



Package Style: MCM 28-Pin, 6.0mm x 6.0mm

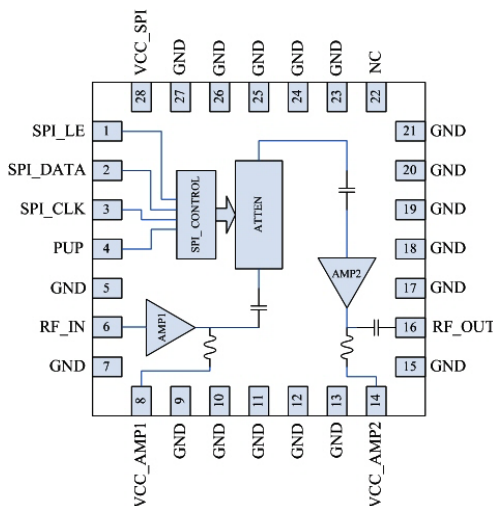


### Features

- Frequency Range 1400MHz to 2700MHz
- 6-Bit Digital Step Attenuator
- SPI Serial Control Programming
- Max Gain = 32dB at 2GHz, and 29.3dB @ 2.6GHz
- Gain Control Range = 31.5dB (0.5dB Step Size)
- High OIP3/P1dB = +42.5/25dBm
- Single +5V Supply
- Small 28-Pin, 6.0mm x 6.0mm, MCM
- Power-up Programming

### Applications

- Cellular, 3G Infrastructure
- WiBro, WiMax, LTE
- Microwave Radio
- High-Linearity Power Control



Functional Block Diagram

### Product Description

RFMD's RFDA2026 is a digital controlled variable gain amplifier featuring high linearity over the entire gain control range with a noise figure less than 4.1dB in its maximum gain state. The gain of the 6-bit digital step attenuator is programmed with a serial mode control interface (SPI). The RFDA2026 is packaged in a small 6.0mm x 6.0mm leadless laminate MCM, which contains plated through thermal vias for ultra-low thermal resistance. This module is easy to use with no external matching components required.

### Ordering Information

|                 |                                               |
|-----------------|-----------------------------------------------|
| RFDA2026SQ      | Sample bag with 25 pieces                     |
| RFDA2026SR      | 7" Sample reel with 100 pieces                |
| RFDA2026TR13    | 13" Reel with 2500 pieces                     |
| RFDA2026PCK-410 | 1.4GHz to 2.4GHz PCBA with 5-piece sample bag |
| RFDA2026PCK-411 | 2.4GHz to 2.7GHz PCBA with 5-piece sample bag |

### Optimum Technology Matching® Applied

|                                               |                                      |                                                |                                    |
|-----------------------------------------------|--------------------------------------|------------------------------------------------|------------------------------------|
| <input checked="" type="checkbox"/> GaAs HBT  | <input type="checkbox"/> SiGe BiCMOS | <input checked="" type="checkbox"/> GaAs pHEMT | <input type="checkbox"/> GaN HEMT  |
| <input type="checkbox"/> GaAs MESFET          | <input type="checkbox"/> Si BiCMOS   | <input checked="" type="checkbox"/> Si CMOS    | <input type="checkbox"/> BiFET HBT |
| <input checked="" type="checkbox"/> InGaP HBT | <input type="checkbox"/> SiGe HBT    | <input type="checkbox"/> Si BJT                | <input type="checkbox"/> LDMOS     |

## Absolute Maximum Ratings

| Parameter                                  | Rating         | Unit            |
|--------------------------------------------|----------------|-----------------|
| Supply Voltage                             | 5.5            | V <sub>DC</sub> |
| DC Supply Current                          | 300            | mA              |
| Power Dissipation(P <sub>DISS</sub> )      | 1500           | mW              |
| Maximum RF Input Power                     | 12             | dBm             |
| Operating Temperature (T <sub>CASE</sub> ) | -40 to +85     | °C              |
| Storage Temperature                        | -40 to +150    | °C              |
| Junction Temperature (T <sub>J</sub> )     | 175            | °C              |
| ESD Rating - Human Body Model (HBM)        | 500 (Class 1B) | V               |
| Moisture Sensitivity Level                 | MSL 3          |                 |

MTTF>1E6 hours at 175 °C junction temperature.



### Caution! ESD sensitive device.

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.

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RoHS (Restriction of Hazardous Substances): Compliant per EU Directive 2002/95/EC.

| Parameter                    | Specification                   |      |      | Unit | Condition                                                                      |
|------------------------------|---------------------------------|------|------|------|--------------------------------------------------------------------------------|
|                              | Min.                            | Typ. | Max. |      |                                                                                |
| <b>Overall</b>               |                                 |      |      |      | Temp=25 °C, V <sub>CC</sub> =V <sub>DD</sub> =5V, Standard Application Circuit |
| Frequency Range              | 1400                            |      | 2700 | MHz  |                                                                                |
| Max Gain                     |                                 | 32   |      | dB   | Attenuation = 0dB at 2.0GHz                                                    |
|                              |                                 | 29.3 |      | dB   | Attenuation = 0dB at 2.6GHz                                                    |
| Gain Control Range           |                                 | 31.5 |      | dB   |                                                                                |
| Step Accuracy                | ±(0.15 +5% attenuation setting) |      |      | dB   | Major state error up to 2700MHz                                                |
| P1dB                         |                                 | 25   |      | dBm  | Attenuation = 0dB                                                              |
| Output IP3                   | 38                              | 44.5 |      | dBm  | P <sub>OUT</sub> =+5dBm/ tone, 1 MHz spacing                                   |
| Control Interface            |                                 | 6    |      | bit  | SPI interface                                                                  |
| Settling Time                |                                 | 250  |      | ns   | t <sub>ON</sub> , t <sub>OFF</sub> (10%/90% RF)                                |
| Noise Figure                 |                                 | 4.1  |      | dB   | Attenuation = 0dB                                                              |
| Impedance                    |                                 | 50   |      | Ω    |                                                                                |
| Harmonics (1.5GHz to 2.4GHz) |                                 |      |      |      | Using RFDA2026-410 EVB                                                         |
| 2nd Harmonic                 |                                 | 34   |      | dBc  | P <sub>OUT</sub> = 20dBm; 1.5GHz                                               |
|                              |                                 | 39   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2GHz                                                 |
|                              |                                 | 44   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2.4GHz                                               |
| 3rd Harmonics                |                                 | 62   |      | dBc  | P <sub>OUT</sub> = 20dBm; 1.5GHz                                               |
|                              |                                 | 72   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2GHz                                                 |
|                              |                                 | 73   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2.4GHz                                               |
| Harmonics (2.4GHz to 2.7GHz) |                                 |      |      |      | Using RFDA2026-411 EVB                                                         |
| 2nd Harmonics                |                                 | 43   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2.4GHz                                               |
|                              |                                 | 48   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2.7GHz                                               |
| 3rd Harmonics                |                                 | 70   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2.4GHz                                               |
|                              |                                 | 62   |      | dBc  | P <sub>OUT</sub> = 20dBm; 2.7GHz                                               |
| Input Return Loss            |                                 | -15  |      | dB   |                                                                                |
| Output Return Loss           |                                 | -11  |      | dB   |                                                                                |
| Total Supply Current         | 4.75                            | 5.0  | 5.25 | V    |                                                                                |
| Supply Current               |                                 | 192  |      | mA   | From V <sub>CC-SPI</sub> , V <sub>CC-AMP1</sub> and V <sub>CC-AMP2</sub>       |
| Thermal Resistance           |                                 | 46.2 |      | °C/W | Junction to backside of device                                                 |

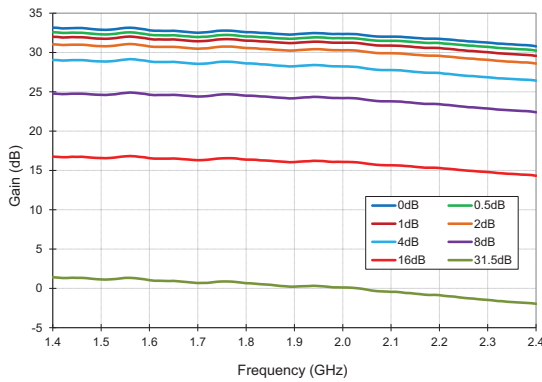
| Parameter               | Unit | 1500MHz | 1800MHz | 2000MHz | 2200MHz | 2400MHz | 2600MHz |
|-------------------------|------|---------|---------|---------|---------|---------|---------|
| Max Small Signal Gain   | dB   | 32.9    | 32.5    | 32.3    | 31.7    | 30.8    | 29.3    |
| Output P1dB             | dBm  | 25.5    | 25.8    | 26.2    | 26.2    | 25.8    | 25.6    |
| Output IP3 <sup>1</sup> | dBm  | 43.5    | 43.0    | 42.5    | 42.0    | 42.0    | 43.0    |
| Input Return Loss       | dB   | -16     | -15     | -15     | -19     | -23     | -19     |
| Output Return Loss      | dB   | -10.5   | -10.8   | -11.8   | -14     | -14.5   | -19     |
| Noise Figure            | dB   | 4.0     | 4.0     | 4.1     | 4.0     | 4.1     | 4.2     |

Note

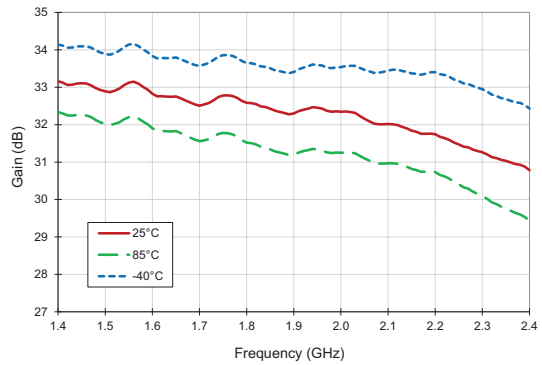
1. OIP3 is tested at  $P_{OUT}=+5$  dBm/Tone and 1 MHz spacing

## 1400MHz to 2400MHz Application Circuit Data

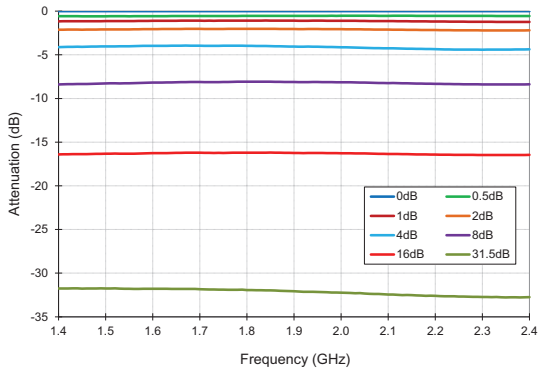
Gain versus Frequency and Attenuation State



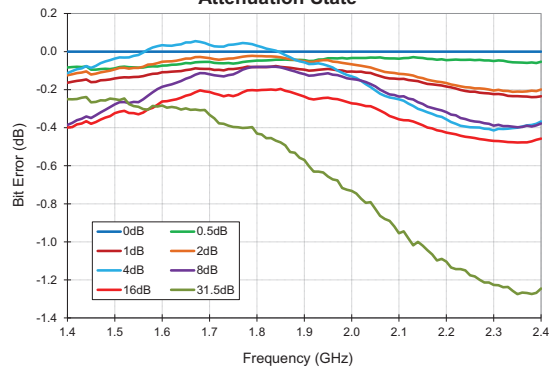
Gain versus Frequency and Temperature at 0dB Attenuation State



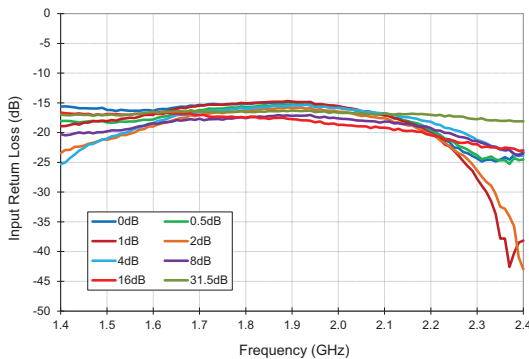
Normalized Attenuation versus Frequency and Attenuation State



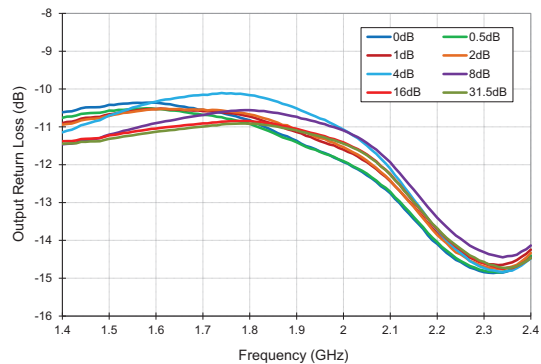
Bit Error versus Frequency and Attenuation State



Input Return Loss versus Frequency and Attenuation State

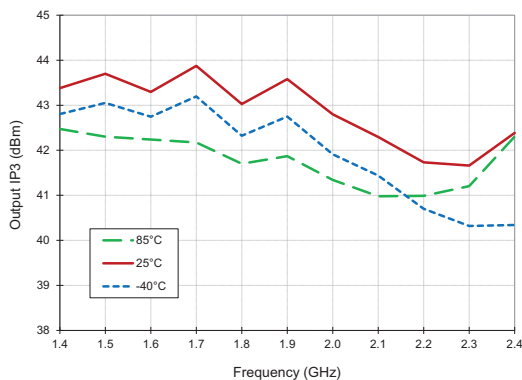


Output Return Loss versus Frequency and Attenuation State

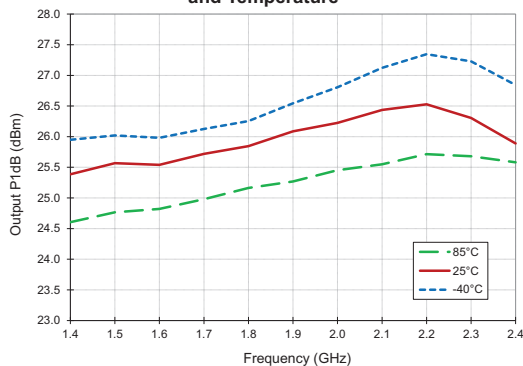


## 1400MHz to 2400MHz Application Circuit Data

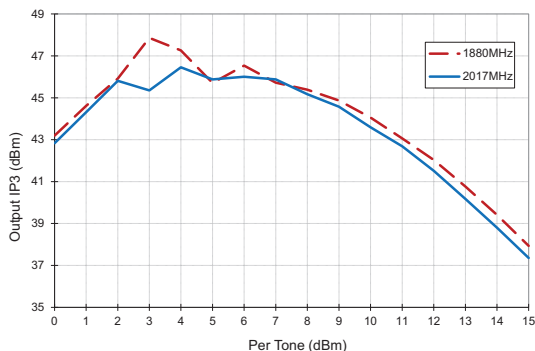
Output IP3 versus Frequency and Temperature



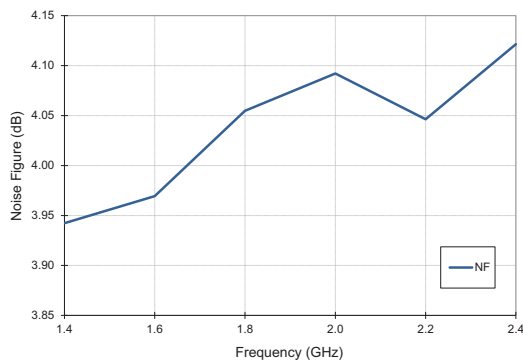
Output P1dB versus Frequency and Temperature



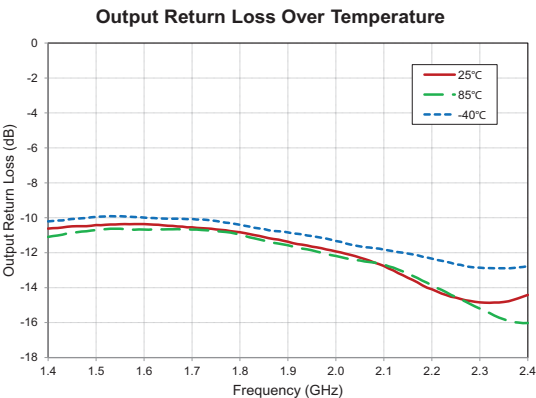
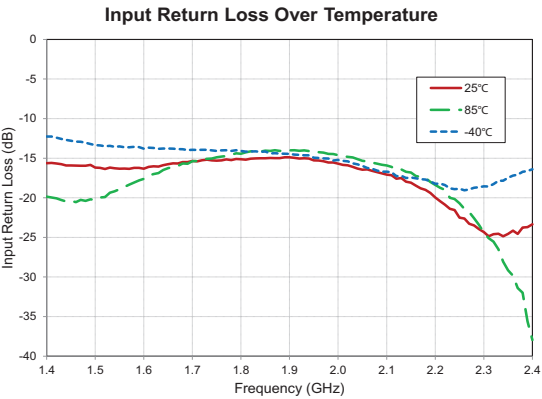
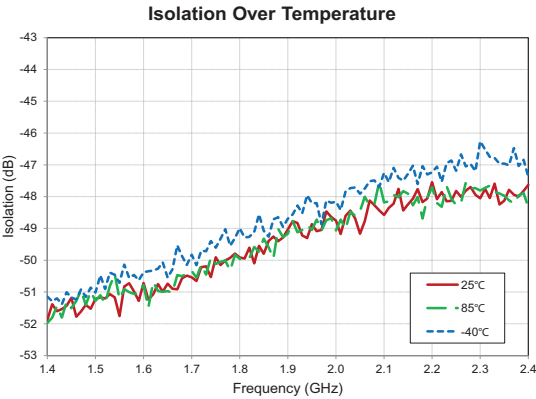
Output IP3 versus Tone Power at 0dB Attenuation State



Noise Figure versus Frequency at 0dB Attenuation State

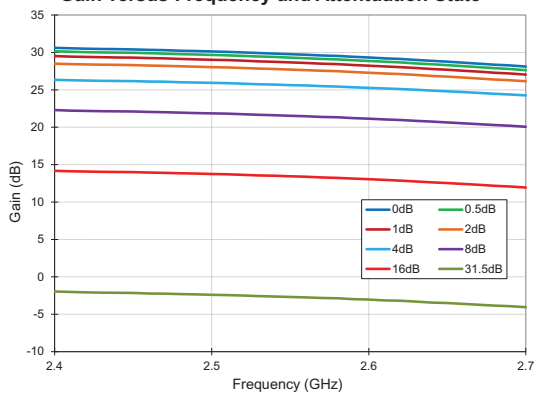


1400MHz to 2400MHz Application Circuit Data

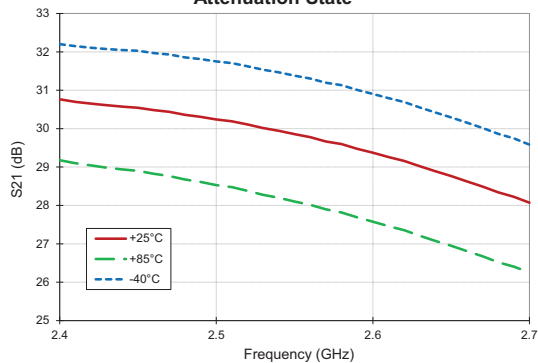


## 2400MHz to 2700MHz Application Circuit Data

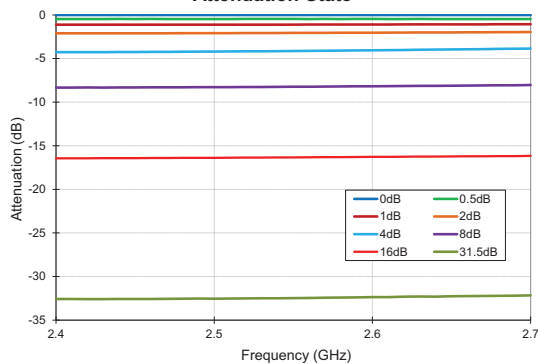
Gain versus Frequency and Attenuation State



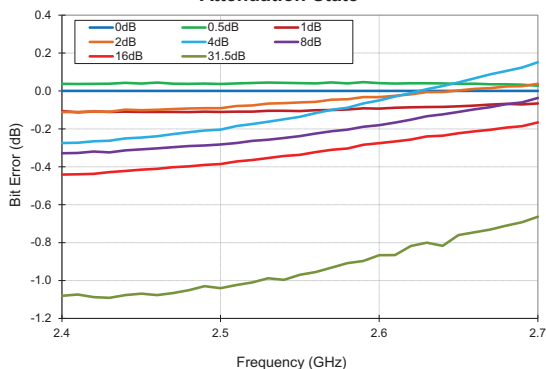
Gain versus Frequency and Temperature at 0dB Attenuation State



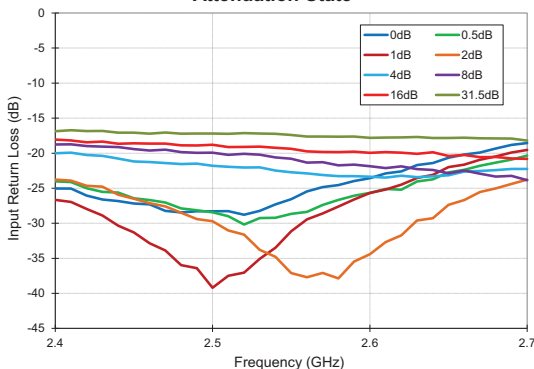
Normalized Attenuation versus Attenuation State



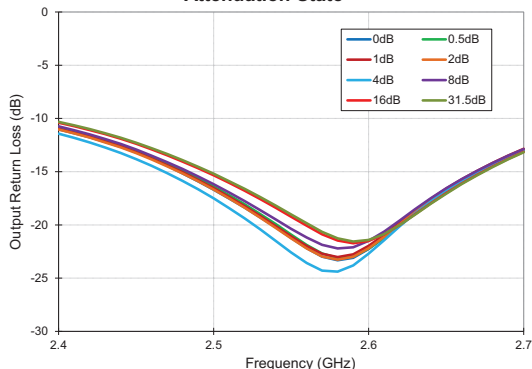
Bit Error versus Frequency and Attenuation State



Input Return Loss versus Frequency and Attenuation State

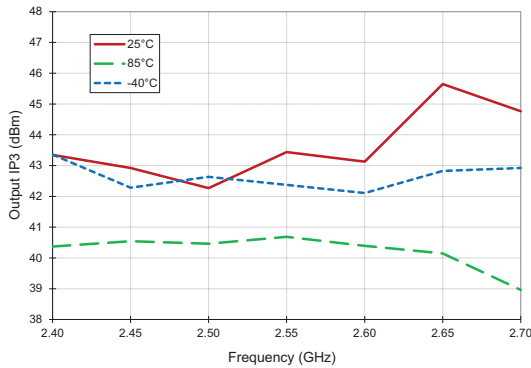


Output Return Loss versus Frequency and Attenuation State

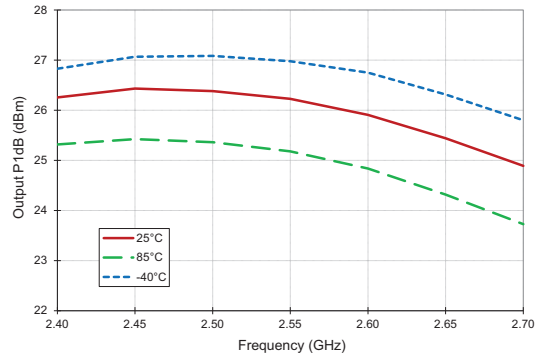


## 2400MHz to 2700MHz Application Circuit Data

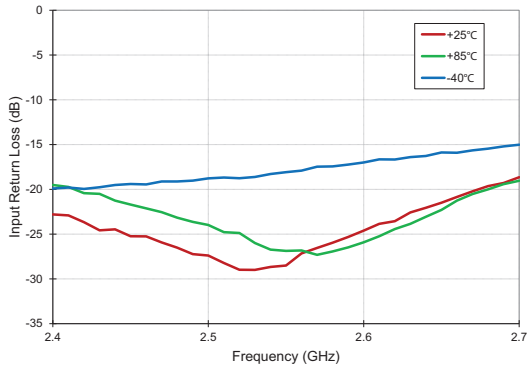
Output IP3 versus Frequency and Temperature



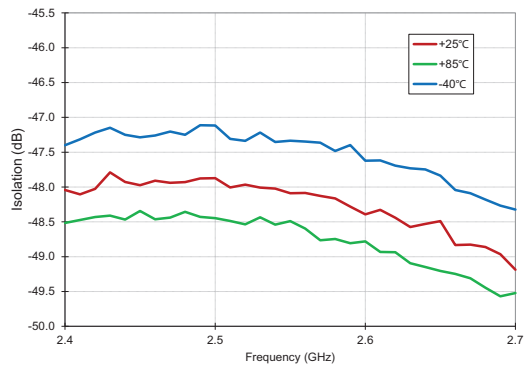
Output P1dB versus Frequency and Temperature



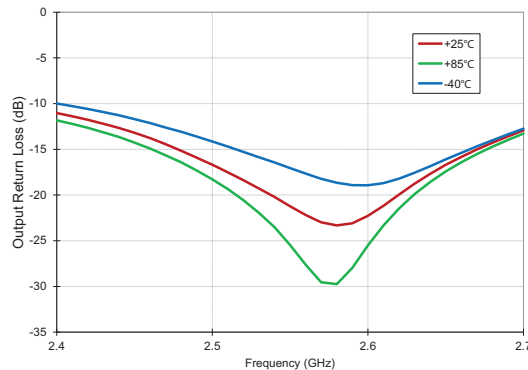
Input Return Loss Over Temperature



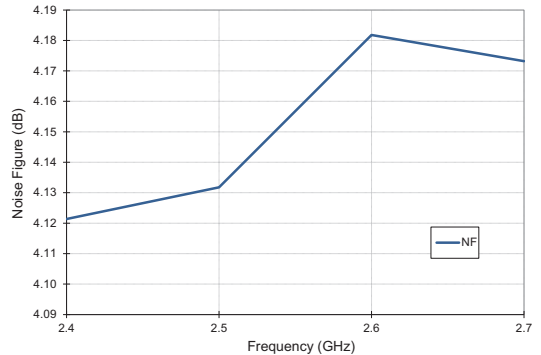
Isolation Over Temperature



Output Return Loss Over Temperature



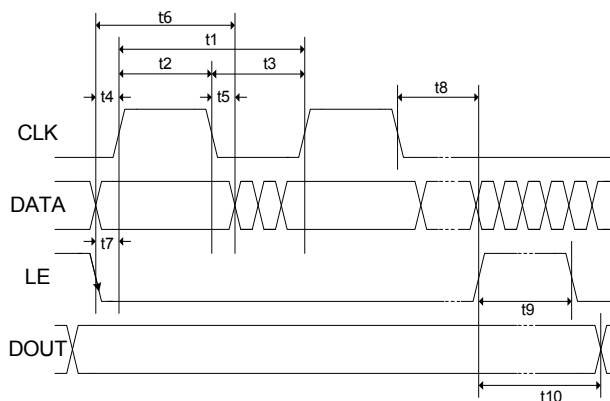
Noise Figure versus Frequency at 0dB Attenuation State



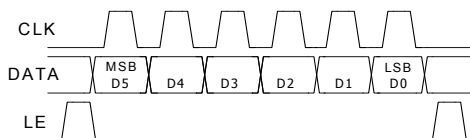
## Truth Table

| Control Bit |    |    |    |    |    | Gain Relative to Maximum Gain |
|-------------|----|----|----|----|----|-------------------------------|
| D5          | D4 | D3 | D2 | D1 | D0 |                               |
| 1           | 1  | 1  | 1  | 1  | 1  | 0dB                           |
| 1           | 1  | 1  | 1  | 1  | 0  | -0.5dB                        |
| 1           | 1  | 1  | 1  | 0  | 1  | -1dB                          |
| 1           | 1  | 1  | 0  | 1  | 1  | -2dB                          |
| 1           | 1  | 0  | 1  | 1  | 1  | -4dB                          |
| 1           | 0  | 1  | 1  | 1  | 1  | -8dB                          |
| 0           | 1  | 1  | 1  | 1  | 1  | -16dB                         |
| 0           | 0  | 0  | 0  | 0  | 0  | -31.5dB                       |

## Serial Port Interface SPI Timing Diagram



## Programming Example, 6-Bit



## SPI Timing Diagram Specifications

| Parameter | Limit | Unit    | Comment                |
|-----------|-------|---------|------------------------|
| t1        | 25    | MHz max | CLK Frequency          |
| t2        | 20    | ns min  | CLK High               |
| t3        | 20    | ns min  | CLK Low                |
| t4        | 5     | ns min  | DATA to CLK Setup Time |
| t5        | 5     | ns min  | DATA to CLK Hold Time  |
| t6        | 30    | ns min  | DATA 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         |
| t10       | 20    | ns max  | Output Set             |

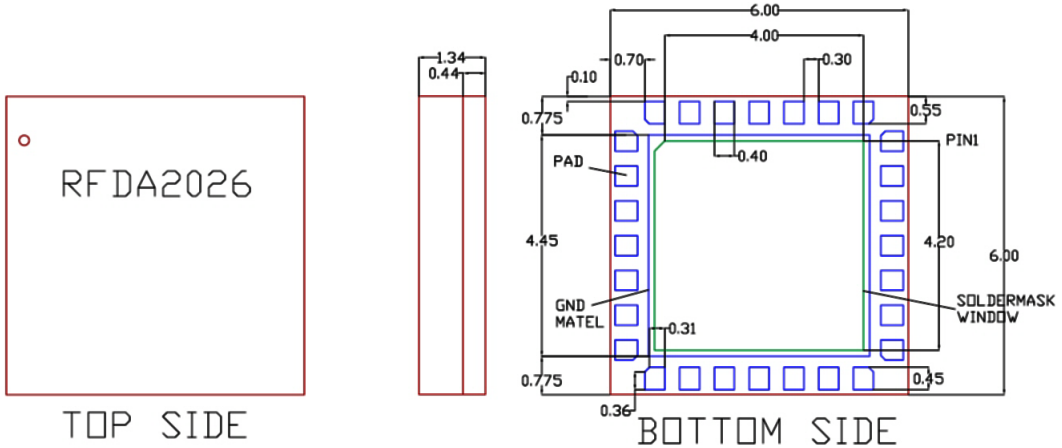
| Logic Voltage Levels |              |
|----------------------|--------------|
| State                | Logic        |
| Low                  | 0V to 0.8V   |
| High                 | 2.0V to 5.0V |

| Power-up Programming Truth Table |                            |
|----------------------------------|----------------------------|
| PUP                              | Attenuator Setting         |
| Low                              | Attenuation at Min, 0dB    |
| High                             | Attenuation at Max, 31.5dB |

## Pin Names and Descriptions

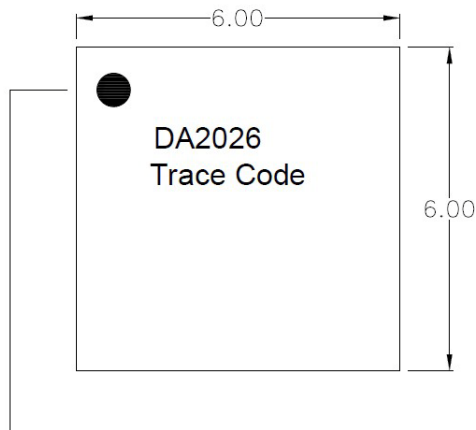
| Pin | Function | Description                         |
|-----|----------|-------------------------------------|
| 1   | SPI_LE   | Serial Latch Enable Input           |
| 2   | SPI_DATA | Serial Data Input                   |
| 3   | SPI_CLK  | Serial Clock Input                  |
| 4   | PUP      | Power-up Programming Pin            |
| 5   | GND      | RF/DC Ground Connection             |
| 6   | RF_IN    | RF Input                            |
| 7   | GND      | RF/DC Ground Connection             |
| 8   | VCC_AMP1 | Supply Voltage for Amplifier 1      |
| 9   | GND      | RF/DC Ground Connection             |
| 10  | GND      | RF/DC Ground Connection             |
| 11  | GND      | RF/DC Ground Connection             |
| 12  | GND      | RF/DC Ground Connection             |
| 13  | GND      | RF/DC Ground Connection             |
| 14  | VCC_AMP2 | Supply Voltage for Amplifier 2      |
| 15  | GND      | RF/DC Ground Connection             |
| 16  | RF_OUT   | RF Output                           |
| 17  | GND      | RF/DC Ground Connection             |
| 18  | GND      | RF/DC Ground Connection             |
| 19  | GND      | RF/DC Ground Connection             |
| 20  | GND      | RF/DC Ground Connection             |
| 21  | GND      | RF/DC Ground Connection             |
| 22  | NC       | Do Not Connect, Leave Open Circuit  |
| 23  | GND      | RF/DC Ground Connection             |
| 24  | GND      | RF/DC Ground Connection             |
| 25  | GND      | RF/DC Ground Connection             |
| 26  | GND      | RF/DC Ground Connection             |
| 27  | GND      | RF/DC Ground Connection             |
| 28  | VCC_SPI  | Supply Voltage for SPI and DSA Chip |

## 6.0mm x 6.0mm Laminate Module



The module thickness tolerance is +/- .04 mm. All other dim tolerances are +/- .075 mm unless otherwise noted.

## Branding Diagram

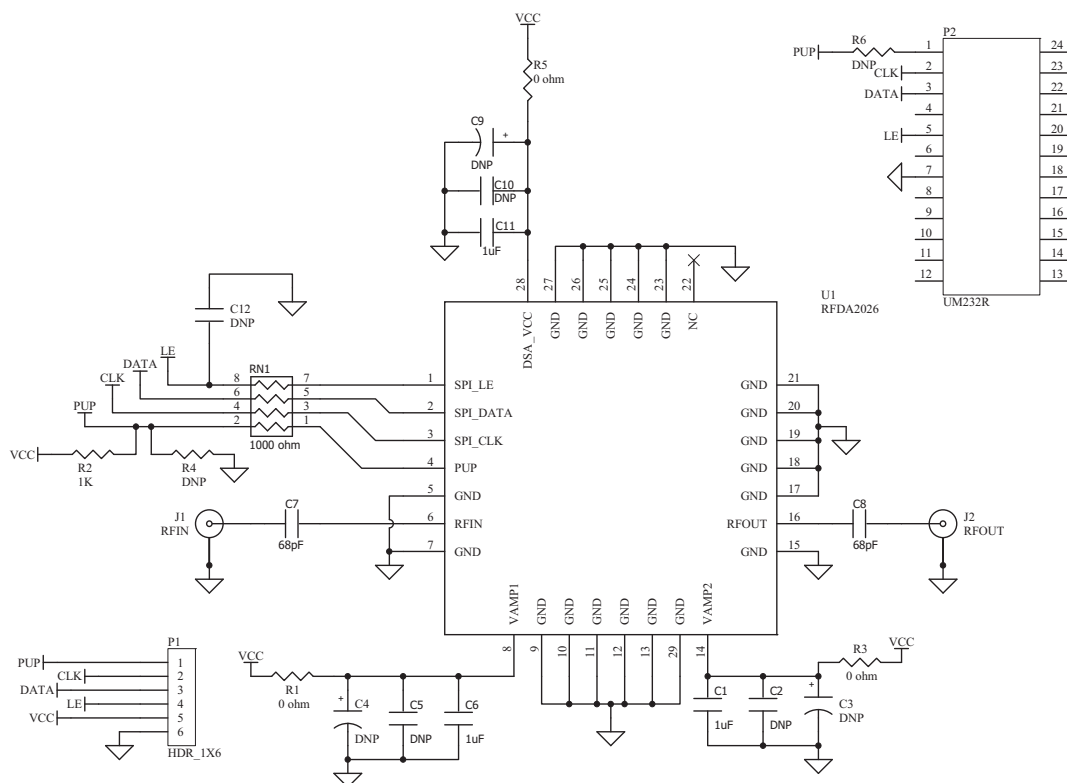


## Pin 1 Indicator

Trace Code to be assigned by SubCon

## Evaluation Board Schematic

### 1400MHz to 2400MHz Application Circuit



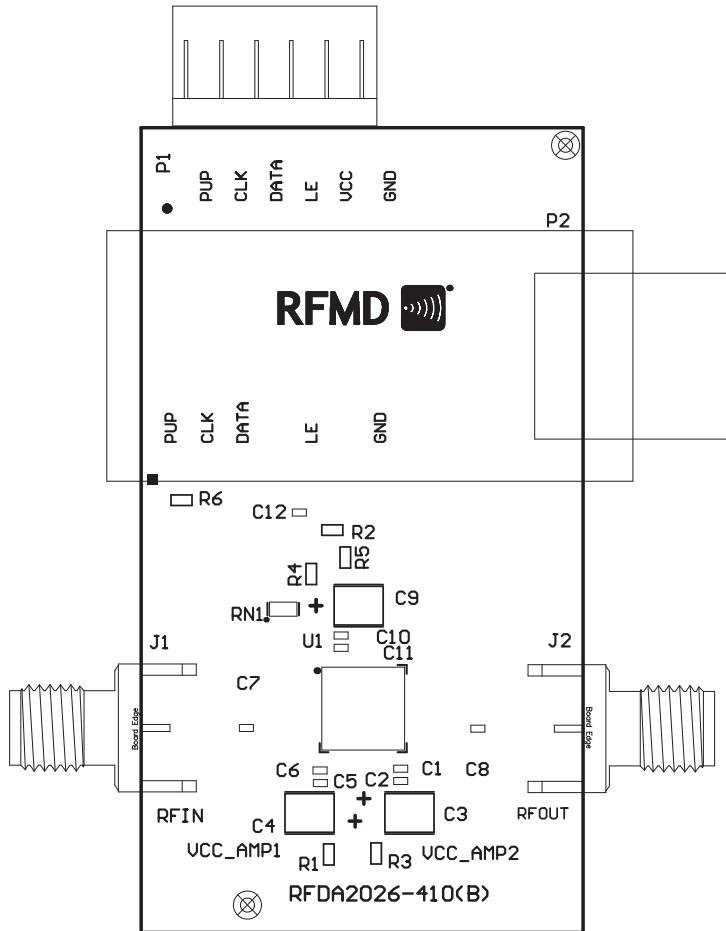
## Evaluation Board Bill of Materials (BOM)

### 1400 MHz to 2400 MHz Application Circuit

| Description                           | Reference Designator | Manufacturer                | Manufacturer's P/N |
|---------------------------------------|----------------------|-----------------------------|--------------------|
| RFDA2026-410(B)                       |                      | Viasystems                  | RFDA2026-410(B)    |
| CAP, 1uF, 10%, 10V, X5R, 0402         | C1, C6, C11          | Murata Electronics          | GRM155R61A105KE15D |
| DNP                                   | C2-C5, C9-C10, C12   |                             |                    |
| CAP, 68pF, 5%, 50V, C0G, 0402         | C7-C8                | Murata Electronics          | GRM1555C1H680JZ01D |
| CONN, SMA, END LNCH, FLT, 0.062"      | J1-J2                | Emerson Network Power       | 142-0701-821       |
| CONN, HDR, ST, PLRZD, 6-PIN, 0.100"   | P1                   | AMP                         | 640454-6           |
| CONN, SKT, 24-PIN DIP, .600", T/H     | P2                   | Aries Electronics, Inc.     | 24-6518-10         |
| Res, 0.0, 1/16W, 5%, 0603             | R1, R3, R5           | Panasonic Industrial Co.    | ERJ-3GSY0R00V      |
| RES, 1K, 5%, 1/16W, 0603              | R2                   | Panasonic Industrial Co.    | ERJ-3GEYJ102       |
| DNP                                   | R4, R6               |                             |                    |
| RES ARRAY, 4-ELEM, 1K, 5%, SMD 4x0402 | RN1                  | KOA Speer Electronics, Inc. | CN1E4KTTD102J      |
| DUT                                   | U1                   | RFMD                        | RFDA2026-410       |

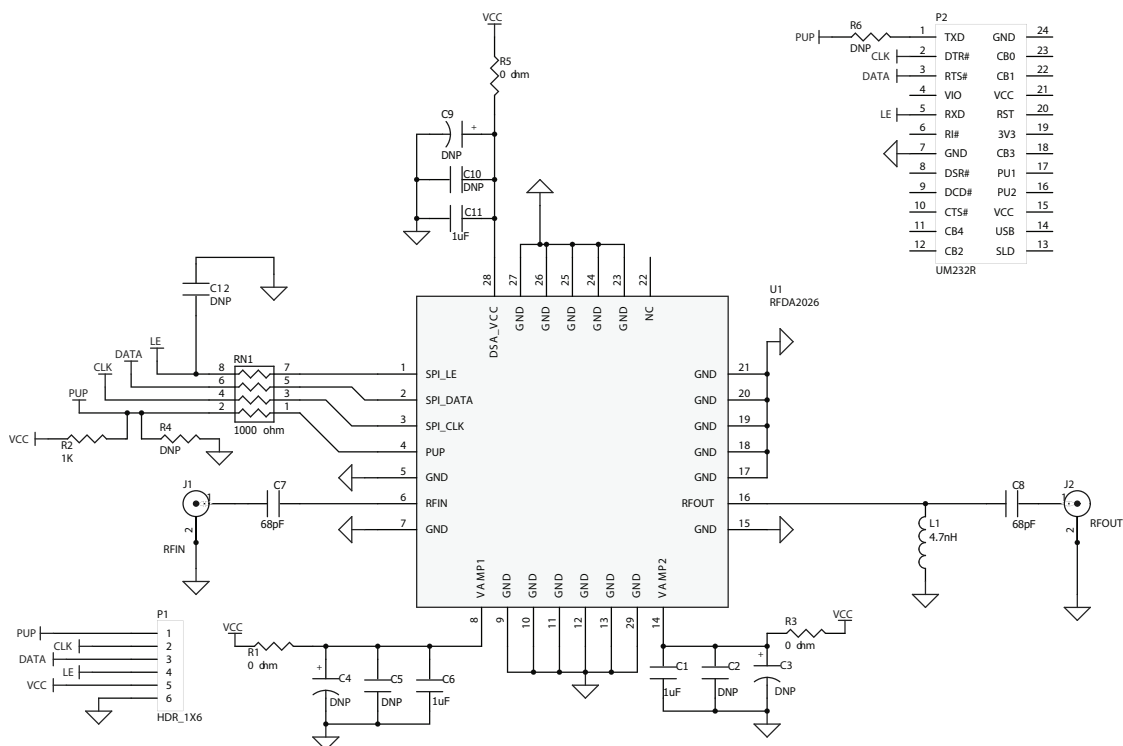
## Evaluation Board Assembly Drawing

### 1400MHz to 2400MHz Application Circuit



## Evaluation Board Schematic

### 2400MHz to 2700MHz Application Circuit

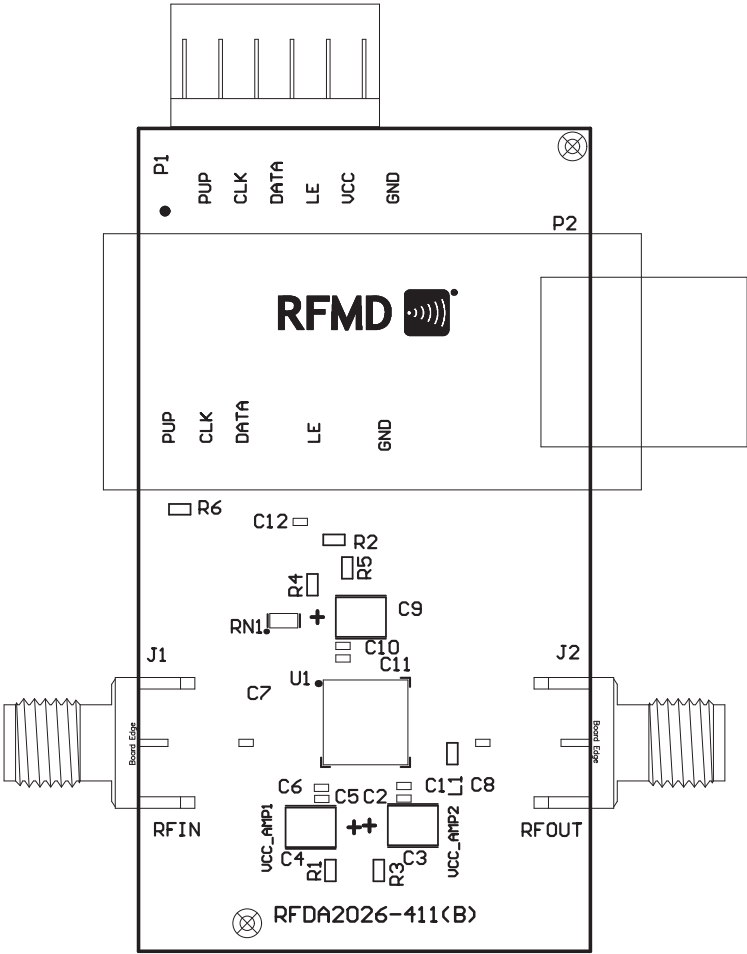


## Evaluation Board Bill of Materials (BOM)

### 2400MHz to 2700MHz Application Circuit

| Description                           | Reference Designator | Manufacturer                   | Manufacturer's P/N |
|---------------------------------------|----------------------|--------------------------------|--------------------|
| RFDA2026-411(B)                       |                      | Viasystems                     | RFDA2026-411(B)    |
| CAP, 1uF, 10%, 10V, X5R, 0402         | C1, C6, C11          | Murata Electronics             | GRM155R61A105KE15D |
| DNP                                   | C2-C5, C9-C10, C12   |                                |                    |
| CAP, 68pF, 5%, 50V, C0G, 0402         | C7-C8                | Murata Electronics             | GRM1555C1H680JZ01D |
| CONN, SMA, END LNCH, FLT, 0.062"      | J1-J2                | Emerson Network Power          | 142-0701-821       |
| CONN, HDR, ST, PLRZD, 6-PIN, 0.100"   | P1                   | AMP                            | 640454-6           |
| CONN, SKT, 24-PIN DIP, .600", T/H     | P2                   | Aries Electronics Inc.         | 24-6518-10         |
| Res, 0.0, 1/16W, 5%, 0603             | R1, R3, R5           | Panasonic Industrial Co.       | ERJ-3GSY0R00V      |
| RES, 1K, 5%, 1/16W, 0603              | R2                   | Panasonic Industrial Co.       | ERJ-3GEYJ102       |
| DNP                                   | R4, R6               |                                |                    |
| IND, 4.7nH, +/-0.3nH, 0603            | L1                   | Toko SH Waigaoqiao F.T.Z. Inc. | LL1608-FSL4N7S     |
| RES ARRAY, 4-ELEM, 1K, 5%, SMD 4x0402 | RN1                  | KOA Speer Electronics, Inc.    | CN1E4KTTD102J      |
| DUT                                   | U1                   | RFMD                           | RFDA2026-411       |

Evaluation Board Assembly Drawing  
2400MHz to 2700MHz Application Circuit



Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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