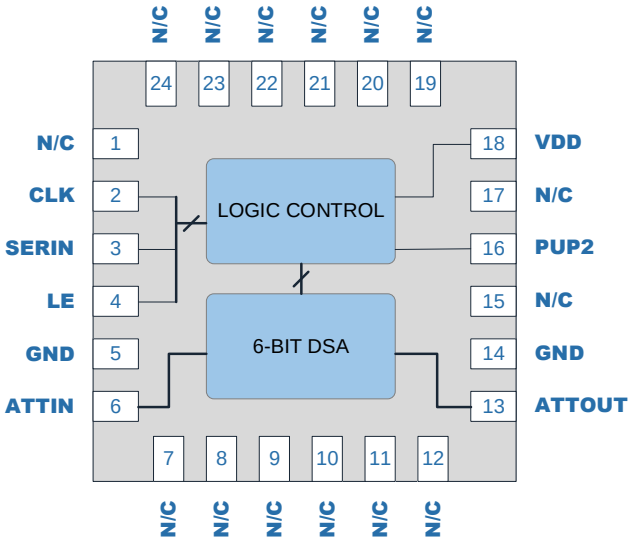
RFMD + TriQuint = Qorvo

QPC6614

5 MHz to 6000 MHz, Digital Step Attenuator

The QPC6614 is a 6-bit digital step attenuator (DSA) that features high linearity over the entire 31.5 dB gain control range with 0.5 dB steps. The QPC6614 uses serial control interface. The QPC6614 has a low insertion loss of 1.4 dB at 2 GHz. Patented circuit architecture provides overshoot-free transient switching performance. The QPC6614 is available in a 4.2 mm x 4.2 mm MCM package.



Functional Block Diagram

Package: MCM, 24-pin,
4.2 mm x 4.2 mm x 0.975 mm

Features

- 6-Bit, 31.5 dB, 0.5 dB Step
- Patented Circuit Architecture
- Overshoot-free Transient Switching Performance
- Frequency Range 5 MHz to 6000 MHz
- High Linearity, IIP3 >+55 dBm
- Serial Control Interface
- Fast Switching Speed, <120 nsec Typical
- Single Supply 3 V to 5 V Operation
- RF Pins Have No DC Voltage, Can be DC Grounded Externally
- Power-up attenuation state programmable

Applications

- 2G through 4G Base Stations
- Point-to-Point
- WiFi
- Test Equipment

Ordering Information

QPC6614SQ	Sample bag with 25 pieces
QPC6614SR	7" Reel with 100 pieces
QPC6614TR13	13" Reel with 2500 pieces
QPC6614PCK401	5 MHz to 6000 MHz PCBA w/ 5-piece sample bag

Absolute Maximum Ratings

Parameter	Rating	Units
Supply Voltage (V_{DD})	−0.5 to +6.0	V
All Other DC and Logic Pins (When V_{DD} Is Applied Prior to Any Other Pin Voltages)	−0.5 to V_{DD}	V
All Other DC and Logic Pins (When V_{DD} Is Not Applied Prior to Any Other Pin Voltages)	−0.5 to +4.0	V
Maximum Input Power at ATTIN Pin at +85°C Case Temperature	+30	dBm
Maximum Input Power at ATTOUT Pin at +85°C Case Temperature	+27	dBm
Storage Temperature Range	−40 to +150	°C
ESD Rating - Human Body Model (HBM)	1000	V
Moisture Sensitivity Level	MSL2	

Caution! ESD sensitive device.

RFMD Green: RoHS status based on EU Directive 2011/65/EU (at time of this document revision), halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

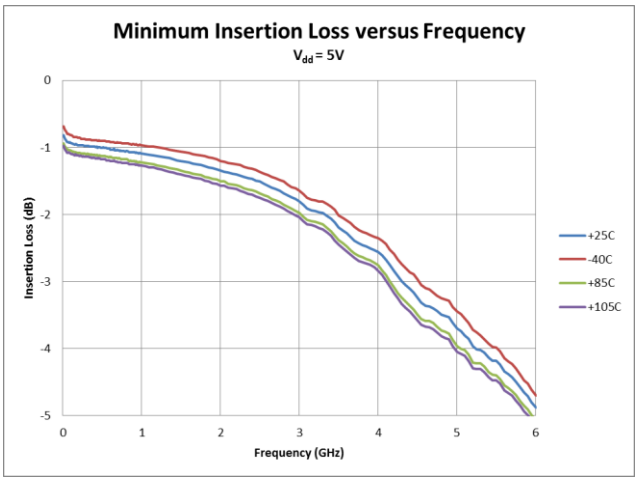
Recommended Operating Condition

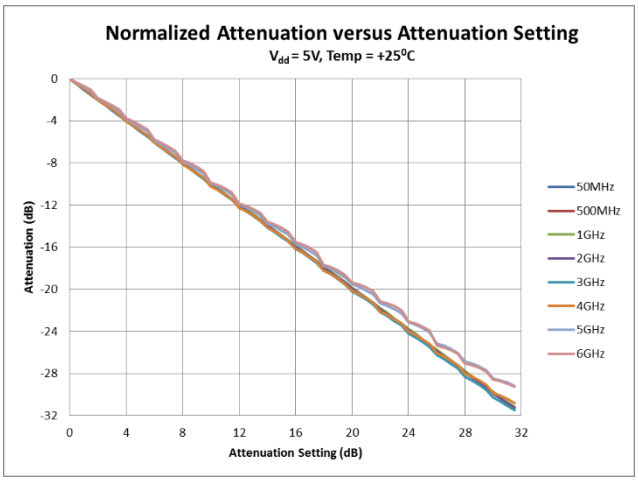
Parameter	Specification			Units
	Min	Typ	Max	
Operation Temperature Range (Derate RF Input Power Handling Above 85 °C)	−40		+105	°C
Operating Junction Temperature			+125	°C
Supply Voltage	+2.7		+5.5	V

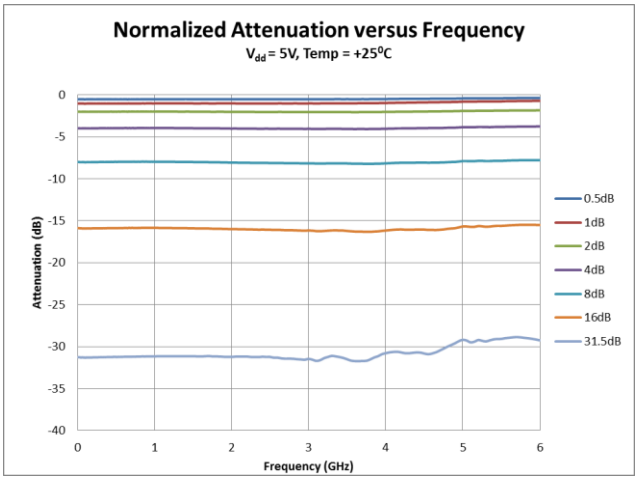
Electrical Specifications

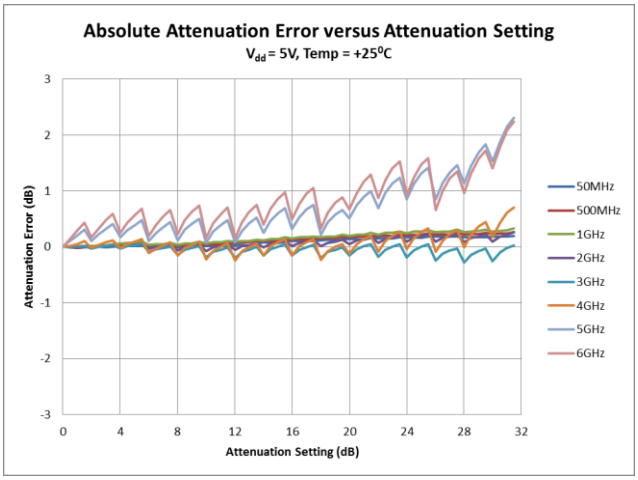
Parameter	Specification			Units	Condition
	Min	Typ	Max		
General Performance					
Supply Current		180		µA	Steady state operation, current draw during attenuation state transitions is higher
Thermal Resistance		60		°C/W	At maximum attenuation state with RF power applied to the ATTIN pin
RF Input Power at ATTIN Pin			+27	dBm	Continuous operation at +85 °C case temperature
RF Input Power at ATTOUT Pin			+20	dBm	
RF Performance					**Typical Performance at 2000 MHz, V_{SUPPLY}=+5 V, Temp. = +25°C**
Frequency Range	5		6000	MHz	
Insertion Loss		1.4	2.4	dB	0 dB attenuation
Attenuation Range		31.5		dB	0.5 dB step size
Absolute Attenuation Error		0.3 ± 3%		dB	
Input IP3		+55		dBm	
Input P0.1dB		+30		dBm	
Return Loss		15		dB	
Input and Output Impedance		50		Ω	
Switching Speed		120		nsec	50 % control to 10 % / 90 % RF
Successive Step Phase Delta		2		Deg	
Control					**Serial Bus and PUP2 Pins**
Digital Logic Low			+0.63	V	
Digital Logic High	+1.17			V	

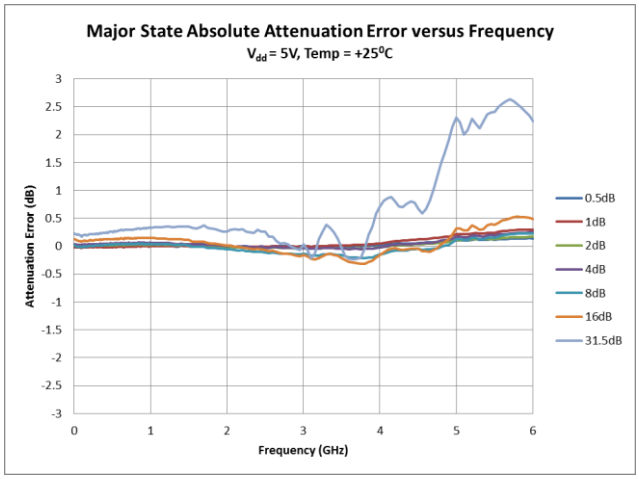
RF Performance Plots

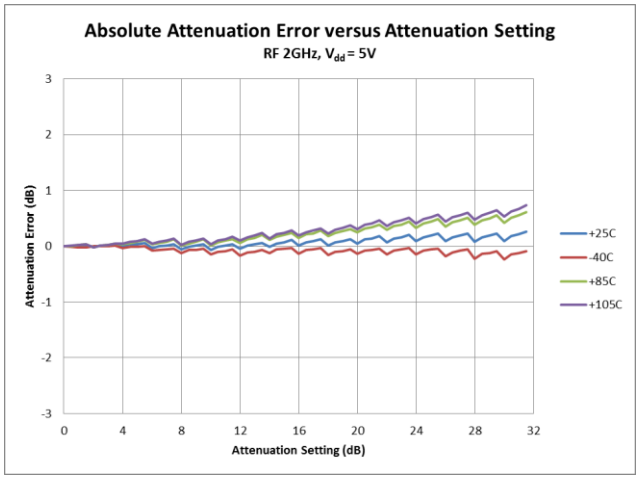




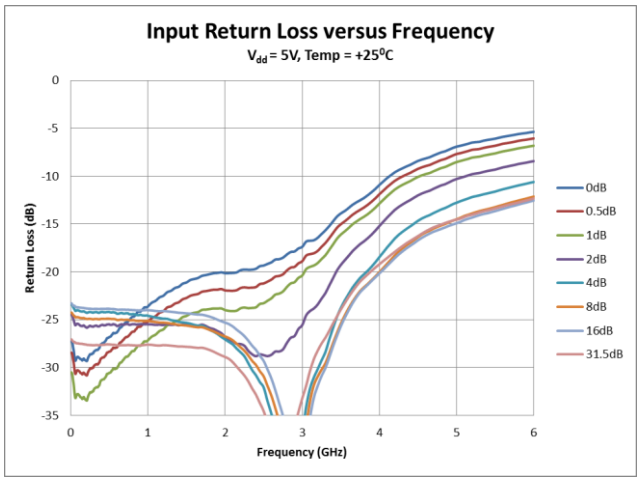


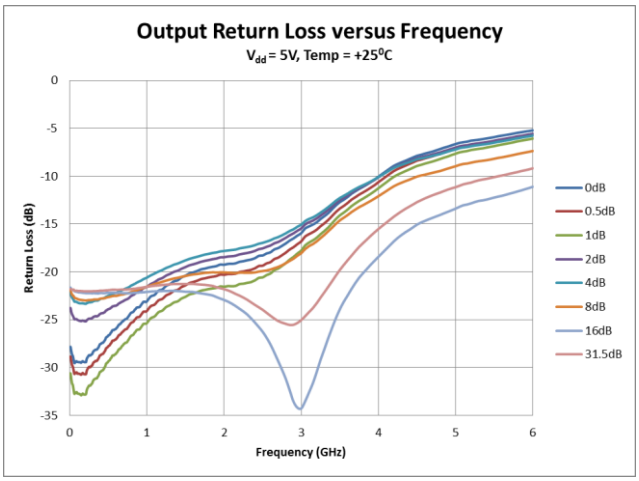


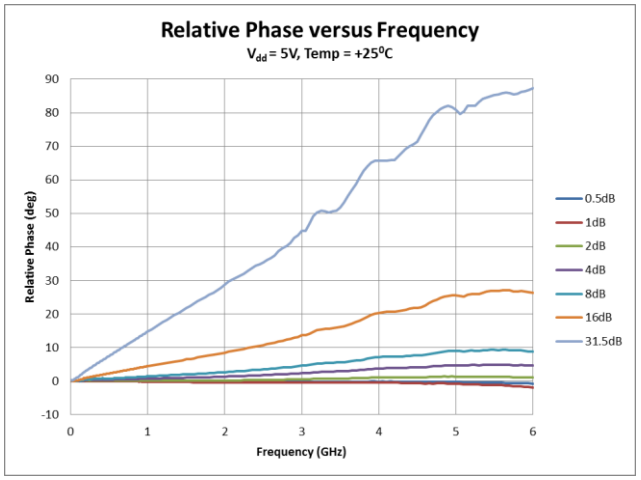


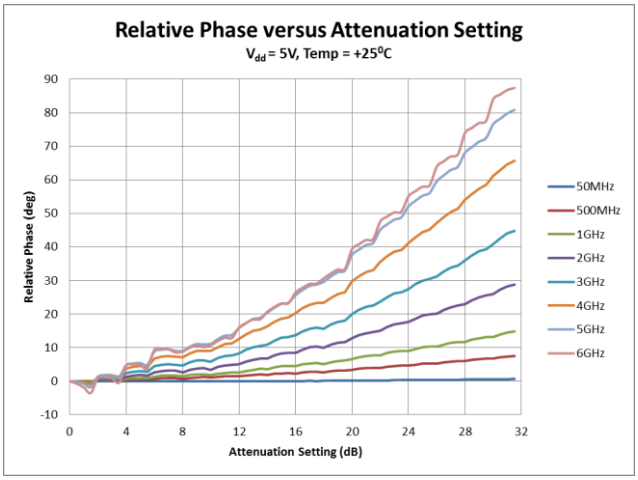


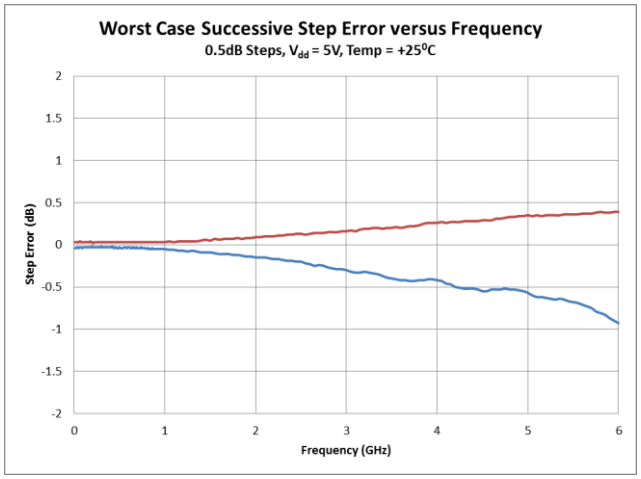
RF Performance Plots

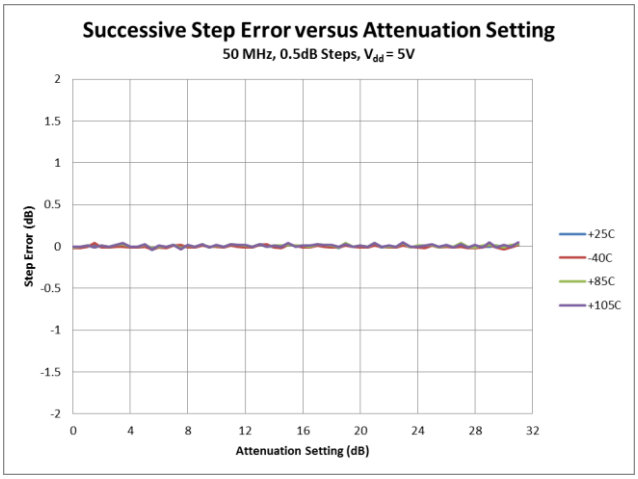






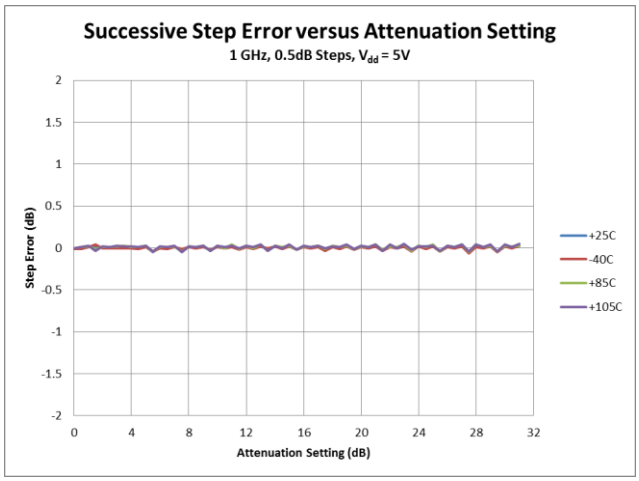


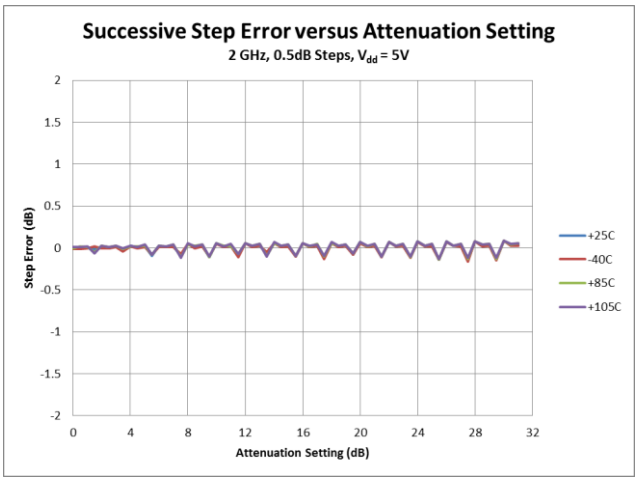


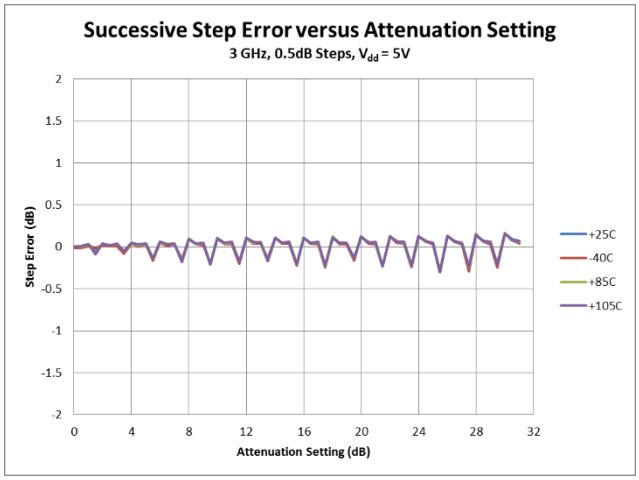


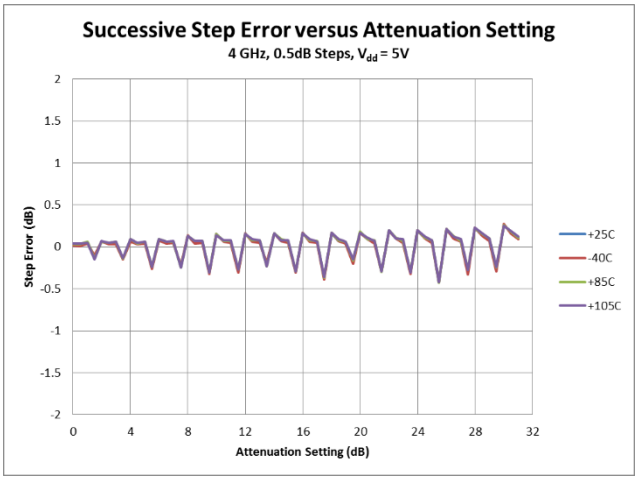
Note: Attenuator remains monotonic if step error is less than +0.5dB.

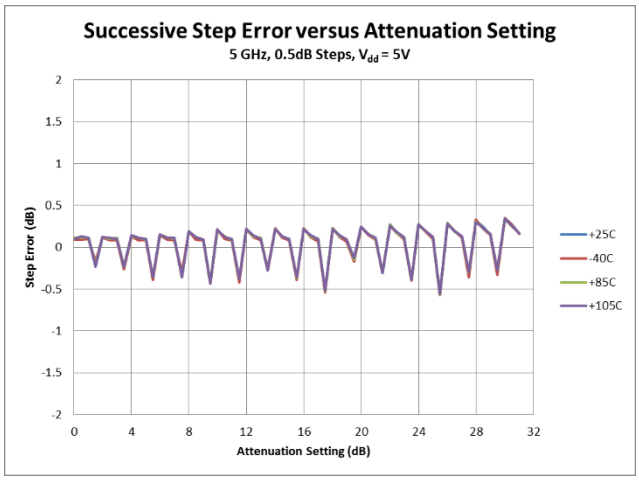
RF Performance Plots

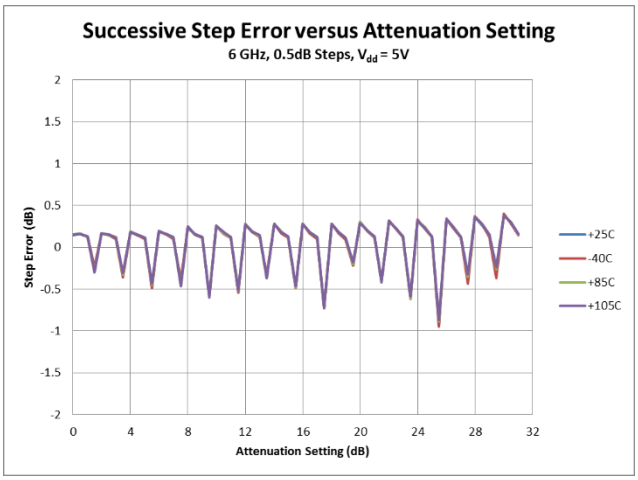






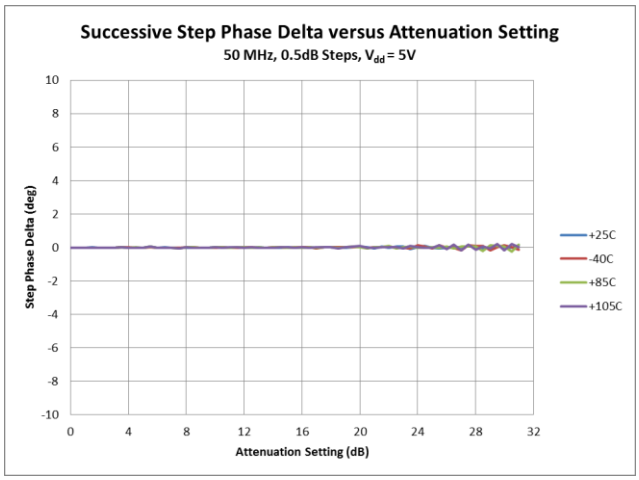


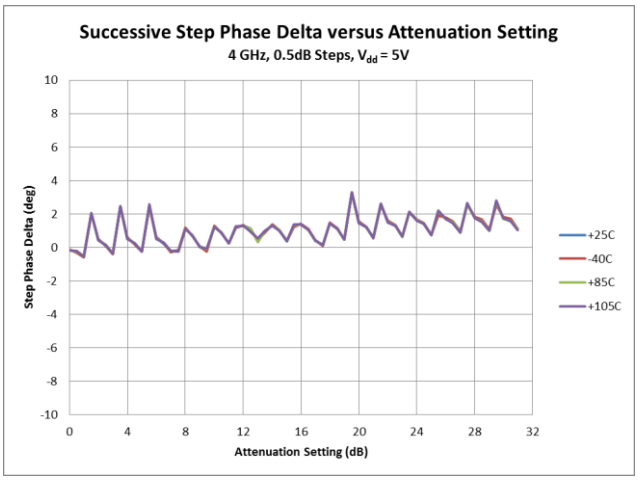


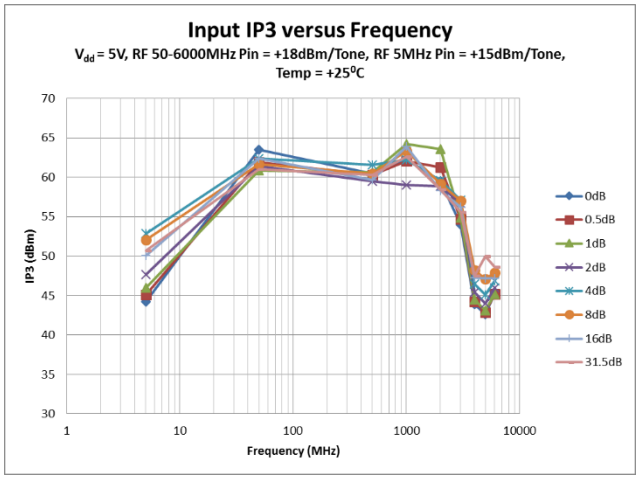


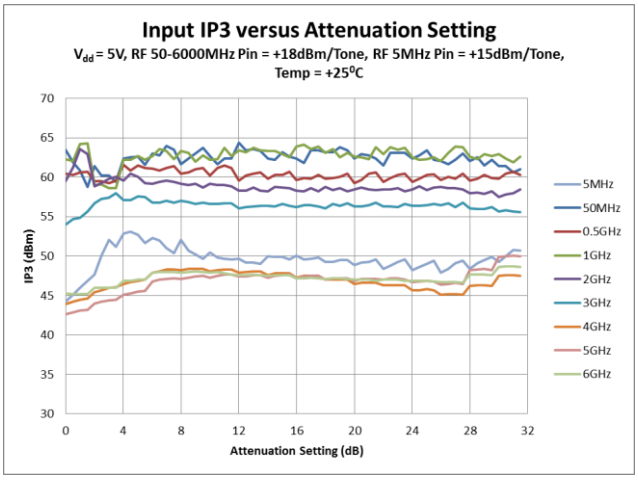
Note: Attenuator remains monotonic if step error is less than +0.5dB

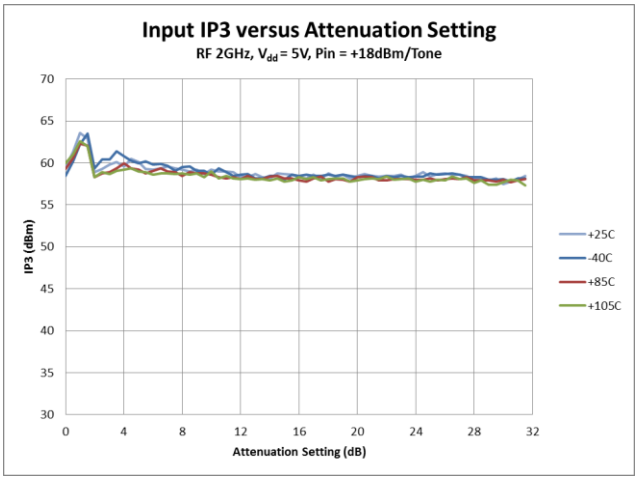
RF Performance Plots

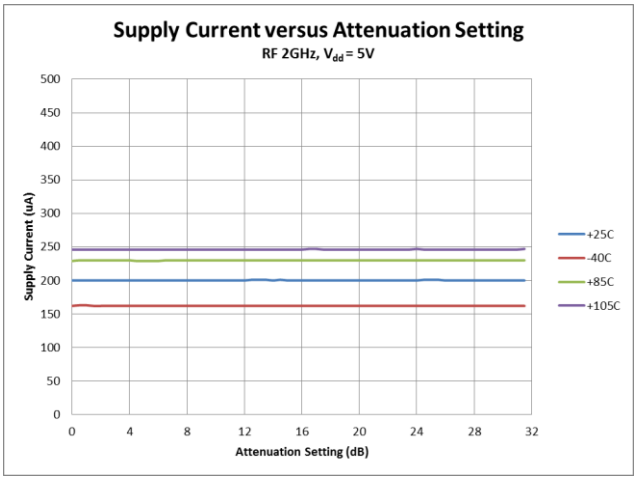




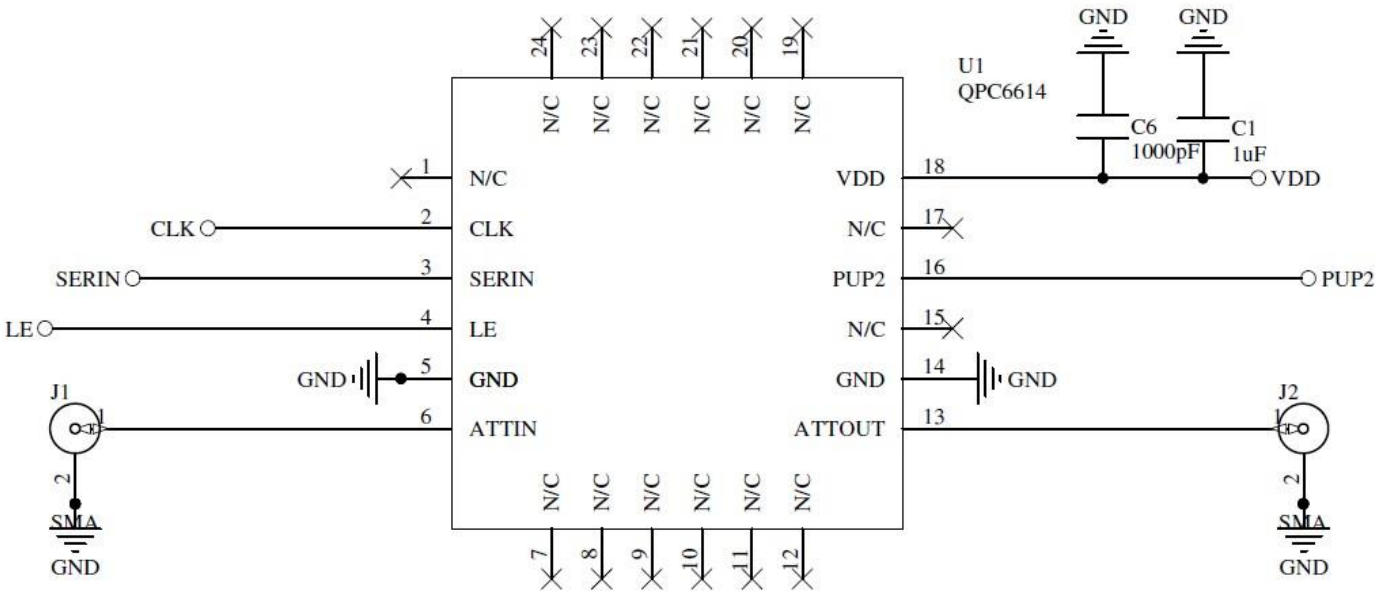




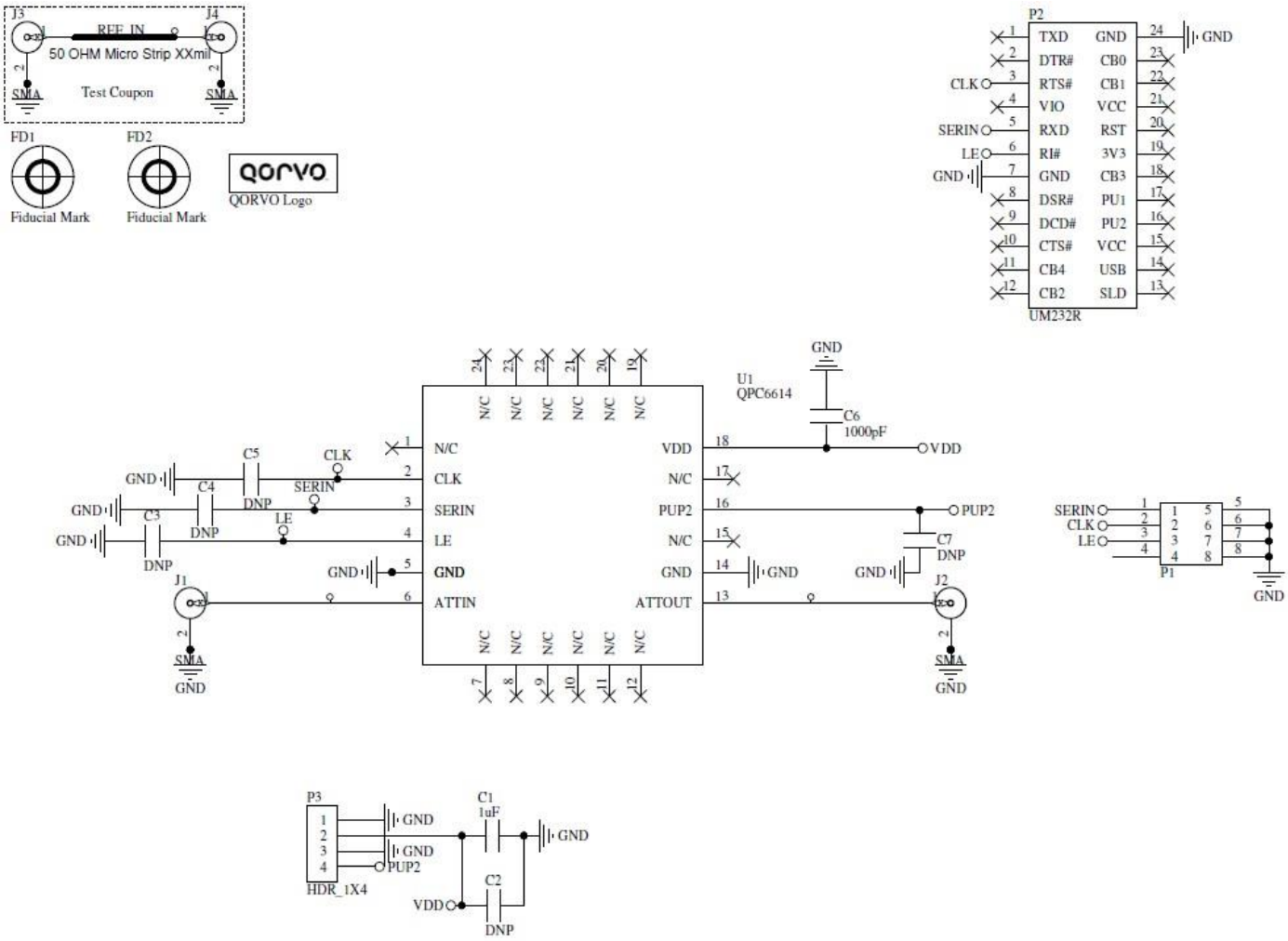




Typical Application Schematic



Evaluation Board Schematic



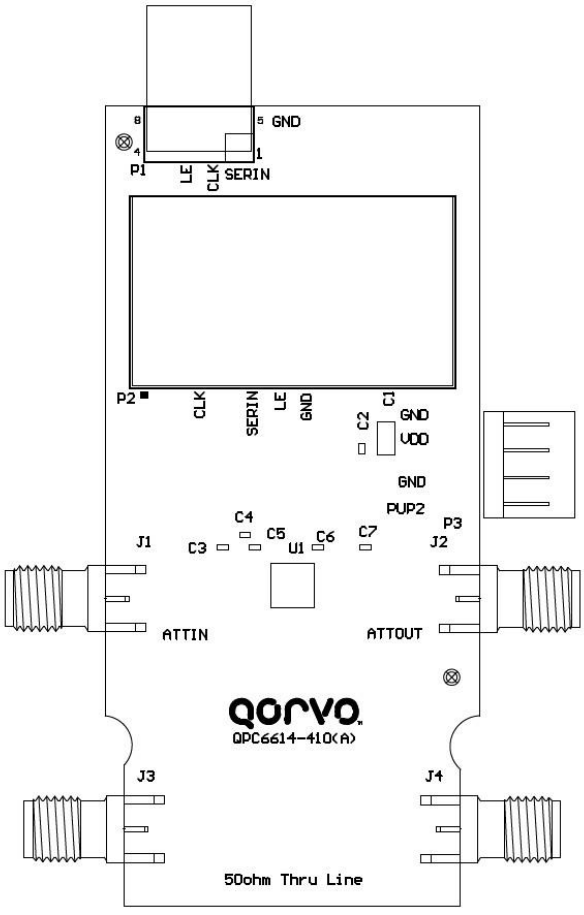
Evaluation Board Bill of Materials (BOM)

Description	Reference Designator	Manufacturer	Manufacturer's P/N
QPC6614-410		ViaSystems	QPC6614-410(A)
Digital Step Attenuator 5 MHz to 6000 MHz	U1	Qorvo	QPC6614SB
CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	J1- J4	Molex	SD-73251-4000
CAP, 1µF, 10%, 25V, X7R, 1206	C1	Taiyo Yuden (USA), Inc.	CE TMK316B7105KL-T
CAP, 1000pF, 10%, 50V, X7R, 0402	C6	TDK Corporation	C1005X7R1H102KT000F
CONN, SKT, 24-PIN DIP, .600", T/H	P2	Aries Electronics Inc.	24-6518-10
MOD, USB TO SERIAL UART, SSOP-28	M1 (See Note Below)	Future Technology Devices Int'l	UM232R
CONN, HDR, ST, 4-PIN, 0.100"	P3	SAMTEC INC.	TSW-104-08-S-S
CONN, HDR, 2 X 4, RA, 0.100, T/H	P1	SAMTEC INC.	TSW-104-08-G-D-RA
DNP	C2- C5, C7	NA	NA

Notes:

1. M1 should be mounted into P2 with respect to the Pin 1 alignment of M1 and P2.

Evaluation Board Assembly Drawing



Evaluation Board Programming Using USB Interface

Serial Mode

Refer to the Control Bit Generator (CBG) Software Reference Manual for detailed instructions on how to setup the software for use. Apply the supply voltage to P3. Select QPC6614 from the RFMD Parts List of the CBG user interface. Set the attenuation value using the CBG user interface. The attenuator is set to the desired state and measurements can be taken.

Evaluation Board Programming Using External Bus

Serial Mode

This configuration allows the user to control the attenuator through the P1 connector using an external harness. Remove the USB interface board if it is currently installed on the evaluation board. Connect a user-supplied harness to the P1 connector. Note the top row of the P1 contains the serial bus signals and the bottom row is ground. Apply the supply voltage to P3. Send the appropriate signals onto the serial bus lines in accordance with the Serial Mode Timing Diagram. The attenuator is set to the desired state and measurements can be taken.

Default Power-up State

The attenuation state set during power-up can be controlled using the PUP2 pin. To power-up in the maximum attenuation state, apply a logic low to PUP2 pin prior to applying supply voltage V_{DD}. To power-up in the minimum attenuation state apply a logic high to the PUP2 pin prior to applying supply voltage V_{DD}.

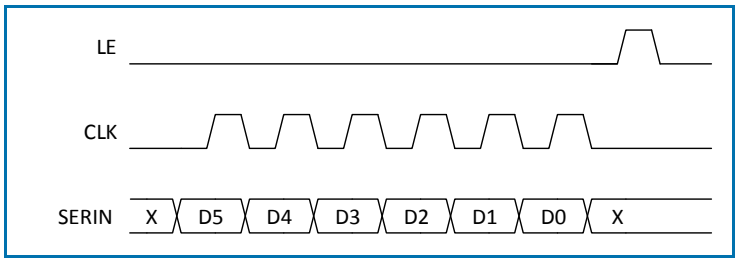
Pin Names and Descriptions

Pin	Name	Description
1	NC	No Internal Connection
2	CLK	Serial Clock Input
3	SERIN	Serial Data Input
4	LE	Latch Enable
5	GND	Connect to PCB Ground
6	ATTIN	RF Input Pin. Incident RF power must enter this pin for rated thermal performance and reliability. Do not apply DC power to this pin. Pin may be DC grounded externally and is grounded thru resistors internal to the part.
7	NC	No Internal Connection
8	NC	No Internal Connection
9	NC	No Internal Connection
10	NC	No Internal Connection
11	NC	No Internal Connection
12	NC	No Internal Connection
13	ATTOUT	RF Output Pin. Do not apply DC power to this pin. Pin may be DC grounded externally and is grounded thru resistors internal to the part.
14	GND	Connect to PCB Ground
15	NC	No Internal Connection
16	PUP2	Power-up Programming Pin. See Default Power-up State Section for use.
17	NC	No Internal Connection
18	VDD	Supply Voltage
19	NC	No Internal Connection
20	NC	No Internal Connection
21	NC	No Internal Connection
22	NC	No Internal Connection
23	NC	No Internal Connection
24	NC	No Internal Connection

Serial Mode Attenuation Word Truth Table

Attenuation Word						Attenuation State (dB)
D5 (MSB)	D4	D3	D2	D1	D0 (LSB)	
H	H	H	H	H	H	0dB / Reference Insertion Loss
H	H	H	H	H	L	0.5 dB
H	H	H	H	L	H	1 dB
H	H	H	L	H	H	2 dB
H	H	L	H	H	H	4 dB
H	L	H	H	H	H	8 dB
L	H	H	H	H	H	16 dB
L	L	L	L	L	L	31.5 dB

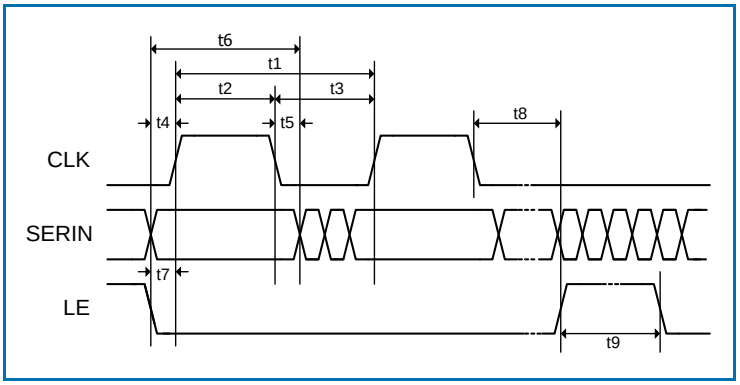
Serial Mode Timing Diagram



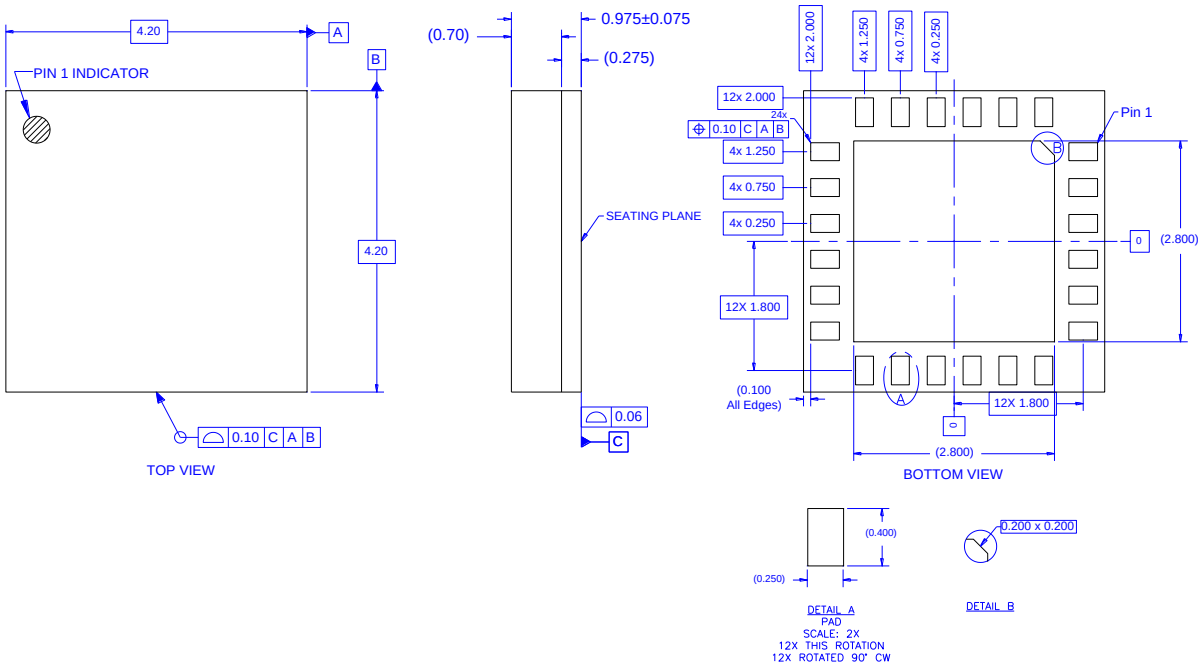
Serial Bus Timing Specifications

Parameter	Limit	Units	Comment
t1	25	MHz max	CLK Frequency
t2	20	ns min	CLK High
t3	20	ns min	CLK Low
t4	5	ns min	SERIN to CLK Setup Time
t5	5	ns min	SERIN to CLK Hold Time
t6	30	ns min	SERIN Valid
t7	5	ns min	LE to CLK Setup Time
t8	5	ns min	CLK to LE Setup Time
t9	10	ns min	LE Pulse Width

Serial Bus Timing Diagram

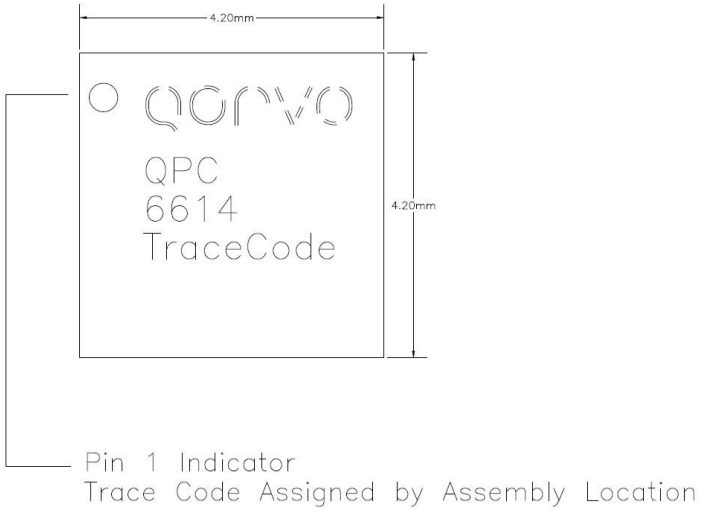


Package Outline



Notes:
1. Dimensions in millimeters

Branding Diagram



RFMD + TriQuint = Qorvo

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: www.rfmd.com **Tel: 1-844-890-8163**
Email: customer.support@qorvo.com

For information about the merger of RFMD and TriQuint as Qorvo:

Web: www.qorvo.com

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