EM750 Narrow-Linewidth DFB Laser Module

Features

- Narrow Linewidth
- Low RIN
- High Power
- Tunable
- Pin-Compatible with EM650
- Custom 50 GHz ITU Grid Wavelengths Available

Applications

- Sensors
- Spectroscopy
- Analog Communications
- LIDAR

General Description

The Gooch and Housego EM750 represents a new generation of OEM narrow-linewidth lasers. It is based on the EM650 family of integrated DFB lasers known for their ultra-low noise, stability, and tunability. The new EM750 combines these traits with a patent pending mechanism that retains the advantages of the EM650, but reduces the linewidth to a typical value of <10 kHz. Laser phase noise is significantly reduced for Fourier frequencies below ~15MHz, providing considerable improvements in performance for many linewidth-sensitive applications. The Relative Intensity Noise (RIN) of the EM750 is below -140dBc/Hz between 10 kHz and 40 GHz, making it suitable for the most demanding analog applications. The EM750 is also widely tunable, making it well suited for high-resolution laser spectroscopy.

Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and operation of the device at these or conditions beyond these is not implied. Exposure to absolute maximum ratings for extended periods of time may affect device reliability.

Parameter	Sym.	Condition	Min	Max	Unit
Storage Temperature	T_{STG}		-40	+85	°C
Operating Case Temperature	T_{OP}		-10	+65	°C
Voltage Supply	V_{cc}		4.6	5.5	V
Current Supply	I_{cc}			3.5	A
Laser Enable Input Voltage	LE		GND-0.3	V_{cc}+0.3	V
Laser Enable Input Current	I_{LE}			2	mA
Power Adjust Input Voltage	V_{pa}	**Warning:** see notes	0	3.4	V
Power Adjust Input Current		**Warning:** see notes	-3.5	+3.5	mA
Temperature Adjust Input Voltage	V_{ta}	**Warning:** see notes	0	5	V
Temperature Adjust Input Current		**Warning:** see notes	-3.5	+3.5	mA
Monitor Detector Output Voltage	V_{mon}			V_{cc}	V
Monitor Detector Output Current	I_{mon}		-15	+15	mA
Optical Output Power[1]	P_{op}		P_{bol}	1.1*P_{bol}	mW

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Optical Characteristics

T_{amb}=25°C baseplate temperature, continuous wave, and beginning of life (bol[2]) unless otherwise specified. All parameters measured after 60s settling time. V_{cc} = LE = 5.0V with PA and TA open.

Parameter	Sym.	Condition	Min	Typ	Max	Unit
Optical Output Power Setpoint	P_{op}		30	35		mW
Optical Frequency Setpoint Accuracy	F_{op}	T_{amb}=25C	-5	±2.5	+5	GHz
Optical Frequency Stability	F_{opt}	P=P_{bol}		15	25	MHz
Linewidth[3]	Δv			10	15	kHz
Relative Intensity Noise[4]	RIN	P=P_{bol}, peak value		-150	-140	dBc/Hz
Side Mode Suppression[5]	SMSR	P=P_{bol}	30			dB
Optical Isolation	ISO	F_{opt} within C-Band	45	55		dB
Polarization Extinction Ratio	PER	w/ high quality patch cable	17			dB
Power Adjust Tuning Coeff. (Power, above threshold) FOR REFERENCE ONLY	dP/dV_{pa}	2.05V DC offset	----	+P_{bol}/2	----	mW/V
Power Adjust Tuning Coeff. (Wavelength, at operating point) FOR REFERENCE ONLY	$d\lambda/dV_{pa}$	2.05V DC offset	----	-100	----	GHz/V
Temperature Tuning Coeff. (Wavelength)	$d\lambda/dV_{ta}$	2.5V DC offset		+58		GHz/V
Guaranteed Mode-Hop Free Tuning Range[6]			F_{opt}-75	F_{opt}	F_{opt}+75	GHz

Electrical Characteristics

All voltages in this document are taken at the device pins, referenced to GND at the device pins, unless otherwise mentioned.

Parameter	Sym.	Condition	Min	Typ	Max	Unit
Voltage Supply	V_{cc}		4.8	5	5.2	V
Current Supply[7]	I_{cc}				3.5	A
Laser Enable High	LE_H		3.5			V
Laser Enable Low	LE_L				1.5	V
Laser Enable Input Impedance	Z_{LE}			5		kΩ
Laser Enable Bandwidth[8]				35		Hz
Power Adjust[9]	V_{PA}	**Warning:** see notes	0		3	V
Power Adjust Input Impedance	Z_{PA}	to 2V Vref		1		kΩ
Power Adjust Bandwidth		-3dB		8		kHz
Temperature Adjust[10]	V_{TA}	**Warning:** see notes	1		4	V
Temp Adjust Input Impedance	Z_{TA}	To 2.5V Vref		1		kΩ
Monitor Detector Output	V_{MON}	at P_{op}	1		3	V

Fiber & Connector Characteristics

Parameter	Sym.	Condition	Min	Typ	Max	Unit
Fiber Type		PM Panda Parallel to slow axis				
Core Diameter				8		µm
Connector Keying		Parallel to slow axis	2.05mm keyway			
Connector Type			FC/APC			

Environmental Characteristics

All temperatures in this document are taken at the device baseplate unless otherwise mentioned.

Parameter	Sym.	Condition	Min	Typ	Max	Unit
Storage Temperature	V_{cc}		-40		+85	°C
Operational Temperature	I_{cc}		-10		+60	°C
Humidity			noncondensing			

Notes

1) Output power should not be driven more than 10% beyond delivered operating point.
2) ”bol” references beginning of life, at as-delivered setpoints. Due to manufacturing tolerances, output power may be significantly above rated power.
3) Linewidth measured using 80 km delay, 10 kHz resolution bandwidth, 250 ms sweeptime averaged over 75 scans
4) RIN peak value determined using a 20pt moving average and a 2000 point sweep.
5) EM750 is screened for SMSR within 25MHz of line center during linewidth testing. Internal DFB is screened for SMSR via wavelength meter.
6) Guaranteed mode-hop free range based on course tuning. Mode-hops in the range of 20Mhz are likely over long periods of time.
7) Supply current limit should never be set below 3A, which could result in an undervoltage condition at startup, resulting in erratic behavior and potential failure.
8) Please note that Laser Enable (LE) input has a slow response and is not intended for modulation of the laser. Modulation should be performed using the PA input.
9) While the PA pin can be pulled to 3V, it should not be used to drive the laser beyond 110% of its BOL as-delivered power setpoint. PA should be sequenced as described in EM4 DS-7047 EM650 Tuning App Note .
10) Temperature adjust (TA) allowable settings are dependent on ambient/heatsink conditions and laser output power. Care should be used when adjusting the PA input as driving it too far can result in thermal runaway of the internal TEC and damage or destruction of the device. TA should be sequenced with respect to the power supply as described in DS-7047 EM650 Tuning App Note and in Warnings section of this document.

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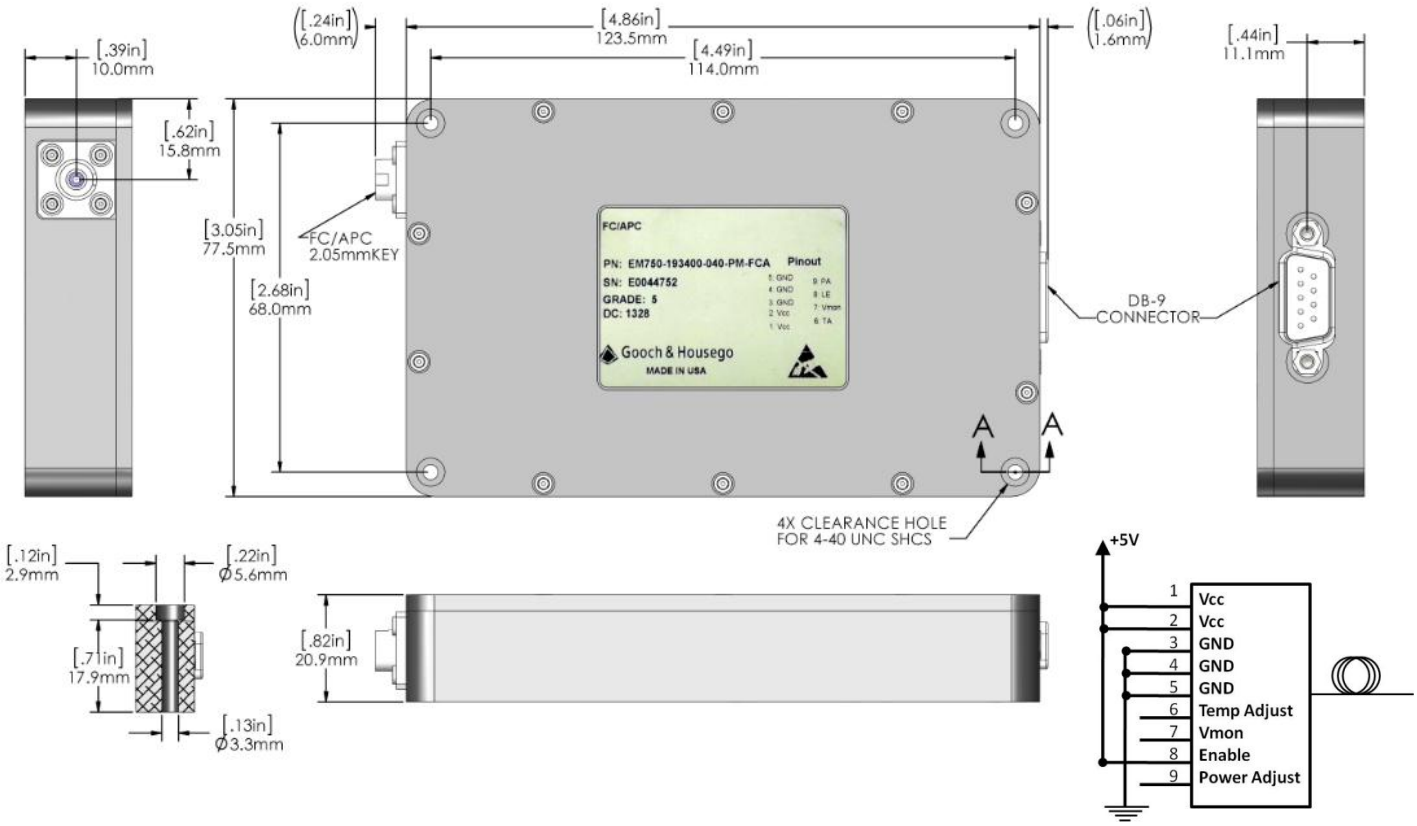
Ordering Information

EM750- FREQUE- POW- FB- CON

Parameter	Option	Description
Connector	FCA	FC/APC
Fiber	PM	PM (Panda) Fiber
Rated Output Power	030	30mW Rated Output
Optical Frequency	FFFFFF	Frequency in GHz leave as XXXXXX for don't care. Standard frequencies range between 192000 and 196000 other frequencies available upon request
Product Family	EM750	Narrow-Linewidth DFB Laser Module

Pinout and Mechanical Drawing



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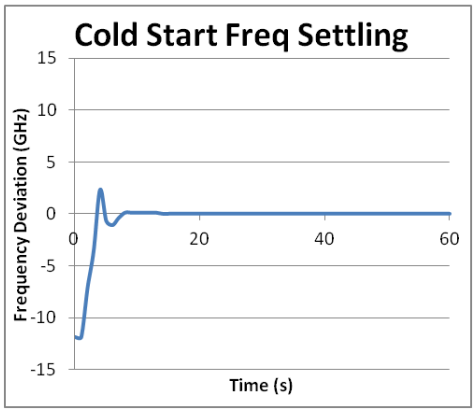
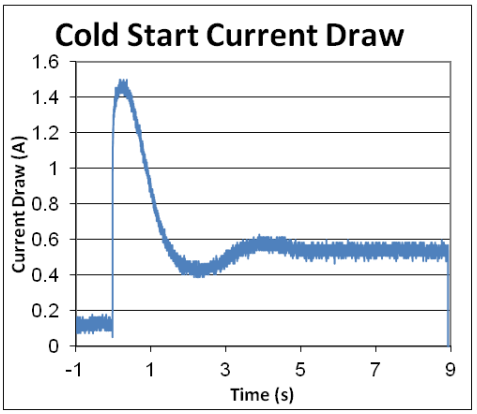
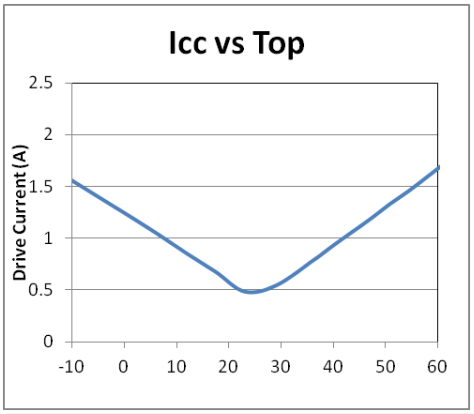
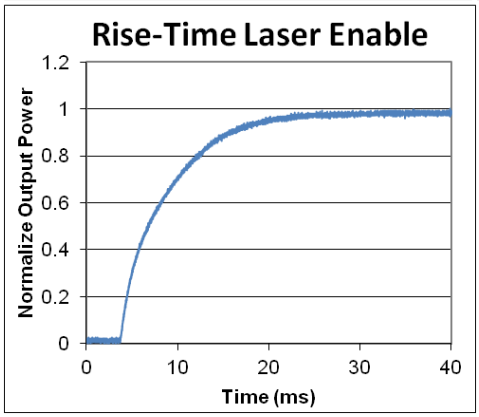
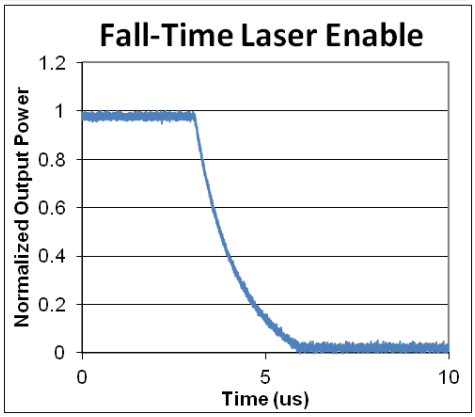
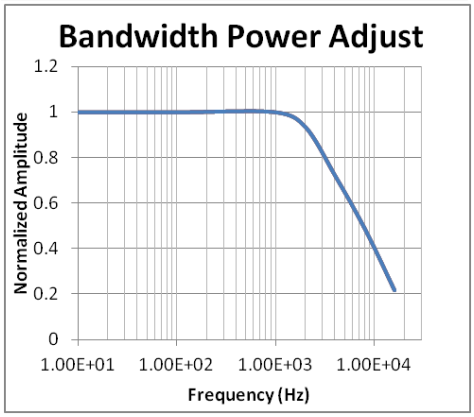


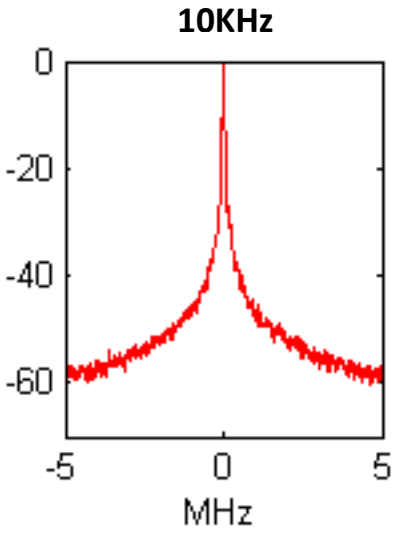




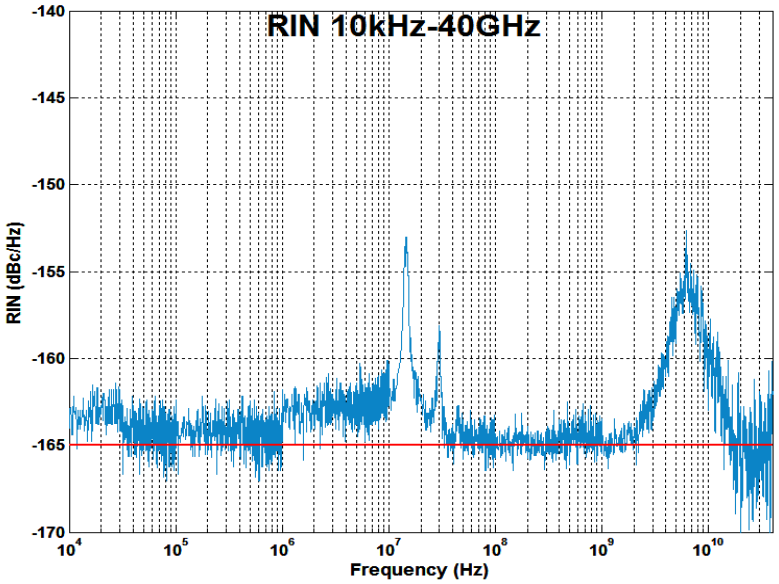








Typical Linewidth



WARNINGS: several of the parameters listed in the specifications above are denoted with a warning. These warnings are covered by the following notes which should be understood before operating the device.

Mounting

The EM750 is conductively cooled through its base and needs to be mechanically clamped or bolted to a customer supplied heatsink using a thermal interface material. EM4 recommends Panasonic PGS series pyrolitic graphite sheets, available in the US from Digi-Key Corporation. Should PGS not be available, a high-quality non-silicone heatsink grease applied per the manufacturer's instructions is an acceptable alternative. Care should be taken to keep the base temperature of the module between -10 and 60°C at all times during operation.

Noise suppression

The EM750 is a no-compromises low-noise integrated laser solution; the temperature controller output is class AB linear, there are no DC/DC converters in the module, the lowest noise components and architectures available are used along with heavy filtering. Nevertheless, power supply ripple and noise should be minimized and the cable shield should be connected to the EM750 connector shield and tied to the appropriate signal at the power supply end of the cable.

Power Adjust (PA)

The EM750 is designed to run in constant current mode with the drive current set for the as-ordered output power to achieve the highest possible performance. However, some applications require fine tuning of the laser drive current to fine-tune frequency and power. The PA input provides this functionality, but its use carries an amount of risk. Use of this input carries the potential to overdrive the laser and/or circuitry with the ability to destroy or drastically reduce the device lifetime. No internal protections on this input are provided, but the user is encouraged to clamp or otherwise limit the voltage and current that may be applied to this input to levels corresponding to the desired operating conditions of the laser module. The addition of a series resistor to this input, which will increase laser current noise and linewidth, is not recommended. The safest method of driving this input is with a tri-state output whose output is current limited when active, maintained at high-impedance until Vcc is established, and whose output returns to high-impedance before VCC is removed. Damage due to overdrive will not be covered under warranty. Use of this input will likely decrease the performance of the EM750 by bypassing its internal ulra-low noise voltage reference.

The PA input must never be shorted directly to Vcc which would cause circuit malfunction or rapidly destroy the DFB laser.

Temperature Adjust (TA)

The EM750 is designed to operate the laser chip at a constant temperature holding the output frequency within 5 GHz of the ordered frequency. However, some applications require coarse tuning of the output frequency via temperature. In these cases, the laser may be tuned using the TA input. Temperature deviations of more than 8 degrees (100 GHz in laser frequency) from the as-ordered setpoint may result in decreased stability and increases the likelihood of the laser experiencing a longitudinal mode-hop. The achievable tuning range will depend on the specific laser chip, the ambient temperature, and the thermal resistance to the ambient. Use of this input carries the inherent potential of overdriving the TEC. The TA input is clamped to Vcc through integrated protection diodes. If Vta is established before Vcc these clamp diodes will conduct. The input current should always be limited to ≤3.5mA to prevent destruction of the clamp diodes. The safest method of driving this input is with a tri-state output whose output is current limited when active, maintained at high-impedance until Vcc is established, and whose output returns to high-impedance before Vcc is removed. The device warranty will not be honored for lasers with overdriven TECs. Use of this input also carries the likelihood of decreased frequency stability as it bypasses the internal ultra-low noise voltage reference.

The TA input must never be shorted directly to Vcc or ground which would cause circuit malfunction or rapidly destroy the DFB laser.

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Grounding

Care must be taken with grounding, cabling, and connections due to the amount of current the module consumes. Make sure that the voltage on pins PA/TA reference ground as close to the EM750 as possible if either input is connected. **DO NOT** connect the cable shield to ground at both ends of the cable to avoid producing a ground loop. **DO NOT** connect the EM750 housing to ground to avoid producing a ground loop. **DO** use large gauge and/or short wire runs to minimize power rail fluctuations due to drive current. If your DC supply has remote sense lines, consider using them to control the voltage as close to the module pins as possible.

Startup Considerations

The EM750 consumes a considerable amount of current in the startup phase and when operating at temperature extremes. A voltage source plus cabling able to deliver the maximum specified current at no less than the minimum voltage is therefore needed. Current limiting below the specified maximum during the startup phase will result in an internally measured drive voltage lower than specified. This condition can result in permanent, non-warrantable damage to the device.

If the user fails to sequence the supplies as described in the Power and Temperature adjust sections of this document and Applications Note DS-7047, the device will immediately suffer non-warrantable damage or destruction.

Applications Information

Be sure to check the EM4 website for the latest applications information for this device. Application note DS-7047 covers general usage of EM4's integrated modules along with information particular to tuning via temperature or chirp. If you plan to tune this device, it is highly recommended that you read this app note.

The component complies with all applicable portions of 21 CFR 1040.10, 21 CFR 1010.2 and 21 CFR 1010.3. Since this is a component, it does not comply with all of the requirements contained in 21 CFR 1040.10 and 21 CFR 1040.11 for complete laser products.

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