élantec
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

EL6274C

4-Ch Laser Diode Driver + Oscillator

Features

- Shrink Small Outline Package
- Voltage-controlled output current source to 100 mA per channel, requiring one external set resistor per channel
- Current-controlled output current source to 100 mA per channel
- Rise time = 3.0 ns
- Fall time = 3.5 ns
- On chip oscillator with frequency and amplitude control by use of external resistors to ground
- Oscillator to 500 MHz
- Oscillator to 100 mA pk/pk
- Single +5V supply (±10%)
- Current amplification = 100
- Disable feature for power-up protection and power savings
- TTL/CMOS control signals

Applications

- CD-RW applications
- Writable optical drives
- Laser diode current switching

Ordering Information

Part No	Temp. Range	Package	Outline #
EL6274CU	0°C to +70°C	QSOP-24	MDP0040

General Description

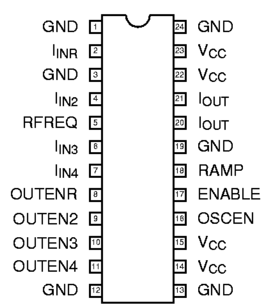
The EL6274C is a four channel laser diode current amplifier that provides controlled current to a grounded laser diode. The four amplifiers can provide up to 100 mA per channel of DC or pulsed current. Channels 2, 3, and 4 should be used as the write channels, with switching speeds of approximately three nanosecond rise/fall time. All four channels are summed together at the I_{OUT} output, allowing the user to create multilevel waveforms in order to optimize laser diode performance. The level of the output current is set by an analog voltage applied to an external resistor which converts the voltage into a current at the I_{IN} pin (virtually ground). The current seen at this pin is then amplified by 100X to become a current source at pin I_{OUT}.

An on-chip 500 MHz oscillator is provided to allow output current modulation when in any mode. This is turned on when the OSCEN pin is held high. Complete control of amplitude and frequency is set by two external resistors connected to ground at pins RFREQ and RAMP (see graphs in this data sheet for further explanation).

Output current pulses are enabled when an ‘L’ signal is applied to the OUTEN pin. No output current flows when OUTEN is ‘H’, and additional laser diode protection is provided since the OUTEN input will float high when open. Complete I_{OUT} shutoff is also achieved by holding the ENABLE pin low, which will override the OUTEN control pins.

The external resistors allow the user to accurately and independently set each amplifier transconductance by applying a voltage to each resistor, without restriction on the voltage range, thus ensuring broad voltage DAC compatibility. Alternatively, the I_{IN} pin can be biased from a current DAC or other current source.

Connection Diagram



Note: All information contained in this data sheet has been carefully checked and is believed to be accurate as of the date of publication; however, this data sheet cannot be a “controlled document”. Current revisions, if any, to these specifications are maintained at the factory and are available upon your request. We recommend checking the revision level before finalization of your design documentation.

EL6274C

4-Ch Laser Diode Driver + Oscillator

Absolute Maximum Ratings (T_A = 25 °C)

Voltages Applied to:	
V_{CC}	-0.5V to +6.0V
OUTEN	-0.5V to V_{CC} +0.5V
I_{IN}	-0.5V to +0.5V
I_{OUT}	-0.5V to V_{CC}-(8*I_{OUT})
Power Dissipation (maximum)	See Curves
Operating Ambient Temperature Range	0°C to +70°C
Maximum Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
I_{OUT} Current	200 mA AVG

Important Note:

All parameters having Min/Max specifications are guaranteed. The Test Level column indicates the specific device testing actually performed during production and Quality inspection. Elantec performs most electrical tests using modern high-speed automatic test equipment, specifically the LTX77 Series system. Unless otherwise noted, all tests are pulsed tests, therefor $T_J = T_C = T_A$.

Test Level	Test Procedure
A	100% production tested at the specified temperature(s).
B	QA sample tested per QA test plan QCX0002 at the specified temperature(s).
C	Parameter is a typical value at the specified temperature(s) for informational purposes only.

Electrical Characteristics

V_{CC}=+5V, T_A=25°C, ENABLE=HI, OSCEN=LO, OUTEN=HI, unless otherwise specified.

General

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
V_{CC}	Supply Voltage		4.5	5.0	5.5	C	V
IS1	Supply Current (Disabled)	ENABLE=<0.5V		0.1	10	A	uA
IS2	Supply Current	$I_{INR/2/3/4}$=0µA, RFREQ=2500Ω, RAMP=Open	15	19	24	A	mA
IS3	Supply Current	OSCEN=HI, RFREQ=2500Ω, RAMP=Open	20	33	40	A	mA
IS4	Supply Current	OUTEN=HI, I_{INR}=I_{IN2}=I_{IN3}=I_{IN4}=500µA	30	44	54	A	mA
IS5	Supply Current	OUTENR=LO, I_{INR}=I_{IN2}=I_{IN3}=I_{IN4}=500µA	80	105	123	A	mA
DV_{LO}	Digital Low Voltage	OUTEN, OSCEN Inputs			1.3	A	V
EV_{LO}	Enable Low Voltage	ENABLE Pin (to Guarantee IS1)			0.5	A	V
DV_{HI}	Digital High Voltage	OUTEN, OSCEN Inputs	2.0			A	V
EV_{HI}	Enable High Voltage	ENABLE Pin Only	0.6*V_{CC}			A	V
DI_{LO}	Digital Low Current	OUTEN=0.0V	-100			A	µA
DI_{HI}	Digital High Current	OUTEN=5.0V			100	A	µA
V_{SHUT}	V_{CC} Shutdown Voltage		3.4		3.7	A	V

Laser Amplifier

V_{CC}=+5V, T_A=25°C, ENABLE=HI, unless otherwise specified.

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
GAINR	Best Fit Current Gain	Channel R [1]	90	103	117	A	mA/mA
IOSR	Best Fit Current Offset	Channel R [1]	+3		+13	A	mA
GAIN	Best Fit Current Gain	Channels 2,3,4 [1]	80	91	103	A	mA/mA
IOS	Best Fit Current Offset	Channels 2,3,4 [1]	-5		+3	A	mA
ILIN	Output Current Linearity	Any Channel [1]	-3		3	A	%

Laser Amplifier

V_{CC}=+5V, T_A=25°C, ENABLE=HI, unless otherwise specified.

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
IDAC	Input Current Range	Input is Sinking	0		2	C	mA
I_{OUTR}	Output Current per Channel	Output is Sourcing	100	200		A	mA
R_{OUT}	I_{OUT} Series Resistance	I_{OUT}=188mA (Total R_{OUT} to V_{CC} Rail)			8	A	Ω
R_{IN}	I_{IN} Input Impedance	R_{IN} is to GND	375	500	625	A	Ω
VTH	OUTEN Threshold	Temperature Stabilized		1.68		C	V
I_{OFF1}	Output Off Current 1	ENABLE=LO			5	A	mA
I_{OFF2}	Output Off Current 2	OUTEN=HI, Total for All Channels			5	A	mA
I_{OFF3}	Output Off Current 3	OUTEN=LO, I_{IN}=0µA, Total for All Channels			5	A	mA
VC1	I_{OUT} Supply Sensitivity	I_{OUT}=40mA, V_{CC}=5V ±10%, Read Only	-4	-1	+2	A	%/V
VC2	I_{OUT} Supply Sensitivity	I_{OUT}=80mA, 40mA Read + 40mA Write	-5	-2	+1	A	%/V
IN_{OUT}	I_{OUT} Current Output Noise	I_{OUT}=40mA, OSCEN=LO		3.5		C	nA/rt-Hz
TC1	I_{OUT} Temperature Sensitivity	I_{OUT}=40mA, Read Only.		-200		C	ppm/°C
TC2	I_{OUT} Temperature Sensitivity	I_{OUT}=80mA, 40mA Read + 40mA Write		-150		C	ppm/°C

1. The amplifier linearity is calculated using a best fit method at three operating points. The output currents chosen are 20 mA, 40 mA, and 60 mA. The transfer function for I_{OUT} is defined as follows: $I_{OUT} = (I_{IN} * GAIN) + I_{OS}$

Laser Current Amplifier Outputs AC Performance

V_{CC}=+5V, T_A=25°C, I_{OUT}=40 mA DC with 40 mA pulse unless otherwise specified.

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
tr2	Write Risetime	I_{OUT}=40mA (Read) + 40mA (10%-90%)		3.0	5.0	C	nsec
tf2	Write Falltime	I_{OUT}=40mA (Read) + 40mA (10%-90%)		3.5	5.0	C	nsec
OS	Output Current Overshoot	See Application Notes		5		C	%
t_{ON}	I_{OUT} ON Prop Delay	OUTEN 50% H-L to I_{OUT} at 50% of Final Value		2.0		C	nsec
t_{OFF}	I_{OUT} OFF Prop Delay	OUTEN 50% L-H to I_{OUT} at 50% of Final Value		2.0		C	nsec
T_{DIS}	Disable Time	ENABLE 50% H-L to I_{OUT} at 50% of Final Value		20		C	nsec
T_{EN}	Enable Time	ENABLE 50% L-H to I_{OUT} at 50% of Final Value		150		C	nsec
B/W	Amplifier Bandwidth	I_{IN}=500µA, All Channels, -3dB Value		8		C	MHz
F_{OSC}	Oscillator Frequency	RFREQ=2500Ω	380	470	560	A	MHz
$TC_{OSC}1$	Oscillator Temperature Coefficient	RFREQ=2500Ω		-150		C	ppm/°C

EL6274C

4-Ch Laser Diode Driver + Oscillator

Pin Descriptions

Name	Type	Description
GND	Power Supply	Ground (connect all)
V_{CC}	Power Supply	+5V Supply (connect all)
I_{OUT}	Analog	Output Current Source for Laser Diode (sum of all channels)
I_{IN}	Analog	Input Current for Current Amplifier (add external series resistor when voltage driven)
OUTEN	Digital	Digital Control for Output Current (OUTEN Low = I_{OUT} On), Floats High
ENABLE	Digital	Disables Output Current Regardless of OUTEN (ENABLE Low = No I_{OUT}), Cannot Float
RFREQ	Analog	External Resistor to Ground Sets Oscillator Frequency
RAMP	Analog	External Resistor to Ground Sets Oscillator Amplitude
OSCEN	Digital	Oscillator Shutdown (OSCEN Low = Oscillator Off, Floats Low)

Recommended Operating Conditions

V_{CC}	5V ±10%	RAMP	300Ω (min)
I_{INR}/2/3/4	2 mA (max)	F_{OSC}	100-500 MHz
RFREQ	2000Ω (min)	A_{OSC}	40-100 mA pk/pk (max)

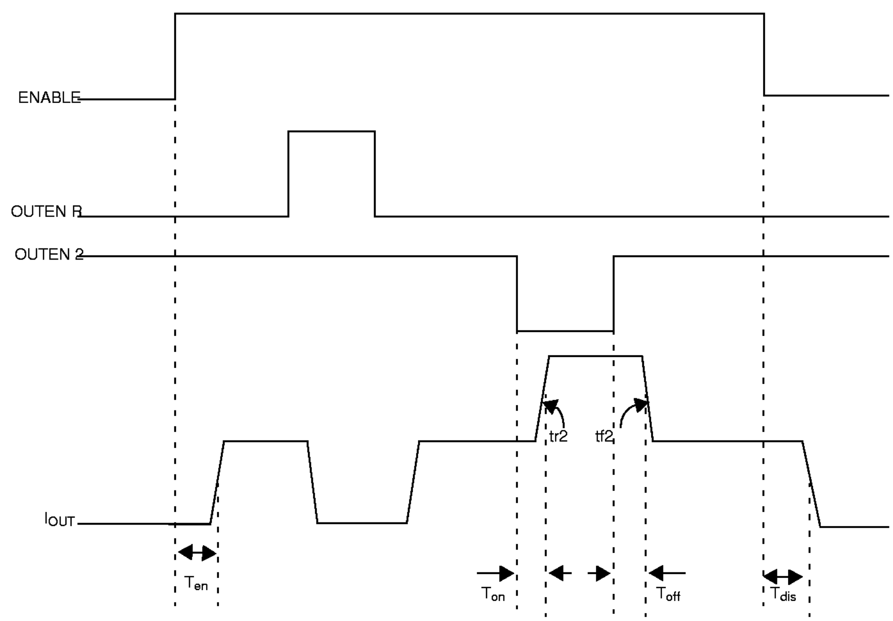
Iout Control

ENABLE	OUTENR	OUTEN2	OUTEN3	OUTEN4	I_{OUT}
0	X	X	X	X	OFF
1	1	1	1	1	OFF
1	0	1	1	1	$97*I_{INR}$
1	1	0	1	1	$97*I_{IN2}$
1	1	1	0	1	$97*I_{IN3}$
1	1	1	1	0	$97*I_{IN4}$

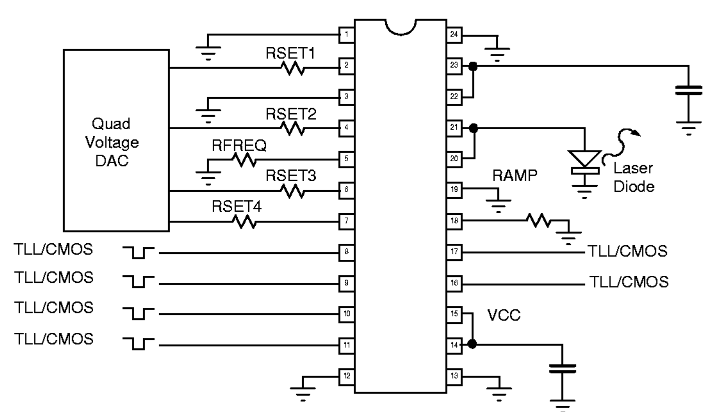
Oscillator Control

ENABLE	OSCEN	OUTENR	OUTEN2	OUTEN3	OUTEN4	OSCILLATOR
0	X	X	X	X	X	OFF
1	0	X	X	X	X	OFF
1	1	1	X	X	X	OFF
1	1	0	X	X	X	ON

Timing Diagram



Typical Application



Applications Information

Definition

The defining equation for each amplifier is:

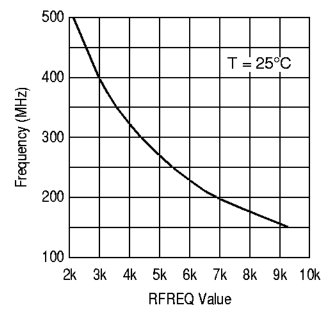
$$I_{OUT} = (V_{DAC} / (R_{SET} + 500)) \times 94$$

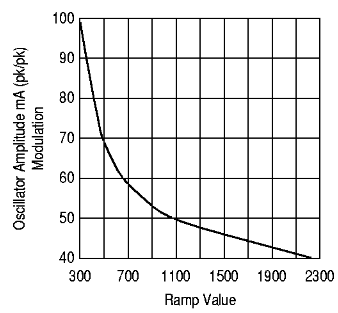
Due to the high values of current being switched rapidly on and off, it is important to ensure that the power supply is well decoupled to ground. During switching, the V_{CC} undergoes severe current transients, thus every effort should be made to decouple the V_{CC} as close to the package as possible. Symptoms that could arise include poor rise/fall times, current overshoot, and poor settling response.

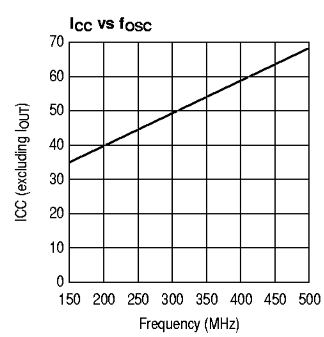
The R_{SET} resistors should also be placed as close as possible to the I_{IN} pins, to avoid picking up stray signals on these input lines. No capacitance should be added to the node between the R_{SET} resistors and the EL6274C package. In particular, the digital signals on the OUTEN inputs should not be allowed to couple into the I_{IN} inputs. If long input lines are necessary, capacitors can be added to the high side of the R_{SET} resistors.

It is very important to minimize the lead inductance between the I_{OUT} pin and the laser diode. Excessive inductance will worsen the rise/fall times, and cause overshoot and current ringing due to the I_{OUT} output seeing an under-damped LC network at the load. If ringing persists, the addition of an RC snubber network right at the output of the laser driver will be necessary, but rise/fall times and oscillator amplitude will be compromised. Users should expect to lose 0.5 nsec of tr/tf for every 1 cm of distance from I_{OUT} to the laser diode and back to the V_{CC} decoupling capacitor.

Oscillator Control







Large Oscillator Amplitude Effect

The oscillator within the EL6274C can be set to a wide range of values. It has been found that when the amplitude becomes large, a potential problem may arise.

When the read threshold is low, and the oscillator amplitude is high, then the oscillator approaches 100% modulation of the read current. However, due to the internal design of the product, the oscillator amplitude can be affected by the value of the read current, as shown in Figure 1.

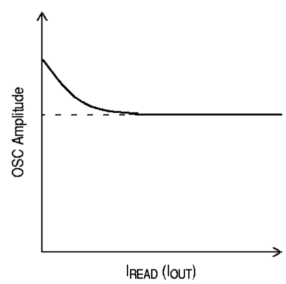


Figure 1.

In some cases, if the oscillator amplitude is high enough, even as the read current is reduced, the laser diode power output can increase. As a result, it is not possible to reach a bias condition where no light is emitted from the laser diode (Figure 2).

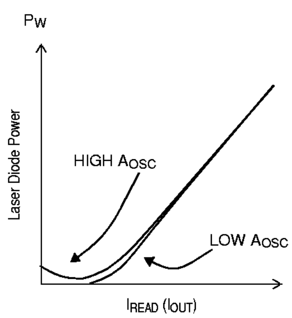


Figure 2.

Users should consider whether they really need a high value of oscillator amplitude, or whether it is just a consequence of, for example, poor board layout. If the problem is found to occur, and no reduction of the oscillator amplitude is possible, then the addition of a resistor in parallel with the laser diode (Figure 3) will move the bias condition such that the light level can always be reduced to zero light when I_{READ} is nonzero (Figure 4). R_{EXT} typically ranges from 100Ω to 1000Ω and depends on R_{FREQ} and R_{AMP}. Contact applications support for exact values.

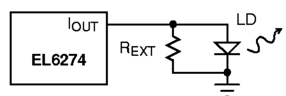


Figure 3.

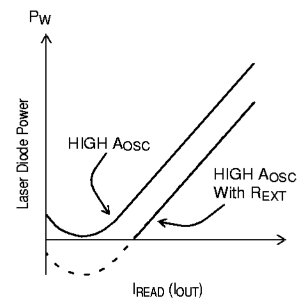


Figure 4.

Power Consumption Issues

The EL6274C has been designed for low power consumption. When disabled, the part takes negligible power consumption, regardless of the state of the other pins. In addition, for V_{CC}<3.5V, the EL6274C will shut down to less than 1mA of supply current.

The EL6274C total power consumption depends strongly on the laser diode current and voltage. Since the total power consumption under worst case conditions could approach one watt, the burden is on the user to dissipate the heat into the board ground plane or chassis. An in-depth discussion of the effects of ground plane layout and size can be found in the Elantec 1997 data book, under application note #8, pages 8-40 to 8-42.

An approximate equation for the device power consumption is as follows (users must adjust accordingly for any duty cycle issues):

$P_{diss} = ((Is + (13*\Sigma I_{IN}))*V_{CC})+(I_{DIODE}*(V_{CC}-V_{DIODE}))$

where:

Is = IS2 when oscillator off, or IS3 when oscillator on (see page 2)

ΣI_{IN} = Sum of all the I_{IN} currents

V_{CC} = Device power supply voltage

I_{DIODE} = Laser diode current

V_{DIODE} = Forward voltage of laser diode at current of I_{DIODE}

When using the EL6274C, the user must take extreme care not to exceed the maximum junction temperature of +150°C. Since the case to ambient thermal coefficient will dominate, and since this is very much defined by the user's thermal engineering, it is not practical to define a strict limit on power consumption. Furthermore, the case to ambient thermal coefficient may not be known precisely.

To assist in worst case conditions, it is possible to monitor the silicon temperature of the EL6274C by forcing current into the ENABLE pin, which will then be at a voltage of $V_{CC} + V_{PN}$, where V_{PN} is the forward biassed voltage of the ESD protection diode. Since ENABLE=HI is necessary for normal operation, the device can be operated as it would be in the real-life applications, while the temperature is monitored. The EL6274C has been calibrated with a 1MΩ resistor to +10V connected in series with the ENABLE pin, which results in an input current of approximately 4.5µA. The following graph allows the silicon temperature to be determined directly. The graph shows the measured ENABLE pin to V_{CC} pin differential voltage, which shows a linear voltage sensitivity of -2.26 mV/°C. Users may wish to measure their specific part at +20°C (no warm up) to allow for any statistical/process distribution, but the method is reliable and accurate.

By applying this method to the EL6274C in an actual application, users can measure the silicon temperature under all operating conditions to determine whether their thermal engineering is sufficient. The package manufacturers' measured thermal resistance is 135°C/W for the QSOP-24 package in a standard PCB test board. Actual thermal resistance is highly dependent on circuit board layout considerations.

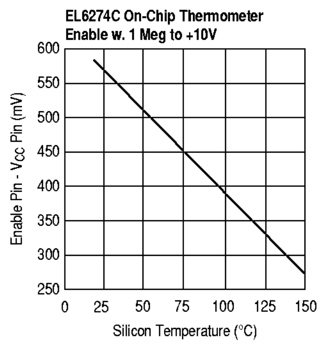
Temperature Measurement Set-up and Results

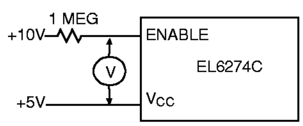
Example: Measure ENABLE-V_{CC} under coolest condition of V_{CC}=0V and V_{ENABLE}=5V through 1MΩ. Suppose the result was 580mV at $T_{AMBIENT}$=20°C.

Now measure ENABLE-V_{CC} under the actual operating conditions. Suppose result (must be after thermal equilibrium has been reached) is 450 mV, and the new I_{CC} value is 100 mA.

Now one can calculate the temperature rise of (450-580)/-2.26 =57°C. Using the power dissipation of

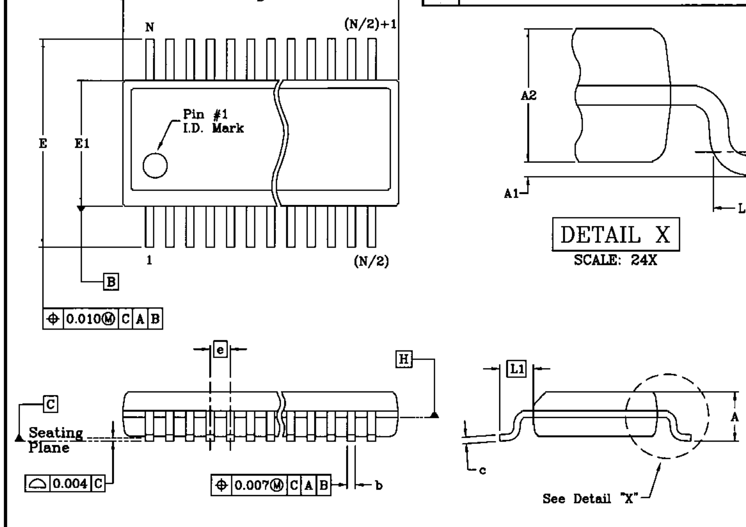
$P_{W}=(V_{CC}*I_{CC}) - (I_{DIODE}*V_{DIODE})$, the θJA of the application can be calculated.





Package Outline Drawing

Rev.	Description	Date	ECN No.
A	Initial Release	11/13/96	
B	Drawing revision and add QSOP16	6/11/98	



DIMENSION TABLE			
Symbol	QSOP16	QSOP24	Tolerance
A	0.068	0.068	MAX.
A1	0.006	0.006	+/- 0.002
A2	0.058	0.058	+/- 0.002
D[1][3]	0.193	0.341	+/- 0.004
E	0.236	0.236	+/- 0.008
E1[2][3]	0.154	0.154	+/- 0.004
L	0.025	0.025	+/- 0.009
L1	0.041	0.041	Basic
b	0.010	0.010	+/- 0.002
c	0.008	0.008	+/- 0.001
e	0.025	0.025	Basic
N	16	24	Reference

Notes:
(1) Plastic or metal protrusions of 0.006" maximum per side are not included.
(2) Plastic interlead protrusions of 0.010" maximum per side are not included.
(3) Dimensions "D" and "E1" are measured at Datum Plane "H".
(4) Dimensioning and tolerancing per ASME Y14.5M-1994.

Size: A	PACKAGE OUTLINE DRAWING QSOP - 0.150" NARROW BODY PACKAGE
Scale: 8X	
Units: Inches	
Sheet: 1 of 1	Drawing #: MDP0040 Rev: B Date: 6/11/98
JEDEC Reg: MO-137	élantec Semiconductor, Inc.
Drawn: B. Hawthorne	HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS
Checked: B. Hawthorne	

EL6274C

4-Ch Laser Diode Driver + Oscillator

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