PE53231

Document Category: Product Specification

Dual-channel Switch LNA Module, 3.3–4.2 GHz

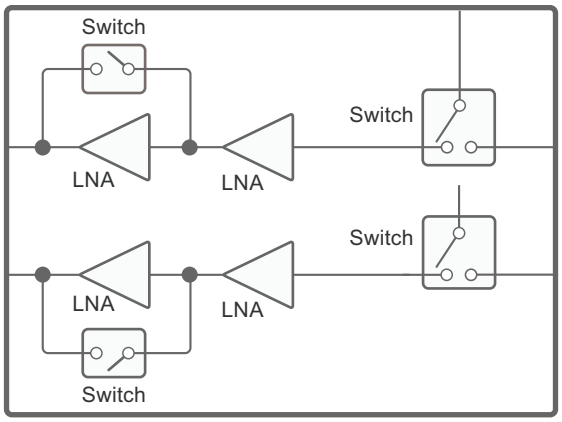
Features

- Integrates dual-channel LNA with bypass function and a high-power switch
- 20W average RF input power
- Low noise figure of 1 dB
- 36.5 dB gain at max gain mode
- 35 dBm OIP3
- +105 °C operating temperature
- Packaging: 40-lead 6 × 6 mm LGA

Applications

- Wireless infrastructure
- 4G/4.5G TDD-LTE macro/micro cell
- Pre-5G/5G massive MIMO systems
- TDD-based communication systems

Figure 1 • PE53231 Functional Diagram



Product Description

The PE53231 is a highly integrated front-end module targeted for wireless infrastructure applications, such as TDD macro/micro base stations and MIMO applications. It is designed for use at the front end of a receiver chain for TDD-based systems and is ideally suited to 5G solutions or small cell applications.

The dual-channel receiver integrates two independent LNAs with bypass function and a high-power switch. The PE53231 is for use across the 3.3 GHz–4.2 GHz frequency range with internal impedance matching networks.

This receiver uses pSemi UltraCMOS® SOI technology, which supports input RF power signals up to 20W average power, assuming 9-dB PAR and an extremely low noise figure, excellent linearity, and very low power consumption. Each channel is controlled individually within the selected frequency band, which allows more flexibility in the system design.

Absolute Maximum Ratings

Exceeding the absolute maximum ratings listed in **Table 1** can cause permanent damage. Restrict operation to the limits listed in **Table 2**. Operation between the operating range maximum and the absolute maximum for extended periods can reduce reliability.

ESD Precautions

When handling this UltraCMOS device, observe the same precautions as with any other ESD-sensitive devices. Although this device contains circuitry to protect it from damage due to ESD, do not exceed the rating listed in **Table 1**.

Table 1 • PE53231 Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit
Power supply voltage	–0.3	-	5.25	V
Storage temperature range	–60	-	+150	°C
Maximum junction temperature range	-	-	+140	°C
RF Input power, peak, transit mode, 9-dB PAR LTE	-	-	53	dBm
RF Input power, peak, receive mode, 9-dB PAR LTE	-	-	27	dBm
ESD voltage, human-body model(1), all pins	-	-	1000	V
ESD voltage, charged device model(2), all pins	-	-	500	V

1) Human body model (MIL-STD 883 Method 3015)
2) Charged device model (JEDEC JESD22-C101)

Recommended Operating Conditions

Table 2 lists the PE53231 recommending operating conditions. Do not operate the device outside the recommended operating conditions listed below.

Table 2 • PE53231 Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
V_{DD} supply voltage	4.75	5	5.25	V
Control voltage range	0	-	5	V
Supply current, high gain	-	96	125	mA
Supply current, low gain	-	50	65	mA
Supply current, Tx mode	-	10	12	mA
Control voltage high-switch_SWCTRL	1.15	-	3.6	V
Control voltage low-switch_SWCTRL	0	-	0.6	V
Control voltage high-LNA_LNACTRL	1.15	1.8	5	V
Control voltage low-LNA_LNACTRL	0	-	0.6	V
Control voltage high-LNA_BYPASSCTRL	1.15	1.8	5	V
Control voltage low-LNA_BYPASSCTRL	0	-	0.6	V
RF input power, lifetime, average with 9-dB PAR LTE signal (Tx mode)	-	-	43	dBm
Operating temperature range	–40	-	105	°C
Frequency range	3300	-	4200	MHz

Electrical Specifications

Table 3 lists the PE53231 key electrical specifications at +25 °C, V_{DD} = 5V (Z_S = Z_L = 50Ω at 25 °C), unless otherwise specified.

Table 3 • PE53231 Electrical Specifications

Parameter/Condition	Min	Typ	Max	Unit
OIP3, high-gain mode, two-tone output power 11 dBm per tone at 1 MHz tone spacing at 3800 MHz	31.5	35	-	dBm
OIP3, low-gain mode, two-tone output power 11 dBm per tone at 1 MHz tone spacing at 3800 MHz	28.5	31	-	dBm
Output 1 dB compression, high-gain mode	18	19	-	dBm
Output 1 dB compression, low-gain mode	16	17	-	dBm
Switching time, 50% control voltage to 90% or 10% of RX OUT1 or RX OUT2 in receive operation	-	350	-	ns
Switching time, 50% control voltage to 90% or 10% of LOAD1 or LOAD2 in transmit operation	-	530	-	ns
Electrical Performance in the 3.3 GHz–3.8 GHz Range				
Frequency range	3.3	-	3.8	GHz
Gain, high-gain mode at 3500 MHz	36	36.5	-	dB
Gain, low-gain mode at 3500 MHz	18	19	-	dB
Gain flatness, high-gain mode in any 100 MHz BW	-	0.4	0.5	dB
Gain flatness, low-gain mode in any 100 MHz BW	-	0.4	0.5	dB
Noise figure, high-gain mode at 3500 MHz	-	1	1.3	dB
Noise figure, low-gain mode at 3500 MHz	-	1	1.3	dB
Insertion loss at 3500 MHz	-	0.4	0.7	dB
Channel-to-channel isolation, RX OUT1 and RX OUT2, receiver high-gain mode at 3500 MHz	45	50	-	dB
Channel-to-channel isolation, LOAD1 and LOAD2, transmit mode at 3500 MHz	51	53	-	dB
Switch isolation, ANT1 to LOAD1 and ANT2 to LOAD2, receiver high-gain mode at 3500 MHz	12	13	-	dB
Electrical Performance in the 3.5 GHz–4.2 GHz Range				
Frequency range	3.5	-	4.2	GHz
Gain, high-gain mode at 3800 MHz	35	36	-	dB
Gain, low-gain mode at 3800 MHz	18	19	-	dB
Gain flatness, high-gain mode in any 100 MHz BW	-	0.5	0.6	dB
Gain flatness, low-gain mode in any 100 MHz BW	-	0.5	0.6	dB
Noise figure, high-gain mode at 3800 MHz	-	1	1.3	dB

Table 3 • PE53231 Electrical Specifications (Cont.)

Parameter/Condition	Min	Typ	Max	Unit
Noise figure, low-gain mode at 3800 MHz	-	1	1.3	dB
Insertion loss at 3800 MHz	-	0.4	0.65	dB
Channel-to-channel isolation, RX OUT1 and RX OUT2, receiver high-gain mode at 3800 MHz	48	56	-	dB
Channel-to-channel isolation, LOAD1 and LOAD2, transmit mode at 3800 MHz	52	54	-	dB
Switch isolation, ANT1 to LOAD1 and ANT2 to LOAD2, receiver high-gain mode at 3800 MHz	10.5	12	-	dB

Logic Table

Table 4 • PE53231 Logic Table

Mode	SW_CTRL1/2	LNA_CTRL1/2	BYPASS1/2
Tx mode	0V	1.8/5V	0V
Rx high-gain mode	1.8V	0V	0V
Rx low-gain mode	1.8V	0V	1.8V/5V

Typical Performance Data

Figure 2–Figure 17 show the typical performance data at 25 °C, V_{DD} = 5V (Z_S = Z_L = 50Ω at 25 °C), unless otherwise specified.

Figure 2 • Gain vs. Frequency at Various Temperatures, 3.3–3.8 GHz, Low Band

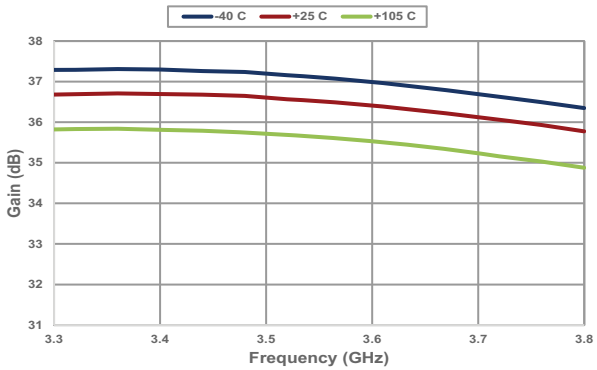


Figure 3 • Input/Output Return Loss vs. Frequency at Various Temperatures, Low Band

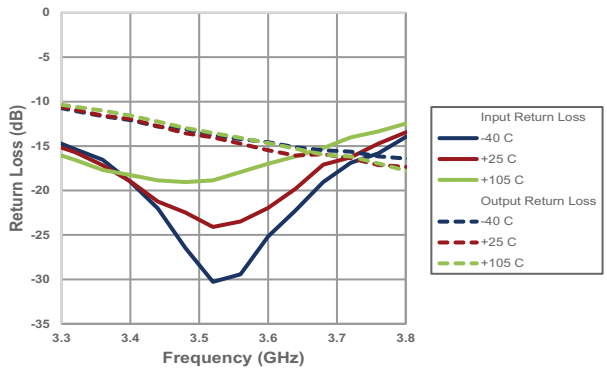


Figure 4 • Noise Figure vs. Frequency at Various Temperatures, Low Band

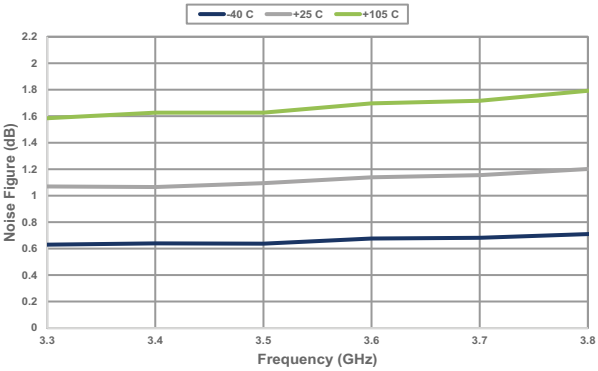


Figure 5 • Channel-to-channel Isolation vs. Frequency, Low Band

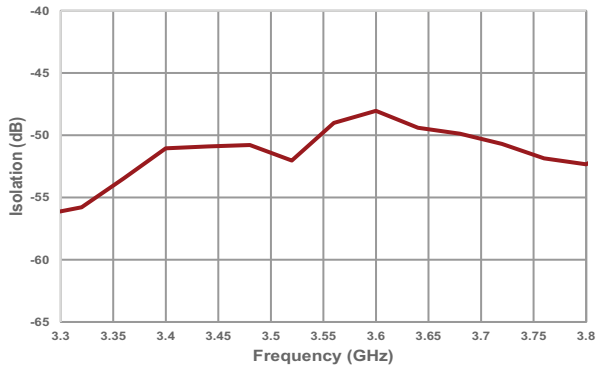


Figure 6 • Output IP3 vs. Frequency at Various Temperatures, Low Band

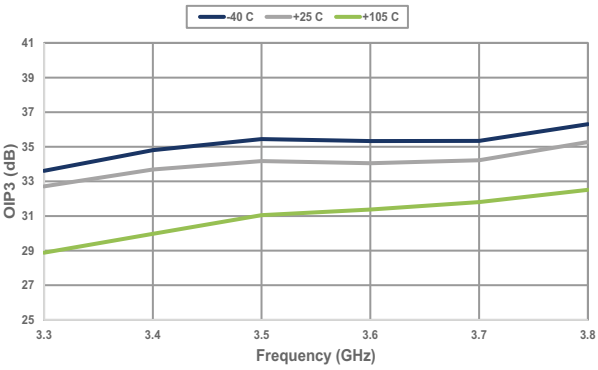


Figure 7 • Output IP3 vs. Output Power at Various Temperatures, 3.6 GHz, Low Band

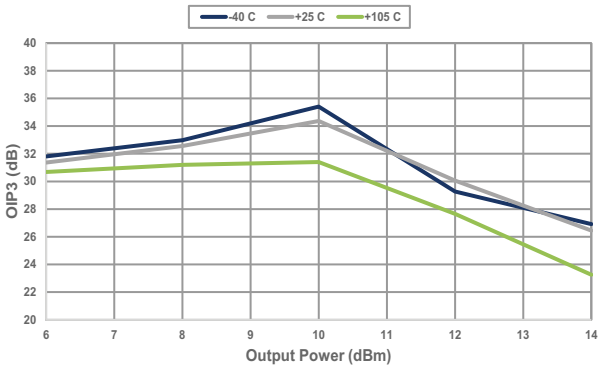


Figure 8 • Output P1dB vs. Frequency at Various Temperatures, Low Band

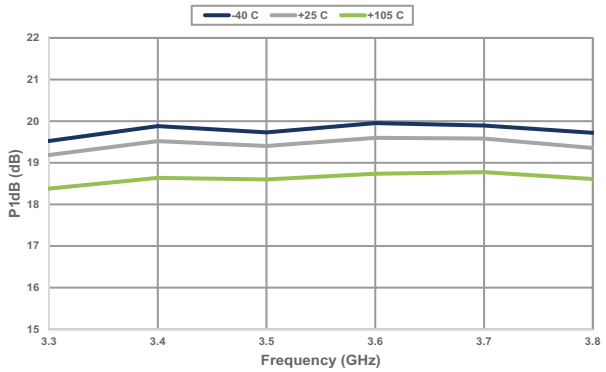


Figure 9 • Insertion Loss vs. Frequency at Various Temperatures, Low Band

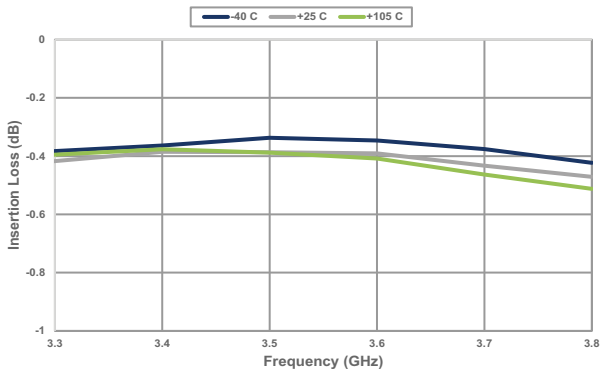


Figure 10 • Gain vs. Frequency at Various Temperatures, 3.5-4.2 GHz, High Band

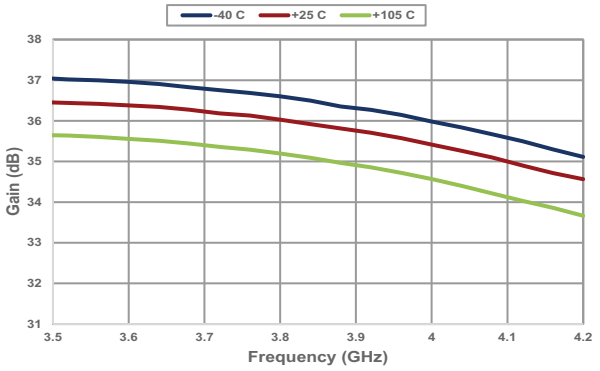


Figure 11 • Input/Output Return Loss vs. Frequency at Various Temperatures, High Band

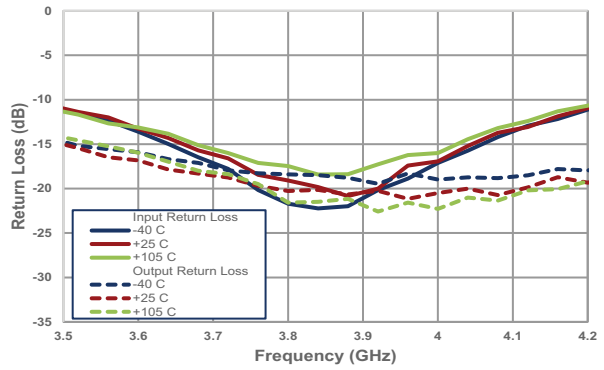


Figure 12 • Noise Figure vs. Frequency at Various Temperatures, High Band

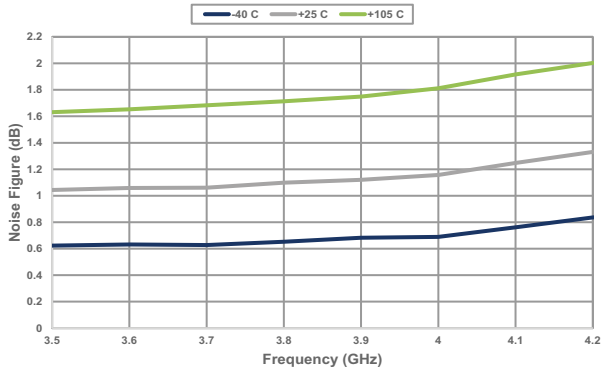


Figure 13 • Channel-to-channel Isolation vs. Frequency, High Band

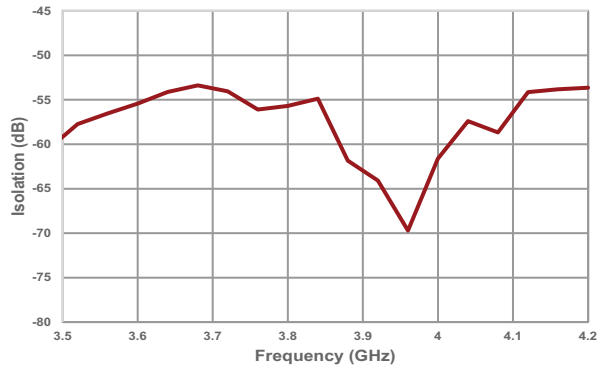


Figure 14 • Output IP3 vs. Frequency at Various Temperatures, , High Band

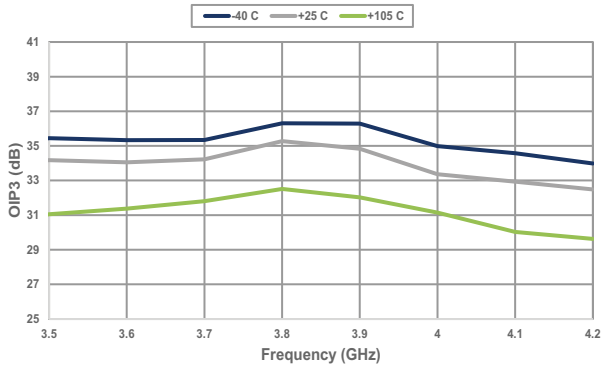


Figure 15 • Output IP3 vs. Output Power at Various Temperatures, 3.6 GHz, High Band

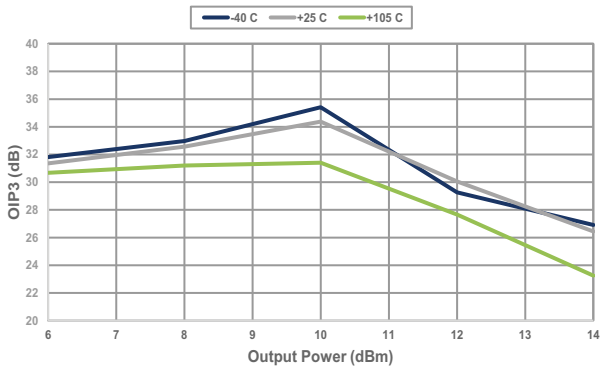


Figure 16 • Output P1dB vs. Frequency at Various Temperatures, High Band

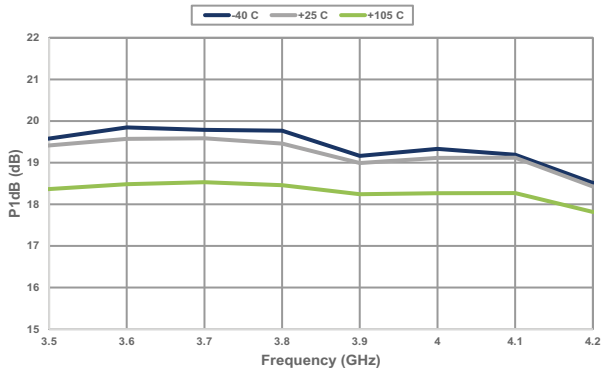
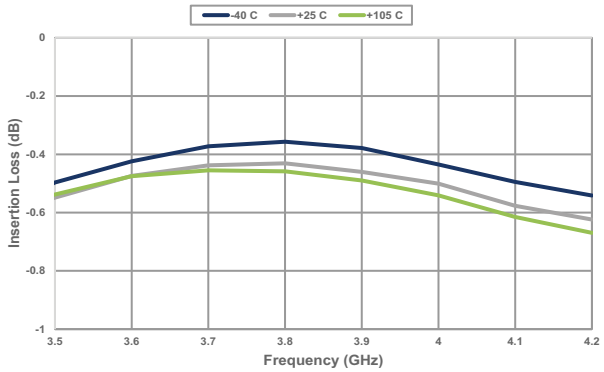


Figure 17 • Insertion Loss vs. Frequency at Various Temperatures, High Band



Pin Configuration

Figure 18 shows the PE53231 pin configuration for the 40-lead 6 × 6 mm LGA package. **Table 5** lists the description for each pin.

Figure 18 • Pin Configuration (Top View)

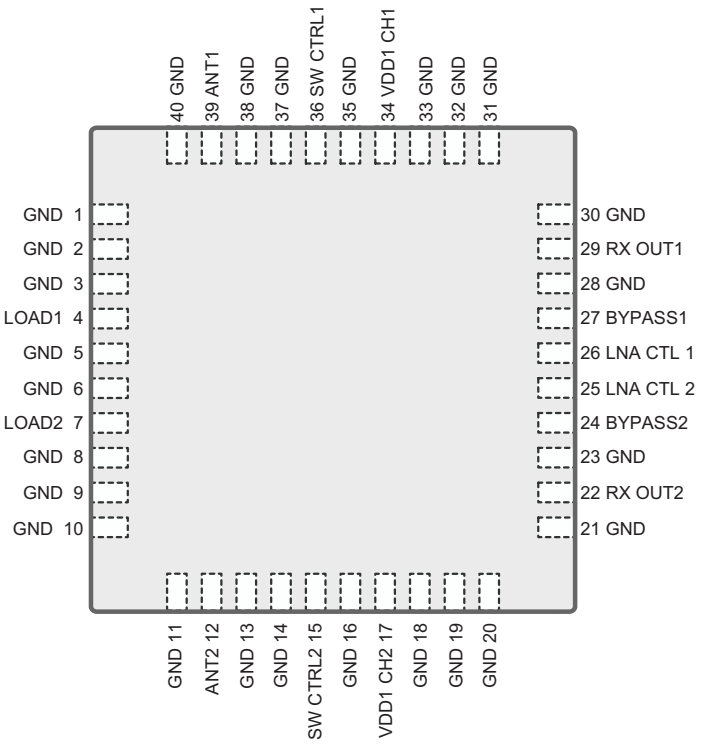


Table 5 • PE53231 Pin Descriptions

Pin No.	Pin Name	Description
1–3, 5–6, 8–11, 13–14, 16, 18–21, 23, 28, 30–33, 35, 37–38, 40	GND	Ground
4	LOAD1	Channel 1 load
7	LOAD2	Channel 2 load
12	ANT2	Channel 2 antenna
15	SW CTRL2	High power switch control channel 2
17	VDD1 CH2	Supply voltage channel 2
22	RX OUT2	RF output port channel 2
24	BYPASS2	LNA bypass control channel 2
25	LNA CTL 2	LNA enable control channel 2
26	LNA CTL 1	LNA enable control channel 1
27	BYPASS1	LNA bypass control channel 1
29	RX OUT1	RF output port channel 1
34	VDD1 CH1	Supply voltage channel 1
36	SW CTRL1	High power switch control channel 1
39	ANT1	Channel 1 antenna

Evaluation Board Schematics and BOMs

Figure 19 shows the evaluation board schematic for low-band (3.3-3.8 GHz) operations. **Table 6** lists the evaluation board bill of materials.

Figure 19 • PE53231 Evaluation Board Schematic for Low-band Operation (3.3-3.8 GHz)

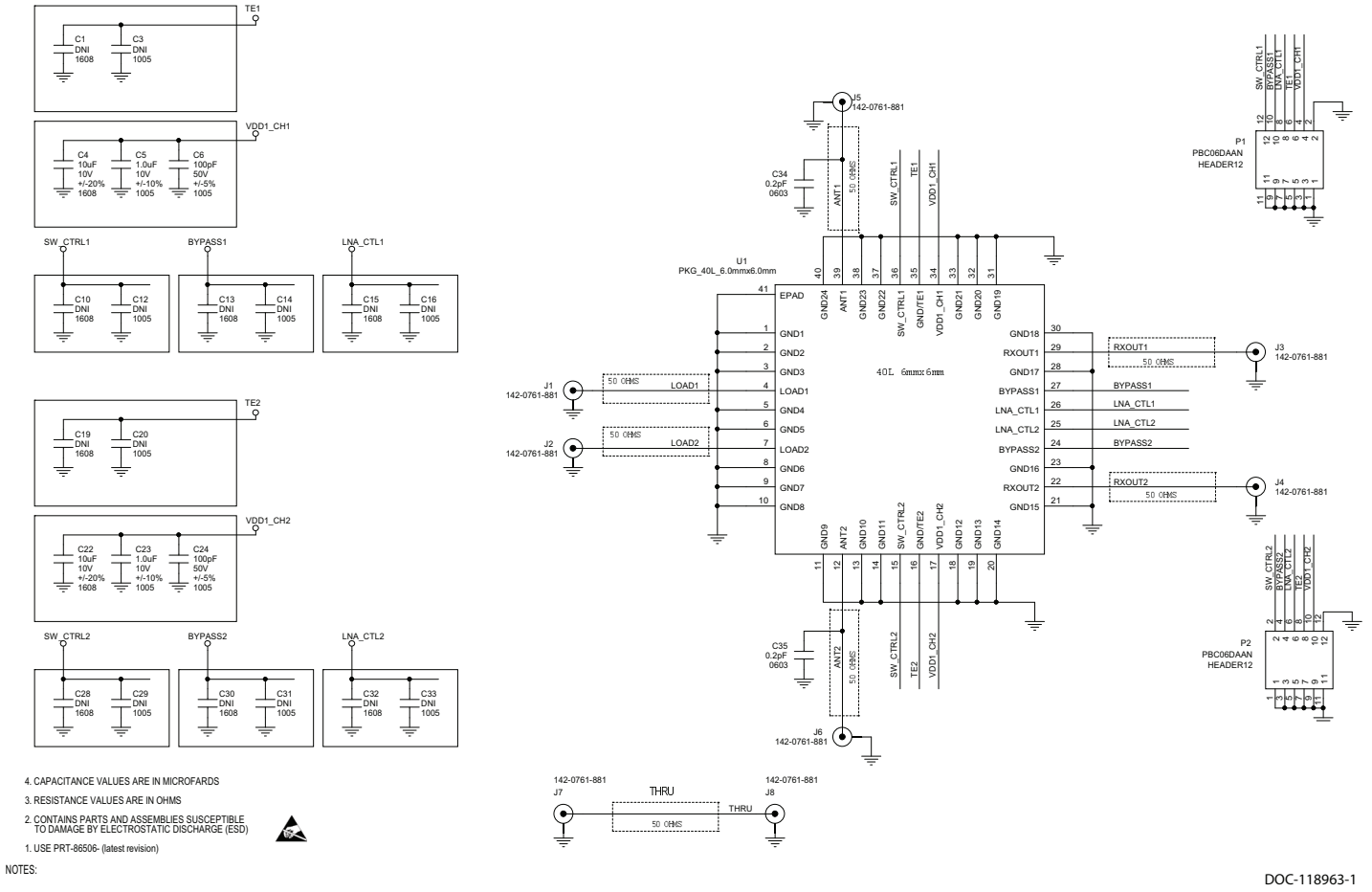


Table 6 • PE53231 Evaluation Board BOM Components (3.3-3.8 GHz)

Reference	Value	Description	Manufacturer	Mfg. Part Number
C1,C10,C13, C15,C19,C28, C30,C32	DNI	CAP, SMD, CER, TBD, n/a, n/a, n/a, 0603 (1608 Metric)	-	-
C3,C12,C14, C16,C20,C29, C31,C33	DNI	CAP, SMD, CER, TBD, n/a, n/a, n/a, 0402 (1005 Metric)	-	-
C4,C22	10 µF	CAP, SMD, CER, 10 µF, 10V, ±20%, X5R, 0603 (1608 metric)	Murata	GRM188R61A106ME69D
C5,C23	1.0 µF	CAP, SMD, CER, 10 µF, 10V, ±20%, X5R, 0402 (1005 metric)	Murata	GRM155R61A105KE01D
C6,C24	100 pF	CAP, SMD, CER, 100 pF, 50V, ±5%, C0G, NP0, 0402 (1005 Metric)	Murata	GRM1555C1H101JA01J
C34,C35	0.2 pF	CAP, SMD, CER, 0.2 pF, 100V, ±0.05 pF, X8G, 0201 (0603 Metric)	Murata	GJM0335G2AR20WB01
J1,J2,J3,J4,J5, J6,J7,J8	142-0761-881	CONN, Coaxial Connectors (RF), SMA, SMD, Jack, Female Socket, 50 Ohm	Cinch Connectivity Solutions Johnson	142-0761-881
PCB1	PCB	MISC, DOC, PCB, PCB, N/A	pSemi Corporation	PRT-86506-01
P1,P2	PBC06DAAN	CONN, Rectangular Connectors - Headers, Male Pins, Header Unshrouded Breakaway, TH, Male, 2	Sullins Connector Solutions	PBC06DAAN
U1	LGA 40-lead, 6 x 6 mm	Dual-channel Switch LNA Module, 3.3–4.2 GHz	pSemi Corporation	PE53231

Figure 20 shows the evaluation board schematic for high-band (3.5-4.2 GHz) operations.**Table 7** lists the evaluation board bill of materials.

Figure 20 • PE53231 Evaluation Board Schematic for High-band Operation (3.5-4.2 GHz)

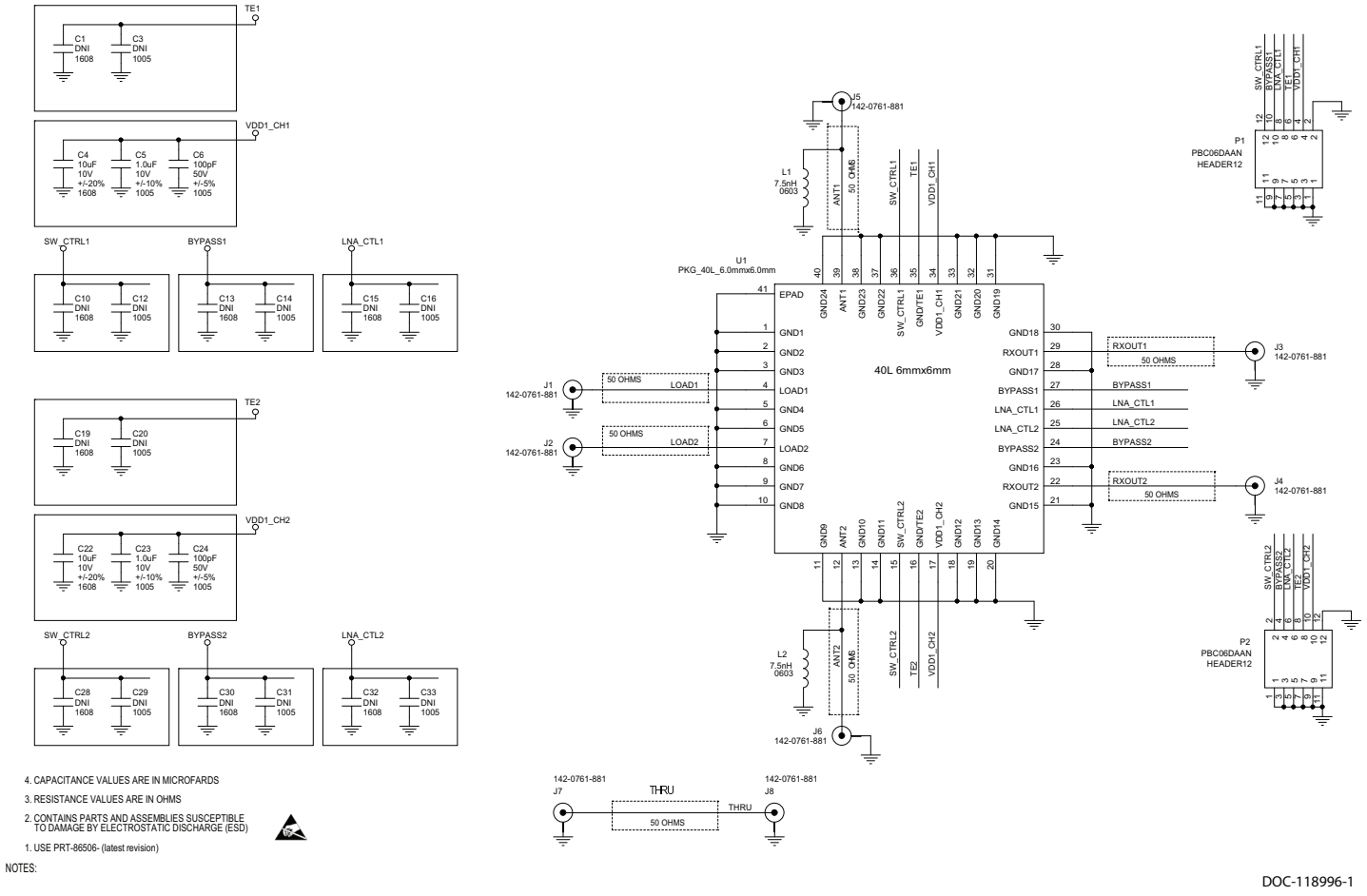


Table 7 • PE53231 Evaluation Board BOM Components (3.5-4.2 GHz)

Reference	Value	Description	Manufacturer	Mfg. Part Number
C1,C10,C13, C15,C19,C28, C30,C32	DNI	CAP, SMD, CER, TBD, n/a, n/a, n/a, 0603 (1608 Metric)	-	-
C3,C12,C14, C16,C20,C29, C31,C33	DNI	CAP, SMD, CER, TBD, n/a, n/a, n/a, 0402 (1005 Metric)	-	-
C4,C22	10 µF	CAP, SMD, CER, 10 µF, 10V, ±20%, X5R, 0603 (1608 metric)	Murata	GRM188R61A106ME69D
C5,C23	1.0 µF	CAP, SMD, CER, 10 µF, 10V, ±20%, X5R, 0402 (1005 metric)	Murata	GRM155R61A105KE01D
C6,C24	100 pF	CAP, SMD, CER, 100 pF, 50V, ±5%, C0G, NP0, 0402 (1005 Metric)	Murata	GRM1555C1H101JA01J
L1,L2	7.5 nH	IND, SMD, LQP03HQ, 7.5 nH, ±5% 0201 (0603 metric)	Murata	LQP03HQ7N5J02
J1,J2,J3,J4,J5, J6,J7,J8	142-0761-881	CONN, Coaxial Connectors (RF), SMA, SMD, Jack, Female Socket, 50 Ohm	Cinch Connectivity Solutions Johnson	142-0761-881
PCB1	PCB	MISC, DOC, PCB, PCB, N/A	pSemi Corporation	PRT-86506-01
P1,P2	PBC06DAAN	CONN, Rectangular Connectors - Headers, Male Pins, Header Unshrouded Breakaway, TH, Male, 2	Sullins Connector Solutions	PBC06DAAN
U1	LGA 40-lead, 6 x 6 mm	Dual-channel Switch LNA Module, 3.3–4.2 GHz	pSemi Corporation	PE53231

Packaging Information

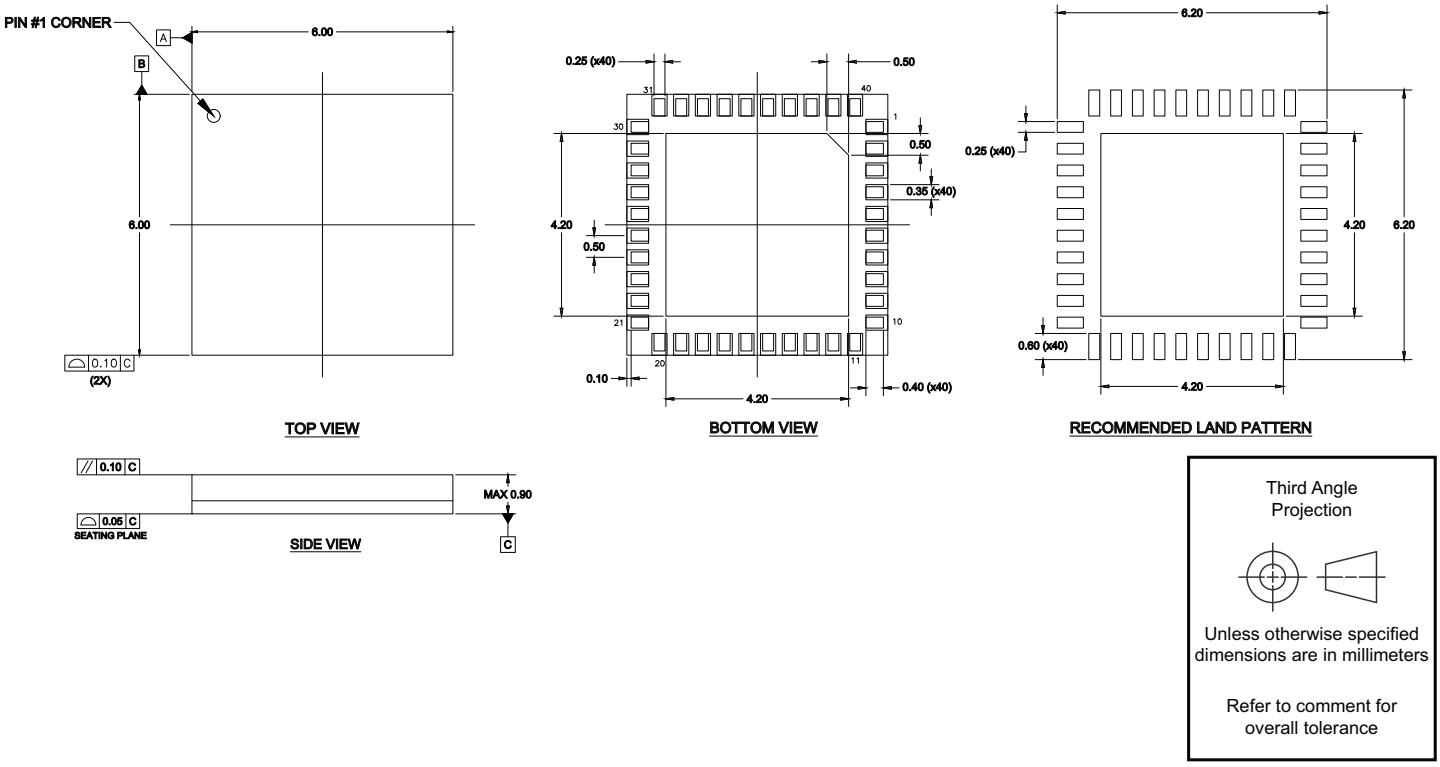
This section provides packaging data including the moisture sensitivity level, package drawing, package marking and tape-and-reel information.

Moisture Sensitivity Level

The PE53231 moisture sensitivity level rating for the 40-lead 6 × 6 mm LGA package is MSL 3.

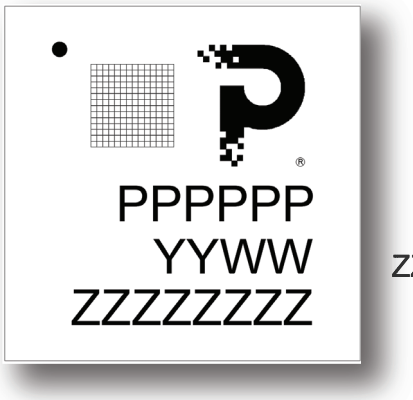
Package Drawing

Figure 21 • Package Mechanical Drawing for the 40-lead 6 × 6 mm LGA



Top-Marking Specification

Figure 22 • PE53231 Package Marking Specifications



● = Pin 1 indicator
PPPPPP = Product part number
YY = Last two digits of assembly year (2025 = 25)
WW = Work week of assembly lot start date (01, ..., 52)
ZZZZZZZZ = Assembly lot code (max eight characters)

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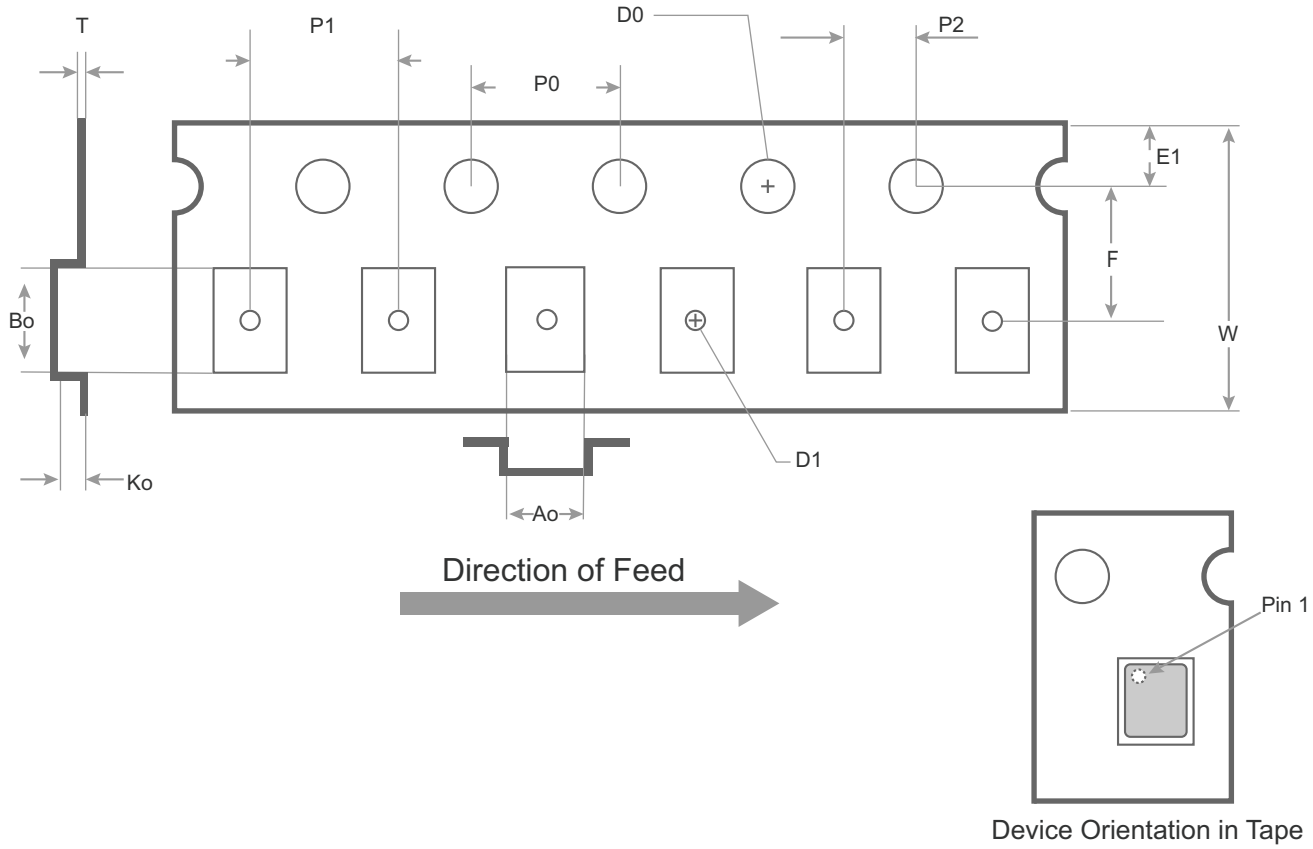
Tape and Reel Specification

Figure 23 • Tape and Reel Specifications for the 40-lead 6 × 6 mm LGA



Notes:

- The diagram is not drawn to scale.
- The units are in millimeters (mm).
- The maximum cavity angle is five degrees.
- The bumped die are oriented active side down.

Table 8 • Tape and Reel Dimensions

Carrier Tape Dimensions					
Pocket	**Nominal**	**Tolerance**	**Pocket**	**Nominal**	**Tolerance**
Ao	6.30	±0.05	**D1**	1.50	+0.10/-0
Bo	6.30	±0.05	**D0**	1.50	+0.10/-0
Ko	1.10	±0.10	**E1**	1.75	±0.10
P1	12.0	±0.10	**P0**	4.00	±0.10
W	16.0	±0.30	**P2**	2.00	±0.10
F	7.50	+0.10/-0	**T**	N/A	N/A

Ordering Information

Table 9 lists the PE53231 order codes and shipping methods.

Table 9 • PE53231 Order Codes and Shipping Methods

Order Codes	Description	Packaging	Shipping Method
PE53231A–Z	PE53231 switch LNA module	Green 40-lead 6 × 6 mm LGA	3000 units/T&R
EK53231–01	PE53231 low-band (3.3–3.8 GHz) evaluation kit	Evaluation kit	1/Box
EK53231–02	PE53231 high-band (3.5–4.2 GHz) evaluation kit	Evaluation kit	1/Box

Document Categories

Advance Information

The product is in a formative or design stage. The datasheet contains design target specifications for product development. Specifications and features may change in any manner without notice.

Preliminary Specification

The datasheet contains preliminary data. Additional data may be added at a later date. pSemi reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The datasheet contains final data. In the event pSemi decides to change the specifications, pSemi will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

Product Brief

This document contains a shortened version of the datasheet. For the full datasheet, contact sales@psemi.com.

Sales Contact

For additional information, contact Sales at sales@psemi.com.

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