Data Sheet | October 10, 2002 | FN7221

Dual Laser Driver Oscillator

The EL6207 is a dual push-pull oscillator used to reduce laser noise. It is optimized for 350MHz operation, allowing reduced concern for harmonic EMI. It uses the standard interface to existing ROM controllers. The frequency and amplitude are each set with a separate resistor connected to ground, for each output. The tiny package and harmonic reduction allow the part to be placed close to a laser with low RF emissions.

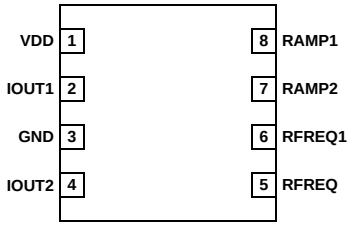
If the voltage at both I_{OUT} pins is less than 1.0V, the chip will be powered down and not oscillate. If the voltage at either I_{OUT} pin is above 1.4V, the chip will be powered up and oscillating. If both I_{OUT} pins are above 1.4V, the chip will also be powered down, and not oscillate.

The current drawn by the oscillator consists of a small utility current, plus the peak oscillator amplitude in the positive cycle, which is routed to the enabled I_{OUT} pin. In the negative cycle the oscillator subtracts peak oscillator amplitude from the laser APC current.

The part operates from a single 5V supply, and is specified for operation from 0°C to +85°C.

Pinout

EL6207
(8-PIN LPP)
TOP VIEW



Features

- Low power dissipation
- User-selectable frequency from 100MHz to 600MHz controlled with a single resistor for each laser
- User-specified amplitude from $10mA_{PK-PK}$ to $100mA_{PK}$ controlled with a single resistor for each output
- Auto turn-off threshold
- Soft edges for reduced EMI
- Small 8-pin LPP package

Applications

- Combi drive using dual laser

Ordering Information

PART NUMBER	PACKAGE	TAPE & REEL	PKG. NO.
EL6207CL	8-Pin LPP	-	MDP0047

CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.
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Absolute Maximum Ratings (T_A = 25°C)

Voltages Applied to:

- V_{DD} . . . . . -0.5V to +6.0V
- I_{OUT} . . . . . -0.5V to +6.0V
- R_{FREQ}, R_{AMP} . . . . . -0.5V to +6.0V

Operating Ambient Temperature Range . . . . . 0°C to +85°C
Maximum Die Temperature . . . . . +150°C
Storage Temperature Range . . . . . -65°C to +150°C
I_{OUT} Current . . . . . $100mA_{PK-PK}$
Power Dissipation (maximum) . . . . . See Curves

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

IMPORTANT NOTE: All parameters having Min/Max specifications are guaranteed. Typical values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: $T_J = T_C = T_A$

Supply & Reference Voltage Characteristics

V_{DD} = +5V, T_A = 25°C, R_L = 10Ω, R_{FREQ} = 5210Ω (FREQ = 360MHz), R_{AMP} = 2540Ω (Amp = $50mA_{P-P}$ measured at 95MHz), V_{OUT} = 2.2V (One channel active)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
PSOR	Power Supply Operating Range		4.5		5.5	V
I_{SO}	Supply Current Disabled	V_{OUT1} and V_{OUT2} < 1.3V		550	750	µA
I_{STYP}	Supply Current Typical Conditions	R_{FREQ} = 5.21kΩ, R_{AMP} = 2.54kΩ, V_{OUT1} or V_{OUT2} >1.4V		17	22	mA
I_{SLO}	Supply Current Low Conditions	R_{FREQ} = 18.2kΩ, R_{AMP} = 13kΩ, V_{OUT1} or V_{OUT2} >1.4V		6		mA
I_{SHI}	Supply Current High Conditions	R_{FREQ} = 3.05kΩ, R_{AMP} = 1.3kΩ, V_{OUT1} or V_{OUT2} >1.4		32		mA
V_{CUTOFF}	Output Cutoff Voltage	Average voltage at cutoff	1.1		1.4	V
V_{FREQ}	Voltage at R_{FREQ} Pin			1.27		V
V_{RAMP}	Voltage on R_{AMP} Pin			1.27		V

Oscillator Characteristics

V_{DD} = +5V, T_A = 25°C, R_L = 10Ω, R_{FREQ} = 5210Ω (FREQ = 360MHz), R_{AMP} = 2540Ω (Amp = $50mA_{P-P}$ measured at 100MHz), V_{OUT} = 2.2V (One channel active)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
F_{OSC}	Frequency Tolerance	Unit-unit frequency variation	310	360	410	MHz
F_{HIGH}	Frequency Range High	R_{FREQ} = 3.0kΩ		600		MHz
F_{LOW}	Frequency Range Low	R_{FREQ} = 18.2kΩ		100		MHz
TC_{OSC}	Frequency Temperature Sensitivity	-40°C to +85°C ambient		50		ppm/°C
$PSRR_{OSC}$	Frequency Change ΔF/F	V_{DD} from 4.5V to 5.5V		1		%

Driver Characteristics

V_{DD} = +5V, T_A = 25°C, R_L = 10Ω, R_{FREQ} = 18.2kΩ (FREQ = 100MHz), R_{AMP} = 2540Ω (Amp = $50mA_{P-P}$ measured at 100MHz), V_{OUT} = 2.2V (One channel active)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
AMP_{HIGH}	Amplitude Range High	R_{AMP} = 1.27kΩ		100		mA_{P-P}
AMP_{LOW}	Amplitude Range Low	R_{AMP} = 12.7kΩ		10		mA_{P-P}
$IOFF_{NOM}$	Average Output Current @ 2.2V	R_{FREQ} = 5210Ω, 10Ω load, V_{OUT} = 2.2V		-4		mA
$IOFF_{HIGH}$	Average Output Current @ 2.8V	R_{FREQ} = 5210Ω, 10Ω load, V_{OUT} = 3.0V		-4.8		mA
$IOFF_{LOW}$	Average Output Current @ 1.8V	R_{FREQ} = 5210Ω, 10Ω load, V_{OUT} = 1.8V		-3.5		mA
I_{OUTP-P}	Output Current Tolerance	Defined as on standard deviation		2		%
Duty Cycle	Output Push Time/Cycle Time	R_{FREQ} = 5210Ω		43		%
$PSRR_{AMP}$	Amplitude Change of Output ΔI/I	V_{DD} from 4.5V to 5.5V		-54		dB

Driver Characteristics V_{DD} = +5V, T_A = 25°C, R_L = 10Ω, R_{FREQ} = 18.2kΩ (FREQ = 100MHz), R_{AMP} = 2540Ω (Amp = 50mA_{P-P} measured at 100MHz), V_{OUT} = 2.2V (One channel active) **(Continued)**

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
T_{ON}	Auto Turn-on Time	Output voltage step from 0V to 2.2V		15		µs
T_{OFF}	Auto Turn-off Time	Output voltage step from 2.2V to 0V		0.5		µs
IN_{OUT}	I_{OUT} Current Output Noise Density	R_{FREQ} = 5210Ω, $F_{MEASURE}$ = 10MHz		2.5		nA/√Hz

Pin Descriptions

PIN NAME	PIN TYPE	PIN DESCRIPTION
1	V_{DD}	Positive power for laser driver (4.5V - 5.5V)
2	IOUT1	Current output to laser anode
3	GND	Chip ground pin (0V)
4	IOUT1	Current output to laser anode
5	RFREQ2	Set pin for oscillator frequency
6	RFREQ1	Set pin for oscillator frequency
7	RAMP2	Amplitude control input pin
8	RAMP1	Amplitude control input pin

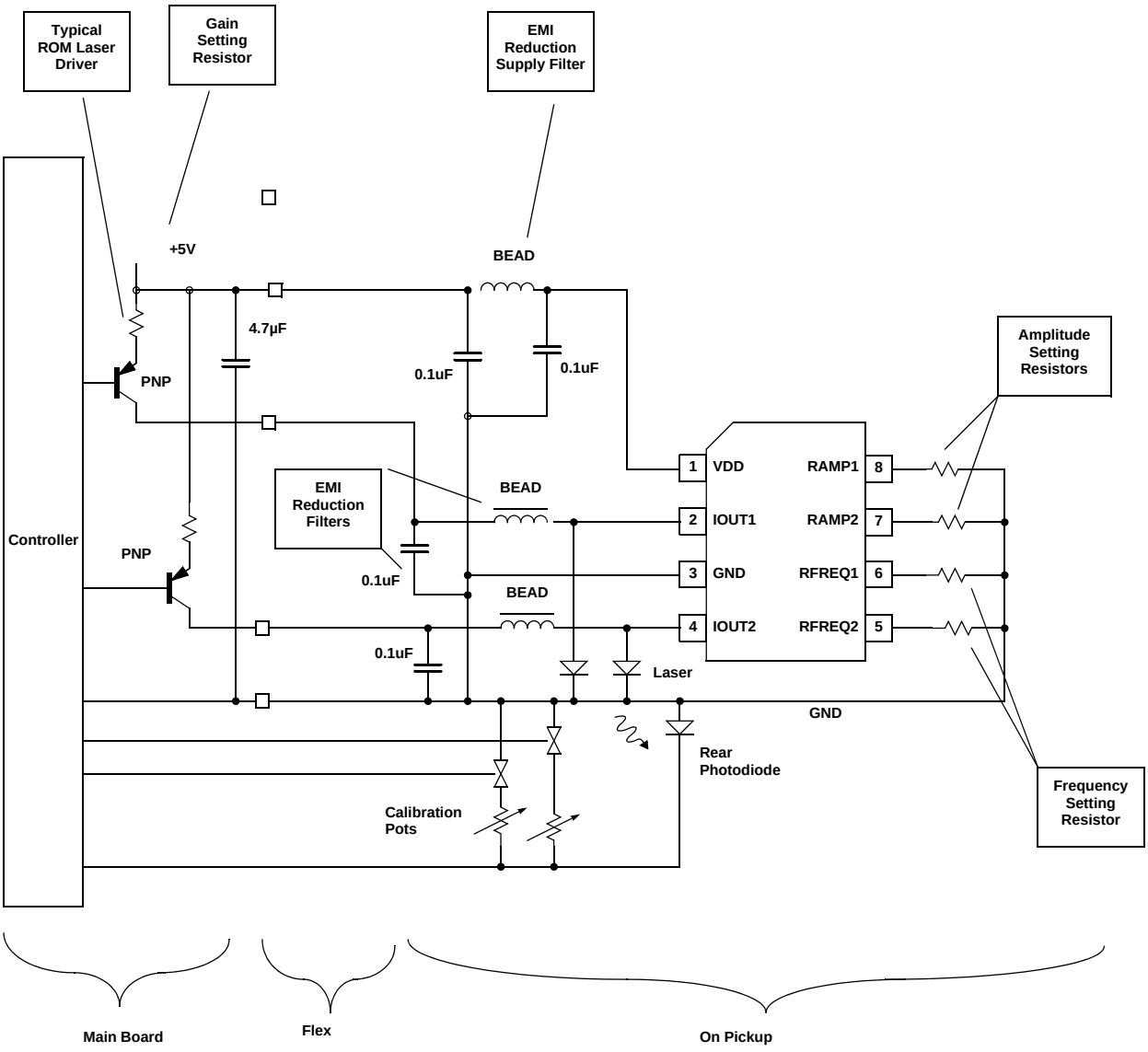
Recommended Operating Conditions

V_{DD} . . . . . 5V ±10%
V_{OUT} . . . . . 2V - 3V
R_{FREQ} . . . . . 3kΩ (min)
R_{AMP} . . . . . 1.3kΩ (min)
F_{OSC} 80-600MHz
A_{OSC} . . . . . 10-100mA_{PK-PK}

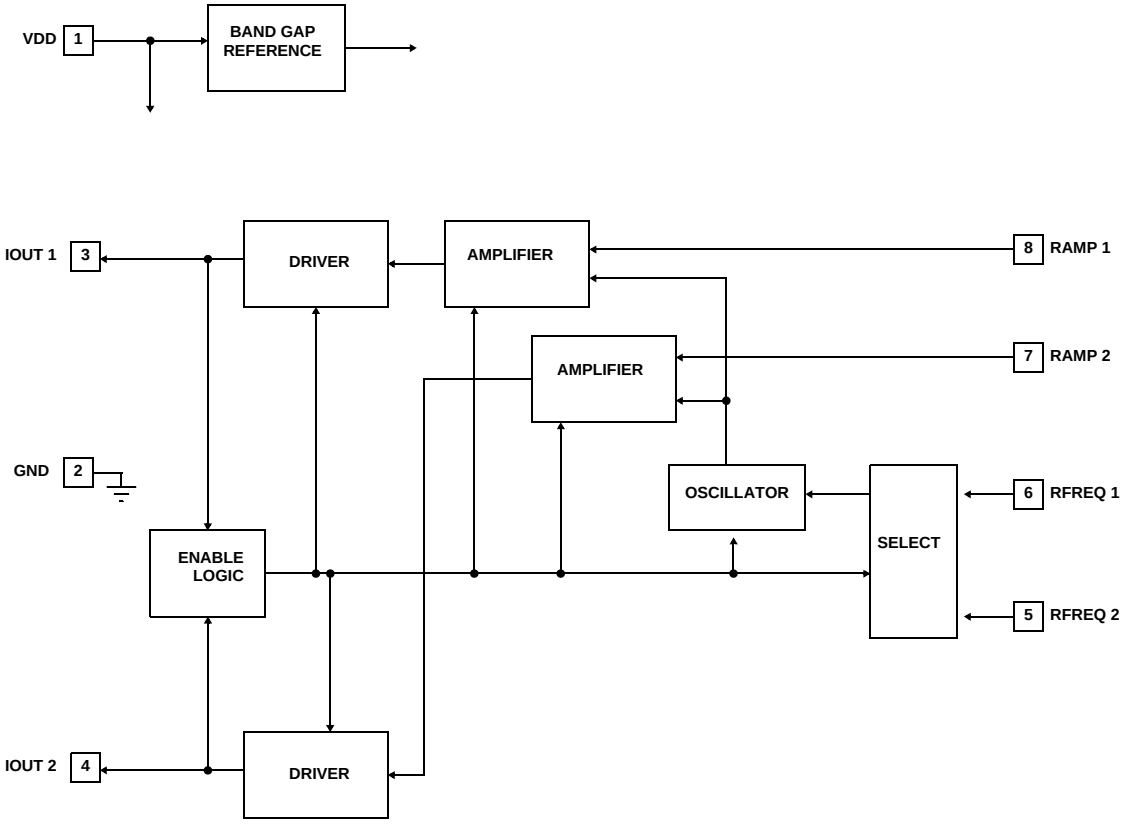
I_{OUT} Control

V_{OUT1}	V_{OUT2}	I_{OUT}	I_{OUT}
Less than V_{CUTOFF}	Less than V_{CUTOFF}	OFF	OFF
Less than V_{CUTOFF}	More than V_{CUTOFF}	OFF	Normal Operation
More than V_{CUTOFF}	Less than V_{CUTOFF}	Normal Operation	OFF
More than V_{CUTOFF}	More than V_{CUTOFF}	OFF	OFF

Block Diagram



Block Diagram (Continued)



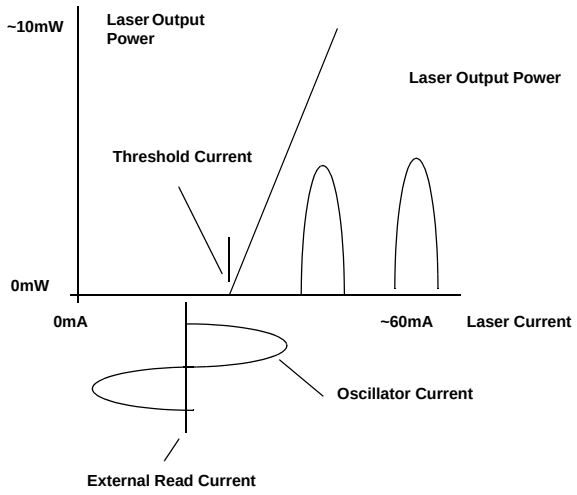
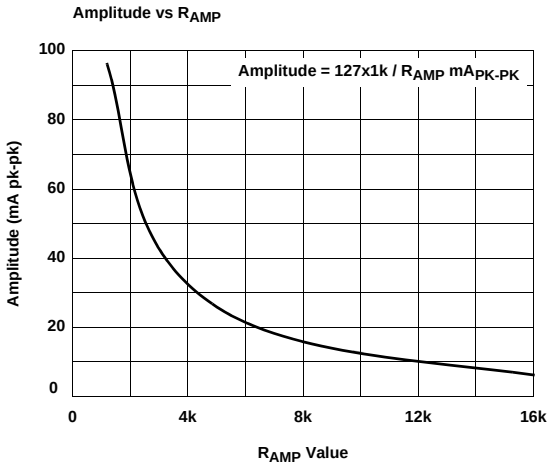
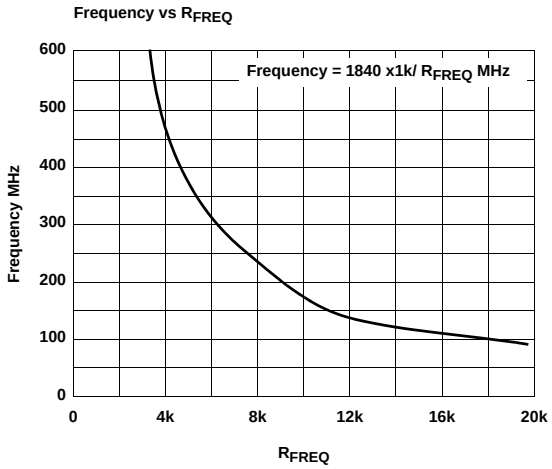

~10mW
Laser Output Power
Laser Output Power
Threshold Current
0mW
0mA
~60mA
Laser Current
Oscillator Current
External Read Current

FIGURE 1.


Amplitude vs R_{AMP}
Amplitude = 127x1k / R_{AMP} mA_{PK-PK}
Amplitude (mA pk-pk)
100
80
60
40
20
0
0
4k
8k
12k
16k
R_{AMP} Value


Frequency vs R_{FREQ}
Frequency = 1840 x1k/ R_{FREQ} MHz
Frequency MHz
600
500
400
300
200
100
0
0
4k
8k
12k
16k
20k
R_{FREQ}

Applications Information

Theory of Operation

A typical semiconductor laser will emit a small amount of incoherent light at low values of forward laser current. But after the threshold current is reached, the laser will emit coherent light. Further increases in forward current will cause rapid increases in laser output power. A typical threshold current is 30mA and a typical slope efficiency is 0.7mW/mA.

When the laser is lasing, it will often change its mode of operation slightly, due to changes in current, temperature, or optical feedback into the laser. In a DVD-ROM, the optical feedback from the moving disk forms a significant noise factor due to feedback induced mode hopping.

In addition to the mode hopping noise, a diode laser will typically have a noise level above threshold that is almost constant regardless of the power level. The signal-to-noise ratio of the output power can be defined by the DC power level divided by the laser noise power. Because of the almost constant noise power above threshold, higher level of output power have higher SNR (signal-to-noise ratio).

The RF oscillator is designed to produce a low noise oscillating current that is added to the external DC current. The effect of the AC current is to cause the laser power to change at twice the oscillator frequency. This changing power level causes the laser to go through rapid mode hopping. The low frequency component of laser power noise due to mode hoping is translated up to sidebands around the oscillator frequency by this action. Since the oscillator frequency can be filtered out of the low frequency read and servo channels, the net result is that the laser noise seems to be reduced.

The second source of laser noise reduction is caused by the increase in the laser power above the average laser power during the on cycle. The SNR is better at higher laser powers. In addition, when the laser is off, the noise is also very low.

Setting the R_{AMP} Resistor

The laser should always have a forward current during operation. This will prevent the laser voltage from collapsing, and ensure that the high frequency components reach the junction without having to charge the junction capacitance. By looking at Figure 1, it can be seen that the applied DC current should be larger than the peak oscillator current.

Generally it is desirable to make the oscillator current as large as possible to obtain the greatest reduction in laser noise. But it is not a trivial matter to determine this critical value. The amplitude depends on the waveshape of the oscillator current reaching the laser junction.

If the output current is sinusoidal, and the components in the output circuit are fixed and linear, then the shape of the current will be sinusoidal. But the amount of current reaching the laser junction is a function of the circuit parasitics. Also, the amount of junction current causing laser emission is variable with frequency due to the junction capacitance. But even this easy case is not available because the output impedance of the oscillator changes somewhat with output voltage.

In conclusion, the size of the R_{AMP} resistor must be determined experimentally. But, a good starting point is to use a peak amplitude that is less than the minimum laser threshold current.

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