

FREQUENCY SYNTHESIZERS PHASE-LOCKED OSCILLATORS



Luff RESEARCH, inc.

Welcome to the Luff Research Inc. Frequency Source Solution Catalog. You will find inside frequency source products available in a range of standard frequency bands as well as custom designs to fit your required specifications.

Our frequency synthesizers, oscillators and custom designs are available in traditional housings as well as surface mountable packaging. RoHS compliant products are also available.

All of our products are designed and manufactured with pride by Luff Research Inc. at our plant in the U.S.A.

We look forward to working with you on your current frequency source requirement. Please call us at (516) 358-2880 to discuss your current application and to answer any questions you may have. We can design and manufacture your next frequency source requirement using state of the art technologies with a minimum lead time and at excellent value.

Best regards,

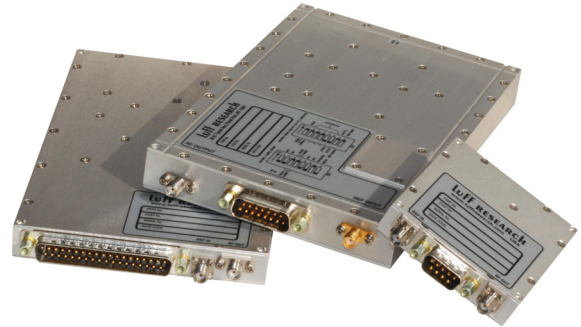
Richard Scheer

Richard Scheer
General Manager
(516) 358-2880

Product Line Overview

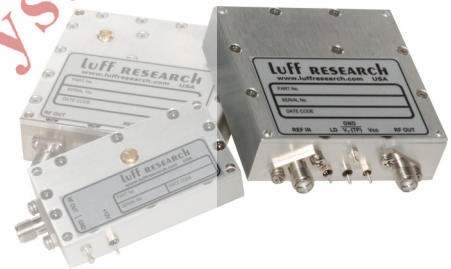
● FREQUENCY SYNTHESIZERS

- ☆ High performance multi-loop designs up to 25 GHz
- ☆ Single loop designs up to 25 GHz
- ☆ Surface mount designs up to 8 GHz
- ☆ Custom designs
- ☆ Customized interfaces



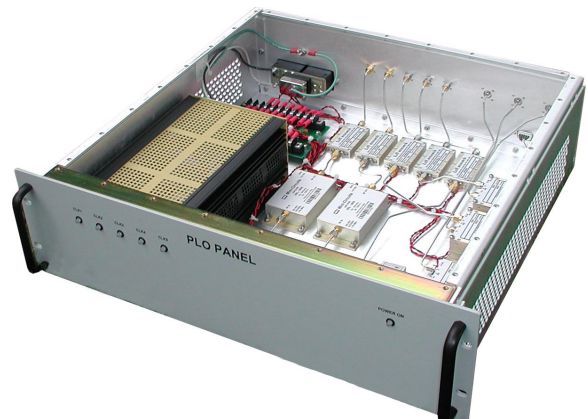
● PHASE-LOCKED OSCILLATORS

- ☆ Dielectric resonator oscillators up to 16 GHz
- ☆ Coaxial resonator oscillators up to 7 GHz
- ☆ High-Q LC oscillators up to 750 MHz
- ☆ Crystal oscillators up to 1400 MHz
- ☆ Voltage controlled oscillators to 14 GHz
- ☆ Custom designs up to 25 GHz



● CUSTOM PRODUCTS and ASSEMBLIES

- ☆ We design and develop exceptional frequency sources
- ☆ Multiple output frequency sources
- ☆ Phase noise clean-up loops
- ☆ Buffered C & X band VCOs



Luff RESEARCH

20 N. Tyson Ave., Floral Park, NY 11001-1514

Tel.: (516) 358-2880 Fax: (516) 358-2757

sales@luffresearch.com www.luffresearch.com

FREQUENCY SOURCE WORKSHEET

COMPANY NAME: _____

DATE: _____

CONTACT: _____

TEL: _____

E-MAIL: _____

FAX: _____

Output Frequency	Requirement	Typical Specifications
Tuning range or Fixed Output Frequency (MHz):		
Frequency step size (kHz):		
Frequency stability & accuracy for internal ref. (PPM):		±1 PPM (-10°C to +60°C)
Phase noise in dBc/Hz (typ.)	L(100 Hz)	
	L(1 kHz)	
	L(10 kHz)	
	L(100 kHz)	
	L(1 MHz)	
Spurious (dBc):		-60 dBc
Harmonics typical (dBc):		-20 dBc
Power out minimum (dBm):		+13 dBm
Output power variation (dB):		2 dB
Output VSWR:		1.5:1 (typical)
Load VSWR:		2:1 (typical)

Input Frequency	
Input reference frequency (MHz):	10 MHz (typically)
Input ref. freq. level (dBm):	0 dBm (± 3 dB)

Frequency Tuning / Alarm	
Frequency control (serial or parallel):	serial or parallel
Acquisition time (msec):	<50 msec
Phase-lock indicator (TTL or Open Collector):	

Typical DC Power	
+5.0, +5.2, +12.0, +15.0 Vdc (mA):	

Environment	
Operating temperature range (surface):	0°C to 60°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

Company Profile

Starting in 1980, our focus has been the design, development and manufacture of high performance frequency synthesizers, phase-locked oscillators, frequency sources and complex assemblies that incorporate these components.

We have a highly experienced and seasoned team of dedicated engineers and technicians performing every phase of product design, manufacturing and test. Our products are of the highest reliability, and are offered at a superior value.

General Information

● Quality Assurance

At Luff our policy and passion is to provide products that are of the highest quality. We strive to produce products that meet specification and function reliably throughout their expected life.

All of our processes are continuously tested through the manufacturing cycle for performance and for possible latent problems. This ensures that the equipment we deliver is of exceptional quality.

We pride ourselves on our customer support. When you contact Luff, you will always deal with a senior engineer who is a specialist in frequency sources and is happy to assist you in the implementation of a best solution for a given problem.

For more information about our Quality Control please reference our Quality Assurance Program page.

● Application Support

Frequency sources generally are customized and optimized components. Luff Research's dedicated senior design engineers are available to provide technical support to assist in specifying the appropriate frequency source for a given requirement.

Contact: Richard Scheer
Tel: (516) 358-2880
Fax: (516) 358-2757
Email: rich@luffresearch.com

● Ordering Information

To obtain a quotation, place an order, or get additional information, please contact the factory directly or one of our sales representatives. Our quotations generally go out within 48 hours.

Contact us direct: Luff Research, Inc.
20 N. Tyson Avenue
Floral Park, NY 11001-1514
Tel: (516) 358-2880
Fax: (516) 358-2757
Email: sales@luffresearch.com

For a list of our current reps in your area, please visit our website at www.luffresearch.com

● Terms and Conditions of Sale

Terms of Sale are outlined in the "General Policy and Terms of Sale" document available upon request.

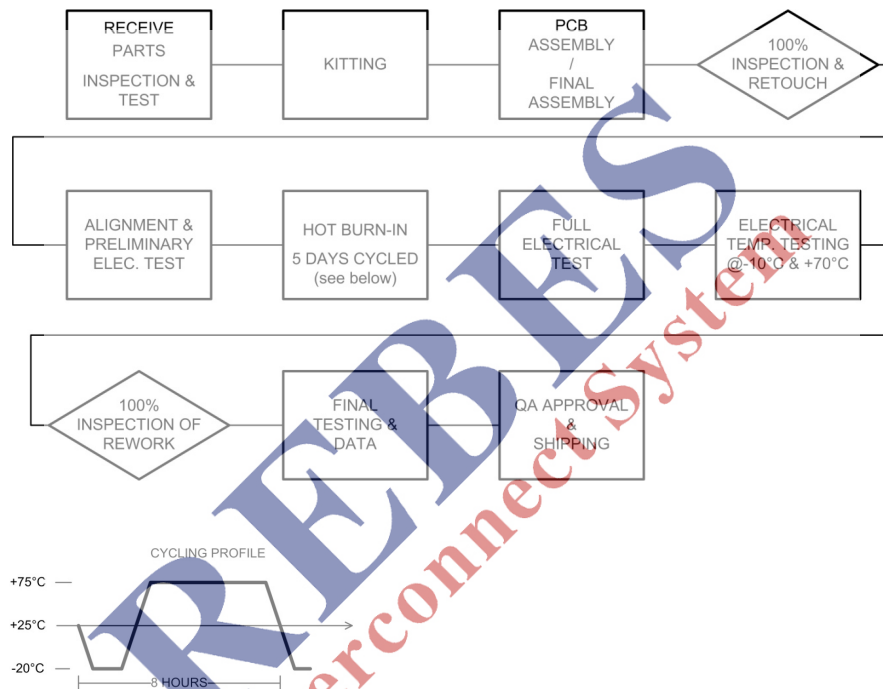
● Warranty

Each product manufactured by Luff Research Inc. is thoroughly tested and inspected, and is warranted against defects in materials and workmanship. This warranty applies for **two years** from date of original delivery. Luff will perform all appropriate repairs during the warranty period, provided the parts are returned by buyer to Luff Research, and have not been subject to misuse. No other warranty is expressed or implied. We are not liable for any consequential damage.

Quality Assurance Programs

At Luff our focus is on component performance and quality. Our quality control program is designed to result in the manufacture of products that perform to all specifications and are highly reliable. We achieve this by modeling our quality assurance program after ISO9001: 2001 and IPC-A-610 as a starting point.

The typical steps in the manufacture of our products are shown below. Our manufacturing cycle employs sophisticated manufacturing techniques, automatic testing, temperature cycling and burn-in before final electrical and ATE testing.



Quality is forged into our products by the team of dedicated professionals that perform and monitor all of the manufacturing processes. All aspects of design and production are continuously monitored. Any identified problems are immediately dealt with so that our products can have the highest possible reliability.

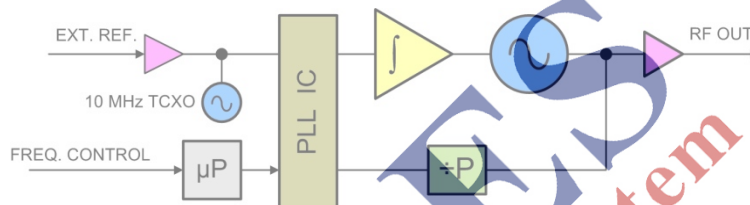
- Our quality control manual is available upon request.
- Our equipment is of the latest technologies and is fully calibrated.
- Detailed records are kept on all designs and testing
- All returned equipment is fully evaluated for any failure modes and corrective action taken. A detailed report is issued.

Standard Frequency Synthesizer Products

• The New SLSM5 and SLSM3 - Single loop synthesizers that feature:

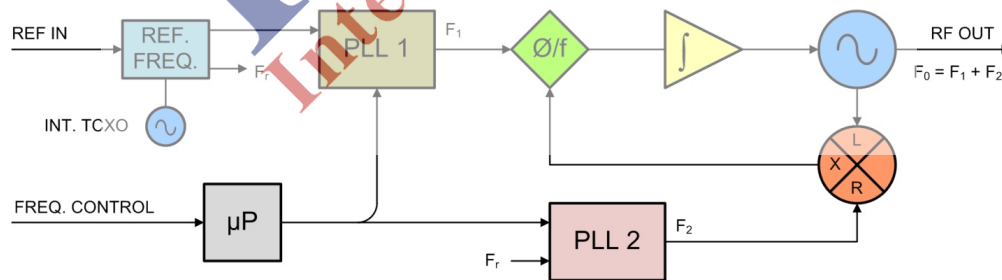
- Frequencies up to 25 GHz
- Frequency steps down to 1 kHz
- Broad band frequency coverage
- Good phase noise and spectral quality
- Low cost

• Block Diagram



• The New TLSE and the TLSD and TLS - Triple loop synthesizers that feature:

- Frequencies up to 25 GHz
- Broad band frequency coverage
- Excellent phase noise and spectral quality
- Moderate cost



Fundamental VCO based synthesizers are available up to 12.5 GHz. For frequencies above 12.5 GHz, frequency doublers can be supplied to extend the desired frequency range to 25 GHz.

We custom design frequency synthesizers to optimize a specific set of requirements.

Model SLSM5 and SLSM3: Single Loop Configuration

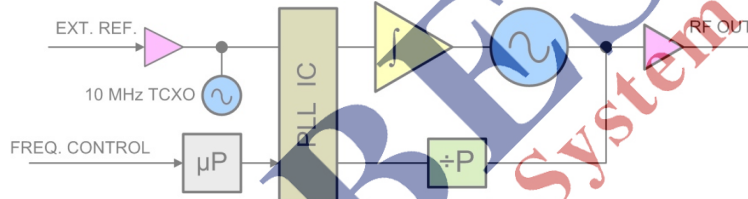
• Features

- Frequencies up to 25 GHz
- Wide frequency range per unit (up to octave bands)
- Frequency steps 1 kHz (typical)
- Good phase noise
- Good spectral purity
- Serial Interface
- Internal or external frequency reference
- Small size
- Low cost

SLSM5 & SLSM3



• Block Diagram



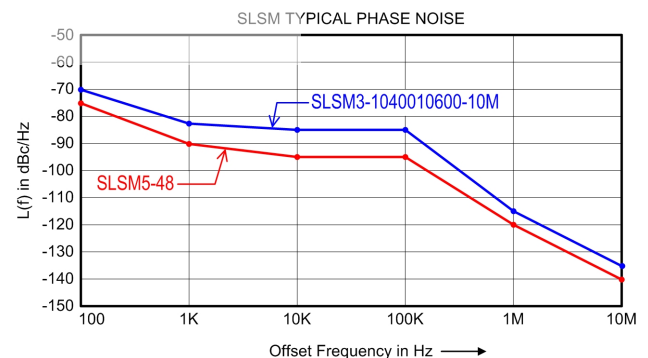
• Description

The Luff SLSM models are advanced technology single phase-locked loop frequency synthesizer designs. These are self contained system level components. These units offer excellent performance for many applications.

In this basic architecture, a tradeoff between frequency resolution and phase noise performance needs to be made. These units are packaged in a miniature connectorized housing. The designs offer flexibility and easy customization for your specific requirement.

• SLSM Key Specifications

Model:	SLSM5	SLSM3
Output Frequency:	up to 12.5 GHz fundamental and to 25 GHz with X2 multiplier	up to 12.5 GHz fundamental and to 25 GHz with X2 multiplier
Frequency Steps (typ.):	1 kHz	>0.5 MHz @ 10 GHz
Spurious:	-60 dBc	-60 dBc (min.)
Harmonics (typ.):	-20 dBc	-20 dBc
Output Power (min.):	+13 dBm	+13 dBm
Output Power Variation:	3 dB	3 dB
External Reference:	10 MHz (typ.) 0 dBm \pm 3 dB	10 MHz (typ.) 0 dBm \pm 3 dB
or Internal Reference:	\pm 0.5 PPM (-10°C to +70°C)	\pm 0.5 PPM (-10°C to +70°C)
Frequency Control:	Serial RS485	SPI
Alarm:	Open Collector or TTL	Open Collector or TTL
Power Requirements:	+5.0 Vdc	+5.0 Vdc
Size:	2.50" x 2.50" x 0.63"	2.50" x 2.50" x 0.63"



FREQUENCY SYNTHESIZER SPECIFICATIONS**Output Frequency**

Output Frequency Range:	4 - 8 GHz
Frequency step size:	1 kHz
Frequency stability and accuracy	
<input checked="" type="checkbox"/> External reference unit	Same as input
<input type="checkbox"/> Internal reference unit	±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	
L(100 Hz)	-75
L(1 kHz)	-90
L(10 kHz)	-95
L(100 kHz)	-95
L(1 MHz)	-120
L(10 MHz)	
Spurious (typ.):	-60 dBc
Harmonics (typ.):	-20 dBc
Power out (min.):	+13 dBm
Power variation (freq. & temp.) (max.):	3 dB
VSWR (typ.):	1.5:1

Reference Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

Frequency Tuning / Alarm

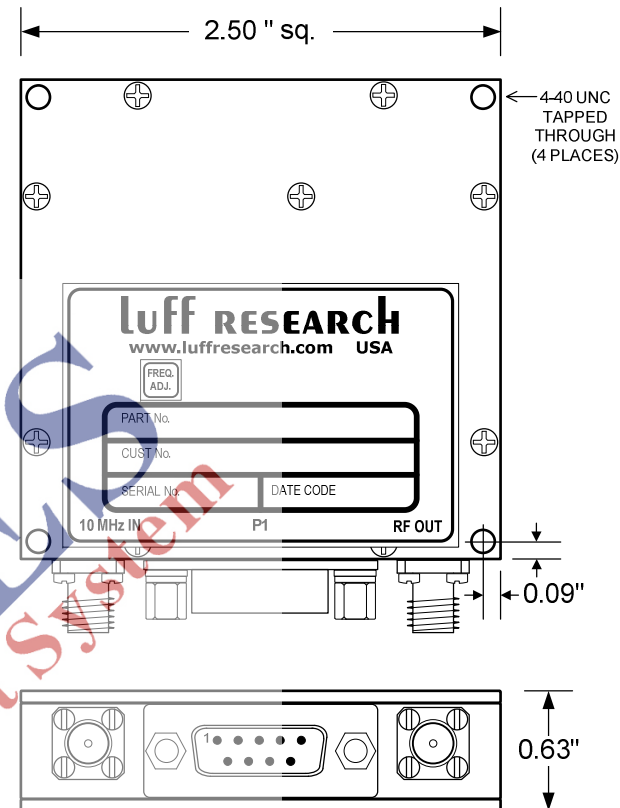
Frequency control:	RS-485
Acquisition time (typ):	< 5 msec
Phase-lock indicator (LD), High = lock:	<input type="checkbox"/> Open collector <input checked="" type="checkbox"/> TTL

DC Power

+5.0 Vdc (min.) +5.5 Vdc (max.)	550 mA
---------------------------------	--------

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. SLISM5-48-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The '10 MHz IN' connector is not provided on units with internal reference.
4. There is a very small set of frequencies at which a spectral anomaly occurs where the close in spurious are >-60 dBc. These can often be eliminated by shifting Fo by 1 or 2 kHz.
5. These units have a non-volatile memory feature and at power on the unit will return to the last set frequency.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

FREQUENCY SYNTHESIZER

Model: SLISM5-48

Rev. A

05/31/12

SPECIFICATIONS**Output Frequency**

Tuning range:	10.4 - 10.6 GHz	
Frequency step size:	10 MHz	
Freq. stability and accuracy (Ext. Ref):	Same as Input	
Freq. stability and accuracy (Int. Ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-70
	L(1 kHz)	-80
	L(10 kHz)	-80
	L(100 kHz)	-90
	L(1 MHz)	-120
Spurious (max.):	-60 dBc	
Harmonics (typ.):	-20 dBc	
Power out (min.):	+13 dBm	
Output power variation (freq. & temp.):	2 dB	
VSWR:	2:1	

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

Frequency Tuning / Alarm

Frequency control:	3 Wire Serial Input (TTL)
Acquisition time (typ.):	1 msec
Phase-lock indicator:	High = lock (TTL compatible)

DC Power

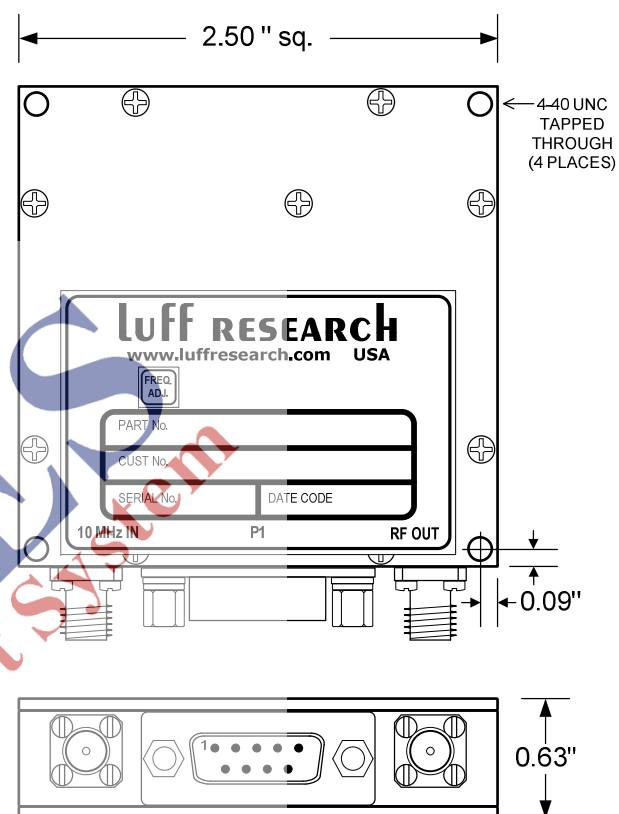
+5.2 Vdc (min.) to +6.0 Vdc (max.)	350 mA (max.)
Internal regulator	

Mechanical

RF connector:	SMA (F)
Digital & DC connection:	DB9 (M)

Environment

Operating temperature range (surface):	-10°C to +70°C
Storage temperature range:	-40°C to +85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. SLSM3-1040010600-10M-INT)
2. The Frequency adjustment is located on the top of the unit and is only applicable on units with internal reference.
3. The 'REF IN' connector is not provided on units with internal reference.

luff RESEARCH, inc.**FLORAL PARK, NY****PHONE: (516) 358-2880 FAX: (516) 358-2757****PRODUCT DATA SHEET****SLSM3 FREQUENCY SYNTHESIZER****Model: SLSM3-1040010600-10M****10/27/10**

SPECIFICATIONS**Output Frequency**

Tuning range:	8 - 12.5 GHz	
Frequency step size:	1 kHz	
Freq. stability and accuracy (Ext. Ref):	Same as Input	
Freq. stability and accuracy (Int. Ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-65
	L(1 kHz)	-80
	L(10 kHz)	-80
	L(100 kHz)	-90
	L(1 MHz)	-115
Spurious (typ.):	-60 dBc	
Harmonics (min.):	-20 dBc	
Power out (min):	+13 dBm	
Output power variation (freq. & temp.):	3 dB	
VSWR:	2:1	

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ± 3 dB

Frequency Tuning / Alarm

Frequency control:	RS-485
Acquisition time (typ):	< 5 msec
Phase-lock indicator:	High = lock (TTL compatible)

DC Power

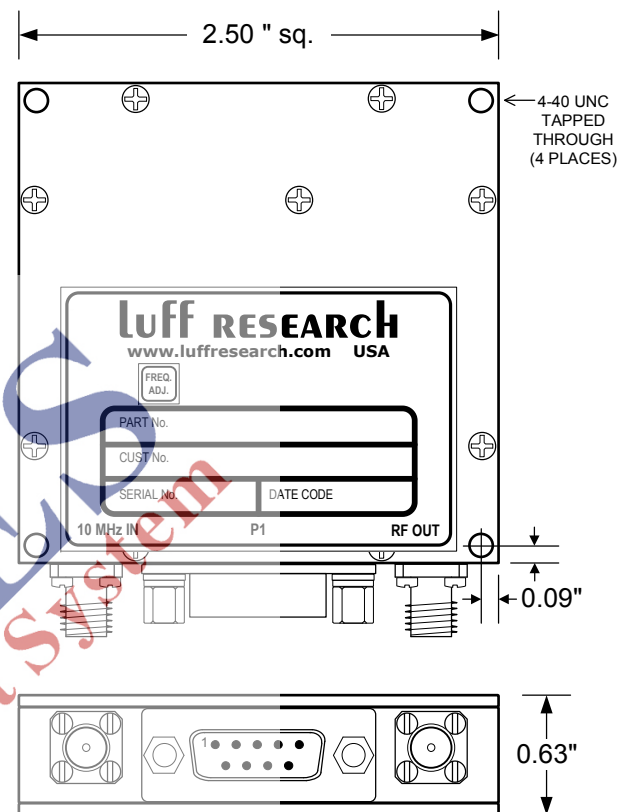
+5.0 Vdc (min.) to +5.5 Vdc (max.)	650 mA (max.)
Internal regulator	

Mechanical

RF connector:	SMA (F)
Digital & DC connection:	DB9 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. SLSM5-812-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The '10 MHz IN' connector is not provided on units with internal reference.
4. There is a very small set of frequencies at which a spectral anomaly occurs where the close in spurious are >-60 dBc. These can often be eliminated by shifting Fo by 1 or 2 kHz.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

SLSM5 FREQUENCY SYNTHESIZER

Model:SLSM5-812

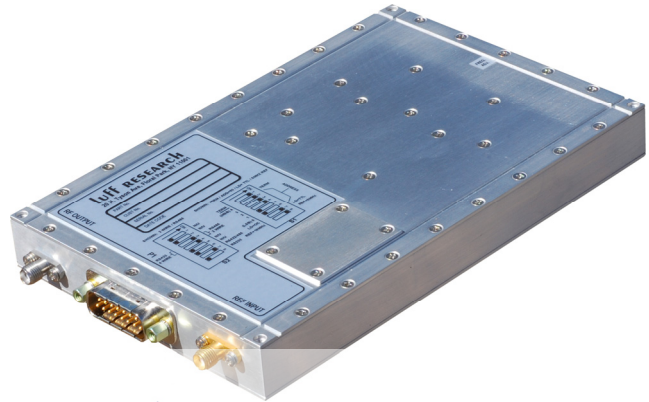
Rev. C

03/27/12

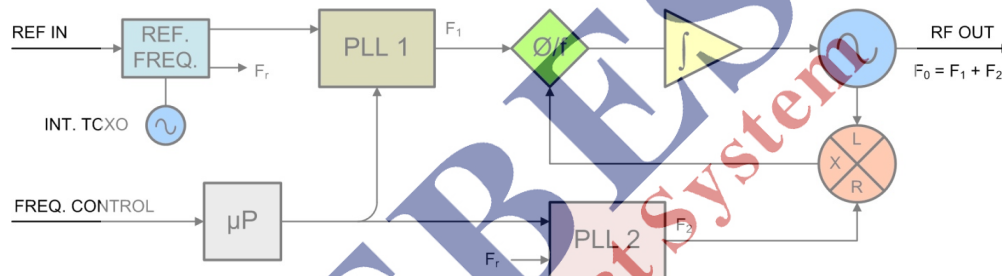
Model TLSE: New C, S, X & Ku Band Synthesizer

• Features

- Frequencies up to 25 GHz
- Low phase noise, spurious and microphonics
- Reference frequencies: 5, 10 or 100 MHz or internal reference (± 0.5 PPM)
- Standard frequency control options, RS-232/422/485, and multi-drop capable
- Reliable field proven designs
- Rugged EMI shielded enclosure
- Cost effective product



• Block Diagram



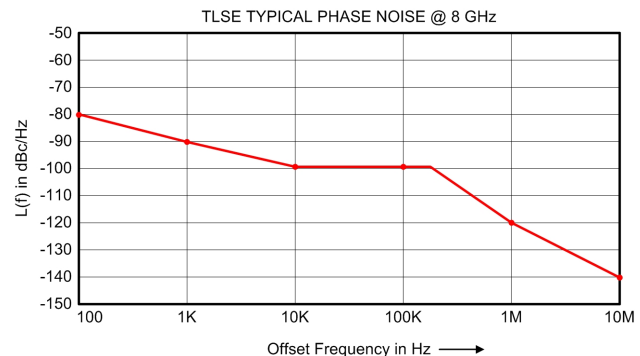
• Description

The TLSE is an improved high performance frequency synthesizer ideal for many **SatCom, telecommunication** and **instrumentation** applications. This synthesizer's frequency control is via standard industrial busses and has multi-drop capabilities. The input reference frequencies are either 5, 10 or 100 MHz. Additionally, the synthesizer circuitry cleans-up the input reference signal. With no input present the unit switches automatically to the internal reference.

This design is field proven and has been deployed in critical applications throughout the world. The TLSE offers excellent value providing great performance at a low cost.

• TLSE Key Specifications

Output Frequency:	up to 12.5 GHz fundamental and to 25 GHz with X2 multiplier
Frequency Steps (typ.):	100 kHz
Spurious:	-60 dBc
Harmonics (typ.):	-20 dBc
Output Power (min.):	+13 dBm
Output Power Variation:	3 dB
External Reference:	10 MHz (typical) 0 dBm ± 3 dB
Or Internal Reference:	± 0.5 PPM (-10°C to $+70^\circ\text{C}$)
Frequency Control:	RS-232, RS422 AND RS-485 (Selectable in unit)
Alarm:	Open Collector or TTL
EMI (typical):	-90 dBm
Power Requirements:	+5.2 Vdc (min.) +15.0 Vdc (min.)
Size:	6.80" x 4.40" x 0.80"



SPECIFICATIONS

Output Frequency

Tuning range:	6780 - 7880 MHz	
Frequency step size:	100 kHz	
Frequency stability and accuracy (Ext ref):	Same as input	
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-76
	L(1 kHz)	-92
	L(10 kHz)	-98
	L(100 kHz)	-100
	L(1 MHz)	-120
Spurious (max.):	-60 dBc	
Harmonics (typ.):	-20 dBc	
Power out (min.):	+13 dBm	
Output power variation (freq. & temp.):	3 dB	
Load VSWR:	2:1	

Input Frequency

Input reference frequency:	5, 10, 100 MHz or Internal
Input ref. freq. level:	0 dBm ±3dB

Frequency Tuning / Alarm

Frequency control:	Serial RS-232 / RS-422 / RS-485
Acquisition time:	100 msec
Phase-lock indicator (LD):	High = lock
	(Open collector or CMOS / TTL)

DC Power

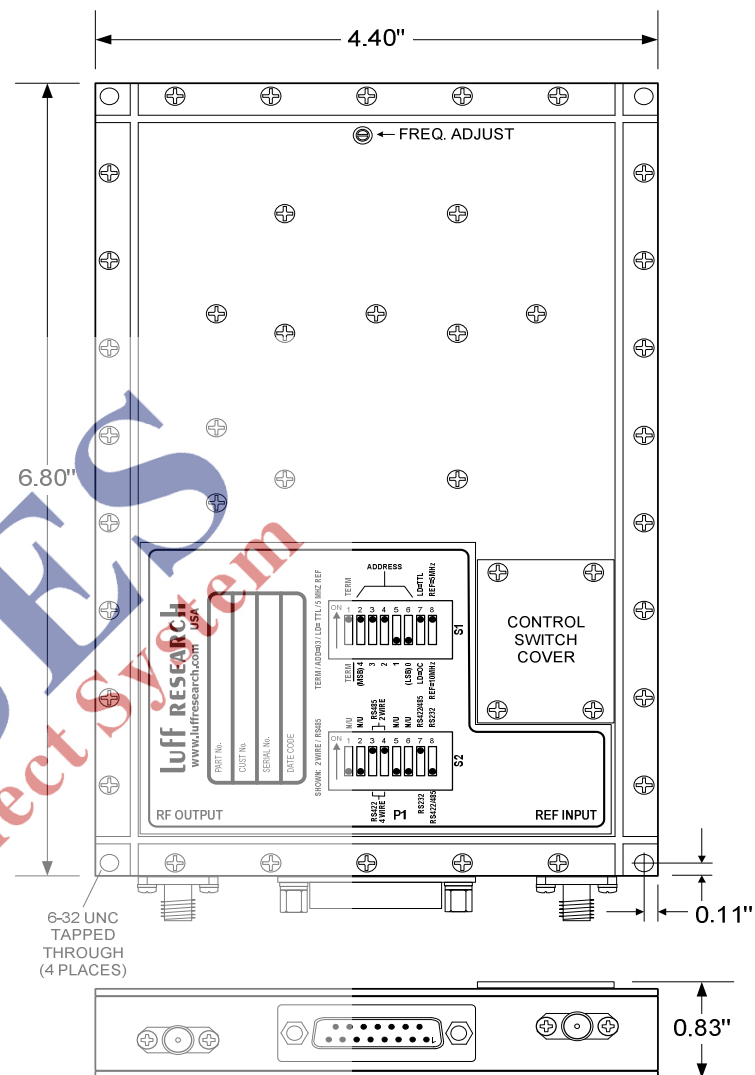
+5.2 Vdc (min) +7.0 Vdc (max)	750 mA
+15.0 Vdc (min) +17.0 Vdc (max)	150 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB15 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz
EMI leakage:	-90 dBc



Notes:

1. This is an EMI gasketed package with a filtered DB15 connector.
2. This unit has the feature that when the input reference is removed, the internal reference is automatically switched in as the reference for the synthesizer.

luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLSE FREQUENCY SYNTHESIZER

Model: TLSE67807880/100K

08/17/11

SPECIFICATIONS

Output Frequency

Tuning range:	12 - 25 GHz	
Frequency step size:	200 kHz	
Frequency stability and accuracy (Ext ref):	Same as input	
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(10 Hz)	-49
	L(100 Hz)	-68
	L(1 kHz)	-84
	L(10 kHz)	-89
	L(100 kHz)	-91
	L(1 MHz)	-112
Spurious (max.):	-60 dBc	
Harmonics & Subharmonics (typ.):	-20 dBc	
Power out (min.):	+10 dBm	
Output power variation (freq. & temp.):	3 dB	
Load VSWR:	1.5:1	

Input Frequency

Input reference frequency:	5, 10, 100 MHz or Internal
Input ref. freq. level:	0 dBm ±3dB

Frequency Tuning / Alarm

Frequency control:	Serial RS-232 / RS-422 / RS-485
Acquisition time:	100 msec
Phase-lock indicator:	High = lock
	(Open collector or CMOS / TTL)

DC Power

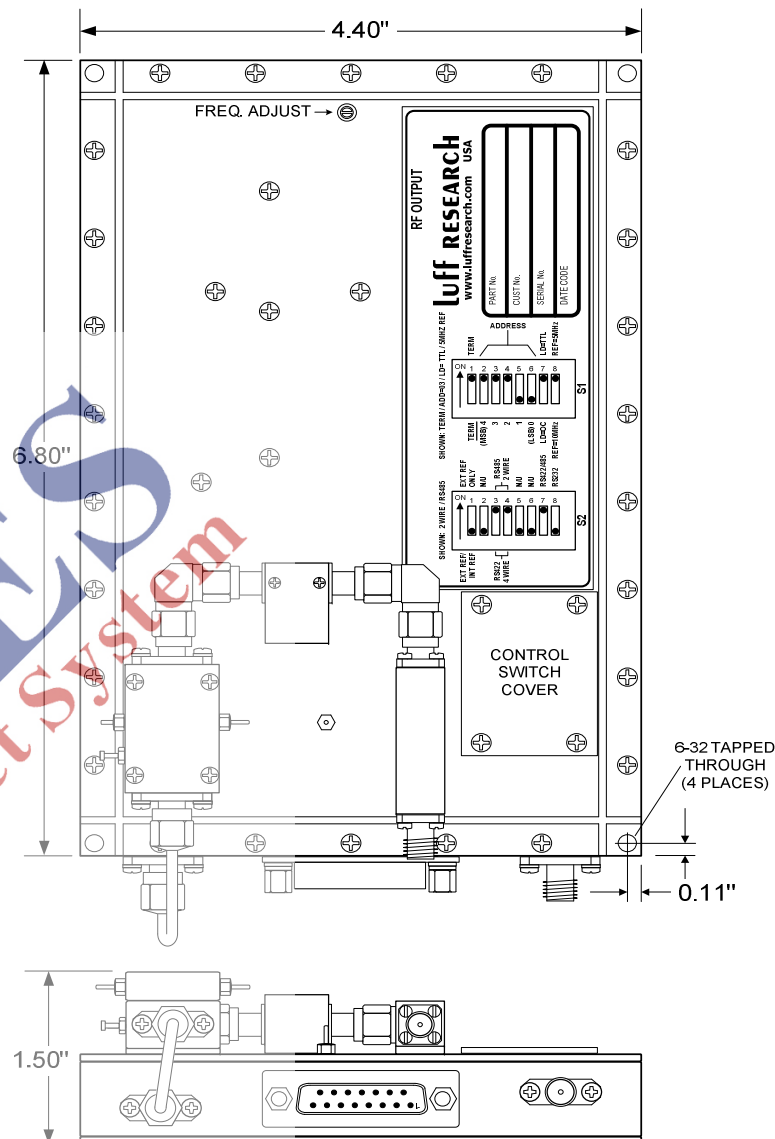
+5.2 Vdc (min) +5.5 Vdc (max)	900 mA
+15.0 Vdc (min) +17.0 Vdc (max)	150 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB15 (M)

Environment

Operating temperature range (surface):	0°C to 60°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz
EMI leakage (typ):	-90 dBc



Notes:

1. This is an EMI gasketed package with a filtered DB15 connector (1000pF per pin).

luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLSE FREQUENCY SYNTHESIZER

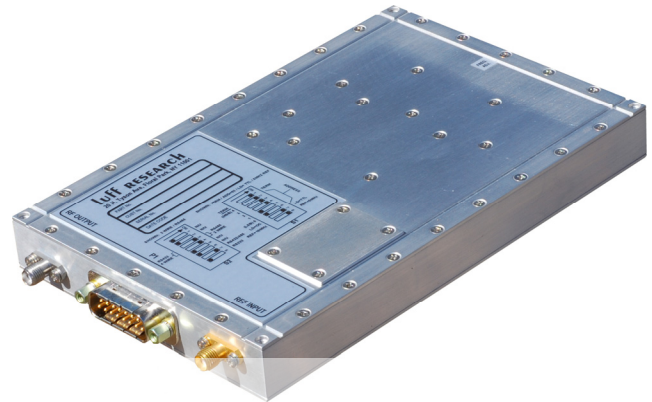
Model: TLSE1200025000/200K

09/19/11

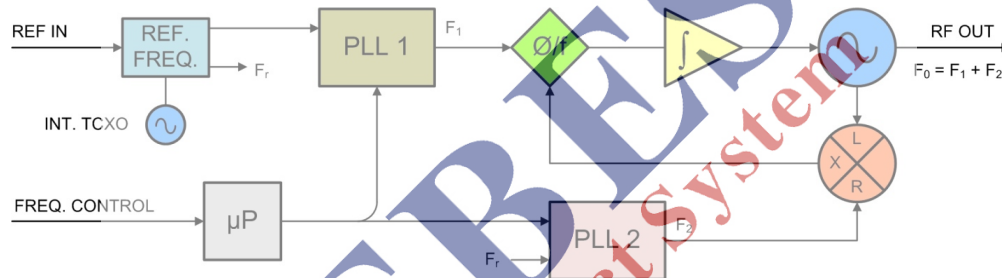
Model TLSD: C, S, X & Ku Band Synthesizer

• Features

- Frequencies up to 25 GHz
- Low phase noise, low microphonics and no phase hits (over temperature)
- Low spurious
- All standard interface options selectable within the unit (RS232, RS422, RS485)
- Multi drop bus configurations
- Reference Frequency: 1, 5, 10, or 20 MHz or Internal ref ($\pm 0.5\text{PPM}$)
- Rugged EMI shielded enclosure



• Block Diagram



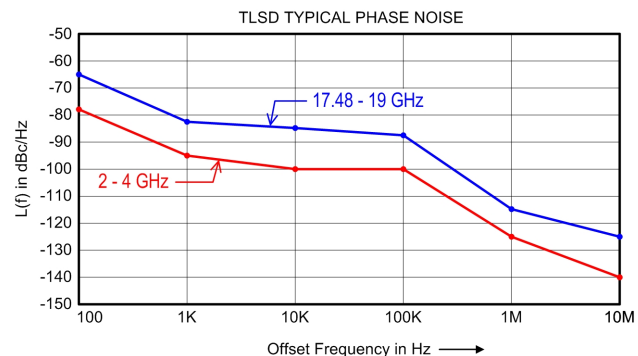
• Description

This frequency synthesizer is designed for sensitive converter applications. The TLSD synthesizers operate from 1 to 25 GHz (in bands) and can cover in excess of octave bandwidths. The spectral quality is excellent, typically better than -90 dBc/Hz at X-band @10 kHz off the carrier.

This design is extremely flexible, providing customer selectable interfaces of RS232, RS422 and RS485. There is also a provision for multiple units on one buss. Operating several units within one draw is possible because the unit offers a multi-drop bus configuration. The units are housed in an EMI enclosure with filtered connectors for minimum radiation and interference. This low cost frequency synthesizer offers high performance in a unit with proven quality and reliability.

• TLSD Key Specifications

Output Frequency:	Up to 12.5 GHz fundamental and to 25 GHz with X2 multiplier
Frequency Steps (typ.):	100 kHz
Spurious:	-60 dBc
Harmonics (typ.):	-20 dBc
Output Power (min.):	+13 dBm
Output Power Variation:	3 dB
External Reference:	10 MHz (typical) 0 dBm ± 3 dB
Or Internal Reference:	± 0.5 PPM (-10°C to $+70^\circ\text{C}$)
Frequency Control:	RS-232, RS422 AND RS-485 (Selectable in unit)
Alarm:	Open Collector or TTL
EMI (typical):	-90 dBm
Power Requirements:	+5.2 Vdc (min.) +15.0 Vdc (min.)
Size:	6.80" x 4.40" x 0.80"



SPECIFICATIONS**Output Frequency**

Tuning range:	2000 - 4000 MHz	
Frequency step size:	100 kHz	
Frequency stability and accuracy (Ext ref):	Same as input	
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-80
	L(1 kHz)	-95
	L(10 kHz)	-100
	L(100 kHz)	-100
	L(1 MHz)	-125
Spurious:	-60 dBc	
Harmonics (typ.):	-20 dBc	
Power out (min.):	13 dBm	
Output power variation (freq. & temp.):	3 dB	
Load VSWR:	2:1	

Input Frequency

Input reference frequency:	5 MHz, 10 MHz or Internal
Input ref. freq. level:	0 dBm ± 3 dB

Frequency Tuning / Alarm

Frequency control:	Serial RS-232 / RS-422 / RS-485
Acquisition time:	100 msec
Phase-lock indicator:	High = lock
	(Open collector or CMOS / TTL)

DC Power

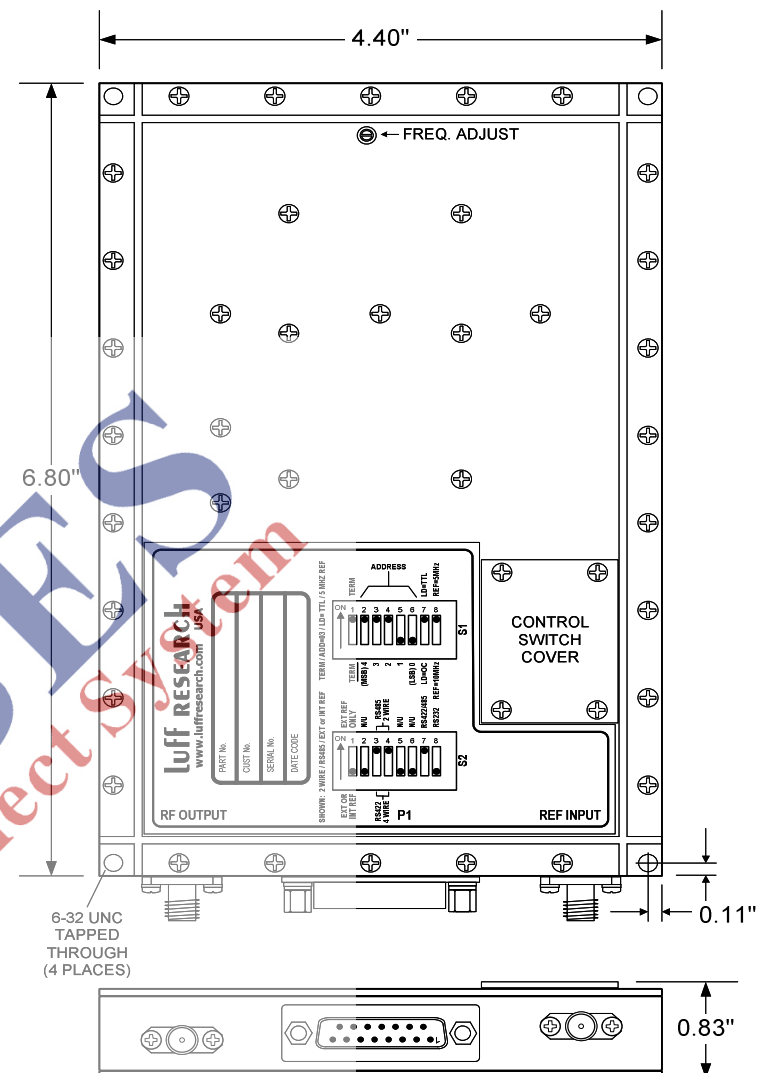
+5.2VDC (min) +7.0VDC (max)	800 mA
+15.0VDC (min) +17.0VDC (max)	150 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB15 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz
EMI leakage:	-90 dBc

**Notes:**

1. This is an EMI gasketed package with a filtered DB15 connector.
2. Use Rev.M (04-16-09) of the Interface Definition for this unit.

luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLSD FREQUENCY SYNTHESIZER

Model: TLSD20004000/100K

11/08/07

SPECIFICATIONS

Output Frequency

Tuning range:	6780 - 7880 MHz	
Frequency step size:	100 kHz	
Frequency stability and accuracy (Ext ref):	Same as input	
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-75
	L(1 kHz)	-85
	L(10 kHz)	-85
	L(100 kHz)	-93
	L(1 MHz)	-117
Spurious:	-60 dBc	
Harmonics (typ.):	-20 dBc	
Power out (min.):	13 dBm	
Output power variation (freq. & temp.):	3 dB	
Load VSWR:	2:1	

Input Frequency

Input reference frequency:	5 MHz, 10 MHz or Internal
Input ref. freq. level:	0 dBm ± 3 dB

Frequency Tuning / Alarm

Frequency control:	Serial RS-232 / RS-422 / RS-485
Acquisition time:	100 msec
Phase-lock indicator:	High = lock
	(Open collector or CMOS / TTL)

DC Power

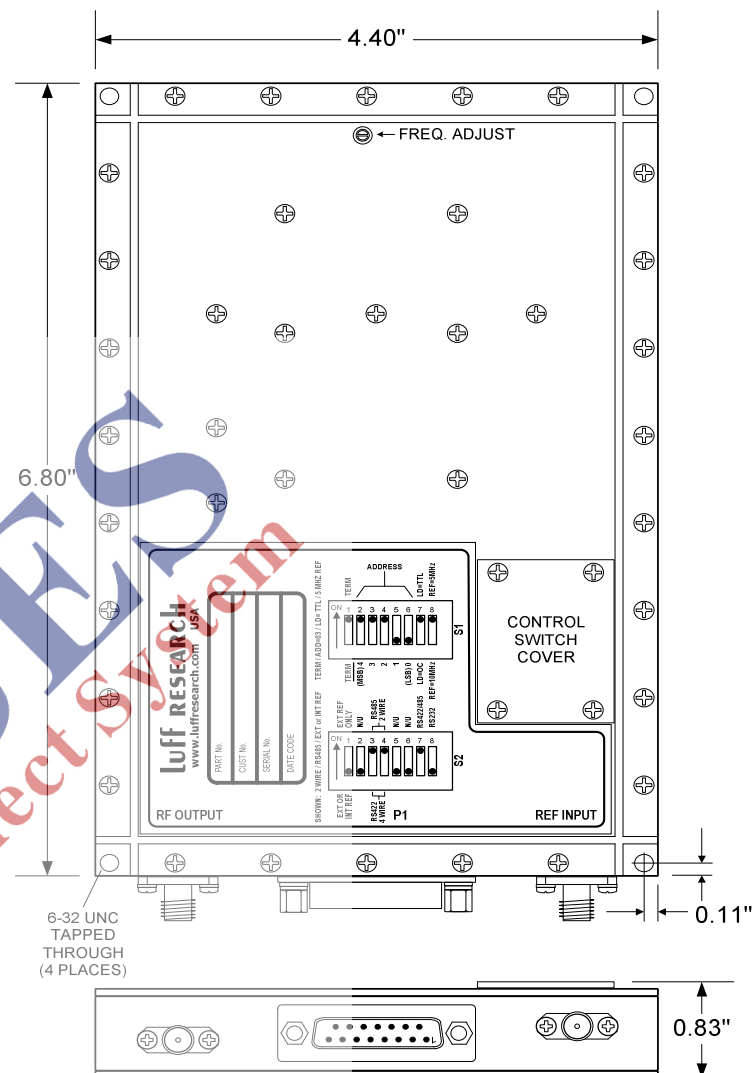
+5.2 Vdc (min) +7.0 Vdc (max)	750 mA
+15.0 Vdc (min) +17.0 Vdc (max)	150 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB15 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz
EMI leakage:	90 dBc



Notes:

1. This is an EMI gasketed package with a filtered DB15 connector.
2. Use Rev.M (04-16-09) of the Interface Definition for this unit.

luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLSD FREQUENCY SYNTHESIZER

Model: TLSD67807880/100K

Rev. F

10/15/09

SPECIFICATIONS**Output Frequency**

Tuning range:	8 - 12.5 GHz	
Frequency step size:	100 kHz	
Frequency stability and accuracy (Ext ref):	Same as input	
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-73
	L(1 kHz)	-83
	L(10 kHz)	-83
	L(100 kHz)	-90
	L(1 MHz)	-115
Spurious (max.):	-60 dBc	
Harmonics (typ.):	-20 dBc	
Power out (min.):	12 dBm	
Output power variation (freq. & temp.):	3 dB	
Load VSWR:	2:1	

Input Frequency

Input reference frequency:	5 MHz, 10 MHz or Internal
Input ref. freq. level:	0 dBm ± 3 dB

Frequency Tuning / Alarm

Frequency control:	Serial RS-232 / RS-422 / RS-485
Acquisition time:	100 msec
Phase-lock indicator:	High = lock
	(Open collector or CMOS / TTL)

DC Power

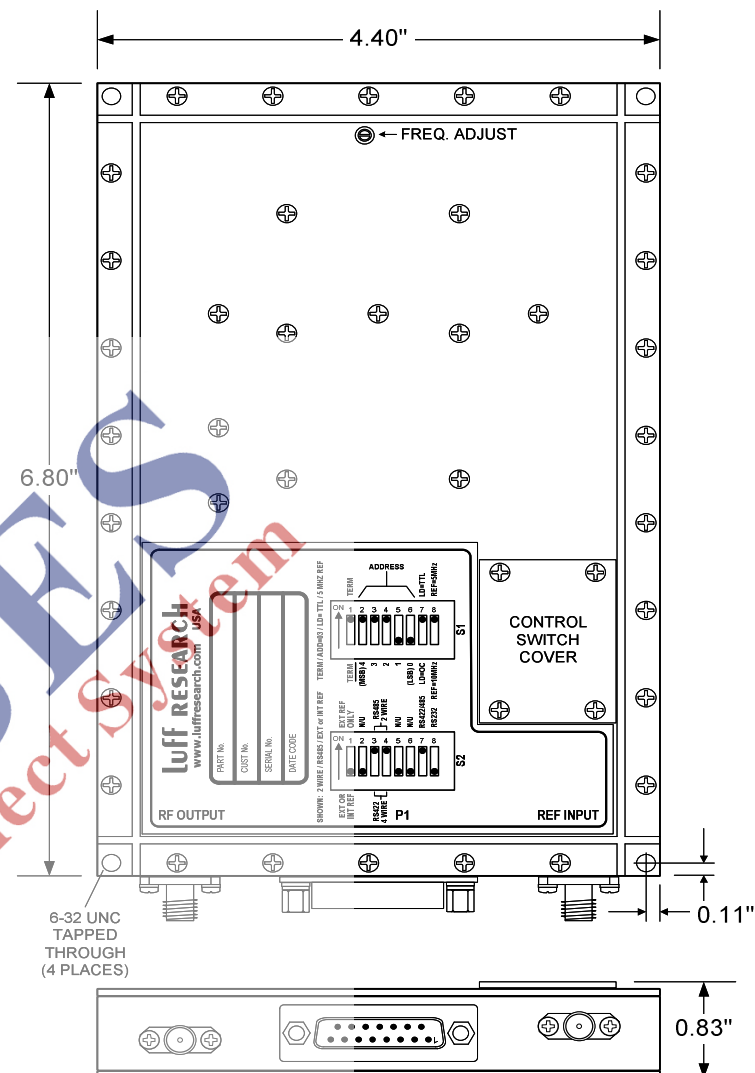
+5.2VDC (min) +7.0VDC (max)	800 mA
+15.0VDC (min) +17.0VDC (max)	150 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB15 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz
EMI leakage:	-90 dBc

**Notes:**

1. This is an EMI gasketed package with a filtered DB15 connector.
2. Use Rev.M (04-16-09) of the Interface Definition for this unit.

luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLSD FREQUENCY SYNTHESIZER

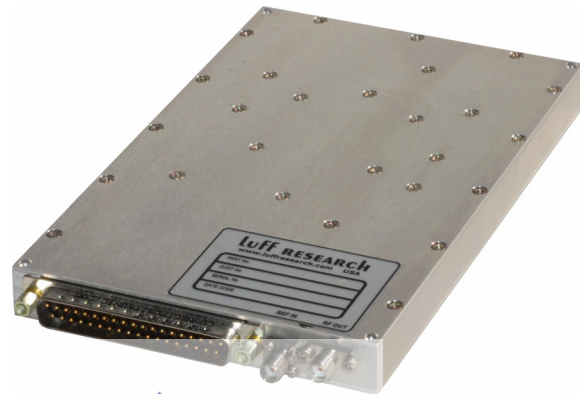
Model: TLSD800012500/100K

09/01/11

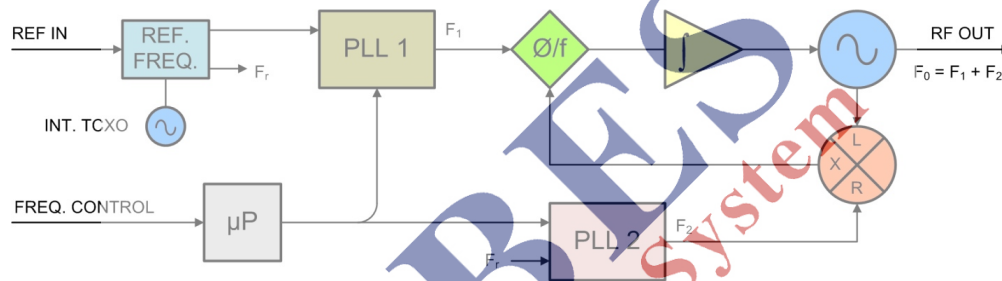
Model TLS: Triple Loop Configuration

• Features

- Frequencies up to 25 GHz
- 100 kHz step resolution (typical)
- Excellent phase noise
- Excellent spectral purity
- Parallel or serial RS485 frequency control
- Internal or external frequency reference
- Small size
- Low cost



• Block Diagram



• Description

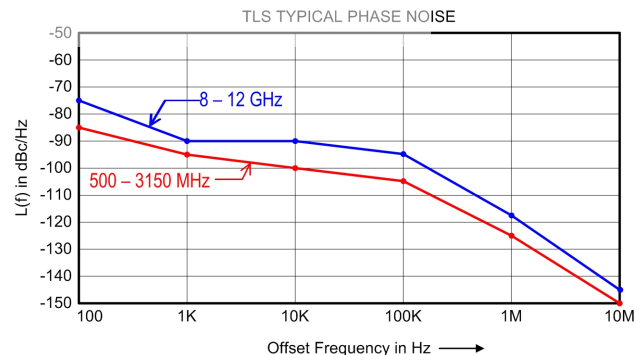
The TLS is an advanced frequency synthesizer design using a unique triple loop architecture in a miniature low profile package that offers either a serial RS485 or parallel frequency control.

This unit is ideal for applications requiring more demanding phase noise, spectral purity and resolution requirements than are offered by a single phase-locked loop frequency synthesizer configuration.

These units are easily customized to specific requirements and offer a great performance to cost factor.

• TLS Key Specifications

Output Frequency:	up to 12.5 GHz fundamental and to 25 GHz with X2 multiplier
Frequency Steps (typ.):	100 kHz
Spurious:	-60 dBc
Harmonics (typ.):	-20 dBc
Output Power (min.):	+13 dBm
Output Power Variation:	3 dB
External Reference:	10 MHz (typical) 0 dBm \pm 3 dB
Or Internal Reference:	\pm 0.5 PPM (-10°C to +70°C)
Frequency Control:	Parallel BCD Coded CMOS Input or Serial RS485
Alarm:	Open Collector or TTL
Power Requirements:	+5.2 Vdc (min.) +15.0 Vdc (min.)
Size:	6.50" x 4.10" x 0.60"



SPECIFICATIONS**Output Frequency**

Tuning range:	500 - 3150 MHz
Frequency step size:	100 kHz
Frequency stability and accuracy (Ext ref):	Same as input
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(100 Hz) -80
	L(1 kHz) -95
	L(10 kHz) -100
	L(100 kHz) -100
	L(1 MHz) -130
Spurious:	-60 dBc
Harmonics (typ.):	-20 dBc
Power out (min.):	13 dBm
Output power variation (freq. & temp.):	3 dB
Load VSWR:	2:1

Input Frequency

Input reference frequency:	10 MHz
Input ref. freq. level:	0 dBm ±3dB

Frequency Tuning / Alarm

Frequency control: <i>(please specify required interface)</i>	Parallel BCD Coded CMOS Input or Serial RS-485
Acquisition time:	100 msec
Phase-lock indicator:	High = lock (open collector)

DC Power

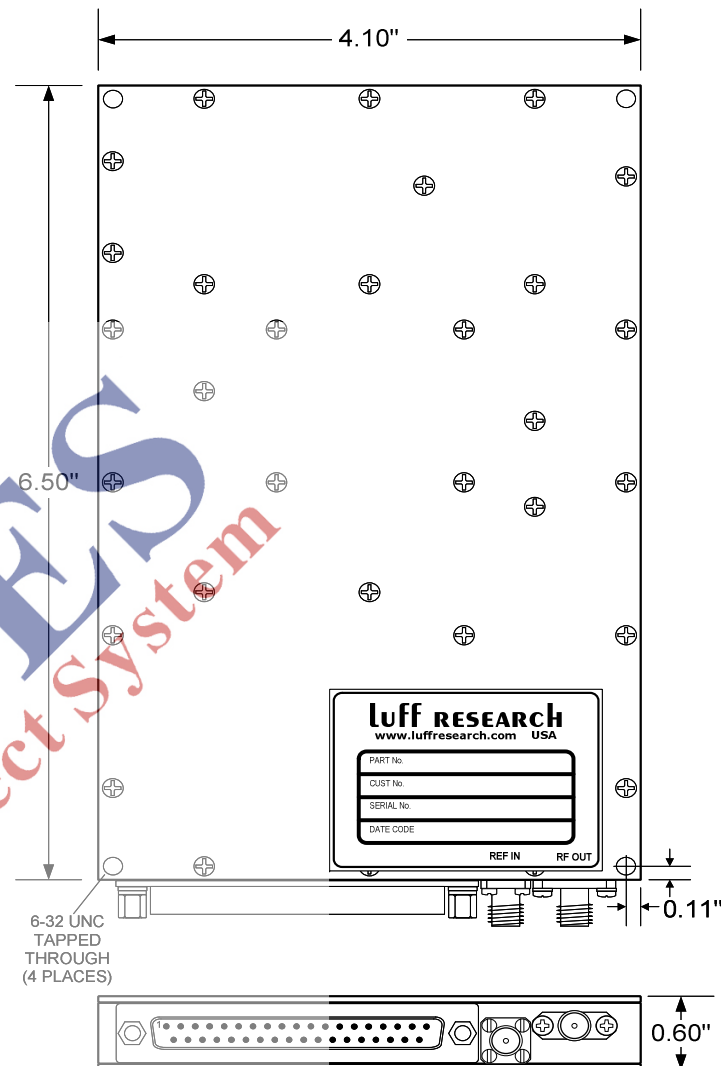
+5.2 Vdc (min) +7.0 Vdc (max)	600 mA
+15.0 Vdc (min) +17.0 Vdc (max)	200 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB37 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**Notes:**

1. These unit are available with an internal TCXO. (Model No. TLS05003150/100K/INT)
2. Units come standard with a serial interface. For Parallel units order Model No. TLS05003150/100K/P

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLS FREQUENCY SYNTHESIZER

Model: TLS05003150/100K

06/02/08

SPECIFICATIONS**Output Frequency**

Tuning range:	8 - 12 GHz	
Frequency step size:	100 kHz	
Frequency stability and accuracy (Ext ref):	Same as input	
Frequency stability and accuracy (Int ref):	±0.5 PPM (over temp range)	
Aging (After 2 months):	±1 PPM max per year @ 25°C	
Adjustability (typ.):	10 years	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-75
	L(1 kHz)	-85
	L(10 kHz)	-85
	L(100 kHz)	-90
	L(1 MHz)	-115
Spurious:		-60 dBc
Harmonics (typ.):		-20 dBc
Power out (min.):		13 dBm
Output power variation (freq. & temp.):		3 dB
Load VSWR:		2:1

Input Frequency

Input reference frequency:	10 MHz
Input ref. freq. level:	0 dBm ±3dB

Frequency Tuning / Alarm

Frequency control: (please specify required interface)	Parallel BCD Coded CMOS Input or Serial RS-485
Acquisition time:	100 msec
Phase-lock indicator:	High = lock (open collector)

DC Power

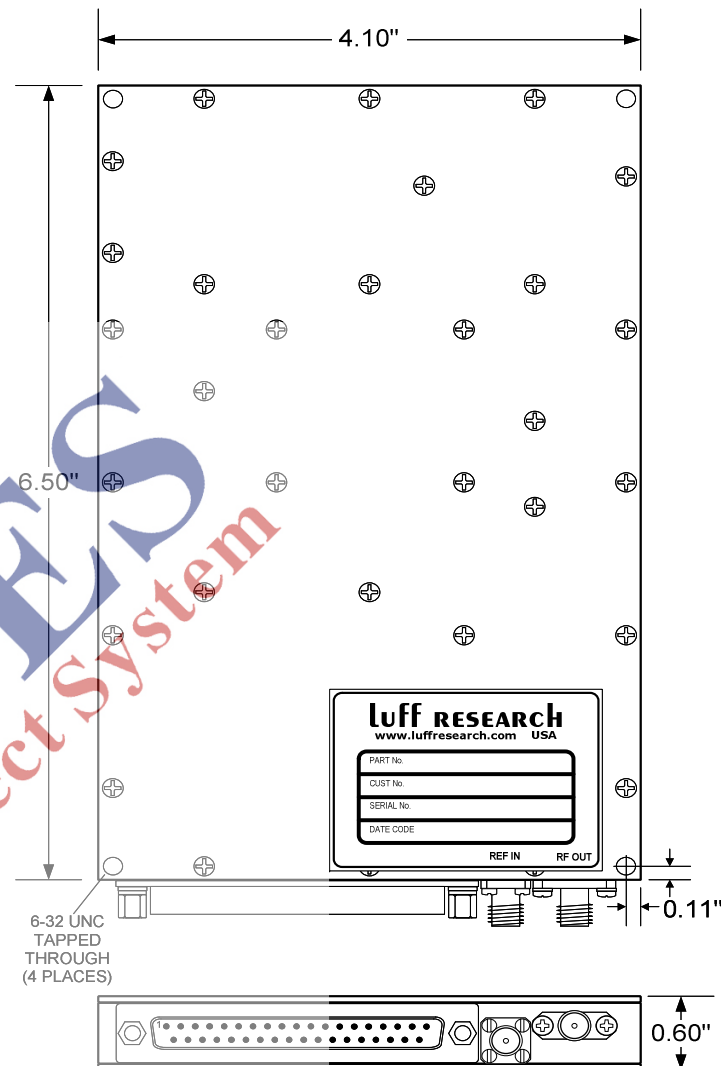
+5.2 Vdc (min) +7.0 Vdc (max)	850 mA
+15.0 Vdc (min) +17.0 Vdc (max)	150 mA

Mechanical

RF connectors:	SMA (F)
Digital & DC connection:	DB37 (M)

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**Notes:**

1. These unit are available with an internal TCXO. (Model No. TLS800012000/100K/INT)
2. Units come standard with a serial interface. For Parallel units order Model No. TLS800012000/100K/P

luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

TLS FREQUENCY SYNTHESIZER

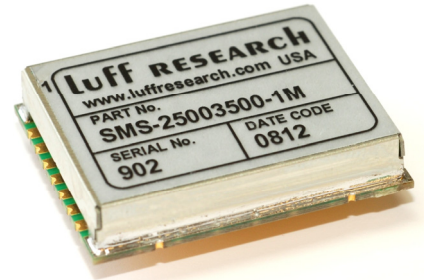
Model: TLS800012000/100K

06/01/08

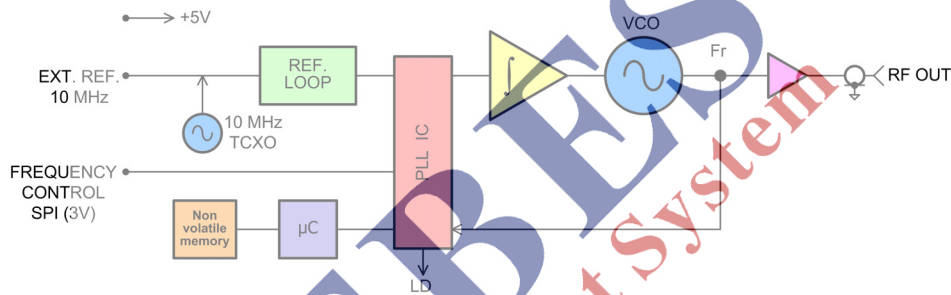
Model SMS: Surface Mount Synthesizers and Fixed Frequency Sources

● Features

- Frequencies synthesizers up to 8 GHz (up to octave bands)
- Fixed frequency sources up to 8 GHz (no programming needed)
- Reference frequency: external 10 MHz or internal TCXO
- Single 5V operation
- Low phase noise & spurious
- Customized configurations



● Block Diagram



● Description

The new SMS surface mount frequency sources are aimed at integrated RF and microwave applications. The SMS design is a single PLL design that can be configured to be either programmable to step across a frequency range or as a fixed frequency source requiring no programming.

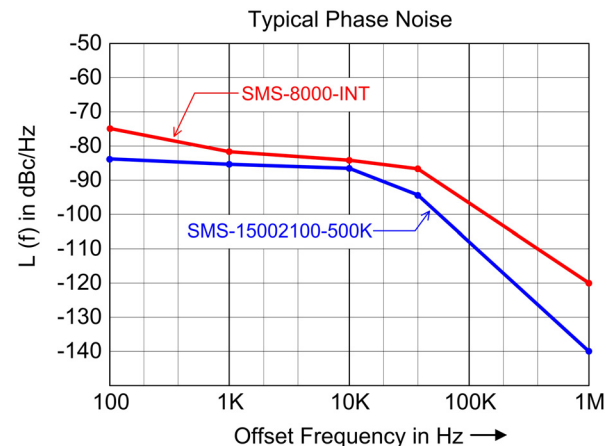
These units are very user friendly. They operate on either an external 10 MHz reference or on a high performance internal TCXO. In addition these units operate on only one single +5V supply.

The phase noise and spurious performance is excellent and with the output being buffered and filtered these units are a great addition to any system requiring a miniature frequency source.

The design is robust and in quantity is configured for reflow applications.

● SMS Key Specifications

Output Frequency:	up to 8 GHz
Frequency Bandwidth:	up to an octave
Frequency Steps (typ.):	1 MHz
Spurious (max.):	-60 dBc
Harmonics (max.):	-20 dBc
Output Power (typ.):	+13 dBm
External Reference:	10 MHz (typical) 0 dBm ± 3 dB
or Internal Reference:	± 0.5 PPM (-10°C to +70°C)
Frequency control	
Synthesizer:	SPI (3V)
Fixed freq. source:	Not required
Switching Speed (typ.):	1 msec.
Alarm:	CMOS (3V)
Power Requirements:	+5.0 Vdc @ 200 mA
Size:	1.25" x 1.00" x 0.25"



● **SMS Ordering Information**

1. Frequency synthesizer defined by a part number structured as the follows:

SMSxxxxyyy-zzz

xxxx = start frequency in MHz

yyy = end frequency in MHz

zzz = 10 for 10 MHz external input ref. freq.

or

zzz = INT for internal ref. freq.

2. Fixed frequency source defined by a part number structured as the follows:

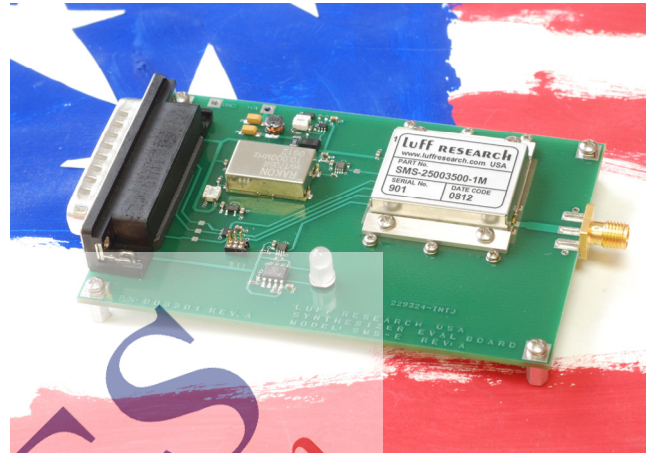
SMSxxxx-zzz

xxxx = output frequency in MHz

zzz = 10 for 10 MHz external input ref. freq.

or

zzz = INT for internal ref. freq.



● **Model SMS-E Evaluation Board**

The evaluation board comes with the desired SMS module mechanically attached so that it can be easily removed after it has been evaluated or tested. This evaluation board is intended to be used as a test fixture for the SMS modules.

For frequency control, the evaluation board has a SPI (5V) input to control the SMS synthesizer module. The SMS fixed frequency sources do not need programming.

For test purposes the evaluation board can be driven from the parallel printer port of a PC or a USB port. For the USB interface a USB to parallel convert module is required. This converter module is available from Analog Devices (p/n: EVAL-ADF4XXXZ-USB) and can be ordered from Digi-Key or Avnet Express. We can also supply this converter as an integral part of the evaluation board.

To order, please specify the evaluation board needed and the desired SMS module required.

For SPI or Parallel printer port input – P/N: SMS-E and SMSxxxxyyy-zzz or

For USB input – P/N: SMS-E-USB and SMSxxxxyyy-zzz.

SPECIFICATIONS

Output Frequency

Tuning range:	1500 - 2100 MHz	
Frequency step size:	500 kHz	
Freq. stability and accuracy (Ext. Ref):	Same as Input	
Phase noise in dBc/Hz (typ.):	L(100 Hz)	-73
	L(1 kHz)	-83
	L(10 kHz)	-88
	L(100 kHz)	-105
	L(1 MHz)	-130
Spurious (max.):	-60 dBc	
Harmonics (typ.):	-20 dBc	
Power out (min.):	+10 dBm	
Power variation (freq. & temp.) (max.):	2 dB	
VSWR:	2:1	

Input Frequency

Input reference frequency:	10 MHz
Input level:	+3 dBm \pm 3 dB

Frequency Tuning / Alarm

Frequency control:	SPI (3V)
Acquisition time (typ.):	1 msec
Phase-lock indicator:	High = lock (CMOS 3V)

DC Power

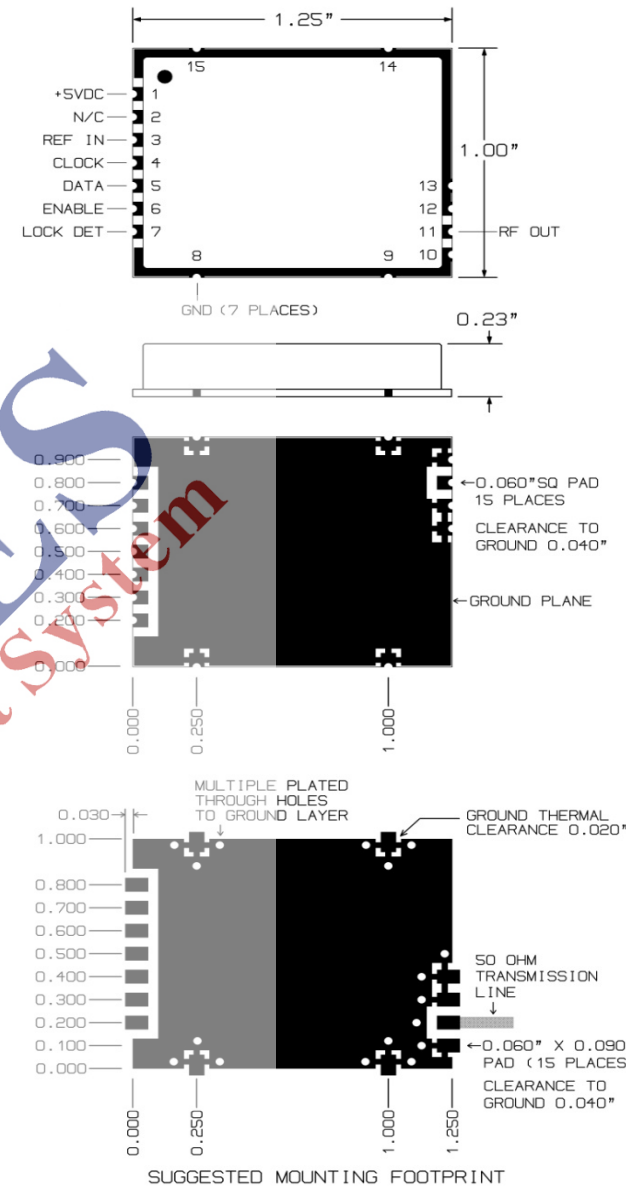
+5.0 Vdc (min.) to +5.25 Vdc (max.)	200 mA (max.)
-------------------------------------	---------------

Mechanical

RF connector:	SMD
Digital & DC connection:	SMD

Environment

Operating temperature range (surface):	0°C to 60°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz



luff research, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

SURFACE MOUNT FREQUENCY SYNTHESIZER

Model: SMS-15002100-500K

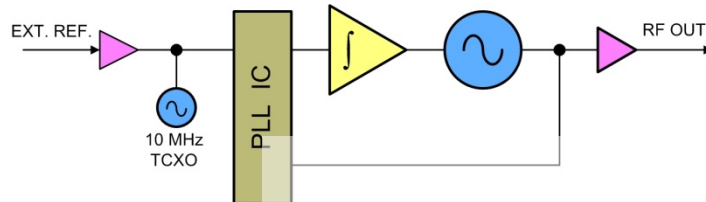
03/01/12

Standard Phase-Locked Oscillator Products (Basic product description)

Luff Research offers phase-locked oscillators (PLO) that span the 10 MHz to 24 GHz frequency range. PLO's are realized in one of the three architectures show below:

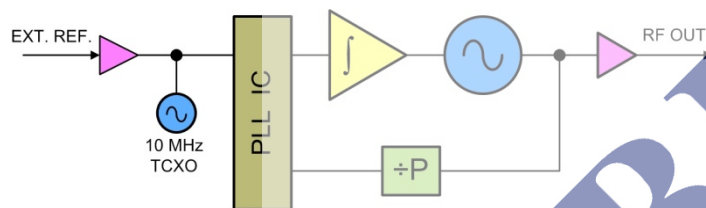
• Phase-locked oscillators with digital Phase-lock IC:

Features



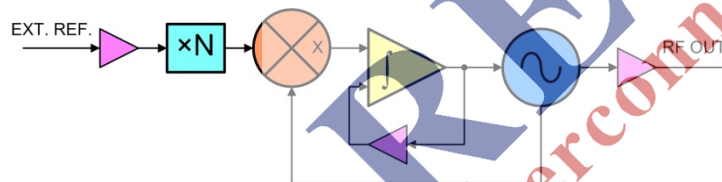
- Straight forward PLL implementation
- Moderate performance

Or



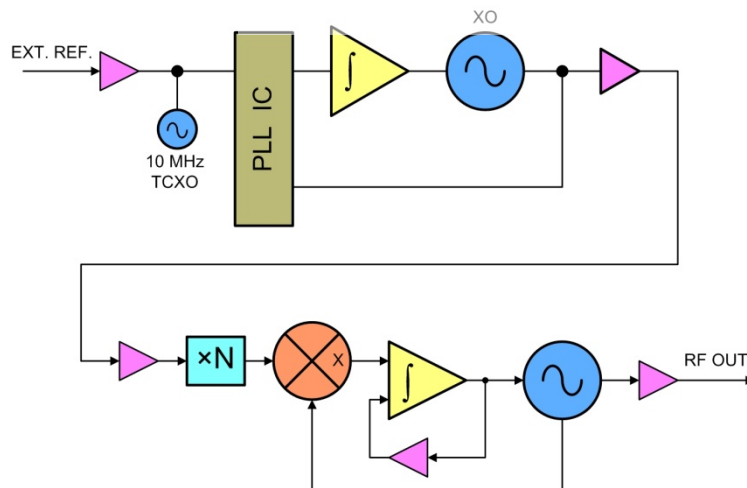
- High frequency capabilities
- Moderate performance

• Phase-locked oscillators with analog sampling phase detector:



- Analog PLL implementation
- Best possible performance
- Fr typically 100 MHz

• Dual loop phase-locked oscillators:



- Analog PLL implementation
- 10 MHz reference or int. reference
- Best possible performance

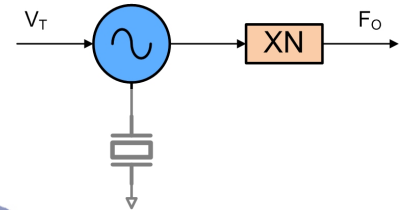
The implementation of a specific PLO depends on its specific set of requirements. These usually are;

- output frequency
- external reference frequency (or internal reference frequency requirements)
- required spectral quality (phase noise, spurious and harmonics)
- power output
- environmental requirements

PLO requirements will determine the selection of the appropriate fundamental oscillator to be used. These fundamental oscillators operate over the frequency ranges shown.

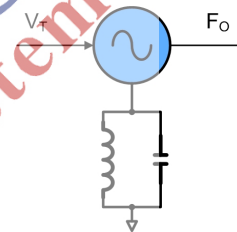
● **PLXO - Crystal Oscillators 10 to 1400 MHz:**

- Very Stable
- The best available phase noise
- Moderate cost



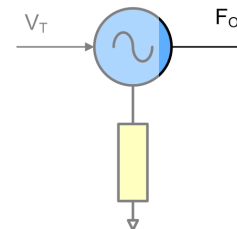
● **PLLCO - LC Oscillators 10 MHz to 750 MHz:**

- Moderate Stability
- Phase noise depends on Q realized
- Very low cost



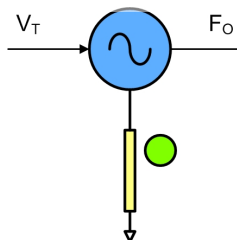
● **PLCRO - Coaxial Resonator Oscillators 0.5 to 7 GHz:**

- Very Stable
- Excellent phase noise
- Moderate cost



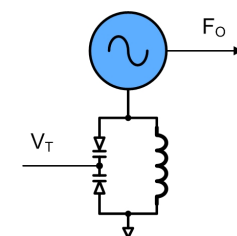
● **PLDRO - Dielectric Resonator Oscillators 6 to 16 GHz:**

- Very stable
- Excellent phase noise
- Moderate cost



● **PLVCO - Voltage Controlled Oscillators 10 MHz to 14 GHz:**

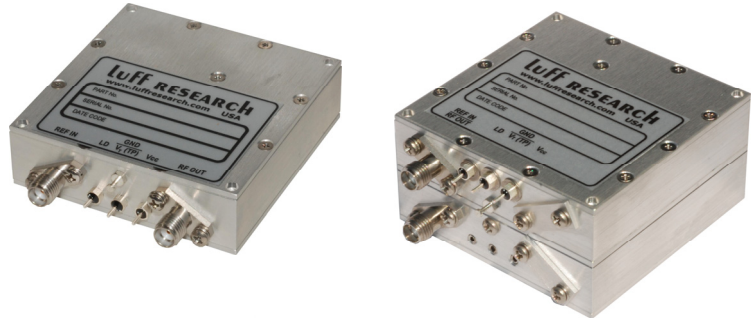
- Moderate Stability
- Moderate phase noise
- Very low cost



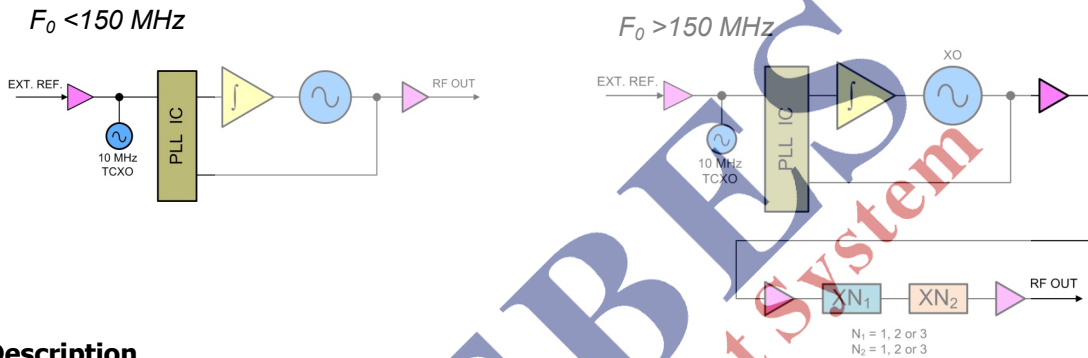
Model PLOX: Phase-Locked Crystal Oscillator (PLXO)

• Features

- Fixed frequency: 10 – 1400 MHz
- Very low phase noise
- Spurious: -80 dBc
- Harmonics: -30 dBc
- Internal TCXO (0.5± PPM) or phase-locked to an external reference
- Low cost



• Block Diagram



• Description

Our model PLOX is a line of very low phase noise, phase-locked crystal oscillators. These units have been designed for a wide variety of demanding applications in communications, radar and instrumentation systems. Fundamental units are supplied for operation below 150 MHz and above 150 MHz units are multiplied to the desired frequency. Multiplied low noise crystal oscillators offer the lowest phase noise frequency sources available.

These PLXO units offer excellent phase noise and harmonic and sub-harmonic performance.

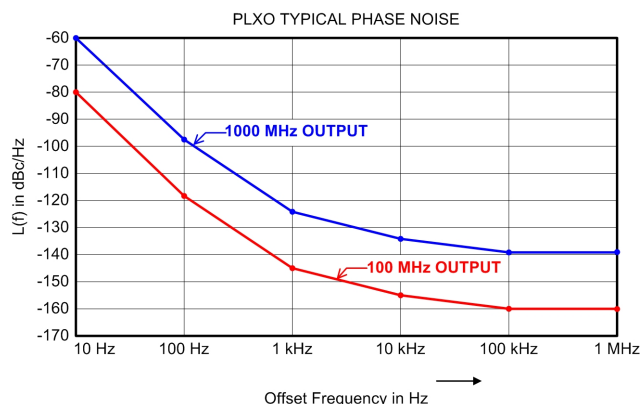
The output frequency from these units can be phase-locked to an input reference frequency or the unit can be configured with an internal TCXO. These units offer many options and can easily be customized to a specific requirement.

These units are available with an internal reference TCXO or OCXO. This unit has the feature that when the input reference is removed, the internal reference is automatically switched in as the reference to the phase-locked loop.

The PLXO is a rugged and economical solution for many demanding communication and instrumentation applications.

• PLXO Key Specifications

Output Frequency:	up to 150 MHz
with multiplier:	up to 1400 MHz
Spurious:	-80 dBc
Harmonics (typ):	-43 dBc
Output Power (min.):	+13 dBm
External Reference:	5 MHz, 10 MHz or Custom
Internal Reference:	±0.5 PPM (0°C to +60°C)
Alarm (LD):	Open Collector or TTL
Power Requirements:	+5.0 Vdc @ 200 mA
with multiplier:	+5.0 Vdc @ 350 mA
Size:	2.25" x 2.25" x 0.62"



SPECIFICATIONS**Output Frequency**

Frequency:	100 MHz
Freq. stability and accuracy (Ext. Ref):	Same as Input
Freq. stability and accuracy (Int. Ref):	< ±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(10 Hz) -85
	L(100 Hz) -115
	L(1 kHz) -145
	L(10 kHz) -155
	L(100 kHz) -160
Spurious (max.):	-80 dBc
Harmonics (typ.):	-40 dBc
Power out (min.):	+13 dBm
Output power variation (freq. & temp.):	2 dB
VSWR:	1.5:1
Load VSWR (max.):	2:1
Phase-lock indicator (LD):	High = lock (open collector)
V _T Tuning Voltage (nom.):	+2.5V

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ± 3 dB

DC Power

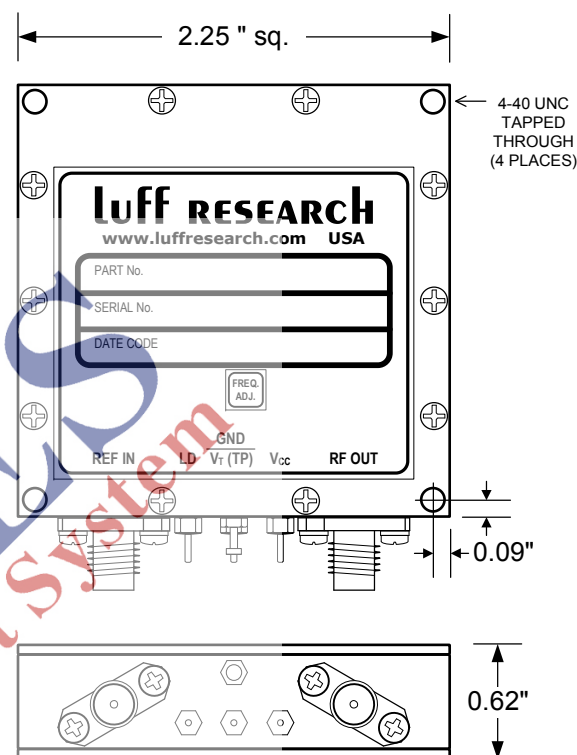
+5.0 Vdc (min.) +6.0 Vdc (max.)	200 mA (max.)
Internal regulator	

Mechanical

RF connector:	SMA (F)
DC connection:	Filtered Feed Throughs

Environment

Operating temperature range (surface):	0°C to 60°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**Notes:**

1. This unit has the feature that when the input reference is removed, the internal reference is automatically switched in as the reference to the phase-locked loop.
2. The frequency adjustment is fragile and needs to be used with care.
(recommended tuning tool size 0.060" x 0.015")

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET**Phase-Locked Crystal Oscillator****Model: PLOX100-10****Rev. A****06/27/11**

SPECIFICATIONS

Output Frequency

Frequency:	660 MHz
Freq. stability and accuracy (Ext. Ref):	Same as Input
Freq. stability and accuracy (Int. Ref):	± 0.5 PPM (over temp range)
Aging (After 2 months):	± 1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(10 Hz) -75
	L(100 Hz) -108
	L(1 kHz) -133
	L(10 kHz) -138
	L(100 kHz) -150
Spurious (max.):	-60 dBc
Harmonics (typ.):	-40 dBc
Power out (min.):	+13 dBm
Output power variation (freq. & temp.):	2 dB
VSWR:	1.5:1
Load VSWR (max.):	2:1
Phase-lock indicator (LD):	High = lock (open collector)
V _T Tuning Voltage (nom.):	+2.5V

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ± 3 dB

DC Power

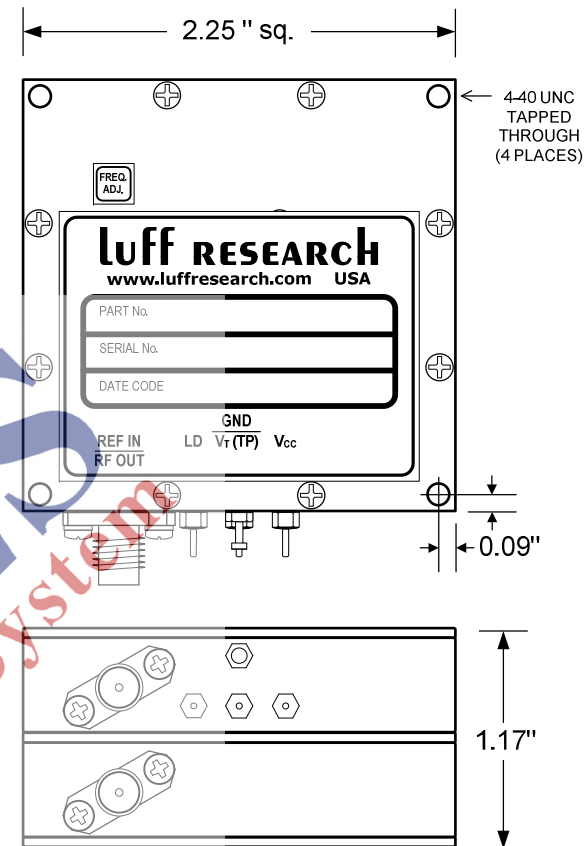
+5.0 Vdc (min.) +6.0 Vdc (max.)	350 mA (max.)
Internal regulator	

Mechanical

RF connectors:	SMA (F)
DC connections:	Filtered Feed Throughs

Environment

Operating temperature range (surface):	0°C to 60°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz



Notes:

1. This unit has the feature that when the input reference is removed, the internal reference is automatically switched in as the reference to the phase-locked loop.
2. The frequency adjustment is fragile and needs to be used with care.
(recommended tuning tool size 0.060" x 0.015")

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Phase-Locked Crystal Oscillator

Model: PLOX660-10

09/12/11

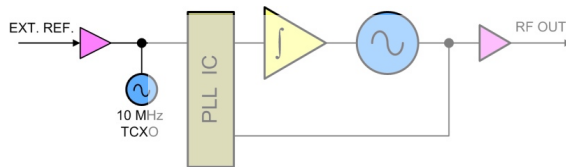
Model PLOD: Phase-Locked High-Q LC Oscillator (PLLCO)

• Features

- Output frequencies up to 750 MHz
- Good phase noise
- Internal or external reference frequency
- Small size (2.25" x 2.25" x 0.62")
- Low cost



• Block Diagram

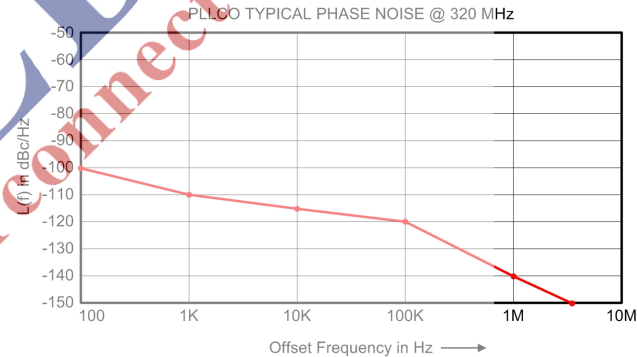


• Description

For requirements where the desired output frequencies are relatively low and the PLCRO can't be implemented practically, we offer our PLLCO line of products. These are phase-locked oscillators that use a high-Q LC resonator or a transmission line resonator. These units are very versatile and can be customized in many ways to fulfill a desired LO requirement for communications or instrumentation. Packaged in our standard housing these units yield excellent performance and value.

• PLXO Key Specifications

Output Frequency:	up to 750 MHz
Spurious:	-70 dBc
Harmonics (typ.):	-40 dBc
Output Power (min.):	+13 dBm
External Reference:	1 to 20 MHz (0 dBm \pm 3 dB)
Internal Reference:	\pm 0.5 PPM (-10°C to +70°C)
Alarm:	Open Collector or TTL
Power Requirements:	+5.0 Vdc @ 250 mA
Size:	2.25" x 2.25" x 0.62"



SPECIFICATIONS**Output Frequency**

Frequency:	320 MHz
Freq. stability and accuracy (Ext. Ref):	Same as Input
Freq. stability and accuracy (Int. Ref):	±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(10 Hz) -90
	L(100 Hz) -100
	L(1 kHz) -110
	L(10 kHz) -115
	L(100 kHz) -120
	L(1 MHz) -140
Spurious (max.):	-60 dBc
Harmonics (typ.):	-40 dBc
Power out (min.):	+13 dBm
Output power variation (freq. & temp.):	2 dB
VSWR:	1.5:1
Load VSWR (max.):	2:1
Phase-lock indicator:	High = lock (open collector)
VT Tuning Voltage (nom.):	+2.5V

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

DC Power

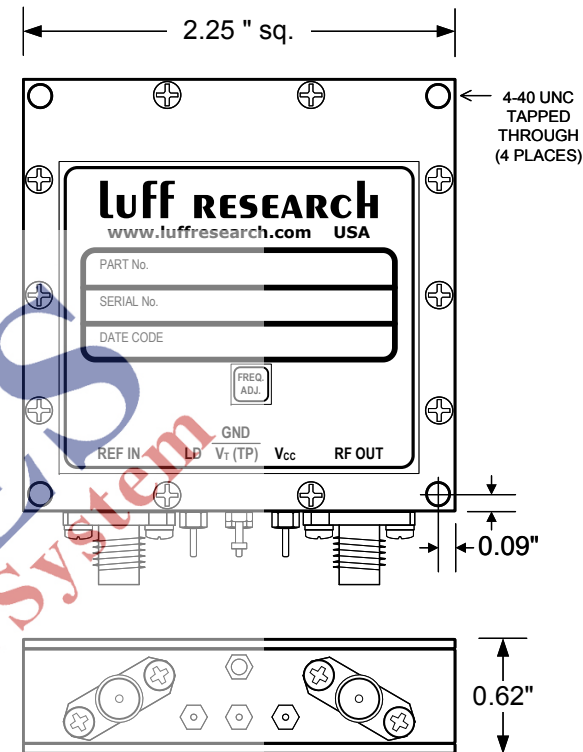
+5.0 Vdc (min.) +6.0 Vdc (max.)	250 mA (max.)
Internal regulator	

Mechanical

RF connector:	2 SMA (F)
DC connection:	3 Filtered Feed Throughs

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. PLODxxxx-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The 'REF IN' connector is not provided on units with internal reference.
4. Model No. PLODxxxx-yy
xxxx = the output frequency in MHz and yy = the reference frequency in MHz.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Phase-Locked Hi-Q LC Oscillator

Model: PLOD0320-10

06/02/08

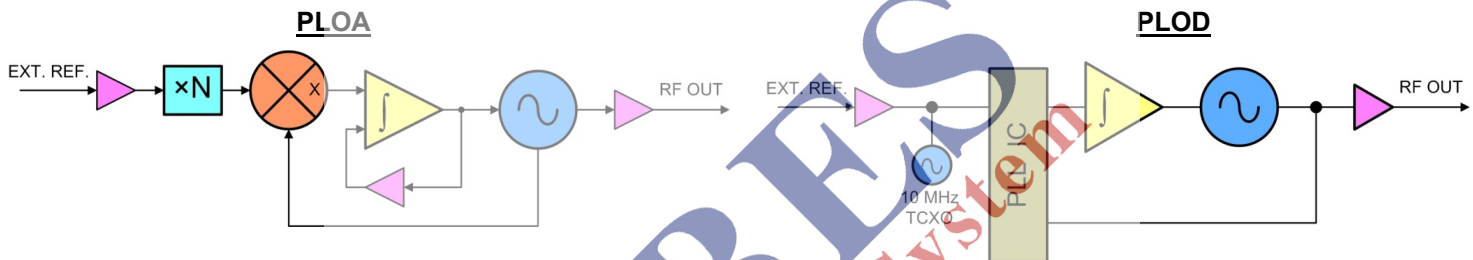
Model PLOA or PLOD: Phase-Locked Coaxial Resonator Oscillator (PLCRO)

• Features

- Output frequencies from 0.5 to 7 GHz
- Very low phase noise
- Full industrial temperature range -45° to +85°C
- Internal or external reference frequency
- Small size (2.25" x 2.25" x 0.62")
- Low cost



• Block Diagram



• Description

This is a line of fixed frequency phase-locked oscillators that use a high-Q ceramic resonator oscillator and either analog sampling phase detector techniques (Luff model PLOA) or digital techniques (Luff model PLOD) to establish phase lock to the reference.

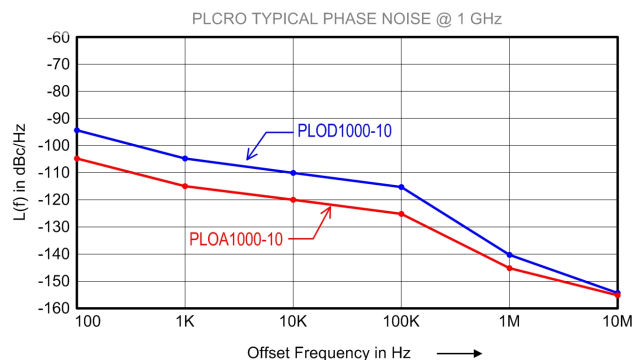
The PLOA configuration is used when the best possible spectral quality is needed. The PLOA configuration has the limitation that the output frequency must be an integer factor of the input frequency.

The PLOD has a much more flexible frequency plan, however, the phase noise of the PLOD is not as low as that of the PLOA.

Both units are housed in a rugged low profile assembly and employ our unique manufacturing techniques that result in units of excellent value.

• PLCRO Key Specifications

Output Frequency:	from 0.5 to 7 GHz
Spurious:	-70 dBc
Harmonics (typ.):	-40 dBc
Output Power (min.):	+13 dBm
External Reference:	1 to 200 MHz (0 dBm \pm 3 dB)
Internal Reference:	\pm 0.5 PPM (-10°C to +70°C)
Alarm:	Open Collector or TTL
Power Requirements:	+5.0 Vdc @ 250 mA
Size:	2.25" x 2.25" x 0.62"



SPECIFICATIONS**Output Frequency**

Frequency:	1000 MHz
Frequency stability and accuracy	
<input checked="" type="checkbox"/> External reference unit	Same as input
<input type="checkbox"/> Internal reference unit	± PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	
	L(100 Hz) -100
	L(1 kHz) -110
	L(10 kHz) -110
	L(100 kHz) -130
	L(1 MHz) -145
	L(10 MHz)
Spurious (max.):	-60 dBc
Harmonics (typ.):	-30 dBc
Power out (min.) @ 25°C:	+13 dBm
Power variation (freq. & temp.) (max.):	2 dB
VSWR (typ.):	1.5:1
Phase-lock indicator (LD), High = lock:	<input checked="" type="checkbox"/> Open collector <input type="checkbox"/> TTL
Tuning Voltage (V _T) (nom.):	2.5 V

Reference Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

DC Power

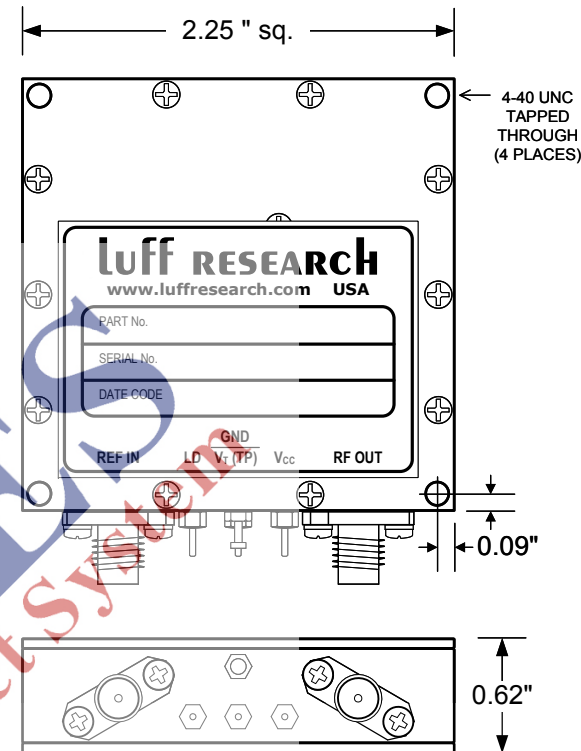
+5.0 Vdc (min.) +6 Vdc (max.)	250 mA
Internal regulator	

Mechanical

RF connectors:	SMA (F)
DC connections:	Filtered Feed Throughs

Environment

Operating temperature range (surface):	0°C to 60°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. PLOA1000-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The 'REF IN' connector is not provided on units with internal reference.
4. Close in phase noise is reference dependent. Output phase noise is typically equal to the reference phase noise - (20logN+3) db.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Analog Phase-Locked Ceramic Resonator Oscillator

Model: PLOA1000-10

05/09/12

SPECIFICATIONS**Output Frequency**

Frequency:	1000 MHz
Freq. stability and accuracy (Ext. Ref):	Same as Input
Freq. stability and accuracy (Int. Ref):	±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(100 Hz) -90
	L(1 kHz) -100
	L(10 kHz) -105
	L(100 kHz) -120
	L(1 MHz) -140
Spurious (max.):	-60 dBc
Harmonics (typ.):	-40 dBc
Power out (min.):	+13 dBm
Output power variation (freq. & temp.):	2 dB
VSWR:	1.5:1
Load VSWR (max.):	2:1
Phase-lock indicator:	High = lock (open collector)
V _T Tuning Voltage (nom.):	+2.5V

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

DC Power

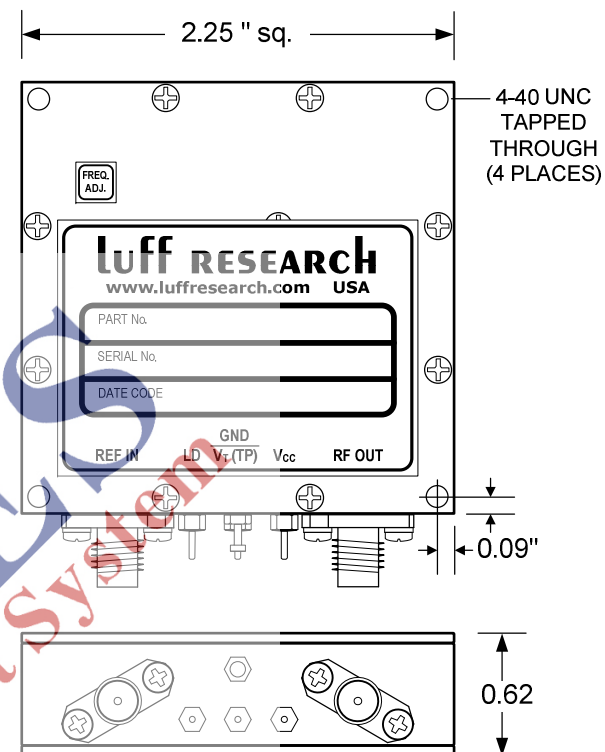
+5.0 Vdc (min.) +6.0 Vdc (nom.)	250 mA (max.)
Internal regulator	

Mechanical

RF connector:	2 SMA (F)
DC connection:	3 Filtered Feed Throughs

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. PLODxxxx-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The 'REF IN' connector is not provided on units with internal reference.
4. Model No. PLODxxxx-yy
xxxx = the output frequency in MHz and yy = the reference frequency in MHz.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Phase-Locked Ceramic Resonator Oscillator

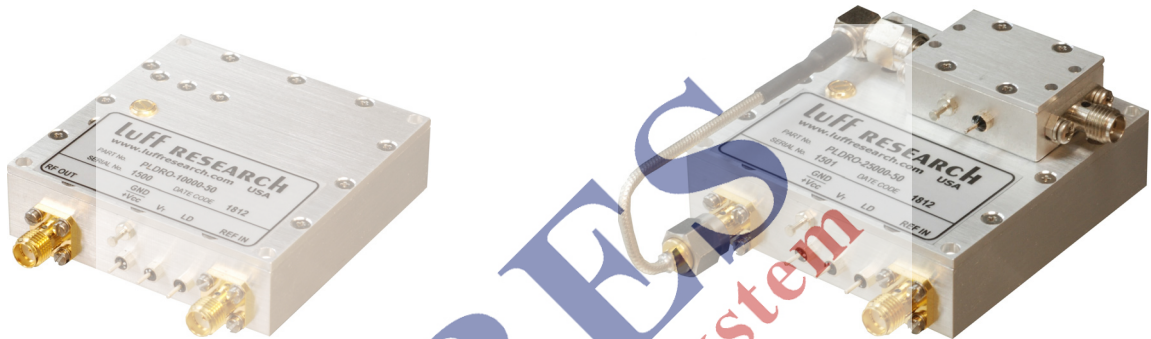
Model: PLOD1000-10

08/25/11

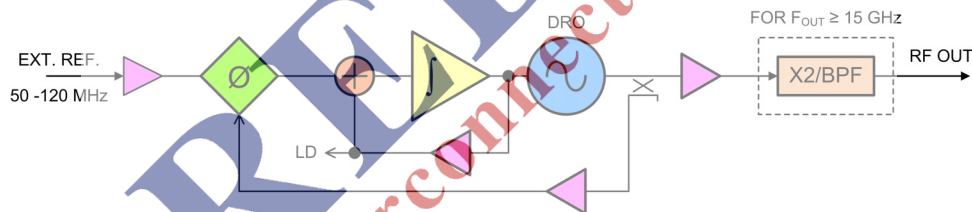
Model PLDRO: Phase-Locked Dielectric Resonator Oscillator

• Features

- Output frequencies from 8 to 25 GHz
- Reference Input - External 50-120 MHz, Internal TCXO or OCXO
- +5.0 Vdc operation, low power design
- Load and drive insensitive
- Best price/performance ratio
- Dual loop 10 MHz reference input option available



• Block Diagram

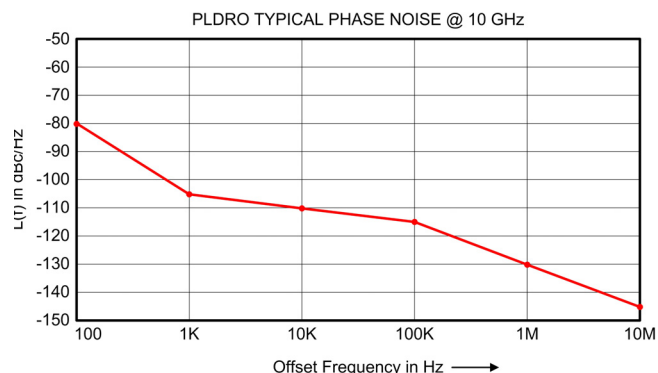


• Description

This new PLDRO design incorporates many highly desirable features in a rugged low cost unit. This unit can be configured to operate with a reference frequency from one of the following sources: (1) external 10 MHz; (2) external input frequency in the 50 - 120 MHz range or (3) internal VCXO, TCXO or OCXO. Another unique feature of this unit is its low power consumption and +5VDC operation. This highly reliable unit is thoroughly burned in and tested.

• PLDRO Key Specifications

Output Frequency:	8 - 25 GHz
Spurious:	-70 dBc
Harmonics (typ):	-30 dBc
Output Power (min.):	+13 dBm
Output Power Variation:	3 dB
External Reference:	10 MHz or 50 - 120 MHz
Internal Reference:	±10 PPM (option A) ±1 PPM (option B) ±0.1 PPM (option C)
Alarm:	Open Collector
Power Requirements:	+5.0 Vdc @ 500 mA
Temperature Range:	-10° to +70°C



SPECIFICATIONS**Output Frequency**

Frequency:	10.0 GHz
Frequency stability and accuracy	
<input type="checkbox"/> External reference unit	Same as input
<input checked="" type="checkbox"/> Internal reference unit	±1 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	
L(100 Hz)	-80
L(1 kHz)	-105
L(10 kHz)	-110
L(100 kHz)	-115
L(1 MHz)	-130
L(10 MHz)	-145
Spurious (max.):	-70 dBc
Harmonics (typ.):	-25 dBc
Power out (min.) @ 25°C:	+13 dBm
Power variation (freq. & temp.) (max.):	2 dB
VSWR (typ.):	1.5:1
Phase-lock indicator (LD), High = lock:	<input checked="" type="checkbox"/> Open collector <input type="checkbox"/> TTL

Reference Frequency

Input reference frequency:	Internal Reference
Input level:	N/A

DC Power

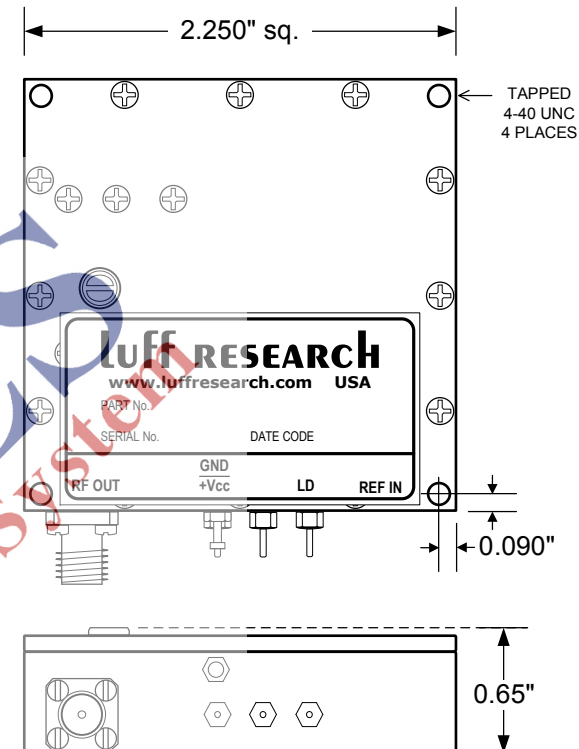
+5.0 Vdc (min.) +6 Vdc (max.)	500 mA
Internal regulator	

Mechanical

RF connectors:	SMA (F)
DC connections:	Filtered Feed Throughs

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz



luff research, inc.		
FLORAL PARK, NY		
PHONE: (516) 358-2880 FAX: (516) 358-2757		
PRODUCT DATA SHEET		
Phase-Locked Dielectric Resonator Oscillator		
Model: PLDRO-10000-INT		05/01/12

SPECIFICATIONS**Output Frequency**

Frequency:	25.0 GHz
Frequency stability and accuracy	
<input checked="" type="checkbox"/> External reference unit	Same as input
<input type="checkbox"/> Internal reference unit	±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	
L(100 Hz)	-75
L(1 kHz)	-100
L(10 kHz)	-100
L(100 kHz)	-110
L(1 MHz)	-125
L(10 MHz)	-135
Spurious (max.):	-70 dBc
Harmonics / Sub-Harmonics (typ.):	-20 / -40 dBc
Power out (min.) @ 25°C:	+13 dBm
Power variation (freq. & temp.) (max.):	2 dB
VSWR (typ.):	1.5:1
Phase-lock indicator (LD), High = lock:	<input checked="" type="checkbox"/> Open collector <input type="checkbox"/> TTL

Reference Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

DC Power

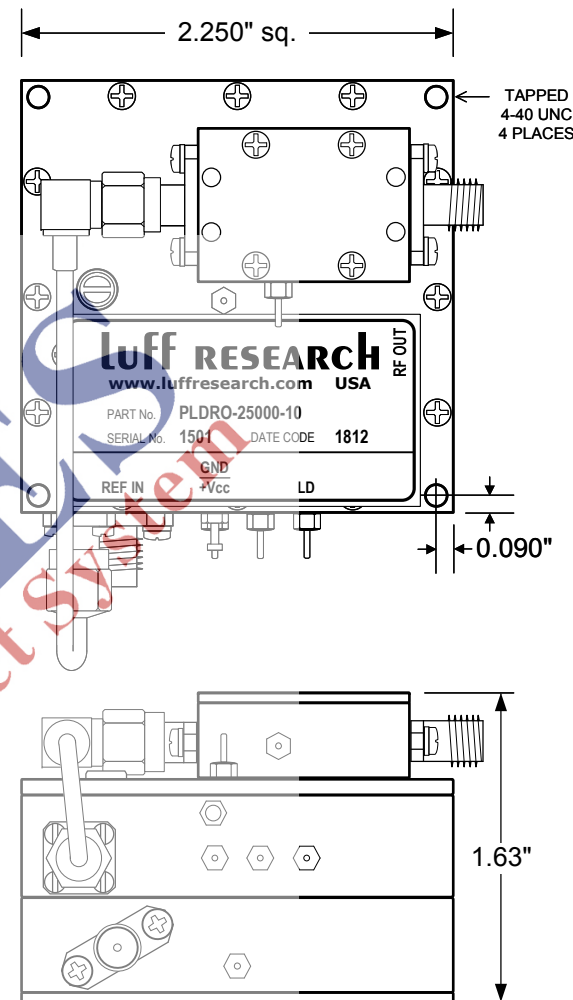
+5.0 Vdc (min.) +6 Vdc (max.)	750 mA
Internal regulator	

Mechanical

RF connectors:	SMA (F)
DC connections:	Filtered Feed Throughs

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**Note:**

1. This unit has the feature that when the input reference is removed, the internal reference is automatically switched in as the reference to the phase-locked loop.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Phase-Locked Dielectric Resonator Oscillator

Model: PLDRO-25000-10

05/01/12

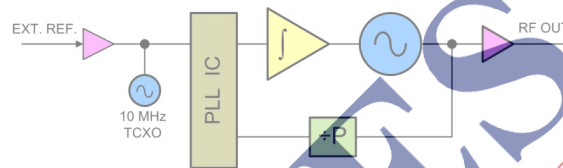
Model PLOD: Phase-Locked Voltage Controlled Oscillator (PLVCO)

• Features

- Output frequencies from 10 MHz to 14 GHz
- Low phase noise & spurious
- Harmonics (typ.) -30 dBc
- Internal (± 0.5 PPM) or external reference frequency
- Small size (2.25" x 2.25" x 0.62")
- Lowest cost X-Band PLO



• Block Diagram

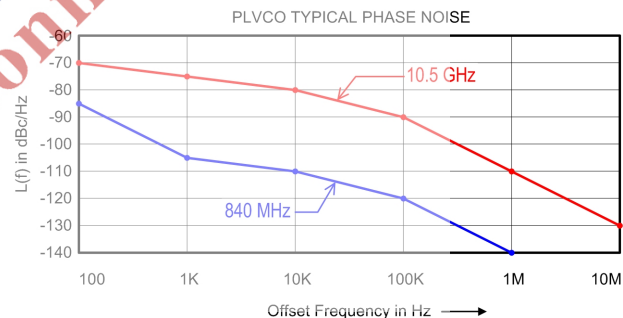


• Description

The model PLVCO is a single PLL design that locks a voltage controlled oscillator (VCO) to either an external or internal reference. Due to the availability of VCO's at a low cost this is a very simple way to realize a desired frequency. The performance is suitable for many applications. The unit is the lowest cost PLO architecture we have available.

• PLXO Key Specifications

Output Frequency:	10 MHz to 14 GHz
Spurious:	-70 dBc
Harmonics (typ.):	-40 dBc
Output Power (min.):	+13 dBm
External Reference:	1 to 20 MHz (0 dBm ± 3 dB)
Internal Reference:	± 0.5 PPM (-10°C to +70°C)
Alarm:	Open Collector or TTL
Power Requirements:	+5.0 Vdc @ 250 mA
Size:	2.25" x 2.25" x 0.62"



SPECIFICATIONS**Output Frequency**

Frequency:	10.5 GHz
Freq. stability and accuracy (Ext. Ref):	Same as Input
Freq. stability and accuracy (Int. Ref):	±0.5 PPM (over temp range)
Aging (After 2 months):	±1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(100 Hz) -70
	L(1 kHz) -75
	L(10 kHz) -80
	L(100 kHz) -90
	L(1 MHz) -110
Spurious:	-60 dBc
Harmonics (typ.):	-25 dBc
Power out (min.):	+13 dBm
Output power variation (freq. & temp.):	2 dB
VSWR:	1.5:1
Load VSWR (max.):	2:1
Phase-lock indicator:	High = lock (open collector)
VT Tuning Voltage (nom.):	+2.5V

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ±3 dB

DC Power

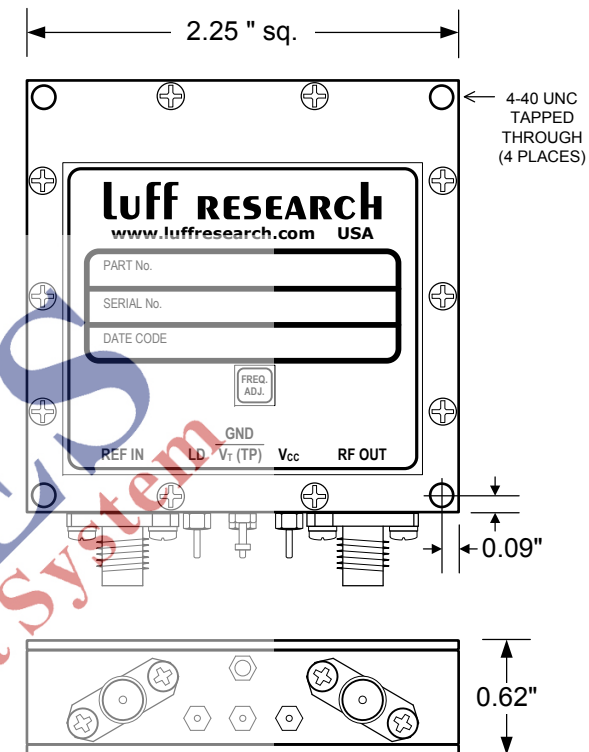
+5.0 Vdc (min.) +6.0 Vdc (max.)	250 mA (max.)
Internal regulator	

Mechanical

RF connector:	2 SMA (F)
DC connection:	3 Filtered Feed Throughs

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. PLODxxxx-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The 'REF IN' connector is not provided on units with internal reference.
4. Model No. PLODxxxx-yy
xxxx = the output frequency in MHz and yy = the reference frequency in MHz.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Phase-Locked Voltage Controlled Oscillator

Model: PLOD10500-INT

09/01/11

SPECIFICATIONS**Output Frequency**

Frequency:	840 MHz
Freq. stability and accuracy (Ext. Ref):	Same as Input
Freq. stability and accuracy (Int. Ref):	± 0.5 PPM (over temp range)
Aging (After 2 months):	± 1 PPM max per year @ 25°C
Adjustability (typ.):	10 years
Phase noise in dBc/Hz (typ.):	L(100 Hz) -80
	L(1 kHz) -105
	L(10 kHz) -110
	L(100 kHz) -120
	L(1 MHz) -140
Spurious:	-60 dBc
Harmonics (typ.):	-25 dBc
Power out (min.):	+13 dBm
Output power variation (freq. & temp.):	2 dB
VSWR:	1.5:1
Load VSWR (max.):	2:1
Phase-lock indicator:	High = lock (open collector)
VT Tuning Voltage (nom.):	+2.5V

Input Frequency

Input reference frequency:	10 MHz
Input level:	0 dBm ± 3 dB

DC Power

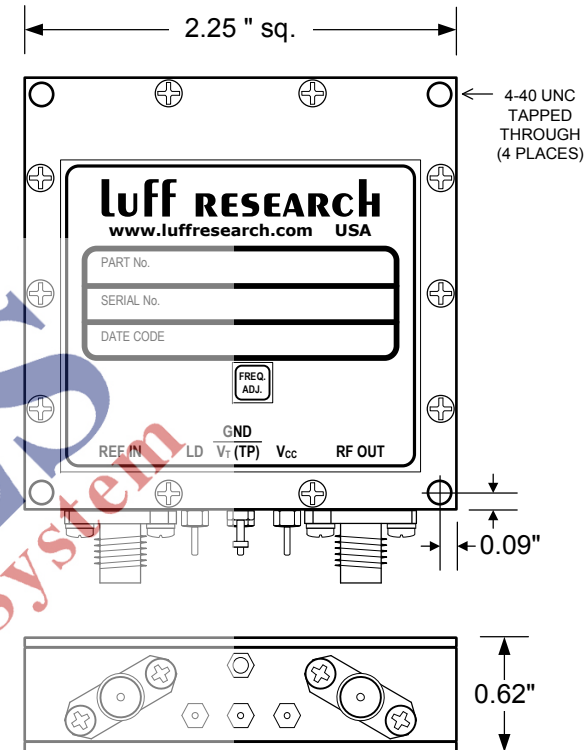
+5.0 Vdc (min.) +6.0 Vdc (max.)	250 mA (max.)
Internal regulator	

Mechanical

RF connector:	2 SMA (F)
DC connection:	3 Filtered Feed Throughs

Environment

Operating temperature range (surface):	-10°C to 70°C
Storage temperature range:	-40°C to 85°C
Relative humidity (non-condensing):	90%RH @ 40°
Shock:	30 G / 10msec
Vibration:	4 G / 20 Hz - 20 kHz

**NOTES:**

1. These unit are available with an internal TCXO. (Model No. PLOD0840-INT)
2. The Frequency adjustment is only applicable on units with internal reference.
3. The 'REF IN' connector is not provided on units with internal reference.
4. Model No. PLODxxxx-yy
xxxx = the output frequency in MHz and yy = the reference frequency in MHz.

luff RESEARCH, inc.

FLORAL PARK, NY

PHONE: (516) 358-2880 FAX: (516) 358-2757

PRODUCT DATA SHEET

Phase-Locked Voltage Controlled Oscillator

Model: PLOD0840-10

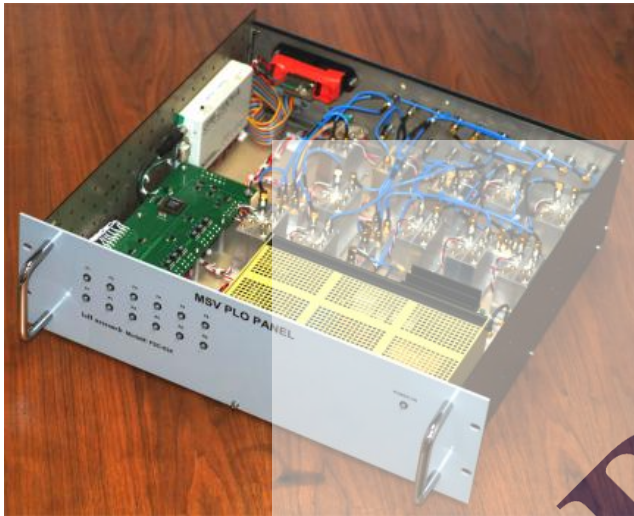
09/30/11

Custom Integrated Multi-Frequency Sources

Luff Research is pleased to present our multi-frequency source capabilities.

We are specialists at integrating multiple frequency sources in one assembly. We have developed sources that are highly integrated for system level applications and multiple sources for drawer level applications as well.

We have a quick turn-around capability for custom designs. Our products offer excellent performance at low cost and have a proven quality and reliability.



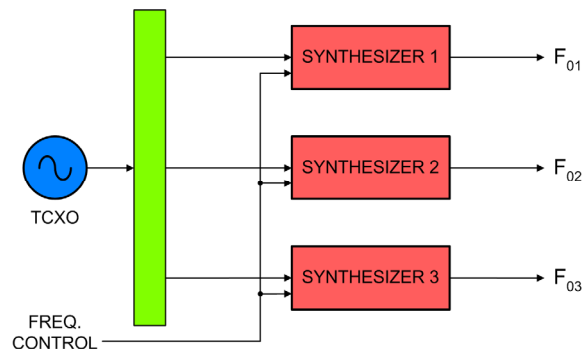
Custom Assemblies

• Features

- 3 independent miniature synthesizers operating in bands up to 12 GHz
- Low phase noise
- Low spurious
- Internal reference TCXO (± 0.5 PPM)
- Small size
- Low cost



• Block Diagram



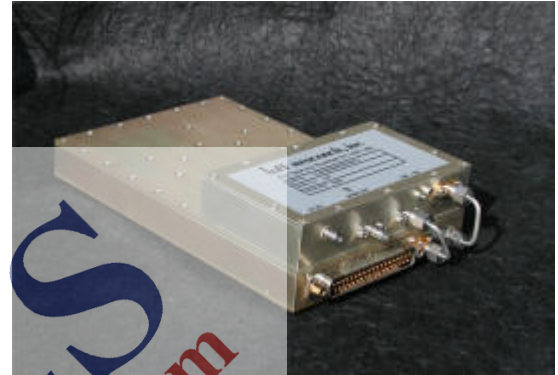
• Description

This small integrated assembly consists of 3 independent (SLSM4) X-Band synthesizers. There is an internal TCXO frequency reference providing $\pm 1\text{PPM}$ accuracy and stability to the output signals. The synthesizer is controlled via a 3 wire bus. This is a rugged miniature EMI packaged assembly that provides diverse functions at a low cost.

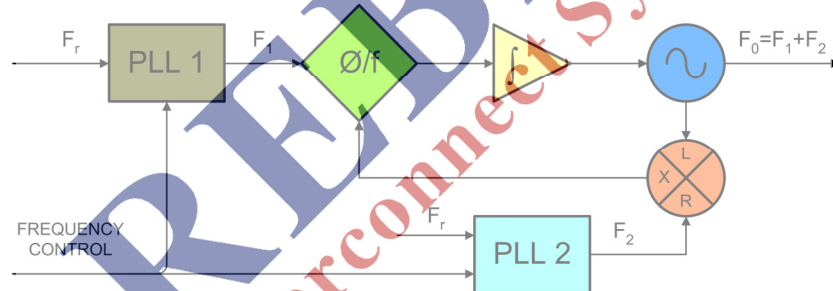
Custom Configurations

• Features:

- Fundamental operation in bands up to 20 GHz
- 100 kHz step resolution (typical)
- Excellent phase noise
- Power output to 23 dBm
- Excellent spectral purity
- Serial frequency control
- Internal (to $\pm 1\text{PPM}$) or external frequency reference
- Small size
- Low cost



• Block Diagram



• Description

Fundamental units are available to 8 GHz. These units have a typical resolution of 100 kHz and offer high spectral quality. In addition, these units are serially programmable via an RS485 bus. The configuration can support up to 20 synthesizers on one bus. The units are EMI isolated and exhibit minimal RF radiation.

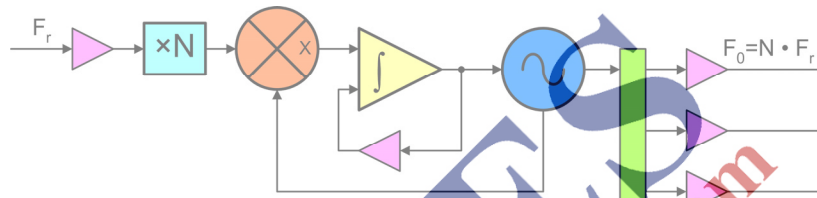
Custom Phase-Locked Ceramic Resonator Oscillator

• Features:

- High performance PLCRO
- Triple output
- Very low phase noise
- Buffered and isolated outputs.
- Encapsulated for humidity.
- Very low microphonics.



• Block Diagram



• Description

This is a unique triple output PLCRO. The outputs are heavily isolated and buffered. The unit uses a new RF encapsulating process making it virtually immune to moisture.

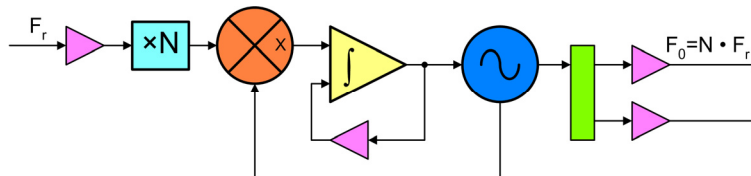
Custom Phase-Locked Dielectric Resonator Oscillator

• Features

- High performance PLDRO
- Very low phase noise
- Full industrial temperature range -45° to +85°C
- Dual isolated output option



• Block Diagram



• Description

This is a unique PLDRO developed at Luff for a specialized system application. This unit uses our unique microwave manufacturing techniques and this unit represents unsurpassed performance and value.