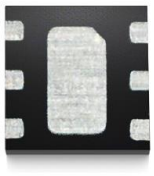
DATA SHEET

PRELIMINARY DATA SHEET



GRF6018

SPDT Failsafe Switch 0.1 to 12 GHz

FEATURES

Path: RFC to RF1: 8 GHz, V_{DD} = 3.3 V

- Insertion Loss: -1 dB
- IP0.1dB: TBD
- IIP3: 29 dBm at P_{OUT} = 12 dBm
- Failsafe Mode: High Loss

Path: RFC to RF2: 8 GHz, V_{DD} = 3.3 V

- Insertion Loss: -1 dB
- IP0.1dB: TBD
- IIP3: 35.5 dBm at P_{OUT} = 12 dBm
- Failsafe Mode: 1.2 dB Loss

APPLICATIONS

- X-Band Applications
- Microwave Radio
- Military and Space
- RFID
- Radar
- ISM Radios
- Automotive Telematics
- Satellite Communications
- Tower Mounted Amplifiers
- Signal Boosters/Repeaters
- Instrumentation and Automated Testing

DESCRIPTION

The GRF6018 is a linear, ultra-low loss SPDT Switch that has been designed with failsafe characteristics when all voltage inputs are removed. In switching mode, the device delivers IP0.1dB levels greater than 1 Watt along with high IIP3 levels for both RF paths.

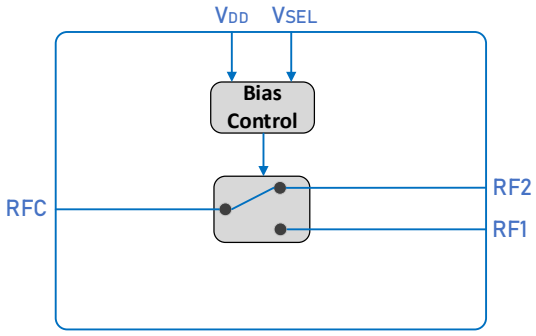
When powered down (failsafe mode), RFC to RF1 defaults to a high insertion loss while RFC to RF2 defaults to a low insertion loss state that retains high linearity.

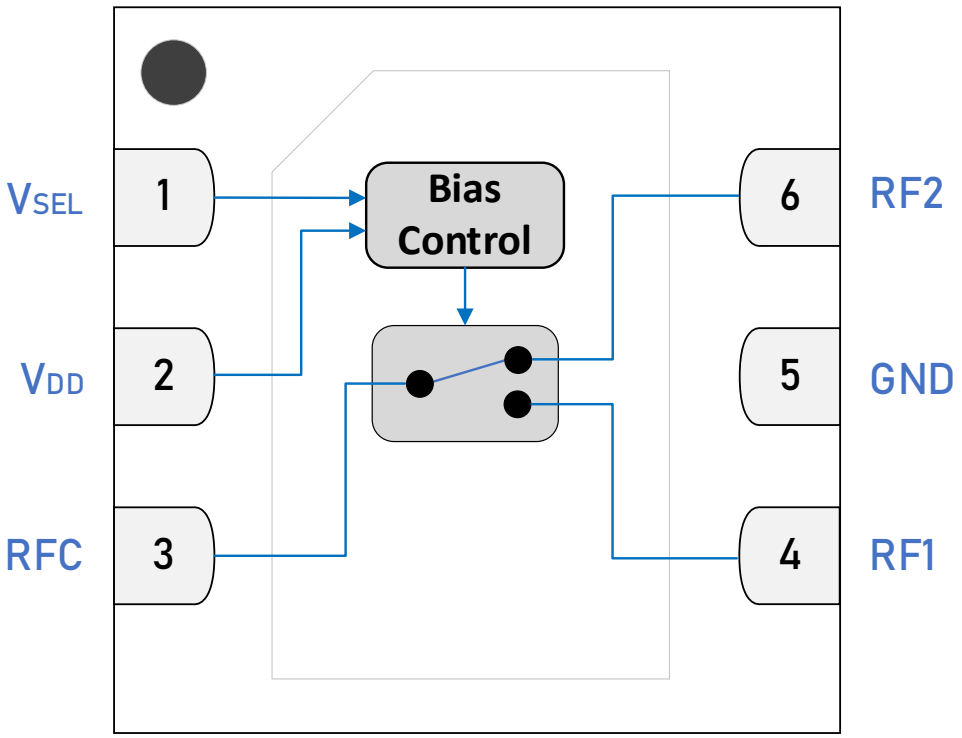
With optimization of external components, the upper frequency range of the device can be extended to 12 GHz and lower down to 100 MHz. Data plots using this high frequency tune are also included on the following pages. Optimization for a particular band essentially involves selecting the optimal series capacitor values (M1, M6, M7) for the three RF Ports.

The device is operated from a supply voltage of 1.8 volts to 5 volts with the single control input (V_{SELECT}) from 1.8 volts up to V_{DD}.

Please consult with the GRF applications engineering team for technical support.

BLOCK DIAGRAM





1.5 x 1.5mm DFN-6 Pin Out (Top View)

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Pin Assignments

Pin	Name	Description	Note
1	V_{SELECT}	Switching Control Input	V_{SEL} selects RF path.
2	V_{DD}	Supply Voltage Input	Provides device V_{DD}.
3	RFC	Common RF Path	An external DC blocking capacitor must be used.
4	RF1	RFC to RF1	This path defaults to high insertion loss when all power is removed. An external DC blocking capacitor must be used.
5	GND	Ground	Connect this pin to ground metal.
6	RF2	RFC to RF2	This path defaults to low insertion loss when all power is removed. An external DC blocking capacitor must be used.
PKG BASE	GND	Ground	Provides DC and RF ground as well as thermal heat sink. Recommend multiple 8 mil vias beneath the package for optimal RF and thermal performance. Refer to evaluation board top layer graphic on schematic page.

Power On/Off Sequence (V_{DD}/V_{SEL}/RF)

	V_{DD}	V_{SEL}	RF
POWER ON →	On →	On →	On

	RF	V_{SEL}	V_{DD}
POWER OFF →	Off →	Off →	Off

Note: Voltage can be applied to and removed from V_{DD} and V_{SEL} simultaneously.

Control Logic Truth Table

Mode	Description	V_{DD}	V_{SEL}
RFC to RF1	Selects RF1	≥ 3.0 V	1
RFC to RF2	Selects RF2	≥ 3.0 V	0
Failsafe	No voltage input (RF2 path selected)	0 V or float	0 V or float
V_{SEL} Logic Level "0"	Logic Low	≥ 3.0 V	< 0.1 V
V_{SEL} Logic Level "1"	Logic High	≥ 3.0 V	3.0 V ≤ V_{SEL} ≤ V_{DD}

Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{DD}	0	6	V
RF Input Power (average) VSWR: 1:1	$P_{IN\ MAX}$		TBD	dBm
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40	105	°C
Maximum Channel Temperature	T_{MAX}		170	°C

Electrostatic Discharge

Human Body Model	HBM	TBD		V

Storage

Storage Temperature	T_{STG}	TBD	TBD	°C
Moisture Sensitivity Level	MSL		TBD	–

Caution! ESD Sensitive Device

Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

Note: For additional information, please refer to *Package Manufacturing Information | Guerrilla RF (guerrilla-rf.com)*

All Guerrilla RF products are provided in RoHS compliant lead (Pb)-free packaging requiring no exemptions. Additional information for this topic can be found at this link - *Environmental and Restricted Substance Statement Library*

Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	0	3.3	5	V	
RF Frequency Range	F_{TEST}	6	8	10	GHz	Typical application schematic with external matching components **(notes 1 & 2)**.
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40		105	°C	
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single-ended.

Note 1: Operation outside this range is possible, but with degraded performance of some parameters.

Note 2: Contact the Guerrilla RF Applications team for guidance on optimizing the tuning of the device for alternative bands.

Nominal Operating Conditions

The following conditions apply unless noted otherwise: typical measurement schematic using the 6 to 10 GHz tuning set, V_{DD} = 3.3 V, V_{SEL} = 3.3 V, I_{DD} = 580 µA, F_{TEST} = 8 GHz, 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Switch Mode: RFC to RF1 Selected						
Loss (Package Device)	Loss_1		1.1		dB	V_{DD} = 3.3 V, V_{SEL} = 3.3 V.
Isolation: RF1 to RF2 **(note 1)**	Isol_1_2		15.7		dB	
Input Power for P0.1 dB Compression Power	IP1dB_1		TBD		dBm	
Input 3rd Order Intercept Point (P_{OUT} = 12 dBm)	IIP3_1		40		dBm	
Supply Current	I_{DD}		580		µA	
Select Current	I_{SEL}		70		µA	
Switch Mode: RFC to RF2 Selected						
Loss (Package Device)	Loss_2		1.1		dB	V_{DD} = 3.3 V, V_{SEL} = 0 V.
Isolation: RF1 to RF2 **(note 2)**	Isol_1_2		15.2		dB	
Input Power for P0.1 dB Compression Power	IP1dB_2		TBD		dBm	
Input 3rd Order Intercept Point (P_{OUT} = 12 dBm)	IIP3_2		37.6		dBm	
Supply Current	I_{DD}		120		µA	
Select Current	I_{SEL}		0		µA	
Failsafe Mode: RFC to RF2 (Default Short)						
Loss	Loss_2		1.5		dB	V_{DD} = 0 V, V_{SEL} = 0 V.
Isolation: RF1 to RF2 **(note 3)**	Isol_1_2		14.1		dB	
Input Power for P0.1 dB Compression Power	IP1dB_2		TBD		dBm	
Input 3rd Order Intercept Point (P_{OUT} = 12 dBm)	IIP3_2		37.2		dBm	
Failsafe Mode: RFC to RF1 (Default Open)						
Loss **(note 4)**	Loss_1		12		dB	V_{DD} = 0 V, V_{SEL} = 0 V.
Thermal Data						
Thermal Resistance (Infrared Scan)	Θ_{JC}		TBD		°C/W	On Standard Evaluation Board.

Note 1: Isolation from RF1 to RF2 with RFC to RF1 path active.
Note 2: Isolation from RF1 to RF2 with RFC to RF2 path active.
Note 3: Isolation from RF1 to RF2 in Failsafe mode.
Note 4: Isolation from RFC to RF1 in Failsafe mode.
Note 5: Loss measurements include EVB de-embedding.

GRF6018 Switching Times

The following conditions apply unless noted otherwise: Typical Measurement Schematic using the 6 to 10 GHz tuning set, V_{DD} = 3.3 V, V_{SEL} = 3.3 V, I_{DD} = 580 µA, F_{TEST} = 8 GHz, 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

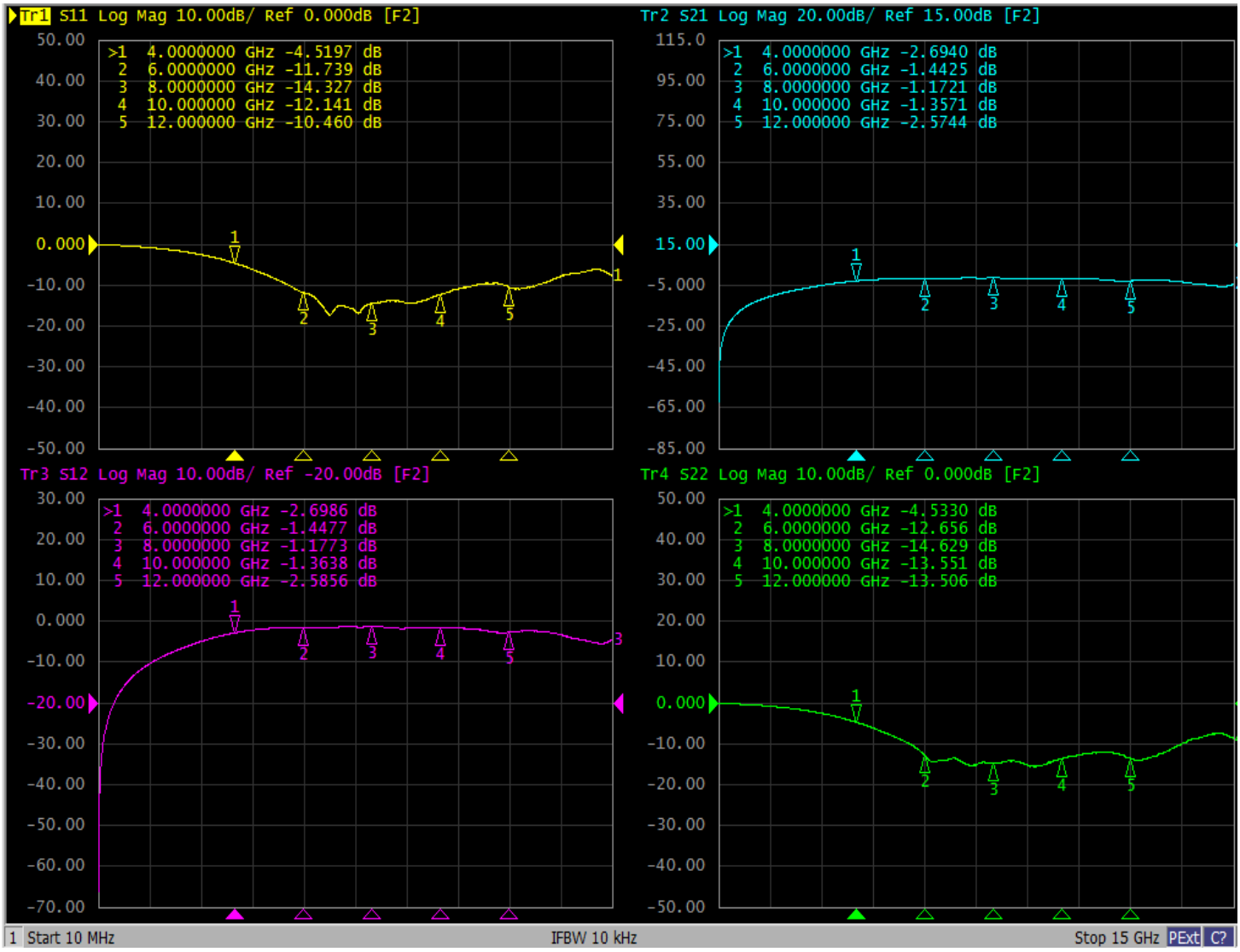
Path	State	Freq (GHz)	V_{DD} (V)	V_{SEL} (V)	P_{IN} (dBm)	Time (ns)
Normal Mode						
RFC to RF1 (50% V_{SEL} to 90% RF1_Out)	On	8	3.3	0 → 3.3	5	TBD
RFC to RF1 (50% V_{SEL} to 10% RF1_Out)	Off	8	3.3	3.3 → 0	5	TBD
RFC to RF2 (50% V_{SEL} to 90% RF2_Out)	On	8	3.3	3.3 → 0	5	TBD
RFC to RF2 (50% V_{SEL} to 10% RF2_Out)	Off	8	3.3	0 → 3.3	5	TBD
Failsafe Mode						
Failsafe Off to Failsafe On	On	8	3.3 → 0	3.3 → 0	5	TBD
Failsafe On to Failsafe Off	Off	8	0 → 3.3	0 → 3.3	5	TBD

Failsafe Characteristics: V_{DD} = 0 V, V_{SEL} = 0 V

1. RFC to RF1 defaults to high insertion loss state.
2. RFC to RF2 defaults to low insertion loss state.

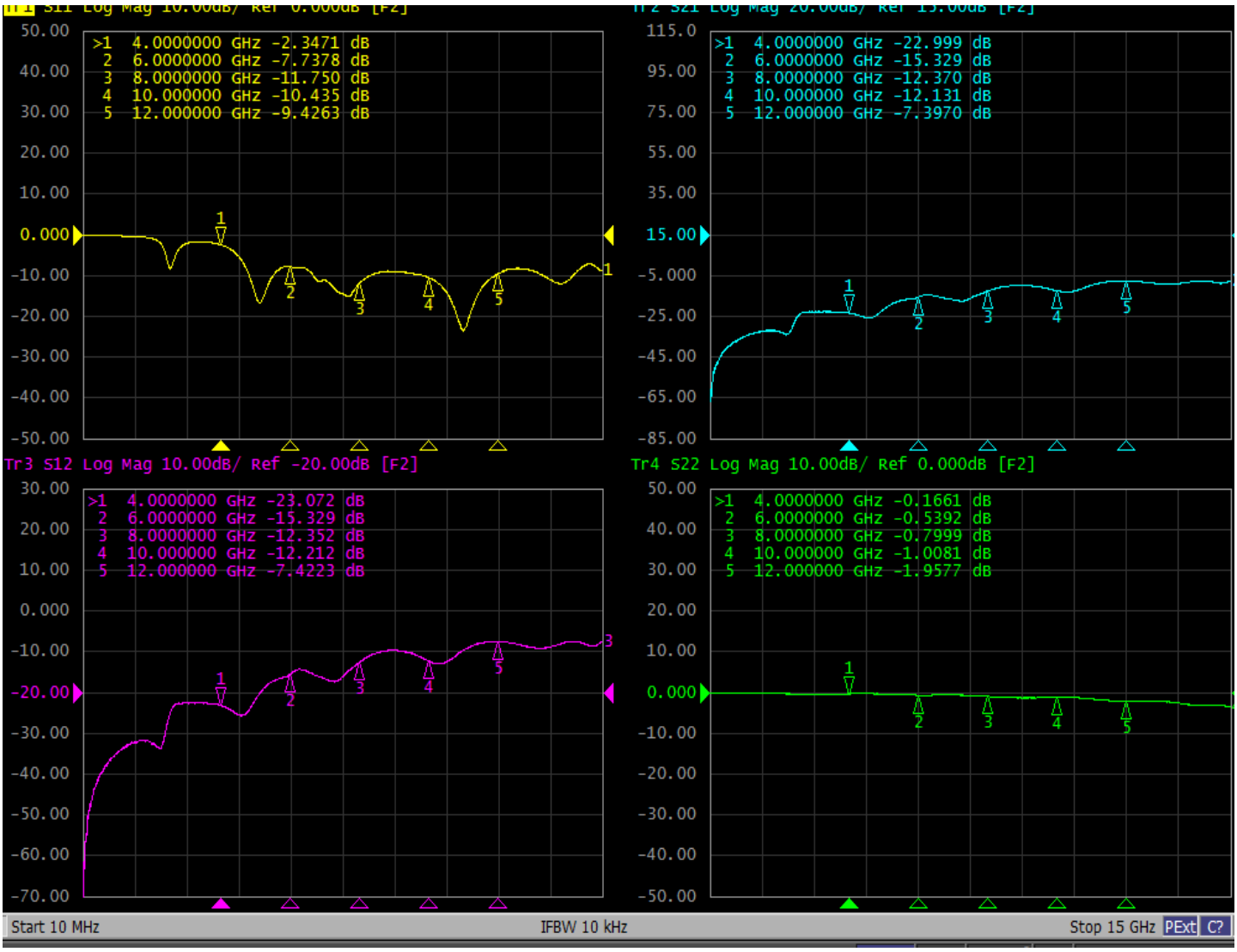
GRF6018 Typical Operating Curves: S-Parameters (3.3 V, 580 µA, 4 to 12 GHz)

RFC to RF1 with RF1 Enabled:



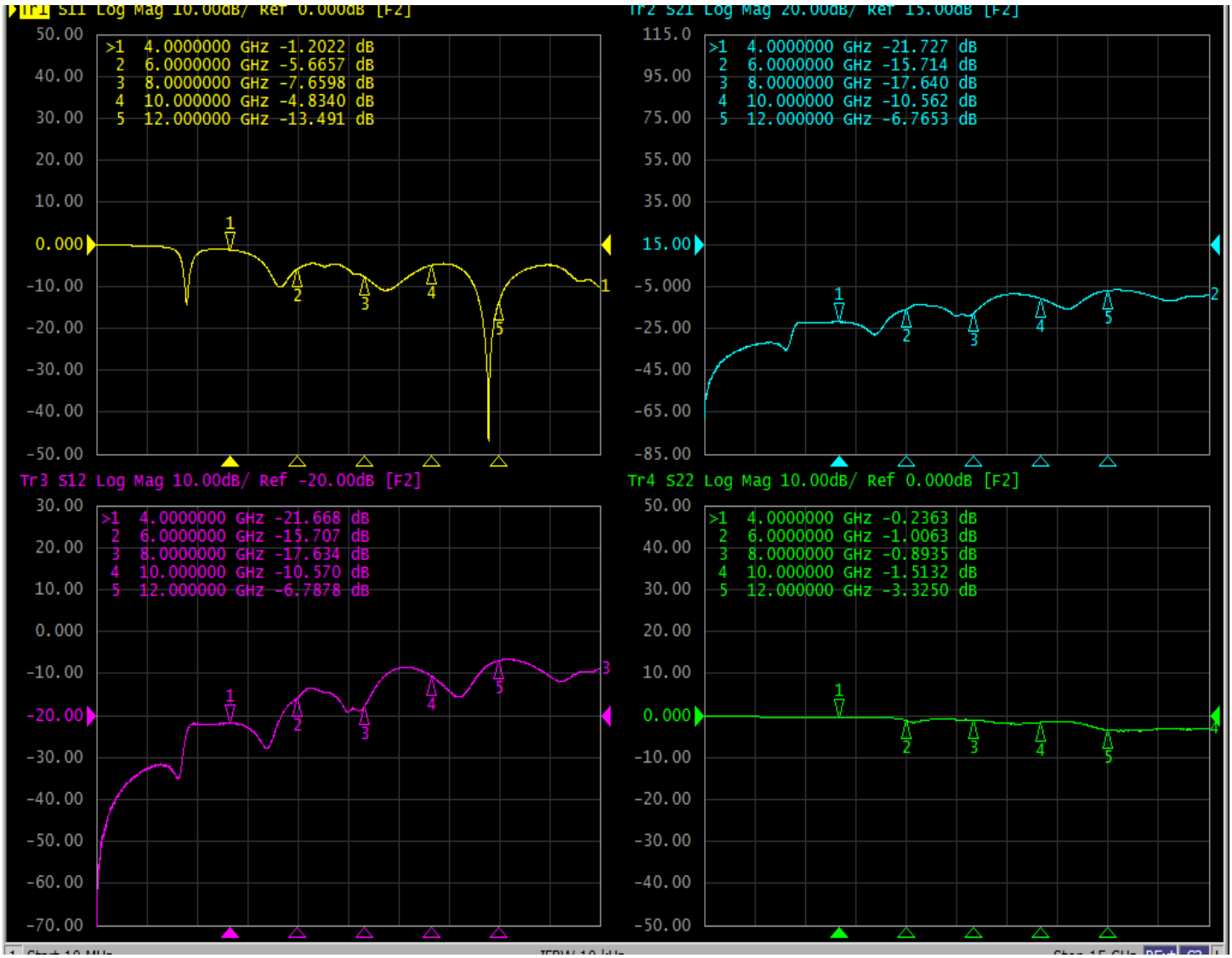
GRF6018 Typical Operating Curves: S-Parameters (3.3 V, 120 µA, 4 to 12 GHz)

RFC to RF1 with RF2 Enabled:



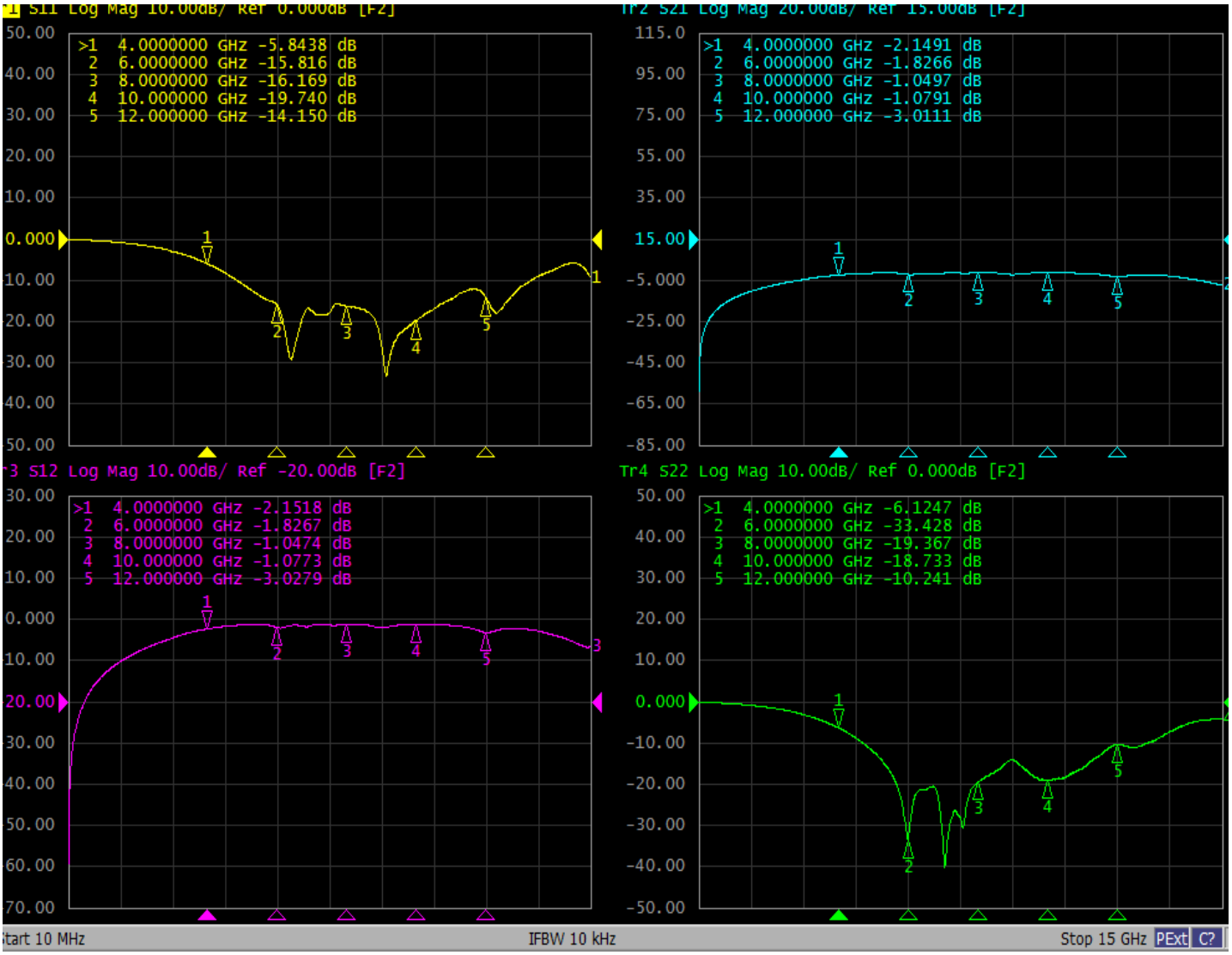
GRF6018 Typical Operating Curves: S-Parameters (3.3 V, 580 µA, 4 to 12 GHz)

RFC to RF2 with RF1 Enabled:



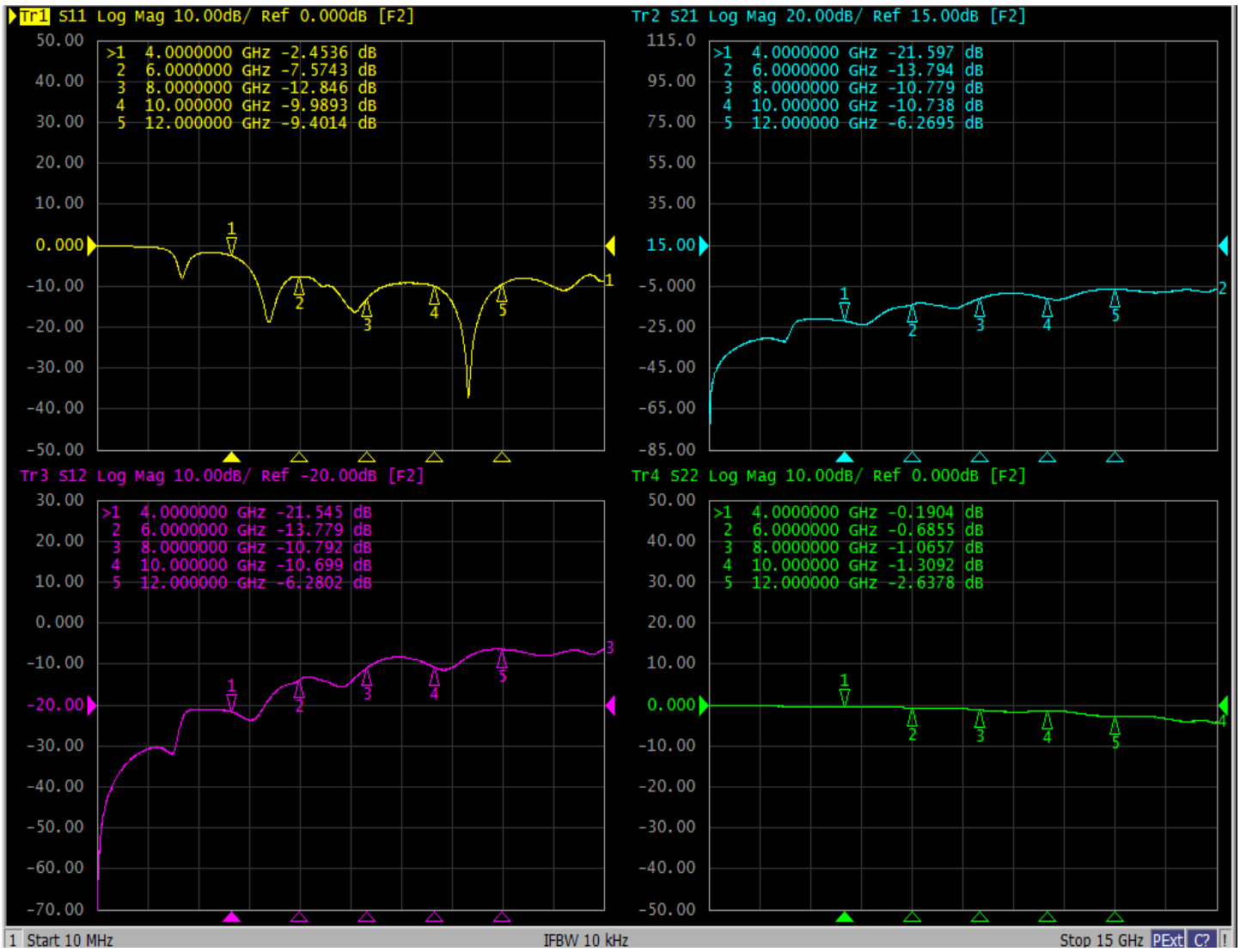
GRF6018 Typical Operating Curves: S-Parameters (3.3 V, 120 µA, 4 to 12 GHz)

RFC to RF2 with RF2 Enabled:



GRF6018 Typical Operating Curves: S-Parameters (0 V, 0 µA, 4 to 12 GHz)

RFC to RF1 (V_{DD} = V_{SEL} = 0 V):



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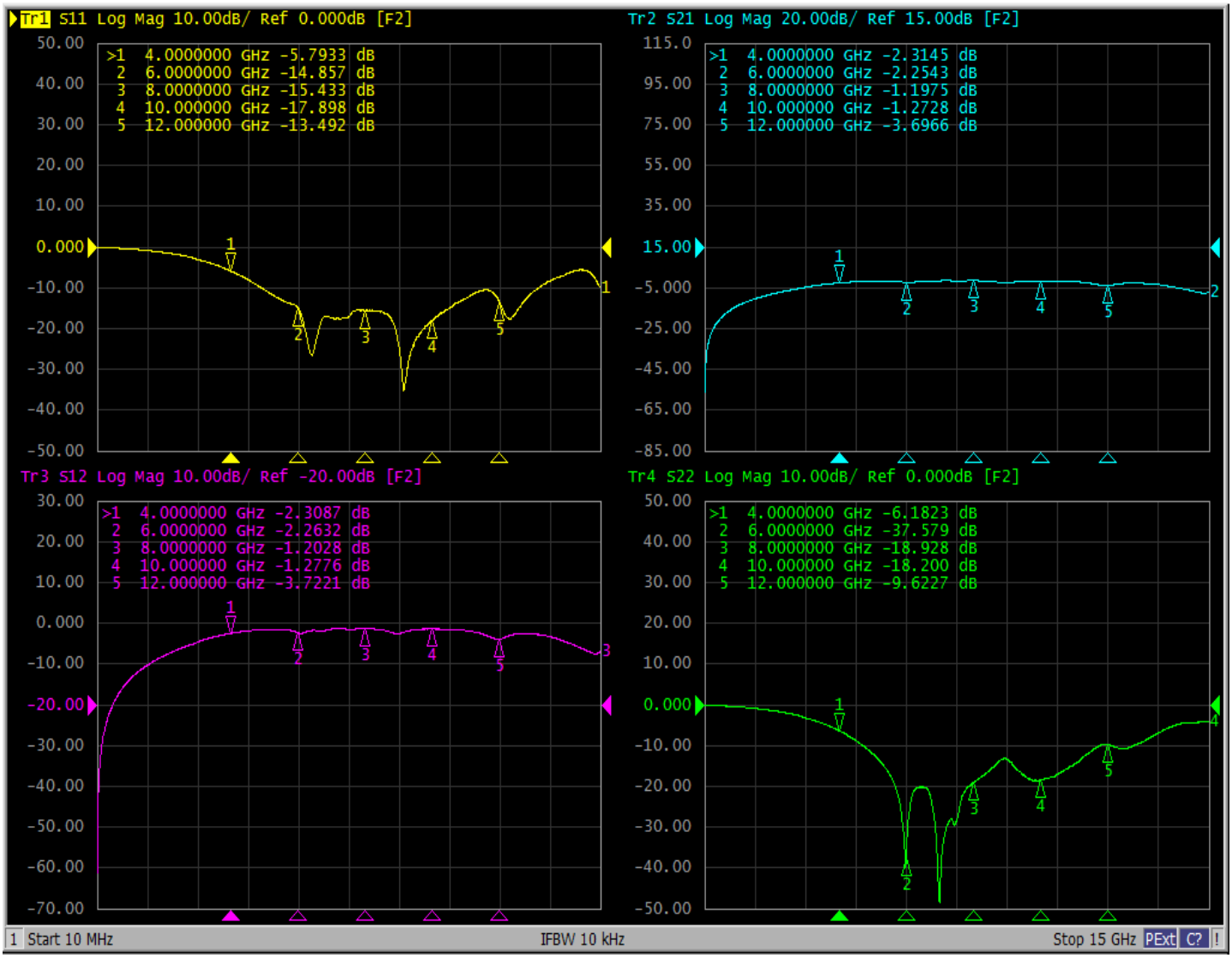
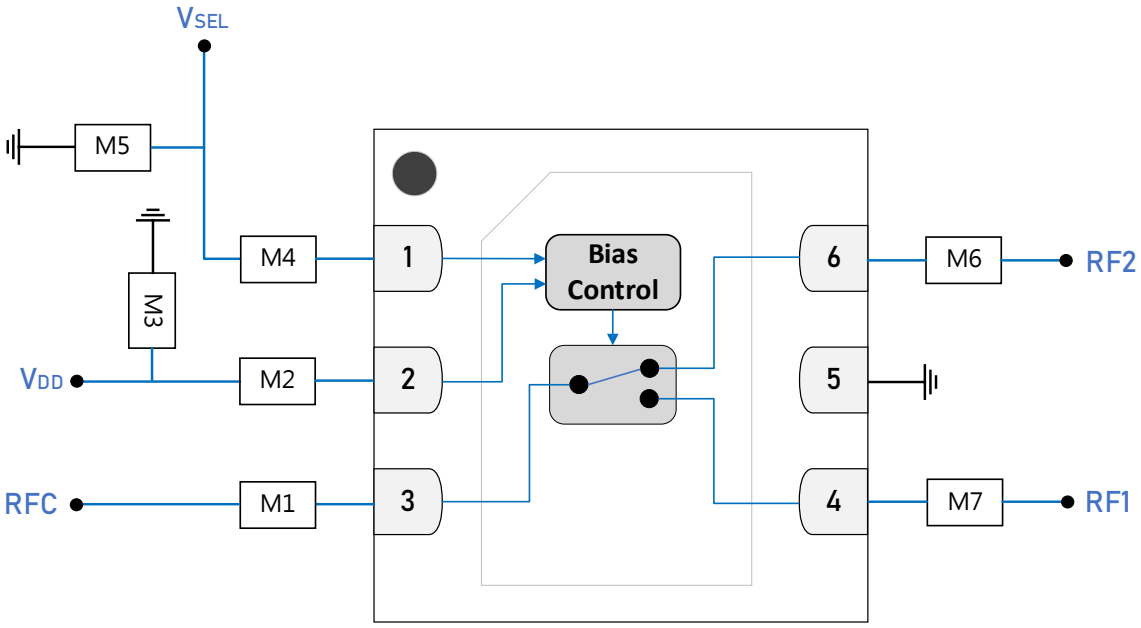
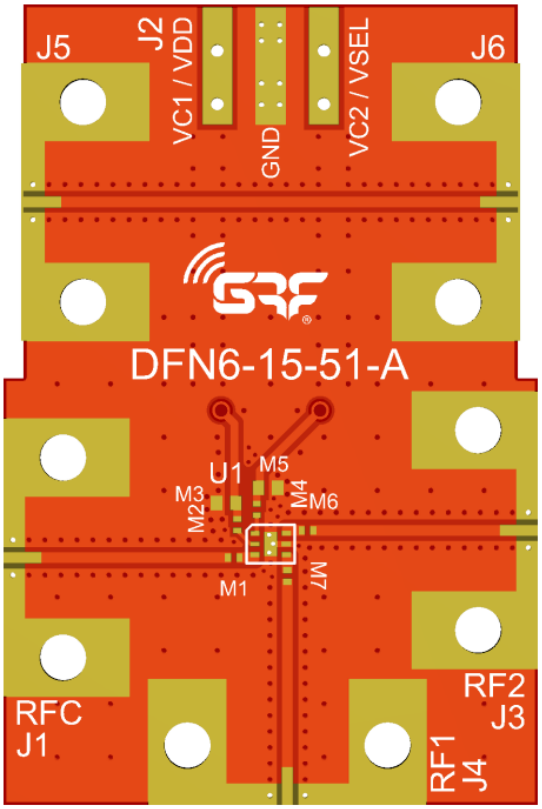
GRF6018 Typical Operating Curves: S-Parameters (0 V, 0 µA, 4 to 12 GHz)

RFC to RF2 (V_{DD} = V_{SEL} = 0 V):





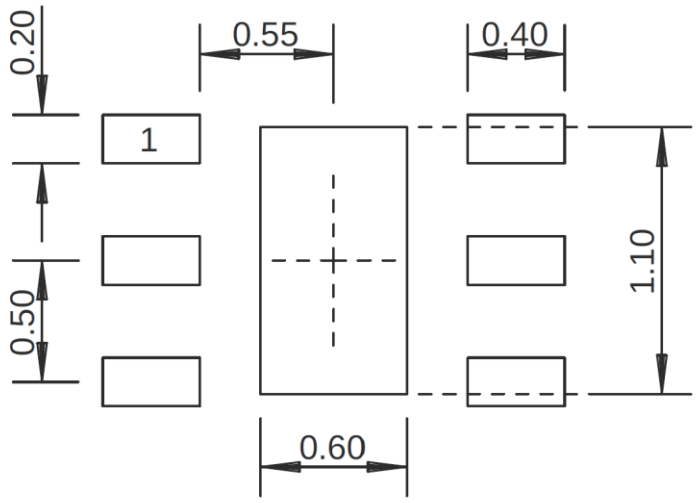
GRF6018 Standard Evaluation Board Schematic



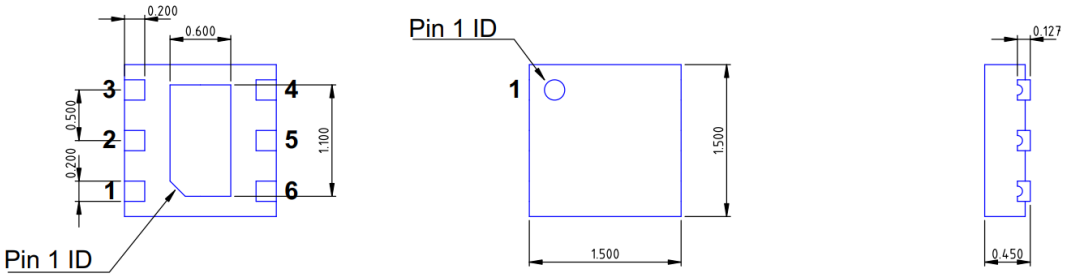
GRF6018 Evaluation Board Assembly Diagram

GRF6018 Standard Evaluation Board Assembly Diagram Reference: 4 to 12 GHz

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Capacitor	Murata	GJM	1 pF	0402	ok
M2	Resistor	Various	5%	0 Ω	0402	ok
M3	Capacitor	Murata	GRM	100 pF	0402	ok
M4	Resistor	Various	5%	0 Ω	0402	ok
M5	Capacitor	Murata	GJM	100 pF	0402	ok
M6	Capacitor	Murata	GJM	1 pF	0402	ok
M7	Capacitor	Murata	GJM	1 pF	0402	ok



1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)



Bottom View **Top View** **Side View**

DFN6 1.5x1.5mm
Dimensions in millimeters
Dimensional Tolerance: ±0.05

1.5 x 1.5 mm DFN-6 Package Dimensions

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Package Marking Diagram

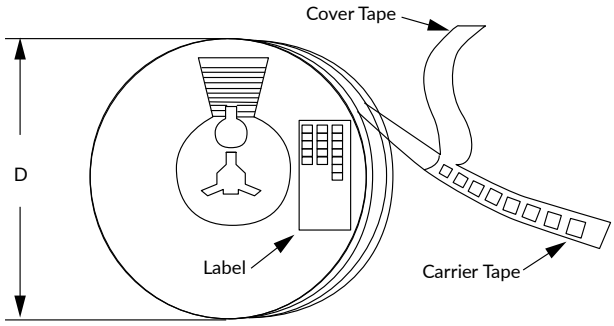
- Line 1: "Y" = YEAR (single digit). "WW" = WEEK the Device was assembled.
- Line 2: "XXXX" = Device Part Number.

Tape and Reel Information

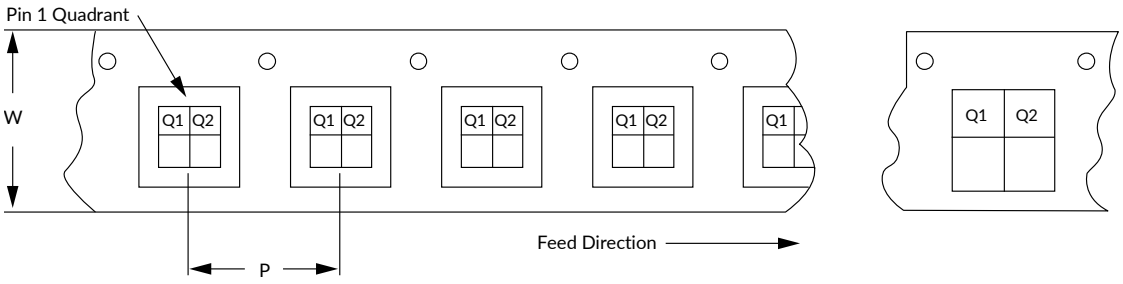
Guerrilla RF's tape and reel specification complies with Electronics Industries Association (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, which includes units per reel.

Devices are loaded with pins down into the carrier pocket with protective cover tape and reeled onto a plastic reel. Each reel is packaged in a cardboard box. There are product labels on the reel, the protective ESD bag and the outside surface of the box.

For the Tape and Reel Reference Table, please refer to: *Package Manufacturing Information | Guerrilla RF (guerrilla-rf.com)*



Tape and Reel Packaging with Reel Diameter Noted (D)



Carrier Tape Width (W), Pitch (P), Feed Direction and Pin 1 Quadrant Information

Revision History

Revision Date	Description of Change
October 15, 2024	Preliminary Data Sheet.

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Datasheet Classifications

Data Sheet Status	Notes
Advance	S-parameter and NF data based on EM simulations for the fully packaged device using foundry-supplied transistor S-parameters. Linearity estimates based on device size, bias condition and experience with related devices.
Preliminary	All data based on limited evaluation board measurements taken within the Guerrilla RF Applications Lab. All parametric values are subject to change pending the collection of additional data.
Release Ø	All data based on measurements taken with *production-released* material. TYP values are based on a combination of ATE and bench-level measurements, with MIN/MAX limits defined using *modelled estimates* that account for part-to-part variations and expected process spreads. Although unlikely, future refinements to the TYP/MIN/MAX values may be in order as multiple lots are processed through the factory.
Release A-Z	All data based on measurements taken with production-released material *derived from multiple lots which have been fabricated over an extended period of time.* MIN/MAX limits may be refined over previous releases as more statistically significant data is collected to account for process spreads.