PE562212

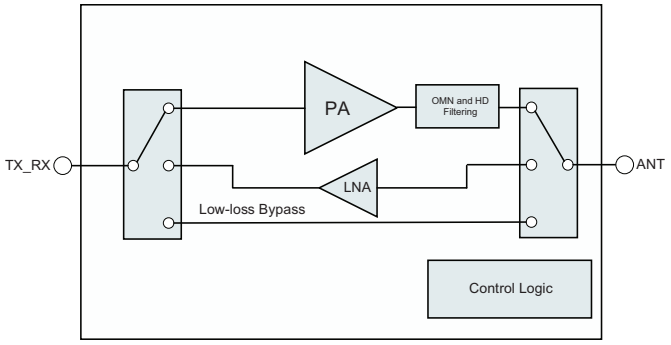
Document Category: Product Specification

2.4 GHz SOI Front-end Module for Thread/Zigbee®/Bluetooth®/ Wi-Fi® IoT Applications

Features

- Fully monolithic high-performance PA, LNA, SW
- Linear PA with up to +21 dBm output power
- Tx digital gain control with 15-dB range, 1-dB steps
- Excellent Rx NF (1.6 dB, typ.) with low-loss bypass path (0.6 dB, typ.)
- Bluetooth BDR (+21 dBm) and EDR (+15 dBm) operation
- Low-to-medium throughput Wi-Fi (MCS7) capability
- Minimal external components required (bypass cap on VCC and VDD)
- Packaging: Ultra-compact 14-lead 1.8 × 1.8 × 0.63 mm LGA (MSL3)
- GPIO control interface

Figure 1 • PE562212 Functional Diagram



Applications

- Smart speakers
- Smart lighting
- Smart thermostats
- In-home appliances
- Internet-of-Things (IoT) devices
- Range extenders
- Wireless audio
- Wearables
- Sensors

Product Description

The PE562212 is a high-performance, fully integrated FEM designed for Thread and Zigbee applications and Bluetooth, including Bluetooth Low Energy. The PE562212 is also capable of low-to-medium Wi-Fi throughput for devices that require FW upgrades or applications with the need for increased data traffic.

The PE562212 is manufactured on pSemi's UltraCMOS® process, a patented advanced form of silicon-on-insulator (SOI) technology.

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Absolute Maximum Ratings

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

Table 1 • PE562212 Absolute Maximum Ratings

Parameter	Condition	Min	Max	Unit
Supply voltage on VCC pin	–	–	3.8	V
Supply voltage on VDD pin	–	–	2.5	V
Storage temperature	–	-55	+150	°C
ESD (*)	All non-RF pins	-2500	2500	V
Note: * Human body model (MIL-STD 883 Method 3015).				

Recommended Operating Conditions

Table 2 lists the PE562212 recommended operating conditions. Do not operate devices outside the recommended operating conditions listed below.

Table 2 • PE562212 Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
Supply voltage on VCC pin	3	3.3	3.6	V
Supply voltage on VDD pin	1.6	1.8	2	V
Operating temperature	-20	–	85	°C

DC and Logic Specifications

Table 3 lists the key DC and logic specifications at 25 °C, V_{DD} = 1.8V, V_{CC} = 3.3V (Z_S = Z_L = 50Ω), unless otherwise specified.

Table 3 • PE562212 DC and Logic Specifications

Parameter	Conditions	Min	Typ	Max	Unit
DC					
Tx mode current	BDR GFSK, P_{OUT} = 21.0 dBm	–	145	–	mA
	BDR GFSK, P_{OUT} = 19.5 dBm	–	134	–	mA
	EDR 8-DPSK, P_{OUT} = 15 dBm	–	92	–	mA
	EDR 8-DPSK, P_{OUT} = 12 dBm	–	81	–	mA
	P_{OUT} = No RF (quiescent current, from V_{CC})	–	65	–	mA
Rx mode current	From V_{DD}	–	4.8	–	mA
Bypass mode current	V_{CC} current	–	35	–	µA
Sleep mode current	High isolation state	–	5	–	µA
Startup time	FEM turn-on and turn-off time (V_{DD} and V_{CC} both high)	–	20	–	µs
Rx/Bypass -> Tx/Bypass switching time	From 50% of CTRL edge to 10%/90% of RF output power	–	230	–	ns
Tx/Bypass -> Rx/Bypass switching time	From 50% of CTRL edge to 10%/90% of RF output power	–	390	–	ns
Logic (GPIO)					
Control voltage - High	V_{IH}	1.2	1.8	2	V
Control voltage - Low	V_{IL}	–	0	0.4	V

Electrical Specifications

Table 4 lists the key electrical specifications at 25 °C, V_{DD} = 1.8V, V_{CC} = 3.3V (Z_S = Z_L = 50Ω), unless otherwise specified.

Table 4 • PE562212 Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Unit
Transmit					
Frequency range		2400	–	2483.5	MHz
Output power at ANT	BDR, GFSK	–	21	–	dBm
	EDR, 8-DPSK	–	15	–	dBm
Small signal gain (S21)		–	23	–	dB
Second harmonics (2fo)	P_{OUT} = 21 dBm, Bluetooth GFSK	–	-37	–	dBm/ MHz
Third harmonics (3fo)	P_{OUT} = 21 dBm, Bluetooth GFSK	–	-42	–	dBm/ MHz
Input return loss		–	12	–	dB
Output return loss		–	9	–	dB
Tx EVM	P_{OUT} = 21 dBm, Thread modulation	–	-40.5	–	dB
Receive					
Frequency range		2400	–	2483.5	MHz
Receive gain	P_{IN} = –35 dBm	–	15.0	–	dB
Receive noise figure (NF)	P_{IN} = –35 dBm	–	1.6	–	dB
Third order input intercept point (IIP3)	P_{IN} = –15 dBm, 1 MHz tone spacing (in-band)	–	-5.0	–	dBm
Input return loss		–	9	–	dB
Output return loss		–	11	–	dB
Rx gain variation over frequency		–	0.5	–	dB
Rx gain variation over temperature		–	0.5	–	dB
Ruggedness	CW, P_{IN} = 20 dBm, load VSWR = 6:1, 0-360 phase angles	No damage			–
Bypass path					
Bypass loss		–	0.6	–	dB
Input return loss		–	13	–	dB
Output return loss		–	13	–	dB

Adjacent Channel Power for Bluetooth EDR Applications

Figure 2–Figure 9 show the typical ACP measurements for enhanced data rate modulations (π/4-DQPSK and 8-DPSK). Measurements taken at 25 °C, V_{DD} = 1.8V, V_{CC} = 3.3V, Z_s = Z_L = 50 Ohms, f = 2441 MHz, unless otherwise specified.

Figure 2 • ACP CH-2 vs. P_{OUT}, (π/4-DQPSK with 2-DH5 packets)

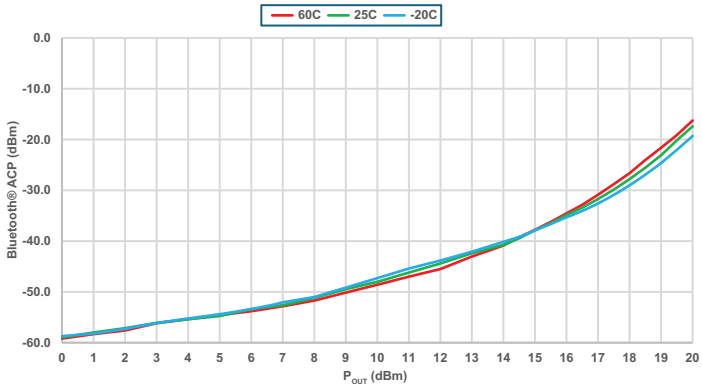


Figure 3 • ACP CH+2 vs. P_{OUT}, (π/4-DQPSK with 2-DH5 packets)

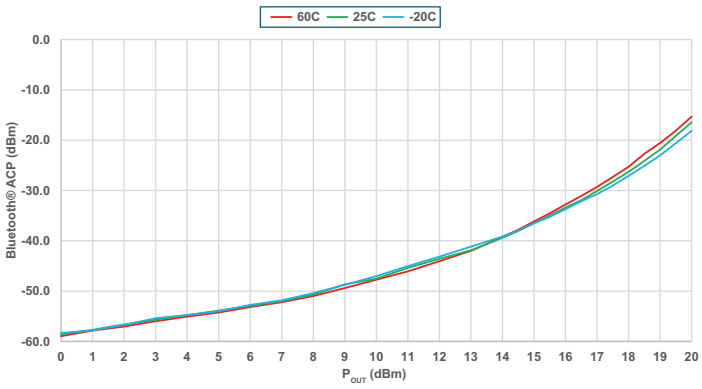


Figure 4 • ACP CH-3 vs. P_{OUT}, (π/4-DQPSK with 2-DH5 packets)

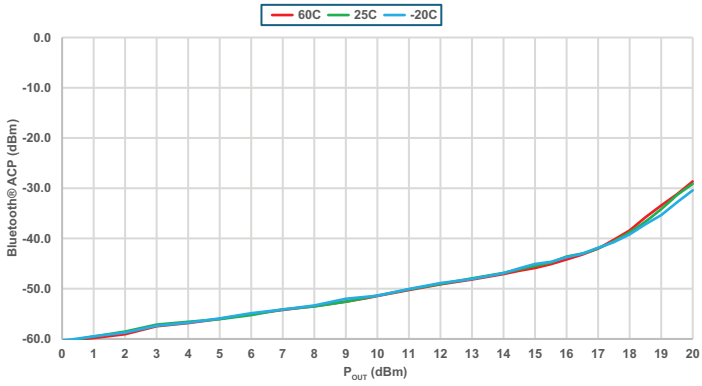


Figure 5 • ACP CH+3 vs. P_{OUT}, (π/4-DQPSK with 2-DH5 packets)

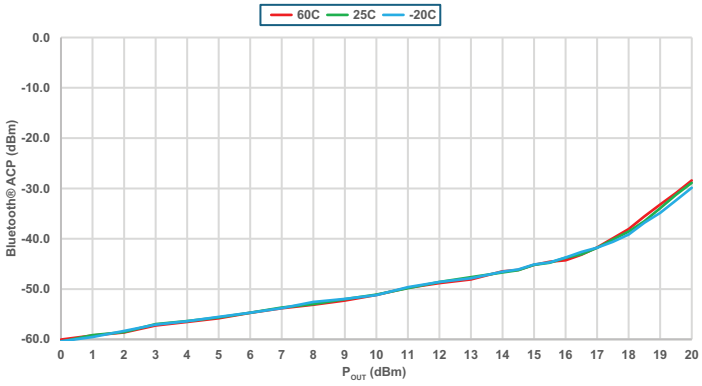


Figure 6 • ACP CH-2 vs. P_{OUT}, (8-DPSK with 3-DH5 packets)

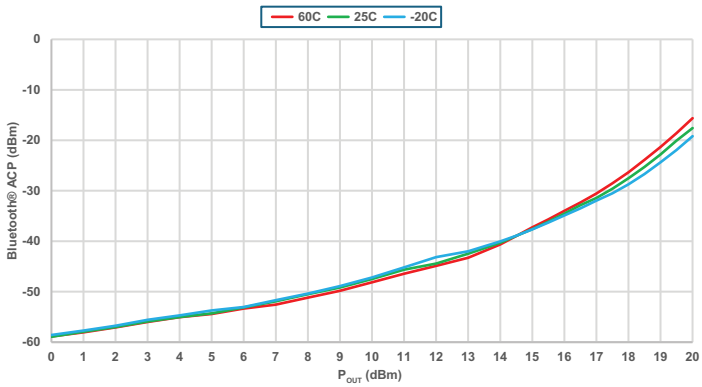


Figure 7 • ACP CH+2 vs. P_{OUT}, (8-DPSK with 3-DH5 packets)

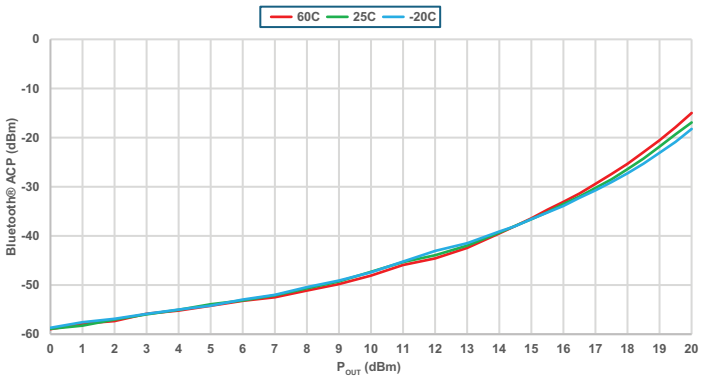


Figure 8 • ACP CH-3 vs. P_{OUT}, (8-DPSK with 3-DH5 packets)

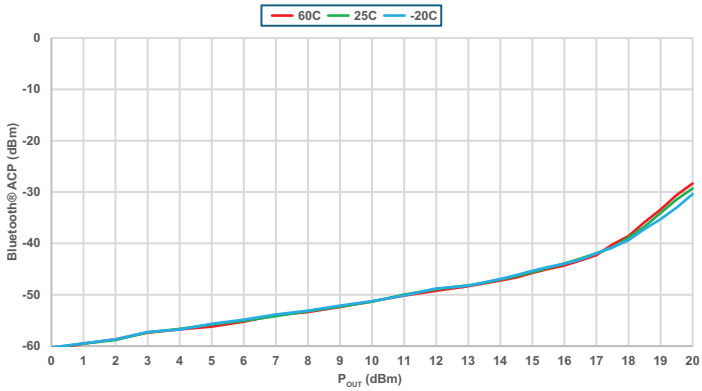
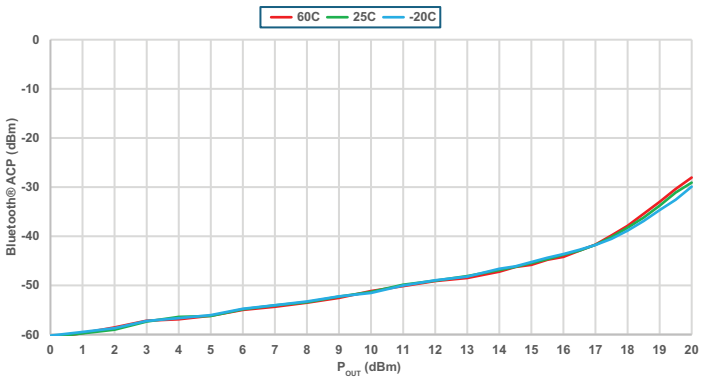
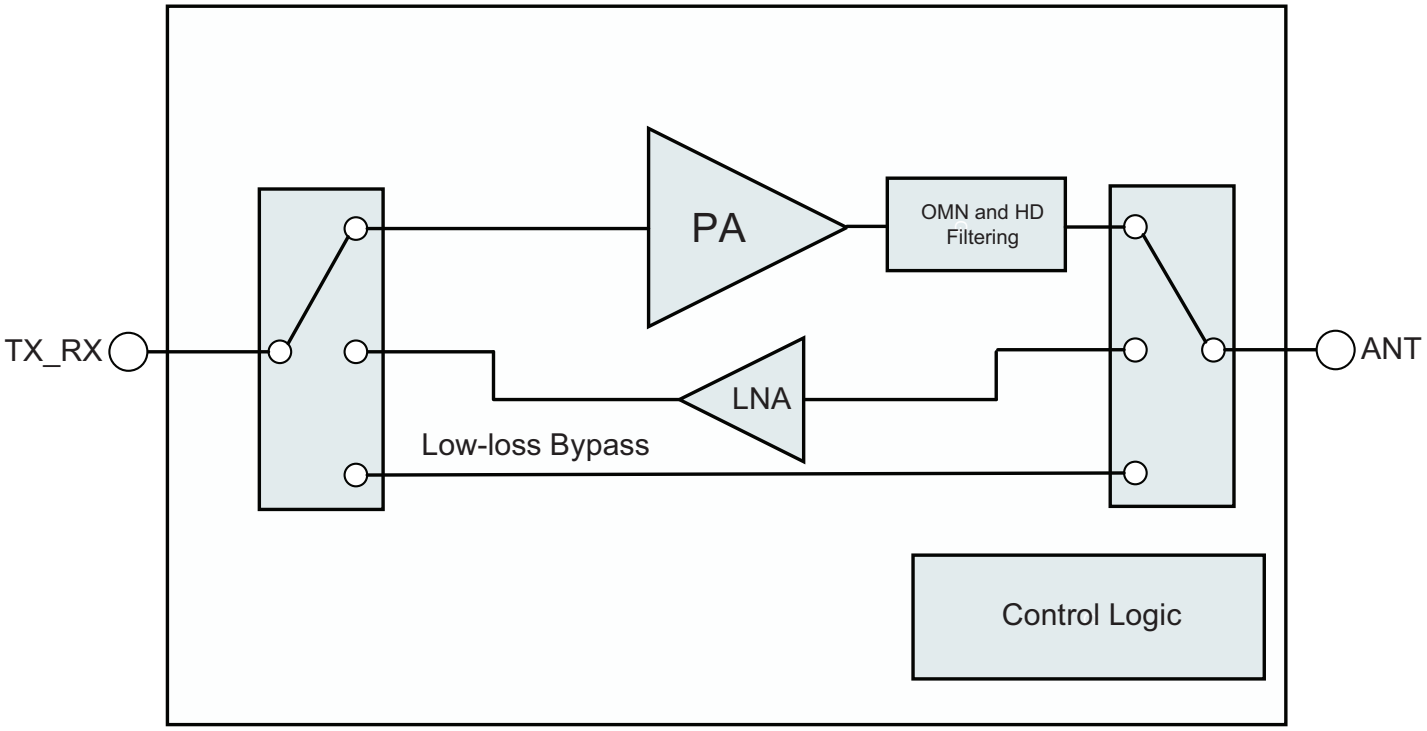


Figure 9 • ACP CH+3 vs. P_{OUT}, (8-DPSK with 3-DH5 packets)



Block Diagram

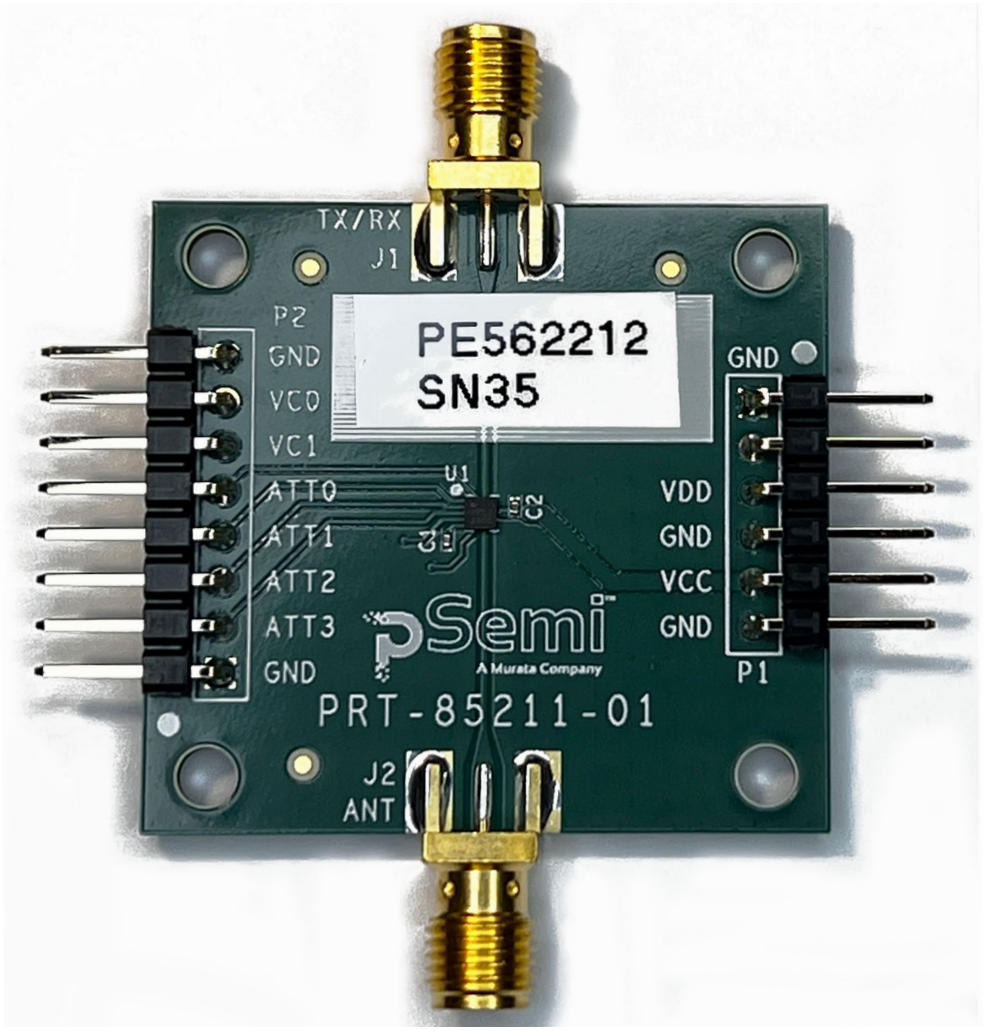
Figure 10 • PE562212 Block Diagram



Evaluation Board

pSemi designed the PE562212 evaluation board to ease your evaluation of the PE562212 2.4 GHz SOI IoT Front-end Module.

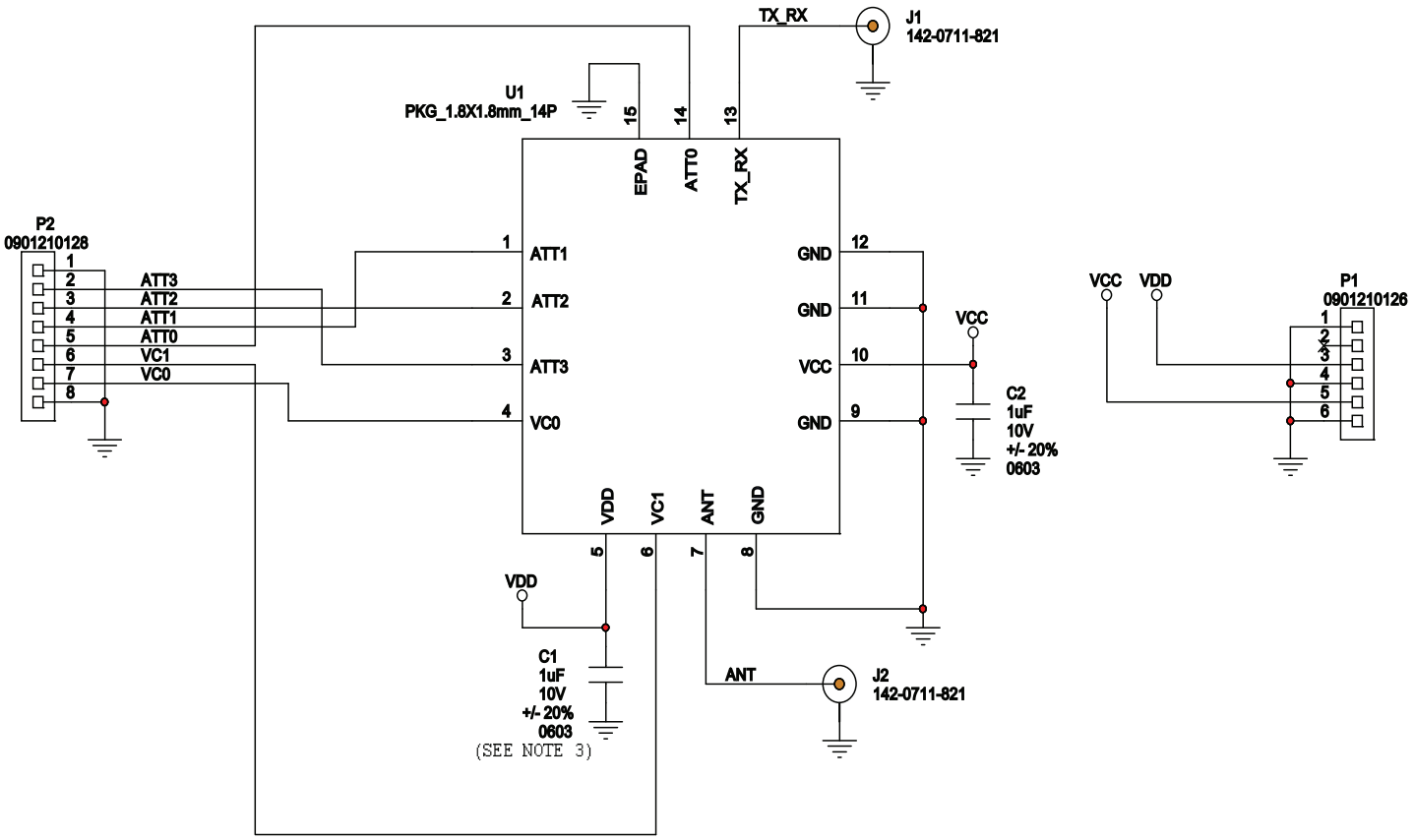
Figure 11 • PE562212 Evaluation Board



Evaluation Board Schematic and BOM

Figure 12 shows the evaluation board schematic, and **Table 5** lists the evaluation board bill of materials.

Figure 12 • PE562212 Evaluation Board Schematic



NOTES:
1. USE PRT-85211-01.
2. CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).
3. C1 1µF CAPACITOR IS OPTIONAL.

Table 5 • PE562212 Evaluation Board BOM Components

Reference	Value	Description	Manufacturer	Mfg. Part Number
C1, C2	1 µF	CAP, SMD, CER, 1uF, 10V, +/- 20%, X6S, 0201 (0603 Metric)	Murata Corporation	GRM033C81A 105ME05D
J1, J2	142-0711-821	CONN, Coaxial Connectors (RF), SMA, SMD, Jack, Female Socket, 50 Ohm	Cinch Connectivity Solutions Johnson	142-0711-821
P1	0901210126	CONN, Rectangular Connectors - Headers, Male Pins, Header, Breakaway, TH-RA, Male Pin, C-Grid III 90121	Molex	0901210126
P2	0901210128	CONN, Rectangular Connectors - Headers, Male Pins, Header, Breakaway, TH-RA, Male Pin, C-Grid III 90121	Molex	0901210128
PCB1	PCB	MISC, DOC, PCB, Universal RF EVB	pSemi Corporation	PRT-85211-01
U1	PKG_1.8X1.8mm_ 14P	IC, SMD, pSemi IC, LGA, 1.8mm x 1.8mm	pSemi Corporation	PE562212

Truth Table

Table 6 • PE562212 Truth Table

MODE	VC1	VC0	ATT3	ATT2	ATT1	ATT0
SLEEP	0	0	X	X	X	X
RX	0	1	X	X	X	X
TX	1	0	0	0	0	0
TX -1 dB			0	0	0	1
TX -2 dB			0	0	1	0
TX -3 dB			0	0	1	1
TX -4 dB			0	1	0	0
TX -5 dB			0	1	0	1
TX -6 dB			0	1	1	0
TX -7 dB			0	1	1	1
TX -8 dB			1	0	0	0
TX -9 dB			1	0	0	1
TX -10 dB			1	0	1	0
TX -11 dB			1	0	1	1
TX -12 dB			1	1	0	0
TX -13 dB			1	1	0	1
TX -14 dB			1	1	1	0
TX -15 dB			1	1	1	1
BYPASS	1	1	X	X	X	X

Pin Configuration

Figure 13 shows the PE562212 pin map for the 14-lead 1.8 × 1.8 × 0.63 mm LGA package, and **Table 7** lists the description for each pin.

Figure 13 • PE562212 Pin Configuration (Top View)

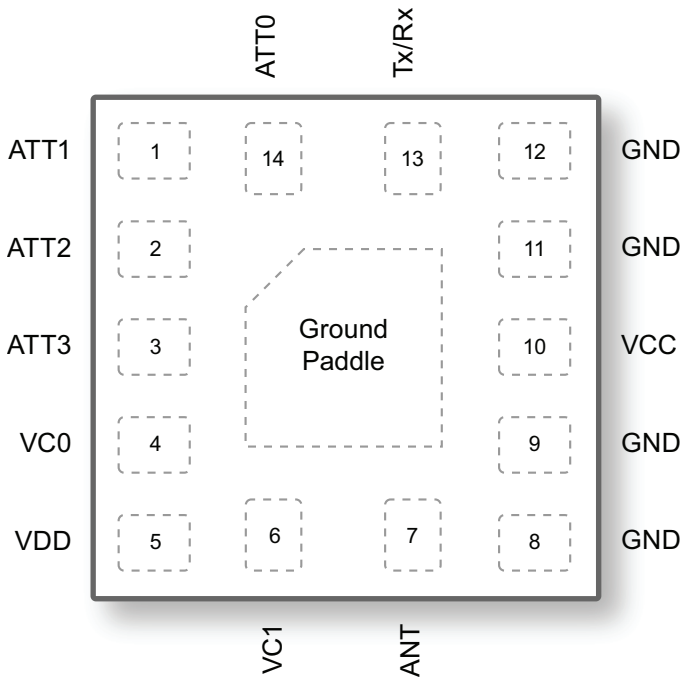


Table 7 • PE562212 Pin Descriptions

Pin No.	Pin Name	Description
1	ATT1	Gain control bit (2 dB)
2	ATT2	Gain control bit (4 dB)
3	ATT3	Gain control bit (8 dB)
4	VC0	Mode control pin 0
5	VDD	1.8V supply voltage
6	VC1	Mode control pin 1
7	ANT	Antenna
8	GND	Ground
9	GND	Ground
10	VCC	3.3V supply voltage
11	GND	Ground
12	GND	Ground
13	Tx/Rx	Transmit/receive
14	ATT0	Gain control bit (1 dB)

Packaging Information

This section provides the following packaging data:

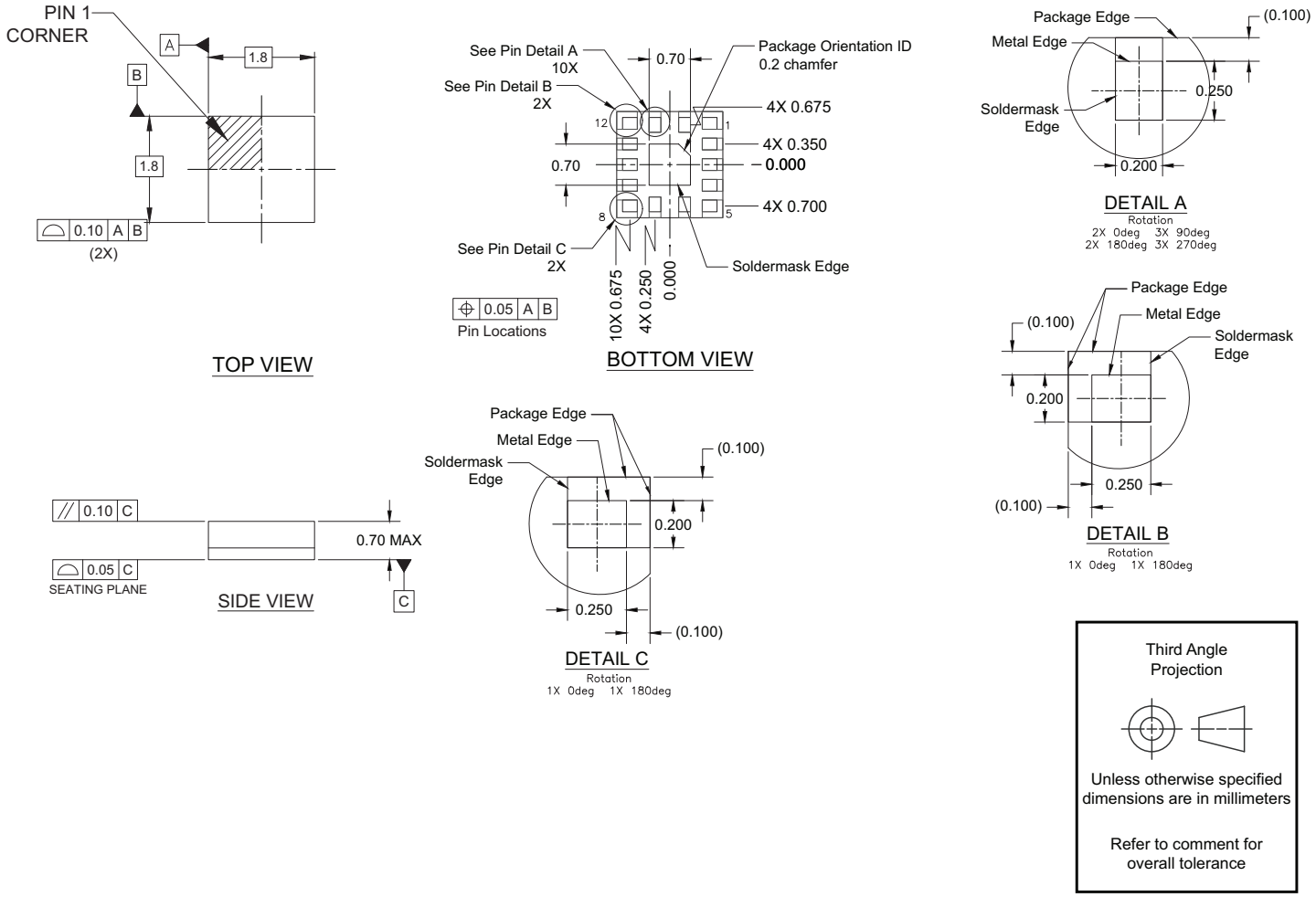
- Moisture sensitivity level
- Package drawing
- Package marking
- Tape-and-reel information

Moisture Sensitivity Level

The PE562212 moisture sensitivity level rating for the 14-lead 1.8 × 1.8 × 0.63 mm LGA package is MSL 3.

Package Drawing

Figure 14 • Package Mechanical Drawing for the 14-lead 1.8 × 1.8 × 0.63 mm LGA package



Top-Marking Specification

Figure 15 • PE562212 Package Marking Specification

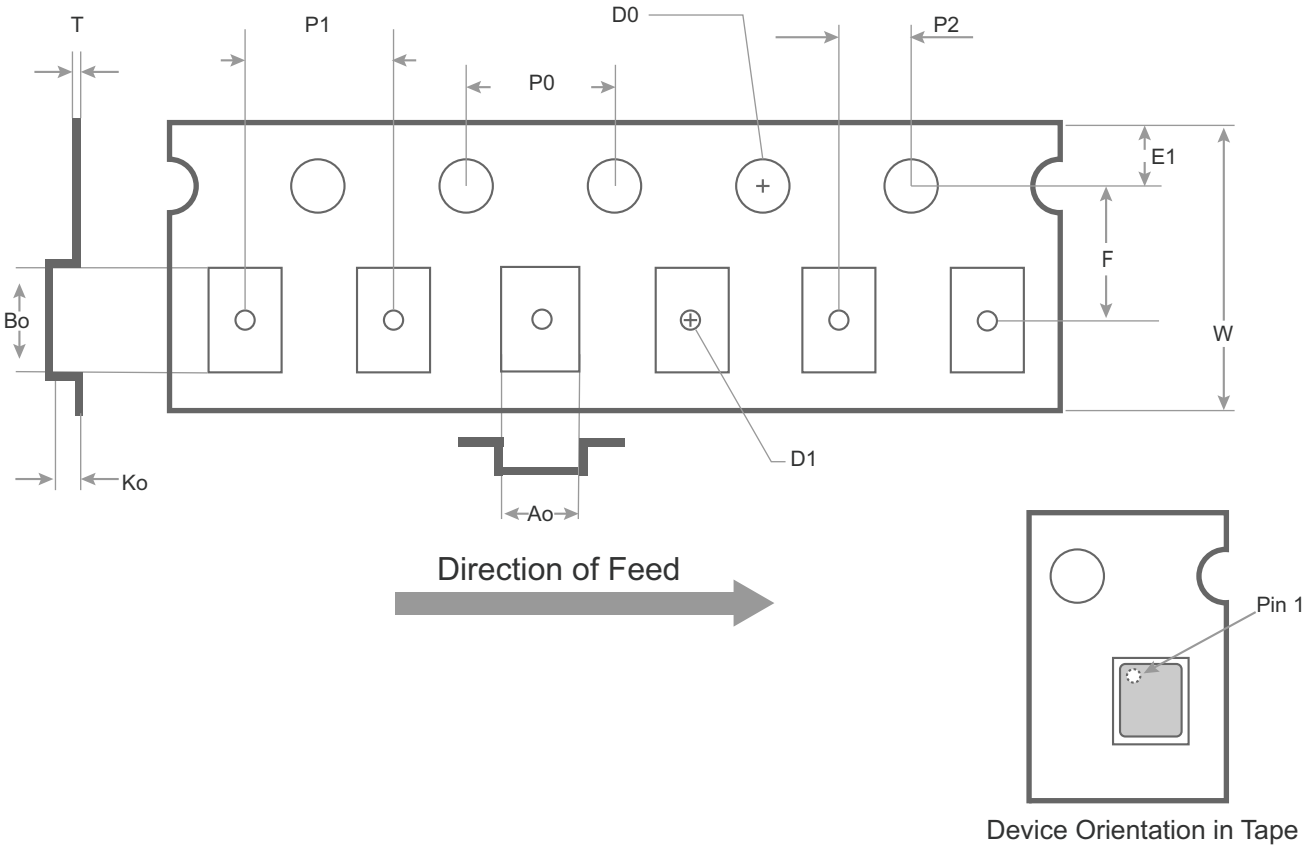
● = Pin 1 indicator
PP = Product part number code
ZZ = Last two characters of assembly lot code
YY = Last two digits of assembly year (23 for 2023, etc.)
WW = Work week of assembly lot molding (01, ..., 52)

DOC-113771

Tape and Reel Specification

This section provides the PE562212 tape and reel specification.

Figure 16 • PE562212 Tape and Reel Specification



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 • PE562212 Tape and Reel Dimensions

Carrier Tape Dimensions					
Pocket	**Nominal**	**Tolerance**	**Pocket**	**Nominal**	**Tolerance**
Ao	2.05	±0.05	**D1**	0.50	±0.05
Bo	2.05	±0.05	**D0**	1.50	+0.10/-0
Ko	1.00	±0.10	**E1**	1.75	±0.10
P1	4.00	±0.10	**P0**	4.00	±0.10
W	8.00	+0.30/-0.10	**P2**	2.00	±0.05
F	3.50	±0.05	**T**	0.30	±0.05

Ordering Information

Table 9 • PE562212 Order Codes and Shipping Methods

Order Codes	Description	Packaging	Shipping Method
PE562212A-R	2.4 GHz IoT FEM	Green 14-lead 1.8 × 1.8 × 0.63 mm LGA	5000 units T/R
EK562212-01	PE562212 Evaluation board	Evaluation board	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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