General Description

The MAX12005 evaluation kit (EV kit) provides a proven PCB layout that facilitates evaluation of the MAX12005 satellite switch RFIC. The EV kit is fully assembled and tested. A software control program with a graphical user interface (GUI) is available from **www.maximintegrated.com/evkitsoftware**, allowing full user control of the IC functions and settings.

The EV Kit has 75Ω RF lines. However, to make evaluation easy with standard 50Ω test equipment, there are 75Ω to 50Ω impedance transformation networks on-board at all input and output ports.

Features

- USB Interface to Host PC
- Easy-to-Use GUI Software
- 75Ω to 50Ω On-Board Impedance Transformation Network at All Ports
- Fully Assembled and Tested

***Ordering Information** appears at end of data sheet.*

EV Kit Contents List

QTY	DESCRIPTION
1	Circuit board assembly: MAX12005 EV kit
1	USB high-speed A-to-mini B cable, 5ft (1.5m)

Quick Start

The EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section to test the device. The EV kit features two methods to control the IC: either through a standard SPI interface or by using Tone/Voltage, Tone Burst, using DiSEqC 1.x/2.x. This procedure describes operation with standard SPI interface.

Test Equipment Required

This section lists the recommended test equipment to verify the operation of the MAX12005. It is intended as a guide only and substitutions may be possible:

- MAX12005 EV kit
- DC supply capable of delivering +3V and 300mA of continuous current
- One HP8648D or equivalent signal source capable of generating up to 2.2GHz
- HP8561E or equivalent RF spectrum analyzer with a minimum 100kHz to 3GHz frequency range
- PC, laptop or tablet with Microsoft Windows XP®, Windows® 7, 8 OS and a USB port
- USB-A male to mini-USB cable

Connections and Setup

This section provides step-by-step instructions for getting the EV kit up and running with SPI.

Software Setup

1) Download the MAX12005 control software zip folder from **https://www.maximintegrated.com**. Unzip the folder before installing the software.
2) Install the CDM20814_Setup.exe file from the Interface_Driver folder by double-clicking on the file icon.
3) Restart your computer.
4) Install the software by double-clicking on the Setup.exe file from the MAX12005_GUI folder. Follow the instructions in the installation Wizard.
5) Now select Control Panel from the Windows Start menu, and double-click on System/Device Manager, expand the Universal Serial Bus controllers icon, and there should be a new USB device, USB Serial Converter. This is highlighted in Figure 2.
6) Go to the installation directory and start the Satellite Reception Switch Control v2.1.2.exe GUI software by double-clicking on the icon shown in Figure 3.

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Software Description

The GUI has several control fields (**Receiver 1– Receiver 4, Configuration, Cascade, Mode, and Gain**) and control buttons (**Default Settings** (brings the GUI back to default settings), Send (sends the current settings to the EV Kit), and a **Quit**).

The **Receiver** group boxes are used to set the RF output states. The **Receiver 1–Receiver 4** group boxes correspond to RF Out 1–RF Out 4. Within each Receiver group box there are seven parameters that define the source of the RF signal, the gain setting, and the type of tone envelope.

If the **Cascade** drop-down list in the **Configuration** group box is set to **Single**, each RF output has eight inputs to select from, such as satellite A or B, low band or high band, horizontal or vertical polarization. These labels do not necessarily refer to the actual sources, but are labeled for user convenience. All input configurations are identical.

Register 01 has the bits to control the mode and switching action of the IC. The three bits; satellite, polarization and band, make eight possible combinations to select which of the eight RFIN1-8 will be seen on a particular output. Table 1 shows what the GUI labels are equivalent to and Table 2 shows the possible combinations on each output RFOUT1-4.

In **Cascade** mode, two EV kits are required. See the MAX12005 IC data sheet for a typical configuration. In this mode, the **Option** switch is enabled, allowing selection of up to four satellite inputs.

Hardware Setup

1) With the output disabled, connect the +3V supply to the V_{CC} terminal on the MAX12005EV Kit.
2) Connect the supply ground to the GND terminal on the MAX12005 EV Kit.
3) Connect a USB cable between the MAX12005 EV Kit and the PC with MAX12005 control software.
4) Set the S202 switch on the EV Kit board to the SPI ON position (right-hand position or towards the USB connector). Figure 1 shows the location of the S202 switch.
5) Set the signal generator to accurately deliver -37dBm (equivalent to 70dBµV) CW tone at 950MHz.
6) Connect it to one of the eight RFIN1-8 inputs ports.
7) Connect one of the four RFOUT1-4 ports to the spectrum analyzer.
8) Set the center frequency on the spectrum analyzer to 950MHz and span to 1MHz.
9) Turn on the +3V power supply and note the current. It should be approximately 135mA.
10) Use the software control GUI to select the input to show up on the output port connected to the spectrum analyzer. Refer to MAX12005 SPI Registers, Table 1 and Table 2 to understand the switching options.
11) On the spectrum analyzer, the output RF signal should be approximately -44dBm at 950MHz with Output Gain set to default +6dB.

Note: Always hit **Send** after making any changes in the GUI.

Note: All RF lines are 75Ω. However, to make testing easy with standard 50Ω test equipment, there are 75Ωto 50Ω impedance transformation networks on-board at all input and output ports. These resistive impedance transformation networks have a loss of 6dB across them. During testing, unused RF connectors, either inputs or outputs, must be terminated in 50Ω loads.

Table 1. Software GUI Labels and Functions

BIT NAME	FUNCTION
Option	0 = Master/Single IC 1 = Slave IC
Satellite	0 = Sat A 1 = Sat B
Polarization	0 = Vertical 1 = Horizontal
Band	0 = low 1 = high

Table 2: Switching Options

SATELLITE BIT	POLARIZATION BIT	BAND BIT	GUI LABEL	INPUT SELECTED
0	0	0	Sat A, vertical, low	RFIN1
0	0	1	Sat A, vertical, high	RFIN3
0	1	0	Sat A, horizontal, low	RFIN2
0	1	1	Sat A, horizontal, high	RFIN4
1	0	0	0 Sat B, vertical, low	RFIN5
1	0	1	Sat B, vertical, high 0	RFIN7
1	1	0	Sat B, horizontal, low	RFIN6
1	1	1	Sat B, horizontal, high	RFIN8

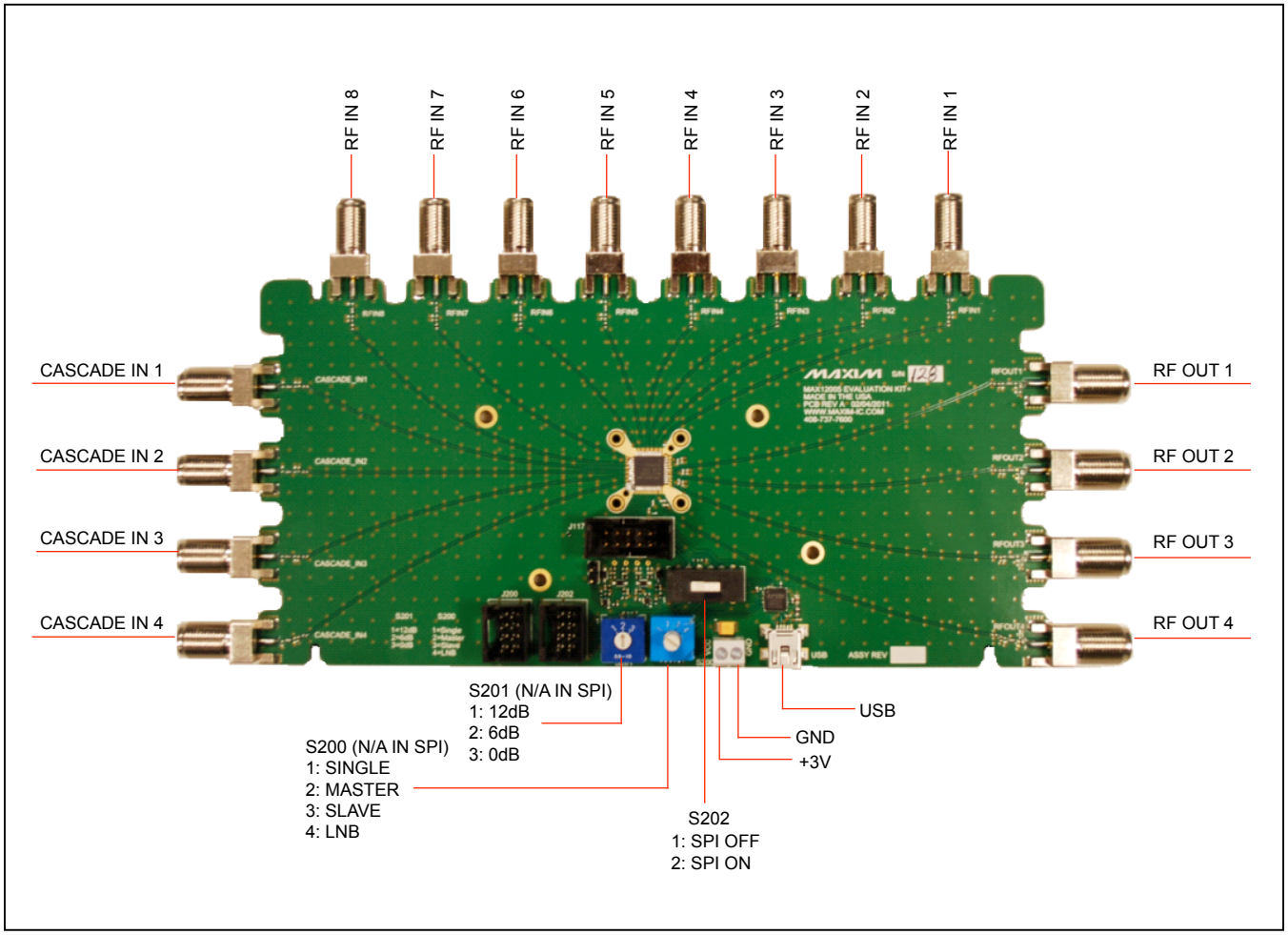


Figure 1. MAX12005 EV KIT.

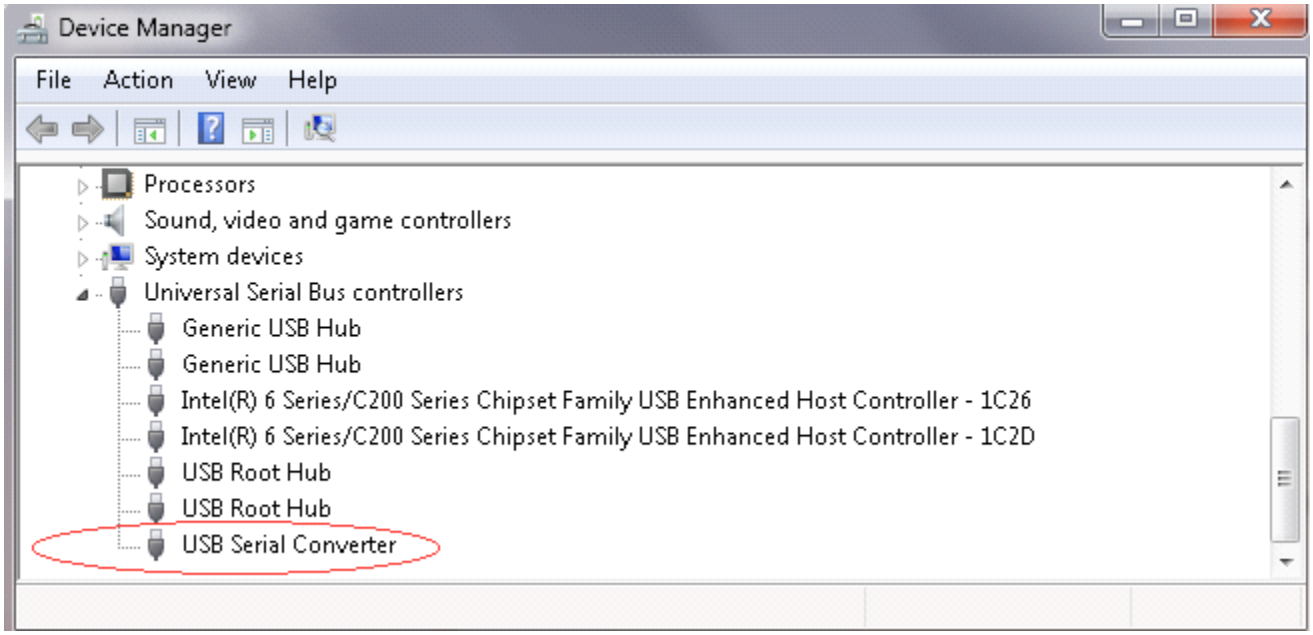


Figure 2. Showing installation of the USB Serial Converter Device

Figure 3. Software GUI Icon

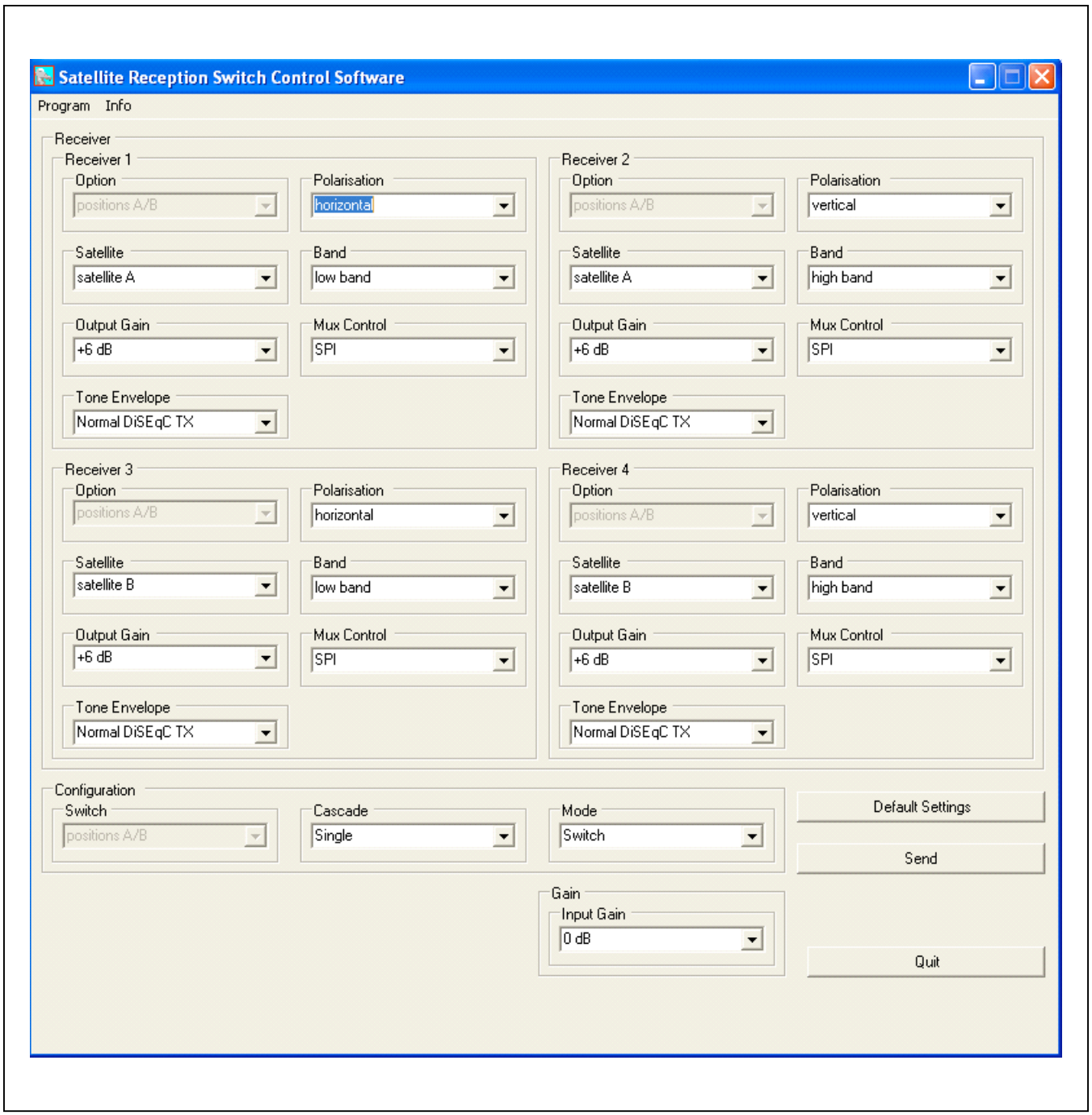


Figure 4. Screenshot of the MAX12005 EV Kit GUI

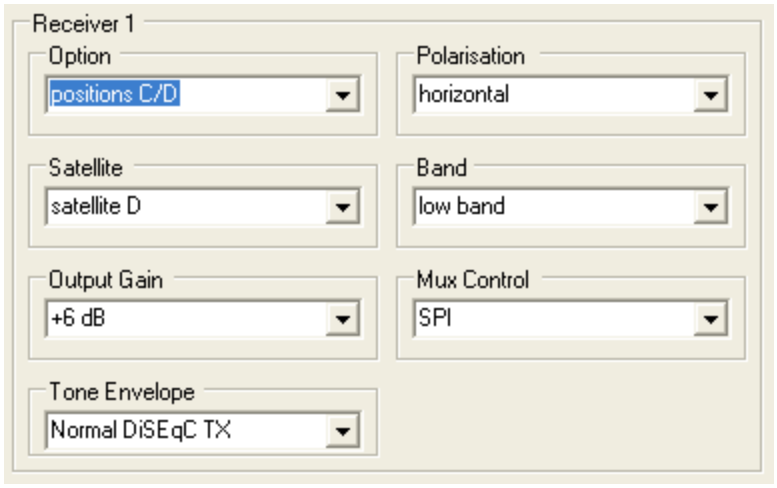


Figure 5. Cascade Mode Allows for Up to Four Satellite Inputs (Labeled A–D).

MAX12005 SPI Registers

Address range 00 to 11 registers are write only.

ADDRESS	BIT	NAME	FUNCTION	DEFAULT
00 (Configuration_reg)	15:11	Unused	—	–
	10	tone_env_en4	0 = Normal DiSEqC_TX4 output. 1 = DiSEqC_TX1 outputs 22kHz envelope as received by DiSEqC_RX4.	0
	9	tone_env_en3	0 = Normal DiSEqC_TX4 output. 1 = DiSEqC_TX1 outputs 22kHz envelope as received by DiSEqC_RX3.	0
	8	tone_env_en2	0 = Normal DiSEqC_TX4 output. 1 = DiSEqC_TX1 outputs 22kHz envelope as received by DiSEqC_R2.	0
	7	tone_env_en1	0 = Normal DiSEqC_TX4 output. 1 = DiSEqC_TX1 outputs 22kHz envelope as received by DiSEqC_RX1.	0
	6	option	0 = Master/single IC, 1 = Slave IC	0
	5	cascade	0 = Single, 1 = Cascaded	0
	4	mode	0 = Switch, 1 = LNB	0
	3:0	mux_ctrl	Switch matrix controlled by: 0 = DiSEqC 1 = SPI Separately for each receiver: Bit 0 = RFOUT1, Bit 1 = RFOUT2 Bit 2 = RFOUT3, Bit 3 = RFOUT4	0000
01 (Mode & Switch_reg)	15	option 3 (RFOUT4)	0 = Master/single IC, 1 = Slave IC	0
	14	satellite 3 (RFOUT4)	0 = RFIN1–RFIN4 (Satellite A) 1 = RFIN5–RFIN8 (Satellite B)	0
	13	polarization 3 (RFOUT4)	0 = RFIN1, RFIN3, RFIN5, RFIN7 1 = RFIN2, RFIN4, RFIN6, RFIN8	0
	12	band 3 (RFOUT4)	0 = RFIN1, RFIN2, RFIN5, RFIN6 1 = RFIN3, RFIN4, RFIN7, RFIN8	0
	11	option 2 (RFOUT3)	0 = Master/single IC, 1 = Slave IC	0
	10	satellite 2 (RFOUT3)	0 = RFIN1–RFIN4, 1 = RFIN5–RFIN8	0
	9	polarization 2 (RFOUT3)	0 = RFIN1, RFIN3, RFIN5, RFIN7 1 = RFIN2, RFIN4, RFIN6, RFIN8	0
	8	band 2 (RFOUT3)	0 = RFIN1, RFIN2, RFIN5, RFIN6 1 = RFIN3, RFIN4, RFIN7, RFIN8	0
	7	option 1 (RFOUT2)	0 = Master/single IC, 1 = Slave IC	0
	6	satellite1 (RFOUT2)	0 = RFIN1–RFIN4, 1 = RFIN5–RFIN8	0
	5	polarization 1 (RFOUT2)	0 = RFIN1, RFIN3, RFIN5, RFIN7 1 = RFIN2, RFIN4, RFIN6, RFIN8	0

MAX12005 SPI Registers (continued)

Address range 00 to 11 registers are write only.

ADDRESS	BIT	NAME	FUNCTION	DEFAULT
01 (Mode & Switch_reg)	4	band 1 (RFOUT2)	0 = RFIN1, RFIN2, RFIN5, RFIN6 1 = RFIN3, RFIN4, RFIN7, RFIN8	0
	3	option 0 (RFOUT1)	0 = Master/single IC, 1 = Slave IC	0
	2	satellite 0 (RFOUT1)	0 = RFIN1–RFIN4, 1 = RFIN5–RFIN8	0
	1	polarization 0 (RFOUT1)	0 = RFIN1, RFIN3, RFIN5, RFIN7 1 = RFIN2, RFIN4, RFIN6, RFIN8	0
	0	band 0 (RFOUT1)	0 = RFIN1, RFIN2, RFIN5, RFIN6 1 = RFIN3, RFIN4, RFIN7, RFIN8	0
10 (Gain_reg)	15:10	unused	—	0
	9:8	in_gain	Common input gain RFIN1 through RFIN8: Bit 8 = 0, Bit 9 = 0: 0dB Bit 8 = 1, Bit 9 = 0: 6dB Bit 8 = 0, Bit 9 = 1: 12dB	00
	7:6	out_gain3	Output gain RFOUT4 (see address 11, bits 15:10) Bit 6 = 0, Bit 7 = 0: 0dB Bit 6 = 1, Bit 7 = 0: -6dB Bit 6 = 0, Bit 7 = 1: +6dB	00
	5:4	out_gain2	Output gain RFOUT3 (see address 11, bits 15:10) Bit 4 = 0, Bit 5 = 0: 0dB Bit 4 = 1, Bit 5 = 0: -6dB Bit 4 = 0, Bit 5 = 1: +6dB	00
	3:2	out_gain1	Output gain RFOUT2 (see address 11, bits 15:10) Bit 2 = 0, Bit 3 = 0: 0dB Bit 2 = 1, Bit 3 = 0: -6dB Bit 2 = 0, Bit 3 = 1: +6dB	00
	1:0	out_gain0	Output gain RFOUT1 (see address 11, bits 15:10) Bit 0 = 0, Bit 1 = 0: 0dB Bit 0 = 1, Bit 1 = 0: -6dB Bit 0 = 0, Bit 1 = 1: +6dB	00
11 (Output Gain Select Mode & Calibrate_reg)	15:10	unused	—	000000
	9	External test clock	0 = Pin 16 inactive 1 = Pin 16 is clock input for DiSEqC interface.	0
	8	fuse output impedance	0 = 10kΩ (no need to use or test) 1 = 100kΩ	0
	7	output cut_off	Cut-off oscillator calibration output (burn = 1)	0
	6	burn_gasket	Burn gasket (burn = 1)	0
	5	burn_in	Burn_in calibration value (burn = 1)	0
	4:0	calibrate	DiSEqC clock frequency calibration value	01100

Component Information, PCB Layout, and Schematic

See the following links for component information, PCB layout diagrams, and schematic.

- **MAX12005 EV BOM**
- **MAX12005 EV PCB Layout**
- **MAX12005 EV Schematic**

Ordering Information

PART	TYPE
MAX12005EVKIT#	EV Kit

#Denotes RoHS compliant.

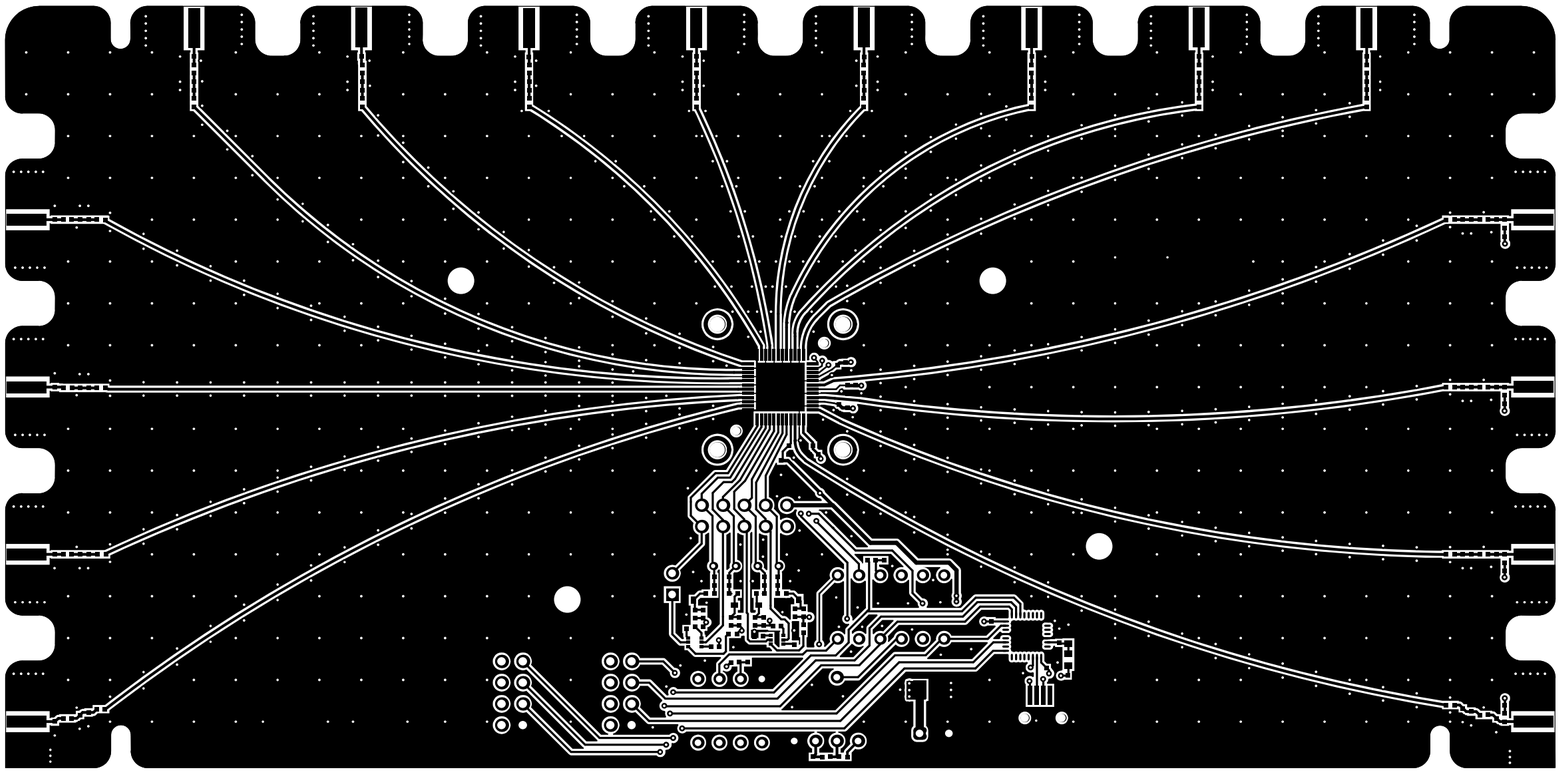
Revision History

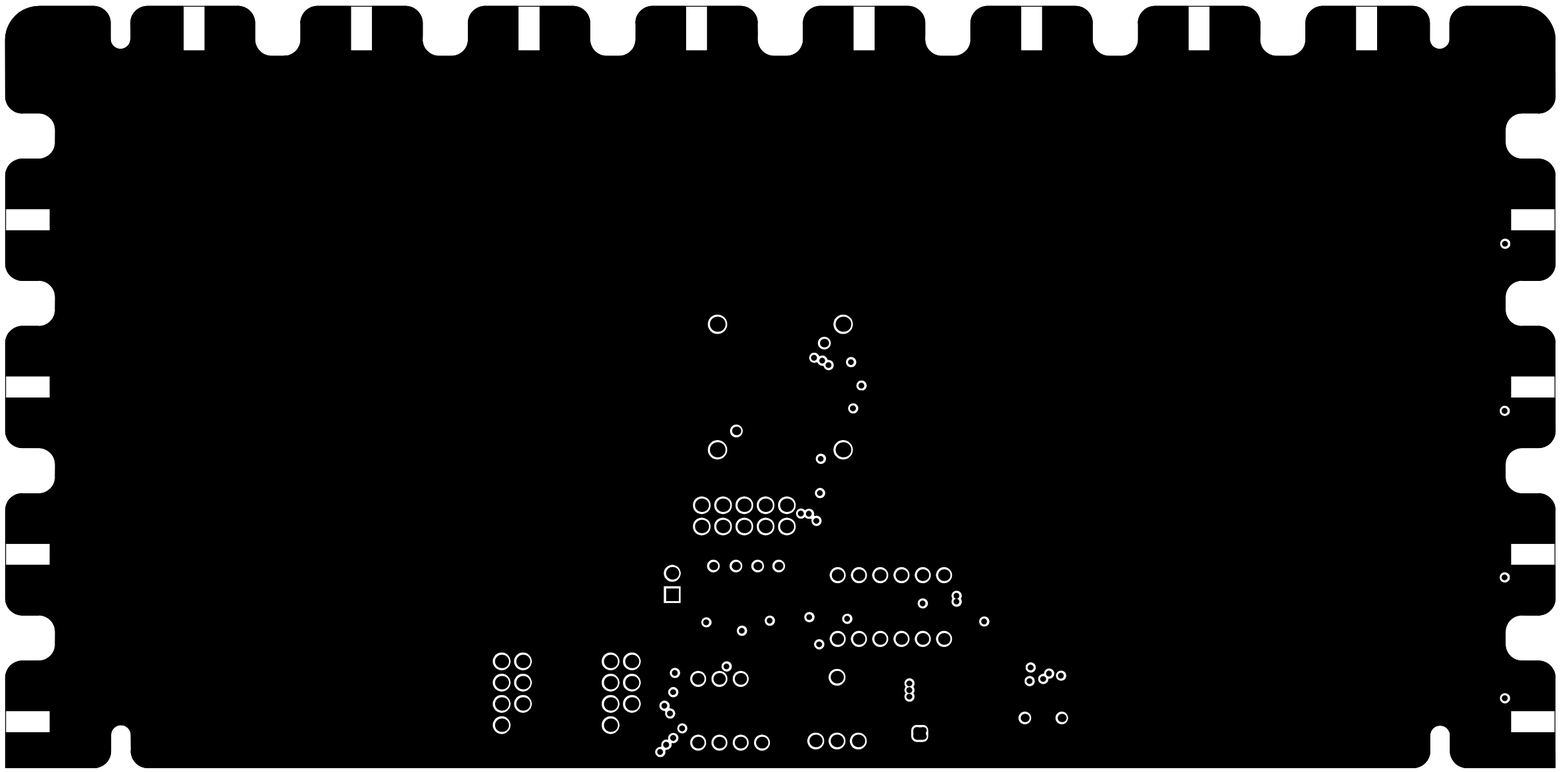
REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/12	Initial release	—
1	5/16	Updated Quick Start section	1–10
2	5/16	Updated part number in *Ordering Information* table	9

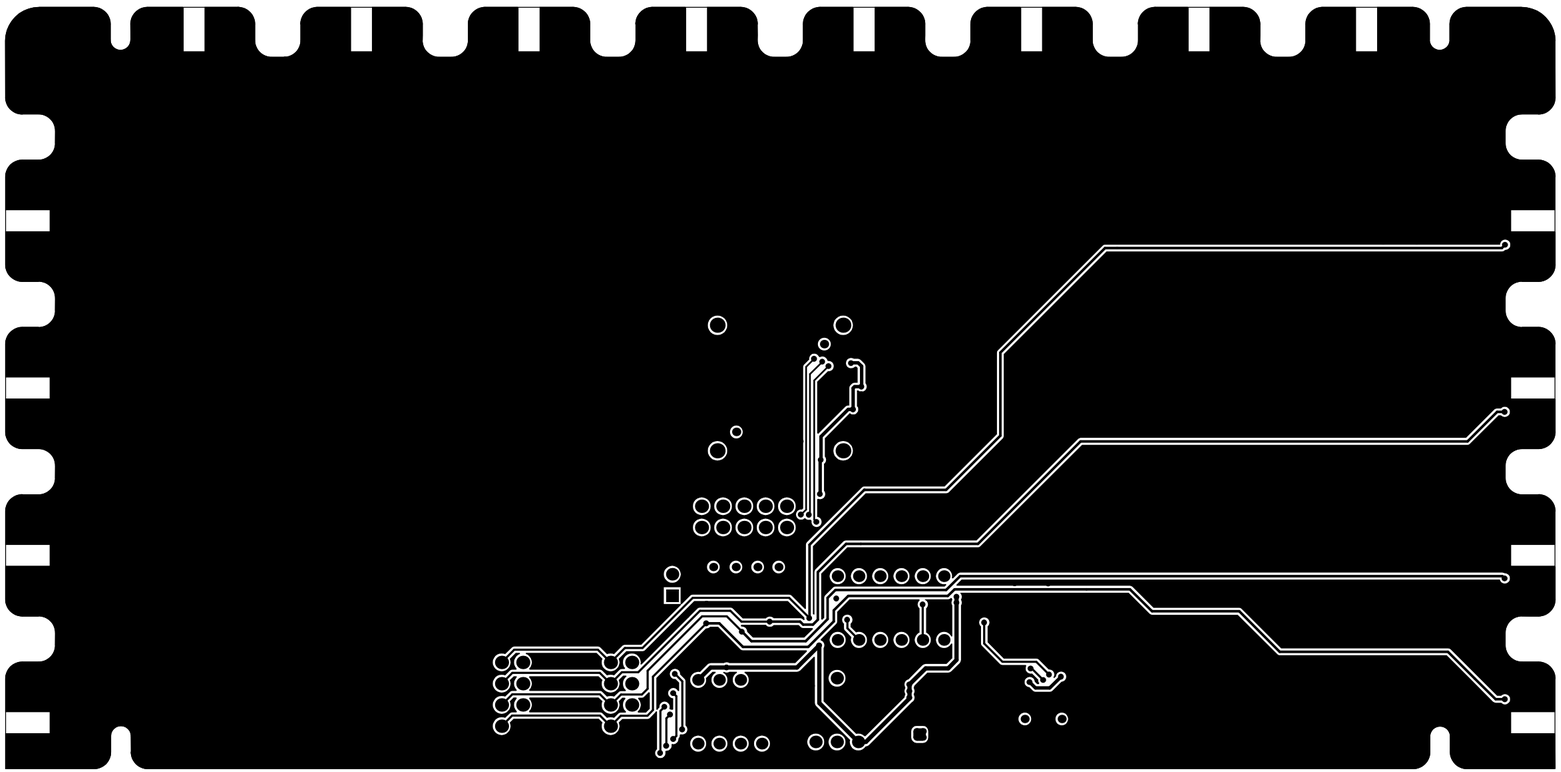
For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

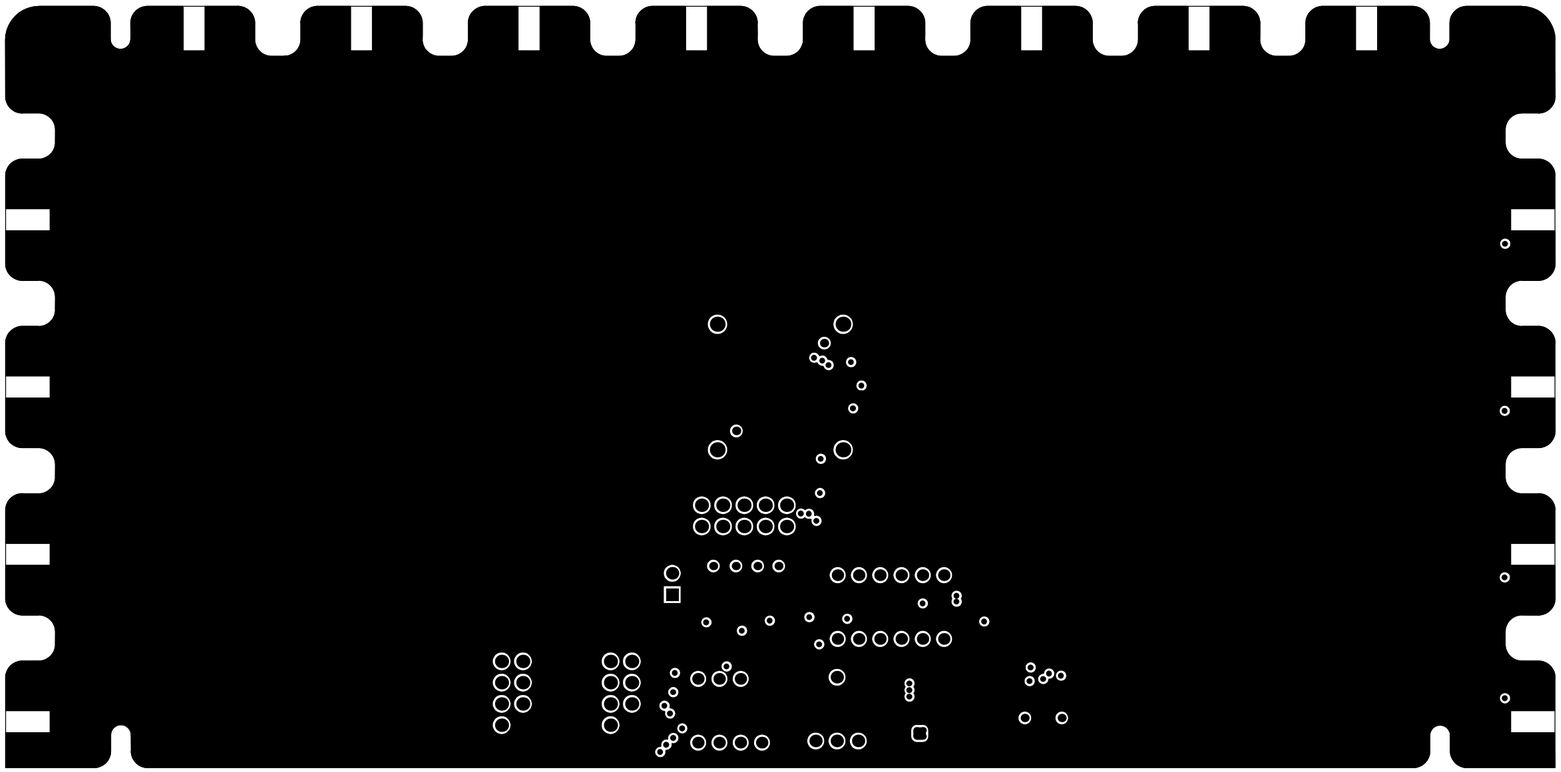
DESIGNATION	QTY	DESCRIPTION
+8V, 3V, ADDR, ARM_MONITOR, DSQOUT, EXTM, EXT_CLK, GROUND, START_MONITOR	9	Single gold pin Sullins PBC36SAAN
ARM, START	2	Normally off momentary SPST switches Tyco FSM2JSMA
C1, C71	2	30pF ±5% ceramic capacitors (0603) Murata GRM1885C1H300J
C1L, C3L, C5L, C9L	4	100µF electrolytic capacitors SANYO 35MV100AX
C2	1	0.1µF ±10%, ceramic capacitor (0603) Murata GRM188R71C104K
C2L, C7L	2	0.1µF ±10%, ceramic capacitors (0603) Murata GRM188R71E104K
C3, C21, C24, C12L, C12L1, C13L, C13L1, CD1–CD4	11	0.01µF ±10%, ceramic capacitors (0603) Murata GRM188R71E103K
C4L, C6L	2	0.47µF ±10%, ceramic capacitors (0603) Murata GRM188R71E474K
C8L, C10L, C11L	3	0.22µF ±10%, 0603 ceramic capacitors (0603) Murata GRM188R71E224K
C22	1	4.7µF ±10%, ceramic capacitor (0603) Murata GRM188R60J475K
COMP, RF_BOARD	2	20-pin (2 x 10) headers, 0.1in centers Sullins PEC36DAAN
D1	1	25V Schottky diode (SOD123) Nihon EP05Q03L
D2, D4	2	25V Schottky diodes (SOD123) General Semi BAT43W
D3	1	25V Schottky diode (Radial) Philips Semi 1N4001
DRXA–DRXD, DTXA–DTXD, JEN, JGAIN, JMODE, USB_J1–USB_J19	30	2-pin jumper blocks, 0.1in spacing Sullins PEC36SAAN
FBEAD	1	470Ω ±2%, 10MHz ferrite bead (0603) Murata BLM18HG471SN1D
J1	1	USB type-B connector Assmann AU_Y1007
L1L	1	22µH ±10% inductor (1210) Murata LQH3C221K34
L2L	1	1kΩ, 100mA ferrite bead (0603) Murata BLM18BD102 SN1D
L3L	1	220µH ±10% inductor (1812) Murata LQH43CN221K03
R1	1	100Ω ±5% resistor (1206)
R2	1	11kΩ ±1% resistor (1206)
R3	1	10kΩ ±1% resistor (1206)
R4	1	15Ω ±5% resistor (1206)
R5	1	100Ω ±5% resistor (2010)
R7, R45–R50	7	47kΩ, 5V SIP resistors Bourns 4310R-101-473
R33, R34	2	1kΩ ±1% resistors (0603)

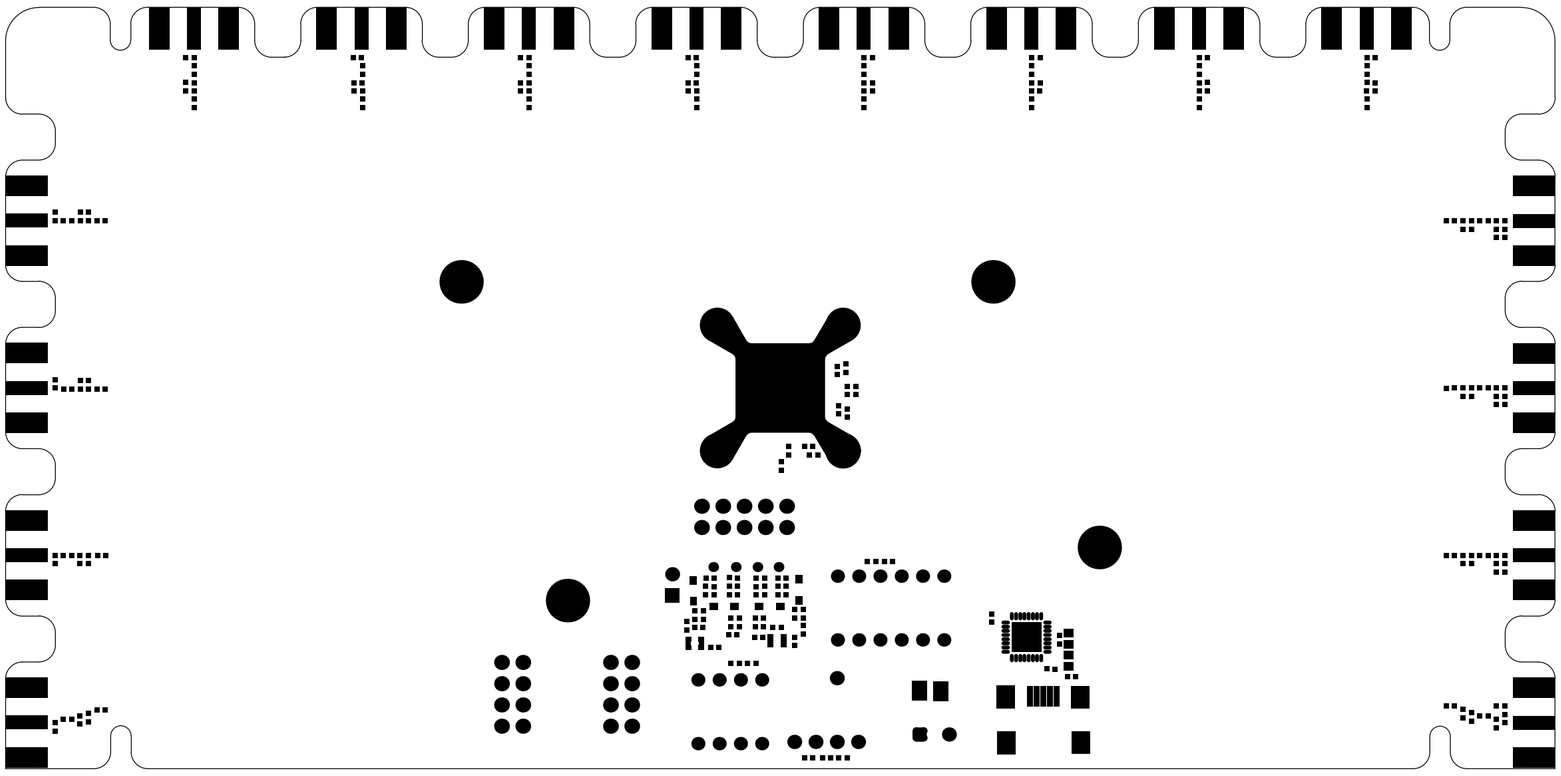
R39, R40, R41	3	2kΩ ±1% resistors (1206)
R42	1	47kΩ ±1% resistor (1206)
R43	1	2.7kΩ ±5% resistor (2010)
R44	1	1.02kΩ ±5% resistor (2010)
R51, R59–R65	8	10kΩ ±5% resistors (2010)
R54, R55	2	47kΩ ±5% resistors (1206)
S1–S7	7	8-position DIP switches CTS Corp. 206-8
U1–U6	6	8-bit parallel-load shift registers TI 74HC165
U7–U12, U17–U20	10	Quad 2-input positive-nand gates TI 74HC00
U13, U14	2	Sync 4-bit up/down binary counters TI 74HC193
U15, U16	2	Dual D-type positive edge-triggered flip-flops TI 74HC74
U21	1	Decade counter Motorola MC74HC4017(J,N,D)
U22	1	LNB supply and control IC with step-up and I^2C interface STMicro LNBH23
U23	1	FTDI USB-to-parallel RS-245 IC Saelig Co. FT245R

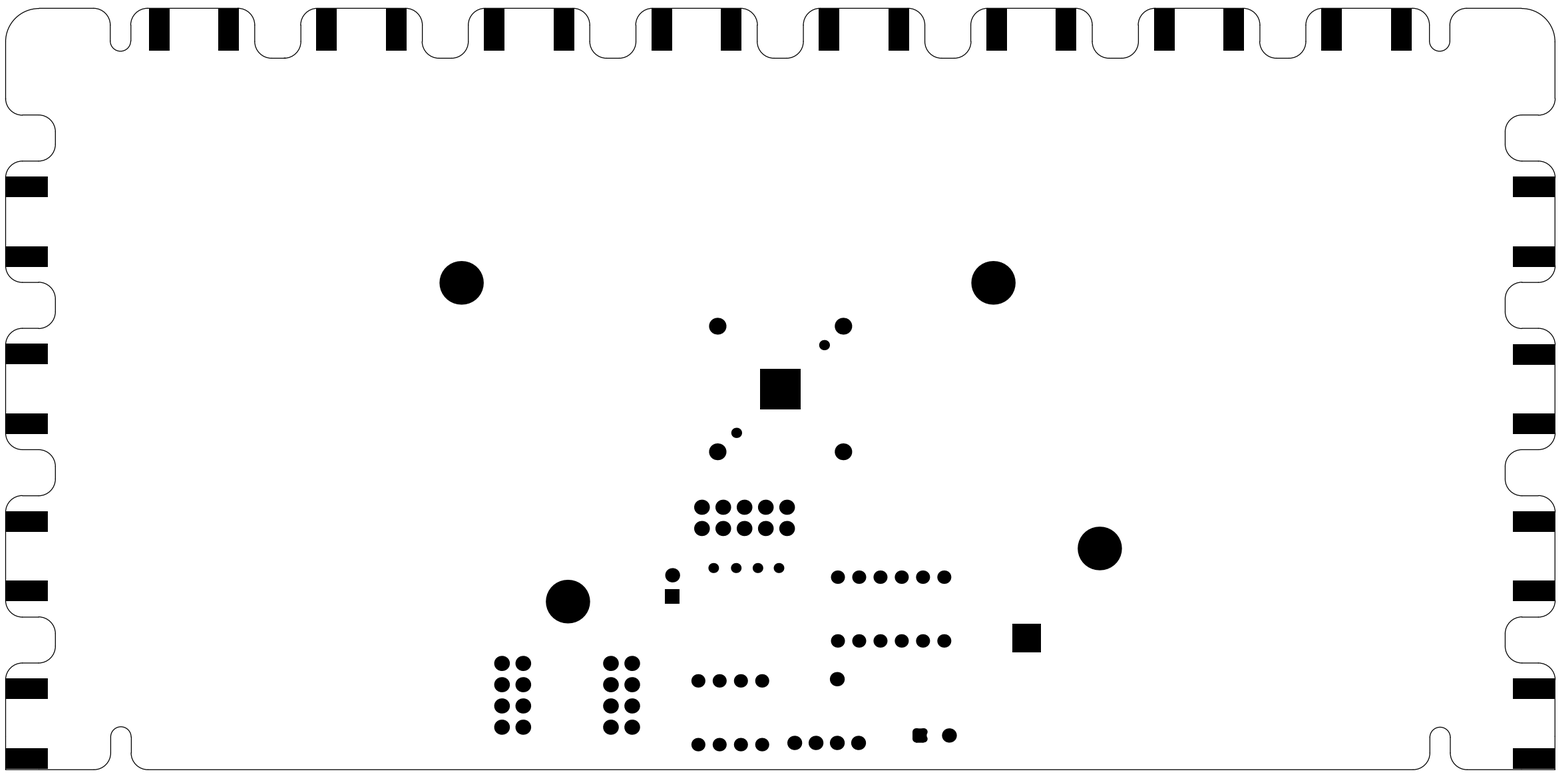


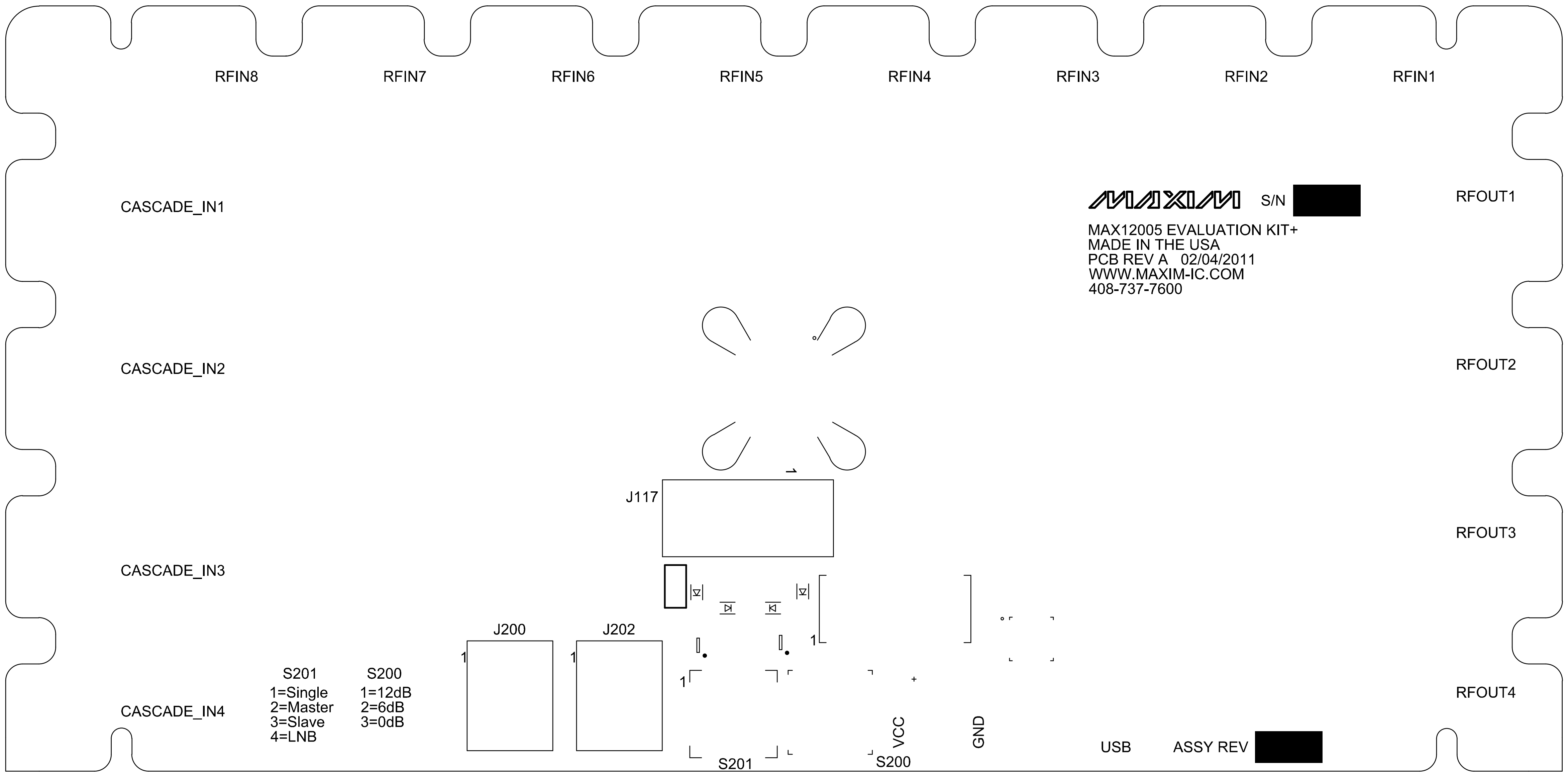


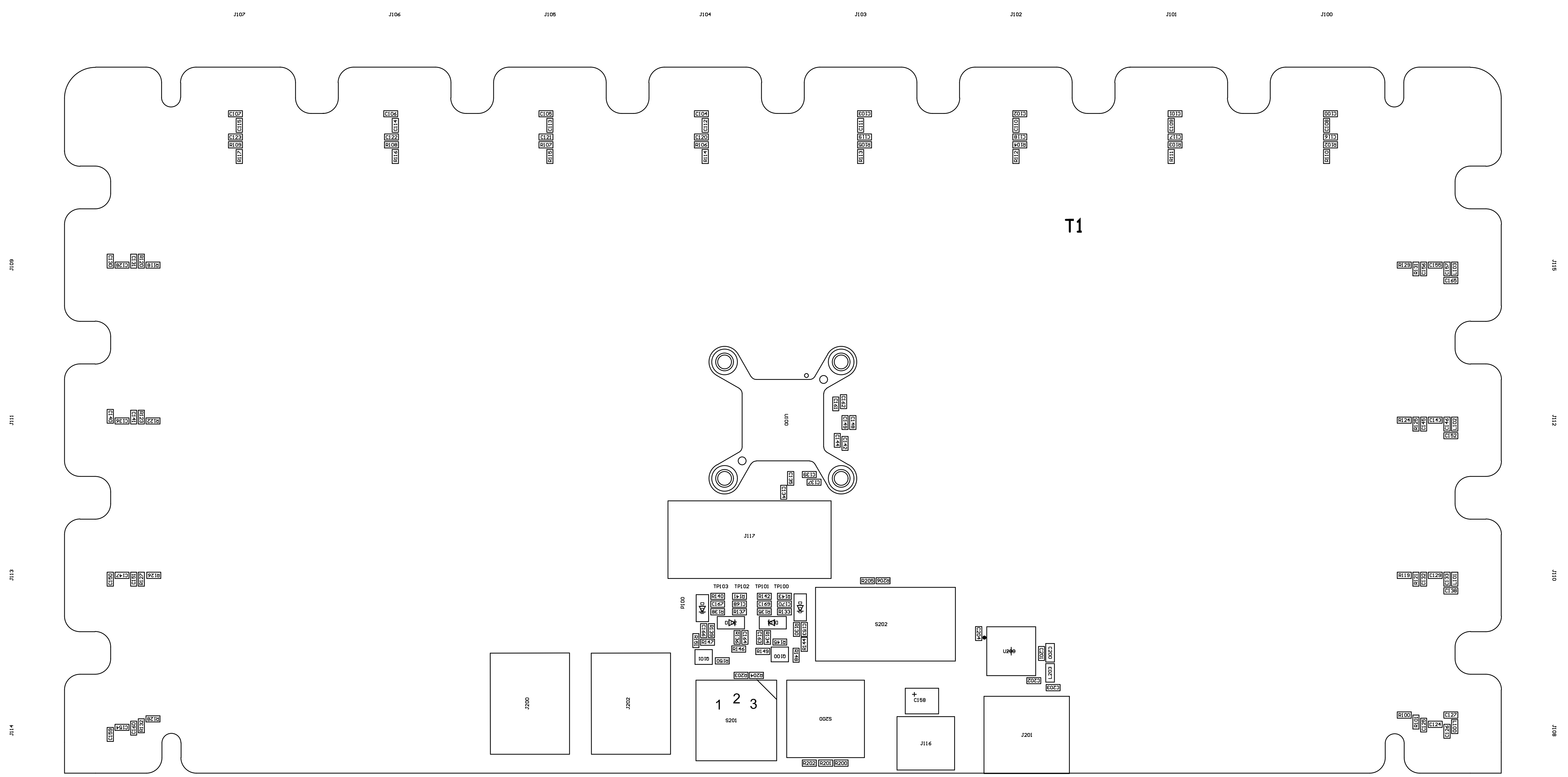


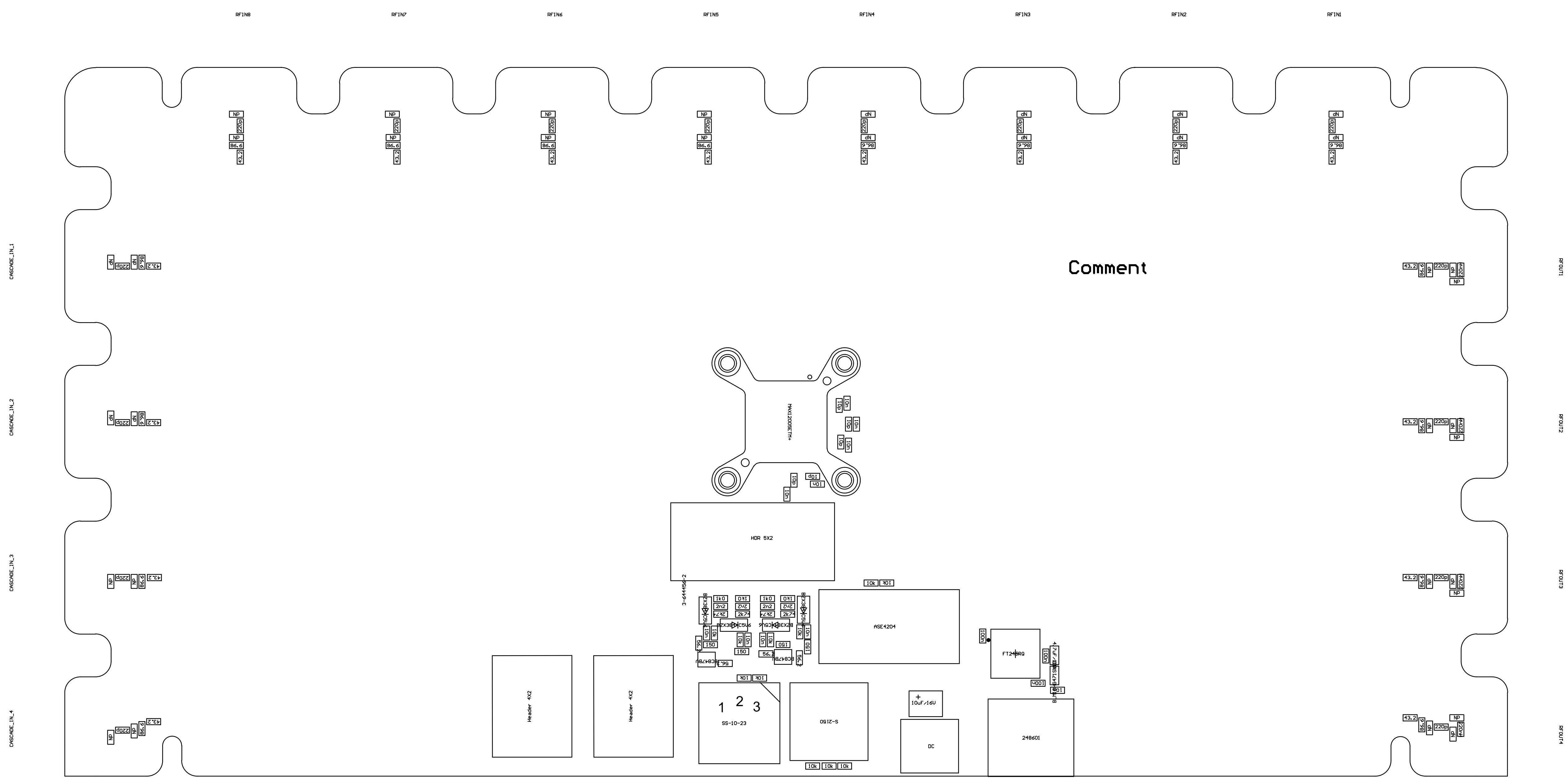


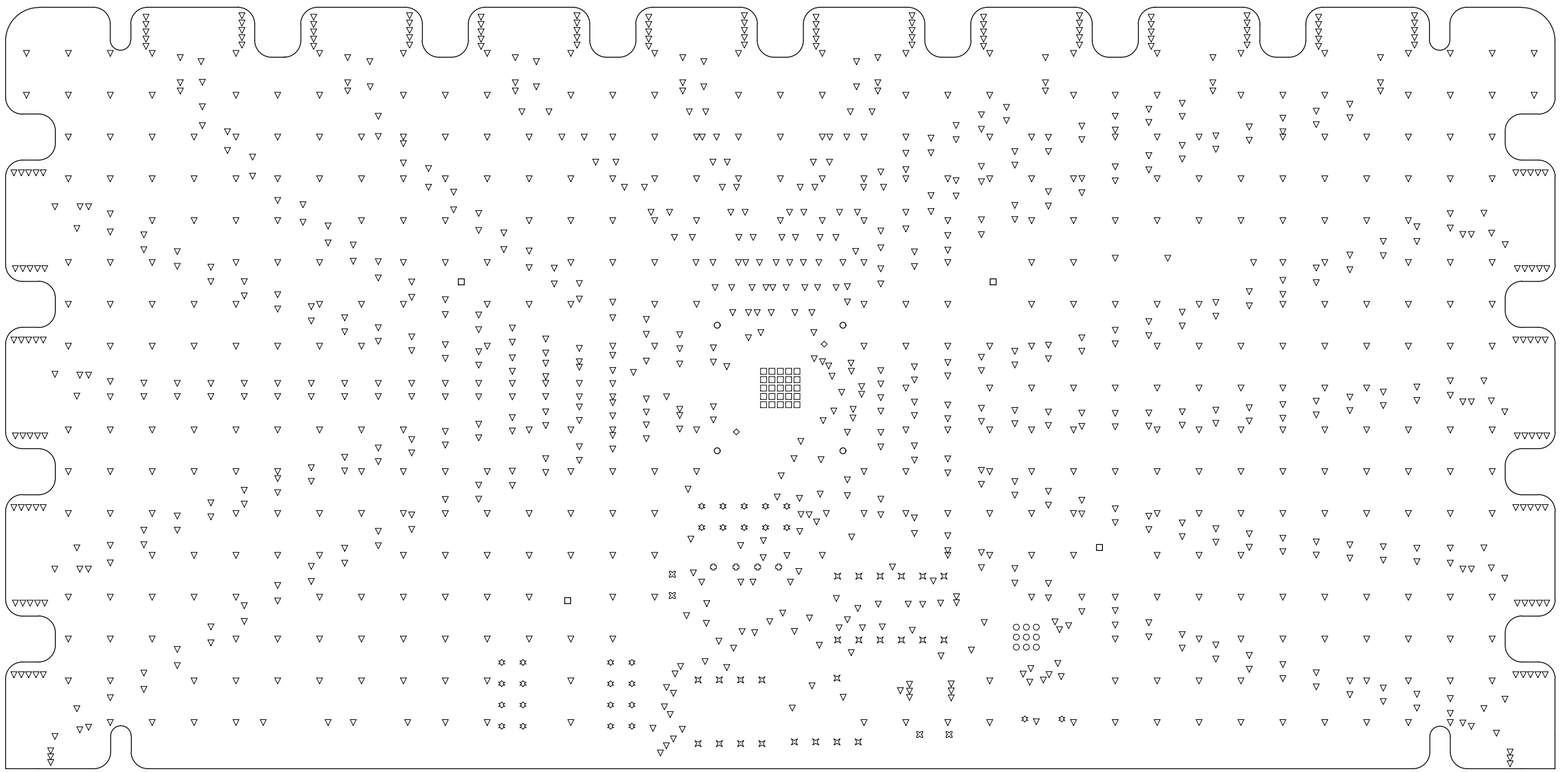




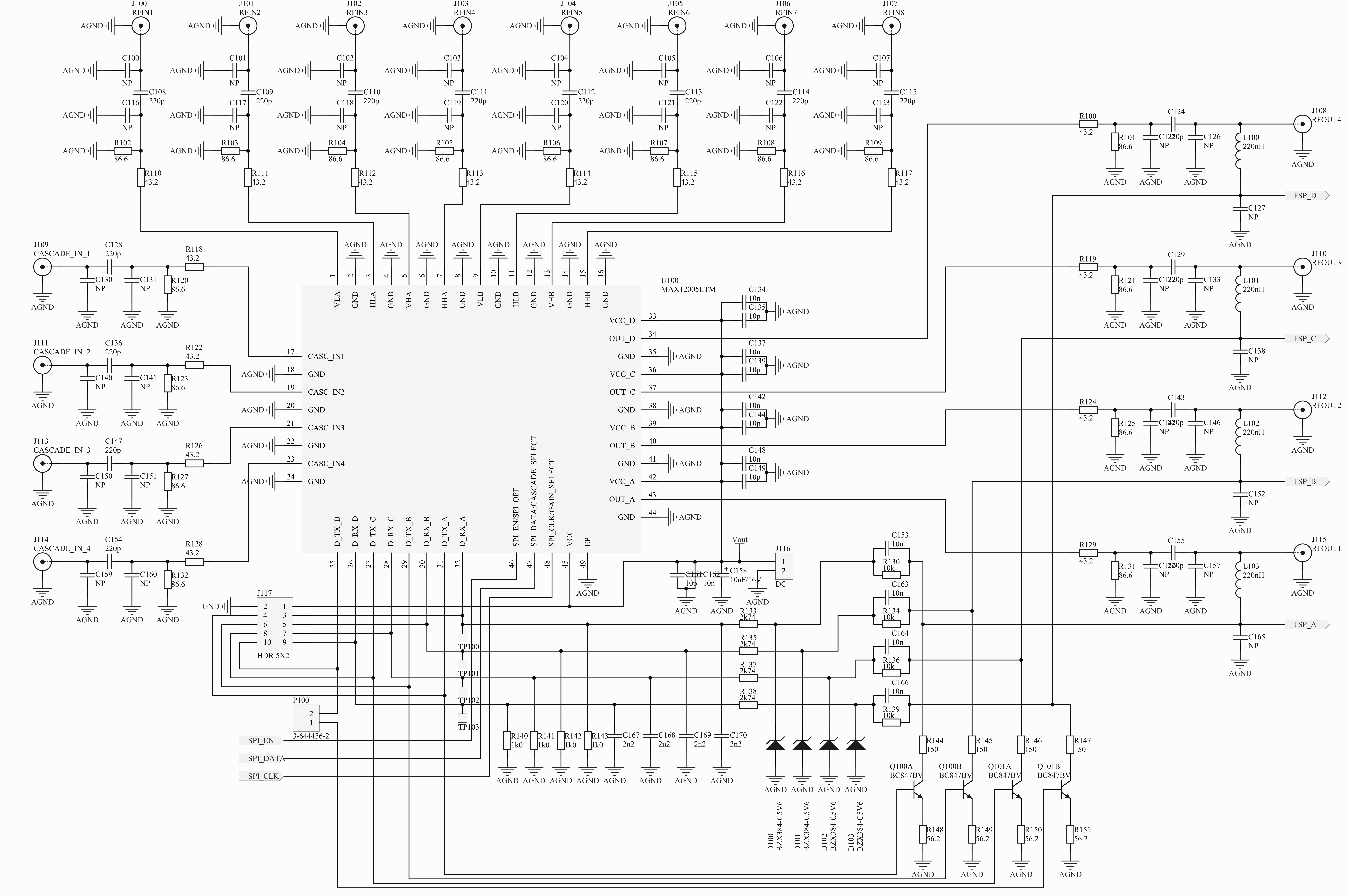

RFIN8
RFIN7
RFIN6
RFIN5
RFIN4
RFIN3
RFIN2
RFIN1
CASCADE_IN1
CASCADE_IN2
CASCADE_IN3
CASCADE_IN4
S/N
MAX12005 EVALUATION KIT+
MADE IN THE USA
PCB REV A 02/04/2011
WWW.MAXIM-IC.COM
408-737-7600
RFOUT1
RFOUT2
RFOUT3
RFOUT4
J117
1
J200
J202
S201
1=Single
2=Master
3=Slave
4=LNB
S200
1=12dB
2=6dB
3=0dB
S201
S200
VCC
GND
USB
ASSY REV


T1
J117
S202
S201
1
2
3
J114
J201
C198
TP103
TP102
TP101
TP100

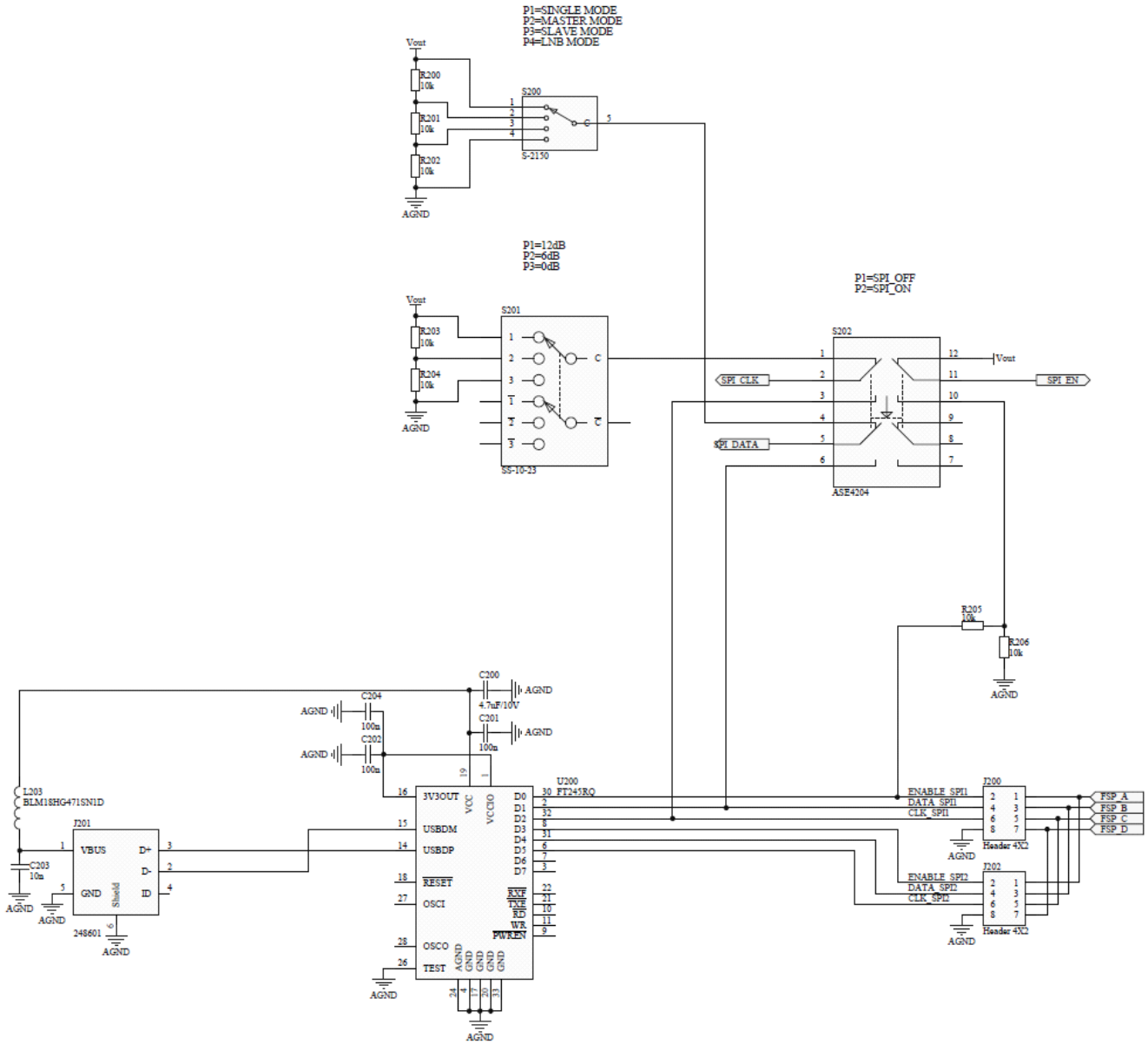

RFIN8
RFIN7
RFIN6
RFIN5
RFIN4
RFIN3
RFIN2
RFIN1
CASCADE_IN_1
CASCADE_IN_2
CASCADE_IN_3
CASCADE_IN_4
Comment
HDR 5X2
ASE4204
Header 4X2
Header 4X2
1 2 3
SS-10-23
OS12-5
10uF,16V
DC
248601



Symbol	Hit Count	Tool Size	Plated	Hole Type
□	25	0.254mm (10mil)	PTH	Round
▽	1229	0.3mm (11.811mil)	PTH	Round
○	9	0.4mm (15.748mil)	PTH	Round
✪	4	0.5mm (19.685mil)	PTH	Round
⌘	25	0.8mm (31.496mil)	PTH	Round
⊠	4	0.9mm (35.433mil)	PTH	Round
✡	28	1mm (39.37mil)	PTH	Round
◇	2	1.02mm (40.157mil)	PTH	Round
○	4	1.8mm (70.866mil)	PTH	Round
□	4	3.175mm (125mil)	PTH	Round
	1334 Total			



J100 RFIN1
J101 RFIN2
J102 RFIN3
J103 RFIN4
J104 RFIN5
J105 RFIN6
J106 RFIN7
J107 RFIN8
C100 NP
C101 NP
C102 NP
C103 NP
C104 NP
C105 NP
C106 NP
C107 NP
C108 220p
C109 220p
C110 220p
C111 220p
C112 220p
C113 220p
C114 220p
C115 220p
C116 NP
C117 NP
C118 NP
C119 NP
C120 NP
C121 NP
C122 NP
C123 NP
R102 86.6
R103 86.6
R104 86.6
R105 86.6
R106 86.6
R107 86.6
R108 86.6
R109 86.6
R110 43.2
R111 43.2
R112 43.2
R113 43.2
R114 43.2
R115 43.2
R116 43.2
R117 43.2
AGND
J109 CASCADE_IN_1
C128 220p
R118 43.2
C130 NP
C131 NP
R120 86.6
J111 CASCADE_IN_2
C136 220p
R122 43.2
C140 NP
C141 NP
R123 86.6
J113 CASCADE_IN_3
C147 220p
R126 43.2
C150 NP
C151 NP
R127 86.6
J114 CASCADE_IN_4
C154 220p
R128 43.2
C159 NP
C160 NP
R132 86.6
U100
MAX12005ETM+
VLA GND HLA GND VHA GND HHA GND VLB GND HLB GND VHB GND HHB GND
CASC_IN1 GND CASC_IN2 GND CASC_IN3 GND CASC_IN4 GND
D_TX_D D_RX_D D_TX_C D_RX_C D_TX_B D_RX_B D_TX_A D_RX_A
SPI_EN/SPI_OFF
SPI_DATA/CASCADE_SELECT
SPI_CLK/GAIN_SELECT
VCC EP
VCC_D OUT_D GND VCC_C OUT_C GND VCC_B OUT_B GND VCC_A OUT_A GND
C134 10n
C135 10p
C137 10n
C139 10p
C142 10n
C144 10p
C148 10n
C149 10p
R100 43.2
R101 86.6
C124 220p
C125 NP
C126 NP
L100 220nH
J108 RFOUT4
FSP_D
C127 NP
R119 43.2
R121 86.6
C129 220p
C132 NP
C133 NP
L101 220nH
J110 RFOUT3
FSP_C
C138 NP
R124 43.2
R125 86.6
C143 220p
C145 NP
C146 NP
L102 220nH
J112 RFOUT2
FSP_B
C152 NP
R129 43.2
R131 86.6
C155 220p
C156 NP
C157 NP
L103 220nH
J115 RFOUT1
FSP_A
C165 NP
Vout
J116
DC
C161 10p
C162 10n
C158 10uF/16V
GND
J117
HDR 5X2
TP100
TP101
TP102
TP103
P100
3-644456-2
SPI_EN
SPI_DATA
SPI_CLK
R133 2k74
R135 2k74
R137 2k74
R138 2k74
C153 10n
R130 10k
C163 10n
R134 10k
C164 10n
R136 10k
C166 10n
R139 10k
R140 1k0
R141 1k0
R142 1k0
R143 1k0
C167 2n2
C168 2n2
C169 2n2
C170 2n2
D100 BZX384-C5V6
D101 BZX384-C5V6
D102 BZX384-C5V6
D103 BZX384-C5V6
R144 150
R145 150
R146 150
R147 150
Q100A BC847BV
Q100B BC847BV
Q101A BC847BV
Q101B BC847BV
R148 56.2
R149 56.2
R150 56.2
R151 56.2


P1=SINGLE MODE
P2=MASTER MODE
P3=SLAVE MODE
P4=LNB MODE
Vout
R200 10k
R201 10k
R202 10k
S200
S-2150
AGND
P1=12dB
P2=6dB
P3=0dB
S201
SS-10-23
R203 10k
R204 10k
P1=SPI_OFF
P2=SPI_ON
S202
ASE4204
SPI_CLK
SPI_DATA
SPI_EN
R205 10k
R206 10k
C200 4.7uF/10V
C201 100n
C202 100n
C204 100n
C203 10n
L203 BLM18HG471SN1D
J201
248601
U200 FT245RQ
3V3OUT
USBDM
USBDP
RESET
OSCI
OSCO
TEST
D0
D1
D2
D3
D4
D5
D6
D7
RXF
TXE
RD
WR
PWREN
VCC
VCCIO
ENABLE_SPI1
DATA_SPI1
CLK_SPI1
ENABLE_SPI2
DATA_SPI2
CLK_SPI2
J200
J202
Header 4X2
FSP_A
FSP_B
FSP_C
FSP_D