USER GUIDE FOR:
ZXHF5000 LOW POWER QUAD LNB EVALUATION BOARD

DESCRIPTION

The ZXHF5000EV2, shown in Figure 1, is an evaluation board for demonstrating the Zetex ZXHF5000 4:2 IF Switch used in a 4-output DBS IF circuit suitable for use in a Quad Low Noise Block (LNB). In addition this board demonstrates the use of the Zetex ZLPM3315 miniature switch mode regulator which greatly enhances the power efficiency of an LNB. This regulator also meets all the power requirements of a Quad LNB, with lower power consumption than existing Twins and even some Singles.

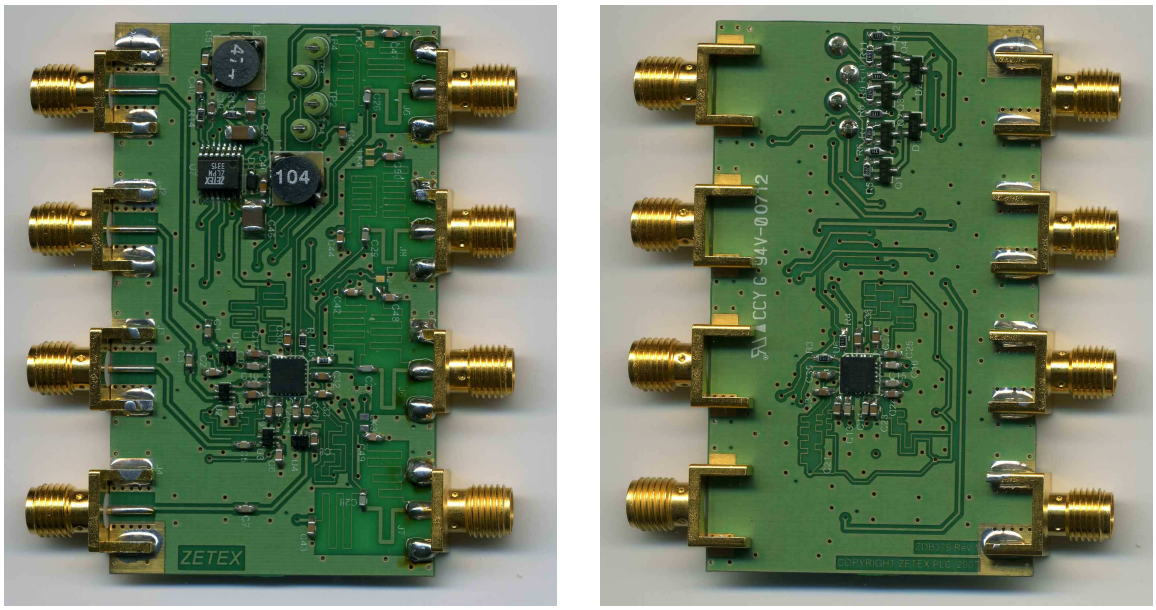


Figure 1: ZXHF5000EV2 evaluation board (top and bottom)

Figure 2 is a block diagram showing how this solution fits into a Quad LNB.

The key feature of this layout is the double-sided assembly. This allows the RF inputs to be split locally with very short paths between the inputs to the two separate switch chips. This avoids the use of resonant junctions such as Wilkinson splitters. In order for the inputs to be connected as closely as possible without crossing traces, the input order of the ZXHF5000 is reversed using the DL logic input pin. DL is set low on the top device and high on the bottom device.

The assembly also includes a set of input amplifiers operating from the common regulated supply at 3.3V. The amplifiers not only provide additional gain which is needed in the LNB system, but also serve to buffer each signal at the point where it splits between the two switch chips. The overall gain is about 25 dB (see later graphs in Performance section). Naturally if more or less gain is needed, alternative amplifiers can be selected.

If the unit is fed with live satellite TV signals such as are found at the mixer outputs in a typical LNB, the evaluation board can be used to drive 4 Set-Top Boxes (STBs). Alternatively the unit can demonstrate switch performance using lab test equipment such as a network analyzer.

There are 4 separate power supply inputs which are each derived from a STB connection via solder links. Alternatively, the solder links can be broken, and the supplies can be connected directly via 4 test point connections provided. No adjustments are required.

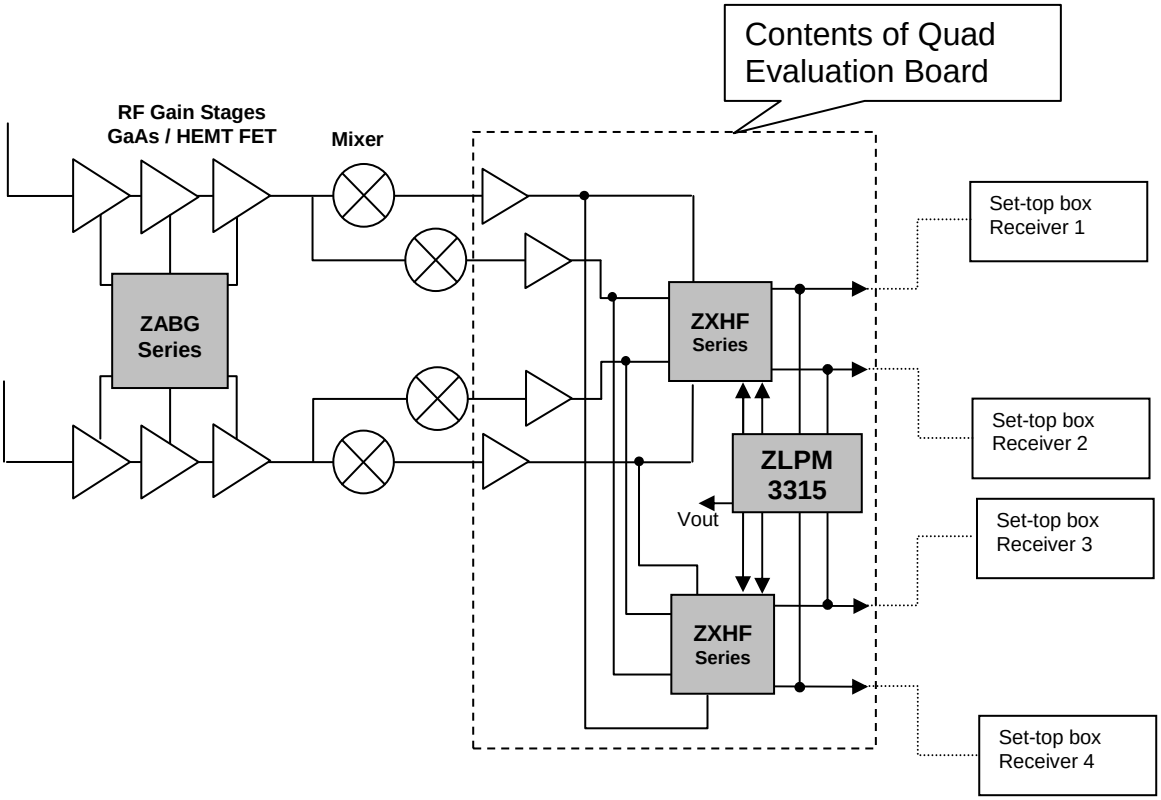


Figure 2: Quad LNB Block Diagram showing Zetex Evaluation Board Sub-system

The inputs are matched to 50 ohms and use four SMA connectors. The outputs are matched to 75 ohms and use four F-type connectors. Alternatively SMA connectors may be fitted as shown in the photographs.

Schematic Diagram and Construction

Figure 3 shows the schematic for the ZXHF5000EV2 evaluation board. Following this a Bill of Material is listed for the assembly. Figures 4 and 5 show the top and bottom component layouts respectively. Figures 6, 7, 8 and 9 show the copper layout on each layer.

There are four solder bridge links, LK1, LK2, LK3 and LK4 which are shown in Figure 10. For laboratory testing, these can be left open circuit and power and control can be provided through the test point connections TP1, TP2, TP3 and TP4.

The printed circuit has components mounted on both sides and has 4 copper layers on FR4 material. The dielectric between layer1 (top) and layer 2 is 0.010 inch thick. The dielectric between layer 3 and layer 4 (bottom) is also 0.010 inch thick. The high frequency input signal connections are designed as microstrip of 50 ohms characteristic impedance. The high frequency output signal connections are designed as microstrip of 75 ohms characteristic impedance. Printed chokes are used for output bias and to separate the STB power and controls from the output signal. In addition printed chokes are used to separate several power supply connections of each chip to maximise the signal isolation between unconnected signal paths.

In order to optimise the output impedance match, some areas of the inner ground plane are cleared. This increases the impedance of the printed output chokes, which provides matching over an increased bandwidth.

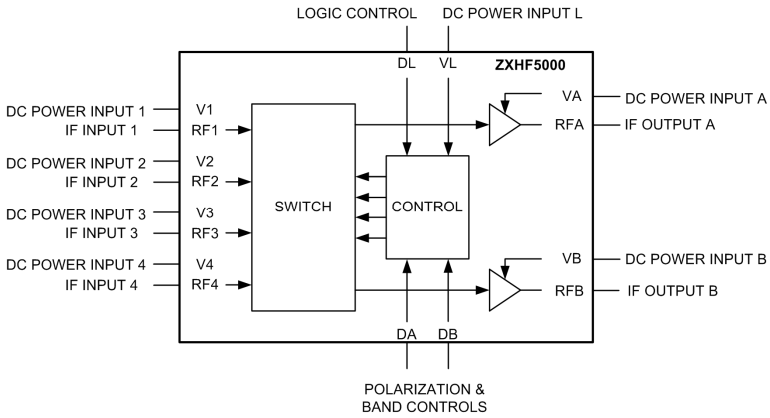
ZXHF5000 DEVICE DESCRIPTION

The ZXHF5000 functions as an analog multiplexer, with switch controls suitable for use in satellite receiver LNBs. It also has application to DBS IF Distribution Switches. The device is used for selecting IF signals to the TV receiver Set Top Box (STB) in the frequency range of 200 MHz to 2150 MHz. The chip includes detectors needed to sense the Voltage and Tone controls from the STB. In addition output amplifiers are provided, which are suitable for driving the 75 ohm cables to the STBs. For more detailed description, please refer to the Zetex data sheet for ZXHF5000.

ZXHF5000 DEVICE FEATURES

- High linearity 4:2 switch
- Integrated cable drive amplifiers
- Integrated switch control – Voltage and Tone
- Wide bandwidth 200 to 2700 MHz
- Gain 19 dB
- High isolation, typ >30 dB, 200 to 2150 MHz
- OIP3 >15 dBm, 200 to 2150 MHz
- Reliable tone detector with unwanted signal rejection filter
- Accurate Voltage detector 14.0V to 15.5V
- Intelligent low power mode
- 3.3V operation
- Unconditionally stable
- Pin-out programmable for double-sided assembly

ZXHF5000 BLOCK DIAGRAM



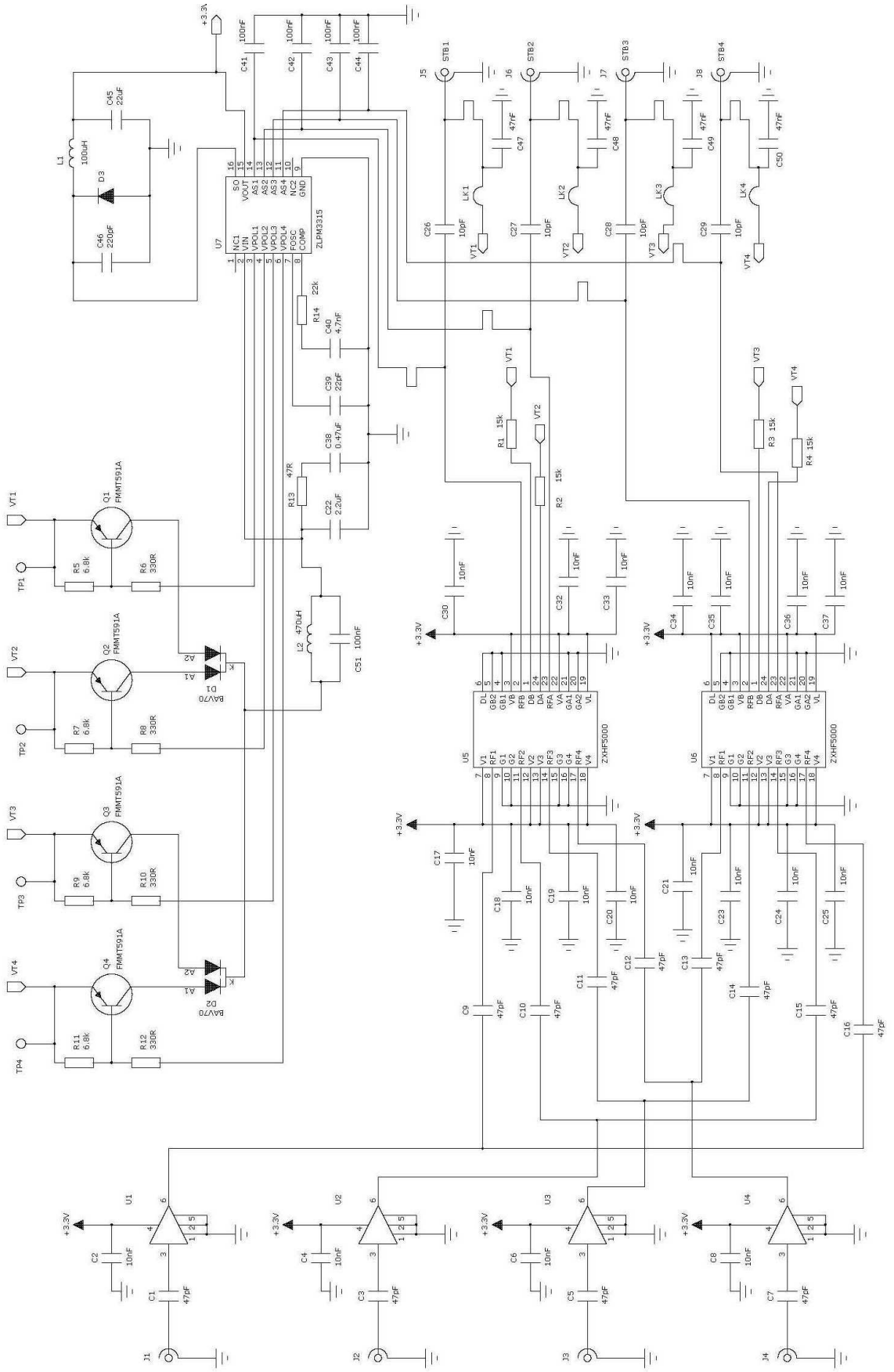
ZLPM3315 DEVICE DESCRIPTION

The ZLPM3315 is a switch-mode buck regulator specially designed to meet the requirements of multi-ouput LNBs. From any input in the range of 10 to 21 V DC, it will provide 3.3 V DC regulated power for the whole LNB. It includes 4 supply switches for the downfeed IF driver amplifiers so that the amplifiers are powered only when necessary. Input selection logic is included to control the STB DC loading such that it is compatible with most LNBs, including those not designed for low power LNBs. For more detailed description, please refer to the Zetex data sheet for ZLPM3315.

ZXHF5000 DEVICE FEATURES

- 3.3V 300 mA switch-mode supply
- Input range 10 to 21 V
- Supports Dual and Quad LNBs
- Efficient use of LNB power
- Filters 22kHz Tone
- ESD protected

Figure 3: Schematic of the Quad Evaluation Board



ZXHF5000EV2 Bill of Material

Ref Des	Description	Value	Rating	Package	Manufacturer	Part Number
	PCB, Zetex design					ZDB379 Rev1
C1 C3 C5 C7 C9-16	CAPACITOR, NPO	47pF	50V	0603		
C26-29	CAPACITOR, NPO	10pF	50V	0603		
C41-C44 C51	CAPACITOR, X7R	100nF	16V	0603		
C2 C4 C6 C8 C17-21 C23-25 C30 C32-37	CAPACITOR, X7R	10nF	50V	0603		
C39	CAPACITOR, NPO	22pF	50V	0603		
C40	CAPACITOR, X7R	4.7nF	50V	0603		
C46	CAPACITOR, NPO	220pF	50V	0603		
C47-50	CAPACITOR, X7R	47nF	50V	0603		
C22	CAPACITOR. X5R	2.2uF	25V	1206	AVX	12063D225KAT2A
C38	CAPACITOR, X7R	0.47uF	25V	0805		
C45	CAPACITOR, X5R	22uF	10V	1210	Murata	GRM32CF51A226ZA01L
Q1-4	TRANSISTOR, PNP	FMMT591A		SOT23	ZETEX	FMMT591A
L1	INDUCTOR	100uH		PG0063	PULSE	PG0063.104
L2	INDUCTOR	470uH		PG0063	PULSE	PG0063.474
U1-4	IC AMPLIFIER WIDEBAND, 3.3V	UPC2745		SC70	NEC	UPC2745TB
R1-4	RESISTOR	15k		0603		
R5 R7 R9 R11	RESISTOR	6.8k		0603		
R13	RESISTOR	47R		0603		
R14	RESISTOR	22k		0603		
R6 R8 R10 R12	RESISTOR	330R		0603		
J1-4	CONNECTOR SMA END LAUNCH JACK, 0.031" PCB				JOHNSON	142-0701-881
J5-8	CONNECTOR F TYPE END LAUNCH				VITELEC	VF312
D1-2	SILICON DUAL SWITCHING DIODE	BAV70		SOT23	FAIRCHILD	BAV70
D3	DIODE, SCHOTTKY, 400 mA	ZHCS400		SOD323	ZETEX	ZHCS400
U7	IC LNB Switch Mode Regulator	ZLPM3315		QSOP16	ZETEX	ZLPM3315Q16
U5-6	IC 4x2 IF SWITCH WITH GAIN & CONTROL	ZXHF5000		QFN24-4x4	ZETEX	ZXHF5000JB24
TP1-4	TEST POINT, 1mm				VERO	20-313137

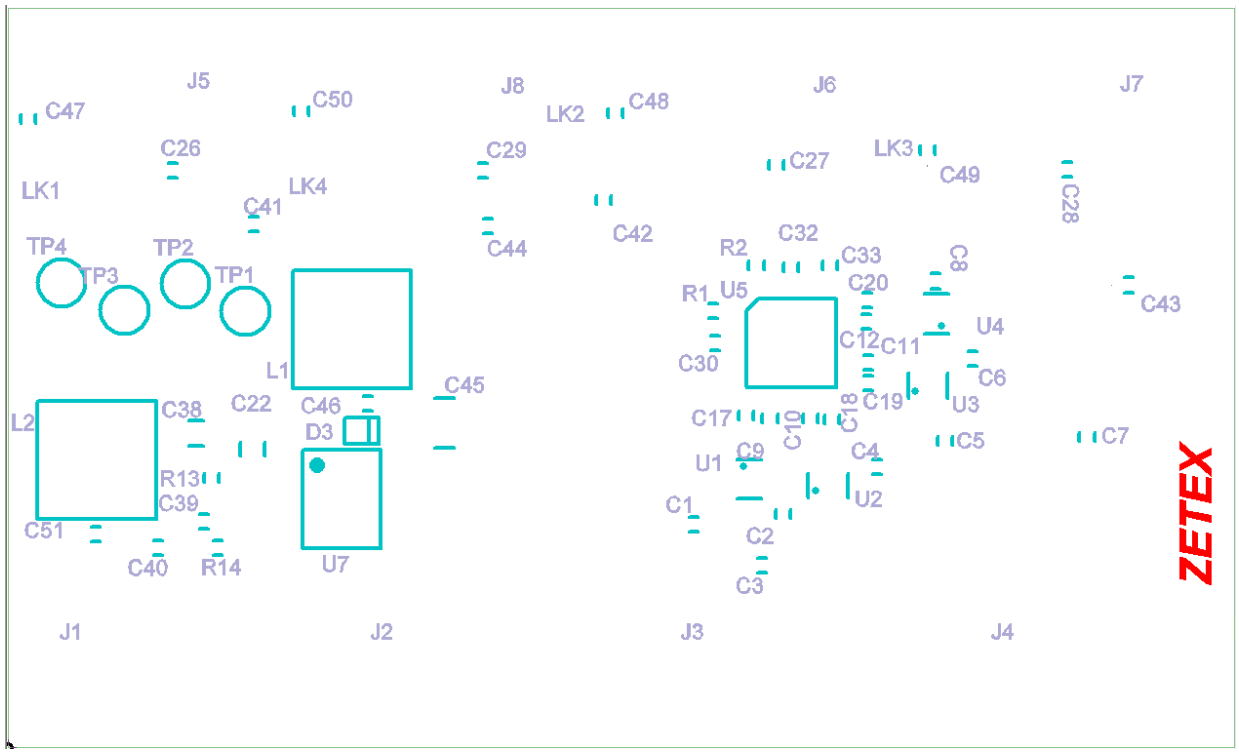


Figure 4: Component layout, top

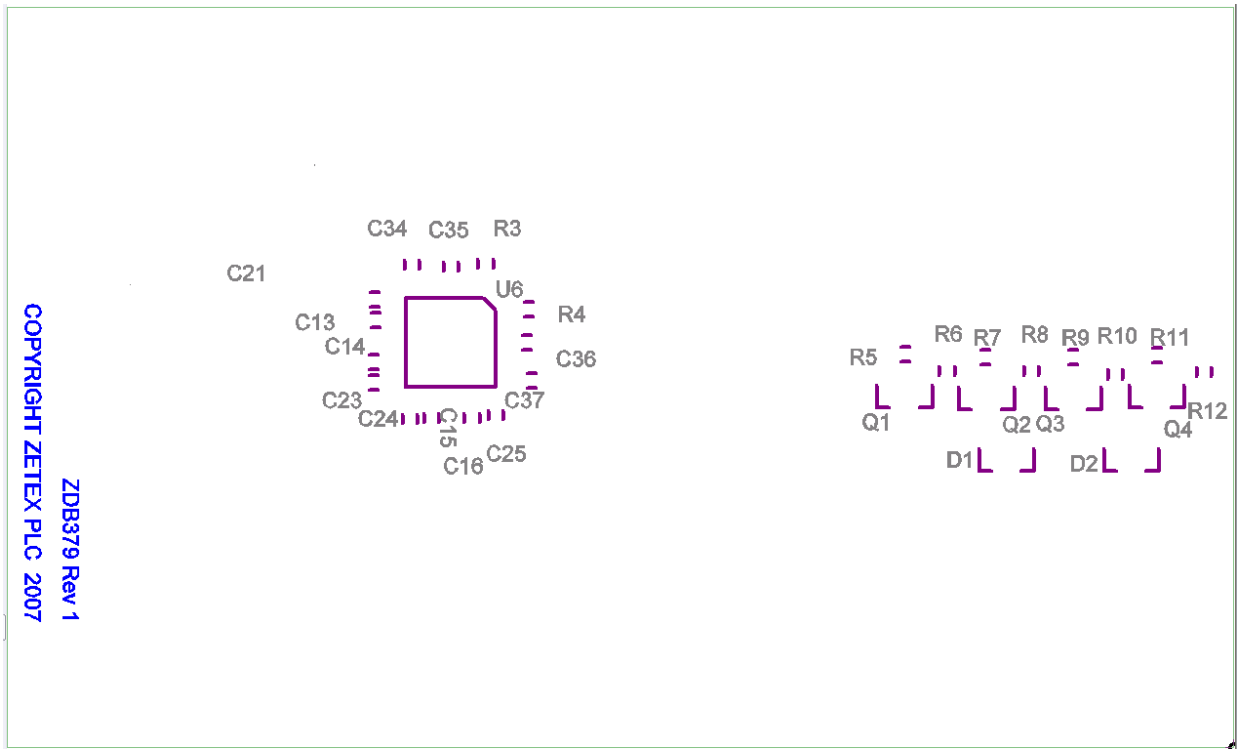


Figure 5: Component layout, bottom

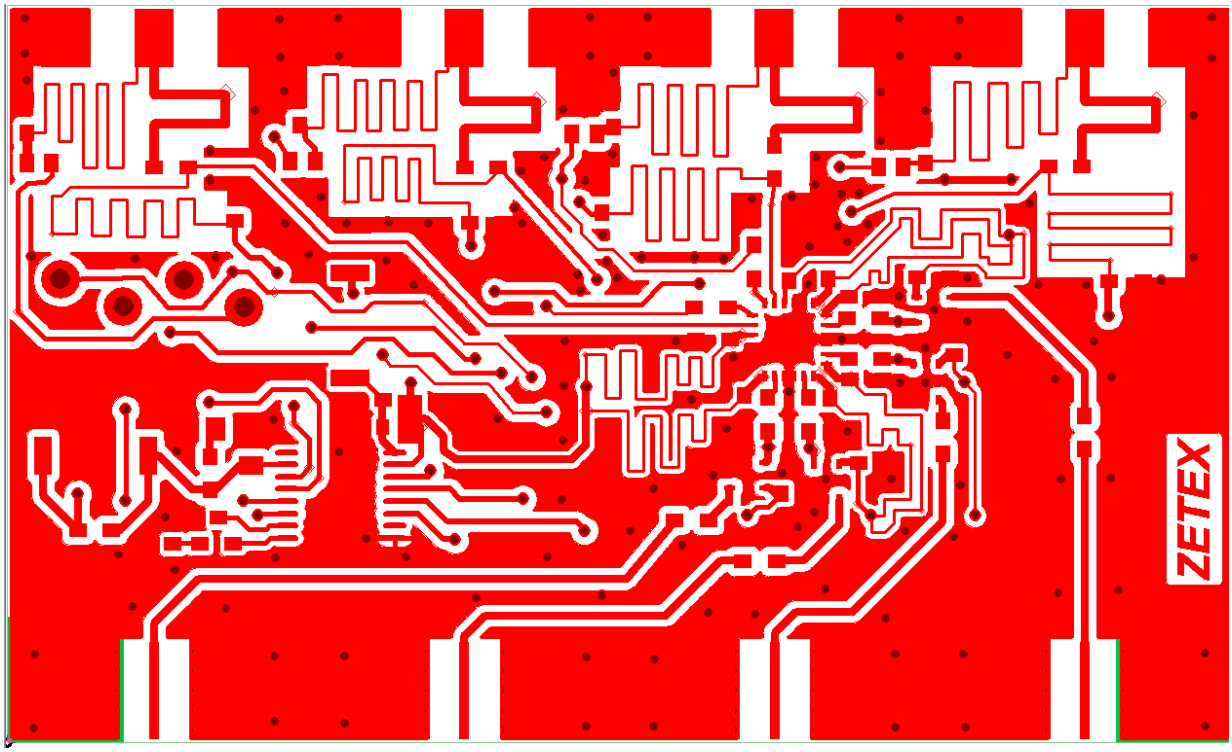


Figure 6: Top Copper (view from top)

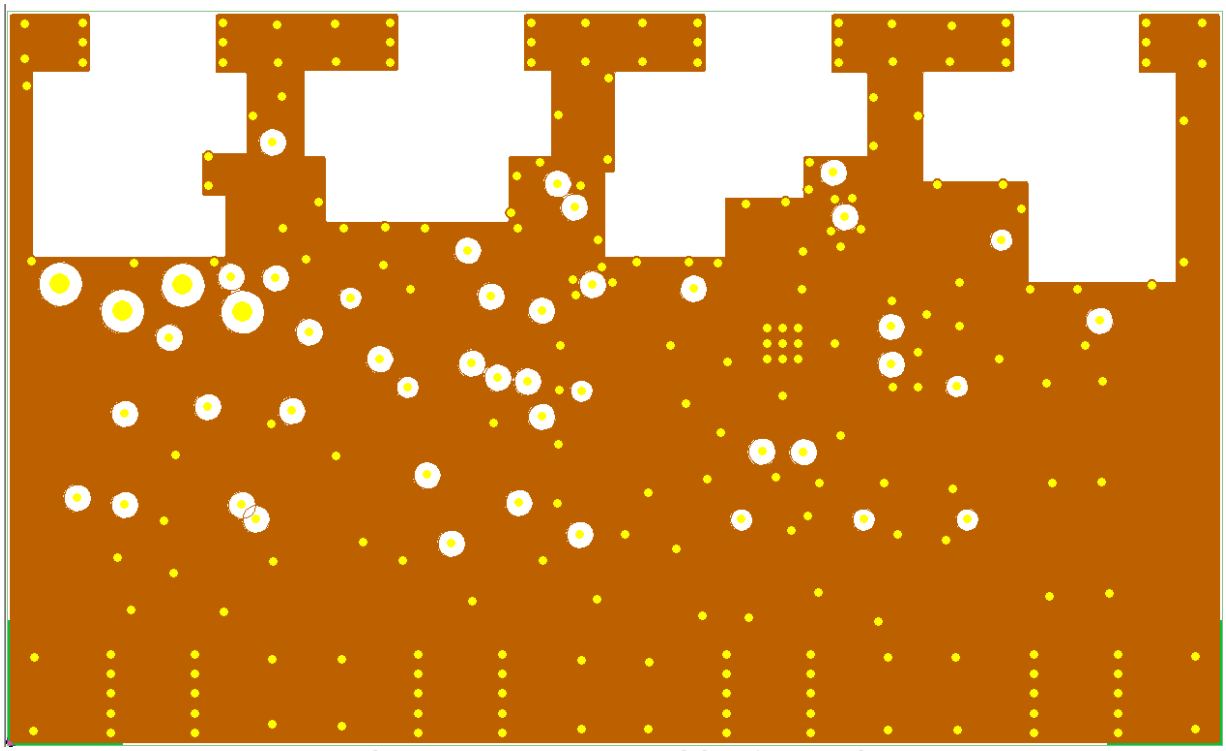


Figure 7: Layer 2 Copper (view from top)

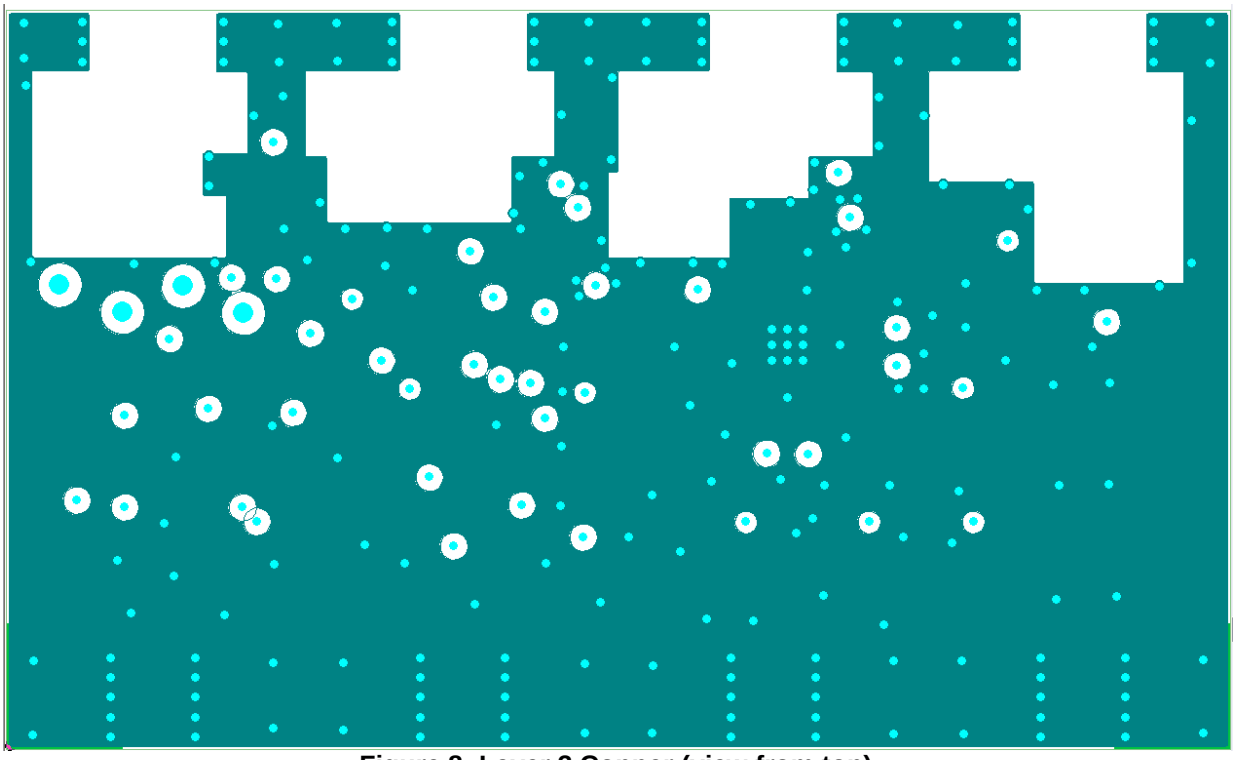


Figure 8: Layer 3 Copper (view from top)

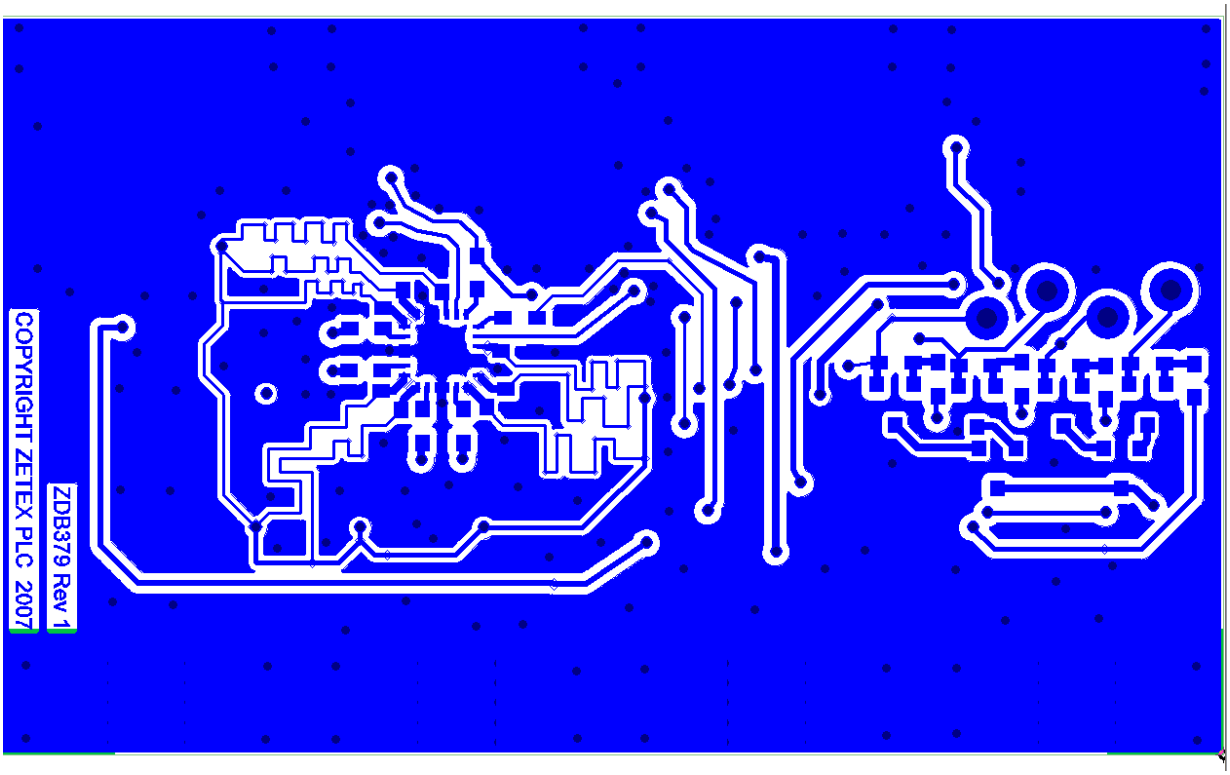


Figure 9: Bottom Copper (view from bottom)

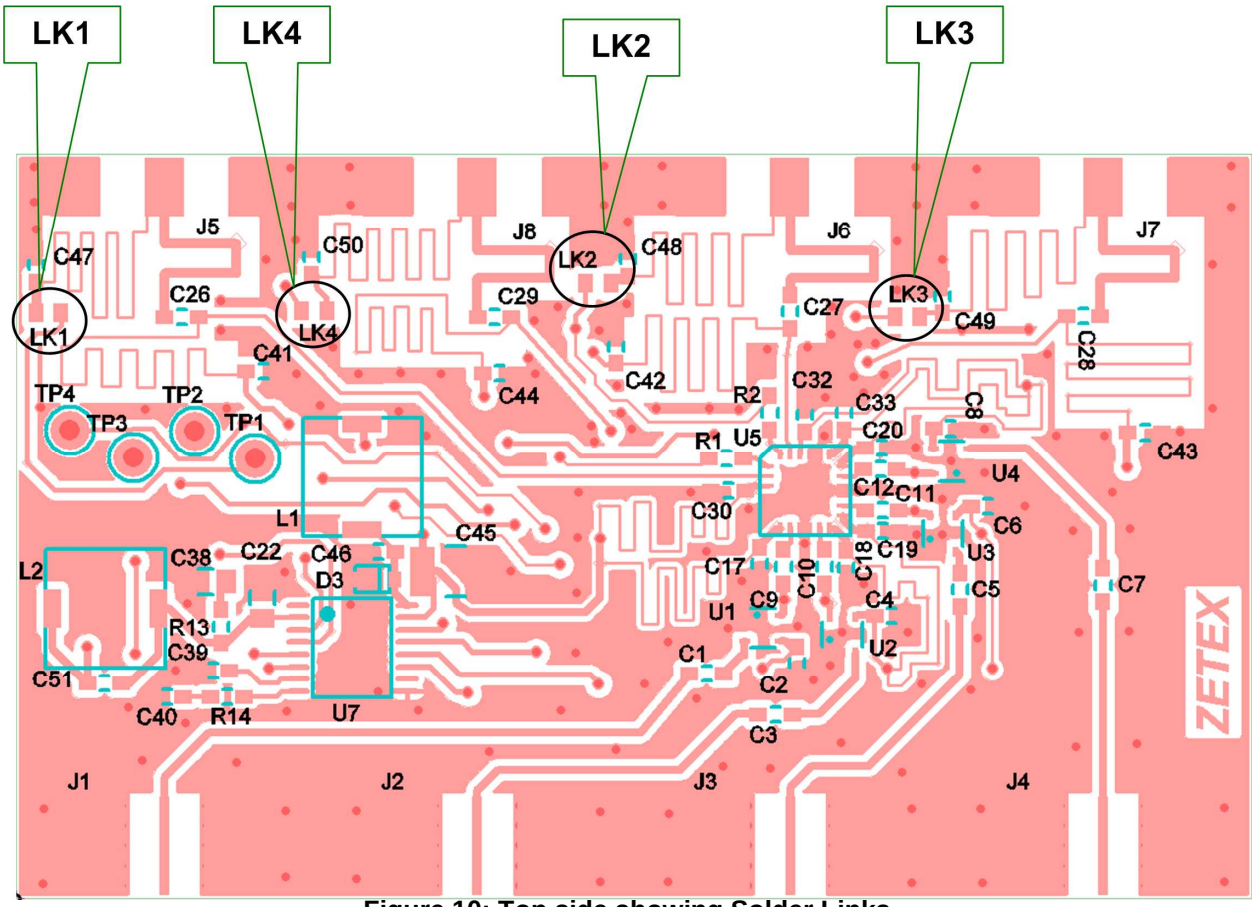


Figure 10: Top side showing Solder Links

ZXHF5000EV2 Connections	
Name	**Description**
J1	IF signal input 1
J2	IF signal input 2
J3	IF signal input 3
J4	IF signal input 4
J5	STB1 (IF signal output 1)
J6	STB2 (IF signal output 2)
J7	STB3 (IF signal output 3)
J8	STB4 (IF signal output 4)
TP1	Test point to monitor STB1 control voltage, or apply power and control with LK1 open
TP2	Test point to monitor STB2 control voltage, or apply power and control with LK2 open
TP3	Test point to monitor STB3 control voltage, or apply power and control with LK3 open
TP4	Test point to monitor STB4 control voltage, or apply power and control with LK4 open

OPERATION

Power and Control Connections

Dependant on how the board is going to be tested, there are two sets of instructions, one for applying power and control through the signal output connectors in the manner of a Set Top Box Receiver, and alternatively applying power and control through separate connections TP1-4.

a) Connection to STB receivers.
This is simply a matter of connecting the input signals from an LNB or other signal source to the input connectors J1 to J4. The output connectors J5 to J8 connect to the STB inputs.

b) Separate power and control connection

1. The input and output connectors may be connected to a network analyser or other desired instrument. Unused RF connectors may be terminated in the correct impedance: 50 ohms for the inputs and 75 ohms for the outputs.
2. Apply power and control to one or more of the test points TP1 to TP4 to control output channels STB1 to STB4 respectively, using suitable test hooks. A 0V common ground connection will be required between the power supplies and the ground plane of the board, normally using a crocodile clip. A suitable circuit for applying power and control is shown in Figure 11. The DC supplies are provided at PSU1, etc. and generators to provide 22kHz control signals at GEN1, etc. Each output has controls for independently selecting one of the four inputs as in the following Truth Tables:

Truth Tables

Voltage at TP1	22kHz Tone at TP1	Input selected at J5, STB1
9.5 to 14.0V	ON	J1
9.5 to 14.0V	OFF	J2
15.5 to 19.0V	OFF	J3
15.5 to 19.0V	ON	J4

Voltage at TP2	22kHz Tone at TP2	Input selected at J6, STB2
9.5 to 14.0V	ON	J1
9.5 to 14.0V	OFF	J2
15.5 to 19.0V	OFF	J3
15.5 to 19.0V	ON	J4

Voltage at TP3	22kHz Tone at TP3	Input selected at J7, STB3
9.5 to 14.0V	ON	J1
9.5 to 14.0V	OFF	J2
15.5 to 19.0V	OFF	J3
15.5 to 19.0V	ON	J4

Voltage at TP4	22kHz Tone at TP4	Input selected at J8, STB4
9.5 to 14.0	ON	J1
9.5 to 14.0	OFF	J2
15.5 to 19.0V	OFF	J3
15.5 to 19.0V	ON	J4

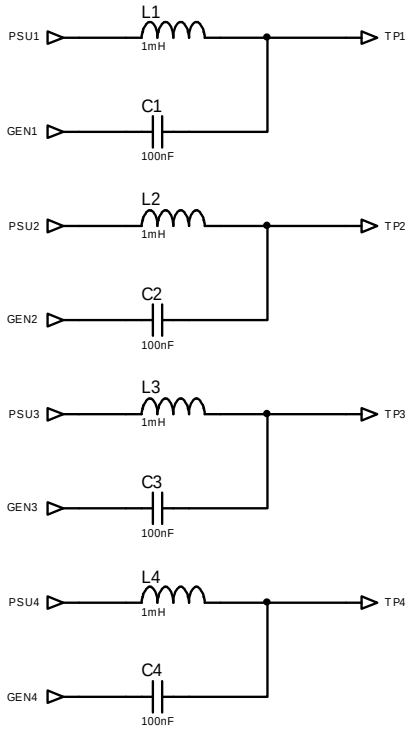


Figure 11: Power and Control Test Interface

Test

If testing using STBs or STB emulators, the STBs will provide the necessary controls.

If testing with separate power and control connections, it is convenient to measure the gain and isolation of the circuit using a Network Analyser. A suitable test power level is -30 dBm. The Quad board has not been tested for all parameters.

PERFORMANCE

Much performance information for the device can be found in the datasheet, although the high frequency performance is naturally affected by the printed circuit layout.

Figure 12 shows the supply current versus voltage when all 4 outputs are activated.

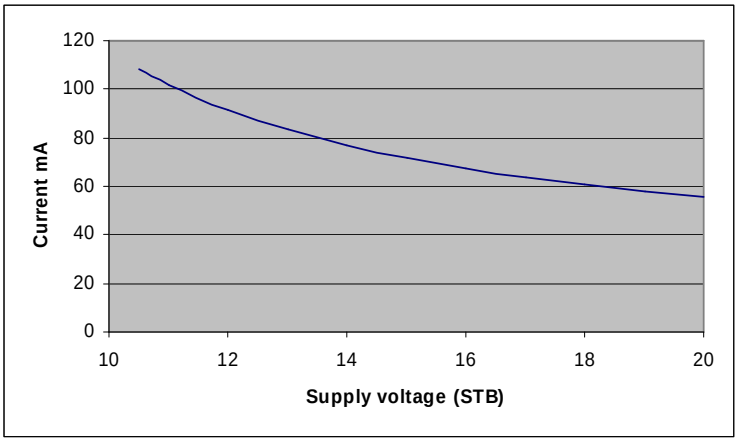


Figure 12: Supply Current versus voltage

Some examples of performance plots from a network analyzer are given here. Figure 13 shows gain to output J5 versus frequency for the case of all outputs selecting the signal on input J3. Figure 14 shows the same for the gain to output J6.

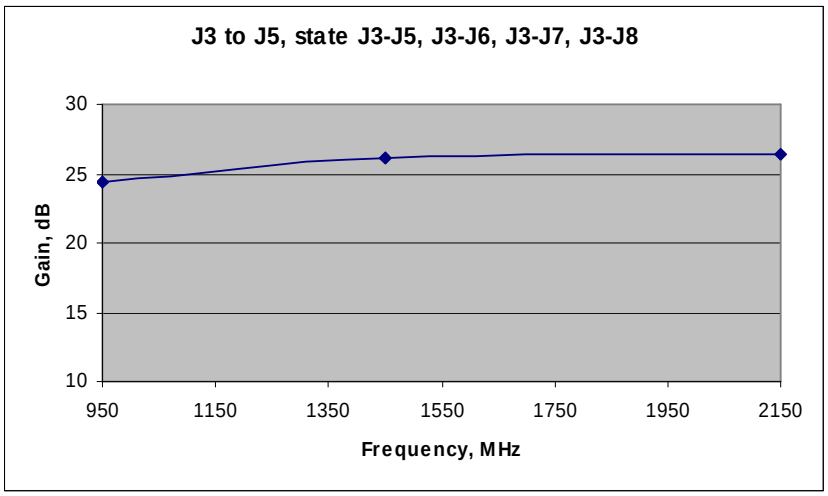


Figure 13: Gain to output J5, input J3 selected at all outputs

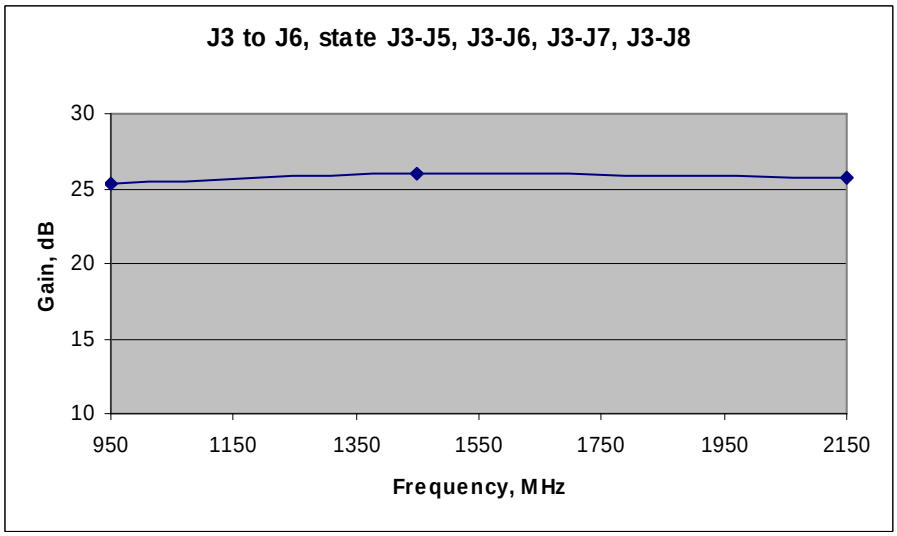


Figure 14: Gain to output J6, input J3 selected at all outputs

Figure 15 shows the channel isolation of output J5 when input J3 selects input J4 and the other outputs select input J3. (The channel isolation is the reciprocal of the crosstalk, represented as a sign change in dB units.) Similarly Figures 16 and 17 show isolation in further states.

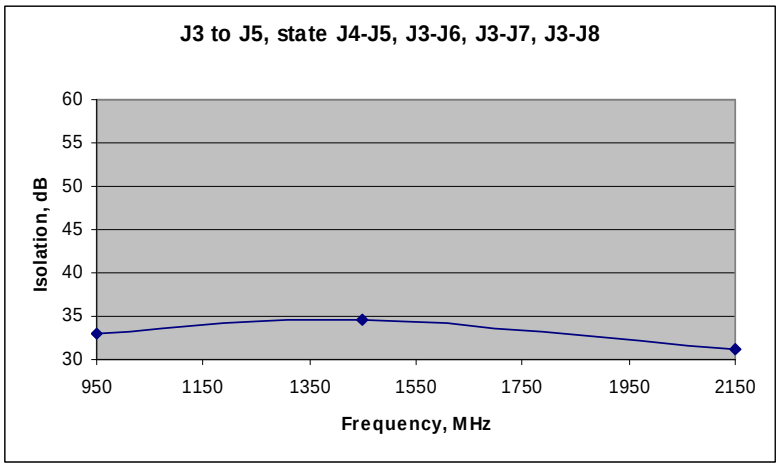


Figure 15: Channel Isolation of output J5, test signal driving input J3, with input 4 selected at output J5 and input J3 selected at all other outputs, versus frequency (MHz)

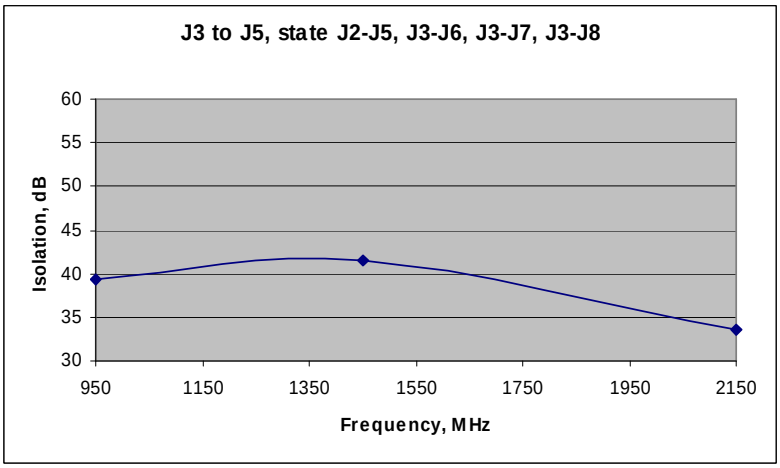


Figure 16: Channel Isolation of output J5, test signal driving input J3, with input 2 selected at output J5 and input J3 selected at all other outputs, versus frequency (MHz)

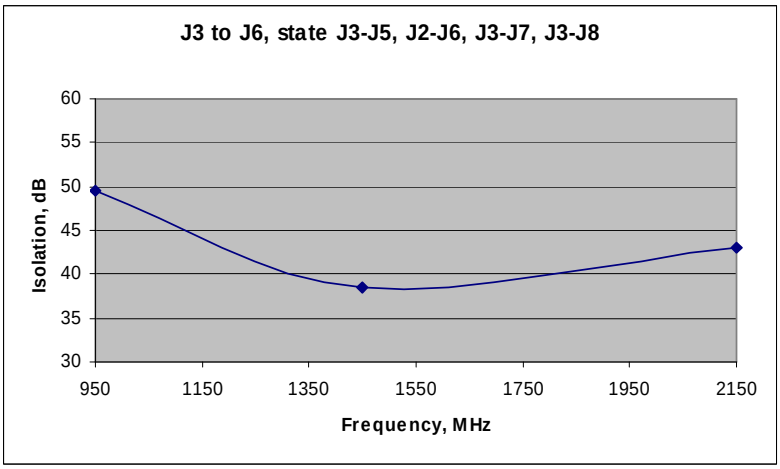


Figure 17: Channel Isolation of output J6, test signal driving input J3, with input 2 selected at output J6 and input J3 selected at all other outputs, versus frequency (MHz)

Conclusion and Other Information

This document has described the construction and use of the ZXHF5000EV2 evaluation board.

This evaluation board demonstrates a reliable, efficient and cost effective way to produce a high performing low power Quad LNB. Although care has been taken over the design of this board, the performance or production reliability cannot be guaranteed by Zetex.

ZXHF5000EV2 has used a multi layer PCB approach but the design techniques used could easily be applied to a multi PCB design.

If PCB design files are required, these are available on request from your local Zetex sales office by quoting ZXHF5000EV2. The files can be provides as either Mentor PADS design files or Gerber outputs.

Other Evaluation Boards

To aid in the design of multi output LNBs the ZXHF5000JB24 is available as an evaluation board. This allows the testing and the performance evaluation of the ZXHF5000JB24 to be done independently.

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