

RadioCarbon™ RF Front-End Reference Design Platform

The RadioCarbon™ RF Front-End is a development platform offering that operates from 4.4 – 5.0 GHz. The design can be modified from DC - 15 GHz, and all design files are available under license.

The platform features a single channel transmitter and receiver, including a circulator, RMS Power detector, and digitally tunable filter. Users are welcome to add an external filter to optimize it for specific applications. Transmit circuitry is a high performance 2 stage Wolfspeed GaN on SiC power amplifier implemented in a balanced configuration. An onboard bias generation and protection IC provide additional levels of configuration. Receive circuitry includes an LNA and bypassable second stage LNA. An included software GUI provides for additional levels of configuration.



Key Features:

- Complete transmit chain with 33 dBm average/ 44.5 dBm peak power, and 42 dB gain at antenna port
- High efficiency GaN power amplifier lineup
- 27% PAE (Class AB bias)
- High performance receiver with 2.1 dB NF, 23 dB of gain, and optional tunable filter
- On-board DC power generation, GaN power up/down sequencing and adjustable PA biasing
- Custom software GUI for system flexibility and control
- Compatible with BytePipe™ SDR System on Module (SoM)
- Compatible with wideband RF transceivers
- Suitable driver board for high power amplifier
- Lab use only – Included heatsink needs to be attached if used for CW or long pulse applications with average input power greater than 3 dBm

Absolute Maximum Ratings:

Parameters	Connector	Symbol	Value	Units
DC Voltage	J2	VIN	60	Vdc
RX_input Power	J13	RX_IN	21	dBm
TX Input Power	J19	TX_IN	22	dBm
HMC892A Video BW Control Voltage	J11	VBWCTL	15	Vdc
UART I/O voltage	J15	UART	-0.3-3.6	Vdc
SPI I/O voltage	J21	SPI	-0.3-3.6	Vdc
Bias Control voltage	J23	Bias	3.3	Vdc

Applications:

Military communications, Satellite communications, Troposcatter, NLOS backhaul, 4G/5G

RF Electrical Specifications (Transmitter):

Transmitter Test Conditions (Lab use only): RFPD-RC-4450-50 Standalone Mode: Vin = 45V DC, Driver Amp Idq =60mA, Final Stage Idq = 150mA (each side), CW signal, TA=21 Deg C, 4.4-5.0GHz

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
Overall					
Frequency Range		4.4		5.0	GHz
Voltage in			45		Vdc
Current in				3.5	A
Temperature	Included heatsink needs to be attached if used for CW inputs with average input power greater than 3 dBm		21		C
Transmit	J19 (Tx in) to J13 (SMA Edge)				
Small Signal Gain	J19 = -9 dBm CW, Pout=2W		42		dB
Gain Flatness			4		dB
Input Return Loss	J19 (Tx in)		-9		dB
Output Return Loss	J13 (SMA Edge)		-20		dB
Power Gain					
Pin = -3 dBm			43		dB
Pin = 3 dBm			40		dB
Pin @ Psat			35		dB
ACPR	LTE 10MHz wide signal Pout = 32.8 dBm		-50		dB
Power Added Efficiency (PAE)	All TRX components included. Class AB PA biasing				
Pin = -3 dBm			23.7		%
Pin = 3 dBm			19		%
Psat	Class AB bias		44.5		dBm
Power Added Efficiency (PAE)	All TRX components included. PA driven to Psat		27		%

RF Electrical Specifications (Receiver):

Receiver Test Conditions: RFPD-RC-4450-50 Standalone: Vin = 45V DC, CW single tone signal, TA=25 Deg C, 4.4-5.0GHz

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
RX Small Signal Gain Output Return Loss OP1dB OIP3 NF	Complete RX Signal Chain	-10	14 9 22.5 2.5		dB dB dBm dBm dB
RX Small Signal Gain Gain Flatness Input Return Loss Output Return Loss OP1dB OIP3 Noise Figure	No Tunable Filter	-10 -10	23 0.5 20 31.5 2.1		dB dB dB dB dBm dBm dB

RX Small Signal Gain Gain Flatness OP1dB OIP3 Noise Figure	2 nd stage LNA Bypassed, No Tunable BPF		13 1.5 14.5 29 2.4		dB dB dBm dBm dB
RX Small Signal Gain OP1dB OIP3 Noise Figure	2 nd stage LNA Bypassed		4 5.5 20 3.3		dB dBm dBm dB
Tunable Band Pass Filter Rejection Low-Side High-Side Re-Entry	4.183 GHz 5.311 GHz 26.79 GHz		≥20 ≥20 ≥30		dB dB dB

RFPD-RC-4450-50 4400 – 5000 MHz

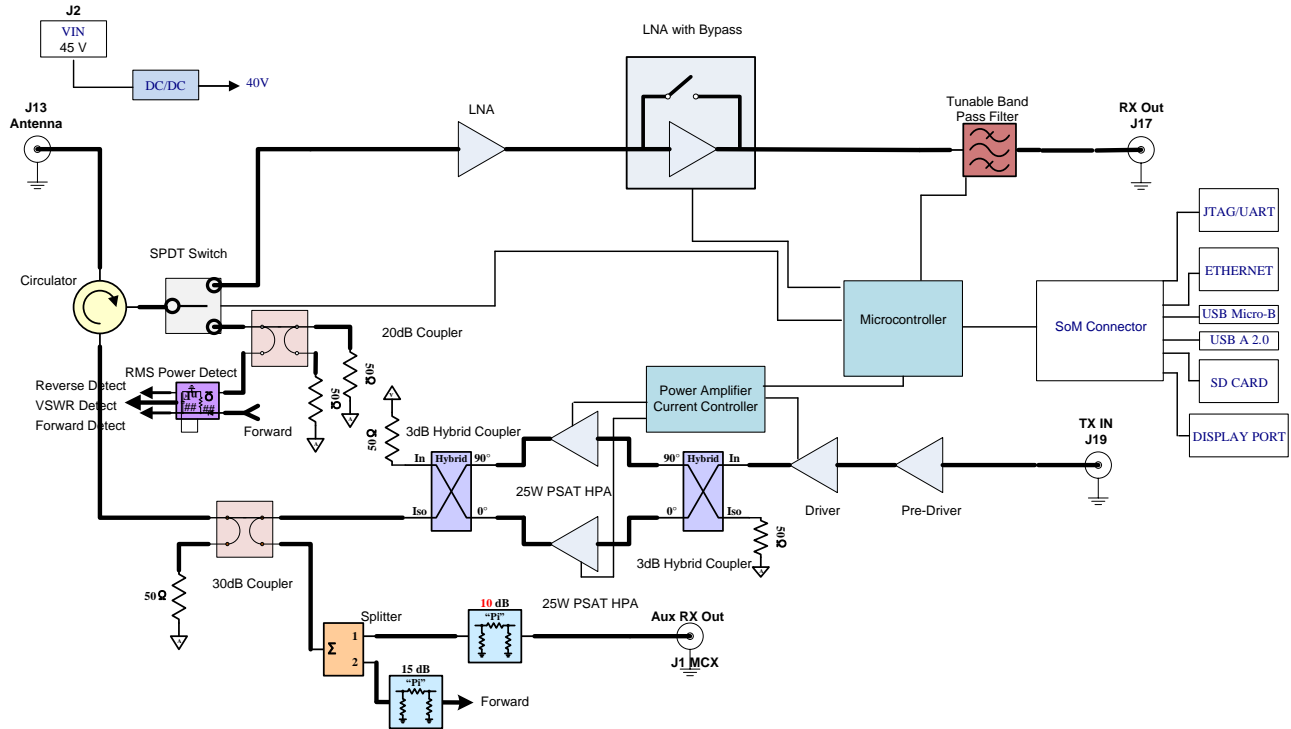


Figure 1 – High Level RFPD-RC-4450-50 System Block Diagram

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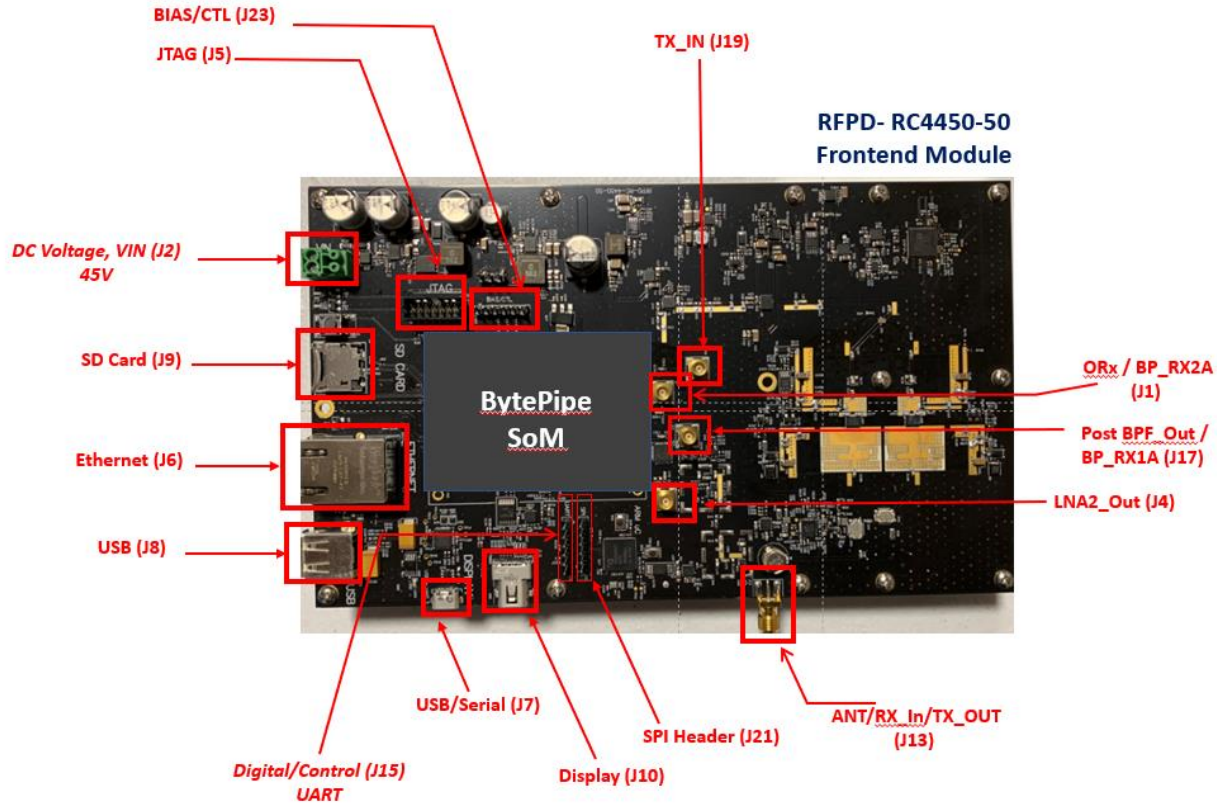


Figure 2 - DC / RF Connection Ports

RadioCarbon Port	Type	Function/Description	Notes
J13	SMA	TX Out and RX IN	
J19	MCX	TX In	MCX to SMA Adaptor Included
J17	MCX	RX Out	MCX to SMA Adaptor Included
J4	MCX	RX Out Tunable Filter Bypass	MCX to SMA Adaptor Included
J1	MCX	Auxiliary RX Out	MCX to SMA Adaptor Included
J2	Phoenix COMBICON 3.5mm Header	DC Voltage In	Phoenix to Barrel Connector Included
J15	6 Pin 100 Mil Vertical Header	Digital UART Micro Control	UART to USB Connector Included
J21	6 Pin 100 Mil Vertical Header	Digital SPI to Micro	
J23	6 Pin 100 Mil Vertical Header	External Analog Control of GaN Bias	
J10	DisplayPort Mini	Display Port Control of BytePipe	BytePipe Control Only
J7	USB MICRO-B	USB Control of BytePipe	BytePipe Control Only
J8	USB-A	USB Control of BytePipe	BytePipe Control Only
J6	RJ45 Ethernet	Ethernet Control of BytePipe	BytePipe Control Only
J9	microSD Reader	Memory Interface to BytePipe	BytePipe Control Only
J5	14 Pin Header	JTAG Control of BytePipe	BytePipe Control Only

Table 1 -RF, DC Power and Digital Ports

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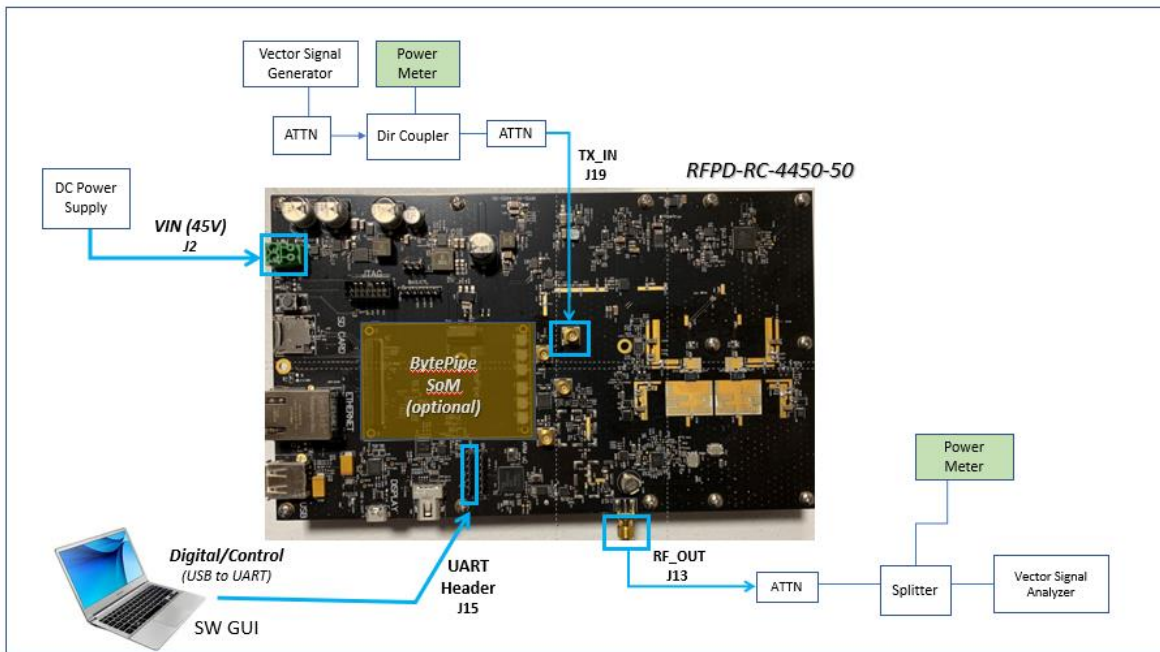


Figure 4 - Recommended Test bench Set-up – Standalone Transmit

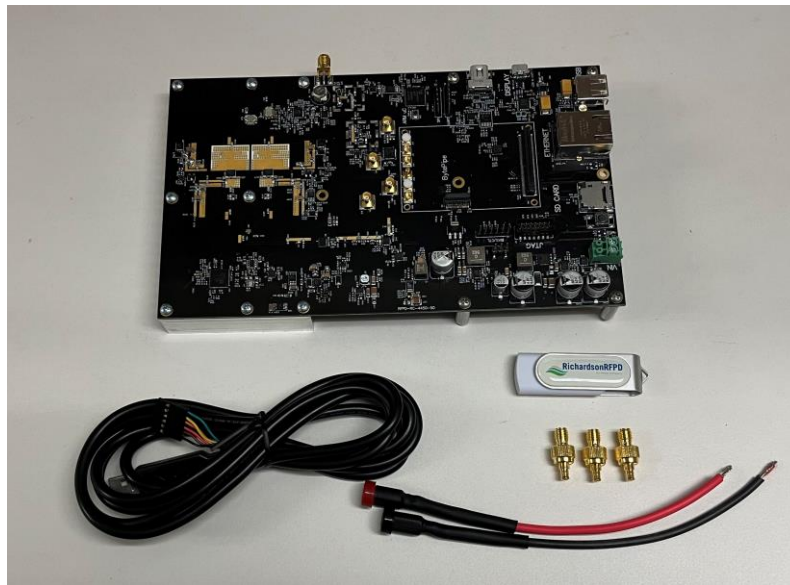


Figure 5 – RFPD-RC-4450-50 Package Contents

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Ordering Information

Part Number	Description
RFPD-RC-4450-50	RF Front End, 4.4-5.0 GHz, Standalone operation
RFPD-RC-1327-50	RF Front End, 1.3-2.7 GHz, Standalone operation
RADIOCARBON-13	RFPD-RC-4450-50 and BytePipe™ SDR SoM
RADIOCARBON-12	RFPD-RC-1327-50 and BytePipe™ SDR SoM

Technical Support:

<https://ez.analog.com/>

[bytepipe sdk/RadioCarbon.md at main · NextGenRF-Design-Inc/bytepipe sdk · GitHub](#)

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