

EL7158

Ultra-High Current Pin Driver

FN7349
Rev 2.00
May 14, 2007

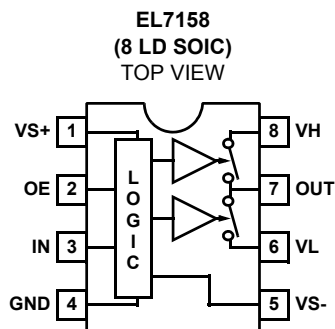
The EL7158 high performance pin driver with three-state is suited to many ATE and level-shifting applications. The 12A peak drive capability makes this part an excellent choice when driving high capacitance loads.

The output pin OUT is connected to input pins VH or VL 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 VH and VL to be set independently, enabling level-shifting to be implemented. Related to the EL7155, the EL7158 adds a lower supply pin VS- and makes VL 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 Ld SOIC package, the EL7158 is specified for operation over the full -40°C to +85°C temperature range.

Pinout



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 plus anneal available (RoHS compliant)

Applications

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

Ordering Information

| PART NUMBER | PART MARKING | PACKAGE | TAPE & REEL | PKG. DWG. # |
|-------------------------|--------------|------------------------|-------------|-------------|
| EL7158IS | 7158IS | 8 Ld SOIC | - | MDP0027 |
| EL7158IS-T7 | 7158IS | 8 Ld SOIC | 7" | MDP0027 |
| EL7158IS-T13 | 7158IS | 8 Ld SOIC | 13" | MDP0027 |
| EL7158ISZ (Note) | 7158ISZ | 8 Ld SOIC (Pb-free) | - | MDP0027 |
| EL7158ISZ-T7 (Note) | 7158ISZ | 8 Ld SOIC (Pb-free) | 7" | MDP0027 |
| EL7158ISZ-T13 (Note) | 7158ISZ | 8 Ld SOIC (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 ($T_A = +25^\circ\text{C}$)

| | |
|---|---|
| Supply Voltage (V_{S+} to V_{S-}) | +18V |
| Input Voltage | $V_{S-} - 0.3\text{V}$, $V_{S+} + 0.3\text{V}$ |
| Continuous Output Current | 500mA |

Thermal Information

| | |
|--------------------------------|---|
| 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 |
| Pb-free reflow profile | see link below http://www.intersil.com/pbfree/Pb-FreeReflow.asp |

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 $V_{S+} = +12\text{V}$, $V_H = +12\text{V}$, $V_L = 0\text{V}$, $V_{S-} = 0\text{V}$, $T_A = +25^\circ\text{C}$, 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 | $V_{IL} = 0\text{V}$ | | 0.1 | 10 | μA |
| C_{IN} | Input Capacitance | | | 3.5 | | pF |
| R_{IN} | Input Resistance | | | 50 | | M Ω |
| OUTPUT | | | | | | |
| R_{OVH} | ON-Resistance V_H to OUT | $I_{OUT} = -500\text{mA}$ | | 0.5 | 1 | Ω |
| R_{OVL} | ON-Resistance V_L to OUT | $I_{OUT} = +500\text{mA}$ | | 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 | $V_H, V_L = 0\text{V}$ | | 4 | 10 | μA |
| SWITCHING CHARACTERISTICS | | | | | | |
| t_R | Rise Time | $C_L = 2000\text{pF}$ | | 12.0 | | ns |
| t_F | Fall Time | $C_L = 2000\text{pF}$ | | 12.2 | | ns |
| $t_{RF\Delta}$ | t_R, t_F Mismatch | $C_L = 2000\text{pF}$ | | 0.2 | | ns |
| t_{d-1} | Turn-Off Delay Time | $C_L = 2000\text{pF}$ | | 22.5 | | ns |
| t_{d-2} | Turn-On Delay Time | $C_L = 2000\text{pF}$ | | 22.0 | | ns |
| $t_{d\Delta}$ | $t_{d-1} - t_{d-2}$ Mismatch | $C_L = 2000\text{pF}$ | | 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 | $R_{LOAD} = 6\Omega$ | | 800 | | V/ μs |
| SR- | V_{OUT-} Slew Rate | $R_{LOAD} = 6\Omega$ | | 800 | | V/ μs |

Electrical Specifications $V_{S+} = +12V$, $V_H = +1.2V$, $V_L = 0V$, $V_{S-} = 0V$, $T_A = +25^\circ C$, unless otherwise specified. (Continued)

| 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 | | $M\Omega$ |
| 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 | $R_{LOAD} = 6\Omega$ | | 80 | | V/ μs |
| SR- | V_{OUT-} Slew Rate | $R_{LOAD} = 6\Omega$ | | 80 | | V/ μs |

Typical Performance Curves

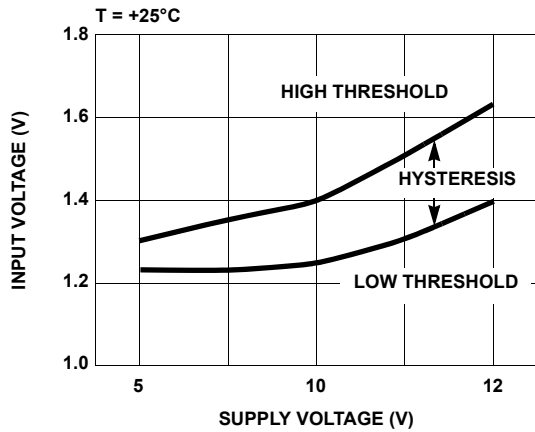


FIGURE 1. INPUT THRESHOLD vs SUPPLY VOLTAGE

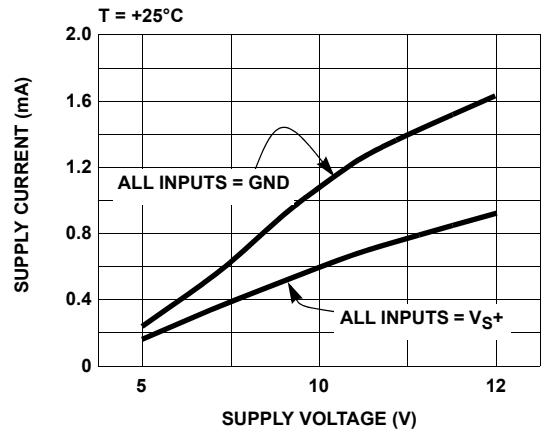


FIGURE 2. QUIESCENT SUPPLY CURRENT vs SUPPLY VOLTAGE

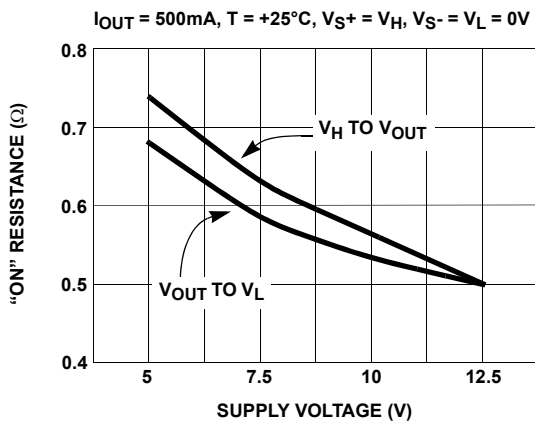


FIGURE 3. "ON"-RESISTANCE vs SUPPLY VOLTAGE (V_{S+})

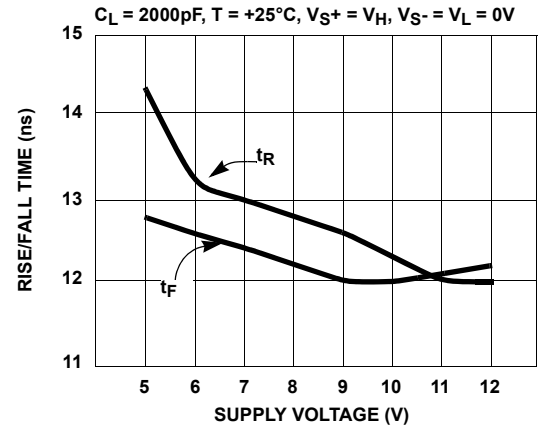


FIGURE 4. RISE/FALL TIME vs SUPPLY VOLTAGE

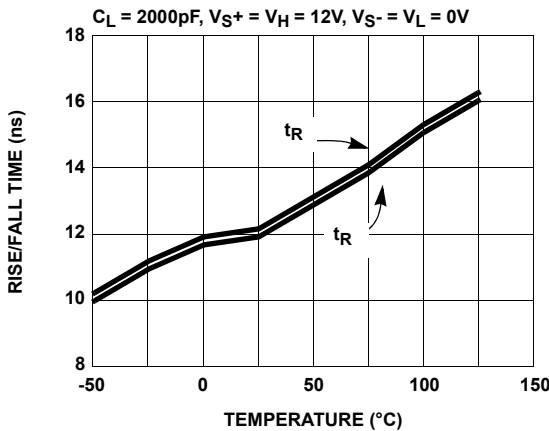


FIGURE 5. RISE/FALL TIME vs TEMPERATURE

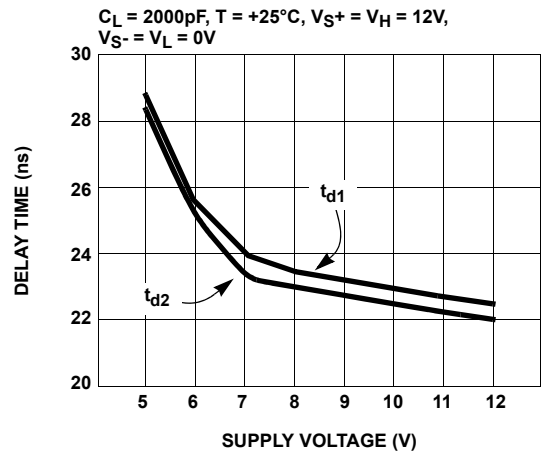


FIGURE 6. PROPAGATION DELAY vs SUPPLY VOLTAGE

Typical Performance Curves (Continued)

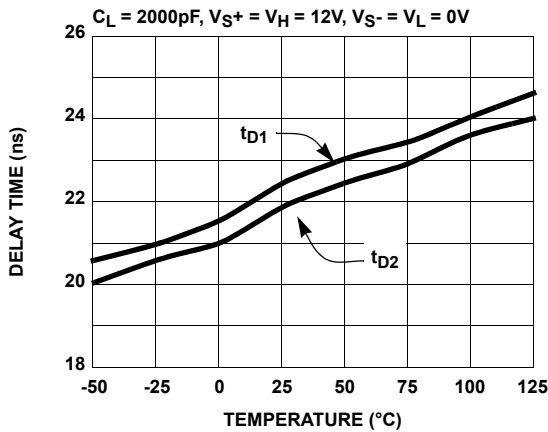


FIGURE 7. PROPAGATION DELAY vs TEMPERATURE

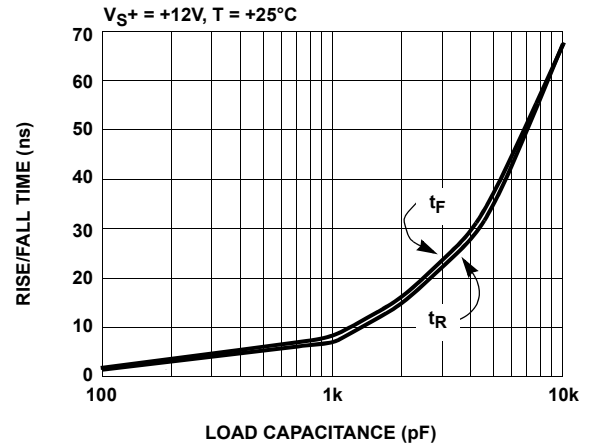


FIGURE 8. RISE/FALL TIME vs LOAD CAPACITANCE

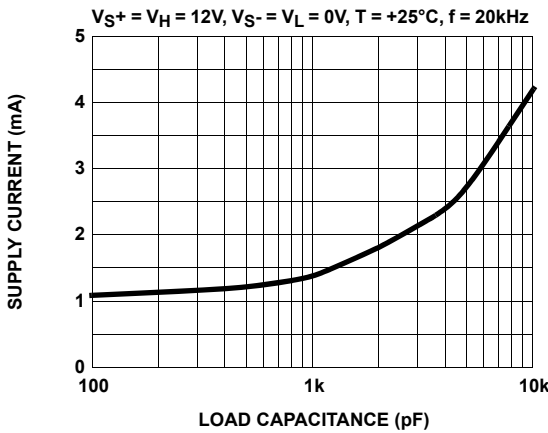


FIGURE 9. SUPPLY CURRENT vs LOAD CAPACITANCE

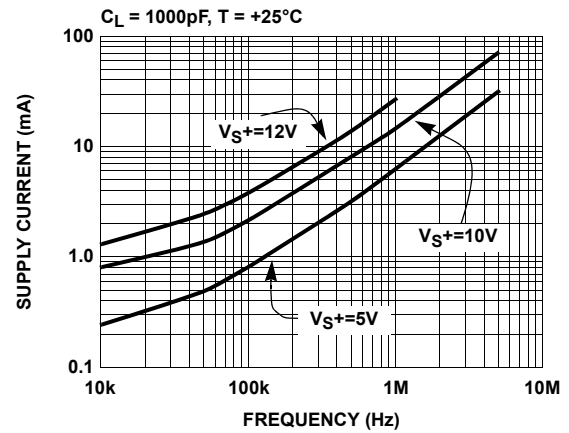


FIGURE 10. SUPPLY CURRENT vs FREQUENCY

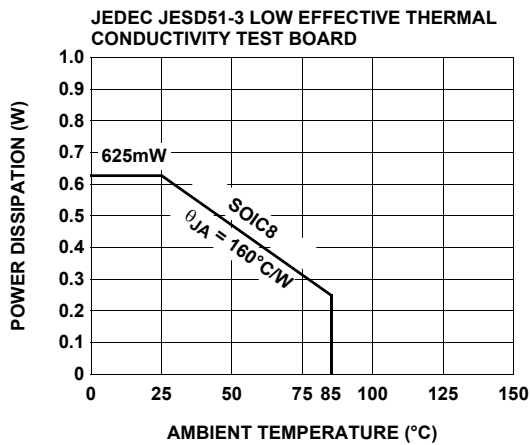


FIGURE 11. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

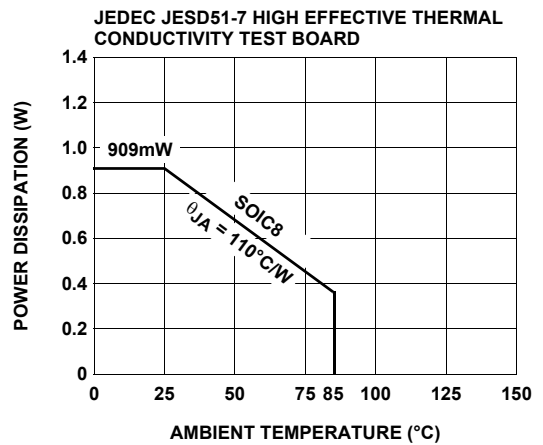


FIGURE 12. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

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 |
|------------------------------------|----------------|----------------|
| V _{S-} to GND | -5 | 0 |
| V _{S+} to V _{S-} | 5 | 18 |
| V _H to V _L | 0 | 12 |
| V _{S+} to V _H | 0 | 12 |
| V _{S+} to GND | 5 | 12 |
| V _L to V _{S-} | 0 | 12 |
| Three-State Output | V _L | V _H |

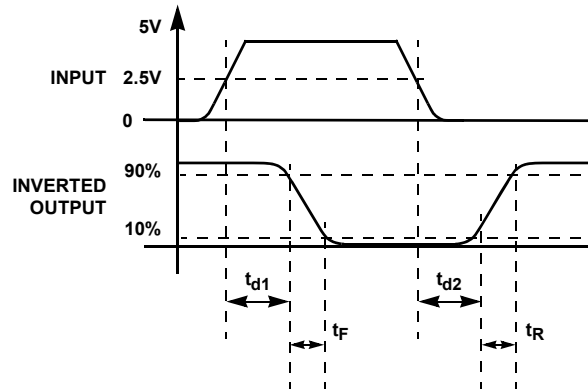


FIGURE 13. TIMING DIAGRAM

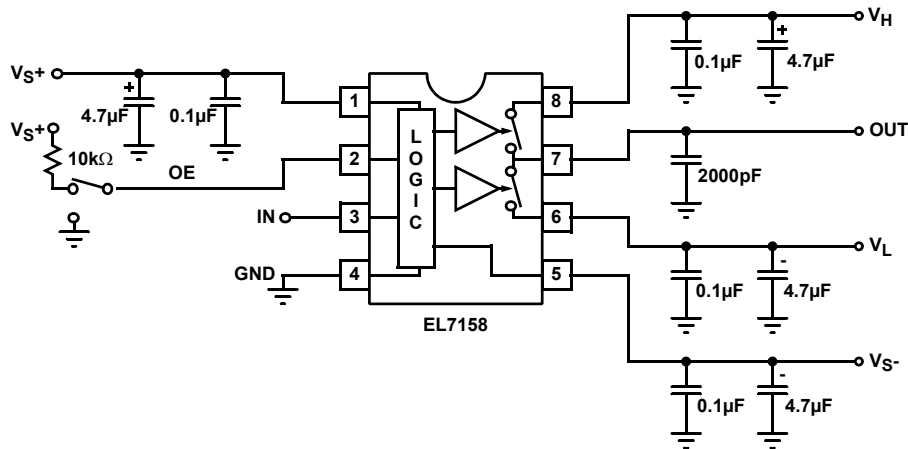


FIGURE 14. STANDARD TEST CONFIGURATION

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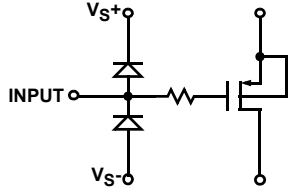
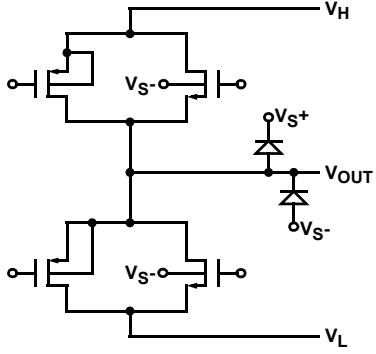
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Pin Descriptions

| PIN | NAME | FUNCTION | EQUIVALENT CIRCUIT |
|-----|------|-------------------------|---|
| 1 | VS+ | Positive Supply Voltage | |
| 2 | OE | Output Enable |  <p style="text-align: center;">Circuit 1</p> |
| 3 | IN | Input | Reference Circuit 1 |
| 4 | GND | Ground | |
| 5 | VS- | Negative Supply Voltage | |
| 6 | VL | Lower Output Voltage | |
| 7 | OUT | Output |  <p style="text-align: center;">Circuit 2</p> |
| 8 | VH | High Output Voltage | |

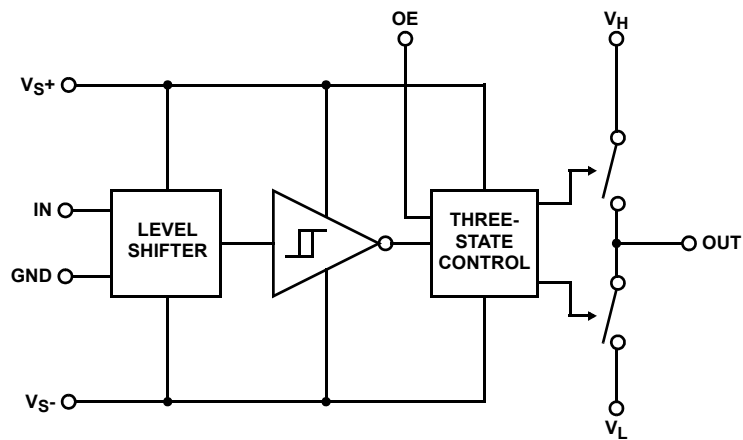


FIGURE 15. BLOCK DIAGRAM

Applications Information

Product Description

The EL7158 is a high performance 40MHz pin driver. It contains two analog switches connecting VH and VL 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 VH and VL pins can be connected to any voltage between the VS+ and VS- pins, but VH must be greater than VL 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 VH and VL, depending on the previous state. At three-state, the output voltage can be pushed to any voltage between VH and VL. The output voltage can't be pushed higher than VH or lower than VL 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 VS+, VS-, VH, VL, and GND pins.

All input pins are compatible with both 3V and 5V CMOS signals. With a positive supply (VS+) 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 (VS+ and VS-) 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 VH and VL 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 TJMAX (+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:

$$PD = (V_S \times I_S) + (C_{INT} \times V_S^2 \times f) + (C_L \times V_{OUT}^2 \times f) \quad (\text{EQ. 1})$$

where:

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

VOUT is the swing on the output (VH - VL)

CL is the load capacitance

CINT is the internal load capacitance (100pF max)

IS 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 TJMAX:

$$\theta_{JA} = \frac{T_{JMAX} - T_{MAX}}{PD} \quad (\text{EQ. 2})$$

where:

TJMAX is the maximum junction temperature (+125°C)

TMAX is the maximum operating temperature

PD is the power dissipation calculated above

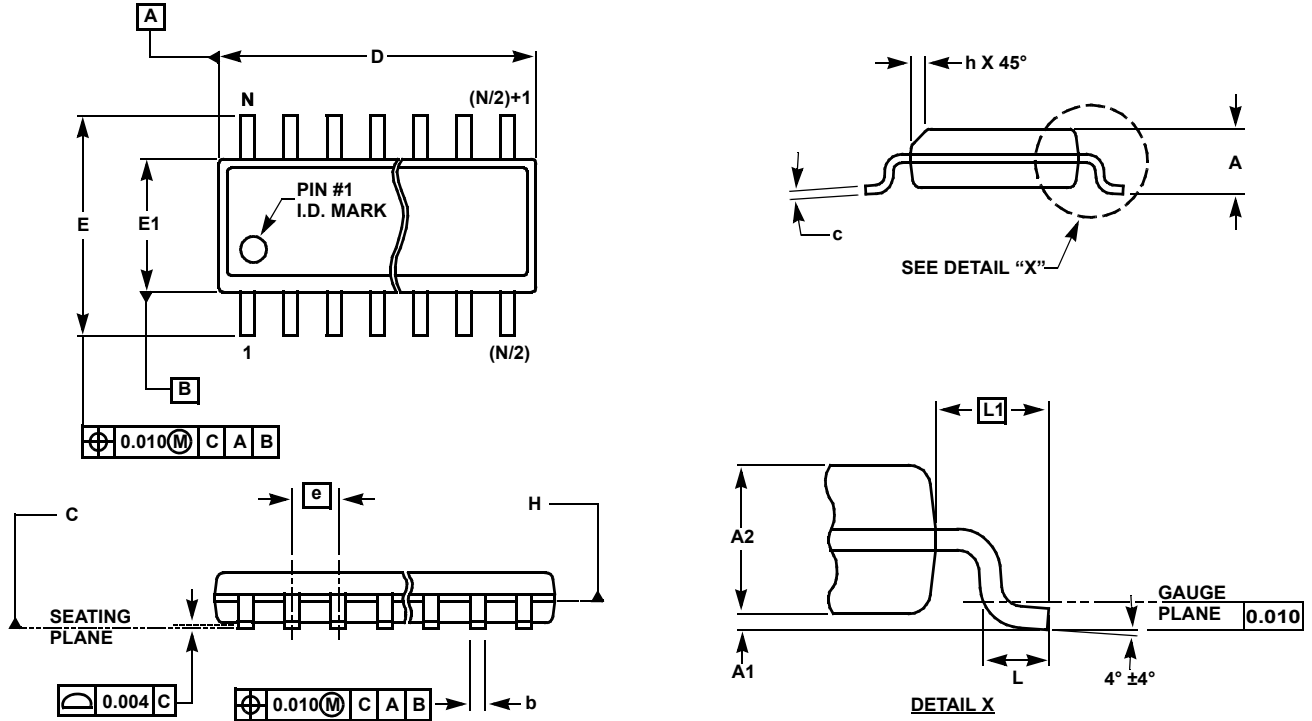
θJA thermal resistance on junction to ambient

θJA is 160°C/W for the SOIC8 package when using a standard JEDEC JESD51-3 single-layer test board. If TJMAX is greater than +125°C when calculated using Equation 2, then one of the following actions must be taken:

Reduce θJA 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 (TMAX)

Small Outline Package Family (SO)



MDP0027

SMALL OUTLINE PACKAGE FAMILY (SO)

| SYMBOL | INCHES | | | | | | | TOLERANCE | NOTES |
|--------|--------|-------|---------------|------------------------|---------------|---------------|---------------|-----------|-------|
| | SO-8 | SO-14 | SO16 (0.150") | SO16 (0.300") (SOL-16) | SO20 (SOL-20) | SO24 (SOL-24) | SO28 (SOL-28) | | |
| A | 0.068 | 0.068 | 0.068 | 0.104 | 0.104 | 0.104 | 0.104 | MAX | - |
| A1 | 0.006 | 0.006 | 0.006 | 0.007 | 0.007 | 0.007 | 0.007 | ±0.003 | - |
| A2 | 0.057 | 0.057 | 0.057 | 0.092 | 0.092 | 0.092 | 0.092 | ±0.002 | - |
| b | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | ±0.003 | - |
| c | 0.009 | 0.009 | 0.009 | 0.011 | 0.011 | 0.011 | 0.011 | ±0.001 | - |
| D | 0.193 | 0.341 | 0.390 | 0.406 | 0.504 | 0.606 | 0.704 | ±0.004 | 1, 3 |
| E | 0.236 | 0.236 | 0.236 | 0.406 | 0.406 | 0.406 | 0.406 | ±0.008 | - |
| E1 | 0.154 | 0.154 | 0.154 | 0.295 | 0.295 | 0.295 | 0.295 | ±0.004 | 2, 3 |
| e | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | Basic | - |
| L | 0.025 | 0.025 | 0.025 | 0.030 | 0.030 | 0.030 | 0.030 | ±0.009 | - |
| L1 | 0.041 | 0.041 | 0.041 | 0.056 | 0.056 | 0.056 | 0.056 | Basic | - |
| h | 0.013 | 0.013 | 0.013 | 0.020 | 0.020 | 0.020 | 0.020 | Reference | - |
| N | 8 | 14 | 16 | 16 | 20 | 24 | 28 | Reference | - |

Rev. M 2/07

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