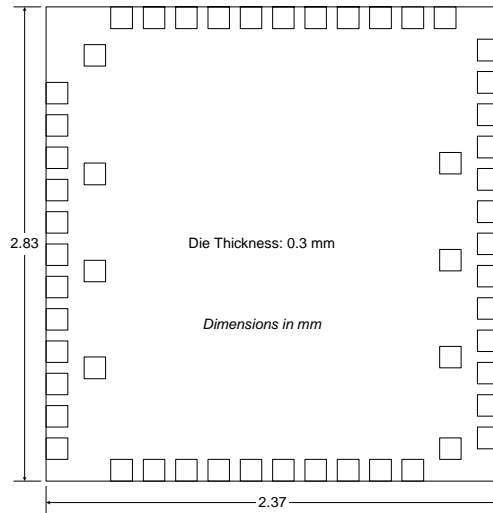


Typical Applications

- Quad-Channel Gigabit and 10Gigabit Ethernet Optical Transceivers
- CWDM/WWDM 4-Channel Parallel Links
- SONET VSR & System Interconnect
- All Fiber Optic Transceiver Applications up to 3.125Gbps Serial Data Rate

Product Description

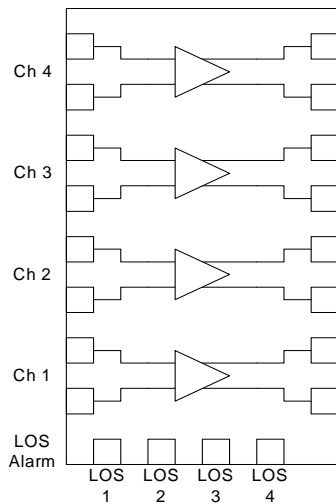
The RF3734 is a quad-channel limiting amp suitable for multi-channel fiber optic transceiver applications operating at line rates in excess of 3.5Gbps/channel. RF3734 features differential input/output design with low power consumption. All four channels operate with +3.3V and 430mW power dissipation. The amplifiers accept a wide range of input voltages and provide constant-level output voltages. Minimum input is 5mV_{P-P} with a maximum input of 500mV_{P-P}. Output is limited to 500mV_{P-P}. Additional features include programmable loss-of-signal (LOS) indication and excellent jitter performance. There is an independent loss of signal alarm for each channel, which has a programmable threshold level using an external resistor. RF3734 is available in a bare die configuration.



Package Style: Bare Die

Optimum Technology Matching® Applied

- | | | |
|-------------------------------------|--|--------------------------------------|
| <input type="checkbox"/> Si BJT | <input type="checkbox"/> GaAs HBT | <input type="checkbox"/> GaAs MESFET |
| <input type="checkbox"/> Si Bi-CMOS | <input checked="" type="checkbox"/> SiGe HBT | <input type="checkbox"/> Si CMOS |
| <input type="checkbox"/> GaInP/HBT | <input type="checkbox"/> GaN HEMT | |



Functional Block Diagram

Features

- 430mW Power Dissipation at +3.3V
- Typical Output Signal 500mV_{P-P} Differential (250mV_{P-P} Single-Ended)
- 4GHz Bandwidth
- 50ps Typical Rise/Fall Time
- Input/Output Return Loss <10dB

Ordering Information

RF3734 Quad-Channel Limiting Amplifier (4x3.125Gbps)

RF Micro Devices, Inc.
7628 Thorndike Road
Greensboro, NC 27409, USA

Tel (336) 664 1233
Fax (336) 664 0454
<http://www.rfmd.com>

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	4	V
Input Voltage	4	V _{P-P}
Operating Temperature Range	-40 to +85	°C
Storage Temperature Range	-65 to +125	°C
Junction Temperature Max	+125	°C



Caution! ESD sensitive device.

RF Micro Devices believes the furnished information is correct and accurate at the time of this printing. However, RF Micro Devices reserves the right to make changes to its products without notice. RF Micro Devices does not assume responsibility for the use of the described product(s).

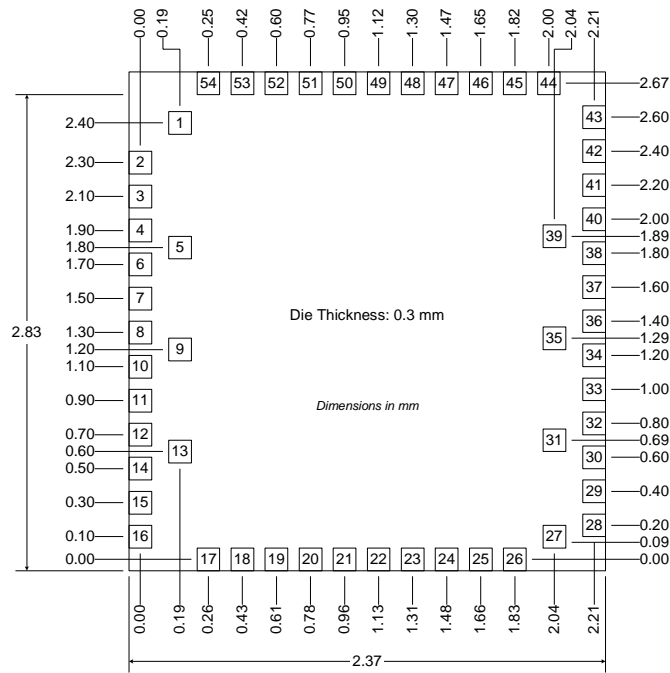
Note: TA=+25°C unless otherwise noted. Functional operation near or above Maximum Ratings is not implied. Exposure to stress levels at or near maximum ratings for any period of time may affect reliability or cause permanent damage to the devices.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Inputs					
Data Rate (BR)	0.1	3.125	4.0	G _{BPS}	T=25 °C, V _{CC} =3.3V, V _{IN} =50mV _{P-P} Data Rate=3.125Gbps, one channel
Supply Voltage (V)	3.0	3.3	3.6	V	
Small Signal Bandwidth (BW)	3.0	4.0	4.5	GHz	P _{IN} =-40dBm
Total Current (I _{CC})		35		mA	
DISABLE Current (I _{CC})		22		mA	All four channels powered on ENABLE=0V
Input Voltage Range (V _{INP-P})	5		500	mV _{P-P}	
Differential Input Resistance (R _{IN})	90	100	110	Ω	
Outputs					
Differential Output V Swing (dV _{OUT})	450	500	550	mV _{P-P}	
Output Random Jitter (RJ _{P-P})		15		ps	@ V _{IN} >10mV _{P-P}
		50		ps	@ V _{IN} >2mV _{P-P}
Low Frequency Cutoff (f _{LOW})			300	kHz	Set by filter capacitor value (0.01uF typ)
Output Return Loss (S22)		-10		dB	
Output 20% to 80% Edge Rate (T _r , T _f)		50	75	ps	
LOS Function					
Alarm Out_Hi (LOS Alarm)		V _{CC}			
Alarm Out_Low (LOS Alarm)		GND			
Hysteresis (H)		TBD		dB	
LOS Signal Detect Threshold (V _{THSD})		TBD		mV	Adjustable within range
Signal Detect Assert Time (T _{SDA})		TBD		us	
Signal Detect De-assert Time (T _{SDD})		TBD		us	
LOS Ext Resistor (LOS_R)	100		1000	Ω	

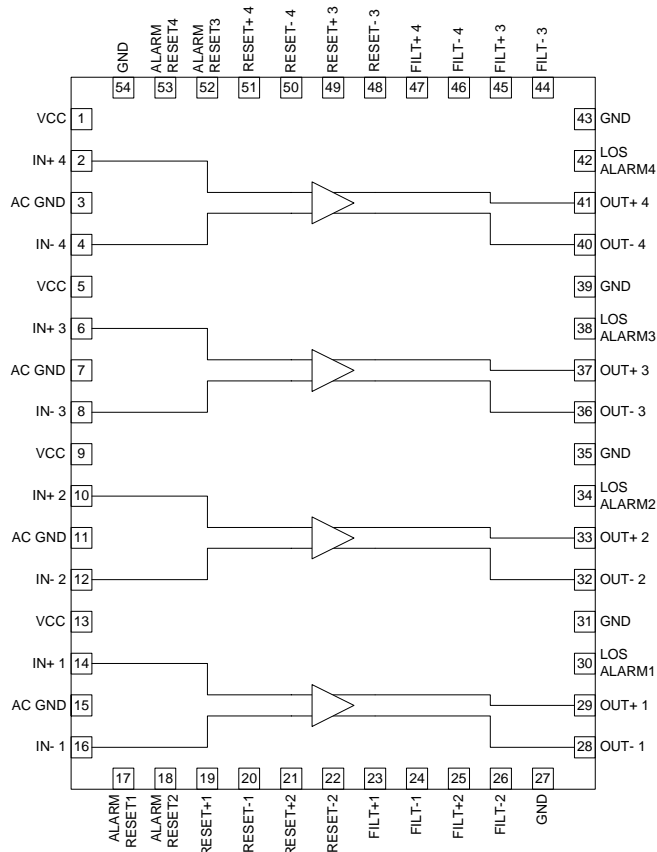
Pin	Function	Description	Bond Pad Center Coordinates (x mm, y mm)
1	VCC	Power supply=+3.3V.	(0.19, 2.40)
2	IN+4	Channel 4 Input voltage, positive differential in.	(0, 2.30)
3	NC	DC voltage is present on this pin. If it is necessary to ground this pin, then a DC-blocking capacitor must be used.	(0, 2.10)
4	IN-4	Channel 4 Input voltage, negative differential in.	(0, 1.90)
5	VCC	Power supply=+3.3V.	(0.19, 1.80)
6	IN+3	Channel 3 Input voltage, positive differential in.	(0, 1.70)
7	NC	DC voltage is present on this pin. If it is necessary to ground this pin, then a DC-blocking capacitor must be used.	(0, 1.50)
8	IN-3	Channel 3 Input voltage, negative differential in.	(0, 1.30)
9	VCC	Power Supply=+3.3V.	(0.19, 1.20)
10	IN+2	Channel 2 Input voltage, positive differential in.	(0, 1.10)
11	NC	DC voltage is present on this pin. If it is necessary to ground this pin, then a DC-blocking capacitor must be used.	(0, 0.90)
12	IN-2	Channel 2 Input voltage, negative differential in.	(0, 0.70)
13	VCC	Power supply=+3.3V.	(0.19, 0.60)
14	IN+1	Channel 1 Input voltage, positive differential in.	(0, 0.50)
15	NC	DC voltage is present on this pin. If it is necessary to ground this pin, then a DC-blocking capacitor must be used.	(0, 0.30)
16	IN-1	Channel 1 Input voltage, negative differential in.	(0, 0.10)
17	ALARM RESET1	Alarm reset pin for channel 1, tied to ground for normal operation.	(0.26, 0)
18	ALARM RESET2	Alarm reset pin for channel 2, tied to ground for normal operation.	(0.43, 0)
19	RESET+1	External LOS threshold resistor.	(0.61, 0)
20	RESET-1	External LOS threshold resistor.	(0.78, 0)
21	RESET+2	External LOS threshold resistor.	(0.96, 0)
22	RESET-2	External LOS threshold resistor.	(1.13, 0)
23	FILT+1	External capacitor for filtering.	(1.31, 0)
24	FILT-1	External capacitor for filtering.	(1.48, 0)
25	FILT+2	External capacitor for filtering.	(1.66, 0)
26	FILT-2	External capacitor for filtering.	(1.83, 0)
27	GND	Ground connection. For best results, keep traces physically short and connect immediately to ground plane.	(2.04, 0.09)
28	OUT-1	Differential output channel 4, positive.	(2.21, 0.20)
29	OUT+1	Differential output channel 4, negative.	(2.21, 0.40)
30	LOS ALARM1	Channel 4 Alarm.	(2.21, 0.60)
31	GND	Ground connection. For best results, keep traces physically short and connect immediately to ground plane.	(2.04, 0.69)
32	OUT-2	Differential output channel 3, positive.	(2.21, 0.80)
33	OUT+2	Differential output channel 3, negative.	(2.21, 1.00)
34	LOS ALARM2	Channel 4 Alarm.	(2.21, 1.20)
35	GND	Ground connection. For best results, keep traces physically short and connect immediately to ground plane.	(2.04, 1.29)

Pin	Function	Description	Bond Pad Center Coordinates (x mm, y mm)
36	OUT-3	Differential output channel 2, positive.	(2.21, 1.40)
37	OUT+3	Differential output channel 2, negative.	(2.21, 1.60)
38	LOS ALARM3	Channel 2 Alarm.	(2.21, 1.80)
39	GND	Ground connection. For best results, keep traces physically short and connect immediately to ground plane.	(2.04, 1.89)
40	OUT-4	Differential output channel 1, positive.	(2.21, 2.00)
41	OUT+4	Differential output channel 1, negative.	(2.21, 2.20)
42	LOS ALARM4	Channel 1 Alarm.	(2.21, 2.40)
43	GND	Ground connection. For best results, keep traces physically short and connect immediately to ground plane.	(2.21, 2.60)
44	FILT-3	External capacitor for filtering.	(2.00, 2.67)
45	FILT+3	External capacitor for filtering.	(1.82, 2.67)
46	FILT-4	External capacitor for filtering.	(1.65, 2.67)
47	FILT+4	External capacitor for filtering.	(1.47, 2.67)
48	RESET-3	External LOS threshold resistor.	(1.30, 2.67)
49	RESET+3	External LOS threshold resistor.	(1.12, 2.67)
50	RESET-4	External LOS threshold resistor.	(0.95, 2.67)
51	RESET+4	External LOS threshold resistor.	(0.77, 2.67)
52	ALARM RESET3	Alarm reset pin for channel 3, tied to ground for normal operation.	(0.60, 2.67)
53	ALARM RESET4	Alarm reset pin for channel 4, tied to ground for normal operation.	(0.42, 2.67)
54	GND	Ground connection. For best results, keep traces physically short and connect immediately to ground plane.	(0.25, 2.67)

Die Package Drawing



Detailed Functional Block Diagram



Theory of Operation and Application Information

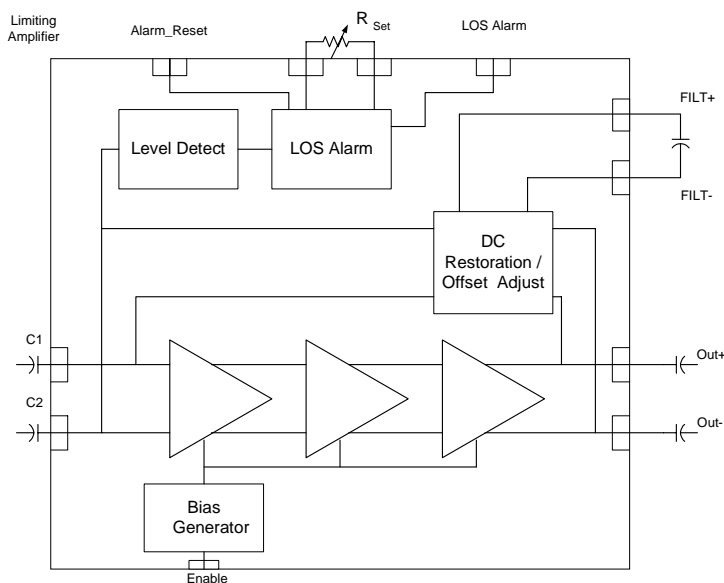


Figure 1. Functional Block Diagram For One Channel of RF3734

General Description of IC

Limiting Amplifier

The basic function of the IC is to provide a constant differential output voltage of $500\text{mV}_{\text{P-P}}$ over a $5\text{mV}_{\text{P-P}}$ to $500\text{mV}_{\text{P-P}}$ differential input voltage range. When the input signal is less than $5\text{mV}_{\text{P-P}}$ the amplifier will function as a linear amplifier without oscillating. Each stage is matched at both the input and output to 50Ω differential impedance. The bias currents for each amplifier stage are based on a reference voltage supplied by the Bias Generator.

Bias Generator

The Bias Generator supplies a voltage that is constant across current draw and temperature to the main amplifier. The ENABLE pin activates the Bias Generator. When ENABLE is logic HI (V_{CC}), the Bias Generator produces the reference voltage and the circuit operates normally. When ENABLE is logic LO (ground), the circuit is disabled, the output is 0V , and the IC draws only 22mA , compared to 32mA in normal operation.

DC Restoration/Offset Adjust

This circuit provides two functions. The first is offset compensation: the circuit establishes equal DC voltages at the inputs and outputs of the limiting amplifier, thus compensating for the built-in offset voltages of the differential amplifier stages. The second is high-pass filtering: the external capacitor that is connected between FILT+ and FILT- sets the low-frequency cutoff of the amplifier.

Level Detect

This block simply provides a signal proportional to the input signal to the decision circuitry in the LOS Alarm block.

LOS Alarm

Taking the signal provided by the level detector, the Loss-Of-Signal (LOS) Alarm circuit compares it to a reference level that is varied by an external resistor, RSET. If the signal level is lower than the reference level, then the output of the LOS alarm taken at pin LOS ALARM, is logic high, indicating an alarm state (insufficient or no signal). If the signal is larger than the reference, LOS ALARM will register logic LO, indicating sufficient input signal for normal operation. Typically, a $1\text{k}\Omega$ potentiometer is used initially to determine the resistance necessary for the desired alarm threshold level. In production, a fixed value resistor can replace the potentiometer.

General Description of Application Schematic

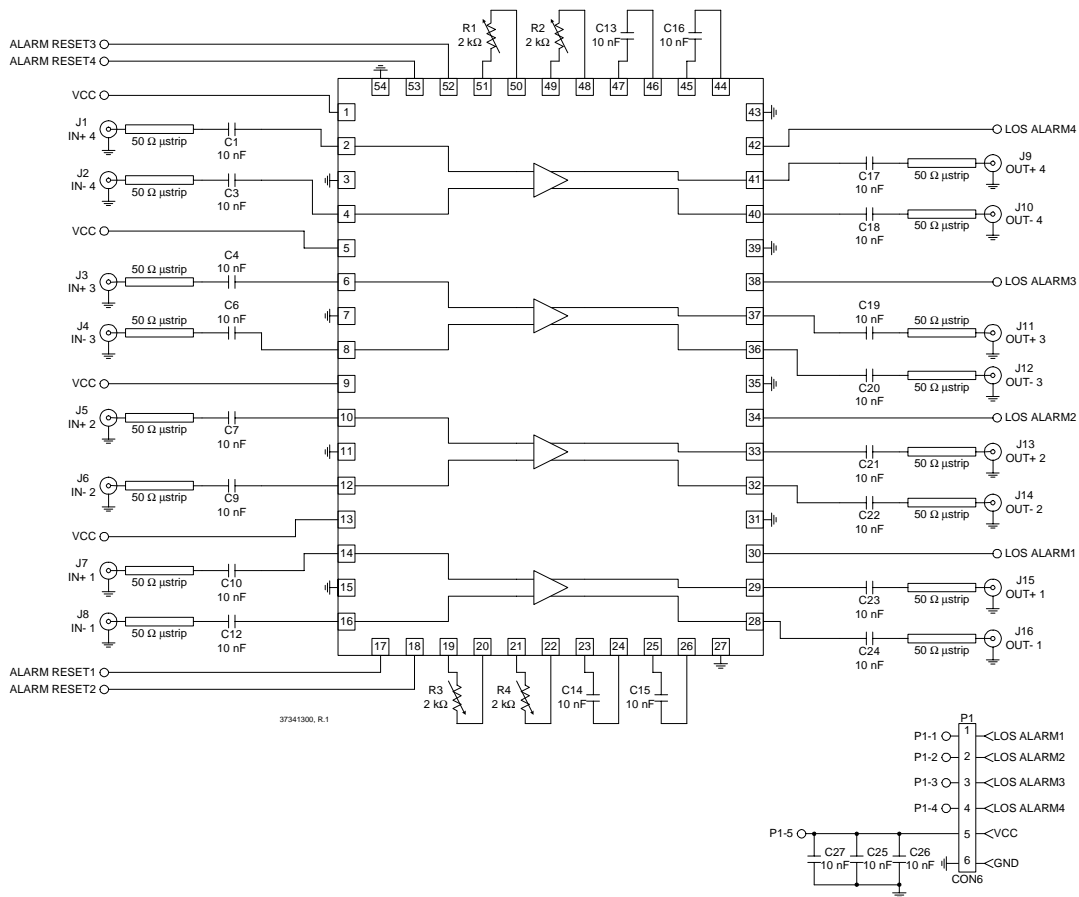


Figure 2. Evaluation Board Schematic

Table 1. Evaluation Board Component List

Designator	Value	Footprint	Description
C1, C3, C4, C6, C7, C9, C10, C12, C17, C18, C19, C20, C21, C22, C23, C24	10nF	0402	DC-blocking capacitor of Input+, Input-, Output+, and Output-.
C13, C14, C15, C16	10nF	0402	Filter capacitor, sets the low frequency cutoff for the internal high pass filter.
C25, C26, C27	10nF	0402	Bypass capacitor.
J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16	N/A	N/A	SMA connector for data inputs.
P1	N/A	N/A	6 pin DC connector.
R1, R2, R3, R4	2kΩ	N/A	Adjusts the threshold for the alarm signal.
U1	RF3734	2.9mmx2.4mm Die	RF Micro Devices' Quad Limiting Amplifier.

The evaluation board schematic for the RF3734 limiting amplifier is shown in Figure 2 and the Bill of Materials for the Evaluation Board is shown in Table 1 with recommended values. All inputs and outputs are internally balanced 50Ω to ground, 100Ω from pin to pin. There is a DC voltage present on both the input and output of the amplifier requiring external DC-blocking capacitors. Since this device is designed for use 0.1 Gbps to 4.0 Gbps, a value of 10nF was chosen to provide the best coupling across all data rates.

The external potentiometer adjusts the input level at which the Alarm signal activates. This is in series with an internal chain of resistors and varying this will vary the overall resistance seen by the alarm circuitry. Also included on the evaluation board is an off-chip filter capacitor (C13-C16). This is required to set the low frequency cut off of an internal high pass filter.

The Enable and V_{CC} pins are tied together on the evaluation board. When Enable equals V_{CC} the amplifier is in normal operation. When Enable is tied LO the amplifier is turned off.

Enable	Chip
1.4V ~ V_{CC}	On
0V ~ 1.3V	Off

Another function of the RF3734 is an output pin to monitor the Loss of Signal alarm. When no signal is present, LOS will go HI (V_{CC}). When the amplifier is in normal operation, LOS will go LO (ground). In order to test the operation of the LOS alarm, the Alarm Reset pin can also be connected to V_{CC} . Doing this will force the LOS alarm to activate and go HI. For normal operation the Alarm Reset pin will be tied to ground, allowing the LOS alarm to activate dependent on the input voltage level.

Evaluation Board Layout Considerations

In order to minimize RF path widths, a multilayer evaluation board is used (see Table 2). For the evaluation board provided by RFMD, an 18mil microstrip line on 8mil Rogers RO4003 material will achieve the desired 50Ω impedance. For this application, the Rogers RO4003 material was used due to the tightly toleranced dielectric constant. Another common board material used, FR-4, can vary its dielectric constant by as much as ±10% depending on the manufacturer. The line width and core material thickness and dielectric constant are critical to maintain controlled line impedances.

It is also necessary to match the electrical lengths of the balanced inputs and outputs as closely as possible. Having unbalanced path lengths can cause the output eye diagram to have slower rise and/or fall times, increased jitter, and ripple on the one or zero.

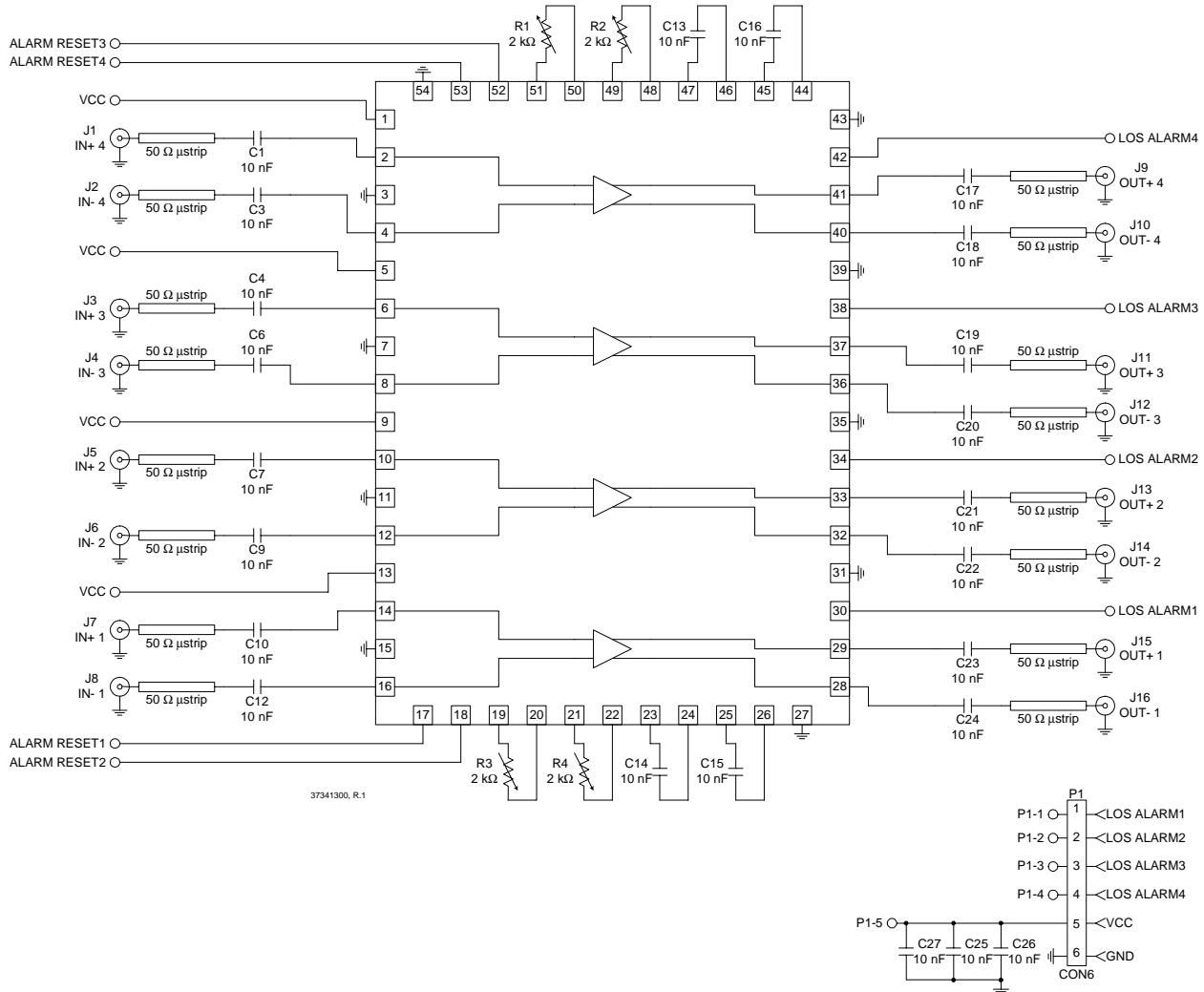
Also, transitions from the connector to the trace and from the trace to the package pin are critical when considering high frequency evaluation board design. Any changes in the trace width can cause a mismatch, thus affecting performance. In order to avoid this, the pad for the SMA center pin and the package pads have the same width as the microstrip traces. If the package pins, SMA pins, and microstrip traces cannot be the same width, then tapering, or other compensation techniques, should be used at all transitions to minimize mismatch.

In order to minimize the amount of noise on the V_{CC} circuitry, place any bypass capacitors as close to the IC as possible. Also, for the RF3734 device the filter capacitor should be placed close to the IC.

Table 2. Evaluation Board Layer Stack Up

Lyr 1 (Signal)	-----	0.5oz CU+Plating	0.002"
	Core Rogers RO4003		0.008" ± 0.0015"
Lyr 2 (Solid Ground Plane)	-----	1.0oz CU	0.0014"
	PrePreg FR4 or Alternative		0.020"
Lyr 3 (Solid Plane, unused)	-----	1.0oz CU	0.0014"
	Core FR4 or Alternative		0.008"
Lyr 4 (Signal)	-----	0.5oz CU+Plating	0.002"

Evaluation Schematic (Download [Bill of Materials](http://www.rfmd.com) from www.rfmd.com.)



Evaluation Board Layout Board Size 61 mm x 71 mm

Board Thickness 0.042", Board Material Rogers RO4003 and FR-4, Multi-Layer

