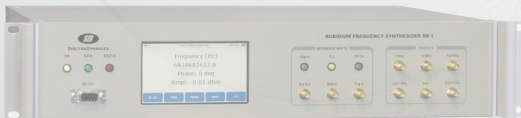




SpectraDynamics, Inc.

A World of Possibilities



Product Catalog 2019



SPECTRADYNAMICS, INC.

Founded in 1994, SpectraDynamics, Inc. (SDI) is a Colorado, USA-based Company specializing in high performance instrumentation for time and frequency distribution systems. SpectraDynamics conducts research and development of technology to provide the low noise electronics needed to support atomic time and frequency standards. Years of experience form the basis of the novel frequency synthesis architectures and time and frequency measurement methods developed by SpectraDynamics.



SpectraDynamics' core product lines are instrumentation for atomic clocks and timescales. Products include microwave and low noise frequency synthesizers, low noise frequency distribution amplifiers, and optical to RF synthesizers.

In addition to the standard products, SpectraDynamics has the ability to deliver **custom solutions** engineered to meet your specific needs. Let us help you determine whether customizing an existing product or creating something new is the right solution for you.

Our customers include National Time and Frequency Laboratories, Government Agencies, Universities, Department of Defense Contractors and Telecommunications Companies.

Located in Colorado ...



Serving the world.

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PRODUCT SELECTION

ATOMIC CLOCK

cRb Clock	Cold Rubidium Atomic Clock	8
-----------	----------------------------	---

AMPLIFIERS

CSDA-1	Clock Signal Distribution Amplifier	10
DA-1G	1 GHz Distribution Amplifier	12
HPDA-15RMi	High Performance Distribution Amplifier, 1 - 50 MHz	14
HPDA-15RMi-S	Autoswitch Amplifier, 1 - 50 MHz	16
LNDA-15RM	Low Noise Distribution Amplifier, 1 - 50 MHz	18
HPDA-100RM	High Performance Distribution Amplifier, 80 - 120 MHz	20
PD-15RMi	Pulse Distribution Amplifier	22
PD-100i	Pulse Distribution Amplifier	24

AMPLIFIER MODULES

HPDA-100i	High Performance Distribution Amplifier, 80 - 120 MHz	26
HPDA-5i	High Performance Distribution Amplifier, 1 - 50 MHz	27
CMA-13SDI	Compact Module Crate for Amplifier Modules	28
CMA-13PWR	Power Module for CMA-13SDI crate	29

MULTIPLIERS

FS020-5RM	Low Noise X 2 Frequency Multiplier	30
FS100-RM	Low Noise X 10 Frequency Multiplier	31

FREQUENCY REFERENCES

LNFR-100	Low Noise Frequency Reference, 5, 10 and 100 MHz	32
LNFR-100E	High Performance 10 MHz Distributed Frequency Reference	34
LNFR-400	Low Noise Frequency Reference, 5, 10, 100 and 400 MHz	36

PRODUCT SELECTION

FREQUENCY SYNTHESIZERS

CS-1	9.192 GHz Frequency Synthesizer	38
HROG-5	High Resolution Phase and Frequency Offset Generator, 5 MHz	40
HROG-10	High Resolution Phase and Frequency Offset Generator, 10 MHz	42
LNFS-100	Low Noise Frequency Synthesizer, 1μHz - 120 MHz	44
LNFS-400	Low Noise Frequency Synthesizer, 1 - 400 MHz	46
PPS-2	Pulse Generator	48
RB-1	6.834 GHz Frequency Synthesizer	50

OPTICAL TO RF SYNTHESIZERS

FC-160-10P	Low Noise Optical to RF Synthesizer	52
FC-080-10P	Low Noise Optical to RF Synthesizer	52

LOW NOISE FREQUENCY DIVIDERS

FD010-100LT	Low Noise Frequency Divider	54
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CUSTOM PRODUCTS

Modules	Amplifiers, Dividers, Multipliers	56
----------------	-----------------------------------	----

GENERAL INFORMATION

SALES CONTACTS	58
-----------------------	----

TERMS OF SALE	59
----------------------	----

Cold Rubidium Atomic Clock, cRb



DESCRIPTION

The cRb-Clock is the world's first commercially available portable cold Rubidium microwave atomic clock. The clock is designed for high frequency stability in the short term of $8 \times 10^{-13} / \sqrt{\tau}$ and for excellent long term frequency stability of 3×10^{-15} at one day and less than 1×10^{-15} at 10 days. With this level of performance this clock can be used as a substitute for expensive, bulky and heavy Hydrogen masers. The cRb-Clock, does not require calibration since there is no long term frequency drift and has an accuracy of a few parts in 10^{-15} .

Maserlike performance is achieved in a small portable package. The entire clock is about the size of a desktop computer 18.75" X 14.75" X 8.77" (47.6cm X 37.5cm X 22.3cm) and weighs 30.5 kg. The clock can run on both 100-240 VAC as well as +24 VDC. Steady state power consumption is 75 W. The clock outputs all signals used in modern timescales, 100 MHz, 10 MHz, 5 MHz and 1 PPS with synchronization capability.

FEATURES

- Excellent short term stability $8 \times 10^{-13} / \sqrt{\tau}$
- Excellent long term stability 1×10^{-15}
- No long term frequency drift
- Clock output at 100 MHz, 10 MHz and 5 MHz
- 1 PPS output with synchronization
- Ethernet monitor port
- Small and portable

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- High performance testing facilities
- Laboratory frequency standard
- Trusted time in GPS denied environment
- Astronomy

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency stability	1 s		5×10^{-13}		
	10 s		3×10^{-13}		
	100 s		8×10^{-14}		
	1000 s		3×10^{-14}		
	10,000 s		8×10^{-15}		
	100,000 s		3×10^{-15}		
	10 days		1×10^{-15}		
Output level	1 PPS	3.7	3.8	5	V
	5 MHz	7	10	12	dBm
	10 MHz	7	10	12	
	100 MHz	7	10	12	
1 PPS	Risetime 10-90%		1.2	1.5	ns
	Falltime 90-10%		1.2	1.5	
Phase noise @ 5 MHz	1 Hz	-	-120	-118	
	10 Hz	-	-145	-142	dBc/Hz
	1 kHz	-	-165	-163	
	10 kHz	-	-170	-168	
Phase noise @ 10 MHz	1 Hz	-	-114	-112	
	10 Hz	-	-138	-137	dBc/Hz
	1 kHz	-	-160	-157	
	10 kHz	-	-164	-162	
Phase noise @ 100 MHz	1 Hz	-	-94	-92	
	10 Hz	-	-119	-117	dBc/Hz
	1 kHz	-	-150	-147	
	10 kHz	-	-170	-168	

POWER REQUIREMENTS

- AC Operation: 100-240 VAC, 47-63 Hz, 100 W max, 75 W steady state
- DC Operation: 24 VDC, 4 A, 100 W

ENVIRONMENT

- Storage Temperature 0 to +50 °C
- Operation Temperature +10 to +35 °C
- Humidity 5% to 95% Non-condensing

CHASSIS

- 18.75" X 14.75" X 8.77" (47.6 cm X 37.5 cm X 22.3 cm)
- Weight 30.5 kg

Distribution Statement "A" (Approved for Public Release, Distribution Unlimited)

This Clock was developed with funding from the Defense Advanced Research Projects Agency (DARPA). The views, opinions and/or findings expressed are those of the author and should not be interpreted as representing the official views or policies of the Department of Defense or the U.S. Government.

CLOCK SIGNAL DISTRIBUTION AMPLIFIER, CSDA-1



DESCRIPTION

The CSDA-1 is a high performance clock signal distribution and isolation amplifier. The device is used to provide distribution of 1 PPS signals, 5 MHz signals and 10 MHz signals. The CSDA-1 is a modular unit implemented with customizable functionality as per the CSDA-1 selection table below. The pulse distribution modules can drive 50-ohm cables. The phase noise of the RF distribution modules is exceptionally low, typically -150 dBc/Hz @ Fourier frequency of 1 Hz and -170 dBc/Hz @ Fourier frequency greater than 10 kHz. The channel-to-channel isolation is typically 130 dB and reverse isolation is 140 dB. Each module contains an output level monitor LED located on the front panel. All output power levels are monitored and compared to a preset threshold of +7dBm. If the signal level on any output drops below this threshold, the monitor LED for that module will turn off indicating a fault condition. Inputs and outputs are matched to 50 ohms to obtain better than 25 dB return loss. All RF outputs are AC coupled and the grounds are DC isolated to reduce the effect of ground loops.

FEATURES

- Distributes:
1 PPS, 5 MHz & 10 MHz signals
- High Isolation
- Low phase noise
- Very high stability
- AC and DC voltage operation

APPLICATIONS

- Clock signal applications
- Atomic frequency standards
- Atomic time scales
- Laboratory frequency distribution
- Reference frequency distribution
- Time synchronization

CSDA-1 SELECTION GUIDE

Part Number	Module 1	Module 2	Module 3
CSDA-1	1 PPS Input, five buffered outputs	5 MHz Input, five buffered outputs	Five 10 MHz outputs
CSDA-1A	1 PPS Input, five buffered outputs	1-50 MHz Input, five buffered outputs	Additional buffered outputs from M2
CSDA-1B	1 PPS Input, five buffered outputs	1-50 MHz Input, five buffered outputs	1-50 MHz Input, five buffered outputs
CSDA-1C	1 PPS Input, five buffered outputs	1 PPS Input, five buffered outputs	5 MHz Input, five 10 MHz outputs
CSDA-1D	1 PPS Input, five buffered outputs	5 MHz Input, five 10 MHz outputs	5 MHz Input, five 10 MHz outputs
CSDA-1E	1 PPS Input, five buffered outputs	10 MHz Input, five 5 MHz outputs	Five 10 MHz outputs

SPECIFICATIONS

Pulse Distribution Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	0.8	0.9	ns
Fall time	10 - 90 %	-	0.8	0.9	ns
Propagation delay	50 ohm load	-	5	6	ns
Differential delay	channel - channel		100	200	ps
Impedance	input output		50 10		Ohms
Input high level	input signal into 50 ohm load	2	-	5	V
Input low level	input signal into 50 ohm load	-0.7	-	0.8	
Output high level	50 ohm load	2.4	4.3	-	V
Output low level	50 ohm load	-	0.1	0.2	
Temperature-delay coefficient	0 - 50 °C		3	5	ps/°C

The rise and fall times were tested with a TTL input signal at 100 kHz.

5 MHz Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Power Level	1 dB compression	16	17		dBm
Bandwidth	+/- 1 dB		1 - 50		MHz
Gain	5 MHz	0	0.5	1	dB
Impedance	input output		50 50		Ohms
Return loss	input (S11) 5 MHz output (S22) 5 MHz		-35 -25	-25 -25	dB
Distortion	+13 dBm		-45	-42	dBc
Isolation	output to output output to input	130 140	140 145		dB
Phase noise Refer to 5 MHz input	1 Hz 10 Hz 100 Hz >10 kHz		-150 -160 -170 -170	-147 -157 -167 -169	dBc/Hz
Temperature-delay coefficient	0 - 50 °C		1.5	3	ps/°C

10 MHz Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Power Level	5 MHz input +13 dBm		14	15	dBm
Bandwidth	+/- 1 dB	0.5	0.6	1	MHz
Impedance	output		50		Ohms
Return loss	output (S22) 10 MHz		-25	-20	dB
Distortion	+13 dBm		-45	-42	dBc
Isolation	output to output	120	130		dB
Phase noise Referred to 5 MHz input	1 Hz 10 Hz 100 Hz >10 kHz		-148 -158 -165 -170	-146 -156 -161 -166	dBc/Hz
Temperature-delay coefficient	0 - 50 °C		5	10	ps/°C

1 GHz DISTRIBUTION AMPLIFIER, DA-1G



DESCRIPTION

The DA-1G is a general purpose isolation amplifier designed to distribute frequencies from 700 to 1,100 MHz. This Amplifier offers 80 dB of channel-to-channel isolation and 85 dB of reverse isolation at 1 GHz. The low residual phase-noise of the amplifier (-130 dBc/Hz at 1 Hz and -160 dBc/Hz at 10 KHz) ensures that the distributed signals are not degraded. The outputs have a low VSWR, typically 1.2, to minimize environmental effects on frequency distribution through long transmission lines. The inputs and outputs are chassis grounded. The standard unit has 1 input and 12 outputs. This Amplifier may operate on 100 to 240 VAC, and +12 to +36 VDC when the optional DC operation option is acquired. When the DA-1G is set up to operate with both AC and DC power sources at the same time, the DC power is used as backup power in case of AC power outages.

FEATURES

- Distributes:
700 MHz to 1.1 GHz signals
- High Isolation
- Low phase noise
- Very high stability
- Optional DC voltage operation

APPLICATIONS

- Clock signal applications
- Atomic frequency standards
- Atomic time scales
- Laboratory frequency distribution
- Reference frequency distribution
- Time synchronization

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Power Level	1 dB compression		13	-	dBm
Bandwidth	+/- 1 dB	800	1100	-	MHz
Gain	@ 1 GHz	0	1	2	dB
Impedance	Input	-	50	-	Ohms
	Output	-	50	-	
Return loss	Input (S11) 1 GHz	-	-25	-20	dB
	Output (S22) 1 GHz	-	-25	-20	
Distortion	+10 dBm output level	-	-45	-40	dBc
Isolation	Output to output	75	80	-	dB
	Output to input	80	85	-	
Phase noise	1 Hz	-	-133	-130	dBc/Hz
	10 Hz	-	-145	-140	
	1 kHz	-	-159	-155	
	10 kHz	-	-161	-160	

*All tests done at 1 GHz, +10 dBm output level unless otherwise specified.

Rackmount chassis	1U H, 19" W, 14" D
Power consumption	25 Watts
Weight	10 lbs
Storage temperature	-10 to +75 °C
Operation environment	0 to +50 °C
Humidity	5% to 95% Non-condensing

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER, HPDA-15RMi



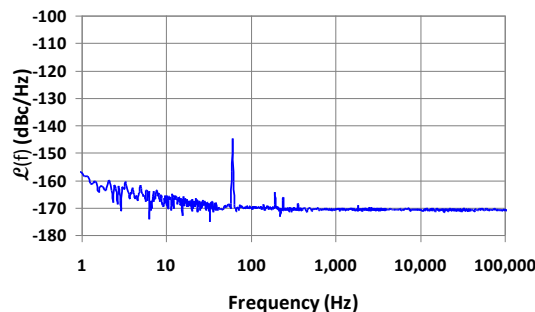
DESCRIPTION

The HPDA-15RMi is a High Performance Distribution and Isolation Amplifier designed to distribute state-of-the-art atomic frequency standards. This model offers exceptionally low additive phase noise and has a frequency bandwidth of 1 MHz to 50 MHz. This amplifier may be used in time scale applications where phase stability is of paramount importance.

The amplifier is designed in a 19 inch rackmount, 1U enclosure for maximum flexibility in system configuration with the possibility of housing up to three RF signal distribution modules. Each module takes one RF input and provides five isolated outputs. All output power levels are monitored and compared to a preset threshold of +7 dBm. If the signal level on any output drops below this threshold, the monitor LED for the corresponding module will turn off indicating a fault condition.

The HPDA-15RMi-C is designed to be powered by a 100 to 240 VAC mains source and/or by a +12 to +36 VDC power source.

HPDA-15RMi Phase Noise Plot



FEATURES

- 1-50 MHz
- Unity gain
- Low VSWR
- High isolation: 140 dB
- High output: +18 dBm
- Low phase noise: -155 dBc/Hz @ 1 Hz
-171 dBc/Hz @ 10 kHz
- Low distortion: -48 dBc
- Low temperature coefficient: 1.2 ps/°C

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- High performance testing facilities
- Laboratory frequency distribution
- Reference frequency distribution

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level	1 dB compression	17	18	-	dBm
Bandwidth	+/- 1 dB	1 - 50	0.5- 65	-	MHz
Gain	5 MHz	0	0.2	0.5	dB
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) 5 MHz output (S22) 5 MHz	- -	-35 -35	-30 -30	dB
Distortion	+13 dBm +17 dBm	- -	-48 -42	-45 -40	dBc
Isolation	output to output output to input	130 140	140 145	- -	dB
Phase noise	1 Hz 10 Hz 1 kHz 10 kHz	- - - -	-155 -165 -170 -171	-150 -160 -168 -170	dBc/Hz
Temperature-delay coefficient	0 - 50 °C	-	1.2	1.5	ps/°C

All tests done at 5 MHz, +13 dBm input unless otherwise specified

HPDA-15RMi SELECTION GUIDE

Part Number	Number of Inputs	Number of Outputs	AC Voltage Operation	DC Voltage Operation
HPDA-5i	1	5		√
HPDA-15RMi-A	1	5	√	√
HPDA-15RMi-B	3	15	√	
HPDA-15RMi-B1	1	10	√	
HPDA-15RMi-B2	2	10	√	
HPDA-15RMi-B3	1	15	√	
HPDA-15RMi-C	3	15	√	√
HPDA-15RMi-C1	1	10	√	√
HPDA-15RMi-C2	2	10	√	√
HPDA-15RMi-C3	1	15	√	√

Specifications may vary per part number, please contact SpectraDynamics for data sheets.

AUTOSWITCH AMPLIFIER, HPDA-15RMi-S



DESCRIPTION

The HPDA-15RMi-S is a high performance frequency distribution amplifier with an autoswitch function that allows the selection of the RF input to be distributed. The selected RF input supplies 10 buffered unity gain outputs. The instrument has a manual mode and autoswitch mode of operation. In manual mode, the RF input can be selected with a toggle switch on the front panel, or by sending a command through the Ethernet interface. In autoswitch mode, the two RF input levels are monitored and compared to a set threshold of +7 dBm. Upon failure of a selected input channel the amplifier switches over to the alternate RF input with a switching time less than 1 μ s.

The selected RF input is buffered and distributed to ten unity gain outputs. The typical cross-channel isolation of the RF distribution is 140 dB and reverse isolation is typically greater than 145 dB. The phase noise of the amplifier is exceptionally low, typically -147 dBc/Hz @ Fourier frequency of 1 Hz and -171 dBc/Hz @ Fourier frequencies greater than 10 kHz. Both the input and output are matched to 50 ohms to obtain better than 25 dB return loss. All outputs are AC coupled and the grounds are DC isolated to reduce the effect of ground loops.

The HPDA-15RMi-S is designed to be powered by a 100 to 240 VAC mains source or by a +12 to +36 VDC power source. The DC power supply may be used as a main power source for the instrument or in conjunction with the AC power supply as a backup in case of loss of the main AC power. The instrument is designed to automatically switch from AC to DC supply operation using a Schottky diode network and charge storage capacitors to avoid any glitches and ensure uninterrupted continuous operation.

FEATURES

- 1-50 MHz
- Unity gain
- Low VSWR
- High isolation
- High output: +18 dBm
- Low phase noise: -147 dBc/Hz @ 1 Hz
-171 dBc/Hz @ 10 kHz
- Low distortion: -45 dBc
- Low temperature coefficient: 1.5 ps/°C

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- High performance testing facilities
- Laboratory frequency distribution
- Reference frequency distribution

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level	1 dB compression	17	18	-	dBm
Minimum input level	No fault	7	8	-	dBm
Bandwidth	+/- 1 dB	1 - 50	0.5- 65	-	MHz
Gain	5 MHz	0	0.2	0.5	dB
Impedance	Output	-	50	-	Ohms
Return loss	Input (S11) 5 MHz	-	-25	-20	dB
	Output (S22) 5 MHz	-	-35	-30	
Distortion	+13 dBm	-	-45	-42	dBc
Isolation	Output to output	130	140	-	dB
	Output to input	140	145	-	
Isolation	Input 1 to input 2	100	110	-	dB
Switching time	Autoswitch mode	-	0.5	1	µs
Phase noise Referred to the Input	1 Hz	-	-147	-145	dBc/Hz
	10 Hz	-	-157	-155	
	1 kHz	-	-167	-166	
	10 kHz	-	-171	-170	
Temperature-delay coefficient	0 - 50 °C	-	1.5	3	ps/°C

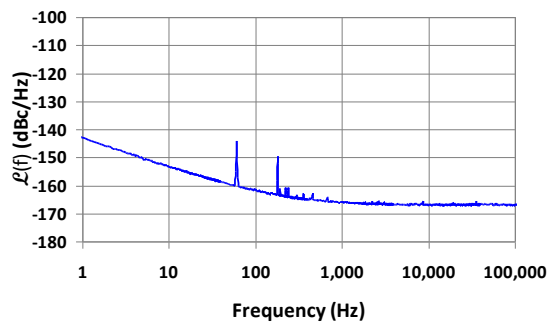
LOW NOISE DISTRIBUTION AMPLIFIER, LNDA-15RM



DESCRIPTION

The LNDA-15RM is an inexpensive low noise distribution and isolation amplifier. This instrument may contain up to three amplifier modules. Each module accepts one input signal in the range of 1 to 50 MHz and provides five buffered outputs of the input signal with unity gain. All outputs are AC coupled and the grounds are DC isolated to reduce the effect of ground loops. The channel-to-channel and reverse isolation are greater than 95 dB which provides ample protection for the signal source and downstream users. Signal monitors are included, if the signal level on any output drops below a predetermined threshold, the monitor LED for that module will turn off indicating a fault condition. The monitor LEDs are visible from the front panel. The instrument operates from AC power and the option for DC power operation is available for some models. The switch from AC to DC power supply is automatic and glitch free ensuring uninterrupted continuous operation. The LNDA-15RM comes in a 1U high, 19" rack-mount enclosure. The power requirements are 100 - 240 VAC and optional +12 to +36 VDC.

LNDA-15RM Phase Noise Plot



FEATURES

- 1-50 MHz
- Unity gain
- Low VSWR
- Isolation: 100 dB
- High output: +18 dBm
- Low phase noise: -143 dBc/Hz @ 1 Hz
-165 dBc/Hz @ 10 kHz
- Low distortion: -45 dBc
- Low temperature coefficient: 3 ps/°C

APPLICATIONS

- Calibration laboratories
- Engineering facilities
- Laboratory frequency distribution
- Production and testing facilities

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level	1 dB compression	17	18	-	dBm
Bandwidth	+/- 1 dB	1 - 50	0.5- 65	-	MHz
Gain	5 MHz	0	0.2	0.5	dB
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) 5 MHz output (S22) 5 MHz	- -	-30 -30	-25 -25	dB
Distortion	+13 dBm +17 dBm	- -	-45 -40	-40 -35	dBc
Isolation	output to output output to input	95 100	100 105	- -	dB
Phase noise Referred to the Input	1 Hz 10 Hz 1 kHz 10 kHz	- - - -	-143 -153 -162 -165	-140 -150 -159 -162	dBc/Hz
Temperature-delay coefficient	0 - 50 °C	-	3	5	ps/°C

All tests done at 5 MHz and +13 dBm input unless otherwise specified

LNDA-15RM SELECTION GUIDE

Part Number	Number of Inputs	Number of Outputs	AC Voltage Operation	DC Voltage Operation
LNDA-15RM-B	3	15	√	
LNDA-15RM-B1	1	10	√	
LNDA-15RM-B2	2	10	√	
LNDA-15RM-B3	1	15	√	
LNDA-15RM-C	3	15	√	√
LNDA-15RM-C1	1	10	√	√
LNDA-15RM-C2	2	10	√	√
LNDA-15RM-C3	1	15	√	√

Notes:

Specifications may vary per part number, please contact SpectraDynamics for data sheets.

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER, HPDA-100



DESCRIPTION

The HPDA-100RM is a high performance distribution and isolation amplifier that may contain up to three distribution amplifier modules. Each module provides five unity gain outputs, 100 dB of channel-to-channel isolation, and 110 dB of reverse isolation. The phase noise of the modules is exceptionally low, typically -158 dBc/Hz @ 10 Hz and -174 dBc/Hz @ 10 kHz from the carrier. All the outputs are AC-coupled and the grounds are DC-isolated to reduce the effects of ground loops. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The HPDA-100RM is available in a 1 U high 19" rack-mount enclosure. The power requirements are 100 - 240 VAC and optional +12 to +36 VDC.

FEATURES

- 80-120 MHz
- Unity gain
- Return loss: -25 dB
- High isolation: 100 dB
- Low phase noise: -158 dBc/Hz @ 10 Hz
 -174 dBc/Hz @ 10 kHz
- Low distortion: -43 dBc
- High output: $+16$ dBm

APPLICATIONS

- Atomic frequency standards
- Instrumentation
- Reference frequency distribution
- Time scales

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level	1 dB compression	15	16	-	dBm
Bandwidth	+/- 1 dB		80 - 120	-	MHz
Gain	100 MHz	0	0.2	0.5	dB
Impedance	input	-	50	-	Ohms
	output	-	50	-	
Return loss	input (S11) 100 MHz	-	-22	-20	dB
	output (S22) 100 MHz	-	-30	-25	
Distortion	+13 dBm	-	-43	-40	dBc
Isolation	output to output	95	100	-	dB
	output to input	105	110	-	
Phase noise	10 Hz	-	-158	-155	dBc/Hz
	100 Hz	-	-165	-162	
	1 kHz	-	-171	-168	
	10 kHz	-	-174	-171	

All tests done at 100 MHz and +13 dBm input unless otherwise specified.

HPDA-100 SELECTION GUIDE

PART NUMBER	NUMBER OF INPUTS	NUMBER OF OUTPUTS	AC VOLTAGE OPERATION	DC VOLTAGE OPERATION
HPDA-100RM-A	1	5	√	
HPDA-100RM-B	3	15	√	
HPDA-100RM-B1	1	10	√	
HPDA-100RM-B2	2	10	√	
HPDA-100RM-B3FA	1	15	√	√
HPDA-100RM-C	3	15	√	√
HPDA-100RM-D	3	15		√

Specifications may vary per part number, please contact SpectraDynamics for data sheets.

PULSE DISTRIBUTION AMPLIFIER, PD-15RMi



DESCRIPTION

The PD-15RMi-C is a TTL Pulse Distribution Amplifier that provides distribution for one pulse per second (PPS) signals. The amplifier can also be used to distribute pulses with a repetition rate of up to 100 MHz. The PD-15RMi-C has three inputs which drive three distribution modules. Each module supplies five buffered outputs designed to drive low impedance loads and long 50 or 75 ohm cables. The outputs provide a 2.7 volt peak-to-peak signal into a 50 ohm load. The channel-to-channel delay differences are typically less than 100 ps. The distribution modules have typically 3 ps/°C temperature coefficient of propagation delay. The small propagation delay characteristics and low temperature coefficient of delay are essential for the distribution of high quality timing signals.

This instrument is designed to be powered by a 100 to 240 VAC mains source or by a +12 to +36 VDC power source. If both AC and DC sources are powering the instrument, the DC source will be used as backup power in case of AC power outages. The instrument is designed to automatically switch from AC to DC supply operation using a Schottky diode network and charge storage capacitors to avoid any glitches and ensure uninterrupted continuous operation. The PD-15RMi-C comes in a 1U high, 19" rack-mount enclosure.

FEATURES

- 1PPS - 100 MHz
- 50 ohm output: 2.4 Vp-p
- Low temperature coefficient: 3 ps/°C
- Matched channel delays : 100 ps typical

APPLICATIONS

- 1 PPS distribution
- Atomic time scales
- Reference clock distribution
- Time synchronization

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	0.8	0.9	ns
Fall time	10 - 90 %	-	0.8	0.9	ns
Propagation delay	50 ohm load	-	5	6	ns
Differential delay	channel - channel	-	100	200	ps
Impedance	input Output	-	50 10	- -	Ohms
Input high level	input signal into 50 ohm load	2	-	5	V
Input low level	input signal into 50 ohm load	-0.7	-	0.8	
Output high level	50 ohm load	2.4	4.3	5	V
Output low level	50 ohm load	-	0.1	0.2	
Frequency range	50% duty cycle	0	100	105	MHz
Temperature-delay coefficient	0 - 50 °C	-	3	5	ps/°C

PULSE DISTRIBUTION SELECTION GUIDE

Part Number	Number of Inputs	Number of Outputs	AC Voltage Operation	DC Voltage Operation
PD-15RMi-A	1	5	√	√
PD-15RMi-C	3	15	√	√
PD-15RMi-C1	1	10	√	√
PD-15RMi-C2	2	10	√	√
PD-15RMi-C3	1	15	√	√

Specifications may vary per part number, please contact SpectraDynamics for data sheets.

FRONT PANEL

- AC and DC Power Monitor LEDs.
- PPS Signal Monitor LEDs.

BACK PANEL

- SMA Input connectors
- SMA Output connectors
- AC and DC power connectors

PULSE DISTRIBUTION AMPLIFIER, PD-100i



DESCRIPTION

The PD-100i is a high speed pulse signal distribution amplifier that provides distribution for 1 PPS signals and RF signals with a frequency range of 1-100 MHz. The first module receives a 1PPS signal and supplies six buffered outputs designed to drive low impedance loads and long 50 or 75 ohm cables. The outputs provide a 3.8 volt peak-to-peak signal into a 50 ohm load. The channel-to-channel delay differences are less than 200ps. The distribution module has the low temperature coefficient of propagation delay that is essential for the distribution of high quality timing signals. The second module of the instrument receives a 1-100 MHz RF signals and provides six buffered square wave outputs. The typical cross-channel isolation on the RF distribution modules is 100 dB and reverse isolation is typically greater than 110 dB. The phase noise of the modules is exceptionally low, typically -148 dBc/Hz @ Fourier frequency of 1 Hz and -170 dBc/Hz @ Fourier frequencies greater than 10 kHz. All outputs are DC coupled and conform to TTL specifications.

The PD-100i is designed to be powered by a 100 to 240 VAC mains source or by a +12 to +36 VDC power source if the instrument was acquired with the DC power option. The DC power module may be used as a main power source for the instrument or in conjunction with the AC power module as a backup power supply in case of loss of the main AC power. The instrument is designed to automatically switch from AC to DC supply operation using a Schottky diode network and charge storage capacitors to avoid any glitches and ensure uninterrupted continuous operation. The PD-100i comes in a 1U high, 19" rack-mount enclosure.

PPS FEATURES

- Distribution of 1PPS - 100 MHz
- 50 ohm output: 3.8 Vp-p
- Low temperature coefficient: 3 ps/°C
- PPS Propagation Delay: 7ns typical

RF FEATURES

- 1 - 100 MHz
- Square wave digital outputs
- High isolation: 110 dB
- Low phase noise: -148 dBc/Hz @ 1 Hz
- -170 dBc/Hz @ 10 kHz
- Low temperature coefficient: 3 ps/°C

SPECIFICATIONS

PPS Distribution Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	0.9	1	ns
Fall time	10 - 90 %	-	0.9	1	ns
Propagation delay	50 ohm load	-	7	8	ns
Differential delay	channel - channel	-	100	200	ps
Impedance	input Output	-	50 9	- -	Ohms
Input high level	input signal into 50 ohm load	3.7	3.8	5	V
Input low level	input signal into 50 ohm load	0	-	0.8	
Output high level	50 ohm load	3.7	3.8	5	V
Output low level	50 ohm load	-	0.4	0.5	
Temperature-delay coefficient	0 - 50 °C	-	3	5	ps/°C

RF / CLOCK Distribution Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Level		7	13	20	dBm
Bandwidth		-	1-100	-	MHz
Impedance	output	-	9	-	Ohms
Rise Time	+13 dBm	-	0.9	1	ns
Fall Time	+13 dBm	-	0.9	1	ns
Isolation	output to output	100	110	-	dB
Phase Noise (Referred to the Input)	1 Hz 10 Hz 100 Hz >10 kHz	- - - -	-148 -163 -168 -170	-145 -160 -165 -167	dBc/Hz
Temperature-delay Coefficient	0 - 50 °C	-	3	-	ps/°C

FRONT PANEL

- AC, DC, PPS & RF Monitor LEDs.
- SMA 1PPS Output connectors
- SMA RF Output connectors

BACK PANEL

- SMA 1PPS Input connectors
- SMA RF Input connectors
- AC and DC power connectors

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER **HPDA-100i**



FEATURES

- 80-120 MHz
- Unity gain
- Return loss: -22 dB
- High isolation: 100 dB
- Low phase noise: -158 dBc/Hz @ 10 Hz
-174 dBc/Hz @ 10 kHz
- Low distortion: -45 dBc
- High output: +16 dBm

APPLICATIONS

- Atomic frequency standards
- Instrumentation
- Reference frequency distribution
- Time scales

DESCRIPTION

The HPDA-100i is a High Performance Distribution and Isolation Amplifier with performance exceeding that required to distribute state-of-the-art atomic frequency standards. The HPDA-100i is intended to be used with a CMA-13SDI Crate.

All unity gain outputs have 100 dB of channel-to-channel isolation and 110 dB of reverse isolation. The outputs are AC coupled and the grounds are DC isolated to reduce the effects of ground loops. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The power supply requirements are +24 VDC, 0.25 A.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level	1 dB compression	15	16	-	dBm
Bandwidth	+/- 1 dB	80 - 120	-	-	MHz
Gain	100 MHz	0	0.2	0.5	dB
Impedance	input	-	50	-	Ohms
	output	-	50	-	
Return loss	input (S11) 100 MHz	-	-22	-20	dB
	output (S22) 100 MHz	-	-30	-25	
Distortion	+13 dBm	-	-43	-40	dBc
Isolation	output to output	95	100	-	dB
	output to input	105	110	-	
Phase noise	10 Hz	-	-158	-155	dBc/Hz
	100 Hz	-	-165	-162	
	1 kHz	-	-171	-168	
	10 kHz	-	-174	-171	

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER HPDA-5i



FEATURES

- 1-50 MHz
- Unity gain
- Low VSWR
- High isolation: 140 dB
- High output: +18 dBm
- Low phase noise: -155 dBc/Hz @ 1 Hz
- -171 dBc/Hz @ 10 kHz
- Low distortion: -48 dBc
- Low temperature coefficient: 1.2 ps/°C

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Reference frequency distribution
- Time scales

DESCRIPTION

The HPDA-5i is an improved version of our previous High Performance Distribution and Isolation Amplifier with performance exceeding that required to distribute state-of-the-art atomic frequency standards. This new model offers the same exceptional low phase noise with a larger frequency bandwidth, greater isolation and improved stability. The Amplifier is intended to be used with a CMA-13SDI Module Crate.

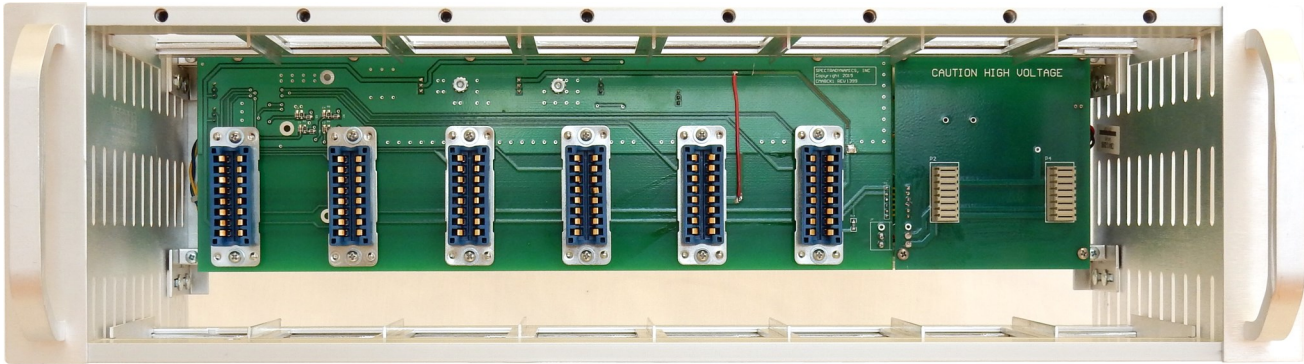
The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The power supply requirements are +24 VDC, 0.25 A.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level	1 dB compression	17	18	-	dBm
Bandwidth	+/- 1 dB	1 - 50	0.5- 65	-	MHz
Gain	5 MHz	0	0.2	0.5	dB
Impedance	input	-	50	-	Ohms
	output	-	50	-	
Return loss	input (S11) 5 MHz	-	-35	-30	dB
	output (S22) 5 MHz	-	-35	-30	
Distortion	+13 dBm	-	-48	-45	dBc
	+17 dBm	-	-42	-40	
Isolation	output to output	130	140	-	dB
	output to input	140	145	-	
Phase noise	1 Hz	-	-155	-150	dBc/Hz
	10 Hz	-	-165	-160	
	1 kHz	-	-170	-168	
	10 kHz	-	-171	-170	
Temp-delay coefficient	0 - 50 °C	-	1.2	1.5	ps/°C

CMA-13 COMPACT MODULE CRATE

CMA-13SDI



DESCRIPTION

The CMA13-SDI is a 19" wide chassis specially designed to host two hot-swappable power supply modules, CMA-13PWR, and the High Performance Distribution Amplifiers HPDA-5i or HPDA-100i.

At least one CMA-13PWR power supply module should be installed to provide power to the six module slots in the crate. If power redundancy is required, a second power supply module should be installed. All modules are hot-swappable.

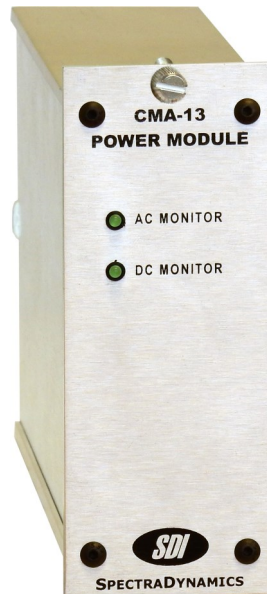


This chassis is designed to operate with a 100 to 240 VAC, 47 to 63 Hz. DC operation is also possible with +24 to +33 VDC, +4 Amperes. When the crate is set up to operate with both AC and DC power sources at the same time the DC power is used as backup power in case of AC power outages.

Optional RS-232 Ports - The chassis may be connected to an RS-232 port to access the remote monitoring functions when the optional RS-232 port is installed.

Optional Sensors: Port 1 and Port 2 - Two temperature probes may be connected when the Port 1 and Port 2 optional sensors are installed in the crate.

POWER MODULE CMA-13PWR



DESCRIPTION

The CMA-13PWR is a power supply module specially designed to powered the CMA-13SDI Crate. This module provides +24 VDC, 0.25 A.to the crate's backplane.

The CMA-13PWR uses the AC Line from the CMA-13SDI Crate as the input power source. If the crate is connected to a DC source, the CMA-13SDI-DPWR module will switch to the DC Input as the backup power source if the AC Line fails.

Two CMA-13PWR modules may be used in the CMA-13SDI crate to provide power supply redundancy to the crate. The CMA-13PWR modules are hot swappable.

SPECIFICATIONS

AC Input	100 - 240 VAC
DC Input	+24 to +33 VDC
DC Output	+24 VDC
Storage temperature	-10 to +75 °C
Operation environment	0 to +50 °C
Humidity	5% to 95% Non-condensing

LOW NOISE FREQUENCY MULTIPLIER FS020-5RM



DESCRIPTION

The FS020-5RM ultra-low noise frequency multiplier that may be used with state-of-the-art crystal frequency sources without degrading phase noise. A 5 MHz input signal is multiplied to provide an output at 10 MHz. This instrument is designed to be powered by a 100 to 240 VAC mains source or by a +12 to +36 VDC power source. If both AC and DC sources are powering the instrument, the DC source will be used as backup power in case of AC power outages. The switch from AC to DC power supply is automatic and glitch free ensuring uninterrupted continuous operation.

FEATURES

- 5 MHz input
- Ultra-low phase noise
- Very low spurious
- Optional DC voltage operation

APPLICATIONS

- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	11	13	15	dBm
Impedance	input	-	50	-	Ohms
	output	-	50	-	
Return loss	input (S11)	-15	-20	-	dB
	output (S22)	-15	-20	-	
Spurious		-	-55	-45	dBc
Harmonic distortion	+10 dBm output	-	-55	-45	dBc
Phase noise	1 Hz	-	-143	-140	dBc/Hz
referred to input	1 kHz	-	-170	-167	
	10 kHz	-	-176	-173	
Temperature-delay coefficient	0 - 50 °C	-	45	50	ps/°C

LOW NOISE FREQUENCY MULTIPLIER FS100-RM



DESCRIPTION

The FS100-RM ultra-low noise frequency multiplier that may be used with state-of-the-art crystal frequency sources without degrading phase noise. This versatile unit allows customers to select an output frequencies of choice at the time of ordering.

The FS100-RM is ideal for phase locking 100 MHz crystal sources to 5 or 10 MHz references.

Available output frequencies are:
10, 20, 40, 80, 90 and 100 MHz.

Part Numbers:

FS-100RM-5 for 5 MHz input

FS-100RM-10 for 10 MHz input

FEATURES

- 5 or 10 MHz input
- Ultra-low phase noise
- Very low spurious
- Optional DC voltage operation

APPLICATIONS

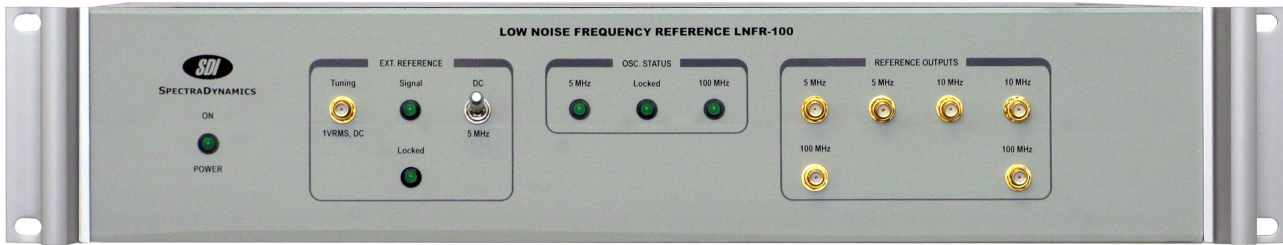
- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	10	13	15	dBm
Impedance	input	-	50	-	Ohms
	output	-	50	-	
Return loss	input (S11)	-15	-20	-	dB
	output (S22)	-15	-20	-	
Spurious		-	-55	-45	dBc
Harmonic distortion	+10 dBm output	-	-55	-45	dBc
Phase noise referred to input	1 Hz	-	-143	-140	dBc/Hz
	1 kHz	-	-170	-167	
	10 kHz	-	-176	-173	
Temperature-delay coefficient	0 - 50 °C	-	45	50	ps/°C

All tests done at +13 dBm input unless otherwise specified.

LOW NOISE FREQUENCY REFERENCE, LNFR-100



DESCRIPTION

The LNFR-100 is an ultra-low noise frequency reference. The LNFR-100 contains 5 MHz and 100 MHz ultra-low noise ovenized oscillators. The outputs at 10 MHz are obtained by multiplying the signal from the 5 MHz oscillator. The 100 MHz oscillator is phase locked to the 5 MHz oscillator to provide a lower phase noise signal inside the bandwidth of the phase-locked loop. The device can be used as a low noise source in phase noise measurement systems. Other applications include high stability frequency synthesizers, reference frequency generation and frequency synthesis chains for atomic standards. The LNFR-100 can be controlled via a +/- 5 VDC tuning signal or with a 5 MHz 1 VRMS signal. This synthesizer is offered in a stand-alone rack mount package. For frequency synthesis chain applications the synthesizer is available in modular form.

FEATURES

- Low environmental sensitivity
- Ultra-low phase noise
- Very low spurious

APPLICATIONS

- Atomic frequency standards
- Phase noise measurements
- Reference frequency generation
- Telecommunications standard

LNFR-100 SELECTION GUIDE

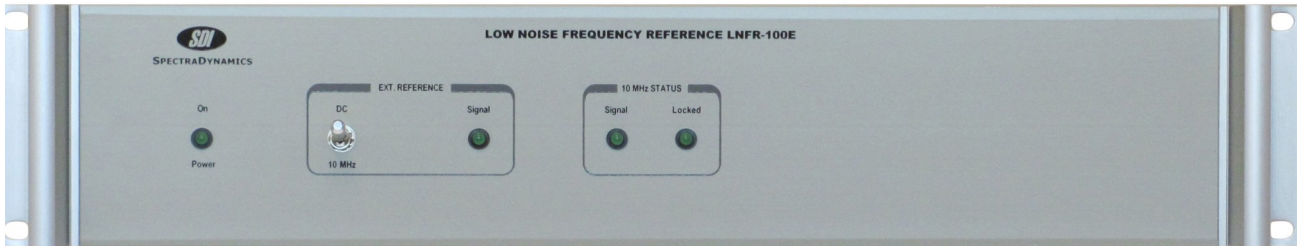
Part Number	Standard Outputs (MHz)	Optional Outputs (MHz)
LNFR-100	5, 10, 100	20, 40, 80
LNFR-100 A	5, 10 two each	-
LNFR-100 Opt 100	5, 10, 100 two each	-
LNFR-100 HS - High Stability Option Temperature stability @ 5MHz, 0 to 60 °C = +/-5 E-10	5, 10, 100	20, 40, 80

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Power Level	5 MHz	+11	+14	-	dBm
Output Power Level	10 MHz	+11	+14	-	dBm
Output Power Level	100 MHz	+11	+14	-	dBm
Electrical Tuning Range	5 MHz, 10 MHz	+/- 2 E ⁻⁷	-	-	-
Tuning Port Voltage			+/- 5		VDC
Temperature Stability	@ 5 MHz, 0 – 50 C	-	+/- 5 E ⁻⁹	+/- 1 E ⁻⁸	-
Phase Noise measured at 5MHz	1 Hz	-	-120	-118	dBc/Hz
	10 Hz	-	-150	-145	
	100 Hz	-	-169	-164	
	1 kHz	-	-175	-173	
	> 10 kHz	-	-175	-173	
Phase Noise measured at 10MHz	1 Hz	-	-114	-112	dBc/Hz
	10 Hz	-	-144	-141	
	100 Hz	-	-160	-156	
	1 kHz	-	-167	-164	
	>10 kHz	-	-170	-167	
Phase Noise measured at 100MHz	10 Hz	-	-124	-121	dBc/Hz
	100 Hz	-	-134	-132	
	1 kHz	-	-157	-154	
	>10 kHz	-	-177	-172	
Harmonics	5 MHz	-	-40	-30	dBc
Harmonics	10 MHz	-	-40	-30	dBc
Harmonics	100 MHz	-	-40	-30	dBc
Spurious	5 MHz	-	-110	-100	dBc
Spurious	10 MHz	-	-110	-100	dBc
Spurious	100 MHz	-	-110	-100	dBc

Rackmount chassis	2U H, 19" W, 16" D
Storage temperature	-10 to +75 °C
Operation environment	0 to +50 °C
Humidity	5% to 95% Non-condensing

LOW NOISE FREQUENCY REFERENCE, LNFR-100E



DESCRIPTION

The LNFR-100E is a high performance 10 MHz distributed frequency reference. It contains a 5 MHz SC-cut ovenized oscillator, a low noise frequency doubler and a distribution amplifier module. The 10 MHz signal is distributed by the distribution amplifier to provide four 10 MHz outputs on the back panel. Typical cross-channel isolation is 70 dB and reverse isolation is typically greater than 75 dB. The distribution module does not degrade the phase noise performance of the oscillator that is typically -142 dBc/Hz @ Fourier frequency of 10 Hz and -170 dBc/Hz @ Fourier frequency greater than 10 kHz. The LNFR-100E outputs are matched to 50 ohms to obtain better than 25 dB return loss. The LNFR-100E can be phase locked via an electrical tuning port or by providing an external 10 MHz reference. A 6-pin alarm output on the rear panel with positive contact closure between pins A and D indicate an external locked status. The alarm load should not exceed 0.5 A at 30 VDC.

FEATURES

- Low environmental sensitivity
- Ultra-low phase noise
- Very low spurious

APPLICATIONS

- Earth station frequency reference
- Phase noise measurements
- Reference frequency generation
- Telecommunications standard

LNFR-100 SELECTION GUIDE

Part Number	Output Frequency (MHz)	Number of Outputs
LNFR-100E	10	Four buffered outputs
LNFR-100E8	10	Eight buffered outputs

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	50 ohm load	+11	+14	+15	dBm
Output impedance	return loss @ 10 MHz		-25		dB
Harmonic distortion	50 ohm load		-40	-38	dBc
Isolation	output to output	60	70		dB
Temperature stability	0 - 50 °C		+/- 5x10 ⁻⁹		-
Mechanical tuning			+/- 1x10 ⁻⁶		-
Electrical Tuning	+/-5VDC		+/- 2x10 ⁻⁷		-
Stability	Allan variance t=1s		1E-12		-
Phase noise @ 10 MHz	1 Hz		-112	-109	dBc/Hz
	10 Hz		-142	-138	
	100 Hz		-160	-156	
	1 kHz		-167	-165	
	10 kHz		-170	-166	
Spurious		-	-120	-110	dBc

Absolute Maximum Ratings

RF power on tuning port +20 dBm Maximum

DC Voltage on tuning port ± 10 VDC Maximum

RF Power on outputs +20 dBm Maximum

DC Voltage on outputs 50 VDC Maximum

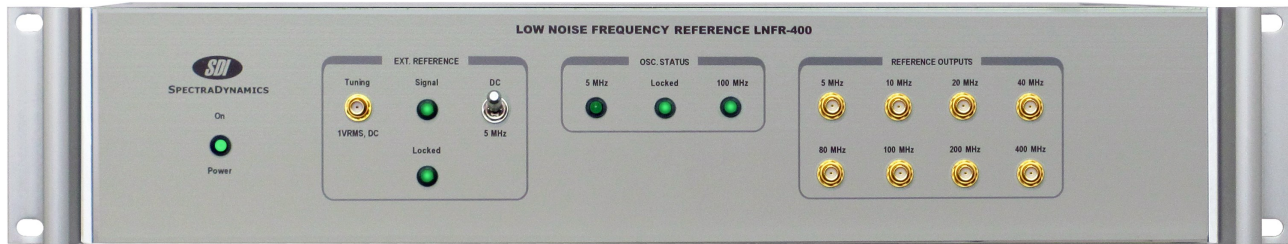
Storage Temperature -10 to +75 °C

Operation Environment 0 to + 50 °C

Alarm Connector Load 0.5 A at 30VDC Maximum

Chassis 2U H, 19 " W, 16" D

LOW NOISE FREQUENCY REFERENCE, LNFR-400



DESCRIPTION

The LNFR-400 is an ultra-low noise frequency reference. The device can be used as a low noise source in phase noise measurement systems. Other applications include high stability frequency synthesizers, reference frequency generation and frequency synthesis chains for atomic standards.

The LNFR-400 contains 5 MHz and 100 MHz ultra-low noise ovenized oscillators. The outputs at 10 MHz, 20 MHz, 40 MHz and 80 MHz are obtained by multiplying the signal from the 5 MHz oscillator. The 100 MHz oscillator is phase locked to the 5 MHz oscillator to provide a lower phase noise signal inside the bandwidth of the phase-locked loop. The output of the 100 MHz oscillator is doubled to obtain 200 MHz and doubled again to obtain 400 MHz. All outputs to the front panel are buffered with low noise isolation amplifiers. The LNFR-400 can be controlled via a +/- 5 VDC tuning signal or phase locked to a 5 MHz 1 VRMS signal. The synthesizer is offered in a stand-alone rack-mount package.

FEATURES

- External 5 MHz/DC tuning
- Low environmental sensitivity
- Ultra-low phase noise
- Very low spurious: -100 dBc

APPLICATIONS

- Atomic frequency standards
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

LNFR-100 SELECTION GUIDE

Part Number	Standard Outputs (MHz)	Optional Outputs (MHz)
LNFR-400	5, 10, 100	20, 40, 80, 200, 400
LNFR-400 HS - High Stability Option Temperature stability @ 5MHz, 0 to 60 °C = +/- 5 E ⁻¹⁰	5, 10, 100	20, 40, 80, 200, 400

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Power Level		+13	+15	-	dBm
Electrical Tuning Range	5 MHz	+/- 2 E ⁻⁷	-	-	-
Tuning Port Voltage			+/- 5		VDC
Temperature Stability	@ 5 MHz, 0 – 60 C	-	+/- 1 E ⁻⁸	-	-
Phase Noise measured at 5MHz	1 Hz	-	-120	-118	dBc/Hz
	10 Hz	-	-150	-145	
	100 Hz	-	-167	-164	
	>1 kHz	-	-175	-171	
Phase Noise measured at 10MHz	1 Hz	-	-114	-112	dBc/Hz
	10 Hz	-	-144	-141	
	100 Hz	-	-160	-156	
	>1 kHz	-	-169	-166	
Phase Noise measured at 100MHz	10 Hz	-	-124	-121	dBc/Hz
	100 Hz	-	-134	-131	
	1 kHz	-	-156	-153	
	>10 kHz	-	-175	-174	
Phase Noise measured at 400MHz (when output is present)	10 Hz	-	-110	-106	dBc/Hz
	100 Hz	-	-120	-117	
	1 kHz	-	-144	-141	
	>10 kHz	-	-163	-161	
Harmonics	5 MHz	-	-40	-35	dBc
Harmonics	10 MHz	-	-40	-35	dBc
Harmonics	100 MHz	-	-40	-35	dBc
Spurious	5 MHz	-	-	-110	dBc
Spurious	10 MHz	-	-	-110	dBc
Spurious	100 MHz	-	-	-110	dBc

9.192 GHz FREQUENCY SYNTHESIZER, CS-1



DESCRIPTION

The CS-1, 9.192 GHz Frequency Synthesizer is a high stability and high resolution signal source designed to be used in the implementation of a Cesium atomic clock. The CS-1 is provided as two separate modules, the Synthesizer Module and the DC Power Module. Both modules come in a 2U, 19 inch rack-mount enclosure. All synthesizer functions are accessed from the front panel or a RS232 interface. An external trigger input may be used to synchronize programmable events such as frequency sweeps, phase modulation and amplitude modulation with external events. The synthesizer is implemented with a flexible modular topology. Two ultra-low noise quartz oscillators are part of the multiplication chain from 5 MHz to 100 MHz. Buffered outputs are provided at the front panel for 5 MHz, 10 MHz and 100 MHz signals. The 100 MHz signal is the highest frequency in the low frequency section of the synthesizer. This 100 MHz signal is distributed using a one input, four output isolation amplifier. One of these 100 MHz signal is used as the reference for a 9.2 GHz DRO. The output of the 9.2 GHz DRO is buffered and used to drive the LO port of a single-sideband mixer. The second 100 MHz signal is used to clock a DDS synthesizer module. The DDS synthesizer generates an IF signal with 48 bit resolution and complete modulation capabilities. The DDS synthesizer output drives the IF port of the single-sideband mixer. The lower sideband of the mixer is selected as the output generating the 9.XXX GHz output signal. The amplitude of the 9.XXX GHz output is controlled with 12 bits of resolution and an internal relay may be used to turn off the RF signal.

FEATURES

- Output signals:
- 5 MHz, 10 MHz, 100 MHz, 7 MHz, 9.2 GHz, 9.192 GHz
- Synchronization capabilities with external events:
 - Amplitude modulation
 - Frequency sweeps
 - Phase modulation
- Low phase noise
- State machine operation

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Reference frequency generation

SPECIFICATIONS

PARAMETER	CONDITIONS	TYP	MAX	UNITS
Frequency Stability $\sigma_y(t)$ Ref. 5 MHz, +13 dBm Pair measurement, Locked	Averaging time 1 s 10 s 100 s 1000 s 100000 s 1000000 s	$1 \cdot 10^{-13}$ $1 \cdot 10^{-14}$ $1 \cdot 10^{-15}$ $2 \cdot 10^{-16}$ $2 \cdot 10^{-17}$ $2 \cdot 10^{-17}$		
Phase Noise L(f) * Carrier 9.192 GHz	Offset frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz	-54 -84 -96 -113 -120 -120 -140	-52 -80 -93 -110 -117 -117 -130	dBc/Hz
Phase Noise L(f) Carrier 100 MHz	Offset frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz	-94 -124 -138 -158 -175	-93 -122 -134 -155 -173	dBc/Hz
Phase Noise L(f) Carrier 10 MHz	Offset frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz	-114 -144 -165 -170 -170	-113 -142 -160 -168 -168	dBc/Hz
Phase Noise L(f) Carrier 5 MHz	Offset frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz	-120 -150 -170 -175 -175	-118 -148 -167 -173 -174	dBc/Hz

* The PM Noise at 1 Hz for Carrier 9.192 GHz (locked 5 Hz BW) -72 dBc/Hz.

External Reference: 5.0 MHz $\pm 2.0 \cdot 10^{-8}$, +7 dBm to +15 dBm

Rack-mount enclosure: 2U X 16" X 19", Weight: 20 lbs

CS-1 SELECTION GUIDE

Part Number	Phase Noise @ 1 Hz 5 MHz Output	Phase Noise @ 1 Hz 9.192 GHz Output
CS-1	-120 dBc/Hz	-54 dBc/Hz
CS-1 Opt C	-130 dBc/Hz	-64 dBc/Hz

HIGH RESOLUTION PHASE AND FREQUENCY OFFSET GENERATOR

US Patent 6,278,330

HROG-5



DESCRIPTION

The HROG-5 is a high-resolution phase and frequency offset generator. The phase and frequency of the output signals are adjustable with respect to a 5 MHz user supplied reference. The output phase resolution of the generator is $2\pi/2^{32}$ radians or an output time step resolution of 0.047 fs. The output frequency resolution is 5×10^{-19} . Both phase and frequency steps are phase continuous. The instrument provides two sine-wave outputs and two pulse outputs. The sine-wave outputs are buffered to provide greater than 80 dB of port to port and reverse isolation. The outputs are at a level of +13 dBm. The pulse outputs are derived from the sine wave outputs by dividing by a factor of $5.0E^6$. The pulse outputs can be synchronized to an external reference pulse to within 200 ns. All instrument functions are displayed and controlled via the front panel LCD display and keypad. Remote control of the instrument is possible through RS-232 communications.

FEATURES

- High isolation: > 80 dB
- High phase resolution: 0.047 fs
- Low harmonic distortion: -45 dBc
- Low phase noise (1 kHz) : -165 dBc/Hz

APPLICATIONS

- Atomic frequency standards
- Clock synchronization
- Time-scales
- Clock steering
- Frequency offset generation

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	$2\pi / 2^{32}$	-	radians
Phase offset range		-	infinite	-	-
Time offset resolution	5 MHz external reference	-	0.047	-	fs
Frequency resolution		-	5 E^{-19}	-	-
Frequency tuning range		-	$\pm 2 \text{ E}^{-7}$	-	-
Mech. tuning range		-	$\pm 1 \text{ E}^{-6}$	-	-
Int. oscillator aging	after 30 days of operation	-	1 E^{-10}	-	Per day
5 MHz output level	50 ohm load	+10	+13	+17	dBm
1PPS output level	50 ohm load	3.7	3.8	5	V
Output isolation	Channel-to-channel reverse	-	80	-	dB
		-	80	-	
Phase noise L(f)	10 Hz	-	-135	-132	dBc/Hz
Note: lower phase noise is available.	100 Hz	-	-160	-157	
	1 kHz	-	-165	-162	
	>10 kHz	-	-165	-163	
Allan deviation $\sigma_y(t)$	$\Delta f = 1.0 \text{ E}^{-12}$				-
	1 s	-	9 E^{-14}	2 E^{-13}	
	10 s	-	9 E^{-15}	3 E^{-14}	
	100 s	-	4 E^{-15}	5 E^{-15}	
	1000 s	-	4 E^{-15}	5 E^{-15}	
Allan deviation $\sigma_y(t)$	$\Delta f = 0$				-
	1 s	-	9 E^{-14}	1 E^{-13}	
	10 s	-	9 E^{-15}	2 E^{-14}	
	100 s	-	1 E^{-15}	2 E^{-15}	
Spurious		-	-110	-100	dBc
Harmonics		-	-45	-40	dBc

External reference: 5.0 MHz $\pm 2.0 \text{ E}^{-8}$, +7 dBm to +15 dBm
 External 1PPS: 800 ns min. pulse width, TTL compatible levels
 AC power: 110–120 / 220–240 VAC

Rack-mount enclosure: 3.5" X 16" X 19", Weight: 20 lbs.

HROG-5 SELECTION GUIDE

Part Number	Phase Noise @ 10 Hz	Phase Noise @ 10 kHz
HROG-5	-135 dBc/Hz	-165 dBc/Hz
HROG-5-LN Low Noise Option	-143 dBc/Hz	-170 dBc/Hz

Optional DC voltage operation for both: +20 to +33 VDC, 2 A
 Add -DC to part number when placing an order or requesting a quote for the DC operation option.

HIGH RESOLUTION PHASE AND FREQUENCY OFFSET GENERATOR

US Patent 6,278,330

HROG-10



DESCRIPTION

The HROG-10 is a high-resolution phase and frequency offset generator. The phase and frequency of the output signals are adjustable with respect to a 10 MHz user supplied reference. The output phase resolution of the generator is $2\pi/2^{32}$ radians or an output time step resolution of 0.024 fs. The output frequency resolution is 5×10^{-19} . Both phase and frequency steps are phase continuous. The instrument provides two sine-wave outputs and two pulse outputs. The sine-wave outputs are buffered to provide greater than 80 dB of port-to-port and reverse isolation. The outputs are at a level of +13 dBm. The pulse outputs are derived from the sine-wave outputs by dividing by a factor of $10.0E6$. The pulse outputs can be synchronized to an external reference pulse to within 100 ns. All instrument functions are displayed and controlled via the front panel LCD display and keypad. Remote control of the instrument is possible through RS-232 communications.

FEATURES

- High isolation: > 80 dB
- High phase resolution: 0.024 fs
- Low harmonic distortion: -45 dBc
- Low phase noise (1 kHz) : -165 dBc/Hz

APPLICATIONS

- Atomic frequency standards
- Clock synchronization
- Time-scales
- Clock steering
- Frequency offset generation

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	$2\pi / 2^{32}$	-	radians
Phase offset range		-	infinite	-	-
Time offset resolution	10 MHz external reference	-	0.024	-	fs
Frequency resolution		-	5 E-19	-	-
Frequency tuning range		-	+/- 1 E-7	-	-
Mech. tuning range		-	+/-1 E-6	-	-
Int. oscillator aging	after 30 days of operation	-	5 E-10	-	Per day
10 MHz output level	50 Ohm load	+10	+13	+15	dBm
1PPS output level	50 Ohm load	3.7	3.8	5	V
Output Isolation	Channel-to-channel reverse	- -	80 80	- -	dB
Phase noise L(f) Note: lower phase noise is available.	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-130 -155 -165 -165	-127 -152 -162 -163	dBc/Hz
Allan deviation $\sigma_y(t)$	$\Delta f = 1.0 \text{ E-}^{12}$ 1 s 10 s 100 s 1000 s	- - - -	9 E-14 9 E-15 4 E-15 4 E-15	2 E-13 3 E-14 5 E-15 5 E-15	
Allan deviation $\sigma_y(t)$	$\Delta f = 0$ 1 s 10 s 100 s	- - - -	9 E-14 9 E-15 9 E-16	1 E-13 2 E-14 2 E-15	
Spurious		-	-110	-100	dBc
Harmonics		-	-45	-40	dBc

External reference: 10.0 MHz \pm 2.0 E-8, +7 dBm to +15 dBm
 External 1PPS: 400 ns min. pulse width, TTL compatible levels
 AC power: 110-120/ 220-240VAC

Rack-mount enclosure: 3.5" X 16" X 19", Weight: 20 lbs.

HROG-10 SELECTION GUIDE

Product Name	Phase Noise @ 10 Hz	Phase Noise @ 10 kHz
HROG-10	-130 dBc/Hz	-165 dBc/Hz
HROG-10-LN Low Noise Option	-137 dBc/Hz	-168 dBc/Hz

Optional DC voltage operation for both: +20 to +33 VDC, 2 A
 Add -DC to part number when placing an order or requesting a quote for the DC operation option.

LOW NOISE FREQUENCY SYNTHESIZER, LNFS-100



DESCRIPTION

The LNFS-100 is a low noise synthesizer with an output frequency range of 1 μ Hz to 120 MHz. The synthesizer has 48 bit frequency resolution, 14 bit phase resolution and 12 bit amplitude control. The low noise internal time base can be phase-locked to an external 5 or 10 MHz signal for long term stability and accuracy. The synthesizer can be used as a frequency source for instrumentation, microwave synthesis, phase noise characterization, radar synthesizers and telecommunication clock systems. The LNFS-100 has AM, FM, PM, FSK, ASK, BPSK and QPSK modulation capabilities. The synthesizer is available in a 2U rack-mount enclosure with LCD display and keypad. Remote control of the instrument is available through a RS-232 interface. This unit may be ordered with up to three independent synthesizers locked to the internal time base.

FEATURES

- Frequency range: 1 μ Hz - 120 MHz
- Amplitude range: -30 to 15 dBm into 50 Ω
- Frequency resolution: 1 μ Hz
- Phase resolution: 0.38 mRadians
- Low phase noise : 5 MHz, +10 dBm output
 - 140 dBc/Hz @ 100 Hz
 - 160 dBc/Hz @ 1 kHz

APPLICATIONS

- Instrumentation
- Microwave synthesis
- Phase noise characterization
- Radar synthesizers
- Telecom clock generation

LNFS-100 SELECTION GUIDE

Part Number	Number of Synthesizers
LNFS-100	1
LNFS-100 OPT2	2
LNFS-100 OPT3	3

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	0.022	-	degrees
Phase offset range		-	+/- 360	-	degrees
Amplitude resolution		-	0.01	-	Vrms
Frequency resolution		-	1 E-6	-	Hz
Frequency tuning range		-	0 – 120	-	MHz
Mech. tuning range		-	+/- 1 E-6	-	-
Int. oscillator aging	after 30 days of operation	-	5 E-10	-	Per day
Max sine output level	50 Ohm Load, accuracy +/-2	+14	+15	+16	dBm
Pulse output level Optional	50 Ohm Load	+9	+10	+11	dBm
Output isolation	channel to channel reverse	- -	80 80	- -	dB
Phase noise L(f) 5 MHz output, +15 dBm	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-135 -147 -154 -160	-133 -145 -152 -155	dBc/Hz
Phase noise L(f) 10 MHz output, +15 dBm	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-130 -142 -150 -155	-127 -140 -147 -153	dBc/Hz
Allan deviation $\sigma_y(t)$ Locked to ext reference	f = 5E6 1 s 10 s 100 s	- - - -	2.1 E-13 3.2 E-14 2.0 E-14	- - -	
Allan deviation $\sigma_y(t)$ Locked to ext reference	f = 10E6 1 s 10 s 100 s	- - - -	3 E-13 4 E-14 6 E-15	- - -	
Spurious		-100	-50	-45	dBc
Harmonics		-60	-45	-32	dBc

External Reference
DC Tuning Voltage
External Trigger
AC Power

10.0 MHz \pm 2.0 E-8
+/- 5VDC
400 ns min. pulse width
110 - 120/ 220 - 240VAC

+7 dBm to +15 dBm
TTL Compatible Levels

Rack-mount Enclosure
Size: 3.5" X 16" X 19"
Weight: 20 lbs

LOW NOISE FREQUENCY SYNTHESIZER, LNFS-400



DESCRIPTION

The LNFS-400 is a versatile low noise synthesizer with an output frequency range of 1 to 400 MHz. The instrument has 32 bit frequency resolution, 14 bit phase resolution and a low noise internal time base that can be phase-locked to an external 5 or 10 MHz signal for long term stability. Applications include frequency generation for instrumentation, microwave synthesis, phase noise characterization, radar synthesizers and telecommunication clock generators. The LNFS-400 has FSK and PSK modulation capabilities. The synthesizer is available in a 2U rack-mount enclosure with LCD display and keypad. Remote control of the instrument is available through a RS-232 interface. This unit may be ordered with up to three independent synthesizers locked to the internal time base.

FEATURES

- Frequency range 1 - 400 MHz
- Frequency Resolution: 0.233 Hz
- Phase resolution: 0.38 mRadians
- Low phase noise : 180 MHz output
 - 130 dBc/Hz @ 1 kHz
 - 140 dBc/Hz @ 100 kHz

APPLICATIONS

- Instrumentation
- Microwave synthesis
- Phase noise characterization
- Radar synthesizers
- Telecom clock generation

LNFS-400 SELECTION GUIDE

Part Number	Number of Synthesizers
LNFS-400	1
LNFS-400 OPT2	2
LNFS-400 OPT3	3

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	0.022	-	degrees
Phase offset range		-	+/- 360	-	degrees
Amplitude resolution		-	1.0	-	dBm
Frequency resolution		-	0.233	-	Hz
Frequency tuning range		-	1 – 400	-	MHz
Mech. tuning range		-	+/-1 E ⁻⁶	-	-
Int. oscillator aging	after 30 days of operation	-	1 E ⁻⁶	-	Per year
Max sine output level	50 ohm load, accuracy +/-2dB	+14	+15	+16	dBm
Output isolation		-	60	-	dB
Phase noise L(f)	10 Hz	-	-130	-125	dBc/Hz
10 MHz output, +13 dBm	100 Hz	-	-135	-130	
	1 kHz	-	-135	-130	
	>10 kHz	-	-145	-140	
Allan deviation $\sigma_y(t)$	f = 5E6				
Locked to ext reference	1 s	-	2.0 E ⁻¹²	4.0 E ⁻¹²	
	10 s	-	3.0 E ⁻¹³	4.0 E ⁻¹³	
	100 s	-	3.0 E ⁻¹⁴	5.0E ⁻¹⁴	
Allan deviation $\sigma_y(t)$	f = 10E6				
Locked to ext reference	1 s	-	2.0 E ⁻¹²	3.0 E ⁻¹³	
	10 s	-	3.0 E ⁻¹³	4.0 E ⁻¹³	
	100 s	-	3.0 E ⁻¹⁴	5.0E ⁻¹⁴	
Spurious	+13 dBm output level	-65	-50	-45	dBc
Harmonics	+13 dBm output level	-60	-40	-30	dBc

External reference

10.0 MHz \pm 2.0 E⁻⁸

+7 dBm to +15 dBm

DC tuning voltage

+/- 5VDC

External trigger

400ns min. pulse width

TTL compatible levels

AC power

110–120/ 220–240VAC

Rack-mount enclosure

Size: 3.5" X 16" X 19"

Weight: 21 lbs

PULSE GENERATOR, PPS-2



DESCRIPTION

The PPS-2 pulse generator is used to generate one pulse per second signals from a sine-wave input signal. The input can be a 1 MHz, 5 MHz or 10 MHz signal. The pulse-per-second (pps) output has a variable pulse width. The input frequency selection and pulse width selections are configured via jumper settings. The output pps can synchronize with an external event. The synchronization is good to $\pm 1/2$ of the input clock cycle. The outputs are designed to drive low impedance loads and long 50 or 75-ohm cables. The channel-to-channel delay differences are less than 1 ns. The instrument is available in a 1U full rack mount enclosure and operates on 110 / 220 VAC. Optional DC operation option is available upon request.

FEATURES

- External sync
- High stability
- Low input VSWR
- Low temperature coefficient: 3 ps/°C
- 50 ohm output: 2 Vp-p

APPLICATIONS

- Reference clock distribution
- Time synchronization
- 1 PPS generation

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	1.5	2	ns
Fall time	10 - 90 %	-	1.5	2	ns
Propagation delay	50 ohm load	-	10	12	ns
Differential delay	Channel - Channel	-	200	500	ps
Impedance	input output	- -	50 10	- -	Ohms
Input High Level	Input signal into 50 ohm load	2	-	5	V
Input Low Level	Input signal into 50 ohm load	-0.7	-	0.8	
Output High Level	50 ohm load	3	4	5	V
Output Low Level	50 ohm load	-	0.1	0.2	
Input Signal Level	1 MHz, 5 MHz and 10 MHz	0	+7	+13	dBm
External Sync. Error	1 MHz 5 MHz 10 MHz	- - -	+/- 500 +/- 100 +/- 50	- - -	ns
Temp-delay Coefficient	0 - 50 °C	-	3	5	ps/°C

PPS SELECTION GUIDE

Part Number	Enclosure	Description
PPS-2RM-A	1U Full-rack	One generator, rear panel connectors
PPS-2RM-B	1U Full-rack	Two generators, rear panel connectors
PPS-2RM-B1	1U Full-rack	Two generators, front panel connectors

Optional DC operation is available upon request. Please add -DC to part number when ordering.

6.834 GHz FREQUENCY SYNTHESIZER, RB-1



DESCRIPTION

The 6.834 GHz Synthesizer, RB-1 is a high stability and high resolution signal source designed to be used in the implementation of a Rubidium atomic clock. The RB-1 is provided in two separate enclosures, the Synthesizer Module and the DC Module, both in a 2U, 19 inch rack-mount enclosure. All synthesizer functions are accessed from the front panel or a RS232 interface. An external trigger input may be used to synchronize programmable events such as frequency sweeps, phase modulation and amplitude modulation with external events. The synthesizer is implemented with a flexible modular topology. Two ultra-low noise quartz oscillators are part of the multiplication chain from 5 MHz to 100 MHz. Buffered outputs are provided at the front panel for 5 MHz, 10 MHz and 100 MHz signals. The 100 MHz signal is the highest frequency in the low frequency section of the synthesizer. This 100 MHz signal is distributed using a one input, four output isolation amplifier. One of these 100 MHz signals is used as the reference for a 6.8 GHz DRO. The output of the 6.8 GHz DRO is buffered and used to drive the LO port of a single-sideband mixer. The second 100 MHz signal is used to generate the 200 MHz clock for the DDS synthesizer module. The DDS synthesizer generates a 34.xx MHz signal with 48 bit resolution and complete modulation capabilities. The DDS synthesizer output drives the IF port of the single-sideband mixer. The upper sideband of the mixer is selected as the output generating the 6.834 GHz output signal. The amplitude of the 6.834 GHz output is controlled with 12 bits of resolution and an internal relay may be used to turn off the RF signal.

FEATURES

- Output signals: 5 MHz, 10 MHz, 100 MHz, 34 MHz, 6.8 GHz, 6.834 GHz.
- Synchronization capabilities with external events:
 - Frequency sweeps
 - Phase modulation
 - Amplitude modulation
- Low phase noise

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Reference frequency generation

SPECIFICATIONS

PARAMETER	CONDITIONS	TYP		UNITS
Frequency Stability $\sigma_y(t)$ Ref. 5 MHz, +13 dBm Pair measurement	Averaging time 1 s 10 s 100 s 1000 s 100000 s 1000000 s	$1 \cdot 10^{-13}$ $1 \cdot 10^{-14}$ $1 \cdot 10^{-15}$ $2 \cdot 10^{-16}$ $2 \cdot 10^{-17}$ $2 \cdot 10^{-17}$	-	-
Phase Noise L(f) Carrier 6.834 GHz (PLL locked at 0.5Hz BW for measurement) (5MHz to 6.834GHz Multiplication Noise at 1 Hz offset is -75dBc/Hz at the 6.834 GHz output)	Offset frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz	-57 -87 -97 -120 -127 -129 -140	-54 -84 -94 -117 -124 -126 -137	dBc/Hz
Phase Noise L(f) Carrier 100 MHz	Offset frequency 10 Hz 100 Hz 1 kHz >10 kHz	-126 -134 -159 -174	-123 -131 -156 -172	dBc/Hz
Phase Noise L(f) Carrier 10 MHz	Offset frequency 1 Hz 10 Hz 100Hz >1 kHz	-113 -146 -163 -167	-110 -144 -160 -165	dBc/Hz
Phase Noise L(f) Carrier 5 MHz	Offset frequency 1 Hz 10 Hz 100Hz >1 kHz	-120 -150 -167 -175	-117 -147 -165 -173	dBc/Hz

External reference : 5.0 MHz $\pm 2.0 \cdot 10^{-8}$, +7 dBm to +15 dBm

Rack-mount enclosure: 3.5" (2U) X 16" X 19", Weight: 20 lbs

RB-1 SELECTION GUIDE

Part Number	Phase Noise @ 1 Hz 5 MHz Output	Phase Noise @ 1 Hz 6.834 GHz Output
RB-1	-120 dBc/Hz	-57 dBc/Hz
RB-1 Opt C	-130 dBc/Hz	-67 dBc/Hz

OPTICAL TO RF SYNTHESIZER, FC-160-10P



DESCRIPTION

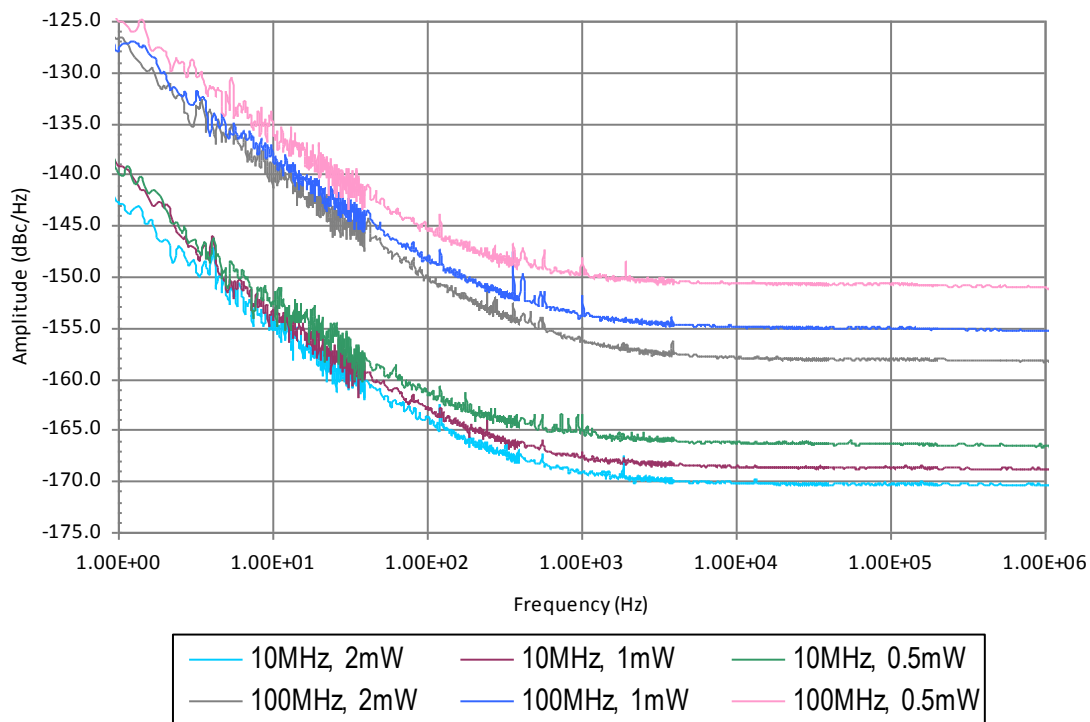
The FC-160-10P is a low noise optical to RF synthesizer. This module can be used to generate low noise 10 MHz, 100 MHz and 1PPS signals that derive their PM noise and stability from an external 800-1650 nm pulsed optical signal with a repetition rate of 160 MHz. A PIN photodiode and bandpass filter are used to select the 800 MHz harmonic and a proprietary multi-stage divider is used to generate 10 MHz, 100 MHz and 1PPS outputs. The instrument comes in an aluminum module and operates from a + 12VDC power source. All PPS input signals conform to TTL levels.

A FC-080-10P module is also available. This module generates 10 MHz, 100 MHz and 1PPS signals that derive their PM noise and stability from an external 800-1650 nm pulsed optical signal with a repetition rate of 80 MHz. A PIN photodiode and bandpass filter are used to select the 400 MHz harmonic and a proprietary multi-stage divider is used to generate 10 MHz, 100 MHz and 1PPS outputs.

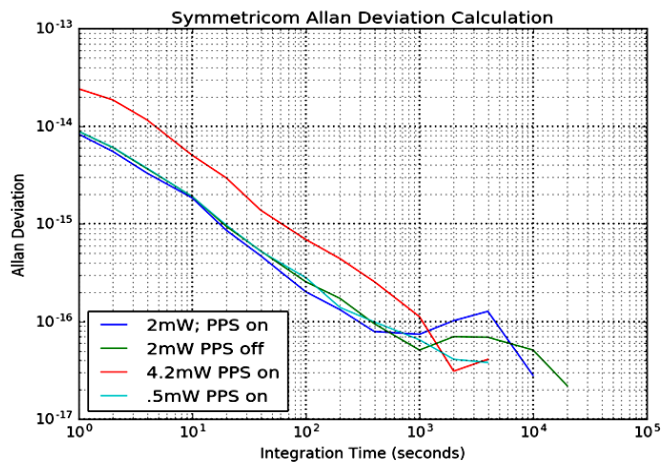
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output power level		-	+13	+14	dBm
Stability of the 10 MHz Output	Pair Measurement		1 e-14	8 e-14	-
Temperature Stability	@10 MHz, 20-50C	-	0.5	1	ps/C
	@100MHz, 20-50C	-	1	2	
Residual Phase Noise of the 10 MHz Output	1 Hz	-	-142	-140	dBc/Hz
	10 Hz	-	-152	-152	
	100 Hz	-	-162	-162	
	1 kHz	-	-167	-167	
	>10 kHz	-	-170	-170	
Residual Phase Noise of the 100 MHz Output	1 Hz	-	-127	-122	dBc/Hz
	10 Hz	-	-137	-132	
	100 Hz	-	-147	-142	
	1 kHz	-	-152	-147	
	>10 kHz	-	-155	-150	
Harmonic Distortion		-	-35	-30	dBc
1 PPS External Sync Error		-	-	5	ns

PHASE NOISE:

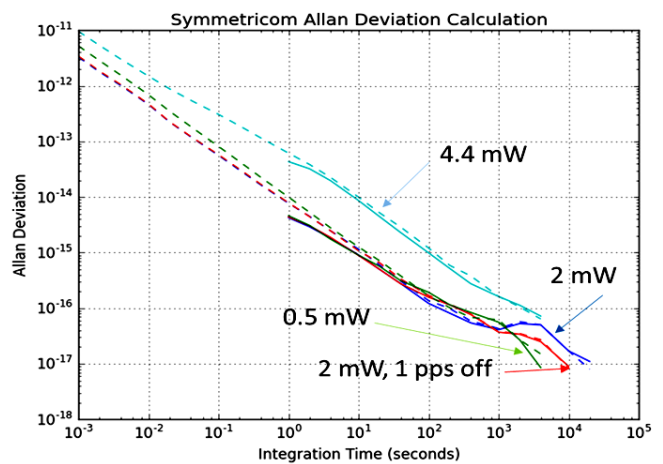
FC-160-10P Frequency Converter Phase noise
1560nm light with pulse repetition rate of 160 MHz



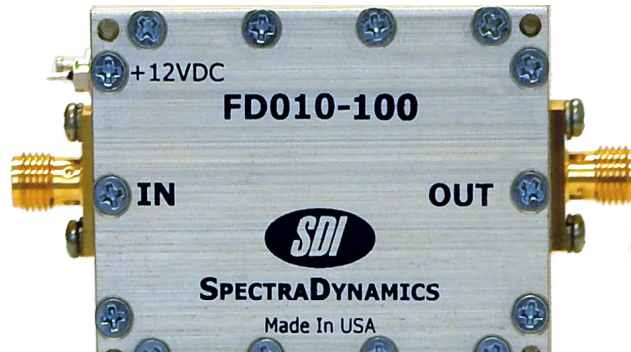
10 MHz OUTPUT:



100 MHz OUTPUT:



LOW NOISE 100 MHz TO 10 MHz FREQUENCY DIVIDER, FD010-100LT



DESCRIPTION

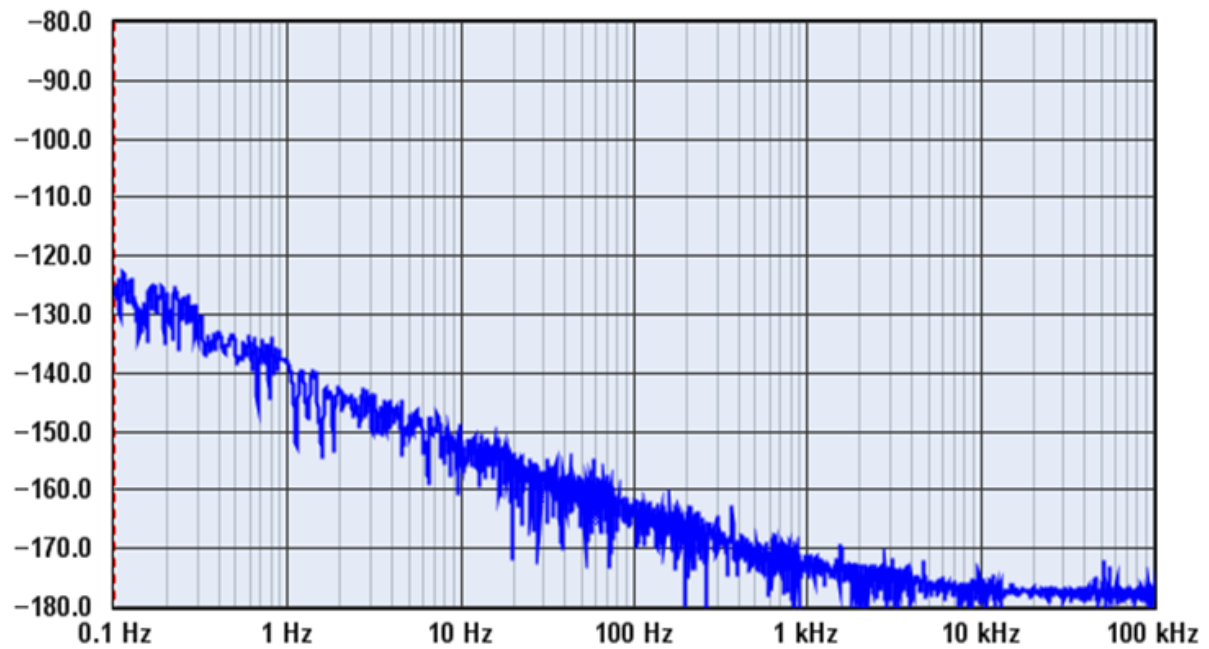
The FD010-100LT is a low noise frequency divider which takes a sinewave input at 100 MHz and divides it down to a 10 MHz sinewave output. This module has been designed for ultra low phase noise and very high stability. The module is temperature compensated to keep the overall delay temperature coefficient below 5 ps/K. SpectraDynamics Dividers are available for different input and output frequencies with similar performance.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency Stability $\sigma_y(t)$ Measured @ 10MHz output Locked to common 100MHz	Averaging time 1 s	-	$1 \cdot 10^{-14}$	$8 \cdot 10^{-14}$	
Phase Noise $L(f)$ Residual noise @ 10 MHz output	Offset frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz	-	-142 -152 -162 -167 -170 -170	-140 -152 -162 -167 -170 -170	dBc/Hz
Input Level	-	0	+13	+15	dBm
Output Level	-	+10	+13	+14	dBm
Impedance	input output	- -	50 50	- -	Ohms
Delay Temp-Coefficient	0 - 50 °C	-	3	5	ps/°C

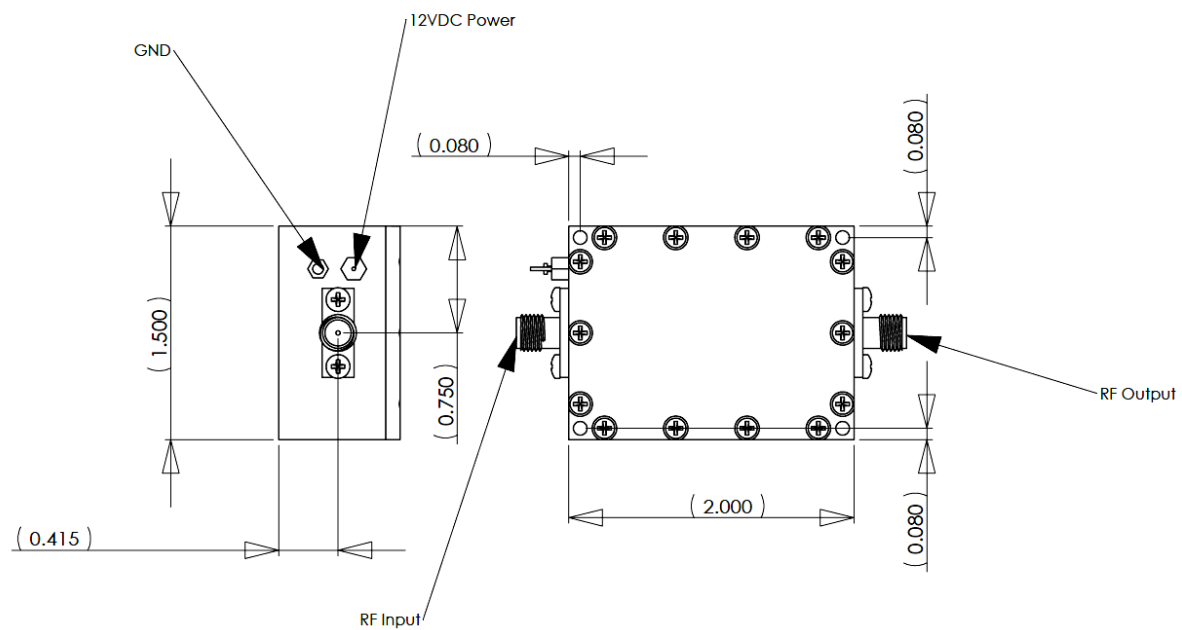
PHASE NOISE:

Phase Noise $\mathcal{L}(f)$ in dBc/Hz



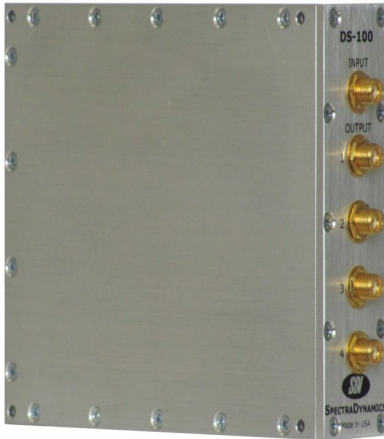
POWER REQUIREMENTS

DC operation: +12 VDC, 150 mA



CUSTOM PRODUCTS

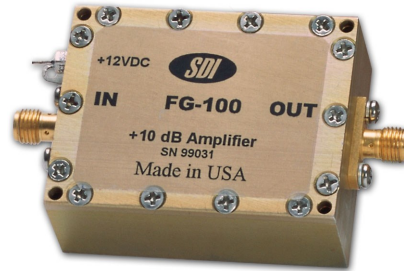
SpectraDynamics, Inc. is aware of the challenges that standard products may represent for a particular application or for the development of a specific project. Therefore SpectraDynamics is happy to provide you with custom engineered solutions and a variety of modular products that may be customized to fit your particular needs:



DS-100

Distribution Amplifier 1-200 MHz

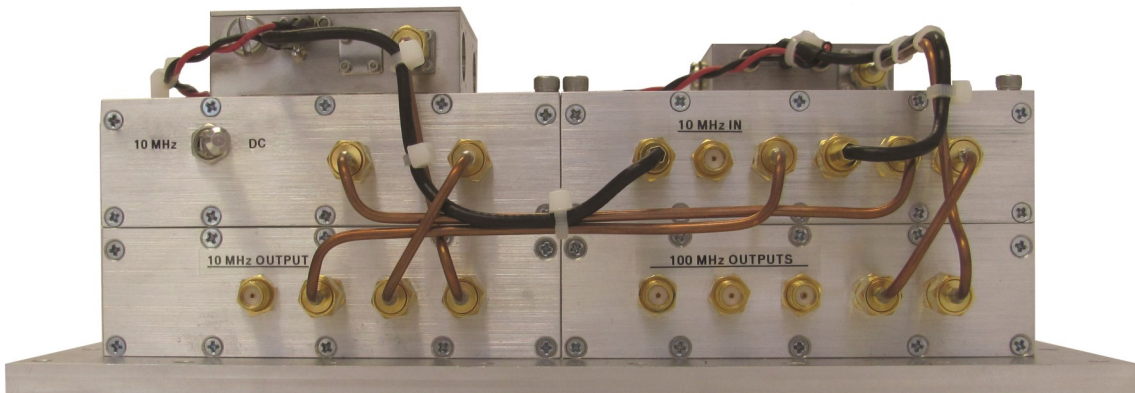
- Unity gain
- Low VSWR
- High isolation: 70 dB @ 5 MHz
50 dB @ 100 MHz
- Low phase noise: -150 dBc/Hz @ 10 Hz
-170 dBc/Hz @ 10 kHz
- Low distortion: -40 dBc
- Max. output: +15 dBm



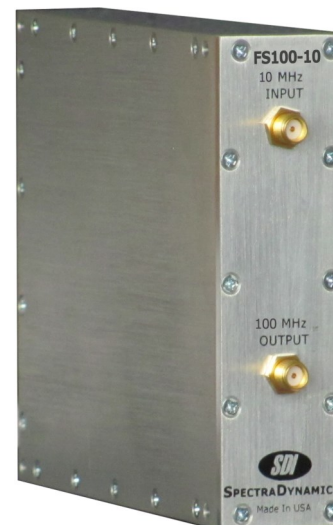
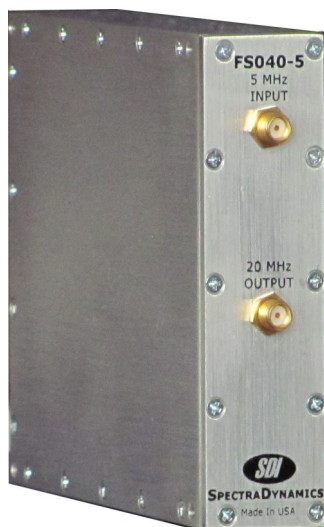
FG-100

Fixed Gain Amplifier

- User specified fixed gain: +10 to +20 dB
- Low phase noise: -160 dBc/Hz @ 10 Hz
-175 dBc/Hz @ 10 kHz
- Low distortion: -40 dBc @ +13 dBm
- 3 dB BW 1 MHz to 1 GHz



FREQUENCY MULTIPLIERS



FS020-X, FS040-X, FS080-X, FS100-X

- Frequency Multiplier
- **X** = User specified input frequency
- 020 = Times two
- 040 = Times four
- 080 = Times eight
- 100 = Times ten
- Ultra-Low Phase Noise:
 - 143 dBc/Hz @ 1 Hz
 - 170 dBc/Hz @ 1 kHz
 - 176 dBc/Hz @ 100 kHz
- Very Low Spurious: -50 dBc
- Voltage requirements: +12 VDC
- Input power requirement: > +11dBm

FREQUENCY DIVIDERS



- Low phase noise:
 - 140 dBc/Hz @ 1 Hz Typ.
 - 175 dBc/Hz @ 10 kHz Typ.
- Voltage requirement: +12 VDC
- Input power requirement: +11 to +15 dBm
- Return loss: -15 dB

FD002-10

- Input freq: 10 MHz
- Output: 5 MHz

FD010-100

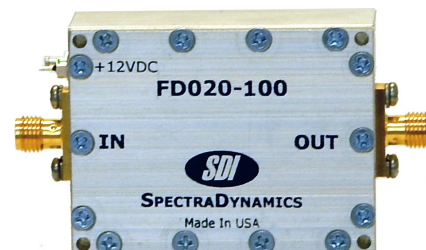
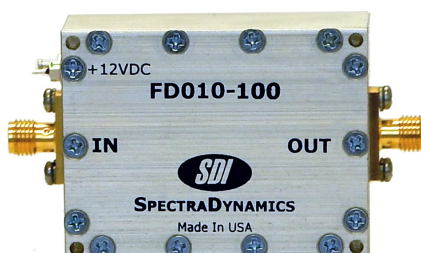
- Input freq: 100 MHz
- Output: 10 MHz
- High Stability - Optional

FD020-100

- Input freq: 100 MHz
- Output: 5 MHz
- High Stability - Optional

FD020-2-100

- Input frequency: 100 MHz
- Two outputs: 10 MHz
- Two outputs: 5 MHz
- Return loss: -25 dB
- Voltage requirement: +12 VDC



If you have any questions concerning a particular application, or would like to know about the possibility of customizing an existing product, please do not hesitate to contact us. Remember that for us it is a pleasure to serve you!

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- b) **Reverse Engineering.** Buyer agrees not to engage in, or cause a third party to engage in, the disassembly, analysis, or testing of the product for the purpose of extracting knowledge regarding the design, material content, or fabrication methods.

9. CHANGES, DELAYS OF SHIPMENT, OR CANCELLATION.

- a) All orders of SpectraDynamics standard manufactured products, EXCLUDING custom orders, may be cancelled upon SpectraDynamics approval and may be subject to restocking fees plus compensation for any resulting loss or damage including, without limitation, the cost of labor, materials, and overhead expenses. Compensation fee should not be less than 40% of the purchase order and no more than 70%.
- b) Customer initiated delays of shipments exceeding 180 days from the original delivery date will be deemed a cancellation and fall under this cancellation policy.

10. REMEDIES. SpectraDynamics shall have the right to terminate any order, or to delay the shipment thereof, by reason of Buyer's bankruptcy or insolvency, breach of any terms herein, unauthorized assignment, or the pendency of any proceedings against Buyer under any statute for the relief of debtors.

11. EXPORT CONTROL. The Buyer agrees to comply with all applicable U.S. export control laws and regulations, specifically including, but not limited to the requirements of the Arms Export Control Act, 22 U.S.C. 2751-2794, including the International Traffic in Arms Regulation (ITAR), 22 C. F. R. 120 et seq.; and the Export Administration Act, 50 U.S.C. app. 2401-2420, including the Export Administration Regulations, 15 C.F.R. 730-774; including the requirement for obtaining any export license if applicable. Without limiting the foregoing, the Buyer agrees that it will not transfer to foreign persons or entities any items, data, or services it receives from the Seller that constitutes any export of controlled items, data, or services, to include transfer to foreign persons employed by or associated with, or under contract to the Buyer or the Buyer's suppliers, without the authority of an export license, agreement, or applicable exemption or exception. The Seller agrees to notify the Buyer if any product, data, or service the Seller supplies to the Buyer is restricted by export laws or regulations. Buyer will defend, indemnify and hold Seller harmless for any damages or costs to Seller arising from Buyer's failure to comply with these terms. Buyer agrees to indemnify Seller for any fines, penalties, claims, losses, damages, costs (including legal costs), expenses and liabilities that may arise as a result of Buyer's breach of this Section.

12. APPLICABLE LAW. This Agreement, and any disagreement arising thereof, will be governed by the laws of the State of Colorado without regard to that State's choice of laws, with exclusive jurisdiction and venue in the Colorado state courts of Boulder County, Colorado (or, if there is exclusive federal jurisdiction, the United States District Court for the State of Colorado). Buyer shall bring action relating to any dispute Buyer may have hereunder within one (1) year of the accrual of such dispute.

13. MISCELLANEOUS. Nothing in these Terms of Sale or the sale of the Products shall imply any license or other rights with respect to any intellectual property rights of SpectraDynamics or its suppliers, and SpectraDynamics reserves all such rights. All waivers of any right hereunder must be in writing and signed by SpectraDynamics. Waiver of a breach by the other party of any provision of these Terms of Sale shall not be deemed a waiver of future compliance therewith. If any provision of these Terms of Sale is held invalid by any U.S. law or regulation or by any U.S. court having valid jurisdiction, such invalidity will not affect the enforceability of other provisions. These Terms of Sale and Buyer's rights hereunder may not be assigned by Buyer without the prior written consent of SpectraDynamics, Inc. and any unauthorized assignment by Buyer shall be void. These Terms of Sale constitute the entire agreement between Buyer and SpectraDynamics with respect to Buyer's purchase of the Products and supersedes all prior agreements and understandings with respect to such purchase and may not be changed or amended, or superseded by conflicting terms and conditions submitted by Buyer, except by a written instrument signed by an authorized SpectraDynamics representative.