IDTF2912NCGI
Advance Datasheet

50Ω SPDT Absorptive RF Switch **DC to 6000MHz**

General Description

The IDTF2912 is a low insertion loss 50Ω SPDT Absorptive RF Switch designed for a multitude of wireless and other RF applications. This device covers a broad frequency range from DC to 6000MHz. In addition to providing low insertion loss, the IDTF2912 also delivers excellent linearity and isolation performance while providing 50ohm termination to the unused RF input port.

The F2912 uses a single positive supply voltage of 3.3V supporting three states using either 3.3V or 1.8V user-selectable control voltage. An added feature includes a Mode CTL pin allowing the user to control the device with either 1-pin or two-pin control.

Competitive Advantage

IDTF2912 provides extremely low insertion loss; particularly important for RF receiver front-end use.

- ✓ Insertion Loss < 0.5dB*
- ✓ $IP3_I$: +55dBm*
- ✓ RF1 to RF2 isolation > 64dB*
- ✓ Negative supply voltage not required
- ✓ Operating temperature to +120C

* 1GHz

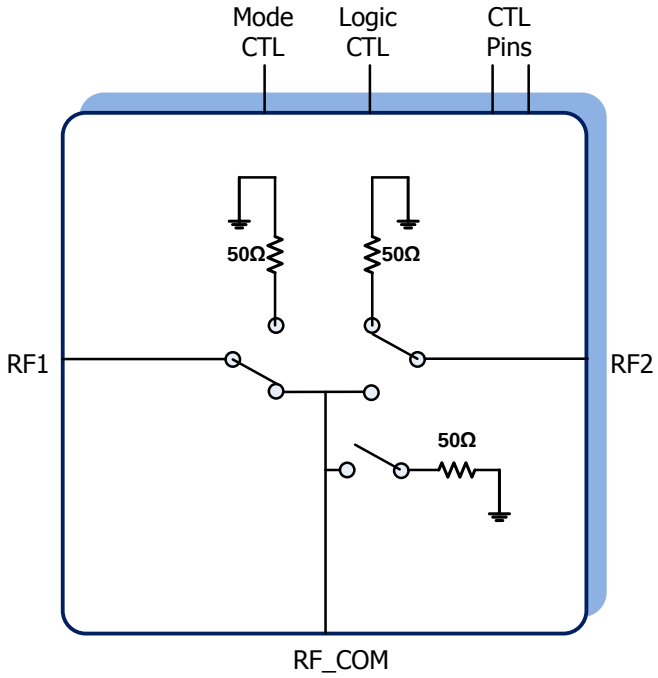
Applications

- Base Station 2G, 3G, 4G,
- Portable Wireless
- Repeaters and E911 systems
- Digital Pre-Distortion
- Point to Point Infrastructure
- Public Safety Infrastructure
- WIMAX Receivers and Transmitters
- Military Systems, JTRS radios
- RFID handheld and portable readers
- Cable Infrastructure
- Wireless LAN
- Test / ATE Equipment

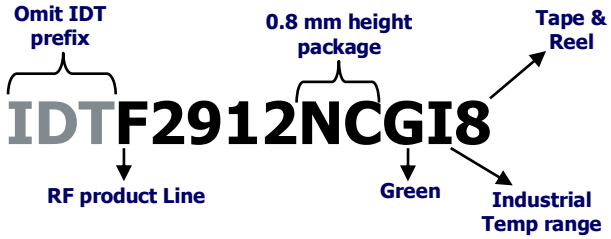
Features

- Very low insertion loss: < 0.5dB @ 1GHz
- High Input IP3: 55dB @ 1GHz
- 64dB Isolation @ 1GHz
- 1-pin or 2-pin device control option
- Low DC current; 50uA using 3.3V logic
- Single positive supply voltage: 3.3V
- 3.3V or 1.8V user-selectable control logic
- Operating temperature to +120C
- 4x4 20 pin TQFN package

Device Block Diagram



Ordering Information



ABSOLUTE MAXIMUM RATINGS

VCC to GND	-0.3V to +3.9V
CTL1, CTL2, LogicCTL	-0.3V to (VCC + 0.3V)
RF1, RF2, RF_COM	-0.3V to +0.3V
θ_{JA} (Junction – Ambient)	+60°C/W
θ_{JC} (Junction – Case) The Case is defined as the exposed paddle	+3°C/W
Maximum Junction Temperature	150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10s)	+260°C

RF POWER AT OPERATING CASE TEMP UP TO +85C

RF1, RF2 (RF1 or RF2 is connected to RF_COM, State 2 and 3)	+33dBm
RF1, RF2 (RF1 or RF2 is NOT connected to RF_COM, State 1, 2 and 3)	+24dBm
RF_COM (RF_COM port is not connected to RF1 or RF2, State 1)	+24dBm

RF POWER AT OPERATING CASE TEMP UP TO +105C

RF1, RF2 (RF1 or RF2 is connected to RF_COM, State 2 and 3)	+33dBm
RF1, RF2 (RF1 or RF2 is NOT connected to RF_COM, State 1, 2 and 3)	+21dBm
RF_COM (RF_COM port is not connected to RF1 or RF2, State 1)	+21dBm

RF POWER AT OPERATING CASE TEMP UP TO +120°C

RF1, RF2 (RF1 or RF2 is connected to RF_COM, State 2 and 3)	+27 dBm
RF1, RF2 (RF1 or RF2 is NOT connected to RF_COM, State 1)	+18dBm
RF_COM (RF_COM port is not connected to RF1 or RF2, State 1)	+18dBm

Note: RF power should be reduced if frequency is lower than 400MHz (see graph on page TBD)

Stresses above those listed above may cause permanent damage to the device. Functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

IDTF2912 Recommended Operating Conditions

Parameter	Comment	Symbol	min	typ	max	Units
Single Supply Voltage	Using 3.3V logic (Pin 18 low)	V_{CC}	2.7		3.6	V
	Using 1.8V logic (Pin 18 high)		3.15		3.45	
Operating Temperature Range	Case Temperature	T_{CASE}	-40		+120	degC
RF Freq Range*		F_{RF}	DC		6000	MHz
RF1 port impedance		Z_{RF1}		50		Ω
RF2 port impedance		Z_{RF2}		50		
RF_COM port impedance		Z_{RF_COM}		50		

* Performance optimized in frequency range from 400MHz to 3GHz

IDTF2912 Specification

Typical Application Circuit, V_{CC} = +3.3V, T_C = +25°C, F_{RF} = 1GHz, 2GHz, 3GHz as noted below. Input power = 0dBm per tone unless otherwise stated. PCB board trace losses are de-embedded unless otherwise noted.

Parameter	Comment	Symbol	min	typ	max	units
Logic Input High Threshold	• For all control pins • Pin 18 low for 3.3V logic	$V_{IH\_3.3V}$	***0.7 x VCC***			V
	• For all control pins • Pin 18 high for 1.8V logic	$V_{IH\_1.8V}$	***1.1***			V
Logic High voltage	• For all control pins • Pin 18 low for 3.3V logic				***3.6***	V
	• For all control pins • Pin 18 high for 1.8V logic				***2***	
Logic Input Low Threshold	• For all control pins • Pin 18 low for 3.3V logic	$V_{IL\_3.3V}$			***0.3 x VCC***	V
	• For all control pins • Pin 18 high for 1.8V logic	$V_{IL\_1.8V}$			***0.63***	V
Logic Current	For all control pins	I_{IH}, I_{IL}	***-TBD***		***+TBD***	µA
DC Current	• 2 control pins version • Pin 18 low for 3.3V logic		TBD		50	uA
	• 2 control pins version • Pin 18 high for 1.8V logic		TBD		200	
	• 1 control pin version • Pin 18 low for 3.3V logic				50	
	• 1 control pin version • Pin 18 high for 1.8V logic				200	
Insertion Loss RF1/RF2 to RF_COM port (State 2 or 3)	RF = 1GHz	IL_RF_{1GHz}		0.45	***TBD***	dB
	RF = 2GHz	IL_RF_{2GHz}		0.55	***TBD***	
	RF = 3GHz	IL_RF_{3GHz}		0.65	***TBD***	
Isolation between RF1 / RF2 ports and RF_COM port (State 2 or 3)	RF = 1GHz	$ISO1\_RF_{1GHz}$	***TBD***	64		dB
	RF = 2GHz	$ISO2\_RF_{2GHz}$	***TBD***	58		
	RF = 3GHz	$ISO3\_RF_{3GHz}$	***TBD***	44		

IDTF2912 SPECIFICATION (CONT)

Typical Application Circuit, V_{CC} = +3.3V, T_C = +25°C, F_{RF} = 1GHz, 2GHz, 3GHz as noted below. Input power = 0dBm per tone unless otherwise stated. PCB board trace losses are de-embedded unless otherwise noted.

Parameter	Comment	Symbol	min	typ	max	units
Isolation between RF1 and RF2 ports (State 2 or 3)	RF = 1GHz	ISO4_RF_{1GHz}	***TBD***	63		dB
	RF = 2GHz	ISO5_RF_{2GHz}	***TBD***	58		
	RF = 3GHz	ISO6_RF_{3GHz}	***TBD***	48		
Return Loss RF_COM Port (State 1)	RF = 1GHz	RL1_RF_{1GHz}		17		dB
	RF = 2GHz	RL2_RF_{2GHz}		16		
	RF = 3GHz	RL3_RF_{3GHz}		13		
Return Loss RF_COM Port (State 2 or 3)	RF = 1GHz	RL1_RF_{1GHz}		22		dB
	RF = 2GHz	RL2_RF_{2GHz}		19		
	RF = 3GHz	RL3_RF_{3GHz}		15		
Return Loss RF1, RF2 port (State 1)	RF = 1GHz	RL4_RF_{1GHz}		17		dB
	RF = 2GHz	RL5_RF_{2GHz}		18		
	RF = 3GHz	RL6_RF_{3GHz}		20		
Return Loss RF1, RF2 port (State 2 or 3)	RF = 1GHz	RL4_RF_{1GHz}		22		dB
	RF = 2GHz	RL5_RF_{2GHz}		21		
	RF = 3GHz	RL6_RF_{3GHz}		16		
Input IP2 RF1 / RF2 (State 2 or 3)	RF = 1GHz, Pin = +13dBm per tone	IIP2_RF_{1GHz}		80		dBm
	RF = 2GHz, Pin = +13dBm per tone	IIP2_RF_{2GHz}		TBD		
	RF = 3GHz, Pin = +13dBm per tone	IIP2_RF_{3GHz}		TBD		
Input IP3 RF1 / RF2 (State 2 or 3)	RF = 1GHz, Pin = +13dBm per tone	IIP3_RF_{1GHz}		55		dBm
	RF = 2GHz, Pin = +13dBm per tone	IIP3_RF_{2GHz}		TBD		
	RF = 3GHz, Pin = +13dBm per tone	IIP3_RF_{3GHz}		TBD		
Input 1dB compression RF1 / RF2 (State 2 or 3)	RF = 1GHz	P1dBi_RF	***TBD***	31		dBm
Switching Time	• 90/10 % RF • RF = 1GHz	Tsw		2		us
Maximum Switching Frequency		SW_{FREQ}		25		KHz
Maximum video feed-through RF_COM port	• 5MHz to 1000MHz • Measured with 1nsec risetime, 0/3.3V pulse	VID_{FT}		15		mV_{pp}
Maximum spurious level on any RF port	• Due to negative voltage generator • From 100KHz to 3GHz	$Spur_{MAX}$		-110		dBm

1 – Items in min/max columns in ***bold italics*** are Guaranteed by Test
2 – All other Items in min/max columns are Guaranteed by Design Characterization
3 – JEDEC 3.3V and JEDEC 1.8V logic

The Preliminary information presented herein represents products that are developmental or prototype. The noted characteristics are design targets. IDT reserves the right to change any circuitry or specification without notice.

Table 1 includes 3 states and provides the truth table for 2-pin control input.

State	Control pin input		RF1, RF2 input / output	
	CTL1, Pin 17	CTL2, Pin 16	RF1 to RF Common	RF2 to RF Common
1	Low	Low	OFF	OFF
2	Low	High	OFF	ON
3	High	Low	ON	OFF
4	High	High	N/A	N/A

Table 1 - Switch control Truth Table for 3 states using 2 control pins; pin 16 and pin 17

Table 2 includes 2 states and provides the truth table for 1-pin control input.

State	Control pin input		RF1, RF2 input / output	
	CTL1, Pin 17	CTL2, Pin 16	RF1 to RF Common	RF2 to RF Common
1	don't care	High	OFF	ON
2	don't care	Low	ON	OFF

Table 2 – Switch control Truth Table for 2 states using a single control pin 17

Table 3 provides the truth table for selecting the use of either 1 or 2 control pins.

Pin control mode	ModeCTL Pin 19
2-pin control: CTL1 and CTL2	GND
1-pin control: CTL2	VCC

Table 3 – Mode Control (pin 19) Truth table to use either 1 or 2 control pins

Notes:

1. When RF1 and RF2 ports are both open (State 1), all 3 RF ports are terminated to an internal 50ohm termination resistor.
2. When RF1 or RF2 port is open (State 2 or State 3 OFF condition), the open port is connected to an internal 50ohm termination resistor.
3. When RF1 or RF2 port is closed (State 2 or State 3 ON condition), the closed port is connected to the RF Common port.

Table 4 provides the truth table for selecting the use of either 1.8V logic control or 3.3V logic control.

Logic Voltage	LogicCTL Pin 18
1.8	VCC
3.3	GND

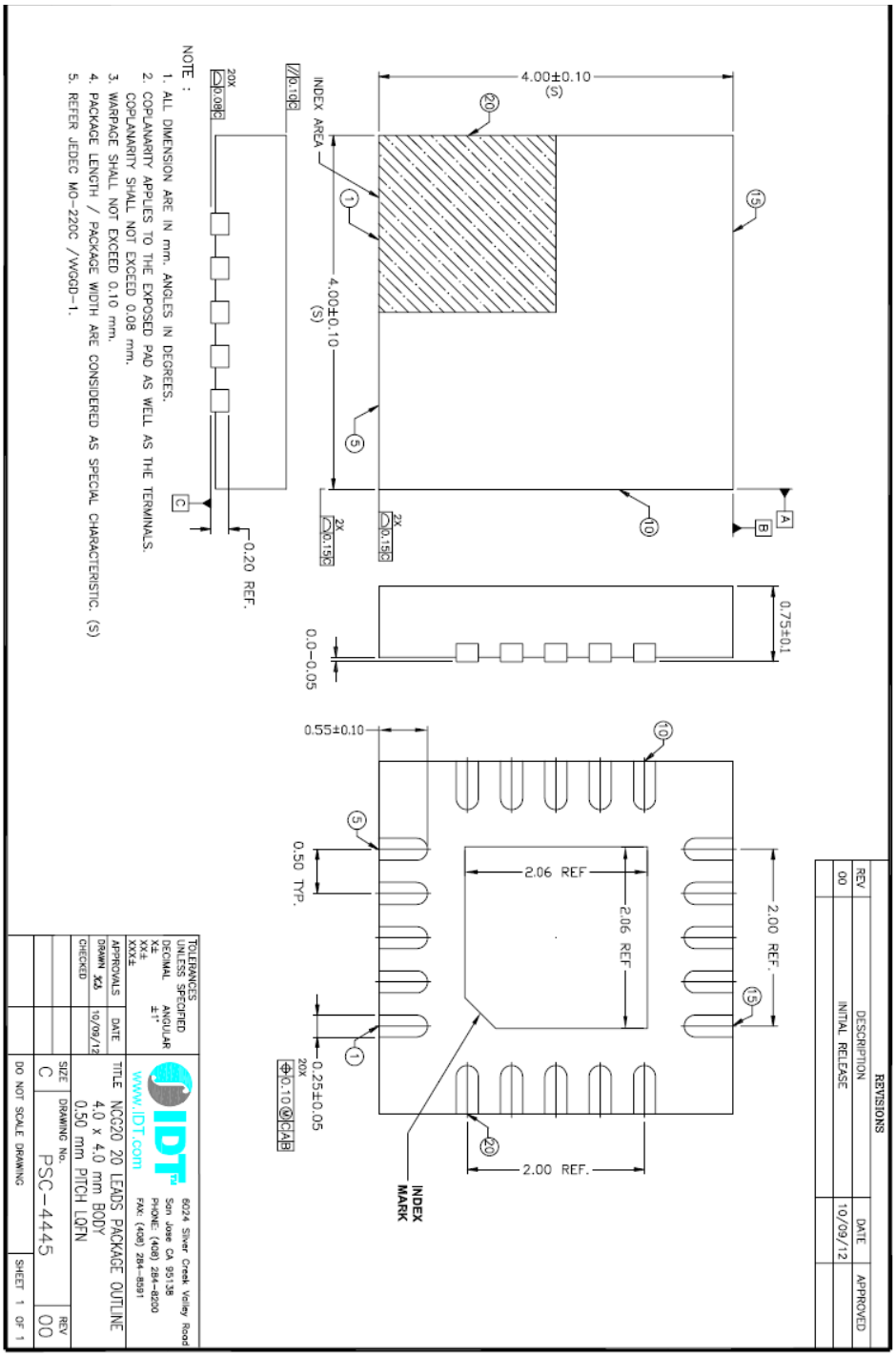
Table 4 - Logic Control (pin 18) Truth Table

TYPICAL OPERATING CURVES (EVKit loss de-embedded, 3.3V unless otherwise noted):

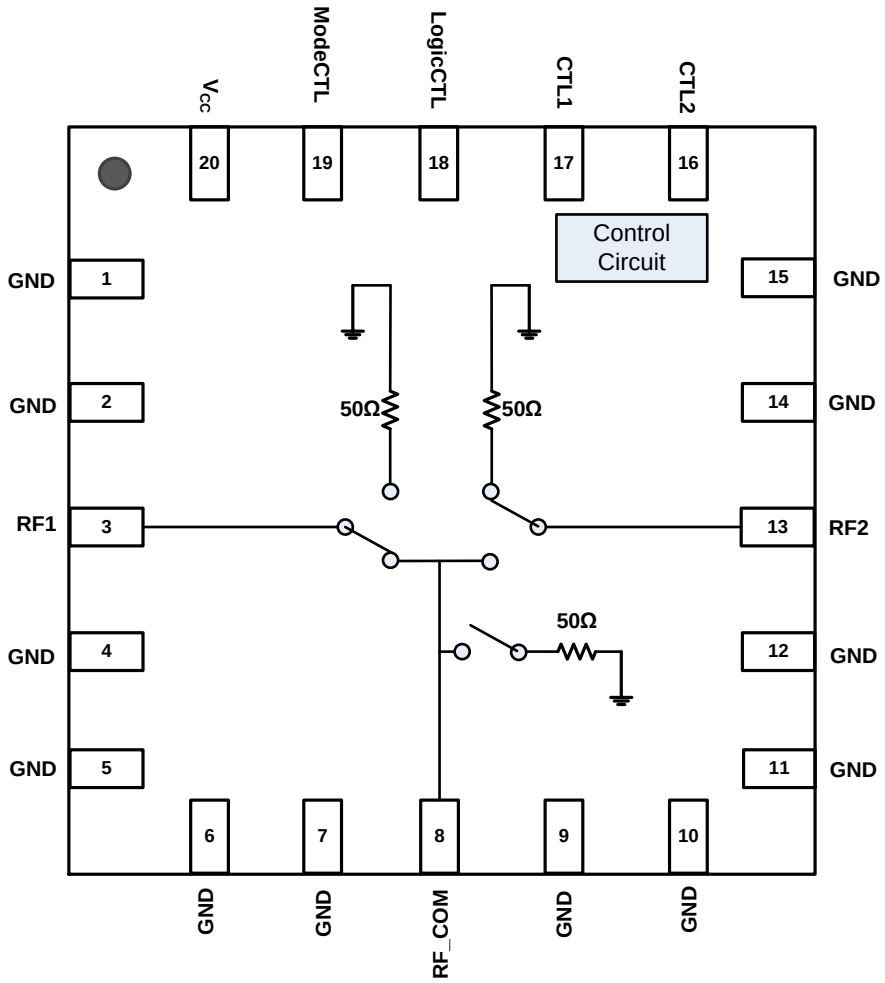
Preliminary list includes parameters vs Tcase and Vcc

- Insertion loss vs Frequency (State 2 and 3)
- Isolation between RF1 to RF_COM vs frequency (State 1)
- Isolation between RF2 to RF_COM vs frequency (State 1)
- Isolation between RF1 & RF2 vs frequency (State 2 and 3)
- Isolation between RF1 & RF2 vs frequency (State 1)
- Return loss vs frequency for all 3 ports (State 1)
- Return loss vs frequency for RF_COM (State 2 and 3)
- Return loss vs frequency for RF1 port (State 3)
- Return loss vs frequency for RF2 port (State 2)
- Input IP3 vs frequency for RF1 (State 3)
- Input IP3 vs frequency for RF2 (State 2)
- Input P1dB compression vs frequency for RF1 (State 3)
- Input P1dB compression vs frequency for RF2 (State 2)

PACKAGE DRAWING (NCG20 4x4 20 PIN)



PINOUT & BLOCK DIAGRAM



PIN DESCRIPTION

Pin	Name	Function
1,2,4,5,6,7,9, 10,11,12,14, 15	GND	Ground these pins.
3	RF1	RF1 Port. Matched to 50 ohms. If this pin is not 0V DC, then an external coupling capacitor must be used.
8	RF_COM	RF Common Port. Matched to 50 ohms. If this pin is not 0V DC, then an external coupling capacitor must be used.
13	RF2	RF2 Port. Matched to 50 ohms. If this pin is not 0V DC, then an external coupling capacitor must be used.
16	CTL2	Control 2 – See Table 1 and Table 2 Switch Control Truth Tables for proper logic setting.
17	CTL1	Control 1 – See Table 1 and Table 2 Switch Control Truth Tables for proper logic setting
18	LogicCTL	Logic Control – See Table 4 Logic Control Truth Table. Apply VCC to select 1.8V logic control or GND for 3.3V logic control
19	ModeCTL	Mode Control – See Table 3 Mode Control Truth Table. Apply VCC to select 1-pin control or GND for 2-pin control
20	VCC	Power Supply. Bypass to GND with capacitors shown in the Typical Application Circuit as close as possible to pin.
	— EP	Exposed Pad. Internally connected to GND. Solder this exposed pad to a PCB pad that uses multiple ground vias to provide heat transfer out of the device into the PCB ground planes. These multiple via grounds are also required to achieve the specified RF performance.

POWER SUPPLIES

A common VCC power supply should be used for all pins requiring DC power. All supply pins should be bypassed with external capacitors to minimize noise and fast transients. Supply noise can degrade noise figure and fast transients can trigger ESD clamps and cause them to fail. Supply voltage change or transients should have a slew rate smaller than 1V/20uS. In addition, all control pins should remain at 0V (+/-0.3V) while the supply voltage ramps or while it returns to zero.

DEFAULT START-UP

Control pins include no internal pull-down resistors to logic LOW or pull-up resistors to logic HIGH. Upon start-up, all control pins should be set to logic LOW (0) thereby enabling 2 pin switch control, opening both RF1 and RF2 paths, and setting logic control voltage to 3.3V (see above tables for LOW logic states).