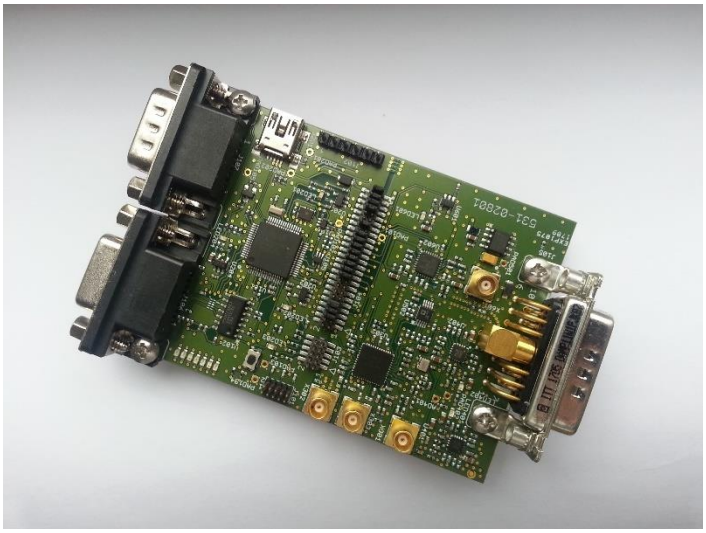
pinkRF

Turn-key RF-Energy Systems
for cooking, lighting, industrial
and medical applications

www.pinkrf.com



p*RF*-S00030915XXE1

The p*RF*-S00030915XXE1 is an easy to use small signal RF generator that locks to the best frequency for optimum RF power transfer into any RF-Energy application. This key amplitude locked loop functionality is implemented in the digital domain (Digital Locked Loop - DLL), in the 915MHz band with +27dBm RF output power.

Product summary	
RF output power (mW / dBm)	500 / 27
Frequency band (MHz)	902 - 928
DC Voltage (V)	5 - 6
Current (A)	1
ROHS compliant	

Description

The pink*RF* small signal generator module **p*RF*-S00030915XXE1** offers an amplitude locked loop functionality, implemented in the digital domain (DLL), enabling development of RF-Energy applications with changing loads like plasma lamps or RF spark plugs. The DLL in closed loop operation will adjust the frequency of the generated RF signal automatically, within a programmed frequency range, based on measuring forward and reflected power, to an optimum for power transfer into a load. The shifting of load characteristics over time, due to e.g. heating, will be tracked real time and keeps the loop locked.

All attributes (frequency, amplitude, phase and PWM modulation) of the generated RF signal can be controlled either by the embedded powerful micro controller or from external (host-) controller.

1.1 Initial (20-07-2017)

Features & Benefits
DLL for ease of use and flexibility
High accuracy settings for all RF attributes
Multiple interfaces (and API) for external host control
Analog inputs for forward and reflected power readings
Closed loop or feedforward (open loop) operation mode
Single power supply (5.5 V, 1 A)
Integrated powerful microcontroller, capable to accommodate the board control firmware and application-level SW
Embedded memory to store calibration, use-case profiles, user recipes etc.

Applications

The pink*RF* small signal generator module **p*RF*-S00030915XXE1** can be used as an RF signal source driving a power amplifier, in a single- or multi-channel system. It delivers RF power to an applicator (i.e. a "device" to contain and/or apply the RF energy) like an antenna or a cavity.

In closed loop operation, with the DLL active, the small signal generator module is capable of tracking and automatically correcting the optimal power transfer frequency real time. For example, with a plasma bulb, when starting and heating up, the DLL function will automatically keep track of the frequency for lowest reflection (i.e. for maximum power transfer from the source to the load) within a user defined frequency window.

With the embedded micro-controller, it is possible to run the **p*RF*-S00030915XXE1** as a stand-alone device in a single channel system. In a multi-channel system, a central controller will communicate with the individual modules, keeping track of the overall system status.

Such a system can be used for various applications like plasma lighting, plasma torches, RF car ignition, industrial heating, solid state cooking, medical treatment or any other high power RF-Energy application.

Functionality
Independent frequency control
Independent output power level control
Independent phase control
Independent modulation scheme (PWM) control
Forward and reflected power detection
Coherent coupling between channels in multi-channel systems (LF & RF-LO)
Host interfaces: USB, CAN, UART and SWD/JTAG

Specifications	
Nominal output power (mW / dBm)	500 / 27
Output power control range (dB)	>32
Output power resolution (dB)	0.1
Frequency band (MHz)	902 - 928
Frequency resolution (Hz)	1
Phase control range (degrees)	0 - 360
Phase resolution (degrees)	1
Typical RF output signal switching time (us)	0.1
Detector input impedance (kΩ)	100
Detector level range (V)	0 – 2.5
Harmonics (dBc)	< -40

Frequency control

In closed loop operation, the upper and lower frequency limit for the search window can be programmed by the user. Depending on the programmed frequency acquisition range, the DLL needs a few milliseconds to lock to the frequency for which the RF power transfer is most optimal.

The DLL mode is more flexible and easy to use in feed forward or open loop control. In feedforward (or open loop) control, the frequency is adjusted externally to optimize other parameters of the system, based on previously acquired system knowledge and/or calibration data.

RF output power level control

In closed loop operation, the amount of RF power transferred to a load or applicator can be monitored (e.g. by observing the FWD and/or RFL power feedback signals) and controlled. A programmed threshold level prevents the loop from locking to a local minimum or running away to the side of the band. In feedforward mode, the generated power level is set, based on calibration data when, for example forward and reflected feedback signals are not available.

Phase control

Phase control is only valid in a multi-channel coherent system where the phase of a 2nd (3rd, 4th, …) channel is adjusted with respect to a reference channel (e.g. 1st channel). Generally, this option is used in feed forward scheme. Only in very specific circumstances (e.g. AM2PM) the closed loop option might be used.

There are multiple options for source selection of the reference signal. The on board 10MHz XCO LF reference signal can be distributed to other DLL modules via MLVDS or coaxial interface. Thus, providing coherent operation, in feed forward mode, over two or more channels in the system. When the coaxial interface is used, a higher frequency external clock, up to 100MHz, can be applied. The module can also use an external RF LO, or supply the internally synthesized LO to other modules via a coaxial interface.

Timing control

The control of the switching times of the generated RF signal can be implemented in three ways:

1. externally to the module (dedicated trigger input)
2. by the next level controller (via data interfaces: UART, CAB or USB) in the RF energy system (or by another host)
3. locally by the embedded processor (HW resources – PWMs and configurable timers equipped with dedicated clocks, are present in the controller for generating pulse trains and other complex waveforms, which can be used for controlling the RF switching events).

Switching latency is typically 0.1us (the lowest latency in feedforward operation).

Acquisition speed

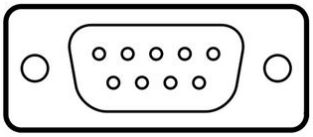
In DLL mode the acquisition and tracking (full frequency sweep 2.4 – 2.5 GHz) speeds are in the order of milli-seconds. The acquisition time in DLL mode can be shortened by proper selection of starting frequency and search direction.

Module p*RF*-S00030915XXE1	
Dimensions (including connectors, mm)	123 x 62 x 17
Weight (kg)	tbd
ROHS compliant	

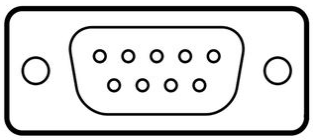
Ambient	
Temperature range of operation	0 – 50 °C
Humidity	< 90%
Altitude	< 2000 m

Related products
ALL/DLL board @ 2450MHz
Housing (heatsink, protective casing and mechanically robust)
RF power amplifier @ 915MHz
Firmware & application level software
Interface cabling

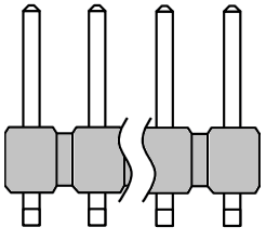
Connections



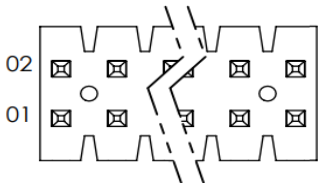
J106 (Sub-D-9 female [RX]):	
1	MLVDS-B
2	CANL
3	GND
4	PWM1 (NC)
5	GND
6	MLVDS-A
7	CANH
8	SHTD-EXT-N
9	AGND (NC)



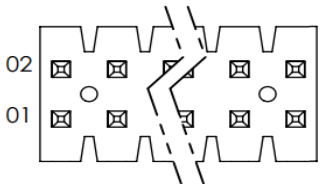
J107 (Sub-D-9 male [TX]):	
1	MLVDS-Z
2	CANL
3	GND
4	PWM2 (NC)
5	GND
6	MLVDS-Y
7	CANH
8	SHTD-EXT-N
9	AGND (NC)



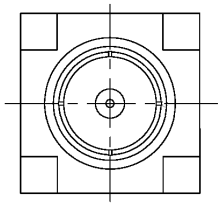
J102 (TSM-106-02-F-SV):	
1	GND
2	UART-CTS
3	NC
4	UART-RXD
5	UART-TXD
6	UART-RTS



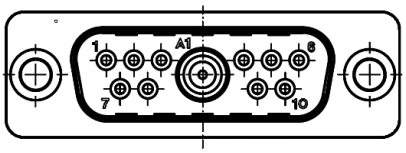
J103 (FTSH-105-01-F-DV):	
1	3V3
2	SWDIO
3, 5, 9	GND
4	SWCLK
6	TDO
7	NC
8	TDI
10	RESETN



J101 (FTSH-105-01-F-D):	
1, 4, 8, 9	GND
2	DAC-OUT (NC)
3	3V3
5	SCL
6	PWM-2
7	SDA
10	PWM-1



RF connections (MCX)	
X-601	RF-OUT
X-301	LF-REF
X-302	LO-OUT
X-303	LO-IN



J901 Combined output / control connector: ITT/Cannon DAMP11W1PJK87	
A1 J901-2	Coaxial analog RF output
1	$P_{forward}$ analog input
2	RFenable output (active high, 3.3V compatible)
3	Not Connected
4, 10	Ground
5	I²C SCL
6	+5-6V DC supply input (1A)
7	$P_{reflected}$ analog input
8	PWM-PA
9	I²C SDA

Contact Information

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