Ultra-High Current Pin Driver

élantec

The EL7158 high performance pin driver with three-state is suited to many ATE and level-shifting applications. The 12A peak drive capability makes this part an excellent choice when driving high capacitance loads.

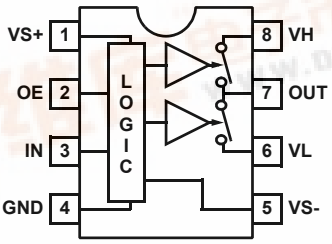
The output pin OUT is connected to input pins V_H or V_L respectively, depending on the status of the IN pin. When the OE pin is active low, the output is placed in the three-state mode. The isolation of the output FETs from the power supplies enables V_H and V_L to be set independently, enabling level-shifting to be implemented. Related to the EL7155, the EL7158 adds a lower supply pin V_S- and makes V_L an isolated and independent input. This feature adds applications flexibility and improves switching response due to the increased enhancement of the output FETs.

This pin driver has improved performance over existing pin drivers. It is specifically designed to operate at voltages down to 0V across the switch elements while maintaining good speed and on-resistance characteristics.

Available in the 8-pin SO package, the EL7158 is specified for operation over the full -40°C to +85°C temperature range.

Pinout

EL7158
(8-PIN SO)
TOP VIEW



Features

- Clocking speeds up to 40MHz
- 12ns t_R/t_F at 2000pF C_{LOAD}
- 0.2ns rise and fall times mismatch
- 0.5ns T_{ON}-T_{OFF} prop delay mismatch
- 3.5pF typical input capacitance
- 12A peak drive
- Low on resistance of 0.5Ω
- High capacitive drive capability
- Operates from 4.5V to 12V
- Pb-free available

Applications

- ATE/burn-in testers
- Level shifting
- IGBT drivers
- CCD drivers

Ordering Information

PART NUMBER	PACKAGE	TAPE & REEL	PKG. DWG. #
EL7158IS	8-Pin SO	-	MDP0027
EL7158IS-T7	8-Pin SO	7”	MDP0027
EL7158IS-T13	8-Pin SO	13”	MDP0027
EL7158ISZ (See Note)	8-Pin SO (Pb-free)	-	MDP0027
EL7158ISZ-T7 (See Note)	8-Pin SO (Pb-free)	7”	MDP0027
EL7158ISZ-T13 (See Note)	8-Pin SO (Pb-free)	13”	MDP0027

NOTE: Intersil Pb-free products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which is compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J Std-020B.

Absolute Maximum Ratings (T_A = 25°C)

Supply Voltage (V_S+ to V_S-) . . . . . +18V
Input Voltage . . . . . V_S- -0.3V, V_S +0.3V
Continuous Output Current 500mA

Storage Temperature Range . . . . . -65°C to +150°C
Ambient operating Temperature . . . . . -40°C to +85°C
Operating Junction Temperature . . . . . 125°C
Power Dissipation . . . . . 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: $T_J = T_C = T_A$

Electrical Specifications

V_S+ = +12V, V_H = +12V, V_L = 0V, V_S- = 0V, T_A = 25°C, unless otherwise specified.

PARAMETER	DESCRIPTION	CONDITION	MIN	TYP	MAX	UNIT
INPUT						
V_{IH}	Logic '1' Input Voltage		2.4			V
I_{IH}	Logic '1' Input Current	$V_{IH} = V_S$+		0.1	10	µA
V_{IL}	Logic '0' Input Voltage				0.8	V
I_{IL}	Logic '0' Input Current	V_{IL} = 0V		0.1	10	µA
C_{IN}	Input Capacitance			3.5		pF
R_{IN}	Input Resistance			50		MΩ
OUTPUT						
R_{OVH}	ON Resistance V_H to OUT	I_{OUT} = -500mA		0.5	1	Ω
R_{OVL}	ON Resistance V_L to OUT	I_{OUT} = +500mA		0.5	1	Ω
I_{OUT}	Output Leakage Current	OE = 0V, OUT = V_H/V_L		0.1	10	µA
I_{PK}	Peak Output Current (linear resistive operation)	Source		12		A
		Sink		12		A
I_{DC}	Continuous Output Current	Source/Sink	500			mA
POWER SUPPLY						
I_S	Power Supply Current	Inputs = V_S+		1.3	3	mA
I_{VH}	Off Leakage at V_H and V_L	V_H, V_L = 0V		4	10	µA
SWITCHING CHARACTERISTICS						
t_R	Rise Time	C_L = 2000pF		12.0		ns
t_F	Fall Time	C_L = 2000pF		12.2		ns
$t_{RF\Delta}$	t_R, t_F Mismatch	C_L = 2000pF		0.2		ns
t_{D-1}	Turn-Off Delay Time	C_L = 2000pF		22.5		ns
t_{D-2}	Turn-On Delay Time	C_L = 2000pF		22.0		ns
$t_{D\Delta}$	t_{D-1}-t_{D-2} Mismatch	C_L = 2000pF		0.5		ns
t_{D-3}	Three-State Delay Enable			22		ns
t_{D-4}	Three-State Delay Disable			22		ns
SR+	V_{OUT}+ Slew Rate	R_{LOAD} = 6Ω		800		V/µs
SR-	V_{OUT}- Slew Rate	R_{LOAD} = 6Ω		800		V/µs

Electrical Specifications $V_S+ = +12V$, $V_H = +1.2V$, $V_L = 0V$, $V_S- = 0V$, $T_A = 25°C$, unless otherwise specified

PARAMETER	DESCRIPTION	CONDITION	MIN	TYP	MAX	UNIT
INPUT						
V_{IH}	Logic '1' Input Voltage		2.0			V
I_{IH}	Logic '1' Input Current	$V_{IH} = V_S+$		0.1	10	µA
V_{IL}	Logic '0' Input Voltage				0.8	V
I_{IL}	Logic '0' Input Current	$V_{IL} = 0V$		0.1	10	µA
C_{IN}	Input Capacitance			3.5		pF
R_{IN}	Input Resistance			50		MΩ
OUTPUT						
R_{OVH}	ON Resistance V_H to OUT	$I_{OUT} = -500mA$		0.5	1	Ω
R_{OVL}	ON Resistance V_L to OUT	$I_{OUT} = +500mA$		0.5	1	Ω
I_{OUT}	Output Leakage Current	OE = 0V, OUT = V_H/V_L		0.1	10	µA
I_{PK}	Peak Output Current (linear resistive operation)	Source		1.2		A
		Sink		1.2		A
I_{DC}	Continuous Output Current	Source/Sink	500			mA
POWER SUPPLY						
I_S	Power Supply Current	Inputs = V_S+		1	2.5	mA
V_H	Off Leakage at V_H and V_L	V_H, $V_L = 0V$		4	10	µA
SWITCHING CHARACTERISTICS						
t_R	Rise Time	$C_L = 2000pF$		11		ns
t_F	Fall Time	$C_L = 2000pF$		11		ns
$t_{RF\Delta}$	t_R, t_F Mismatch	$C_L = 2000pF$		0		ns
t_{D-1}	Turn-Off Delay Time	$C_L = 2000pF$		20.5		ns
t_{D-2}	Turn-On Delay Time	$C_L = 2000pF$		20.0		ns
$t_{D\Delta}$	t_{D-1}-t_{D-2} Mismatch	$C_L = 2000pF$		0.5		ns
t_{D-3}	Three-State Delay Enable			20		ns
t_{D-4}	Three-State Delay Disable			20		ns
SR+	V_{OUT}+ Slew Rate	$R_{LOAD} = 6Ω$		80		V/µs
SR-	V_{OUT}- Slew Rate	$R_{LOAD} = 6Ω$		80		V/µs

Typical Performance Curves

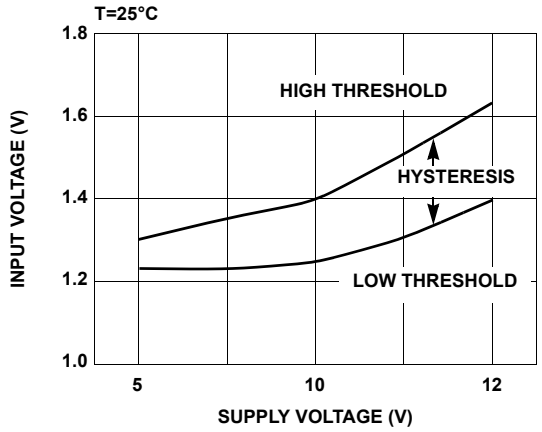


FIGURE 1. INPUT THRESHOLD vs SUPPLY VOLTAGE

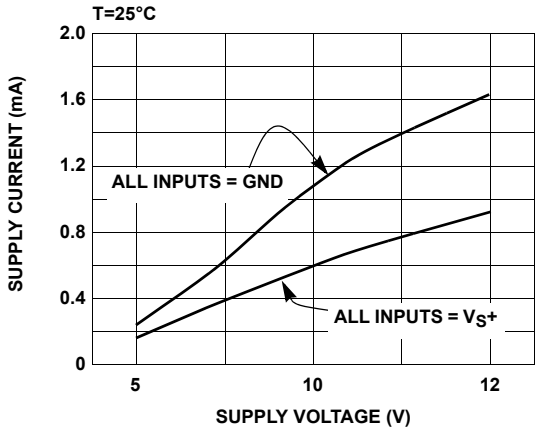


FIGURE 2. QUIESCENT SUPPLY CURRENT vs SUPPLY VOLTAGE

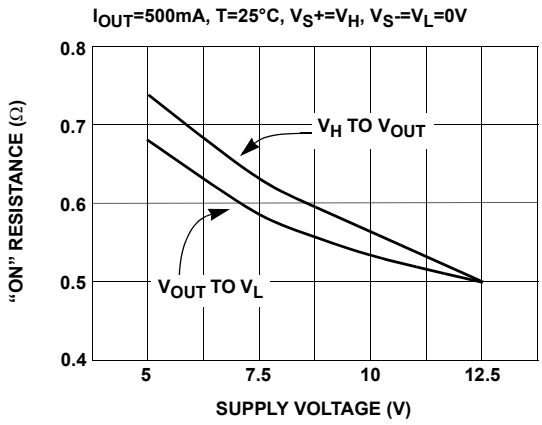


FIGURE 3. "ON" RESISTANCE vs SUPPLY VOLTAGE (V_S+)

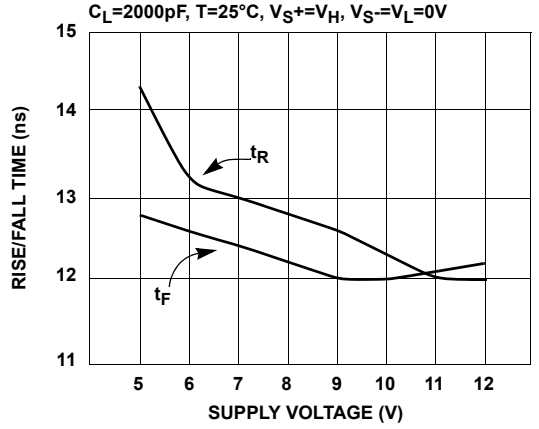


FIGURE 4. RISE/FALL TIME vs SUPPLY VOLTAGE

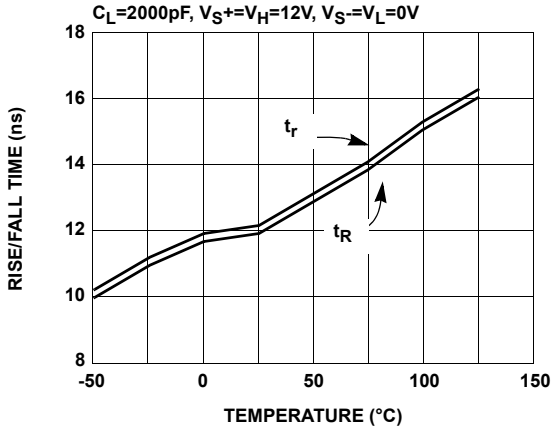


FIGURE 5. RISE/FALL TIME vs TEMPERATURE

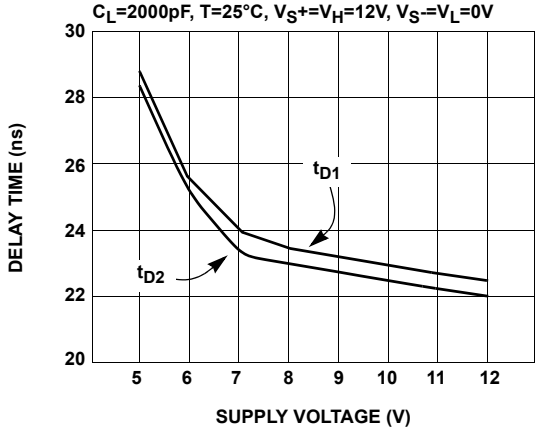


FIGURE 6. PROPAGATION DELAY vs SUPPLY VOLTAGE

Typical Performance Curves (Continued)

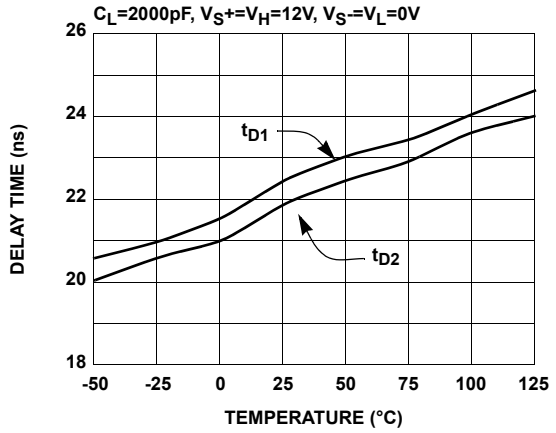


FIGURE 7. PROPAGATION DELAY vs TEMPERATURE

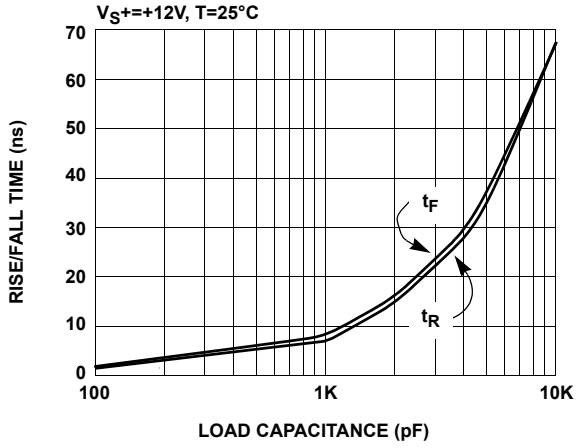


FIGURE 8. RISE/FALL TIME vs LOAD CAPACITANCE

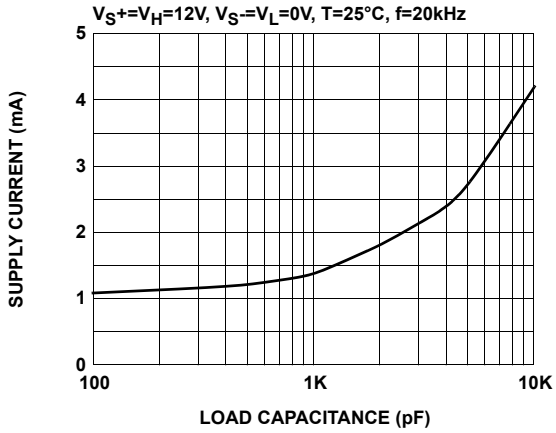


FIGURE 9. SUPPLY CURRENT vs LOAD CAPACITANCE

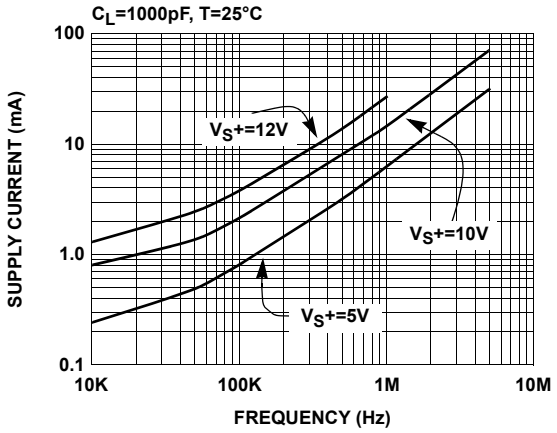


FIGURE 10. SUPPLY CURRENT vs FREQUENCY

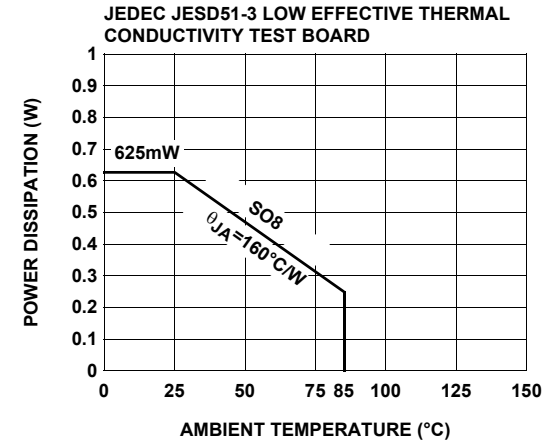


FIGURE 11. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

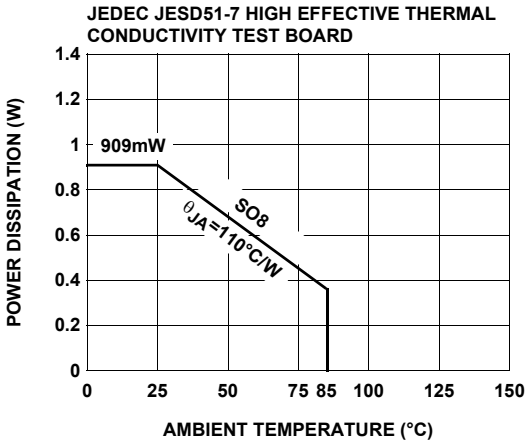


FIGURE 12. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

TABLE 1. TRUTH TABLE

OE	IN	OUT
0	0	Three-State
0	1	Three-State
1	0	V_H
1	1	V_L

TABLE 2. OPERATING VOLTAGE RANGE

PIN	MIN	MAX
GND - V_S-	-5	0
V_S+ - V_S-	5	18
V_H - V_L	0	12
V_S+ - V_H	0	12
V_S+ - GND	5	12
V_L - V_S-	0	12
Three-State Output	V_L	V_H

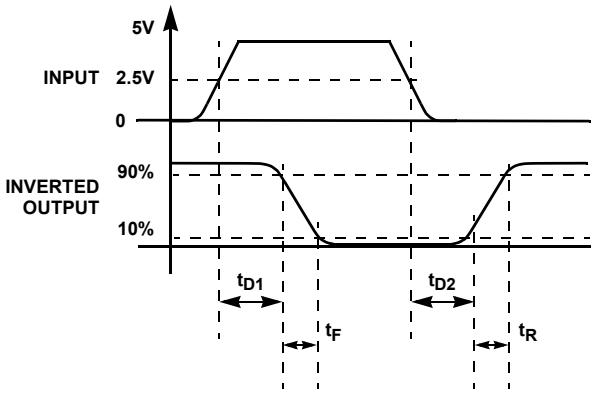


FIGURE 13. TIMING DIAGRAM

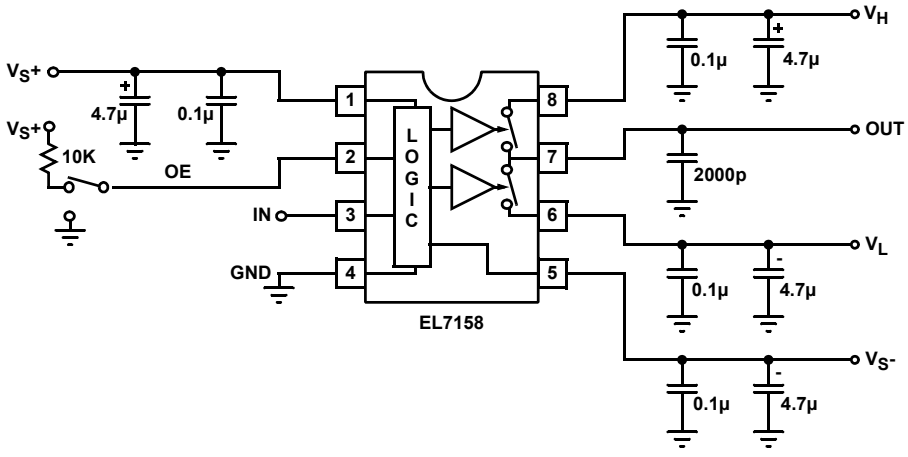
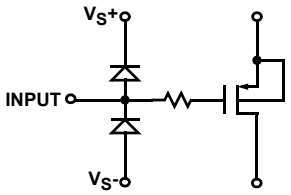
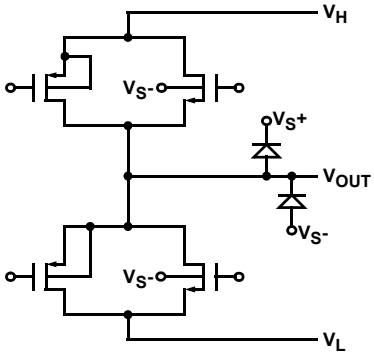


FIGURE 14. STANDARD TEST CONFIGURATION

Pin Descriptions

PIN	NAME	FUNCTION	EQUIVALENT CIRCUIT
1	VS+	Positive Supply Voltage	
2	OE	Output Enable	 Circuit 1
3	IN	Input	Reference Circuit 1
4	GND	Ground	
5	VS-	Negative Supply Voltage	
6	VL	Lower Output Voltage	
7	OUT	Output	 Circuit 2
8	VH	High Output Voltage	

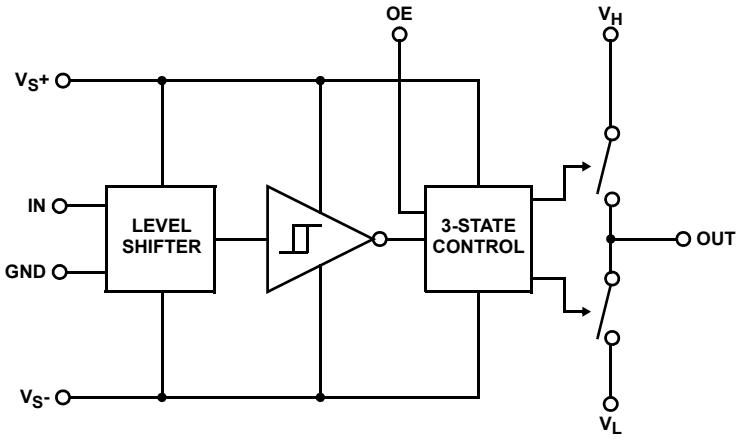


FIGURE 15. BLOCK DIAGRAM

Applications Information

Product Description

The EL7158 is a high performance 40MHz pin driver. It contains two analog switches connecting V_H and V_L to OUT. Depending on the value of the IN pin, one of the two switches will be closed and the other switch open. An output enable (OE) is also supplied which opens both switches simultaneously.

Due to the topology of the EL7158, both the V_H and V_L pins can be connected to any voltage between the V_S+ and V_S- pins, but V_H must be greater than V_L in order to prevent turning on the body diode at the output stage.

Three-State Operation

When the OE pin is low, the output is three-state (floating.) The output voltage is the parasitic capacitance's voltage. It can be any voltage between V_H and V_L, depending on the previous state. At three-state, the output voltage can be pushed to any voltage between V_H and V_L. The output voltage can't be pushed higher than V_H or lower than V_L since the body diode at the output stage will turn on.

Supply Voltage Range and Input Compatibility

The EL7158 is designed for operation on supplies from 5V to 18V (4.5V to 18V maximum). Table 2 shows the specifications for the relationship between the V_S+, V_S-, V_H, V_L, and GND pins.

All input pins are compatible with both 3V and 5V CMOS signals. With a positive supply (V_S+) of 5V, the EL7158 is also compatible with TTL inputs.

Power Supply Bypassing

When using the EL7158, it is very important to use adequate power supply bypassing. The high switching currents developed by the EL7158 necessitate the use of a bypass capacitor between the supplies (V_S+ & V_S-) and GND pins. It is recommended that a 2.2µF tantalum capacitor be used in parallel with a 0.1µF low-inductance ceramic MLC capacitor. These should be placed as close to the supply pins as possible. It is also recommended that the V_H and V_L pins have some level of bypassing, especially if the EL7158 is driving highly capacitive loads.

Power Dissipation Calculation

When switching at high speeds, or driving heavy loads, the EL7158 drive capability is limited by the rise in die temperature brought about by internal power dissipation. For reliable operation die temperature must be kept below T_{JMAX} (125°C). It is necessary to calculate the power dissipation for a given application prior to selecting the package type.

Power dissipation may be calculated:

$$PD = (V_S \times I_S) + (C_{INT} \times V_S^2 \times f) + (C_L \times V_{OUT}^2 \times f)$$

where:

V_S is the total power supply to the EL7158 (from V_S+ to GND)

V_{OUT} is the swing on the output (V_H - V_L)

C_L is the load capacitance

C_{INT} is the internal load capacitance (100pF max)

I_S is the quiescent supply current (3mA max)

f is frequency

Having obtained the application's power dissipation, a maximum package thermal coefficient may be determined, to maintain the internal die temperature below T_{JMAX}:

$$\theta_{JA} = \frac{T_{JMAX} - T_{MAX}}{PD}$$

where:

T_{JMAX} is the maximum junction temperature (125°C)

T_{MAX} is the maximum operating temperature

PD is the power dissipation calculated above

θ_{JA} thermal resistance on junction to ambient

θ_{JA} is 160°C/W for the SO8 package when using a standard JEDEC JESD51-3 single-layer test board. If T_{JMAX} is greater than 125°C when calculated using the equation above, then one of the following actions must be taken:

Reduce θ_{JA} the system by designing more heat-sinking into the PCB (as compared to the standard JEDEC JESD51-3)

De-rate the application either by reducing the switching frequency, the capacitive load, or the maximum operating (ambient) temperature (T_{MAX})