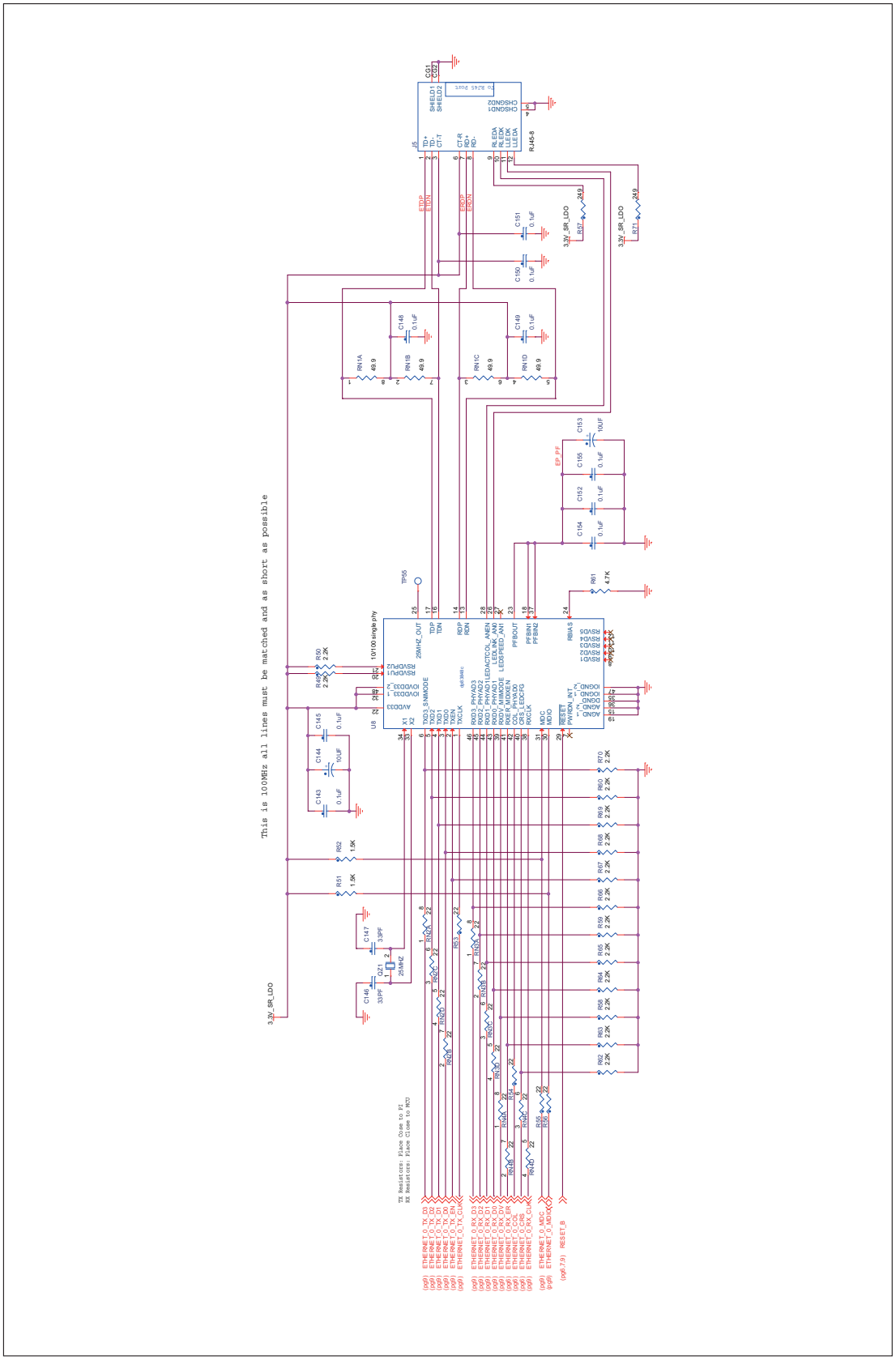

Figure 32. Microcontroller Board Schematic, Part 8

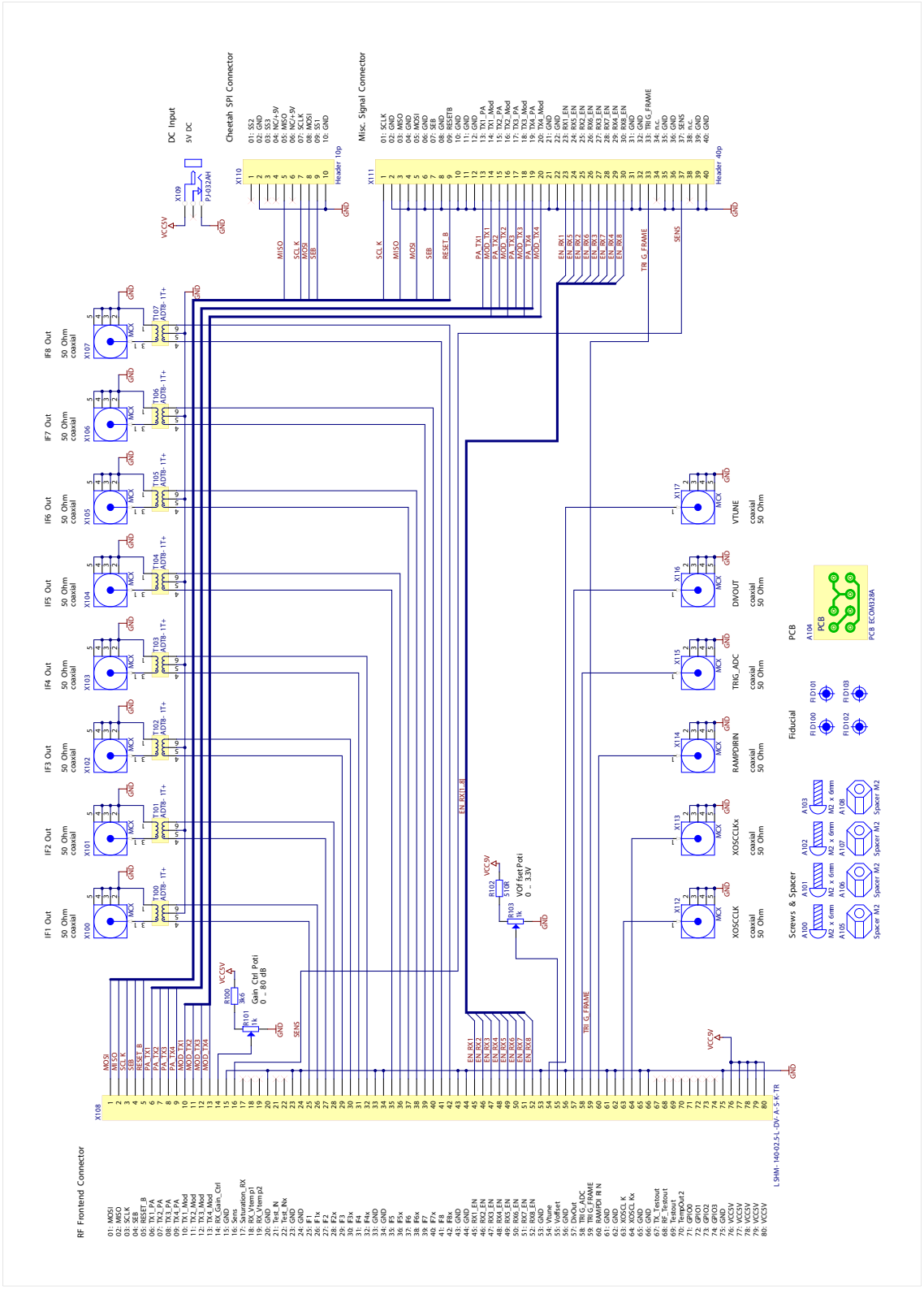

Figure 33. IF Interface Board Schematic

8 Board Layout

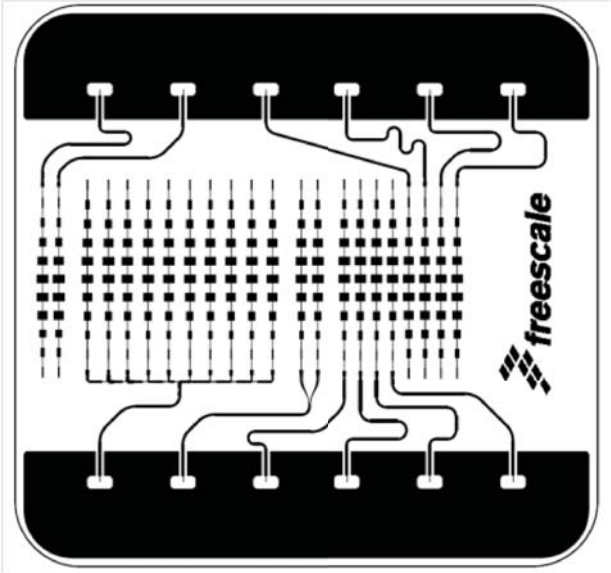

Figure 34. Antenna, Top View

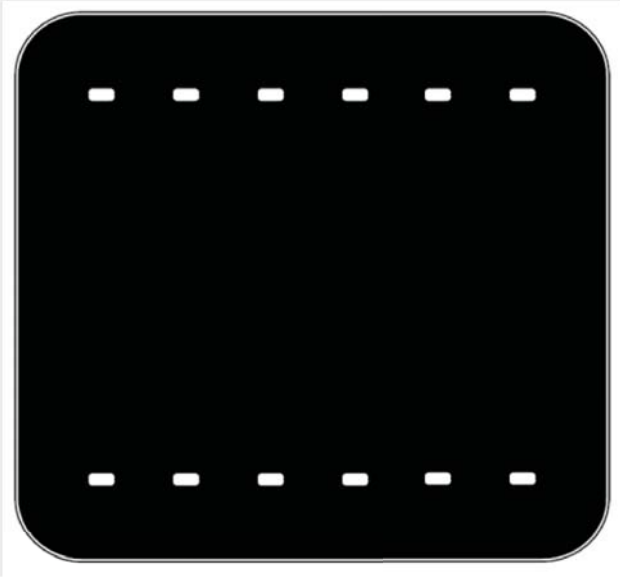

Figure 35. Antenna, Bottom View

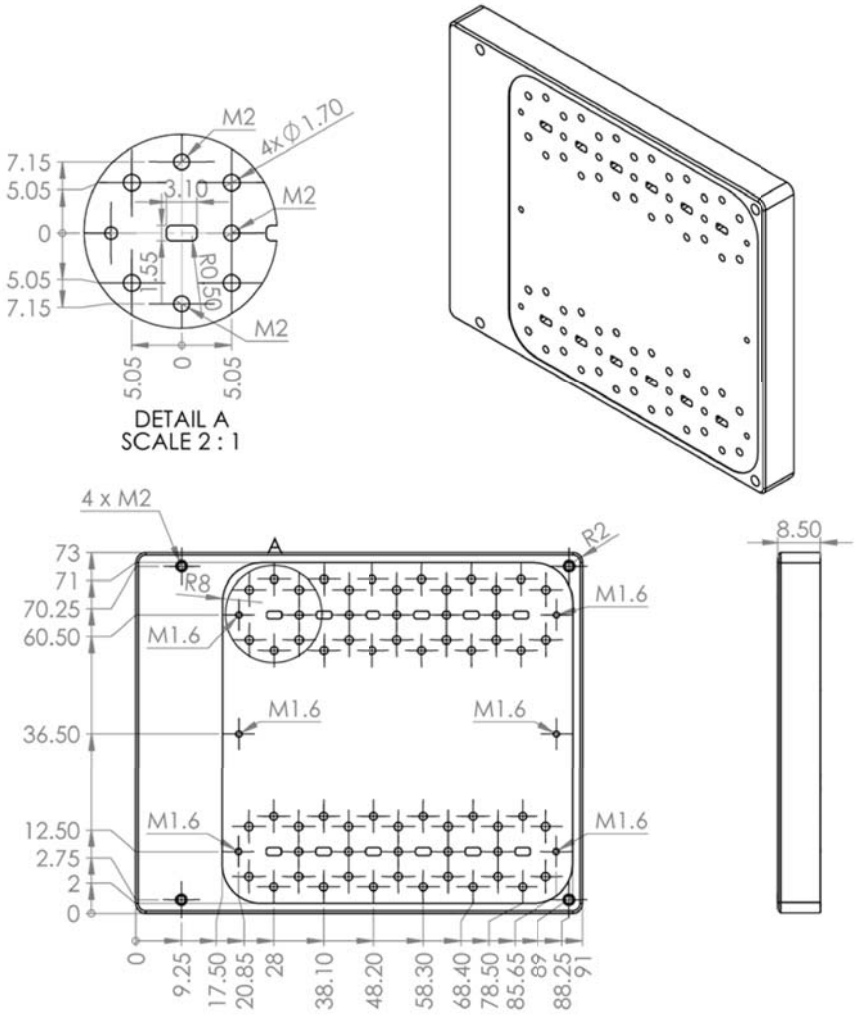

Figure 36. Waveguide Adaptor

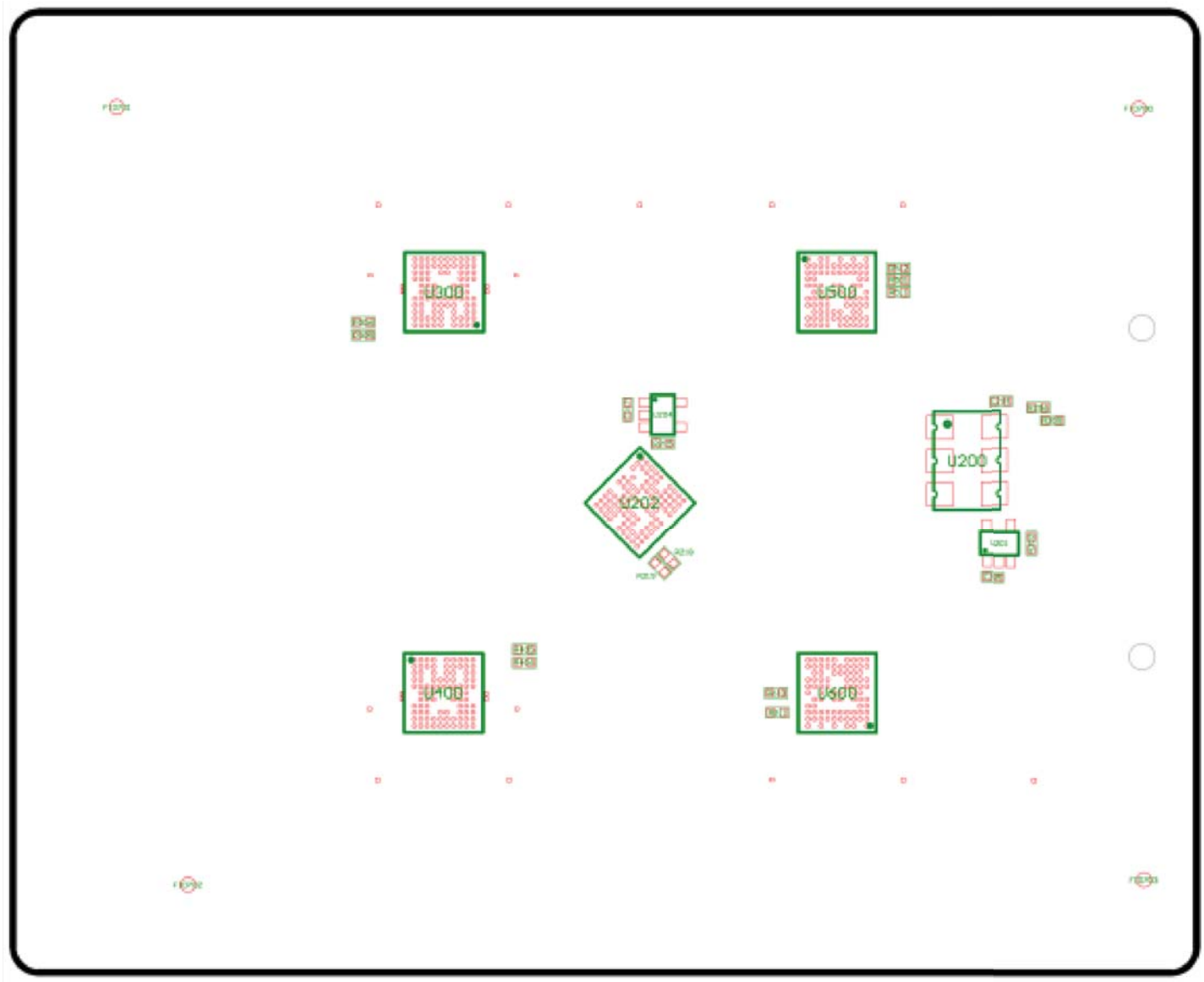

Figure 37. MR2001 Board, Top View

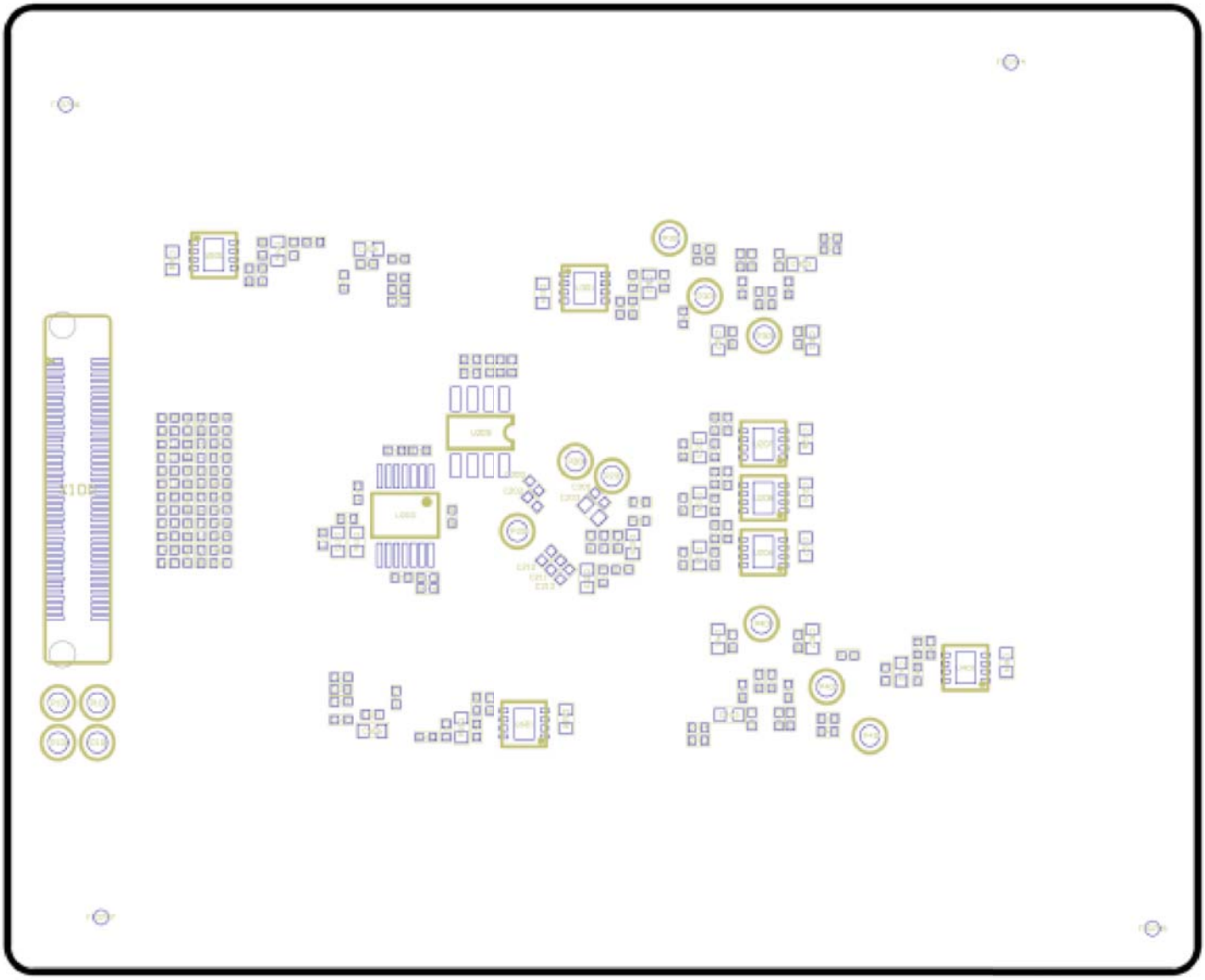

Figure 38. MR2001 Board, Bottom View

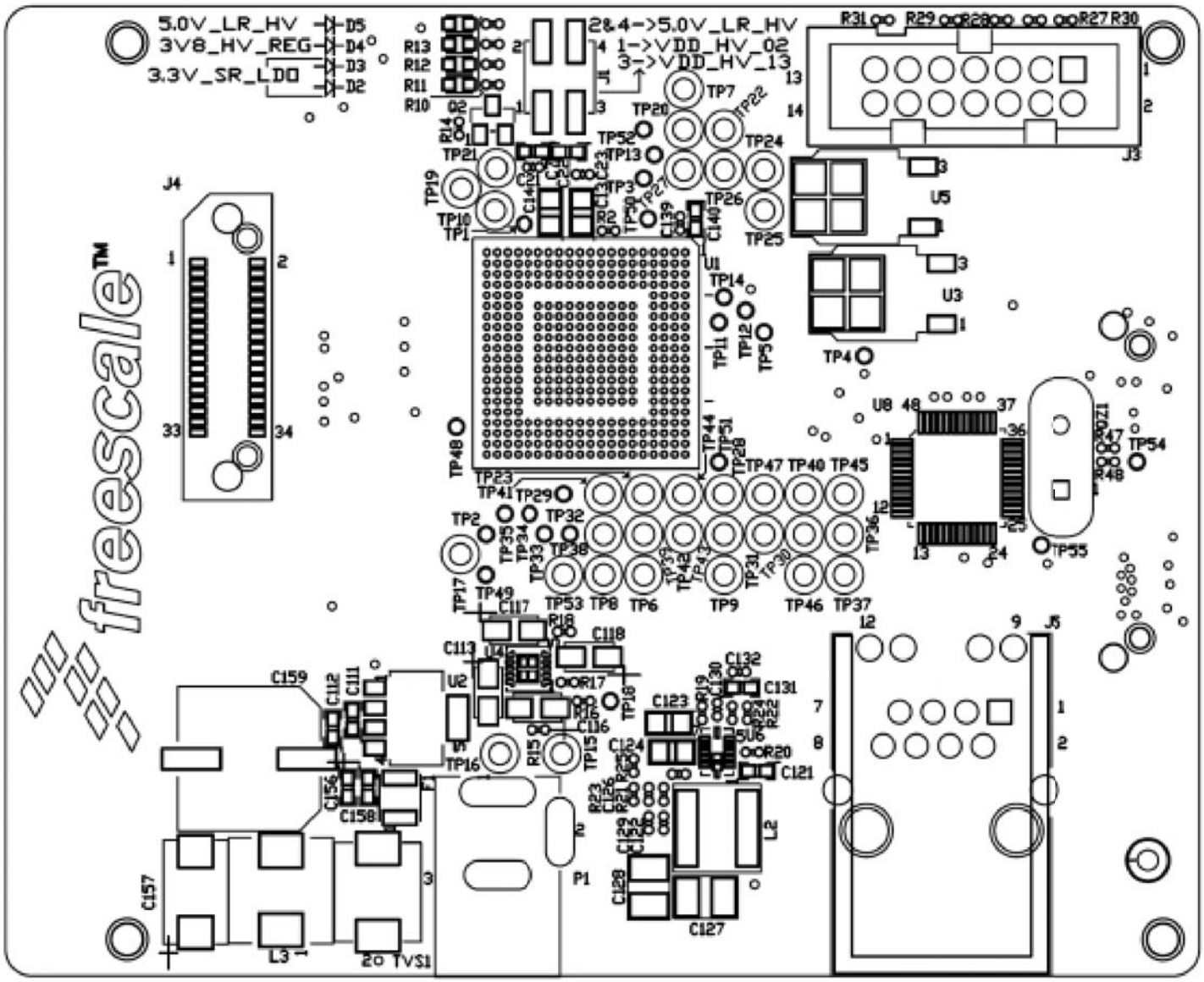

Figure 39. Microcontroller, Top View

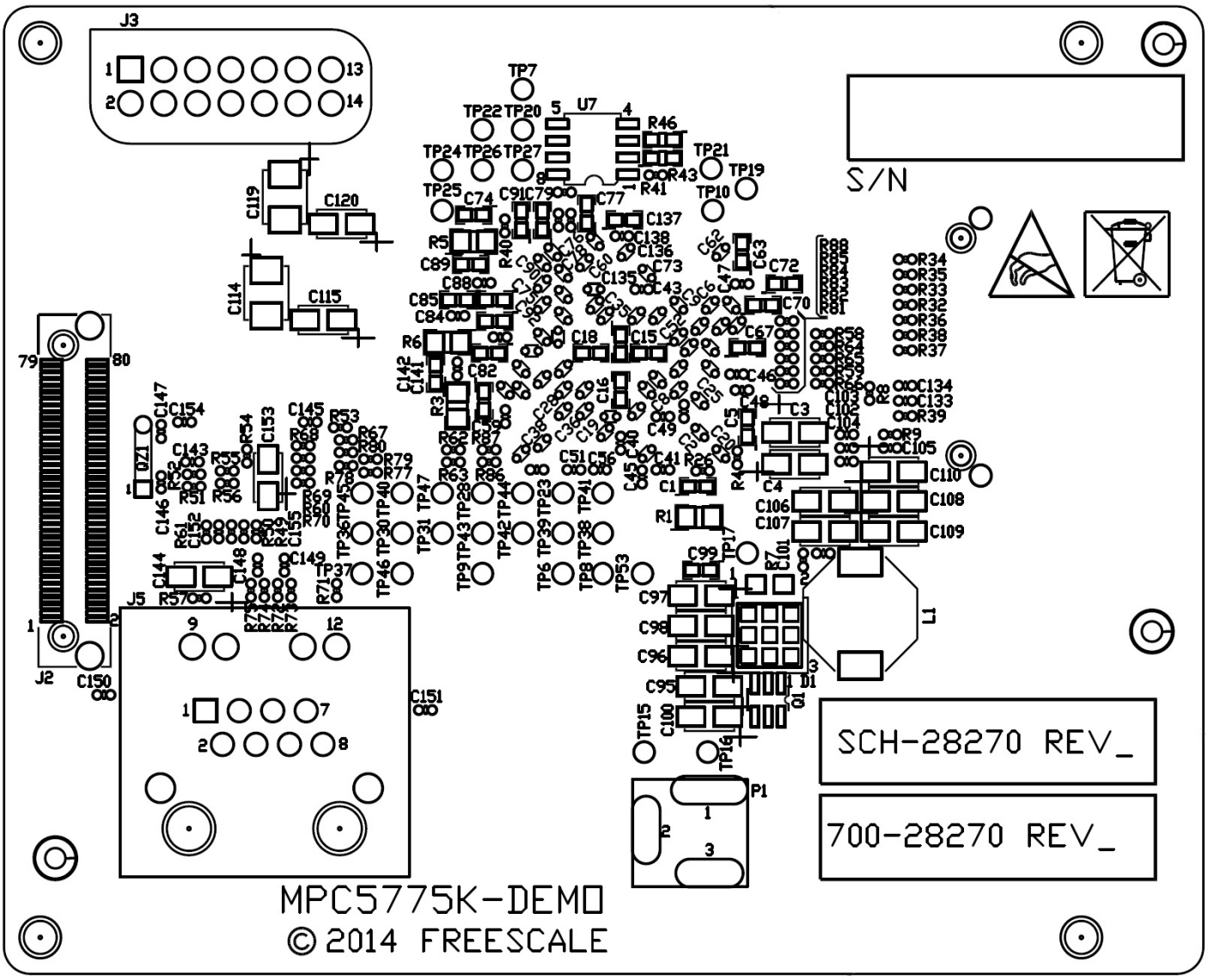

Figure 40. Microcontroller, Bottom View

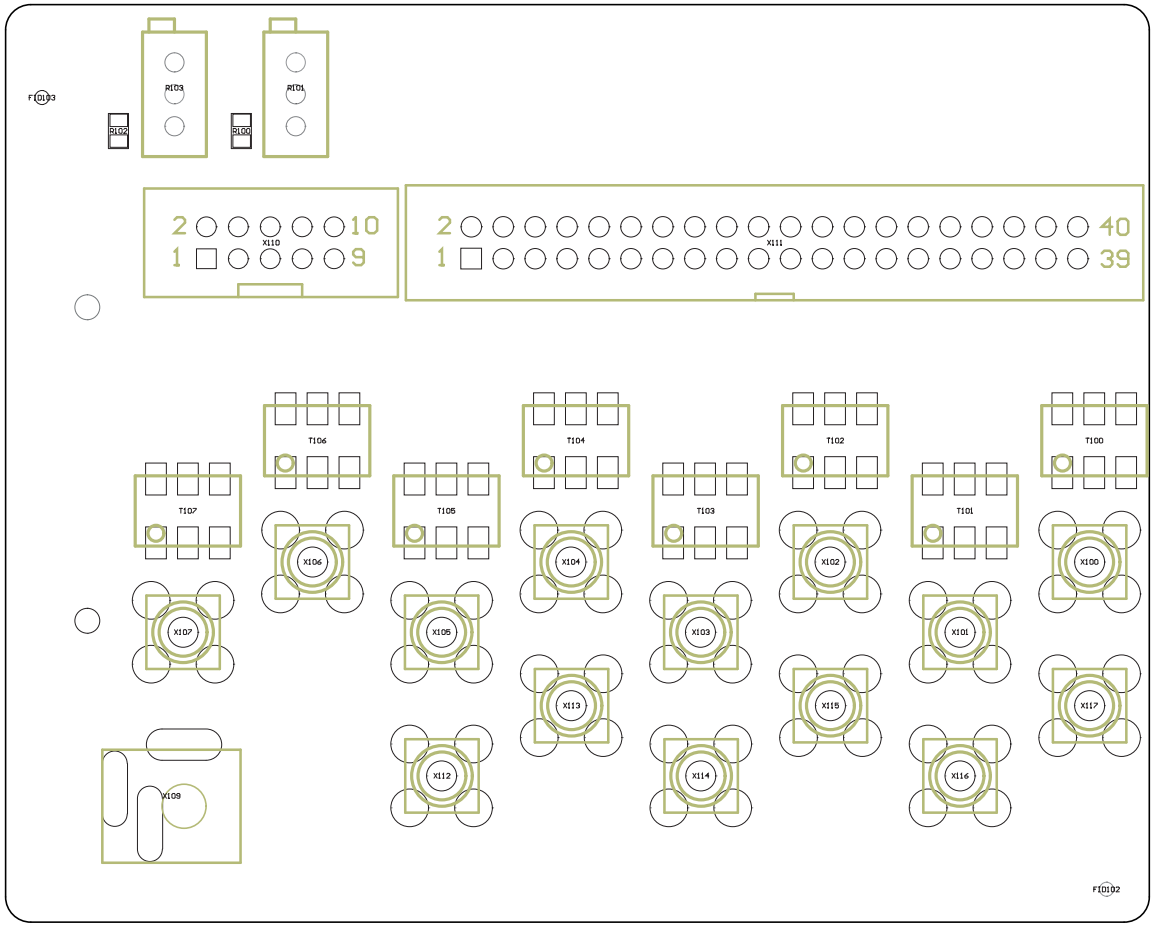

Figure 41. IF Interface Board - Top View

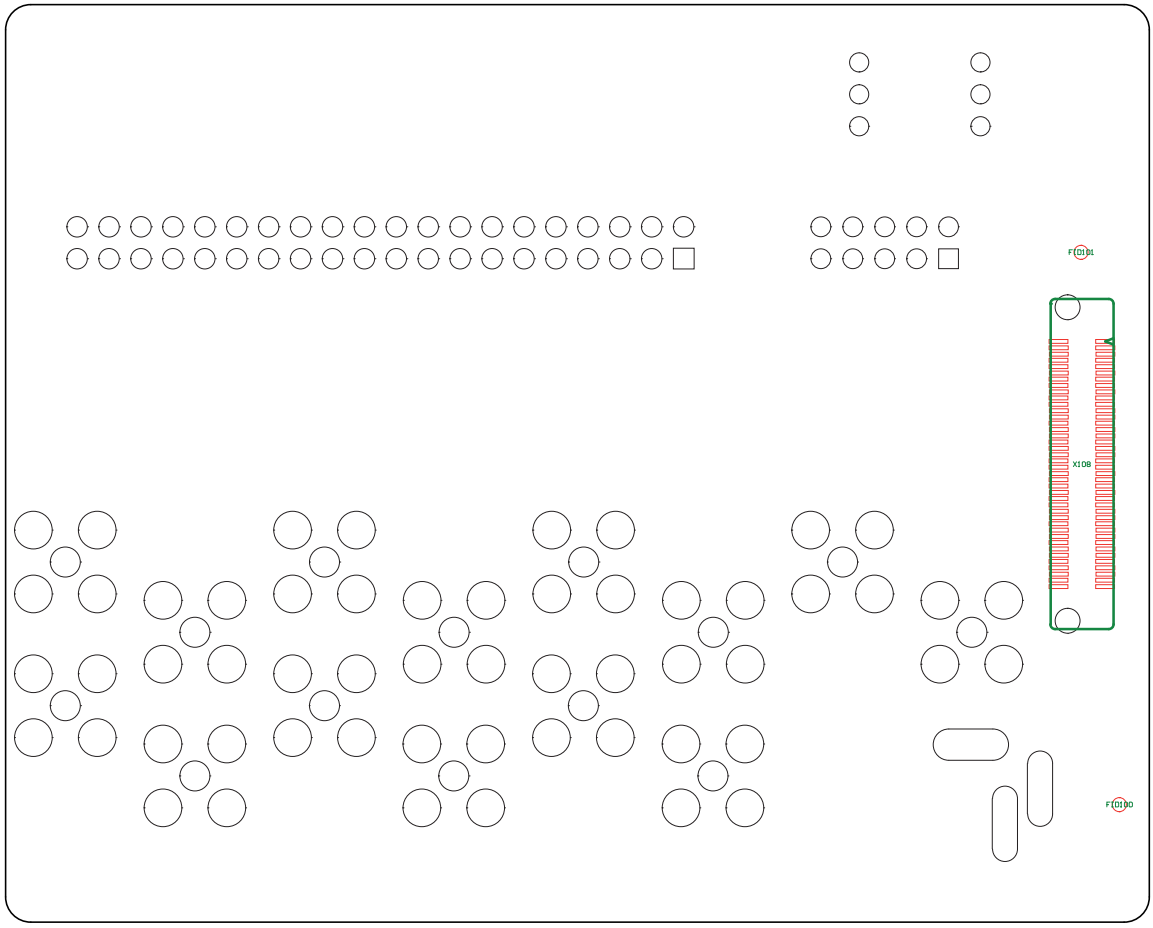

Figure 42. IF Interface Board - Bottom View

9 Bill of Materials

Table 7. Bill of Materials [(1)]

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
Freescale Components						
1	1	U202		Voltage Control Oscillator	MC33MR2001VVK	
2	2	U300, U400		Transmitter	MC33MR2001TVK	
3	2	U500, U600		Receiver	MC33MR2001RVK	
Active Components						
4		U200		Oscillator 33.333 MHz	FXO-HC735-33.333	
5	1	U201		3.3 V LVDS 1-Bit High Speed Differential Receiver	FIN1001M5X	
6	1	U203		Low Cost, High Speed, Rail-to-Rail Amplifiers	AD8054ARUZ	
7	1	U204		3.3 V LVDS 1-Bit High Speed Differential Receiver	FIN1002M5X	
8	1	U205		156 MHz 2, 4, 6, 8, 12, 16 Single Ended Clock Divider	ICS542MLFT	
9	1	U206, U207, U208, U301, U401, U501, U601		1.5 A, Low Voltage, Low Quiescent Current LDO Regulator, 8-Pin DFN, Extended Temperature	MCP1727-ADJE/MF	
Capacitors						
10	13	C200, C206, C210, C300, C304, C308, C400, C404, C408, C500, C501, C600, C601	100 pF	Ceramic Capacitor X5R/X7R ≥ 25 V. (0402)		
11	14	C201, C207, C211, C220, C301, C305, C309, C401, C405, C409, C502, C503, C602, C603	10 nF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0402)		
12	25	C202, C204, C205, C208, C212, C214, C217, C219, C222, C224, C226, C302, C306, C310, C313, C402, C406, C410, C413, C504, C505, C517, C604, C605, C617	100 nF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0402)		
13	11	C203, C209, C213, C303, C307, C311, C403, C407, C411, C506, C606	22 uF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0603)		
14	2	C215, C216	100 nF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0603)		
15	1	C218	1 uF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0402)		
16	14	C221, C223, C225, C227, C228, C229, C312, C314, C412, C414, C516, C518, C616, C618	10 uF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0603)		
17	7	C230, C231, C232, C315, C415, C519, C619	1 nF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0402)		
18	12	C507, C509, C510, C512, C513, C515, C607, C609, C610, C612, C613, C615	220 nF	Ceramic Capacitor X5R/X7R ≥ 10 V. (0402)		
19	6	C508, C511, C514, C608, C611, C614	33 pF	Ceramic Capacitor X5R/X7R ≥ 25 V. (0402)		

Table 7. Bill of Materials [(1)] (continued)

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
Resistors						
20	8	R200, R201, R204, R217, R300, R400, R500, R600	0 Ω	Resistor 1% 0.063 W. (0402)		
21	16	R205, R206, R209, R210, R211, R212, R213, R214, R301, R302, R303, R304, R401, R402, R403, R404	10 kΩ	Resistor 1% 0.063 W. (0402)		
22	2	R207, R208	4.7 kΩ	Resistor 1% 0.063 W		
23	1	R215	100 Ω	Resistor 1% 0.063 W		
24	5	R218, R306, R406, R512, R611	2.15 kΩ	Resistor 1% 0.063 W		(2)
25	5	R219, R305, R405, R511, R610	14.7 kΩ	Resistor 1% 0.063 W		
26	1	R220	470 kΩ	Resistor 1% 0.063 W		
27	6	R221, R222, R307, R407, R513, R612	330 kΩ	Resistor 1% 0.063 W		
28	7	R223, R224, R225, R308, R408, R514, R613	47 kΩ	Resistor 1% 0.063 W		
29	1	R501	365 Ω	Resistor 1% 0.063 W		
30	12	R502, R504, R505, R507, R508, R510, R601, R603, R604, R606, R607, R609	200 Ω	Resistor 1% 0.063 W		
31	6	R503, R506, R509, R602, R605, R608	470 Ω	Resistor 1% 0.063 W		
Connectors, Headers						
32	1	X100		SMD Header, 80-Pin, Pitch 0.5 mm		

Notes:
1. Freescale does not assume liability, endorse, or warrant components from external manufacturers that are referenced in circuit drawings or tables. While Freescale offers component recommendations in this configuration, it is the customer's responsibility to validate their application.
2. **Critical components.** For critical components, it is vital to use the manufacturer listed.

9.1 Bill of Materials for Microcontroller Board

Table 8. Bill of Materials[(3)]

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
Freescale Components						
1	1	U1		IC RADAR BGA356	PPC5775NQK0MMY3	
Active Components						
2	1	QZ1	25 MHz	XTAL 25.000000 MHZ SER -- TH	FOXSLF/250F-20	
3	1	Q1		TRAN PJFET -- TSOP-6 ROHS	SI3443DVTRPBF	
4	1	Q2		TRAN NPN W/RES 100 MA 50 V SOT346	PDTC115TK	
5	1	D1		DIODE SCH 8 A 30 V TO -277 A	SS8P3L-M3/86A	
6	4	D2, D3, D4, D5		LED ULTRA-BRIGHT YELLOW 30 MA 5 V SMT 0603	LTST-C190KSKT	
7	1	F1		FUSE PLYSW PTC 1.5 A 6 V SMT	1210L150WR	

Table 8. Bill of Materials[3]

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
8	1	TVS1		DIODE TVS BIDIR 18 V 1500 W DO-214AB	1.5SMC18CA	
9	1	U2		IC VREG LDO 5 V 500 MA 2.7-10 V SOT-223	LP38693MP-5.0 NOPB	
10	2	U3, U5		IC VREG LDO 3.3 V 1A TO 252-3L	AP1117D33L-13	
11	1	U4		IC VREG LDO ADJ 0.8-5 V 3 A 2.2-6 V DFN10	ISL80103IRAJZ	
12	1	U6		IC VREG STEP DOWN DCDC 0.815-13 V 3 A 4.2-20 V QFN12	MP28258DD-LF-Z	
13	1	U7		IC LIN AMP RCVR DIFFERENTIAL LINE 250 MHz 5 V SOIC8	EL5172ISZ	
14	1	U8		IC 10100 SINGLE PHY ETHERNET TRANSCEIVER	DP83848CVV/NOPB	
Capacitors						
15	24	C1, C5, C7, C22, C59, C63, C67, C70, C72, C74, C77, C79, C82, C85, C86, C89, C91, C94, C99, C111, C112, C121, C137, C140	1 uF	CAP CER 1 uF 25 V 10% X7R 0603	0603X105K250SNT	
16	77	C2, C6, C8, C9, C10, C11, C12, C19, C20, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C58, C60, C61, C62, C66, C69, C73, C75, C76, C78, C81, C84, C87, C88, C90, C93, C102, C103, C104, C105, C125, C126, C129, C132, C136, C139, C141, C143, C145, C148, C149, C150, C151, C152, C154, C155	0.1 uF	CAP CER 0.1 uF 50 V 10% X7R 0402	GRM155R71H104KE14D	
17	2	C3, C100	1.0 uF	CAP TANT 1.0 uF 16 V 10% -- 3216-18	T491A105K016AT	
18	14	C4, C95, C96, C97, C98, C110, C113, C115, C116, C117, C118, C120, C144, C153	10 uF	CAP TANT 10 uF 16 V 10% -- 3216-18	TAJA106K016R	
19	4	C13, C14, C123, C124	10 uF	CAP CER 10 uF 16 V 10% X5R 0805	0805YD106KAT2A	
20	5	C15, C16, C17, C18, C131	4.7 uF	CAP CER 4.7 uF 16 V 10% X5R 0603	C1608X5R1C475K	
21	5	C21, C23, C65, C71, C138	0.01 uF	CAP CER 0.01 uF 50 V 10% X7R 0402	0402B103K500CT	
22	9	C56, C57, C64, C68, C80, C83, C92, C130, C135	1000 pF	CAP CER 1000 pF 50 V 10% X5R 0402	C1005X5R1H102K	
23	1	C101	100 pF	CAP CER 100 pF 50 V 5% X7R 0402	GMC04X7R101J50NT-LF	
24	4	C106, C107, C108, C109	10 uF	CAP TANT 10 uF 16 V 10% -- 3216-18	TAJA106K016R	
25	2	C114, C119	22 uF	CAP TANT 22 uF 20 V 10% -- 3528-21	TAJB226K020RNJ	

Table 8. Bill of Materials[3]

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
26	1	C122	470 pF	CAP CER 470 pF 50 V 10% X7R 0402	GRM155R71H471KA01D	
27	2	C127, C128	22 uF	CAP CER 22 uF 10 V 10% X7R 1210	GRM32ER71A226KE20L	
28	2	C133, C134	10 pF	CAP CER 10 pF 50 V 5% C0G 0402	04025A100JAT2A	
29	1	C142	2.2 uF	CAP CER 2.2 uF 25 V 10% X5R 0603	C1608X5R1E225K	
30	2	C146, C147	33 pF	CAP CER 33 pF 50 V 5% C0G 0402	C0402C0G500-330JNE	
31	1	C156	0.1 uF	CAP CER 0.1 uF 50 V 10% X7R 0603	GRM188R71H104KA93D	
32	1	C157	68 uF	CAP TANT 68 uF 25 V 10% ESR = 0.125 Ω 7343-43	TPSE686K025R0125	
33	1	C158	1000 pF	CAP CER 1000 pF 50 V 10% C0G 0603	06035U102KAT2A	
34	1	C159	1000 uF	CAP ALEL 1000 uF 10 V 20% -- SMD	VZH102M1ATR-1010	
Resistors						
35	4	R1, R3, R5, R6	0.05 Ω	RES MF 0.05 Ω 1/4 W 1% 0805	WSL0805R0500FEA18	
36	20	R2, R4, R8, R15, R20, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R44, R45	0 Ω	RES MF 0 Ω 1/16 W -- AEC-Q200 0402	CRCW04020000Z0ED	
37	2	R7, R9	240 kΩ	RES TF 240 K 1/16 W 1% 0402	CR0402-FX-2403GLF	
38	4	R10, R11, R12, R14	680 Ω	RES MF 680 Ω 1/16 W 1% 0402	RC73A2Z6800FTF	
39	1	R13	1.8k Ω	RES MF 1.8 K 1/16 W 1% 0402	RK73H1ETTP1801F	
40	2	R16, R24	100 kΩ	RES MF 100 K 1/16 W 1% 0402	RC0402FR-07100KL	
41	1	R17	3.3 kΩ	RES MF 3.3 K 1/16 W 1% 0402	RK73H1ETTP3301F	
42	1	R18	510 Ω	RES MF 510 Ω 1/16 W 1% AEC-Q200 0402	CRCW0402510RFKED	
43	2	R19, R22	499 kΩ	RES MF 499 K 1/16 W 1% 0402	RK73H1ETTP4993F	
44	1	R21	432 kΩ	RES MF 432 K 1/16 W 1% 0402	RK73H1ETTP4323F	
45	1	R23	22.6 kΩ	RES MF 22.6 K 1/16 W 1% 0402	RK73H1ETTP2262F	
46	1	R25	7.5 kΩ	RES MF 7.5 K 1/16 W 1% 0402	RK73H1ETTP7501F	
47	2	R26, R61	4.7 kΩ	RES MF 4.7 K 1/16 W 5% 0402	RC0402JR-074K7L	
48	1	R40	39 kΩ	RES MF 39 K 1/16 W 1% 0402	CRCW040239K0FKED	
49	2	R41, R42	1.0 kΩ	RES MF 1.0 K 1/16 W 1% 0402	RC0402FR-071KL	
50	2	R43, R46	50 Ω	RES MF 50 Ω 1/10 W 1% 0603	CRCW060350R0FKEA	
51	2	R47, R48	300 Ω	RES MF 300 Ω 1/16 W 1% 0402	CR02FL6--300R	
52	14	R49, R50, R58, R59, R60, R62, R63, R64, R65, R66, R67, R68, R69, R70	2.2 kΩ	RES MF 2.2 K 1/16 W 1% 0402	RK73H1ETTP2201F	

Table 8. Bill of Materials[3]

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
53	2	R51, R52	1.5 kΩ	RES MF 1.5 K 1/16 W 1% 0402	CR0402-FX-1501GLF	
54	16	R53, R54, R55, R56, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88	22 Ω	RES MF 22.0 Ω 1/16 W 1% 0402	CR0402-FX-22R0GLF	
55	2	R57, R71	249 Ω	RES MF 249 Ω 1/16 W 1% 0402	RK73H1ETTP2490F	
56	4	R72, R73, R74, R75	49.9 Ω	RES MF 49.9 Ω 1/16 W 1% 0402	CR0402-FX-49R9GLF	
Inductors						
57	1	L1	2.2 uH	IND PWR 2.2 uH at100 kHZ 5.2 A 30% SMD	SRU8043-2R2Y	
58	1	L2	4.7 uH	IND PWR 4.7 UH at 100 KHZ 3.08A 30% SMT	SWPA6028S4R7NT	
59	1	L3	47 uH	IND PWR 47 UH at 100 KHZ 1.08 A 20% SMT	DR73-470-R	
Connectors, Jumpers, Test Points						
60	1	J1		HDR 2X2 SMT 100 MIL CTR 380 H AU	TSM-102-01-SM-DV-P-TR	
61	1	J2		CON 2X40 SHLD SMD 0.5 MM SP 305 H AU	LSHM-140-06.0-F-DV-A-S-K-TR	
62	1	J3		CON 2X7 PLUG SHRD TH 100 MIL CTR 390 H 62 MIL PCB AU	N2514-6002RB	
63	1	J4		CON 2X17 SKT SMT 0.8 MM SP 220 H AU	ASP-137973-01	
64	1	J5		CON 8 RJ-45 SHLD RA TH G/Y LEDS 50 MIL SP 520 H AU 130 L	RJ081DDD3527	
65	1	P1		CON 1 PWR PLUG RA TH 1 A -- 430 H NI	RAPC722X	
66	22	TP1, TP2, TP3, TP4, TP5, TP11, TP12, TP13, TP14, TP18, TP29, TP32, TP33, TP34, TP35, TP48, TP49, TP50, TP51, TP52, TP54, TP55		TEST POINT PAD 35 MIL SMT, NO PART TO ORDER	NA	
67	8	TP6, TP7, TP8, TP9, TP10, TP15, TP16, TP17		TEST POINT BLACK 40 MIL DRILL 180 MIL TH 109 L	TP-105-01-00	
68	25	TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP30, TP31, TP36, TP37, TP38, TP39, TP40, TP41, TP42, TP43, TP44, TP45, TP46, TP47, TP53		TEST POINT BLACK 40 MIL DRILL 180 MIL TH 109 L	TP-105-01-00	

Notes:

3. Freescale does not assume liability, endorse, or warrant components from external manufacturers that are referenced in circuit drawings or tables. While Freescale offers component recommendations in this configuration, it is the customer's responsibility to validate their application.

9.2 Bill of Materials for IF Interface Board

Table 9: Bill of Materials [4]

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
Resistors						
1	1	R100	3.6 kΩ	Resistor 1% 0.063 W		
2	2	R101, R103	1 kΩ	Potentiometer		
3	1	R102	510 Ω	Resistor 1% 0.063 W		
Transformers						
4	8	T100, T101, T102, T103, T104, T105, T106, T107		RF Transformer SMD	ADT1-1WT	
Connectors and Headers						
5	14	X100, X101, X102, X103, X104, X105, X106, X107, X112, X113, X114, X115, X116, X117		RF Coaxial PCB Connector, MCX, 180°, 50 Ohm Impedance	733660061	
6	1	X108		SMD Header, 80-Pin, Pitch 0.5 mm	LSHM-140-02.5-L-DV-A-S-K-TR	
7	1	X109		DC Power jack 2 mm Pin	PJ-032AH	
8	2	X110		Header, 10-Pin, 2.54 mm Pitch, Shrouded	302-S101	
9	2	X111		Header, 40-Pin, 2.54 mm Pitch, Shrouded	302-S401	

Notes:

4. Freescale does not assume liability, endorse, or warrant components from external manufacturers that are referenced in circuit drawings or tables. While Freescale offers component recommendations in this configuration, it is the customer's responsibility to validate their application.

10 References

Following are URLs where you can obtain information on related Freescale products and application solutions:

Freescale.com Support Pages	Description	URL
MR2001	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MR2001
MPC577xK	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MPC577xK
KITRADAR2001EVM	Radar Demo Kit Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITRADAR2001EVM

10.1 Support

Visit www.freescale.com/support for the local sales team within your region.

11 Revision History

Revision	Date	Description of Changes
1.0	3/2015	• Initial Release

How to Reach Us:

Home Page:
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Document Number: KTRADAR2001UG
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