

## Features

- Clocking Speeds up to 40MHz
- 15ns tr/tf at 2000pF C<sub>LOAD</sub>
- 0.5ns Rise and Fall Times Mismatch
- 0.5ns T<sub>ON</sub>-T<sub>OFF</sub> Prop Delay Mismatch
- 3.5pF Typical Input Capacitance
- 3.5A Peak Drive
- Low on Resistance of 3.5Ω
- High Capacitive Drive Capability
- Operates from 4.5V to 18V

## Applications

- ATE/Burn-in Testers
- Level Shifting
- IGBT Drivers
- CCD Drivers

## Ordering Information

Part No.	Package	Tape & Reel	Outline #
EL7156CN	8-Pin DIP	-	MDP0031
EL7156CS	8-Pin SOIC	-	MDP0027
EL7156CS-T7	8-Pin SOIC	7"	MDP0027
EL7156CS-T13	8-Pin SOIC	13"	MDP0027

## General Description

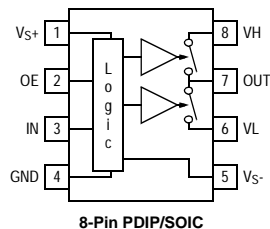
The EL7156C high-performance pin driver with tri-state is suited to many ATE and level-shifting applications. The 3.5A peak drive capability makes this part an excellent choice when driving high capacitance loads.

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 tri-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 EL7155C, the EL7156C adds a lower supply pin V<sub>S-</sub> 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-Pin SOIC and 8-Pin PDIP packages, the EL7156C is specified for operation over the -40°C to +85°C temperature range.

## Pin Configuration



# EL7156C

## High Performance Pin Driver

### Absolute Maximum Ratings (T<sub>A</sub> = 25°C)

Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Supply Voltage (V <sub>S+</sub> to V <sub>S-</sub> )	+18V
Input Voltage	V <sub>S-</sub> -0.3V, V <sub>S</sub> +0.3V
Continuous Output Current	200mA

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
Maximum ESD	2kV

#### Important Note:

All parameters having Min/Max specifications are guaranteed. Typ values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: T<sub>J</sub> = T<sub>C</sub> = T<sub>A</sub>.

### Electrical Characteristics

V<sub>S+</sub> = +15V, V<sub>H</sub> = +15V, V<sub>L</sub> = 0V, V<sub>S-</sub> = 0V, T<sub>A</sub> = 25°C, unless otherwise specified

Parameter	Description	Condition	Min	Typ	Max	Units
<b>Input</b>						
V <sub>IH</sub>	Logic '1' Input Voltage		2.4			V
I <sub>IH</sub>	Logic '1' Input Current	V <sub>IH</sub> = V <sub>S+</sub>		0.1	10	μA
V <sub>IL</sub>	Logic '0' Input Voltage				0.8	V
I <sub>IL</sub>	Logic '0' Input Current	V <sub>IL</sub> = 0V		0.1	10	μA
C <sub>IN</sub>	Input Capacitance			3.5		pF
R <sub>IN</sub>	Input Resistance			50		MΩ
<b>Output</b>						
R <sub>OVH</sub>	ON Resistance V <sub>H</sub> to OUT	I <sub>OUT</sub> = -200 mA		2.7	4.5	Ω
R <sub>OVL</sub>	ON Resistance V <sub>L</sub> to OUT	I <sub>OUT</sub> = +200 mA		3.5	5.5	Ω
I <sub>OUT</sub>	Output Leakage Current	OE = 0V, OUT = V <sub>H</sub> /V <sub>L</sub>		0.1	10	μA
I <sub>PK</sub>	Peak Output Current (linear resistive operation)	Source		3.5		A
		Sink		3.5		A
I <sub>DC</sub>	Continuous Output Current	Source/Sink	200			mA
<b>Power Supply</b>						
I <sub>S</sub>	Power Supply Current	Inputs = V <sub>S+</sub>		1.3	3	mA
I <sub>VH</sub>	Off Leakage at V <sub>H</sub> and V <sub>L</sub>	V <sub>H</sub> , V <sub>L</sub> = 0V		4	10	μA
<b>Switching Characteristics</b>						
t <sub>R</sub>	Rise Time	C <sub>L</sub> = 2000 pF		14.5		ns
t <sub>F</sub>	Fall Time	C <sub>L</sub> = 2000 pF		15		ns
t <sub>RFdelta</sub>	t <sub>R</sub> , t <sub>F</sub> Mismatch	C <sub>L</sub> = 2000 pF		0.5		ns
t <sub>D-1</sub>	Turn-Off Delay Time	C <sub>L</sub> = 2000 pF		9.5		ns
t <sub>D-2</sub>	Turn-On Delay Time	C <sub>L</sub> = 2000 pF		10		ns
t <sub>Ddelta</sub>	t <sub>D-1</sub> -t <sub>D-2</sub> Mismatch	C <sub>L</sub> = 2000 pF		0.5		ns
t <sub>D-3</sub>	Tri-State Delay Enable			10		ns
t <sub>D-4</sub>	Tri-State Delay Disable			10		ns

## Electrical Characteristics

$V_{S+} = +5V$ ,  $V_H = +5V$ ,  $V_L = -5V$ ,  $V_{S-} = -5V$ ,  $T_A = 25^\circ C$ , unless otherwise specified

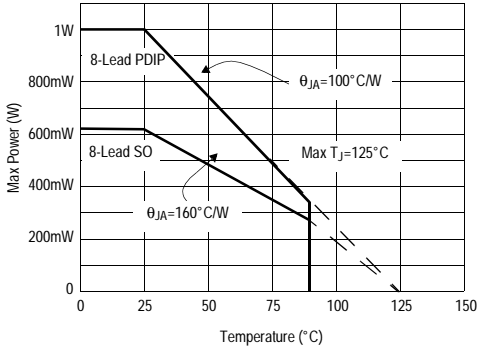
Parameter	Description	Condition	Min	Typ	Max	Units
<b>Input</b>						
$V_{IH}$	Logic '1' Input Voltage		2.0			V
$I_{IH}$	Logic '1' Input Current	$V_{IH} = V_{S+}$		0.1	10	$\mu A$
$V_{IL}$	Logic '0' Input Voltage				0.8	V
$I_{IL}$	Logic '0' Input Current	$V_{IL} = 0V$		0.1	10	$\mu A$
$C_{IN}$	Input Capacitance			3.5		pF
$R_{IN}$	Input Resistance			50		M $\Omega$
<b>Output</b>						
$R_{OVH}$	ON Resistance VH to OUT	$I_{OUT} = -200 mA$		3.4	5	$\Omega$
$R_{OVL}$	ON Resistance VL to OUT	$I_{OUT} = +200 mA$		4	6	$\Omega$
$I_{OUT}$	Output Leakage Current	$OE = 0V$ , $OUT = VH/VL$		0.1	10	$\mu A$
$I_{PK}$	Peak Output Current (linear resistive operation)	Source		3.5		A
		Sink		3.5		A
$I_{DC}$	Continuous Output Current	Source/Sink	200			mA
<b>Power Supply</b>						
$I_S$	Power Supply Current	Inputs = $V_{S+}$		1	2.5	mA
$V_H$	Off Leakage at VH and VL	$V_H, V_L = 0V$		4	10	$\mu A$
<b>Switching Characteristics</b>						
$t_R$	Rise Time	$C_L = 2000 pF$		17		ns
$t_F$	Fall Time	$C_L = 2000 pF$		17		ns
$t_{RFdelta}$	$t_R, t_F$ Mismatch	$C_L = 2000 pF$		0		ns
$t_{D-1}$	Turn-Off Delay Time	$C_L = 2000 pF$		11.5		ns
$t_{D-2}$	Turn-On Delay Time	$C_L = 2000 pF$		12		ns
$t_{Ddelta}$	$t_{D-1} - t_{D-2}$ Mismatch	$C_L = 2000 pF$		0.5		ns
$t_{D-3}$	Tri-State Delay Enable			10		ns
$t_{D-4}$	Tri-State Delay Disable			10		ns

# EL7156C

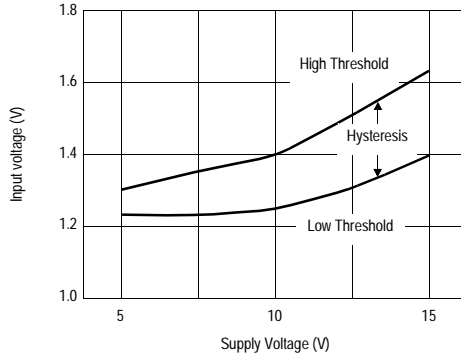
High Performance Pin Driver

## Typical Performance Curves

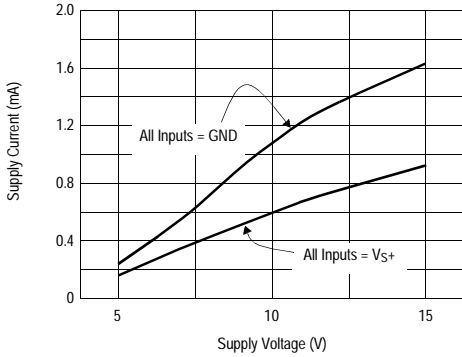
Max Power/Derating Curves



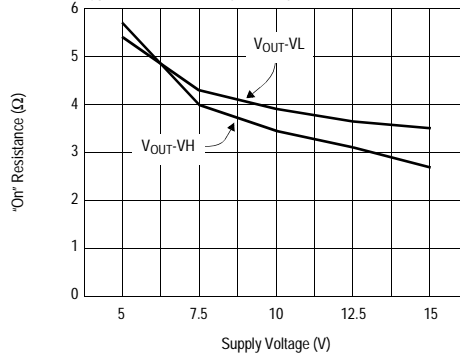
Input Threshold vs Supply Voltage  
 $T = 25^\circ\text{C}$



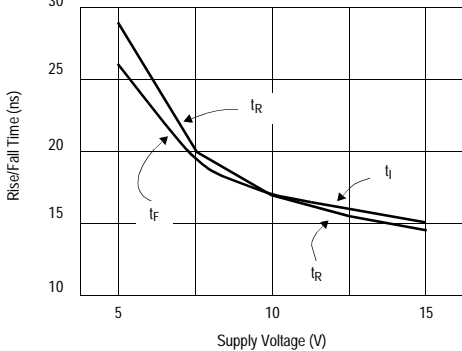
Quiescent Supply Current vs Supply Voltage  
 $T = 25^\circ\text{C}$



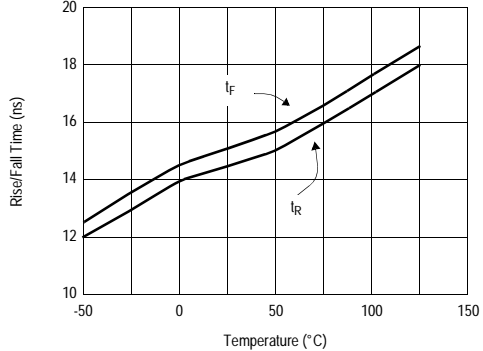
"On" Resistance vs Supply Voltage  
 $I_{OUT} = 200\text{mA}$ ,  $T = 25^\circ\text{C}$ ,  $V_{S+} = V_H$ ,  $V_S = V_L = 0V$



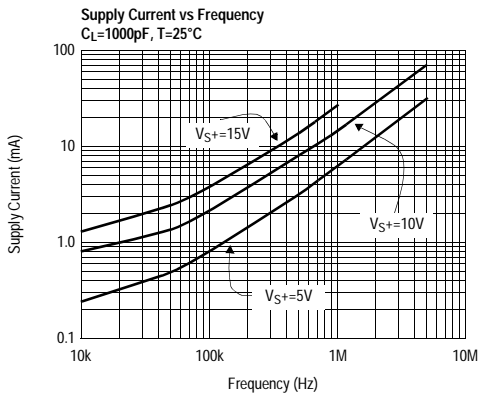
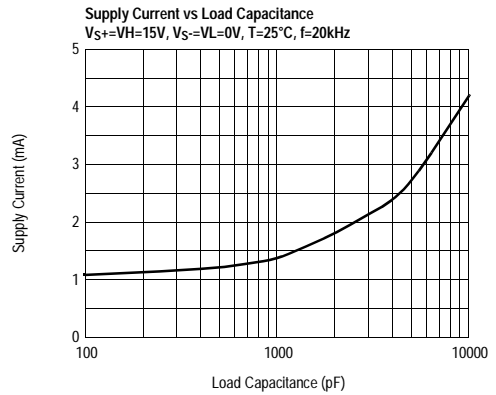
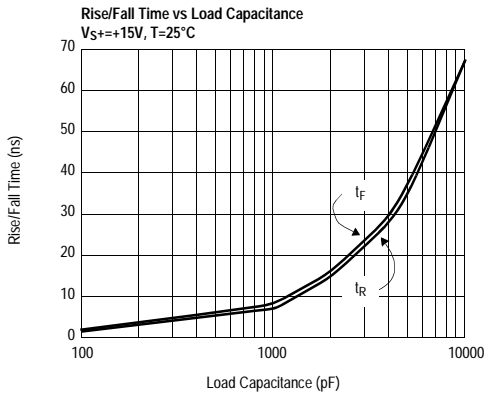
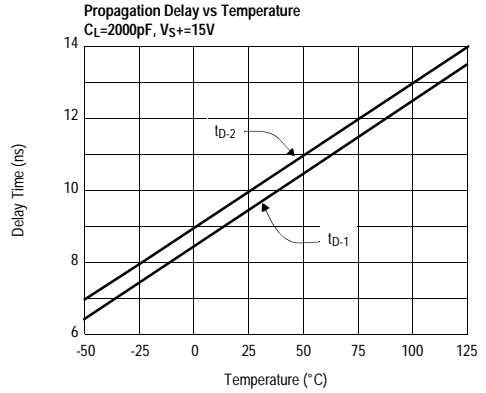
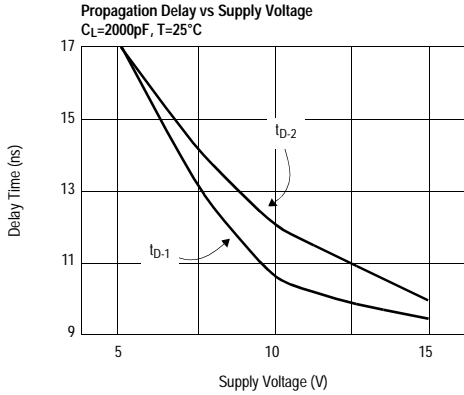
Rise/Fall Time vs Supply Voltage  
 $C_L = 2000\text{pF}$ ,  $T = 25^\circ\text{C}$



Rise/Fall Time vs Temperature  
 $C_L = 2000\text{pF}$ ,  $V_{S+} = 15V$



### Typical Performance Curves



# EL7156C

## High Performance Pin Driver

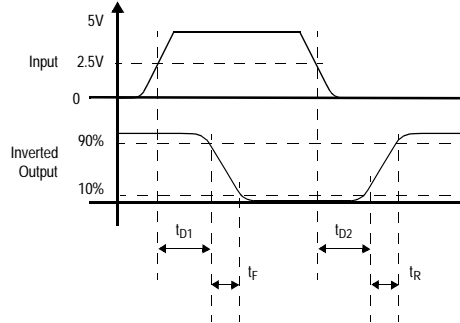
### Truth Table

OE	IN	OUT
0	0	Tri-state
0	1	Tri-state
1	0	VH
1	1	VL

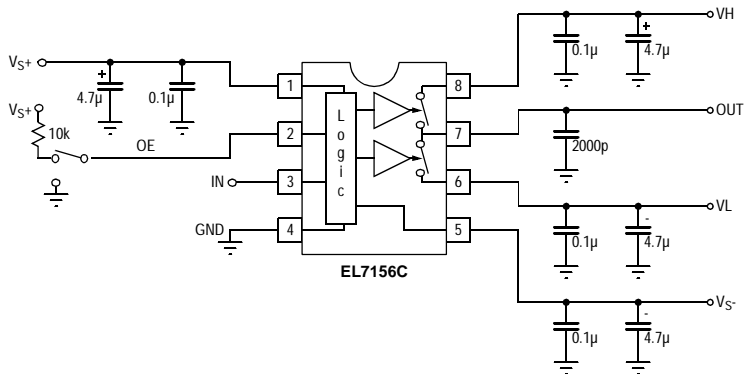
### Operating Voltage Range

PIN	MIN	MAX
GND - $V_{S-}$	-5	0
$V_{S+}$ - $V_{S-}$	5	18
VH - VL	-18	18
$V_{S+}$ - VH	0	18
$V_{S+}$ - GND	5	18

### Timing Diagram



### Standard Test Configuration



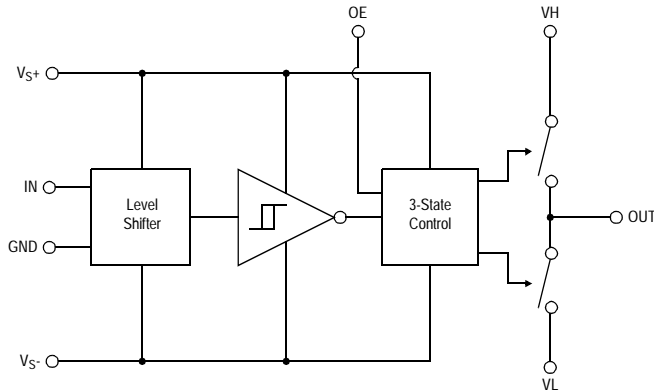
## Pin Description

Pin	Name	Function	Equivalent Circuit
1	V <sub>S+</sub>	Positive Supply Voltage	
2	OE	Output Enable	<p style="text-align: center;"><b>Circuit 1</b></p>
3	IN	Input	Reference Circuit 1
4	GND	Ground	
5	V <sub>S-</sub>	Negative Supply Voltage	
6	VL	Lower Output Voltage	
7	OUT	Output	<p style="text-align: center;"><b>Circuit 2</b></p>
8	VH	High Output Voltage	

# EL7156C

## High Performance Pin Driver

### Block Diagram



### Application Information

#### Product Description

The EL7156C 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 EL7156C, both the VH and VL pins can be connected to any voltage between the  $V_{S+}$  and  $V_{S-}$  pins.

The EL7156C is available in both the 8-pin SOIC and the 8-pin PDIP packages. The relevant package should be chosen depending on the calculated power dissipation.

#### Supply Voltage Range and Input Compatibility

The EL7156C is designed for operation on supplies from 5V to 15V (4.5V to 18V maximum). The table on page 6 shows the specifications for the relationship between the  $V_{S+}$ ,  $V_{S-}$ , VH, VL and GND pins.

All input pins are compatible with both 3V and 5V CMOS signals. With a positive supply ( $V_{S+}$ ) of 5V, the EL7156C is also compatible with TTL inputs.

#### Power Supply Bypassing

When using the EL7156C, it is very important to use adequate power supply bypassing. The high switching currents developed by the EL7156C necessitate the use of a bypass capacitor between the supplies ( $V_{S+}$  &  $V_{S-}$ ) and GND pins. It is recommended that a 2.2 $\mu$ F tantalum capacitor be used in parallel with a 0.1 $\mu$ F 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 EL7156C is driving highly capacitive loads.

#### Power Dissipation Calculation

When switching at high speeds, or driving heavy loads, the EL7156C 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 EL7156C (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 (50pF max.),
- $I_S$  is the quiescent supply current (3mA max.) and
- $f$  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,
- $\theta_{ja}$  thermal resistance on junction to ambient.

$\theta_{ja}$  is 160°C/W for the SO8 package and 100°C/W for the PDIP8 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  $\theta_{ja}$  the system by designing more heat-sinking into the PCB (as compared to the standard JEDEC JESD51-3)
- Use the PDIP8 instead of the SO8 package
- De-rate the application either by reducing the switching frequency, the capacitive load, or the maximum operating (ambient) temperature ( $T_{max}$ )

# EL7156C

*High Performance Pin Driver*

## General Disclaimer

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HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

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