QPA1000

2.8 – 3.2 GHz 50 Watt GaN Amplifier

Product Description

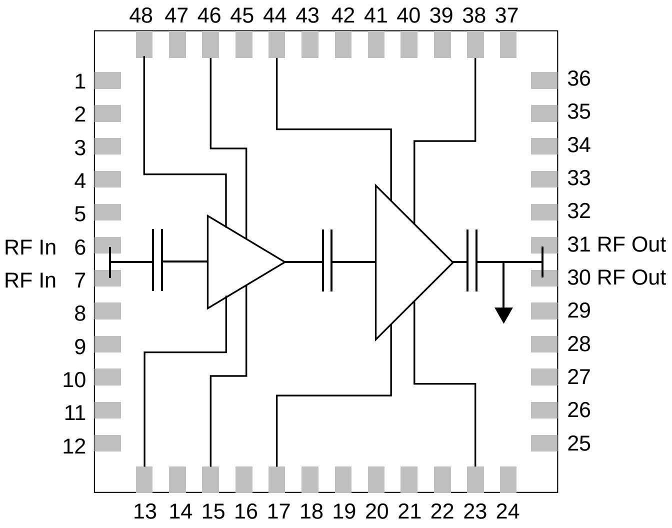
Qorvo's QPA1000 is a high-power, S-band amplifier fabricated on Qorvo's QGaN25 0.25 um GaN on SiC production process. Covering 2.8 – 3.2 GHz, the QPA1000 typically provides 47 dBm of saturated output power and 22 dB of large-signal gain while achieving 58 % power-added efficiency.

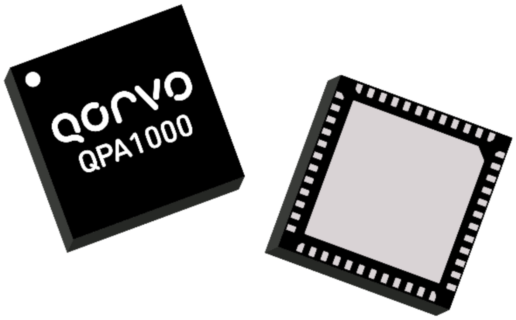
The QPA1000 can also support a variety of operating conditions to best support system requirements. With good thermal properties, it can support a range of bias voltages and will perform well under pulse applications. The QPA1000 is matched to 50 ohms with integrated DC blocking caps on both I/O ports. It is ideal for use in both commercial and military radar systems.

Lead-free and RoHS compliant.

Evaluation boards are available upon request.

Functional Block Diagram





Product Features

- Frequency Range: 2.8 – 3.2 GHz
- Pout: 47 dBm (P_{IN} = 25 dBm)
- Large Signal Gain: 22 dB (P_{IN} = 25 dBm)
- PAE: 58 % (P_{IN} = 25 dBm)
- Bias: V_D = 25 V, I_{DQ} = 200 mA, V_G = −2.8 V (Typ)
- Supports Long Pulse Operation
- Package Dimensions: 7.0 x 7.0 x 0.85 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Applications

- Military Radar
- Commercial Radar

Ordering Information

Part	Description
QPA1000	2.8–3.2 GHz 50 W GaN Power Amplifier

Electrical Specifications

Test conditions, unless otherwise noted: 25 °C, V_D = 25 V, I_{DQ} = 200 mA, Pulse Width = 100 us, Duty Cycle = 10%

Parameter		Min	Typ	Max	Units
Operational Frequency Range		2.8	3.0	3.2	GHz
Output Power @ P_{IN} = 25 dBm	Frequency = 3.0 GHz	46	47		dBm
Power Added Efficiency @ P_{IN} = 25 dBm	Frequency = 3.0 GHz	50	58		%
Small Signal Gain	Frequency = 3.0 GHz		25		dB
Input Return Loss	Frequency = 3.0 GHz		11		dB
Output Return Loss	Frequency = 3.0 GHz		13		dB
Output Power Temperature Coefficient			−0.004		dBm/°C
Recommended Operating Drain Voltage				25	V

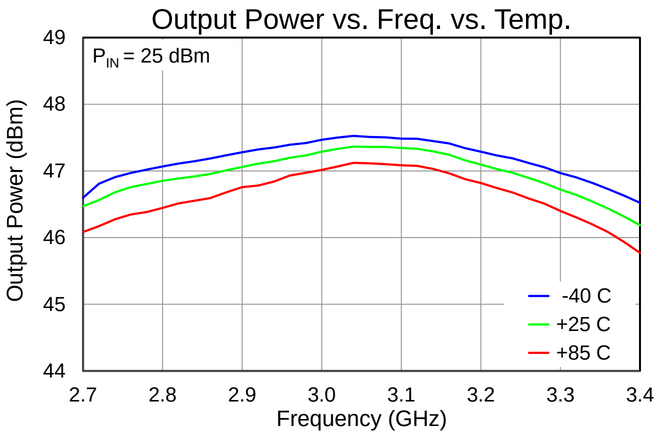
Recommended Operating Conditions

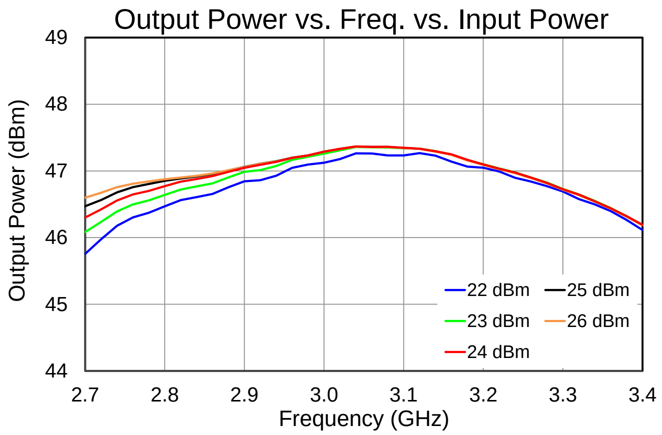
Parameter	Value
Drain Voltage	25 V
Drain Current (quiescent, I_{DQ})	200 mA
Drain Current (under drive, I_D)	3.7 A
Gate Voltage	-2.8 V
Operating Temperature Range	−40 to 85 °C

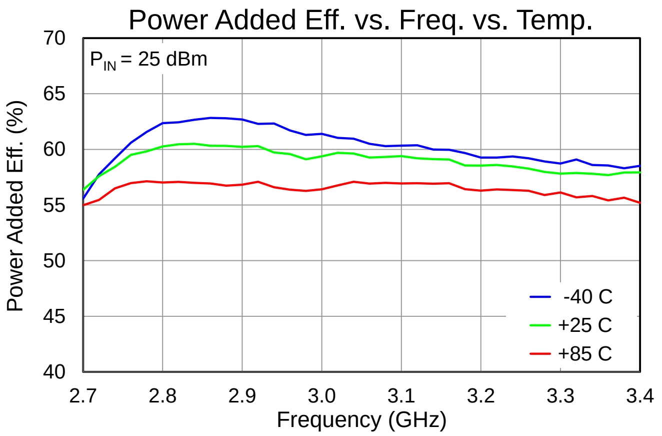
Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

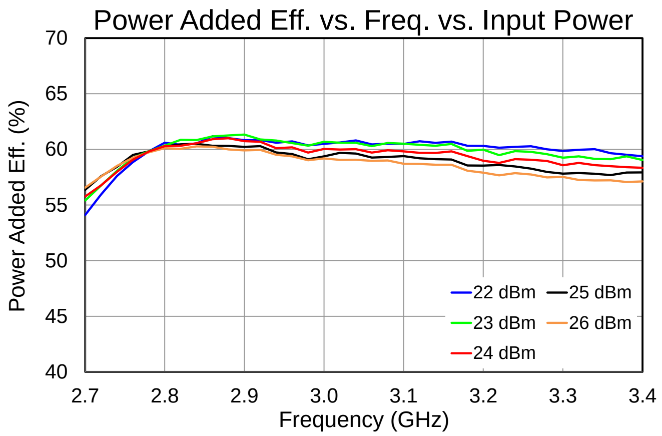
Performance Plots – Large Signal (Pulsed)

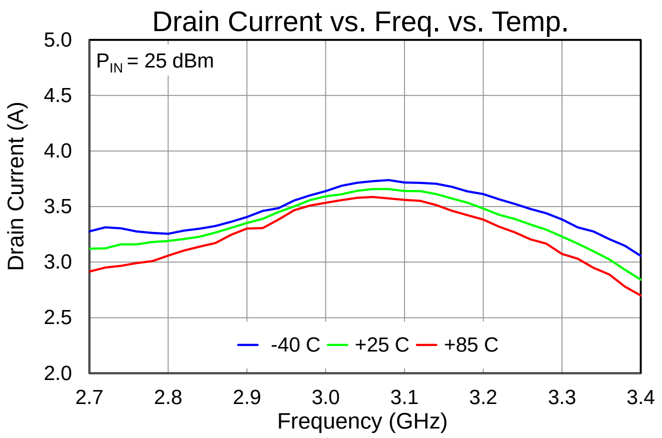
Test conditions unless otherwise noted: Temp. = 25 °C, V_D = 25 V, I_{DQ} = 200 mA, PW = 100 us, Duty Cycle = 10%

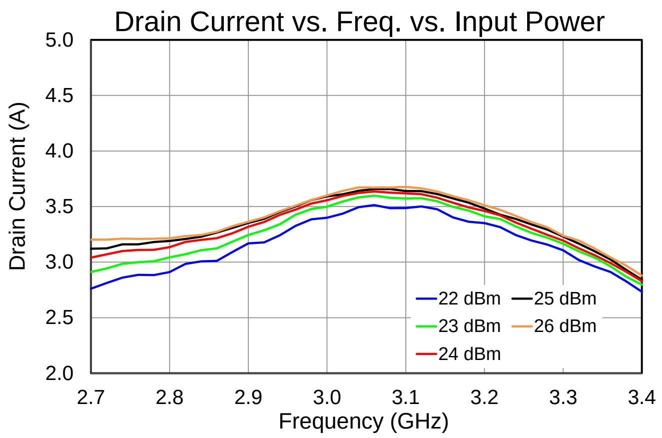

Output Power vs. Freq. vs. Temp.


Output Power vs. Freq. vs. Input Power


Power Added Eff. vs. Freq. vs. Temp.

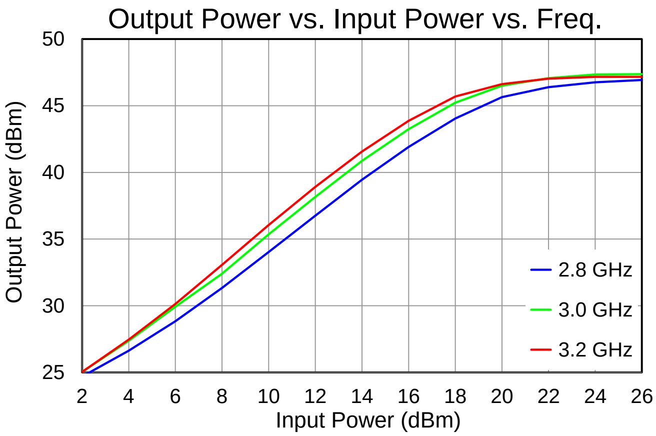

Power Added Eff. vs. Freq. vs. Input Power

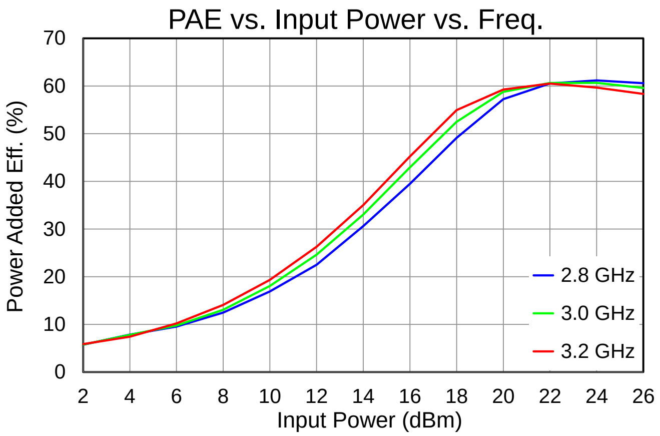

Drain Current vs. Freq. vs. Temp.

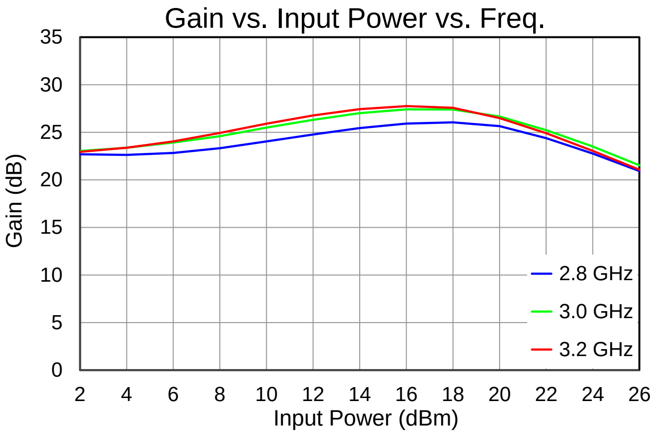

Drain Current vs. Freq. vs. Input Power

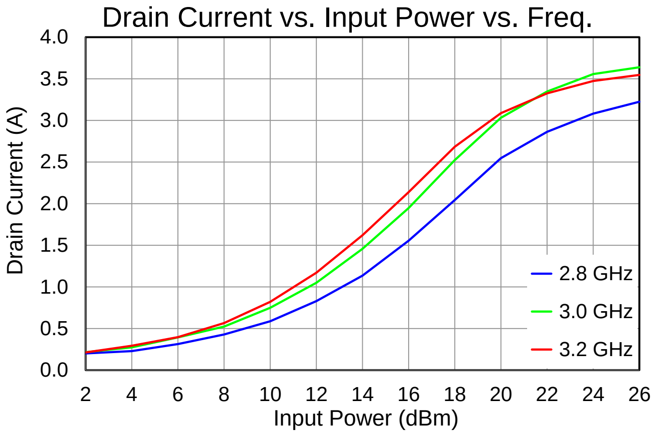
Performance Plots – Large Signal (Pulsed)

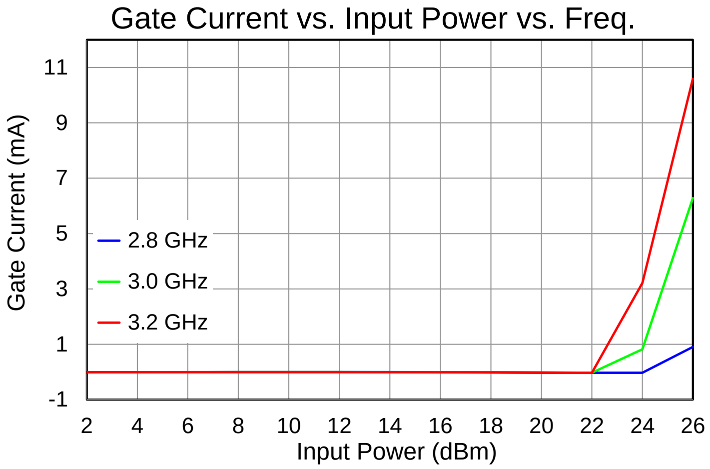
Test conditions unless otherwise noted: Temp. = 25 °C, V_D = 25 V, I_{DQ} = 200 mA, PW = 100 us, Duty Cycle = 10%











Performance Plots – Large Signal (Pulsed)

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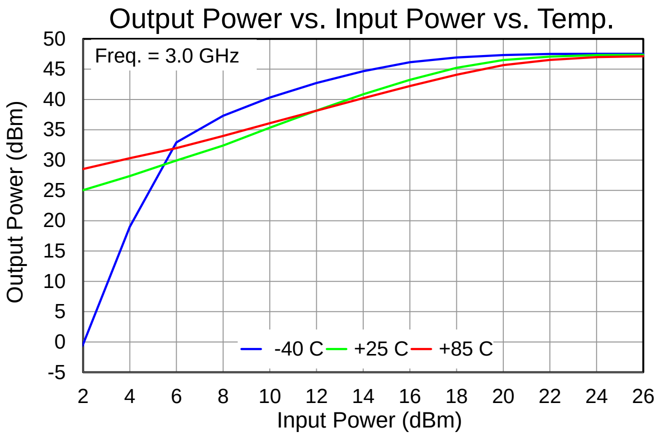
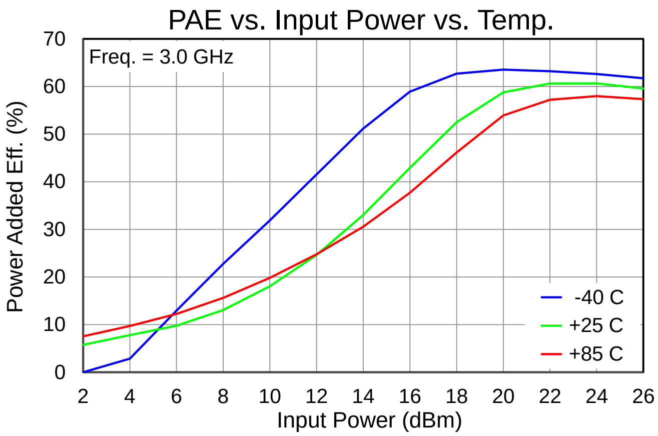
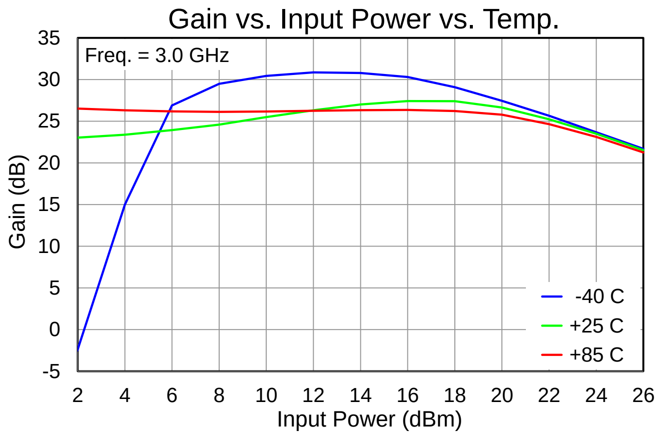
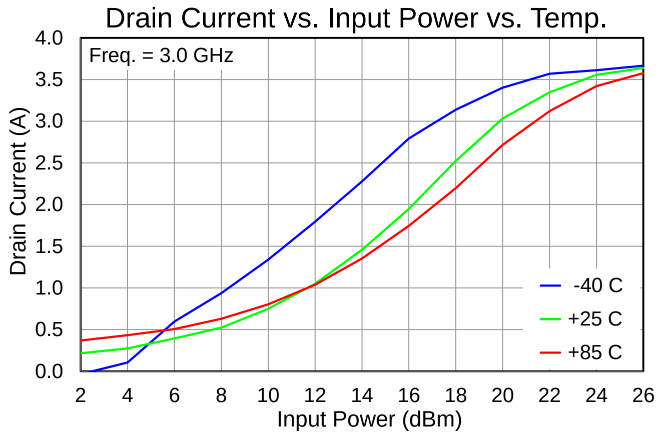
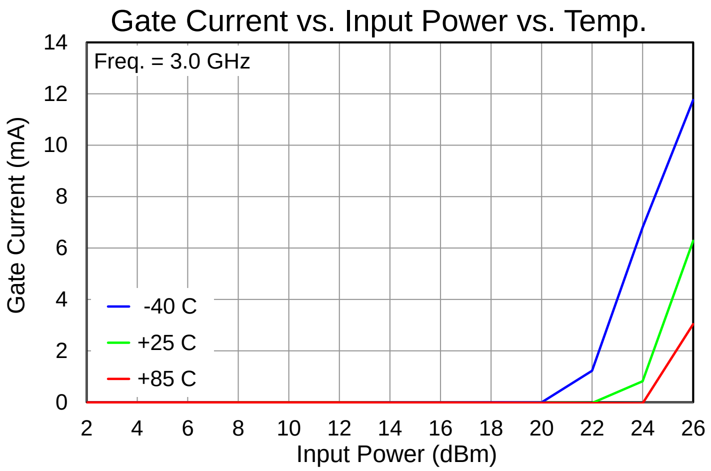




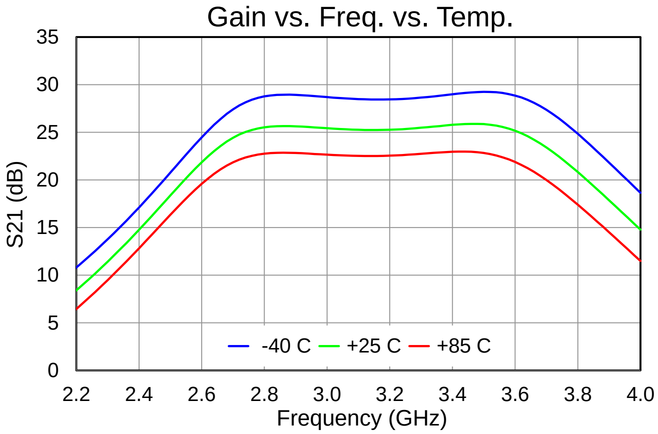


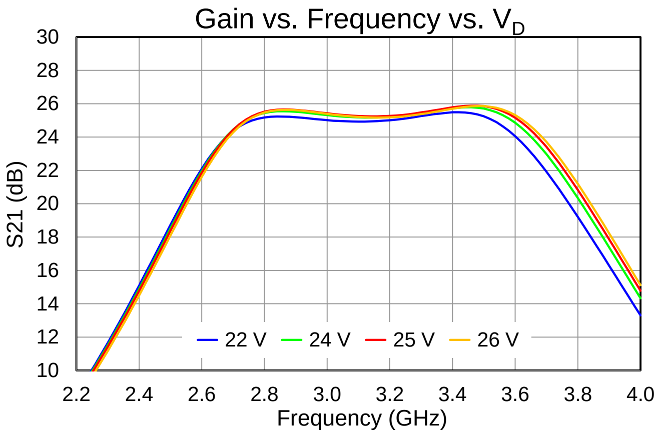


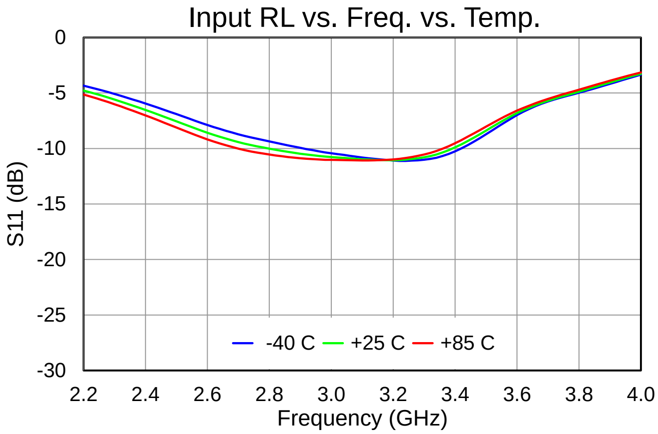


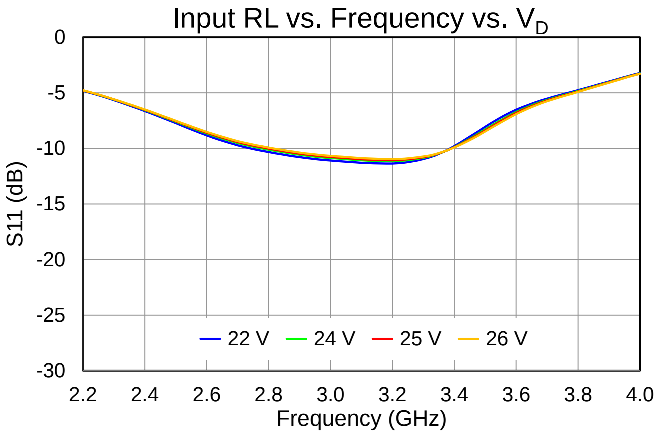
Performance Plots – Small Signal

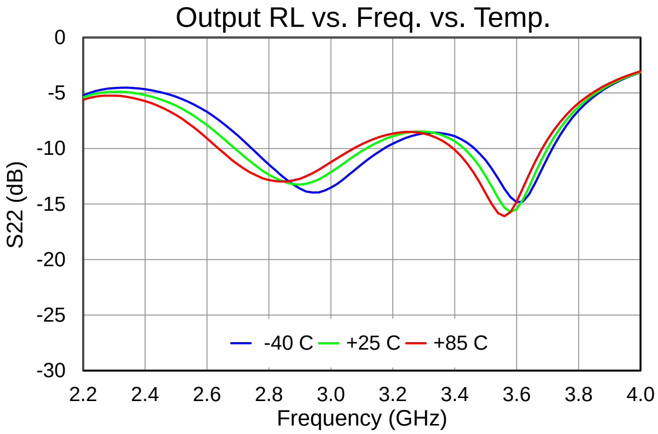
Test conditions unless otherwise noted: Temp. = 25 °C, V_D = 25 V, I_{DQ} = 200 mA

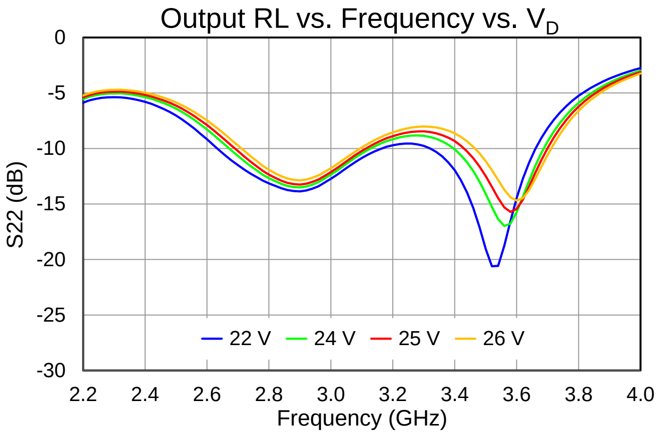






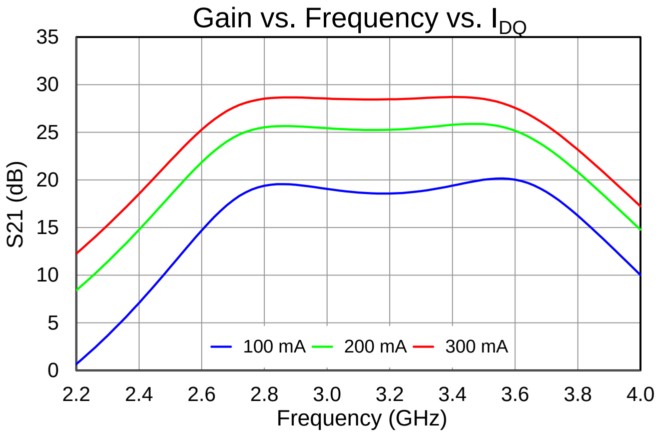


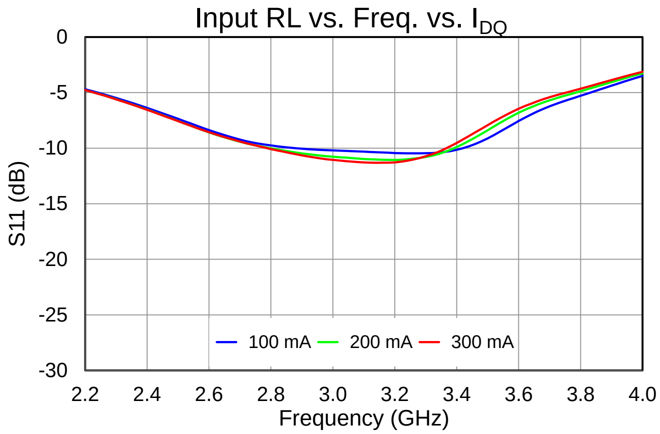


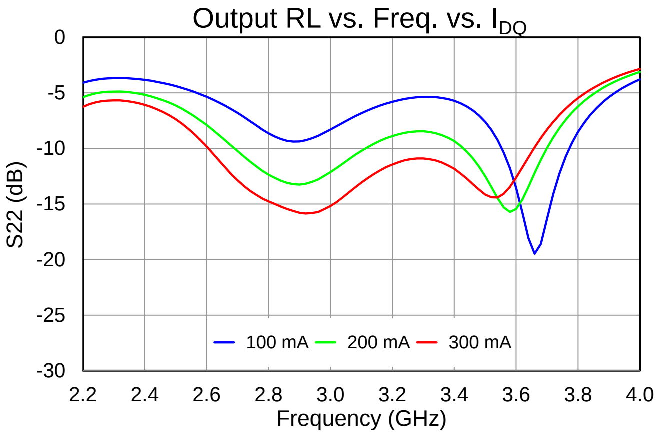


Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp. = 25 °C, V_D = 25 V, I_{DQ} = 200 mA







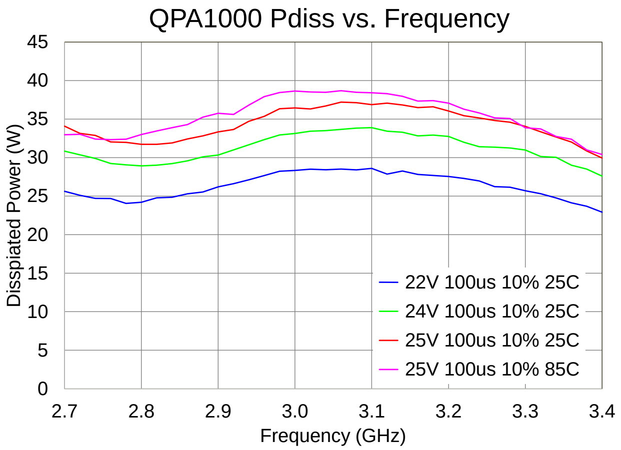
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85°C V_D = 25 V, I_{DQ} = 200 mA P_{DISS} = 5.0 W	0.6	°C/W
Channel Temperature (T_{CH}) (Quiescent)		88	°C
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85°C, V_D = 25 V, I_{DQ} = 200 mA, Freq = 2.8 GHz, I_{D_Drive} = 3.6 A, P_{IN} = 26 dBm, P_{OUT} = 46.6 dBm, P_{DISS} = 33.9 W, PW = 100 us, DC = 10%	0.65	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		107	°C
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85°C, V_D = 25 V, I_{DQ} = 200 mA, Freq = 3.1 GHz, I_{D_Drive} = 3.8 A, P_{IN} = 26 dBm, P_{OUT} = 47.1 dBm, P_{DISS} = 39.4 W, PW = 100 us, DC = 10%	0.66	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		111	°C

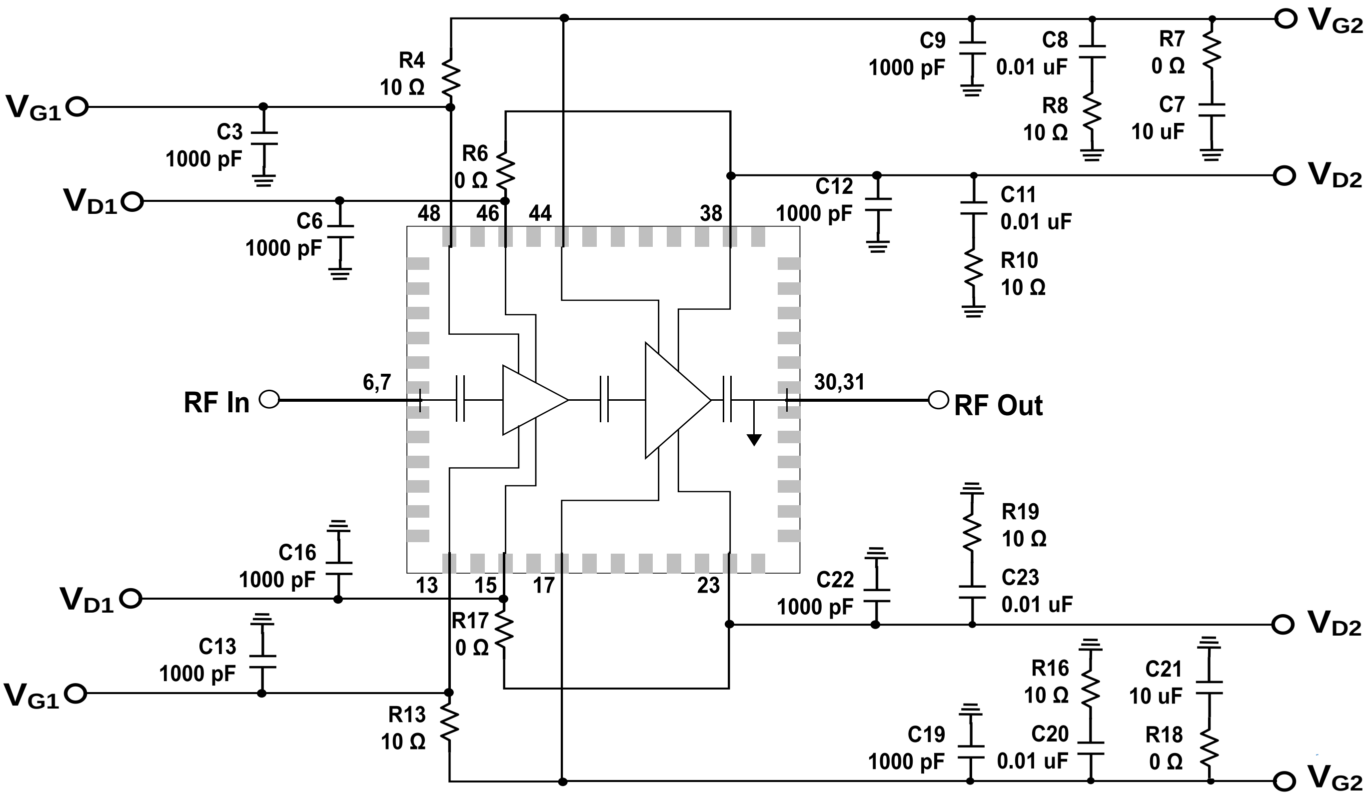
Notes:

1. Thermal resistance measured to back of package.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Power Dissipation



Applications Circuit



Notes:

1. V_G and V_D must be biased from both sides (top and bottom).

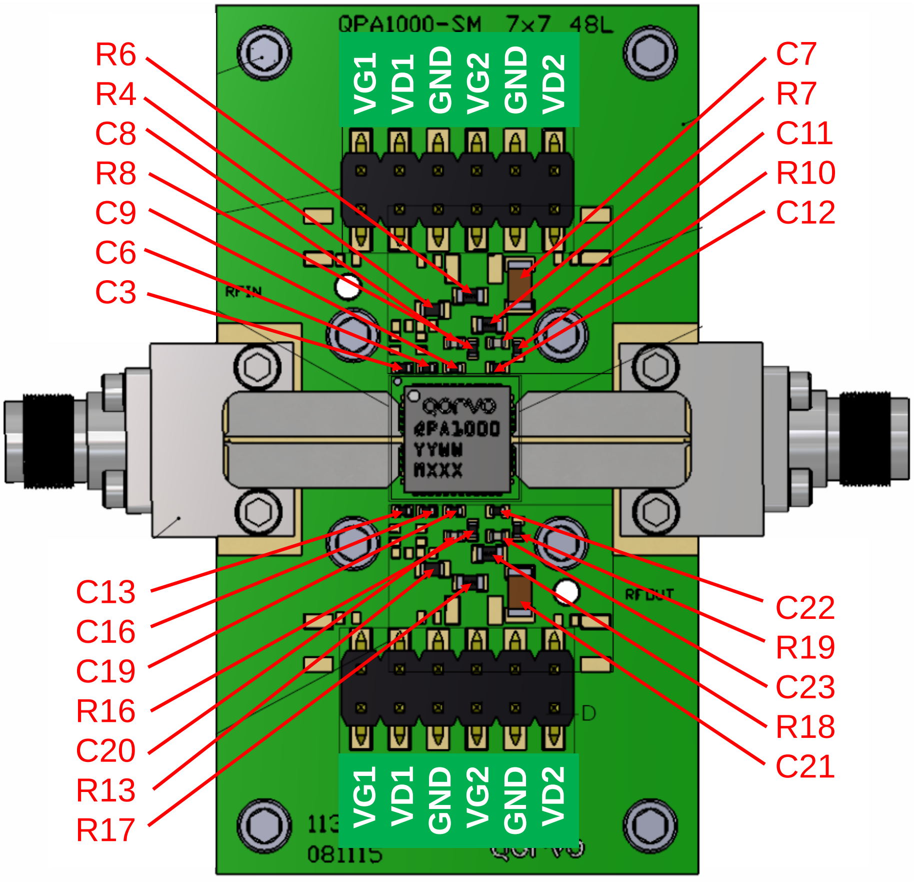
Bias Up Procedure

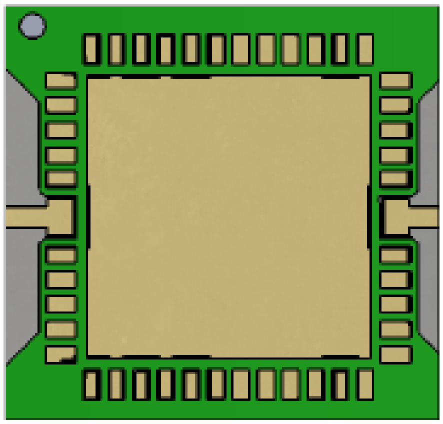
1. Set I_D limit to 6000 mA, I_G limit to 40 mA
2. Set V_G to −6.0 V
3. Set V_D +25 V
4. Adjust V_G more positive until I_{DQ} = 200 mA (V_G ~ −2.8 V Typical)
5. Apply RF signal

Bias Down Procedure

1. Turn off RF supply
2. Reduce V_G to −6.0 V. Ensure I_{DQ} ~ 0 mA
3. Set V_D to 0 V
4. Turn off V_D supply
5. Turn off V_G supply

Evaluation Board and Mounting Detail





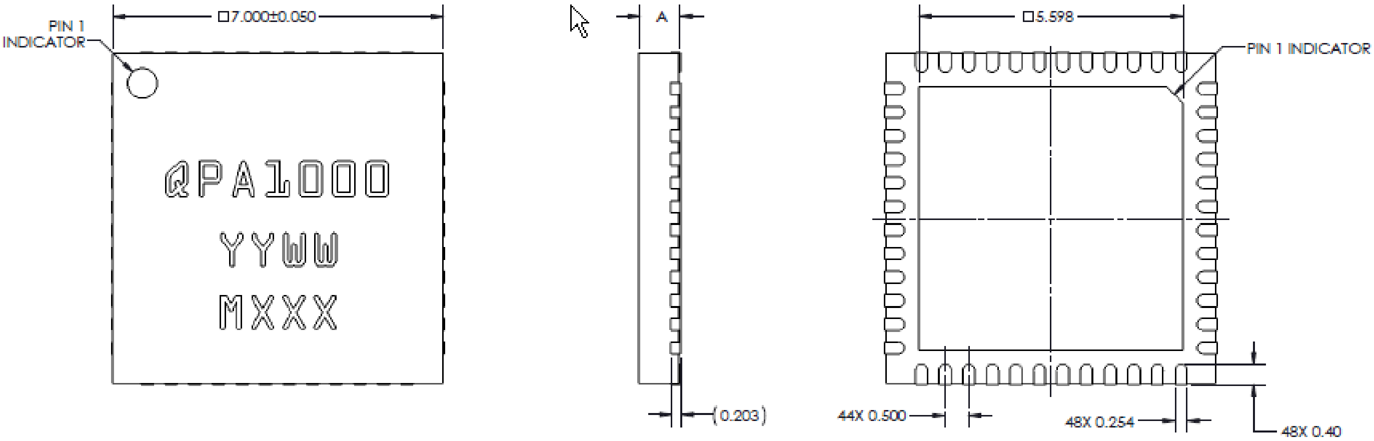
Mounting Detail

RF Layer is 0.008” thick Rogers Corp. RO40003C (εr = 3.35). Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-02A-5.

Bill of Materials

Ref. Des.	Component	Value	Manuf.	Part Number
C7, C21	Surface Mount Cap.	CAP, 1206, 10uF, 20%, 50V, 20%, X5R	Various	
C3, C6, C9, C12, C13, C16, C19, C22	Surface Mount Cap.	CAP, 0402, 1000pF, 10%, 100V, X7R	Various	
C8, C11, C20, C23	Surface Mount Cap.	CAP, 0402, 0.01uF, ±10%, 50V, X7R	Various	
R8, R10, R16, R19	Surface Mount Res.	RES, 10 OHM ± 5% 0402	Various	
R4, R13	Surface Mount Res.	RES, 10 OHM 1/10W ± 5% 0603	Various	
R6, R7, R16, R18	Surface Mount Res.	RES, 0 OHM 5% 0603	Various	

Mechanical Information



		QFN
A	MAX.	0.900
	NOM.	0.850
	MIN.	0.800

NOTES:
PACKAGE METAL BASE AND LEADS ARE GOLD PLATED.

PART MARKING:
QPA1000: PART NUMBER
YY: PART ASSY YEAR
WW: PART ASSY WEEK
MXXX: LOT NUMBER

DIMENSIONS IN MM

Pin Description

Pin Number	Symbol	Description
1-5, 8-12, 14, 16, 18-22, 24-29, 32-37, 39-43, 45, 47	NC	No connection. Can be grounded on PCB if desired.
6, 7	RF Input	50 Ohm RF input. Pad is capacitively coupled to block on-chip DC voltages.
13, 48	V_{G1}	1st Stage Gate Voltage; bias network is required; must be biased from both sides (V_{G1} and V_{G2} can be tied together in application)
15, 46	V_{D1}	1st Stage Drain Voltage; bias network is required; must be biased from both sides (V_{D1} and V_{D2} can be tied together in application)
17, 44	V_{G2}	2nd Stage Gate Voltage; bias network is required; must be biased from both sides (V_{G1} and V_{G2} can be tied together in application)
23, 38	V_{D2}	2nd Stage Drain Voltage; bias network is required; must be biased from both sides (V_{D1} and V_{D2} can be tied together in application)
30, 31	RF Output	50 Ohm RF output. Pad is capacitively coupled to block on-chip DC voltages. Pad is DC grounded.
49	GND	Ground connection.

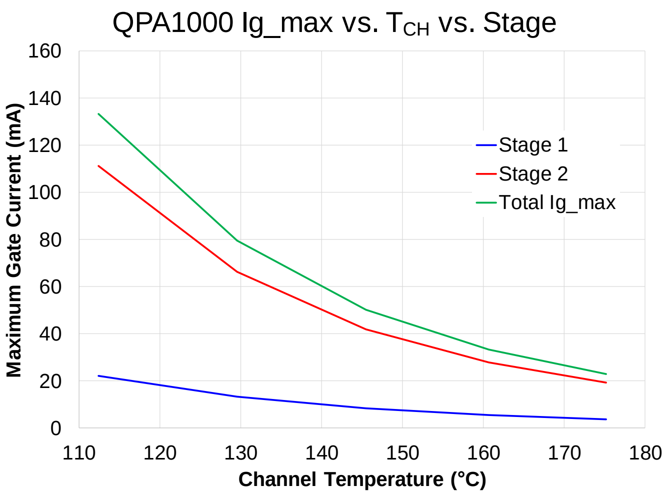
Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	40 V
Drain Current (I_{D1}/I_{D2})	0.77/3.84 A
Gate Voltage Range	−8 to 0 V
Gate Current (I_G)	See I_{G_Max} plot
Dissipated Power (P_{DISS})[1]	44.25 W
Input Power (50 Ω, 85 °C)	33 dBm
Input Power (9:1 VSWR, 85 °C)	33 dBm
Mounting Temperature (30 seconds)	260 °C
Storage Temperature	−55 to 150 °C

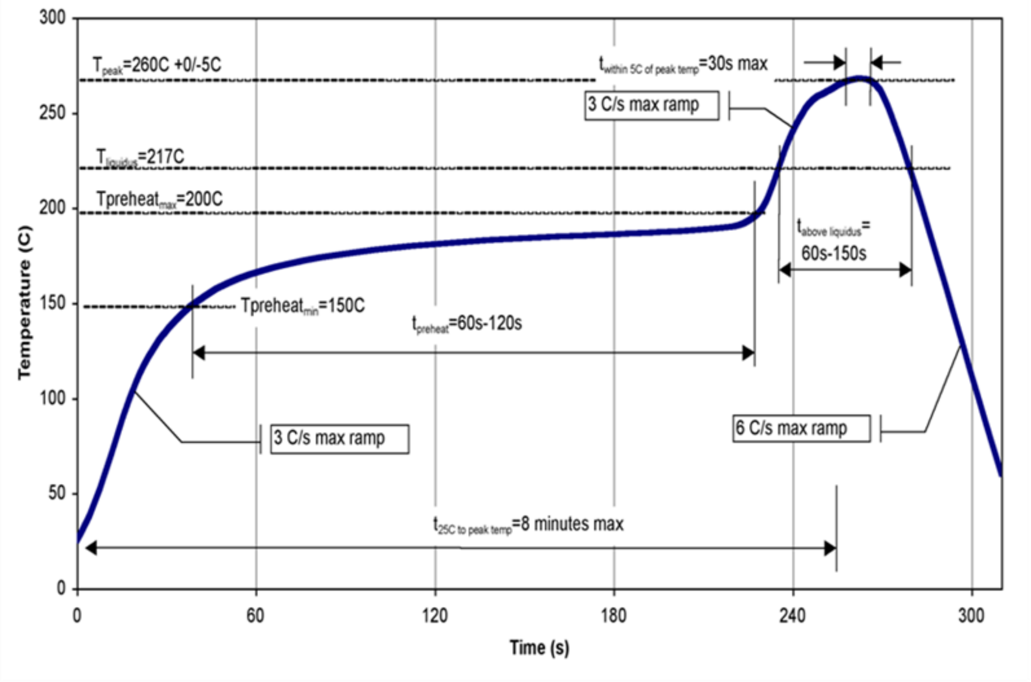
Note:

[1] T_{BASE} = 85 °C, T_{CH} = 225 °C

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.



Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 0B	ANSI/ESD/JEDEC JS-001
ESD – Charge Device Model (CDM)	Class C3	ANSI/ESD/JEDEC JS-002
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with the latest version of J-STD-020 Lead free solder, 260 °C.
Solder profiles available upon request.

RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU. This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free
- Qorvo Green

Contact Information

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

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

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Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

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- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

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