EL6251C
Laser Diode Power Amp W/Sense Amp

Features

- High-performance laser diode driver and power monitor
- Voltage-controlled read and write currents up to 320 mA total (160 mA read/160 mA write)
- 1.7 ns rise time
- 3.2 ns fall time
- Single +5V supply
- Power supply fault sensing for laser diode protection
- Laser diode power sense amplifier with two transimpedance levels compatible with read and write modes
- Uses external set resistors for both read and write transconductance

Applications

- Writeable optical drives

Ordering Information

Part No.	Temp. Range	Package	Outline #
EL6251CM	−40°C to +85°C	24 Pin SOL	MDP0027

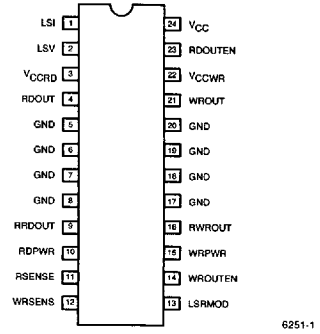
General Description

The EL6251C is a Laser Power Amplifier which provides pulsed write/erase current as well as DC or pulsed read current to a common-cathode laser diode connected to output pins WROUT and RDOUT respectively. Separate pins are provided so that the read output may be inductively isolated from the write output and the laser diode. The levels of these currents are individually set by analog input voltages applied to the WRPWR and RDPWR pins respectively. Write output current pulses are achieved by a TTL "L" signal at the $\overline{\text{WROUTEN}}$ pin. Similarly, Read output pulses are achieved (if a simple DC level is not desired) by a TTL "L" signal at the $\overline{\text{RDOUTEN}}$ pin. Powerdown of both the RDOUT and WROUT pins is also accomplished by applying a TTL "L" signal to the LSRMOD pin. Protection at low power supplies is also provided, with the RDOUT and WROUT outputs turning off when the supply voltage falls below about 4V. Laser Diode Protection is additionally provided since, when open, the LSRMOD floats low, and $\overline{\text{RDOUTEN}}$ and $\overline{\text{WROUTEN}}$ float high, thereby disabling any output current.

The EL6251C also contains all the necessary sense circuitry to produce an output voltage at the LSV pin proportional to the input current at the LSI pin, which is from a laser power-monitor photodiode. Two values of sense circuitry are available, selected by a TTL input on the WRSENS pin (floats high when open).

Three external resistors at pins RSENSE, RRDOUT, and RWROUT are used to accurately set the transimpedance of the sense amplifier, and the read and write transconductance. The output current at RDOUT and WROUT varies inversely with resistor value, while the transimpedance of the sense amplifier varies directly with the value of RSENSE.

Connection Diagram



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Absolute Maximum Ratings (T_A = 25°C)

Voltages Applied to:	
V_{CC}, VCCRD, VCCWR	−0.5V to 6.0V
TTL Inputs	−0.5V to V_{CC} + 0.5V
WRPWR and RDPWR	−0.5V to V_{CC} + 0.5V
LSI	−0.5V to 2.5V
WROUT and RDOUT	−0.5V to V_{CC} + 0.5V
LSV	−0.5V to V_{CC} + 0.5V

Power Dissipation (maximum)	See Curves
Operating Temperature Range	−40°C to +85°C
Operating Junction Temperature	+150°C
Storage Temperature Range	−65°C to 150°C

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, therefore $T_J = T_C = T_A$.

Test Level	Test Procedure
I	100% production tested and QA sample tested per QA test plan QCX0002.
II	100% production tested at T_A = 25°C and QA sample tested at T_A = 25°C, T_{MAX} and T_{MIN} per QA test plan QCX0002.
III	QA sample tested per QA test plan QCX0002.
IV	Parameter is guaranteed (but not tested) by Design and Characterization Data.
V	Parameter is typical value at T_A = 25°C for information purposes only.

Electrical Characteristics

V_{CC} = 5V, RRDOUT = 10 kΩ, RWROUT = 6.2 kΩ, RDOUT and WROUT load = 10Ω to GND, RSENSE = 10 kΩ, T_A = 25°C unless otherwise specified

General

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
V_{CCF}	V_{CC} Fault Voltage	(Note 1)	3.3	3.8	4.1	I	V
I_{S1}	Supply Current	WRPWR = RDPWR = 2.88V, LSRMOD = H		237	270	I	mA
I_{S2}	Supply Current	WRPWR = RDPWR = 0V, LSRMOD = H or L	35	46	58	I	mA

Logic Control Signals (LSRMOD, WRSENS, $\overline{\text{RDOUTEN}}$, $\overline{\text{WROUTEN}}$)

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
V_{IL}	Input Low Voltage				0.8	I	V
V_{IH}	Input High Voltage		2.0			I	V
I_{IL}	Input Low Current	V_{IN} = 0V	−250			I	µA
I_{IH1}	Input High Current 1	V_{IN} = 2.00V (all inputs)	−50	0		I	µA
I_{IH2}	Input High Current 2	V_{IN} = 5.00V (excluding LSRMOD)		0	10	I	µA
I_{IH3}	Input High Current 3	V_{IN} = 5.00V (LSRMOD only)		400	500	I	uA

Note 1: When V_{CC} < VCC_F, WROUT and RDOUT are disabled while the Laser Sense Amplifier circuitry remains active.

V To I Stages

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
V_{OFFSET}	V to I Offset Voltage	RDPWR - RRDOUT, WRPWR - WROUT, RDPWR = WRPWR = 2.88V	−11	−1	10	I	mV
GS1	Gain Scale 1	RRDOUT = 3.6 kΩ (Note 2)	97	100	103	I	%
GS2	Gain Scale 2	RWROUT = 3.6 kΩ (Note 3)	97	100	103	I	%

Electrical Characteristics — Contd.

V_{CC} = 5V, RRDOUT = 10 kΩ, RWROUT = 6.2 kΩ, RDOUT and WROUT load = 10Ω to GND, RSENSE = 10 kΩ, T_A = 25°C unless otherwise specified

Laser Sense Amplifier Input (LSI Pin)

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
V_{LSI}	Voltage at LSI Pin	WRSENS = 0.8V, I_{LSI} = 100 µA (Note 4)	1.4	1.5	1.6	I	V
I_{LSI1}	Input Current Range 1	WRSENS = 2.0V	0		1600	I	µA
I_{LSI2}	Input Current Range 2	WRSENS = 0.8V	0		200	I	µA
C_{LSI}	Input Capacitance			2		V	pF

Laser Sense Amplifier

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
V_{MAX}	Max. Output Voltage	R_{LOAD} = 2 kΩ to GND, LSI = 1.6 mA, WRSENS = 2V	3.70	3.86		I	V
V_{MIN}	Min. Output Voltage	R_{LOAD} = 2 kΩ to GND, LSI = 1 µA, WRSENS = 2V	25	75	110	I	mV
TCV_{MIN}	Min. Output V Drift	R_{LOAD} = 2 kΩ to GND, T_{MIN} to T_{MAX}	−300		300	IV	µV/°C
V_{LIN}	Output Linearity	Best Fit Method, Measured at LSI = 10%, 50%, 90% of ILSI1, ILSI2.	−2	0.1	+2	I	%
Z_{OUT}	Output Impedance	I_{LOAD} = ±1 mA		0.5		V	Ω
I_{OUT}	Current Drive	V_{OUT} from V_{MIN} to V_{MAX}	−1		+2	I	mA
e_{OUT}	Output Noise Voltage	BW = 3.5 MHz		0.7		V	mV RMS
SR	Slew Rate	R_{LOAD} = 2 kΩ to GND	10	15		IV	V/µs
R_{M1}	Transimpedance 1	WRSENS = 2.0V, Note 5, Note 6	2.393	2.467	2.541	I	kΩ
V_{OO1}	Output Offset Voltage 1	WRSENS = 2.0V, Note 5	−100	-54	10	I	mV
R_{M2}	Transimpedance 2	WRSENS = 0.8V, Note 5, Note 6	18.93	19.52	20.11	I	kΩ
V_{OO2}	Output Offset Voltage 2	WRSENS = 0.8V, Note 5	−25	+3	+25	I	mV
TCR_M	Transimpedance Drift		0	65	150	V	ppm/°C
BW	Bandwidth	−3 dB Bandwidth	3	8		V	MHz
PKNG	Peaking			0	3	V	dB
T_{RCVRY}	Recovery Time	WRSENS L to H or H to L, Output Settling to ±20 mV, LSI=100 µA		100	300	V	ns

Note 2: Output current ($IOUT_{GS1}$) is measured with RRDOUT = 3.6 kΩ, RDPWR = 1.200V. This value is compared to the output current ($IOUT_{NOM}$) with RRDOUT = 10 kΩ, RDPWR = 3.333V. GS1 = ($IOUT_{NOM}/IOUT_{GS1}$)

Note 3: Output current ($IOUT_{GS2}$) is measured with RWROUT = 3.6 kΩ, WRPWR = 1.200V. This value is compared to the output current ($IOUT_{NOM}$) with RWROUT = 6.2 kΩ, RDPWR = 2.067V. GS2 = ($IOUT_{NOM}/IOUT_{GS2}$)

Note 4: V_{LSI} = (2 * Vbe) + (I_{LSI} * 200 Ω).

Note 5: The transfer function for the Laser Sense Amplifier is as follows:

WRSENS = 2.0 V: $V_{LSI} = (I_{LSI} * R_{M1}) + V_{OO1}$

WRSENS = 0.8 V: $V_{LSI} = (I_{LSI} * R_{M2}) + V_{OO2}$

Note 6: $R_{M1} \approx 0.247 * RSENSE$

$R_{M2} \approx 1.952 * RSENSE$

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Electrical Characteristics — Contd.

V_{CC} = 5V, RRDOUT = 10 kΩ, RWROUT = 6.2 kΩ, RDOUT and WROUT load = 10Ω to GND, RSENSE = 10 kΩ, T_A = 25°C unless otherwise specified

Laser Current Amplifier Inputs (RDPWR and WRPWR Pins)

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
R_{IN}	Input Resistance	RDPWR and WRPWR. Meas. at 0.576V, 2.88V	18	24		I	kΩ
I_{IB}	Input Bias Current	V_{IN} = 2.88V		115	200	I	µA
C_{IN}	Input Capacitance			1		V	pF
BW	−3 dB Bandwidth	V_{IN} = 2.88V	40	70		V	MHz

Laser Current Amplifier Outputs DC Performance (RDOUT and WROUT pins)

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
I_{RDOUT1}	RDOUT Output I 1	RDPWR = 2.88V	−61	−67	−74	I	mA
I_{RDOUT2}	RDOUT Output I 2	RDPWR = 0.576V	−13	−16	−19	I	mA
I_{WROUT1}	WROUT Output I 1	WRPWR = 2.88V	−89	−98	−107	I	mA
I_{WROUT2}	WROUT Output I 2	WRPWR = 0.576V	−17	−21	−25	I	mA
GM_{RD}	RD Transconductance	Rload = 10Ω Note 7, Note 8, Note 9	0.0208	0.0224	0.0240	I	1/Ω
RDGAIN	Read Current Gain	RDGAIN = GMRD*RRDOUT	208	224	240	I	mA/mA
IOO_{RD}	RD Out. Offset Current	Note 7	−7	−3.4	+0	I	mA
GM_{WR}	WR Transconductance	Rload = 10Ω Note 7, Note 8, Note 9	0.0310	0.0334	0.0358	I	1/Ω
WRGAIN	Write Current Gain	WRGAIN = GMWR*RWROUT	192	207	222	I	mA/mA
IOO_{WR}	WR Out. Offset Current	Note 7	−6	−2.0	+1	I	mA
TCIout1	Output Current Drift	RDOUT and WROUT, Iout = 32 mA	100	500	800	IV	ppm/°C
TCIout2	Output Current Drift	RDOUT and WROUT, Iout = 160 mA	200	900	1250	IV	ppm/°C
I_{LIN}	Output Curr. Linearity	RDPWR = WRPWR = 0.576V to 2.88V, Best Fit Method. Note 7.	−3		3	I	%
I_{OFF1}	Output Off Current 1	WRPWR and RDPWR open.	−1.5	−0.6	0	I	mA
I_{OFF2}	Output Off Current 2	WRPWR = RDPWR = 2.88V, WROUTEN = RDOUTEN = 2V.	−1.5	−0.4	0	I	mA
R_{OUT}	Output Impedance	Iout = 50 mA		750		V	Ω
C_{OUT}	Output Capacitance	Iout = 50 mA		40		V	pF

Note 7: The transfer function for each Laser Current Amplifier is calculated using a best-fit method at 3 points. The input voltages applied to WRPWR and RDPWR for the 3 points are 0.576V, 1.728V, and 2.88V. The transfer functions for I_{RDOUT} and I_{WROUT} are defined as follows:

$-I_{RDOUT} = (V_{RDPWR} * GM_{RD}) + IOO_{RD}$

$-I_{WROUT} = (V_{WRPWR} * GM_{WR}) + IOO_{WR}$

Note 8: $GM_{RD} \approx 224/RRDOUT$ (Nominally)

$GM_{WR} \approx 207/RWROUT$ (Nominally)

Note 9: Datasheet values are based on tester data which implies part is not warmed up, so Tj is similar to Ta.

For precise values, see curves or use the temperature coefficient data.

Laser Current Amplifier Outputs AC Performance

(RDOUT and WROUT pins) V_{CC} = +5V, RWROUT=RRDOUT=3.6 kΩ, RSENSE=10 kΩ, T_A=25°C unless otherwise specified.

Parameter	Description	Conditions	Min	Typ	Max	Test Level	Units
t_r	Output Curr. Rise Time	WRPWR = RDPWR = 2.88V (10%–90%)	1.0	1.7	3.0	IV	ns
t_f	Output Curr. Fall Time	WRPWR = RDPWR = 2.88V (10%–90%)	2.2	3.2	4.2	IV	ns
OS	Output Curr. Overshoot	WRPWR = RDPWR = 2.88V		8	20	IV	%
t_{PD2A}	$\overline{\text{WROUTEN}}$ L-H Prop. Delay A	From $\overline{\text{WROUTEN}}$ 50% L-H to WROUT at 50% of Initial Value. I(WROUT)=150mA		2.9	6.0	IV	ns
t_{PD2B}	$\overline{\text{WROUTEN}}$ L-H Prop. Delay B	From $\overline{\text{WROUTEN}}$ 50% L-H to WROUT at 50% of Initial Value. I(WROUT)=30mA		3.6	7.0	IV	ns
t_{PD3A}	$\overline{\text{WROUTEN}}$ H-L Prop. Delay A	From $\overline{\text{WROUTEN}}$ 50% H-L to WROUT at 50% of Final Value. I(WROUT)=150mA		3.2	6.0	IV	ns
t_{PD3B}	$\overline{\text{WROUTEN}}$ H-L Prop. Delay B	From $\overline{\text{WROUTEN}}$ 50% H-L to WROUT at 50% of Final Value. I(WROUT)=30mA		3.3	7.0	IV	ns

Pin Descriptions

Name	Pin Number	Type	Description
GND	5–8, 17–20	Power Supply	Ground
LSRMOD	13	TTL Input	RDOUT and WROUT Output Current Enable. Outputs enabled when "H".
VCC_{RD}	3	Power Supply	+5V
VCC_{WR}	22	Power Supply	+5V
V_{CC}	24	Power Supply	+5V
LSV	2	Analog Output	Laser Sense Voltage. See Notes 5,6 for formula.
LSI	1	Analog Input	Laser Sense Current
WRSENS	12	TTL Input	I-to-V Sensitivity Selection. 0.25 * RSENSE when "H", 2 * RSENSE when "L"
RSENSE	11	R Connection	Sense Amplifier Gain Control Resistor. Nominally 10 kΩ to ground.
RDPWR	10	Analog Input	Voltage Input to Control RDOUT Current
RDOUT	4	Analog Output	Read Output Current. See Notes 7, 8 for formula.
$\overline{\text{RDOUTEN}}$	23	TTL Input	RDOUT Enable. RDOUT is enabled when "L" and LSRMOD is "H".
RRDOUT	9	R Connection	Read transconductance resistor. Nominally 3.6 kΩ to ground.

Laser Driver (Write Channel)

WRPWR	15	Analog Input	Voltage Input to Control WROUT Current
WROUT	21	Analog Output	Write Output Current. See Notes 7, 8 for formula.
WROUTEN	14	TTL Input	WROUT Enable. WROUT is enabled when "L" and LSRMOD is "H".
RWROUT	16	R Connection	Write transconductance resistor. Nominally 3.6 kΩ to ground.

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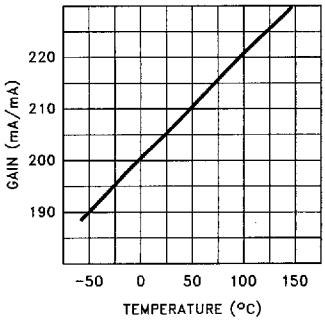
Control Truth Table

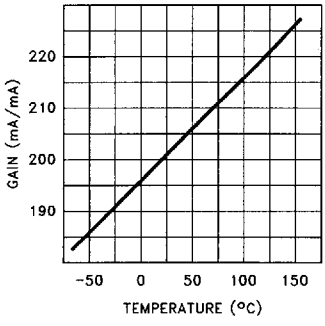
LSRMOD	$\overline{\text{WROUTEN}}$	$\overline{\text{RDOUTEN}}$	Function Description
1	0	0	Ir = ON, Iw = ON
1	0	1	Ir = OFF, Iw = ON
1	1	0	Ir = ON, Iw = OFF
1	1	1	Iw = Ir = 0
0	0	0	Iw = Ir = 0
0	0	1	Iw = Ir = 0
0	1	0	Iw = Ir = 0
0	1	1	Iw = Ir = 0

Typical Performance Curves

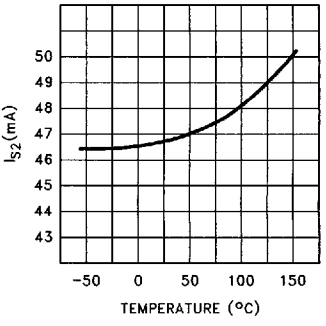
Read Current Gain vs Temperature (VRDPWR = 2.88V, RRDOUT = 3.6 kΩ)



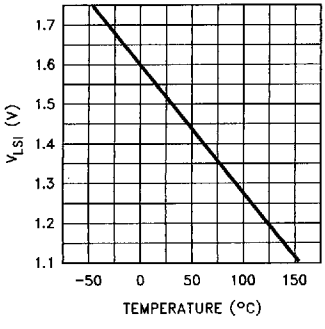
Write Current Gain vs Temperature (VWRPWR = 2.88V, RWROUT = 3.6 kΩ)



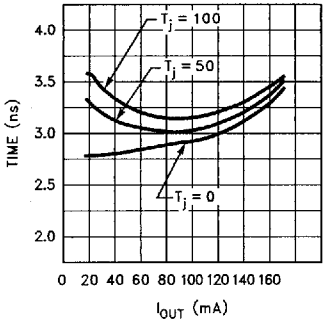
IS2 vs Temperature



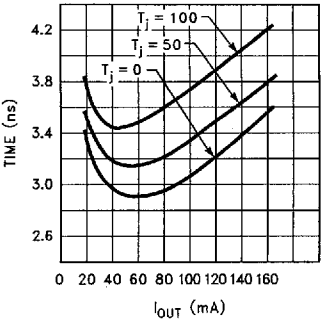
VLSI vs Die Temperature (I_{LSI} through 20 kΩ to 5.0V)



Turn-On Delay vs I_{OUT}

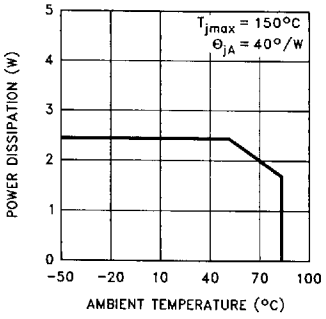


Turn-Off Delay vs I_{OUT}



Typical Performance Curves — Contd.

24-Pin Plastic Fuselead Maximum Power Dissipation vs Ambient Temperature



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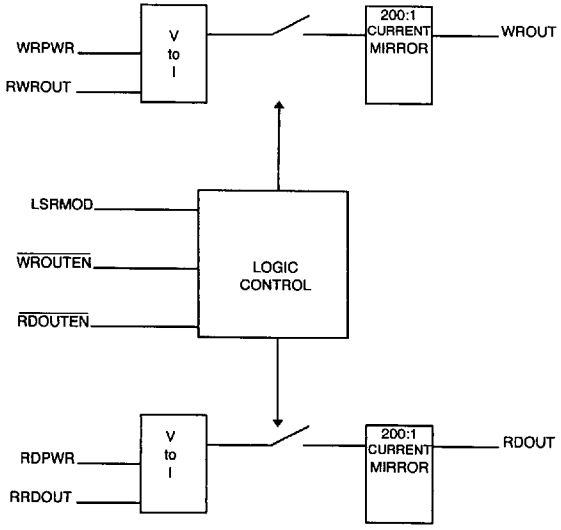
EL6251 Block Diagram



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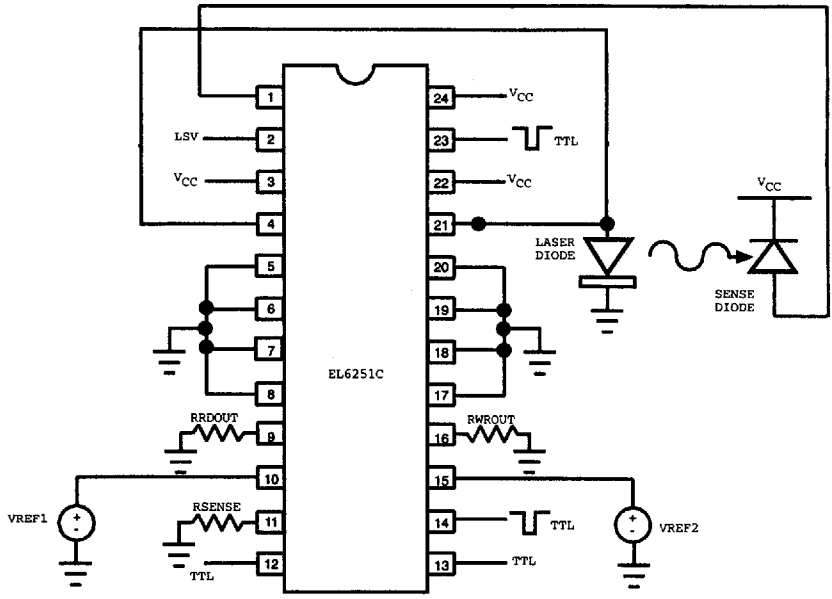
EL6251C
Laser Diode Power Amp W/Sense Amp

Recommended Operating Conditions

V_{CC} Supply Voltage	5.0V ±10%	Read Current	0 to 160 mA
RRDOUT Resistor	1.8 kΩ to 10 kΩ	WROUT Applied Voltage	0V to V_{CC} − 0.3 − (15*Iwrite)
RWROUT Resistor	1.8 kΩ to 10 kΩ	RDOUT Applied Voltage	0V to V_{CC} − 0.3 − (15*Iread)
RSENSE Resistor	5.0 kΩ to 20.0 kΩ	RDPWR and WRPWR Input Range	0V to V_{CC} − 1.5V
Write Current	0 to 160 mA		

Typical Circuit Configuration



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Application Notes:

NOTES:

Due to the high values of current being switched rapidly on and off, it is important to ensure that the power supplies are well decoupled to ground. To this end, the EL6251C has three V_{CC} pins, all of which should be connected, and users should ensure that supply inductance to these pins is minimized. Symptoms that could arise include poor rise/fall times, current ringing during switching, current overshoot, and poor settling response.

Oscillation can also occur due to capacitance on pins RRDOUT and RWROUT. It is important to minimize any stray capacitance on these pins and use the suggested resistors to ground, otherwise current ringing when switching (or even sustained oscillation) may occur.

It is also important to minimize the lead inductance between the WROUT pin and the laserdiode. If the read current is also to be switched, then the same caution applies as well. Too much inductance in series with WROUT will produce an underdamped ringing response on both the rising and falling edges of the current pulse. The ringing can sometimes be reduced with a parallel RC snubber right at the device output, but lack of headroom prevents the use of a series resistor on WROUT as an alternative..

Thermal Considerations:

The total device power consumption is highly dependant on the amount of current flowing through the laserdiode, and may further be altered by any duty cycle effects. Despite this, the equation below is fairly accurate:

$$\mathbf{PD = ((Is2 + (1.1 \times Idiode)) \times V_{CC}) - (Idiode \times Vdiode)}$$

where Is2 = Supply current when LSRMOD = 0 (46 mA typical)

Idiode = Total current through the laserdiode (Iread + Iwrite)

Vdiode = The voltage dropped across the laserdiode

V_{CC} = The EL6251C supply voltage

The die temperature will rise 40°C/W on a typical board where the EL6251C is soldered to a substantial groundplane, due to the 4 ground pins on either side of the device being attached to the mounting pad. Alternatively, the LSI pin acts as a good thermometer, by which the on-chip temperature may be monitored directly if so desired.

6

Soldering Packages to PC Boards

DIP Packages

Wave soldering is recommended for DIP packages. Solder plated boards are recommended. Rosin mildly activated (RMA) flux is needed. Wave soldering using a dual wave system at 250°C ±10°C for two seconds per wave is preferable. Thorough cleaning of boards after soldering is required.

Hand soldering, Elantec's DIP packages will survive a peak temperature of 300°C (at leads) for a maximum period of 10 seconds.

Surface Mount Packages

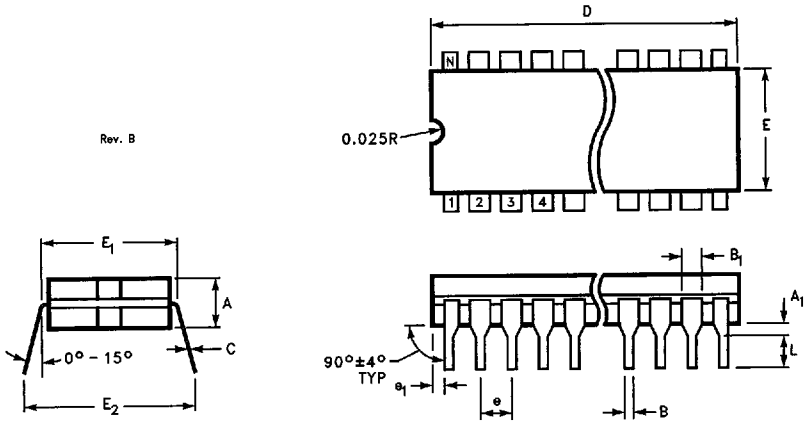
Wave soldering and vapor phase or infrared (IR) reflow can be used for soldering surface mount packages to PC boards. Solder plated boards are recommended for wave soldering and vapor phase or IR reflow methods.

Wave Soldering: Adhesive is used to hold components on the boards during wave soldering. Place components on the board and cure adhesive before wave soldering. Rosin mildly activated (RMA) flux or organic flux is needed. Wave soldering using a dual wave system at 250°C ±10°C for a maximum of two seconds per wave is preferable. Thorough cleaning of boards after soldering is required.

Reflow Soldering: Screen solder paste on board and attach components to board. Solder paste with RMA flux is recommended. Bake boards at 65°C–90°C for 15 minutes. Preheat boards to within 60°C–70°C of the solder temperature. To reflow solder paste with vapor phase method, the solder paste temperature must be maintained at or above 200°C for at least 30 seconds. The components temperature can not exceed 215°C. For the IR reflow method, the solder paste temperature must be maintained at or above 200°C for at least 30 seconds. The components temperature can not exceed 220°C. The temperature/time ramp-up during vapor phase or IR reflow shall be no greater than 2°C/sec.

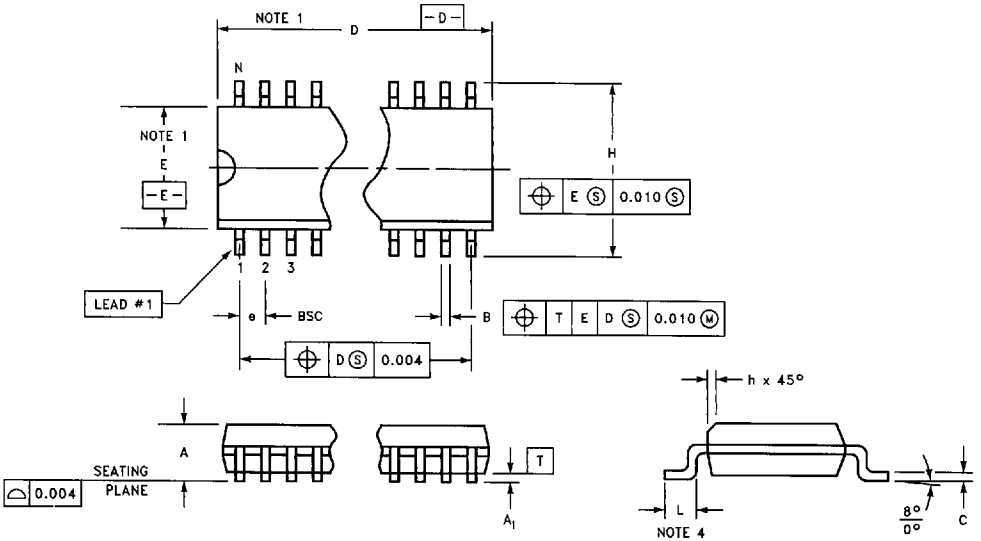
Hand soldering, Elantec's surface mount packages will survive a peak temperature of 260°C (at leads) for a maximum period of 10 seconds.

Package Outlines



MDP0016 Rev. B
CerDIP Package
Lead Finish (Coml)—Tin Plate or Hot Solder DIP
Lead Finish (Mil)—Hot Solder DIP

Common Dimensions	Min	Max	Min	Max	Min	Max	Min	Max
A	0.140	0.160	0.140	0.160	0.140	0.160	0.140	0.160
A_1	0.115	0.055	0.020	0.050	0.015	0.060	0.020	0.050
B	0.016	0.023	0.016	0.021	0.014	0.026	0.016	0.021
B_1	0.050	0.065	0.050	0.060	0.038	0.068	0.050	0.060
C	0.008	0.012	0.008	0.012	0.008	0.018	0.008	0.012
D	0.375	0.395	0.760	0.785	0.940	0.960	1040.925	1.060
E	0.245	0.265	0.220	0.291	0.220	0.310	0.2780	0.298
E_1	0.300	0.320	0.300	0.320	0.290	0.320	0.300	0.320
E_2	0.340	0.390	0.340	0.390	0.360	0.410	0.340	0.390
e	0.090	0.110	0.090	0.110	0.090	0.110	0.090	0.110
e_1	0.020	0.055	0.078	0.098	0.068	0.098	0.078	0.098
L	0.125	0.150	0.125	0.150	0.125	0.150	0.130	0.150
N	8-Lead		14-Lead		18-Lead		20-Lead	



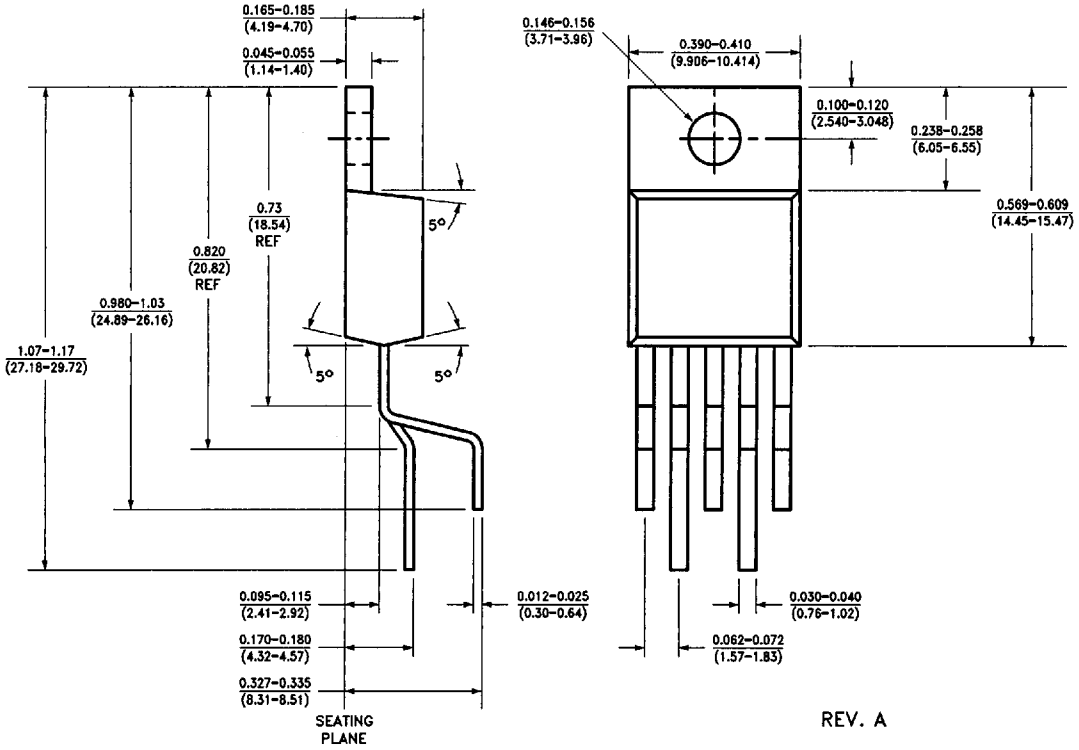
REV. C

Note 1: These dimensions do not include mold flash or protrusions. Mold flash protrusion shall not exceed .006" on any side.
Note 2: SO-8, SO-14, S0-16 packages are narrow body (0.150").
Note 3: Dimensions and tolerancing per ANSI Y14.5M-1982.
Note 4: Flat area of lead foot.
Note 5: SOL-24T2 (thermal package) has 2 fused leads on each side of package.
Note 6: SOL-20T (thermal package) has 4 fused leads on each side of package.
Note 7: SOL-28T contains a thermal metal slug.

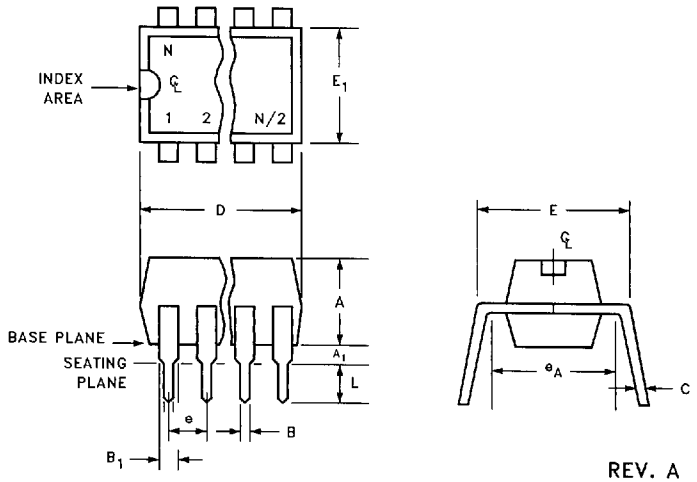
MDP0027 Rev. C
Package Outline—SOIC
Lead Finish—Solder Plate

Symbol	Lead Count													
	SOL-28		SOL-20		SOL-16		SO-16		SO-14		SO-8		SOL-24	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A	0.096	0.104	0.096	0.104	0.096	0.104	0.061	0.068	0.061	0.068	0.061	0.068	0.096	0.104
A_1	0.004	0.011	0.004	0.011	0.004	0.011	0.004	0.010	0.004	0.010	0.004	0.010	0.004	0.011
B	0.014	0.019	0.014	0.019	0.014	0.019	0.014	0.019	0.014	0.019	0.014	0.019	0.014	0.019
C	0.009	0.012	0.009	0.012	0.009	0.012	0.008	0.010	0.008	0.010	0.008	0.010	0.009	0.012
D	0.696	0.712	0.498	0.510	0.397	0.430	0.386	0.394	0.337	0.344	0.189	0.196	0.598	0.614
E	0.291	0.299	0.291	0.299	0.291	0.299	0.150	0.157	0.150	0.157	0.150	0.157	0.291	0.299
e	0.050 BSC		0.050 BSC		0.050 BSC		0.050 BSC		0.050 BSC		0.050 BSC		0.050 BSC	
H	0.398	0.414	0.398	0.414	0.398	0.414	0.230	0.244	0.230	0.244	0.230	0.244	0.398	0.414
h	0.010	0.016	0.010	0.016	0.010	0.016	0.010	0.016	0.010	0.016	0.010	0.016	0.010	0.016
L	0.016	0.024	0.016	0.024	0.016	0.024	0.016	0.024	0.016	0.024	0.016	0.024	0.016	0.024

Package Outlines



MDP0028 Rev. A
5-Lead TO-220
Lead Finish—Solder Plate



MDP0031 Rev. A
Plastic Package
Lead Finish—Hot Solder DIP

Common Dimensions	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A_1	0.020	0.040	0.020	0.040	0.020	0.040	0.020	0.040	0.020	0.040
A	0.125	0.145	0.125	0.145	0.125	0.145	0.125	0.145	0.125	0.145
B	0.016	0.020	0.016	0.020	0.016	0.020	0.016	0.020	0.015	0.021
B_1	0.050	0.070	0.050	0.070	0.050	0.070	0.050	0.070	0.050	0.070
C	0.008	0.012	0.008	0.012	0.008	0.012	0.008	0.012	0.008	0.012
D	0.350	0.385	0.745	0.755	0.745	0.755	0.875	0.905	0.925	1.045
E	0.295	0.320	0.295	0.320	0.295	0.320	0.295	0.320	0.295	0.320
E_1	0.245	0.255	0.245	0.255	0.245	0.255	0.245	0.255	0.245	0.255
e	0.100 Typ		0.100 Typ		0.100 Typ		0.100 Typ		0.100 Typ	
e_A	0.300 Ref		0.300 Ref		0.300 Ref		0.300 Ref		0.300 Ref	
L	0.115	0.135	0.115	0.135	0.115	0.135	0.115	0.135	0.115	0.135
N	8		14		16		18		20	

Note: Package outline exclusive of any mold flashes. Mold flash protrusion shall not exceed 0.006" on any side.