SC1302A/B/C/D/E/F
Dual High Speed Low-Side MOSFET Driver

POWER MANAGEMENT

Features

- Operating Voltage — +4.5V to +16.5V
- Fast rise and fall times (20ns typical with 1000pf load)
- Dual MOSFET driver
- Peak drive current — 2A
- propagation delay — 40ns
- 8-pin SOIC / MSOP lead free packages. This product is fully WEEE and RoHS compliant
- Enable/disable control
- TTL-compatible input
- Under voltage lockout with hysteresis
- Low shutdown supply current
- Over temperature protection
- ESD protection
- Dual inverting/non-inverting and inverting/non-inverting configurations

Applications

- Switch-mode power supplies
- Battery powered applications
- Solenoid and motor drives

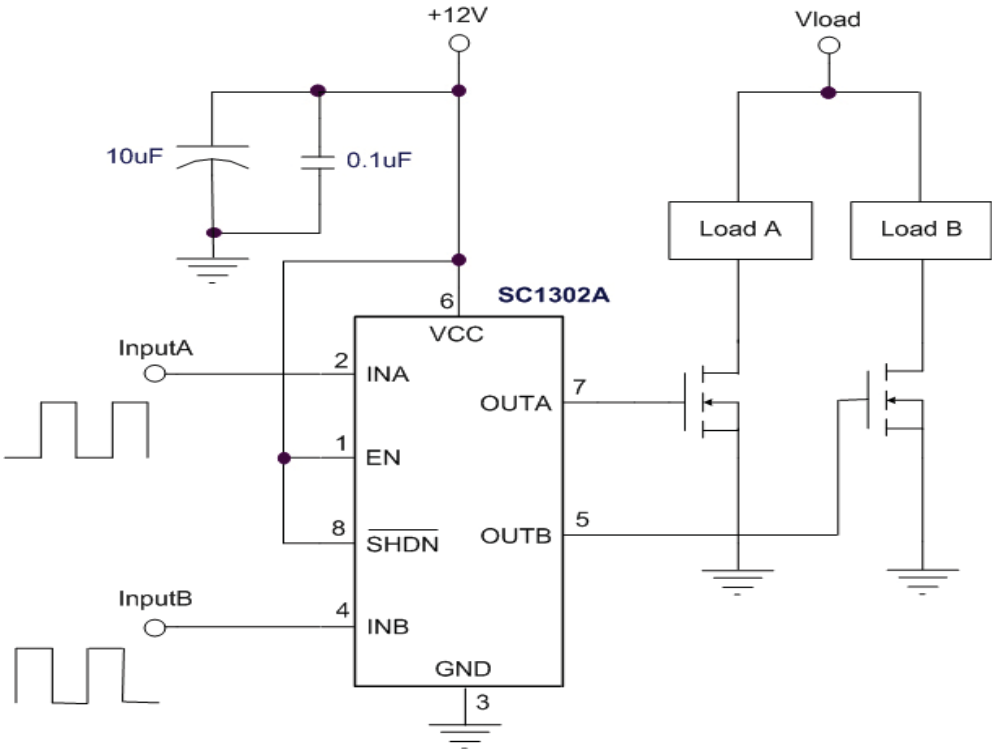
Description

The SC1302A/B/C/D/E/F family are low cost dual low-side MOSFET drivers. These drivers accept TTL-compatible inputs and are capable of supplying high current outputs (> 2A peak) to external MOSFETs. Fast switching allows operation up to 1 MHz. The SC1302A/B/C is available in six configurations: SC1302A is a dual non-inverting, SC1302B is a dual inverting and SC1302C alone has an inverting plus one non-inverting output.

The SC1302D/E/F is the derivative part from SC1302A/B/C with pin 1 (EN) and pin 8 ($\overline{\text{SHDN}}$) internally tied to VCC.

An under-voltage lockout circuit guarantees that the driver outputs are low when Vcc is less than 4.5V (typical). An internal temperature sensor shuts down the driver in the event of over temperature.

Typical Application Circuit



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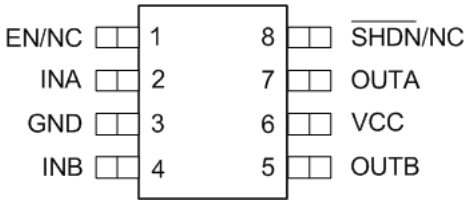
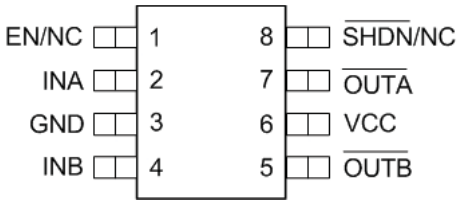
Pin Configuration

SC1302A/D (Dual Non-Inverting)



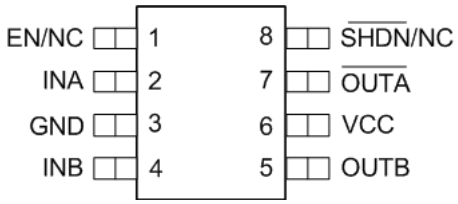
8-Pin SOIC (A/D) or MSOP (A only)

SC1302B/E (Dual Inverting)



8-Pin SOIC (B/E) or MSOP (B only)

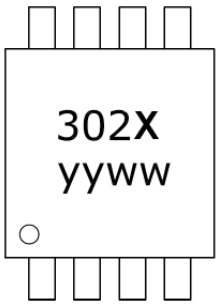
SC1302C/F (Inverting+Non-Inverting)



8-Pin SOIC (C/F) or MSOP (C only)

Top Marking Information

MSOP A/B/C



X=A, B, C
302A = SC1302A
yyww = Date Code

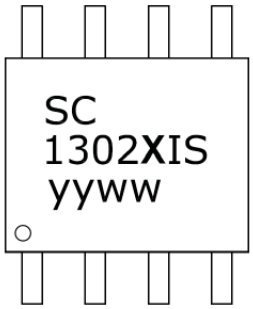
Ordering Information

Device	Package	Temperature Range (T_J)
SC1302AISTRT	SOIC-8	-40°C to +125°C
SC1302BISTRT		
SC1302CISTRT		
SC1302DSTRT		
SC1302ESTRT		
SC1302FSTRT		
SC1302AIMSTRT	MSOP-8	-40°C to +125°C
SC1302BIMSTRT		
SC1302CIMSTRT		

Notes:
(1) Available in tape and reel only. A reel contains 2,500 devices.
(2) Lead-free package only. Device is WEEE and RoHS compliant.

Top Marking Information

SOIC A/B/C



X=A, B, C
yyww = Date Code

SOIC D/E/F

X=D, E, F
yyww = Date Code

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Absolute Maximum Ratings

Supply Voltage V_{CC} (V) ..... -0.3 to +20
Input Voltages (V) ..... -0.3 to V_{CC}
Peak Output Currents (A) 3
Enable Voltage SC1302A/B/C (V) ..... -0.3 to V_{CC}
Shutdown Voltage SC1302A/B/C (V) ..... -0.3 to V_{CC}
Continuous Power Dissipation (W)..... Internally limited
ESD Protection Level (kV) 2

Recommended Operating Conditions

Operating Temperature Range (°C) ..... $-40 \leq T_J \leq +125$
Operating Supply Voltage (V) ..... -0.3 to 16.5

Thermal Information

Thermal Resistance, Junction to Ambient MSOP (°C/W). .206
Thermal Resistance, Junction to Ambient SIOC (°C/W)...165
Maximum Junction Temperature (°C) .....+150
Storage Temperature Range (°C) ..... -65 to +150
Lead Temperature (Soldering)10s (°C) ..... +260

Exceeding the above specifications may result in permanent damage to the device or device malfunction. Operation outside of the parameters specified in the Electrical Characteristics section is not recommended.

DC Electrical Characteristics

Unless otherwise specified, -40°C < $T_A = T_J$ <125°C, V_{CC} = 12V, V_{IN} = 5V, V_{EN} =5V (SC1302A/B/C), $V_{\overline{SHDN}}$ = 5V (SC1302A/B/C)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Current						
Quiescent Current	I_Q	$V_{CC} < V_{START}$		1	1.8	mA
Quiescent Current	I_Q	$V_{EN} = V_{\overline{SHDN}}$ = 3V for SC1302A/B/C, $V_{INA} = V_{INB}$ = 3V		5.7	8.1	mA
Quiescent Current	I_Q	$V_{\overline{SHDN}}$ = 0V for SC1302A/B/C		3	8	µA
Under-Voltage Lockout						
Threshold Voltage	V_{START}	$V_{\overline{SHDN}} = V_{EN}$ = 3V for SC1302A/B/C, $V_{INA} = V_{INB}$ = 3V	4.2	4.5	4.7	V
Hysteresis		$V_{\overline{SHDN}} = V_{EN}$ = 3V for SC1302A/B/C, $V_{INA} = V_{INB}$ = 3V	250	320	475	mV
Enable for SC1302A/B/C						
Enable Voltage	V_{EN}	$0 < V_{EN} < V_{CC}$	2.0			V
Disable Voltage	V_{EN}	$0 < V_{EN} < V_{CC}$			0.8	V
Delay to Output(1)	t_{D_EN}	EN from low to high		70		ns
Delay to Output(1)	t_{D_DIS}	EN from high to low		55		ns
Enable Input Current	I_{EN}	$0 < V_{IN} < V_{CC}$	10	14	19	µA

Electrical Characteristics (continued)

Unless otherwise specified, -40°C < $T_A = T_J$ <125°C, V_{CC} = 12V, V_{IN} = 5V, V_{EN} =5V (SC1302A/B/C), $V_{\overline{SHDN}}$ = 5V (SC1302A/B/C)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input						
High Level Input Voltage	V_{IH}	$0 < V_{IN} < V_{CC}$	2.0			V
Low Level Input Voltage	V_{IL}	$0 < V_{IN} < V_{CC}$			0.8	V
Input Current	I_{IN}	$0 < V_{IN} < V_{CC}$, Non-inverting Input(s) of SC1302A/C/D/F		13	18.5	µA
		$0 < V_{IN} < V_{CC}$, Inverting Input(s) of SC1302B/C/E/F			-8	µA
Output						
Output Peak Current	I_{PK_SOURCE}	V_{OUT} = 0.5V, t_{PW} < 10 µs		1600		mA
	I_{PK_SINK}	$V_{OUT} = V_{CC}$ - 0.5V, t_{PW} < 10 µs		1600		mA
Shutdown for SC1302A/B/C						
$\overline{SHDN}$ Input Voltage High	$V_{\overline{SHDN}}$		2			V
$\overline{SHDN}$ Input Voltage Low	$V_{\overline{SHDN}}$				0.3	V
$\overline{SHDN}$ Pin current	$I_{\overline{SHDN}}$	$V_{\overline{SHDN}}$ = 5V		32	40	µA
Thermal Shutdown						
Over Temperature Trip Point (1)	T_{J_OT}			150		°C
Hysteresis (1)				10		°C

AC Electrical Characteristics

Unless otherwise specified, $T_A = T_J$ = 25°C, V_{CC} =12V, V_{EN} = 5V, C_L = 1000pF

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Rise Time(1)	t_R	See Timing Diagram		20		ns
Fall Time(1)	t_F	See Timing Diagram		20		ns
Propagation Delay Time(1)	t_{D1}	T_A = -40°C ~ 125°C		53	70	ns
Propagation Delay Time(1)	t_{D2}	T_A = -40°C ~ 125°C		41	60	ns

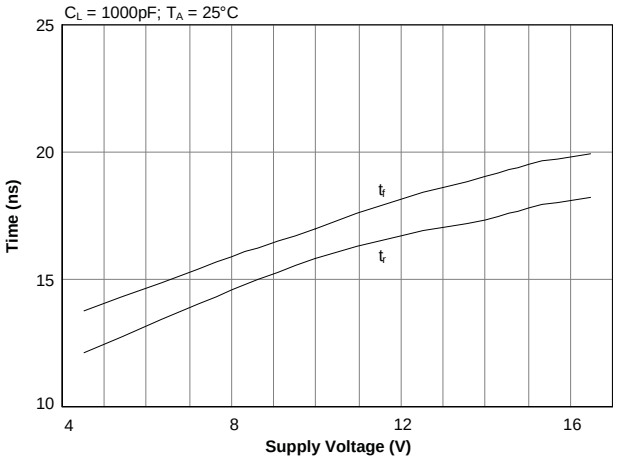
Notes:

(1) Guaranteed by design

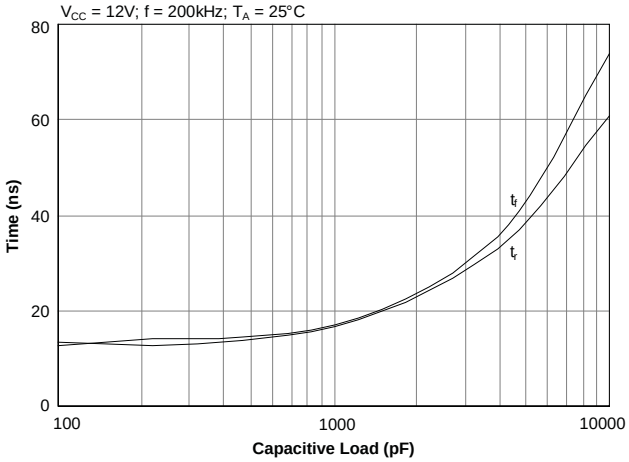
(2) Negative sign indicates that the input current flows out of the device.

Typical Characteristics

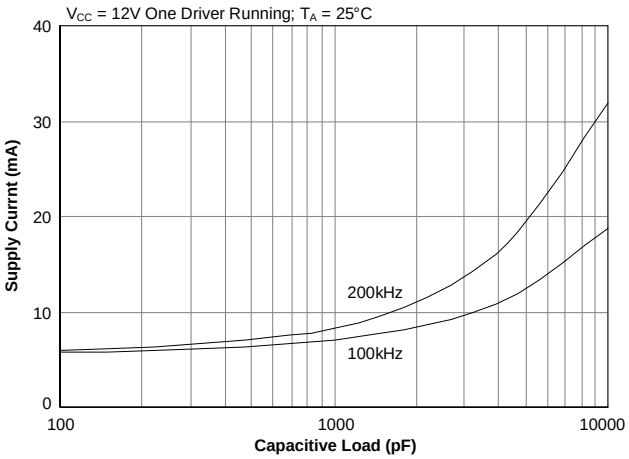
Rise and Fall Time vs. Supply Voltage



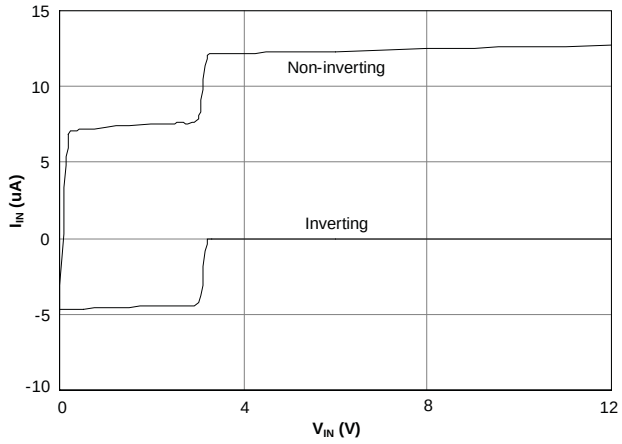
Rise and Fall Time vs. Capacitive Load



Supply Current vs. Capacitive Load



Input Pin Current

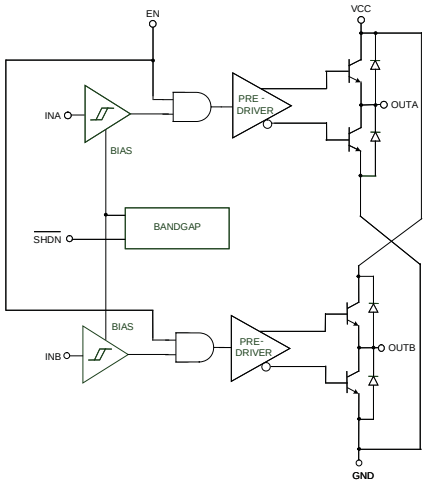


Pin Descriptions

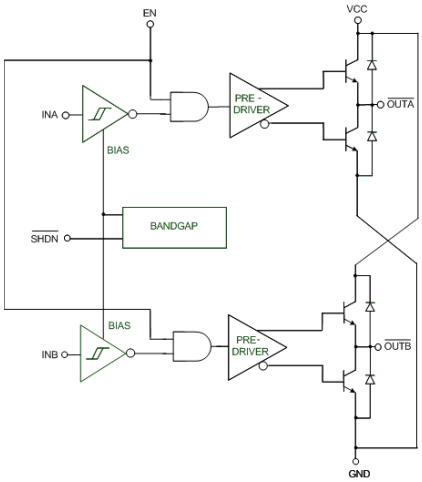
Pin #	SC1302A/D	SC1302B/E	SC1302C/F	Pin Function
1	EN/NC	EN/NC	EN/NC	Enable/Disable Control — When the EN is driven low, both outputs are low. When left open, both outputs are low. Enable both drivers by tying EN pin to a voltage greater than 2V. No connection on versions D, E, and F.
2	INA	INA	INA	TTL compatible input to driver A — When left open, Pin 7 is low.
3	GND	GND	GND	Ground connection
4	INB	INB	INB	TTL compatible input to driver B — When left open, Pin 5 is low.
5	OUTB	$\overline{\text{OUTB}}$	OUTB	Output gate drive B for external MOSFET
6	VCC	VCC	VCC	Supply: +4.5V to +16.5V supply. During UVLO the outputs are held low.
7	OUTA	$\overline{\text{OUTA}}$	$\overline{\text{OUTA}}$	Output gate drive A for external MOSFET
8	$\overline{\text{SHDN}}$/NC	$\overline{\text{SHDN}}$/NC	$\overline{\text{SHDN}}$/NC	Shutdown pin — Apply a voltage from 2V to VCC to enable device. Pull below 0.3V for low-power shut down. No connection on versions D, E, and F.

Block Diagram

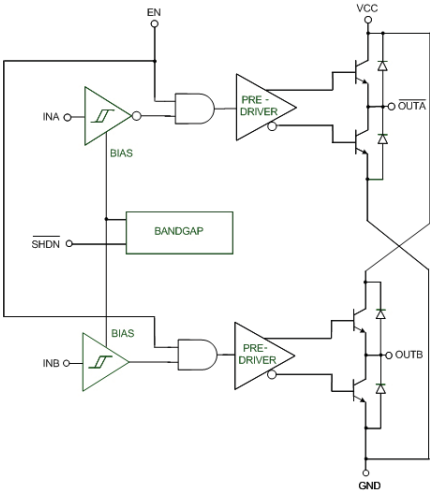
SC1302A



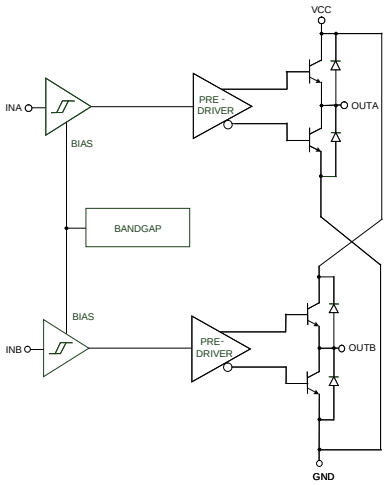
SC1302B



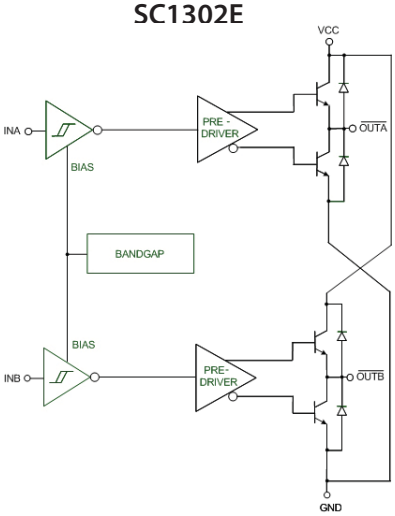
SC1302C



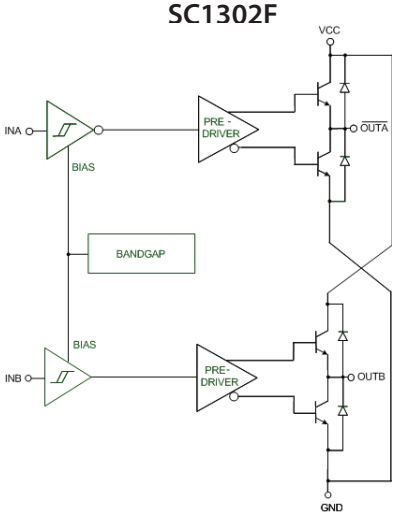
SC1302D



SC1302E



SC1302F



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Applications Information

General Description

The SC1302A/B/C/D/E/F is a high speed, high peak current dual MOSFET driver. It is designed to drive power MOSFETs with ultra-low rise/fall time and propagation delays. As the switching frequency of PWM controllers is increased to reduce power converters volume and cost, fast rise and fall times are necessary to minimize switching losses. While a discrete solution can achieve reasonable drive capability, implementing delay and other housekeeping functions necessary for safe operation can become cumbersome and costly. The SC1302A/B/C/D/E/F presents a total solution for the high-speed, high-power density applications. Wide input supply range of 4.5V to16.5V allows use in battery powered applications as well as distributed power systems.

Supply Bypass and Layout

A 4.7µF to 10µF tantalum bypass capacitor with low ESR (equivalent series resistance) and an additional 0.1µF ceramic capacitor in parallel are recommended as a supply bypass to control switching and supply transients.

As with any high speed, high current circuit, proper layout is critical in achieving optimum performance of the SC1302A/B/C/D/E/F. Attention should be paid to the proper placement of the driver, the switching MOSFET, and the bypass capacitors.

The driver should be placed as close as possible to the external MOSFETs to eliminate the possibility of oscillation caused by trace inductance and the MOSFET gate capacitance. A resistor in the range of 10ohm could be used in series with the gate drive to damp the ringing if the drive output path is not short enough. The bypass capacitors should also be placed closely between V_{CC} and GND of the driver. A Schottky diode may be used to connect the ground and the output pin to avoid latch-ups in some applications.

Drive Capability and Power Dissipation

The SC1302A/B/C/D/E/F is able to deliver 1.6A peak current for driving capacitive loads, such as MOSFETs.

Fast switching of the MOSFETs significantly reduces switching losses for high frequency applications. Thermal stress is reduced and system reliability is improved.

For simplicity, it is assumed that the gate capacitance of a MOSFET is constant. The power delivered from the power supply can be estimated based on this simplification. The energy needed to charge the capacitor is given by the following equation

$$E_{ON} = \frac{1}{2} \times C \times V^2$$

where C is the load capacitance and V is the output voltage swing of the driver.

During turn off, the same amount of energy is dumped to the ground. Therefore, the energy dissipated in one switching cycle is:

$$E_{TOTAL} = C \times V^2$$

The power dissipation due to the gate driving actions is given by:

$$P_{GATE} = f \times C \times V^2$$

where, f is the switching frequency. With V_{CC} = 12V, C = 1nF and f = 200kHz, the power dissipation per output is:

$$P_{GATE} = (200kHz) \times (1nF) \times (12)^2 = 29mW$$

The corresponding supply current is:

$$I = \frac{P_{GATE}}{V_{CC}} = \frac{29mW}{12V} = 2.4mA$$

Thermal Information

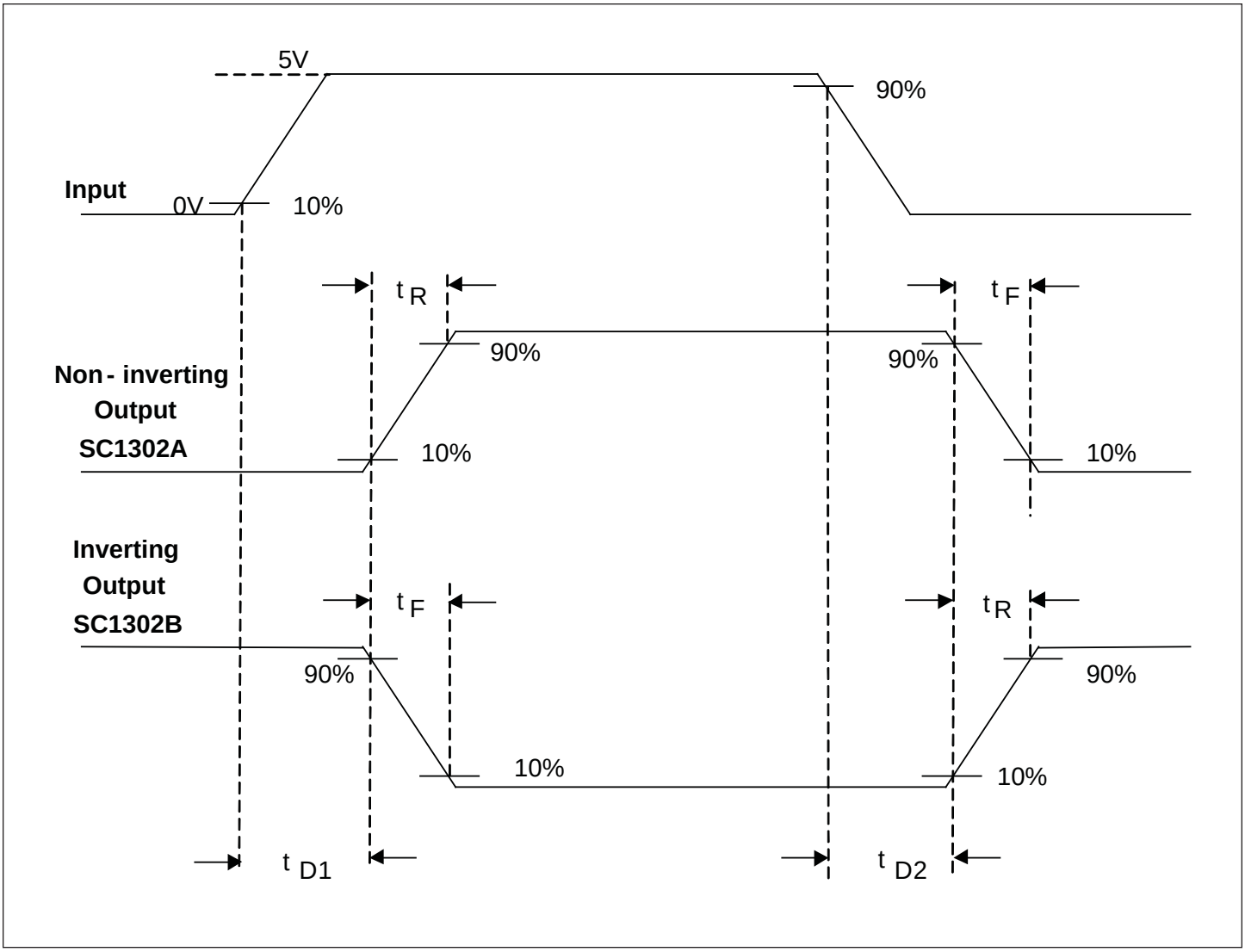
The driver's junction temperature must be kept within the rated limit at any time. The application system has to effectively remove the heat generated in the driver in order for proper functions and performance. If the junction temperature reaches 150°C, the internal protection circuit will be triggered to shut down the gate driver.

The power dissipation of the SC1302A/B/C/D/E/F should be derated according to the following formula:

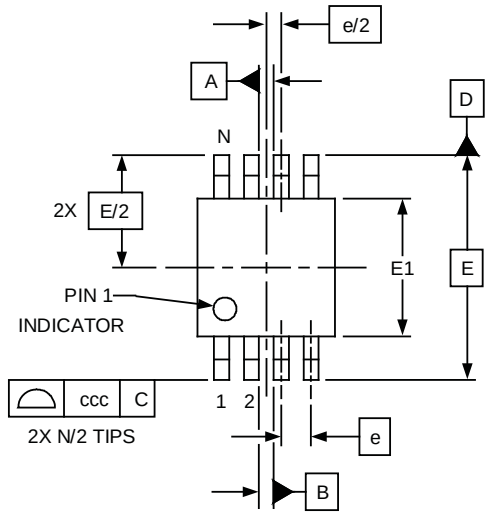
$$\text{PowerDissipation} < \frac{125°C - T_A}{\theta jA}$$

where T_A = ambient temperature.

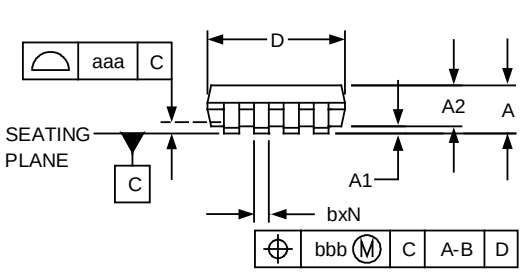
Timing Diagram

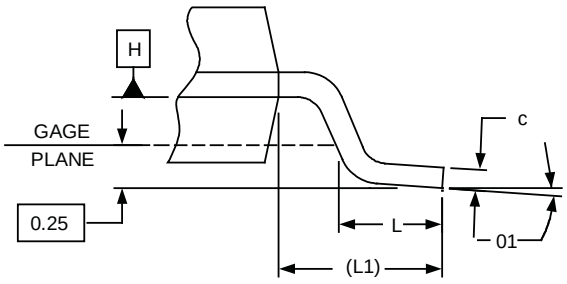


Outline Drawing — MSOP-8

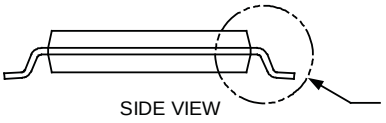


DIMENSIONS						
DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	-	-	.043	-	-	1.10
A1	.000	-	.006	0.00	-	0.15
A2	.030	-	.037	0.75	-	0.95
b	.009	-	.015	0.22	-	0.38
c	.003	-	.009	0.08	-	0.23
D	.114	.118	.122	2.90	3.00	3.10
E1	.114	.118	.122	2.90	3.00	3.10
E	.193 BSC			4.90 BSC		
e	.026 BSC			0.65 BSC		
L	.016	.024	.032	0.40	0.60	0.80
L1	(.037)			(.95)		
N	8			8		
θ1	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.005			0.13		
ccc	.010			0.25		





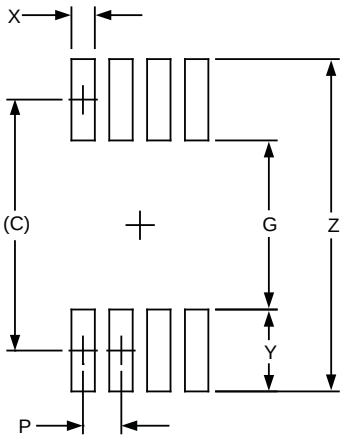
DETAIL A



NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. REFERENCE JEDEC STD MO-187, VARIATION AA.

Land Pattern — MSOP-8



DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.161)	(4.10)
G	.098	2.50
P	.026	0.65
X	.016	0.40
Y	.063	1.60
Z	.224	5.70

NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

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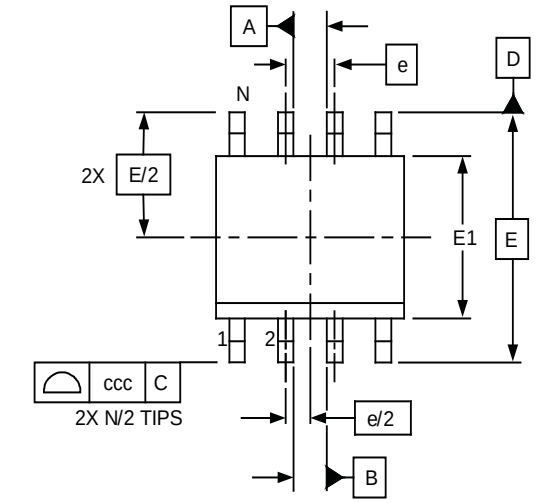
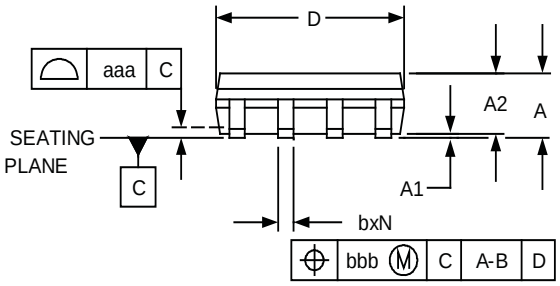
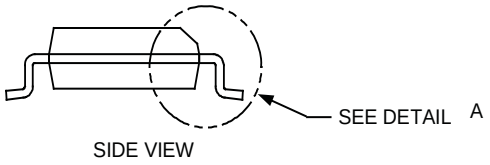
Outline Drawing — SO-8

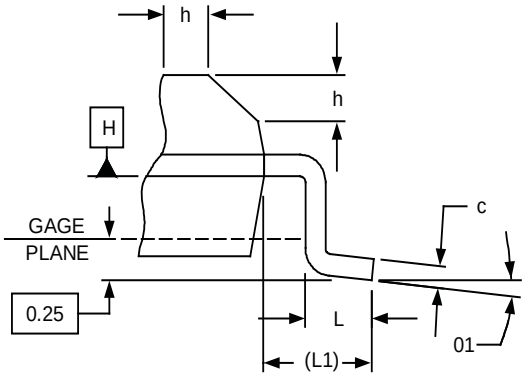






SIDE VIEW

DIMENSIONS						
DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.053	-	.069	1.35	-	1.75
A1	.004	-	.010	0.10	-	0.25
A2	.049	-	.065	1.25	-	1.65
b	.012	-	.020	0.31	-	0.51
c	.007	-	.010	0.17	-	0.25
D	.189	.193	.197	4.80	4.90	5.00
E1	.150	.154	.157	3.80	3.90	4.00
E	.236 BSC			6.00 BSC		
e	.050 BSC			1.27 BSC		
h	.010	-	.020	0.25	-	0.50
L	.016	.028	.041	0.40	0.72	1.04
L1	(.041)			(1.04)		
N	8			8		
−01	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.010			0.25		
ccc	.008			0.20		

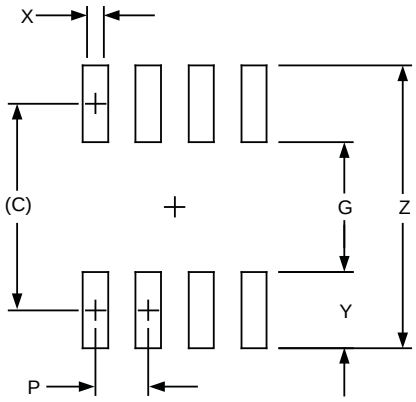


DETAIL A

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. REFERENCE JEDEC STD MS-012, VARIATION AA.

Land Pattern — SO-8



DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.205)	(5.20)
G	.118	3.00
P	.050	1.27
X	.024	0.60
Y	.087	2.20
Z	.291	7.40

NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.
2. REFERENCE IPC-SM-782A, RLP NO. 300A.

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