30V, 5A Dual-Channel Low-Side Gate Driver

GENERAL DESCRIPTION

The SL27624 is a dual-channel, high-speed, low-side gate drivers that can effectively drive MOSFET and IGBT power switches. Using a design that inherently minimizes shoot-through current, SL27624 can source and sink high peak-current pulses into capacitive loads offering rail-to-rail drive capability and extremely small propagation delay, typically 20ns.

The SL27624 provides 5.0 A source, 5.0 A sink peak-drive current capability at 12V VDD supply.

APPLICATIONS

- Switching mode power supplies
- DC-to-DC converters
- Motor Control, solar power
- Gate drive for emerging wide band-gap power devices such as GaN

FEATURES

- Two independent gate drive channels
- 5.0 A peak source and 5.0 A peak sink current drive capability
- Fast propagation delay (20ns typical)
- Fast rise and fall time (7ns and 6ns typical)
- 4.5 to 30V single supply range
- Under-voltage lockout
- TTL and CMOS compatible input logic threshold
- Ability to handle negative voltages (-5V) at inputs
- 2ns typical delay matching between two channels
- Two outputs are paralleled for higher drive current
- Outputs held in low when inputs floating
- Operating temperature range of -40°C to 150°C
- SOP8 and MSOP8-EP package options

TYPICAL APPLICATION CIRCUIT

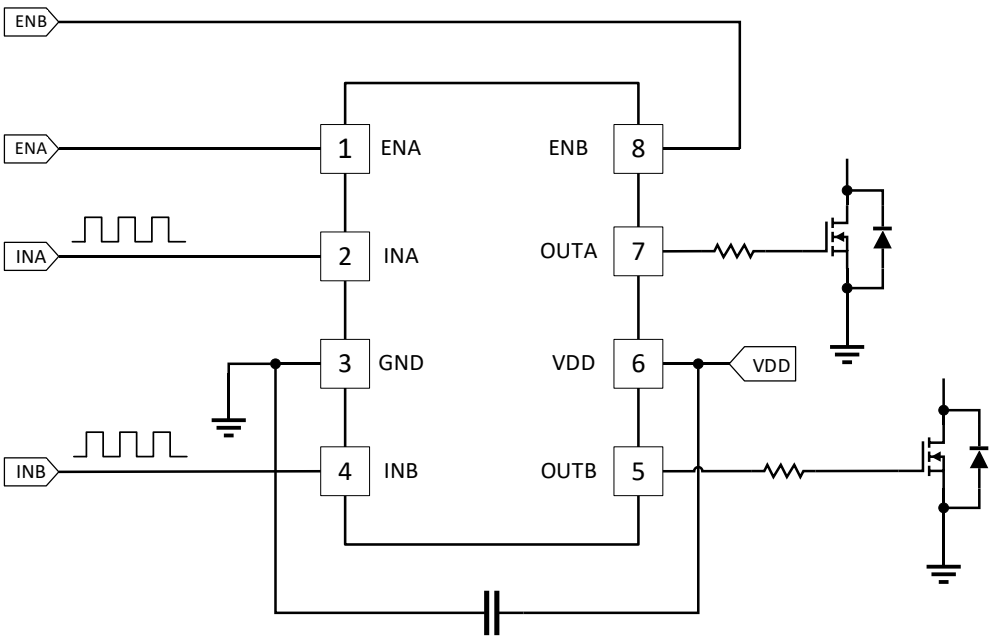
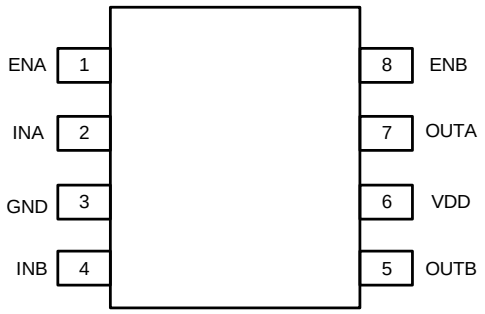
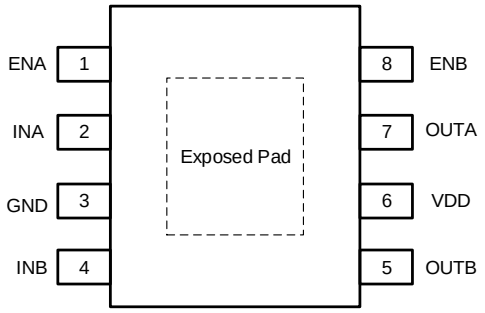


Figure 1. Typical Application Circuit

PIN CONFIGURATION

Package	Pin Configuration (Top View)
SOP8	
MSOP8-EP	

PIN DESCRIPTION

No.	Pin	Description
1	ENA	Enable input for channel A. When ENA is low, the channel A output is disabled regardless of the INA state. When ENA is high, the channel A is enabled. ENA is enabled by default due to the internal pull-up resistor. Recommend to connect the ENA to VDD if this pin is not used.
2	INA	Input of channel A. the OUTA is in phase with INA. OUTA is held low if INA is floating due to the internal pull down resistor. Recommend to connect the INA to ground if this pin is not used.
3	GND	Ground. All signals are referenced to this pin.
4	INB	Input of channel B. the OUTB is in phase with INB. OUTB is held low if INB is floating due to the internal pull down resistor. Recommend to connect the INB to ground if this pin is not used.
5	OUTB	Output of channel B.
6	VDD	Bias Supply Input.
7	OUTA	Output of channel A
8	ENB	Enable input for channel B. When ENB is low, the channel B output is disabled regardless of the INB state. When ENB is high, the channel B is enabled. ENB is enabled by default due to the internal pull-up resistor. It is recommended to connect the ENB to VDD if this pin is not used.
	EP	Exposed pad, connect to ground. Only for MSOP8-EP

FUNCTIONAL BLOCK DIAGRAM

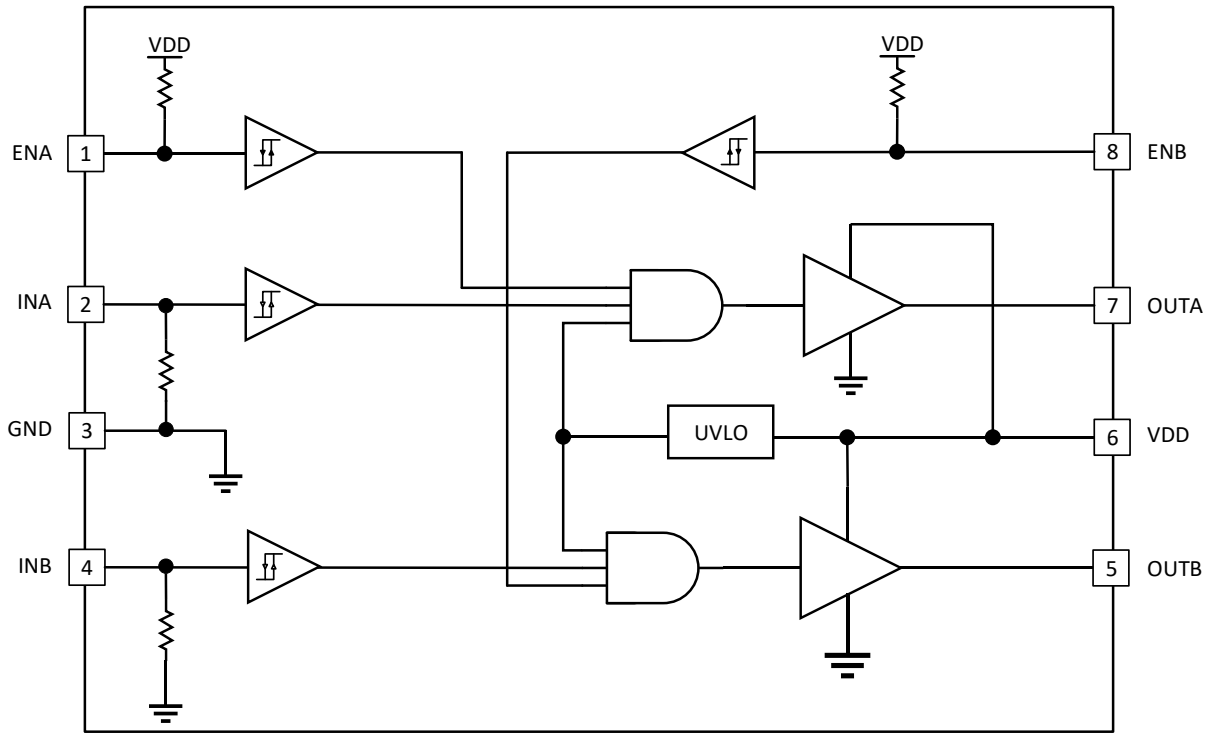


Figure 2. SL27624 Block Diagram

ABSOLUTE MAXIMUM RATINGS[1,2,3]

Symbol	Description	Min.	Max.	Units
V_{DD}	Supply voltage	-0.3	33	V
OUTA, OUTB	Continuous voltage on OUTx	-0.3	V_{DD}+0.3	
	Repetitive pulse less than 200ns[4]	-2	V_{DD}+0.3	
INA, INB, ENA, ENB	Voltage on INA, INB, ENA, ENB.	-6	33	V
T_J	Operation junction temperature range	-40	150	°C
T_L	Lead temperature (soldering, 10 seconds)		300	
T_S	Storage temperature	-55	150	

1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

2) All voltages are with respect to GND unless otherwise noted.

3) These devices are sensitive to electrostatic discharge; follow proper device-handling procedures.

4) Values are verified by characterization on bench.

RECOMMENDED OPERATION CONDITIONS

Over operating free-air temperature range (unless otherwise noted)

Symbol	Definition	Min	Max	Units
V_{DD}	Supply voltage	4.5	30	V
INA, INB	Input voltage	-5	30	
ENA, ENB	Enable voltage	-5	30	
T_J	Operation junction temperature range	-40	150	°C

ORDERING INFORMATION

Order Part No.	UVLO	Package	QTY
SL27624LS	4.2V	SOP8, Pb-Free	2500/Reel
SL27624LE	4.2V	MSOP8-EP, Pb-Free	4000/Reel
SL27624MS	8.5V	SOP8, Pb-Free	2500/Reel
SL27624ME	8.5V	MSOP8-EP, Pb-Free	4000/Reel
SL27624HS	12.5V	SOP8, Pb-Free	2500/Reel
SL27624HE	12.5V	MSOP8-EP, Pb-Free	4000/Reel

DYNAMIC ELECTRICAL CHARACTERISTICS[1]

V_{DD} = 12V, T_A=T_J= - 40°C to 125°C, typical values are specified at 25 °C unless otherwise noted.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
t_R	Rise time[2]	C_{LOAD} = 1.8 nF		7	11	ns
t_F	Fall time[2]	C_{LOAD} = 1.8 nF		6	8.4	
t_M	Delay matching between two channels	INA = INB, OUTA and OUTB at 50% transition point			2	
t_{PW}	Minimum input pulse width that changes the output state[3]			13	15	
t_{D1}, t_{D2}	Input to output propagation delay[2]	C_{LOAD} = 1.8 nF, 5 V input pulse		20	27	
t_{D3}, t_{D4}	EN to output propagation delay[2]	C_{LOAD} = 1.8 nF, 5 V enable pulse		20	27	

1) Values are tested by V_{DD}=15V for SL27624H.

2) See timing diagrams in Figure 3 to Figure 4.

3) Values are verified by characterization on bench.

STATIC ELECTRICAL CHARACTERISTICS[1]

V_{DD} = 12V, T_A=T_J= - 40°C to 125°C, typical values are specified at 25 °C unless otherwise noted.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{VDD_OFF}	VDD startup current	V_{DD} = 3.4 V, ENA = ENB = VDD, INA=INB=3.3V		110	270	μA
I_{VDD}	VDD static current	ENA=ENB=VDD, INA=INB=3.3V		810	1300	μA
		ENA=ENB=VDD, INA=INB=0V		600	900	μA
I_{VDD_OP}	VDD operating current	ENA=ENB=VDD, INA = INB =PWM, 1000kHz, no load at output		3.6	4.6	mA
I_{VDD_DIS}	VDD disable current	INA=INB = 3.3 V, ENA = ENB = GND		630	900	μA
Under Voltage Lockout (UVLO)						
$V_{DD\_UV\_R}$	VDD UVLO rising threshold	SL27624L	3.9	4.2	4.5	V
		SL27624M	8	8.5	9	V
		SL27624H	11.5	12.5	13.5	V
$V_{DD\_UV\_F}$	VDD UVLO falling threshold	SL27624L	3.6	3.9	4.2	V
		SL27624M	7	7.5	8	V
		SL27624H	10.5	11.5	12.5	V
$V_{DD\_UV\_HYS}$	VDD UVLO hysteresis	SL27624L		0.3		V

Symbol	Parameter	Condition	Min	Typ	Max	Unit
		SL27624M		1.0		V
		SL27624H		1.0		V
Input (INA, INB)						
V_{IN_H}	Input signal high threshold		1.8	2	2.3	V
V_{IN_L}	Input signal low threshold		0.8	1	1.2	V
V_{IN_HYS}	Input signal hysteresis			1		V
R_{IN}	Inx pin pulldown resistor	INx=3.3V		120		kΩ
Enable (ENA, ENB)						
V_{EN_H}	Enable signal high threshold		1.8	2	2.3	V
V_{EN_L}	Enable signal low threshold		0.8	1	1.2	V
V_{EN_HYS}	Enable signal hysteresis			1		V
R_{EN}	Enx pin pullup resistor	ENx=0V		200		kΩ
Output (OUTA, OUTB)						
I_{SRC}	Source peak current[2]	C_L = 0.22 μF		5.0		A
I_{SNK}	Sink peak current[2]	C_L = 0.22 μF		5.0		A
V_{OH}	High level output voltage	I_O = –10 mA, V_{DD}-V_O		7.2	14	mV
V_{OL}	Low output voltage	I_O = 10 mA		4.5	8.5	mV
R_{OH}	Output pull-up resistance	I_O = –10 mA	0.52	0.72	1.2	Ω
R_{OL}	Output pull-down resistance	I_O = 10 mA	0.26	0.45	0.74	Ω

1) Values are tested by V_{DD}=15V for SL27624H.

2) Values are verified by characterization on bench.

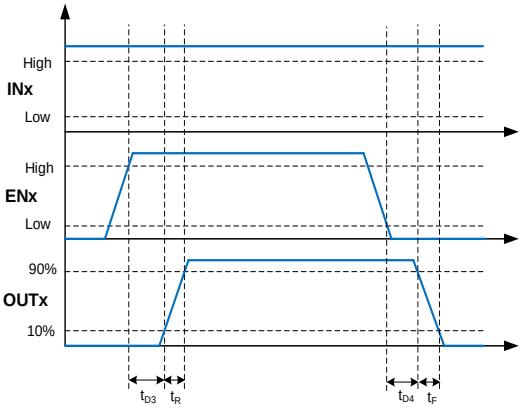


Figure 3. Enable Function

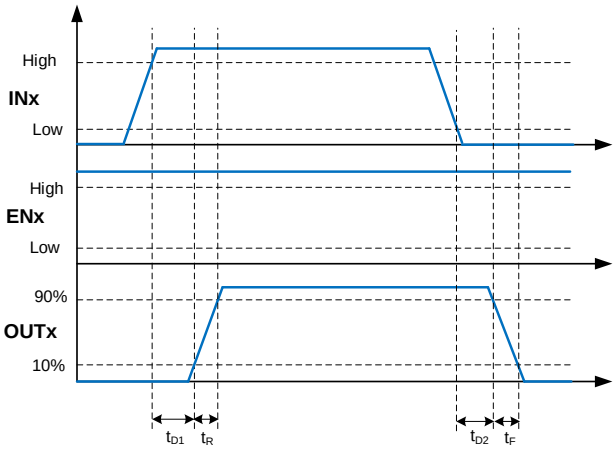


Figure 4. Input and Output Operation

FEATURE DESCRIPTION

VDD and Under-Voltage Lockout

The SL27624 device has internal UVLO protection feature on the VDD pin supply. Whenever the driver is in UVLO condition (for example when V_{DD} voltage is less than $V_{DD\_UV\_R}$ during power up and when VDD voltage is less than $V_{DD\_UV\_F}$ during power down), this circuit holds all outputs low, regardless of the status of the inputs. This hysteresis helps prevent chatter when low V_{DD} supply voltage have noise from the power supply and also when there are droops in the VDD bias voltage when the system starts switching and there is a sudden increase in I_{DD}.

Input Stage

The input pins of the SL27624 gate-driver are based on a TTL and CMOS compatible input threshold logic that is independent of the VDD supply voltage. With typically high threshold = 2 V and typically low threshold = 1 V, the logic level thresholds are conveniently driven with PWM control signals derived from 3.3V and 5V digital power-controller devices. SL27624 also features tight control of the input pin threshold voltage levels which eases system design considerations and ensures stable operation across temperature.

The SL27624 features an important safety feature wherein, whenever any of the input pins is in a floating condition, the output of the respective channel is held in the low state. This is achieved using pull-down resistors on the INA and input pins.

The input stage of each driver is driven by a signal with a short rise or fall time. This condition is satisfied in typical power supply applications, where the input signals are provided by a PWM controller or logic gates with fast transition times (<200 ns) with a slow changing input voltage, the output of the driver may switch repeatedly at a high frequency. While the wide hysteresis offered in SL27624 definitely alleviates this concern over most other TTL input threshold devices, extra care is necessary in these implementations. If limiting the rise or fall times to the power device is the primary goal, then an external resistance is highly recommended between the output of the driver and the power device.

Enable Function

SL27624 is provided with independent enable pins ENx for exclusive control of each driver-channel operation. The enable pins are based on a non-inverting configuration (active high operation). Thus, when ENx pins are driven high, the drivers are enabled and when ENx pins are driven low, the drivers are disabled. Like the input pins, the enable pins are also based on a TTL and CMOS compatible input threshold logic that is independent of the supply voltage and are effectively controlled using logic signals from 3.3V and 5V microcontrollers. The SL27624 also features tight control of the enable function threshold voltage levels which eases system design considerations and ensures stable operation across temperature. The ENx pins are internally pulled up to VDD using pull-up resistors as a result of which the outputs of the device are enabled in the default state. Hence the ENx pins are left floating or Not Connected (N/C) for standard operation, where the enable feature is not needed. If the channel A and channel B inputs and outputs are connected in parallel to increase the driver current capacity, ENA and ENB are connected and driven together.

The enable function is an extremely beneficial feature in gate driver devices especially for certain applications such as synchronous rectification where the driver outputs disabled in light load conditions to prevent negative current circulation and to improve light load efficiency.

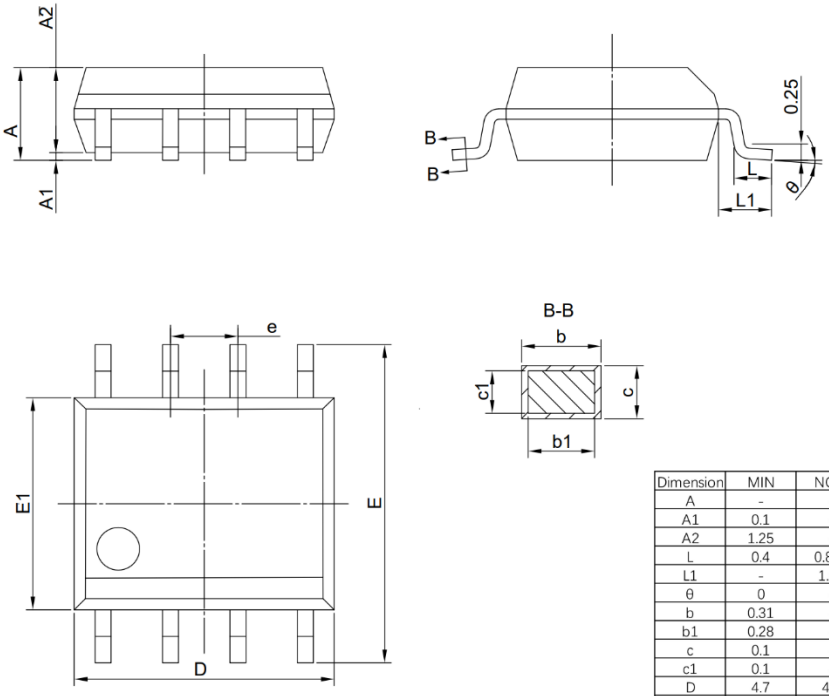
Output Stage

Each output stage in the SL27624 device is capable of supplying 5.0 A peak source and 5.0 A peak sink current pulses. The output voltage swings between VDD and GND providing rail-to-rail operation, thanks to the MOS-output stage which delivers very low drop-out.

The channel A and channel B outputs can be paralleled to provide higher driver current capability. In such application, the INA and INB need to be connected together and ENA, ENB also need be connected together.

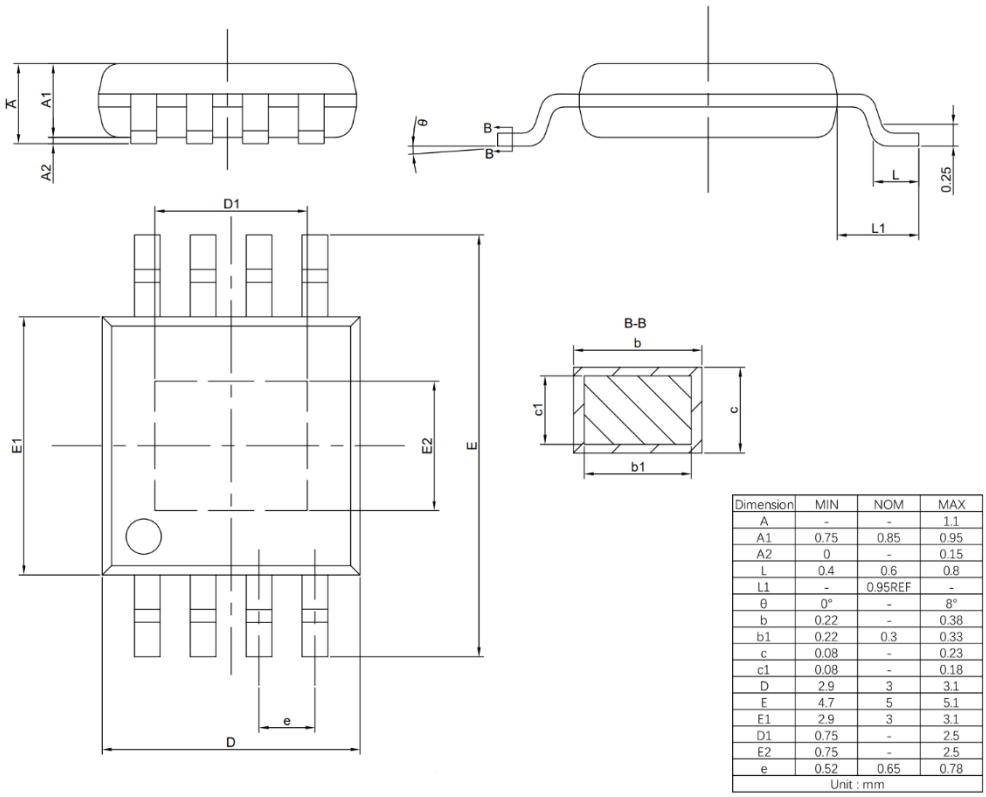
For example, in applications that have zero voltage switching during power MOSFET turn-on or turn-off interval, the driver supplies high-peak current for fast switching even though the miller plateau is not present. This situation often occurs in synchronous rectifier applications because the body diode is generally conducting before power MOSFET is switched on.

PACKAGE CASE OUTLINES



Dimension	MIN	NOM	MAX
A	-	-	1.75
A1	0.1	-	0.25
A2	1.25	-	-
L	0.4	0.835	1.27
L1	-	1.04	-
θ	0	-	8
b	0.31	-	0.51
b1	0.28	-	0.48
c	0.1	-	0.25
c1	0.1	-	0.25
D	4.7	4.9	5.1
E	5.8	6	6.2
E1	3.8	3.9	4
e	1.02	1.27	1.52
Unit : mm			

Figure 5. SOP8 Package Outline Dimensions



Dimension	MIN	NOM	MAX
A	-	-	1.1
A1	0.75	0.85	0.95
A2	0	-	0.15
L	0.4	0.6	0.8
L1	-	0.95REF	-
θ	0°	-	8°
b	0.22	-	0.38
b1	0.22	0.3	0.33
c	0.08	-	0.23
c1	0.08	-	0.18
D	2.9	3	3.1
E	4.7	5	5.1
E1	2.9	3	3.1
D1	0.75	-	2.5
E2	0.75	-	2.5
e	0.52	0.65	0.78
Unit : mm			

Figure 6. MSOP8-EP Package Outline Dimensions

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