SEMTECH

POWER MANAGEMENT

Description

The SC1302A/B/C 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 MOSFET's. Fast switching allows operation up to 1 MHz. The SC1302A/B/C is available in three configurations: dual non-inverting, dual inverting and one inverting plus one non-inverting output.

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

Features

◆ +4.5V to +16.5V operation
◆ Fast rise and fall times (20ns typical with 1000pf load)
◆ Dual MOSFET driver
◆ 2A peak drive current
◆ 40ns propagation delay
◆ 8-pin SOIC / MSOP packages
◆ Enable/disable control
◆ TTL-compatible input
◆ Under voltage lockout with hysterisis
◆ 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

Typical Application Circuit

![SEMTECH logo]
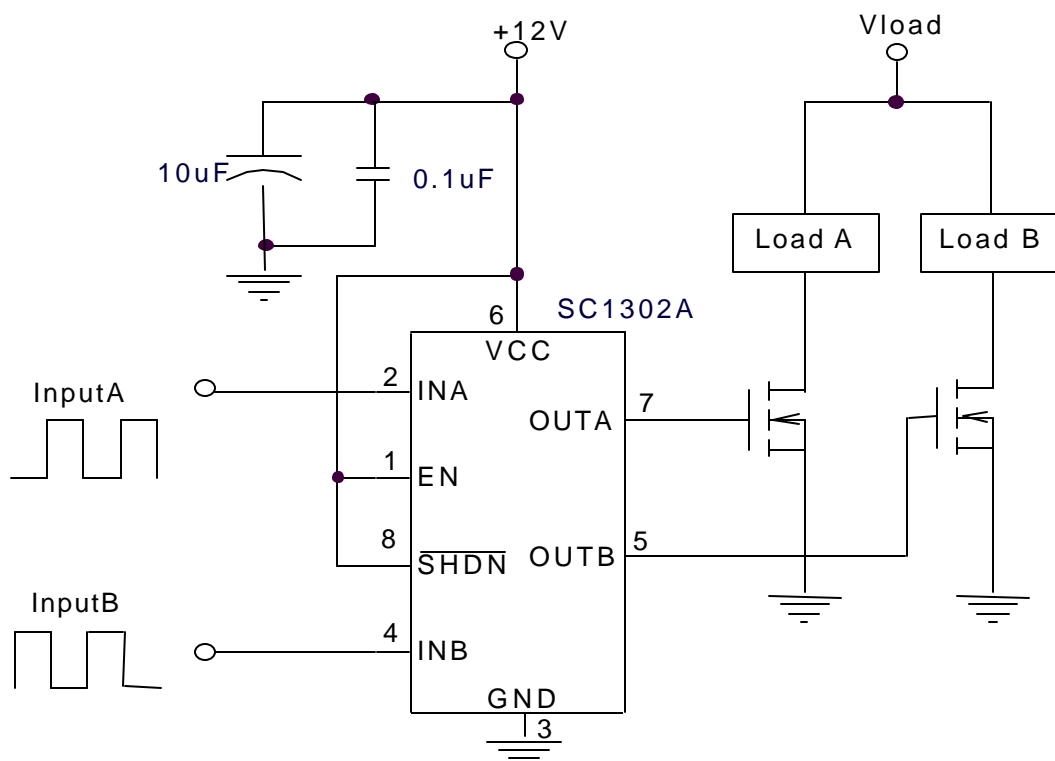
POWER MANAGEMENT
Absolute Maximum Ratings

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

Parameter	Symbol	Typ	Units
Supply Voltage	V_{CC}	-0.3 to 20	V
Operating Supply Voltage	V_{CC}	-0.3 to 16.5	V
Input Voltages	V_{INA}, V_{INB}	-0.3 to V_{CC}	V
Peak Output Currents	I_{OUTA}, I_{OUTB}	3	A
Enable Voltage	V_{EN}	-0.3 to V_{CC}	V
Shutdown Voltage	$V_{\overline{SHDN}}$	-0.3 to V_{CC}	V
Continuous Power Dissipation	Pd	Internally limited	W
Operating Temperature Range	T_A	-40 to +85	°C
Thermal Resistance Junction to Ambient (MSOP)	θ_{JA}	206	°C/W
Thermal Resistance Junction to Ambient (SOIC)	θ_{JA}	165	°C/W
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (Soldering)10 sec	T_{LEAD}	260	°C
ESD Rating (Human Body Model)	ESD	2	kV

DC Electrical Characteristics

Unless otherwise specified: -40°C < T_A < 85°C, V_{CC} = 12V, V_{IN} = 5V, V_{EN} = 5V, $V_{\overline{SHDN}}$ = 5V

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	$V_{EN} = V_{\overline{SHDN}} = V_{INA} = V_{INB}$ = 3V		5.7	8.1	mA
Quiescent Current	I_Q	$V_{\overline{SHDN}}$ =0V		3	8	µA
Under-Voltage Lockout						
Threshold Voltage	V_{START}	$V_{\overline{SHDN}} = V_{EN} = V_{INA} = V_{INB}$ = 3V	4.2	4.5	4.7	V
Hysteresis		$V_{\overline{SHDN}} = V_{EN} = V_{INA} = V_{INB}$ = 3V	250	320	475	mV
Enable						
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}	$0 < V_{EN} < V_{CC}$	10	14	19	µA

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DC Electrical Characteristics (Cont.)

Unless otherwise specified: $-40°C < T_A < 85°C$, $V_{CC} = 12V$, $V_{IN} = 5V$, $V_{EN} = 5V$, $V_{\overline{SHDN}} = 5V$

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		13	18.5	µA
		$0 < V_{IN} < V_{CC}$ Inverting Input(s) of SC1302B/C[2]			-8	µA
Output						
Output Peak Current	I_{PK_SOURCE}	$V_{OUT} = 0.5V$, $t_{PW} < 10uS$		1600		mA
	I_{PK_SINK}	$V_{OUT} = V_{CC} - 0.5V$, $t_{PW} < 10uS$		1600		mA
Shutdown						
$\overline{SHDN}$ 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: $T_A = 25°C$, $V_{CC} = 12V$, $V_{EN} = 5V$, $C_L = 1000pF$

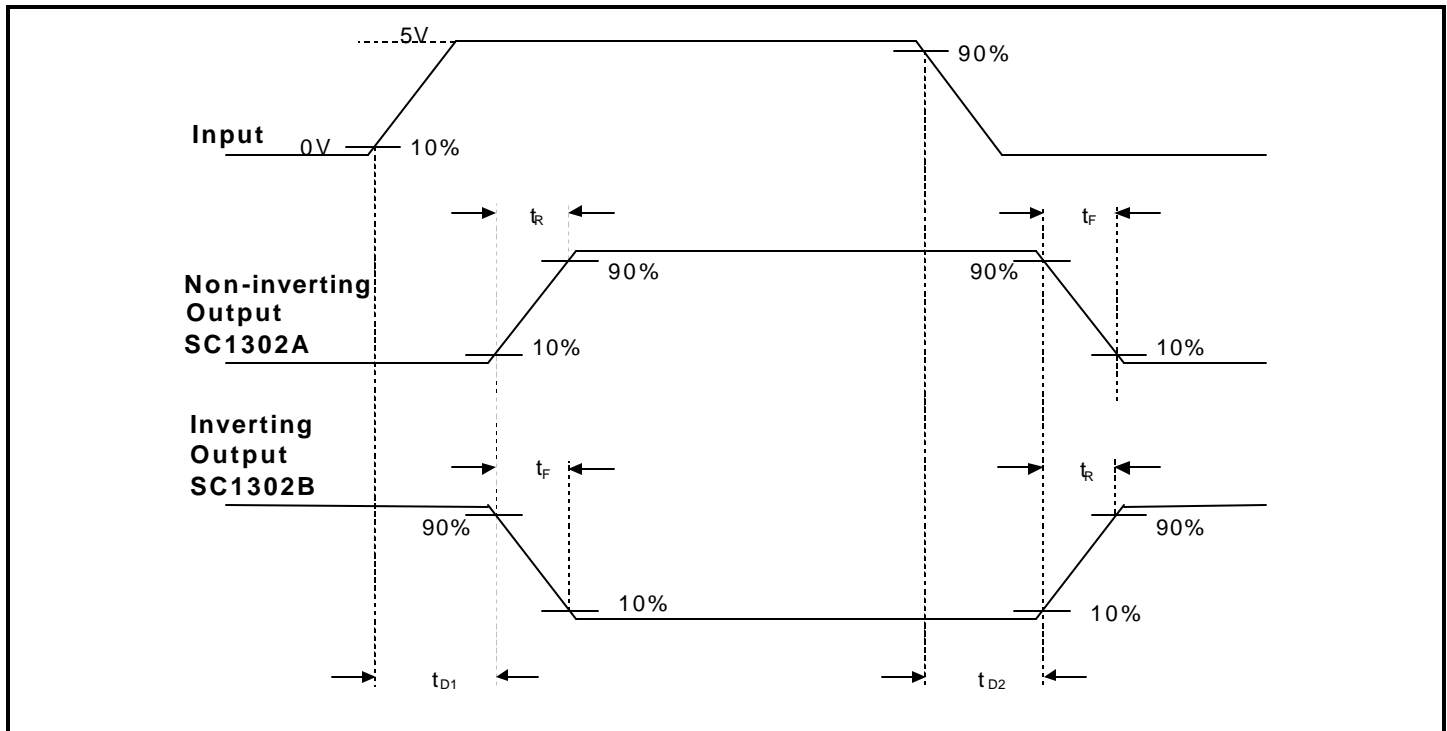| Parameter	Symbol	Conditions	Min	Typ	Max	Units
Rise time[1]	t_R	See Timing Diagram		20		ns
Fall time[1]	t_F	See Timing Diagram		20		ns
Propagation delay time[1]	t_{D1}	See Timing Diagram		53		ns
Propagation delay time[1]	t_{D2}	See Timing Diagram		41		ns

Note:

(1) Guaranteed by design not tested in production.

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

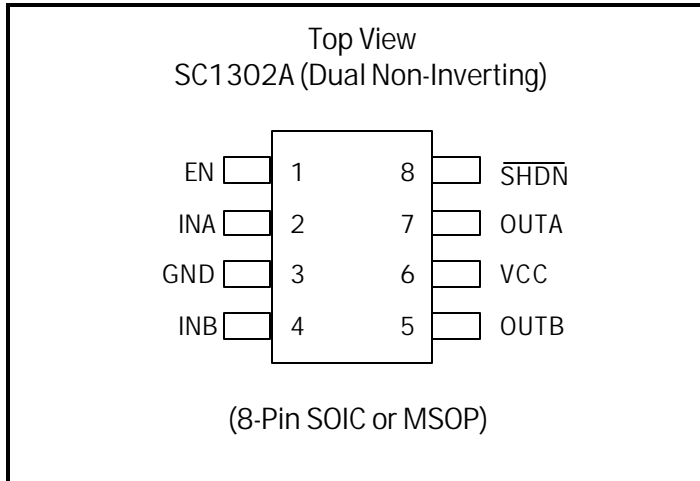## Timing Diagram
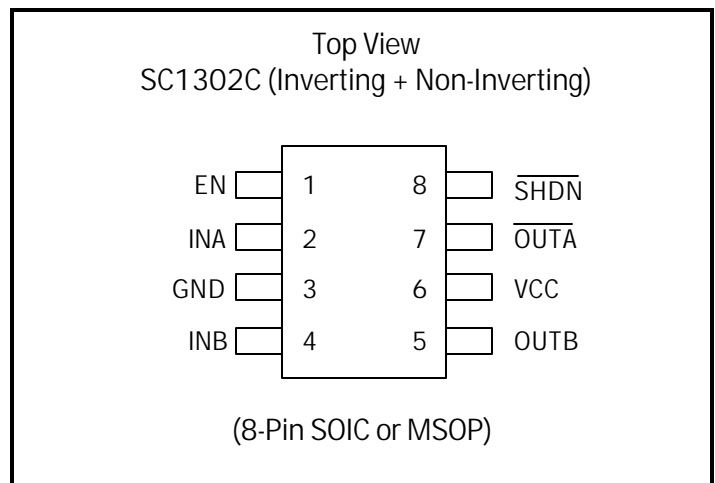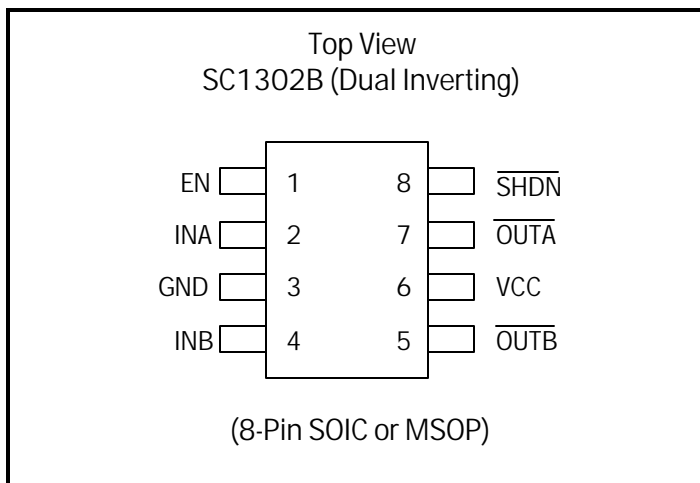
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POWER MANAGEMENT

Pin Configuration

Top View
SC1302A (Dual Non-Inverting)

```
       ┌─────────┐
EN  □──┤ 1     8 ├──□ SHDN
INA □──┤ 2     7 ├──□ OUTA
GND □──┤ 3     6 ├──□ VCC
INB □──┤ 4     5 ├──□ OUTB
       └─────────┘
```

(8-Pin SOIC or MSOP)

Ordering Information

Part Number	Package	Temp. Range (T$_A$)
SC1302AISTR	SOIC-8	-40°C to +85°C
SC1302BISTR		
SC1302CISTR		
SC1302AIMSTR	MSOP-8	-40°C to +85°C
SC1302BIMSTR		
SC1302CIMSTR		

Note:
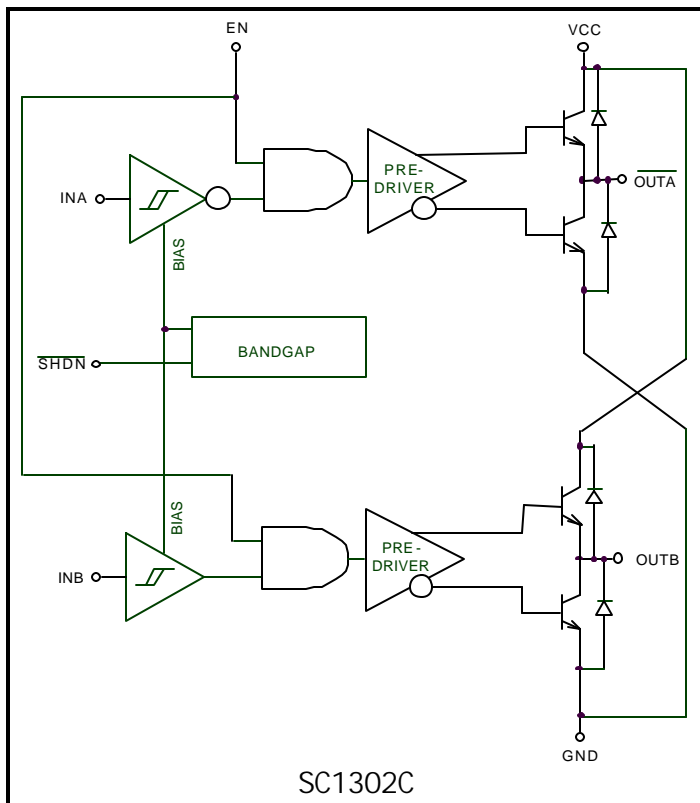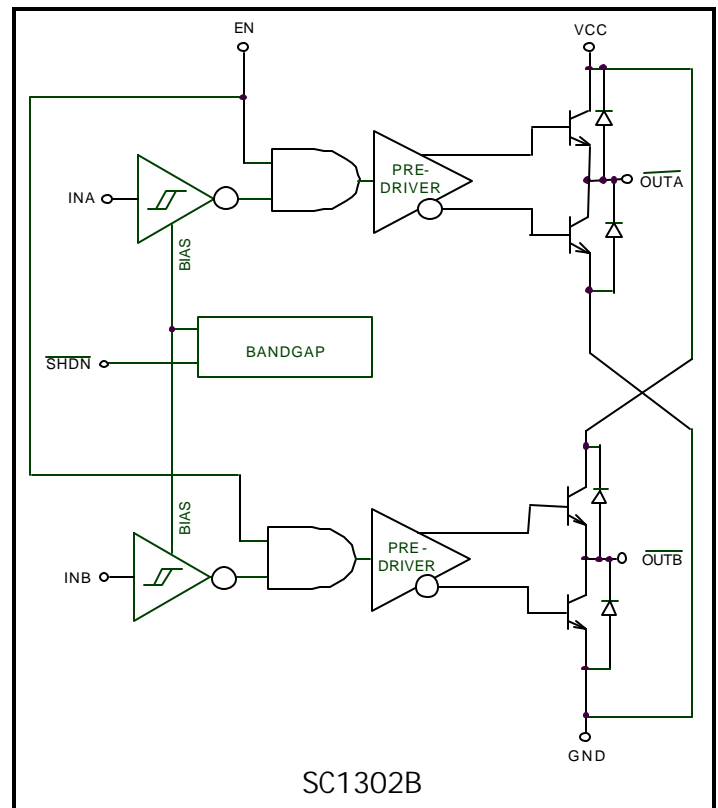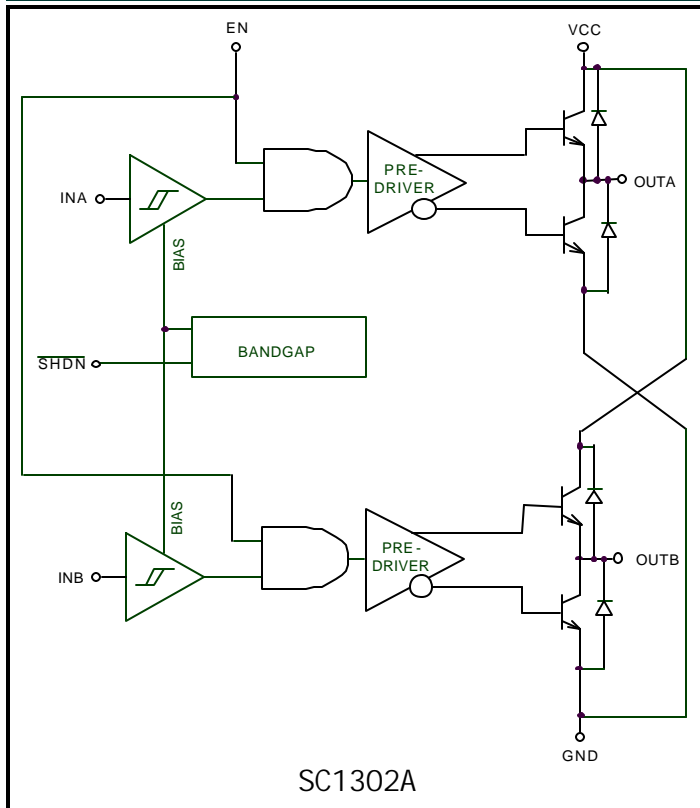Only available in tape and reel packaging. A reel contains 2500 devices.

Top View
SC1302B (Dual Inverting)

```
       ┌─────────┐
EN  □──┤ 1     8 ├──□ SHDN
INA □──┤ 2     7 ├──□ OUTA
GND □──┤ 3     6 ├──□ VCC
INB □──┤ 4     5 ├──□ OUTB
       └─────────┘
```

(8-Pin SOIC or MSOP)

Top View
SC1302C (Inverting + Non-Inverting)

```
       ┌─────────┐
EN  □──┤ 1     8 ├──□ SHDN
INA □──┤ 2     7 ├──□ OUTA
GND □──┤ 3     6 ├──□ VCC
INB □──┤ 4     5 ├──□ OUTB
       └─────────┘
```

(8-Pin SOIC or MSOP)

Pin Descriptions

Pin #	SC1302A	SC1302B	SC1302C	Pin Function
1	EN	EN	EN	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.
2	INA	INA	INA	TTL-compatible input to the driver A. When left open, Pin 7 is low.
3	GND	GND	GND	Ground.
4	INB	INB	INB	TTL-compatible input to the driver B. When left open, Pin 5 is low.
5	OUTB	$\overline{OUTB}$	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	$\overline{OUTA}$	$\overline{OUTA}$	Output gate drive A for external MOSFET.
8	$\overline{SHDN}$	$\overline{SHDN}$	$\overline{SHDN}$	Shutdown pin. Apply a voltage from 2V to VCC to enable device. Pull below 0.3V for low-power shut down.

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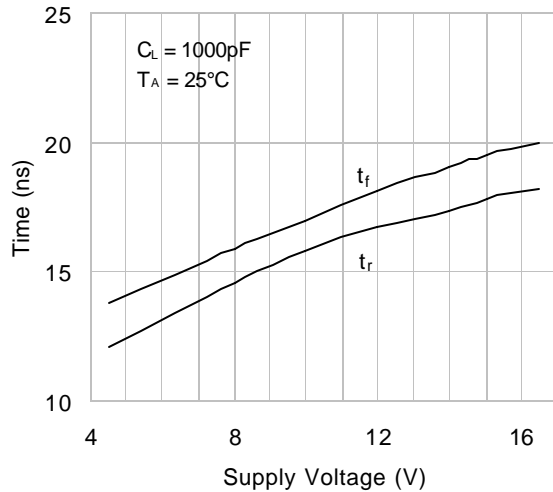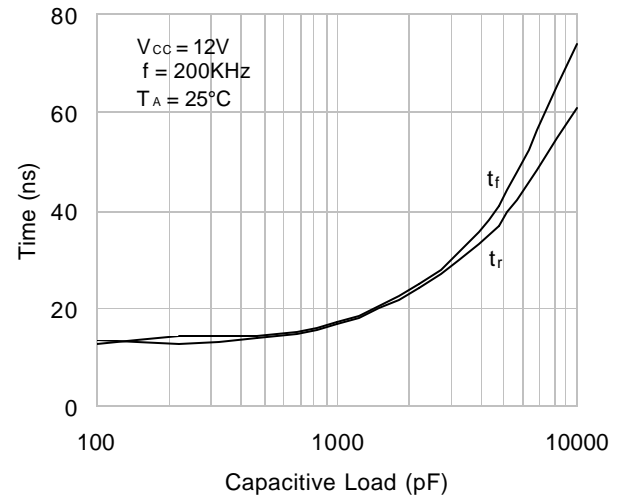## Block Diagrams

SC1302A

SC1302B

SC1302C

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Rise and Fall Time vs. Supply Voltage

$C_L = 1000pF$
$T_A = 25°C$

Time (ns) vs. Supply Voltage (V)

t_f
t_r

Rise and Fall Time vs. Capacitive Load

$V_{CC} = 12V$
$f = 200KHz$
$T_A = 25°C$

Time (ns) vs. Capacitive Load (pF)

t_f
t_r

Supply Current vs. Capacitive Load

$V_{CC} = 12V$
One Driver Running
$T_A = 25°C$

Supply Currnt (mA) vs. Capacitive Load (pF)

200KHz
100KHz

Input Pin Current

Iin (uA) vs. Vin (V)

Non-inverting

Inverting
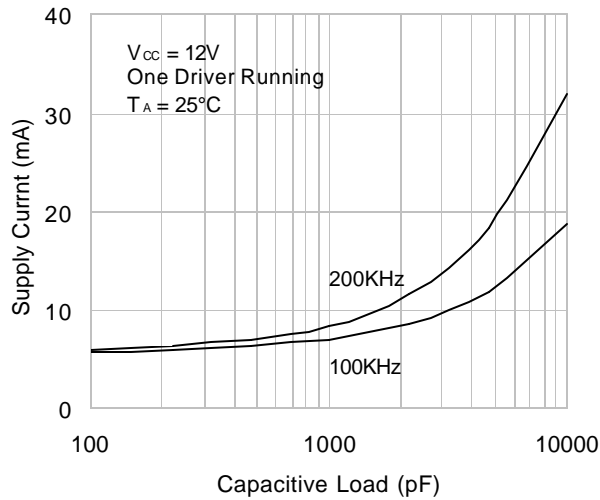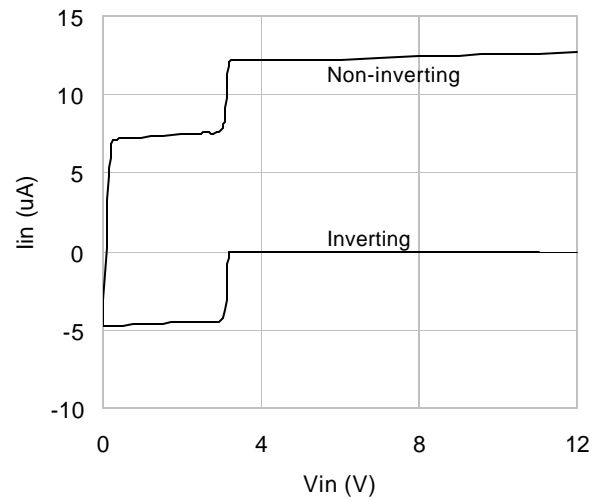
Applications Information

The SC1302A/B/C 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 discrete solution can achieve reasonable drive capability, implementing delay and other housekeeping functions necessary for safe operation can become cumbersome and costly. The SC1032A/B/C presents a total solution for the high-speed, high power density applications. Wide input supply range of 4.5V - 16.5V 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 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. 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 MOSFET's to eliminate the possibility of oscillation caused by trace inductance and the MOSFET gate capacitance. A resistor in the range of 10W 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 Vcc 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 is able to deliver 1.6A peak current for driving capacitive loads, such as MOSFET's.

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

For simplicity, we assume 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:

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

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:

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

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

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

where, f is the switching frequency.

with $V_{CC} = 12V$, $C = 1nF$ and $f = 200kHz$, the power dissipation per output is:

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

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.
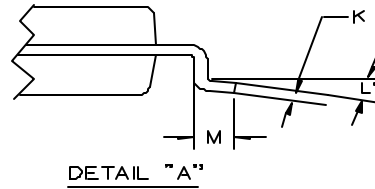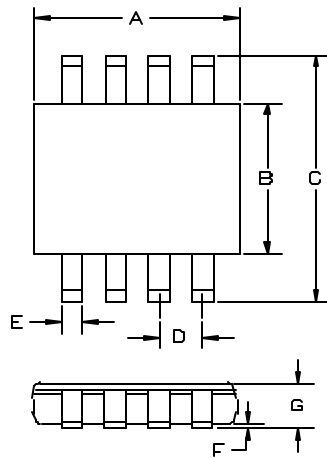
The power dissipation of the SC1302A/B/C should be derated according to the following formula:
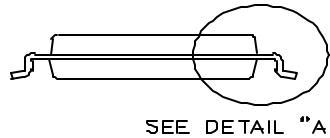
$$Power\,Dissipation < \frac{125°C - T_A}{\theta jA}$$

where TA = ambient temperature.

POWER MANAGEMENT

Outline Drawing - MSOP-8

DIMᴺ	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.114	.122	2.90	3.10	
B	.114	.122	2.90	3.10	
C	.187	.199	4.75	5.05	
D	.025 BSC		.65 BSC		
E	.010	.016	.25	.40	
F	.002	.006	.05	.15	
G	–	.043	–	1.10	
K	.005	.009	.13	.23	
L	0°	6°	0°	6°	
M	.016	.028	.40	.70	

2 PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH AND METAL BURR.

1 CONTROLLING DIMENSIONS: MILLIMETERS.

Land Pattern - MSOP-8

$\dfrac{4.525}{(.178)}$ (REF)

$\dfrac{3.20}{(.126)}$

$\dfrac{5.85}{(.230)}$

$\dfrac{0.65}{(.0256)}$,6X

$\dfrac{1.325}{(.052)}$ (REF),8X

$\dfrac{0.432}{(.017)}$,8X
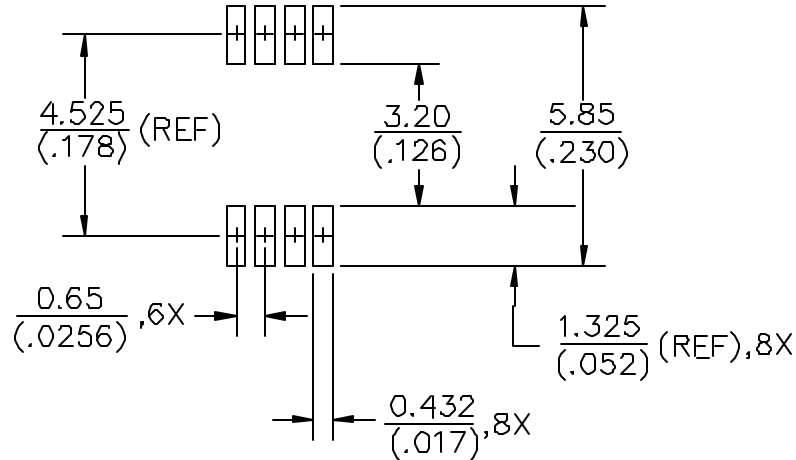
1 DIMENSIONS ARE IN MILLIMETERS (INCHES).

POWER MANAGEMENT

Outline Drawing - SO-8

DETAIL "A"

SEE DETAIL "A"

DIM^N	DIMENSIONS				NOTE
	INCHES		MM		
	MIN	MAX	MIN	MAX	
A	.188	.197	4.80	5.00	
B	.149	.158	3.80	4.00	
C	.228	.244	5.80	6.20	
D	.050	BSC	1.27	BSC	
E	.013	.020	0.33	0.51	
F	.004	.010	0.10	0.25	
H	.053	.069	1.35	1.75	
J	.011	.019	0.28	0.48	
K	.007	.010	.19	.25	
L	0°	8°	0°	8°	
M	.016	.050	0.40	1.27	

Land Pattern - SO-8
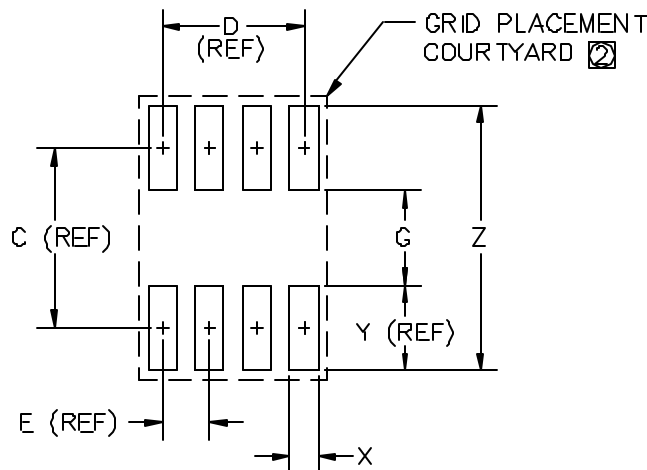
DIM^N	DIMENSIONS ①				NOTE
	INCHES		MM		
	MIN	MAX	MIN	MAX	
C	–	.19	–	5.00	–
D	–	.15	–	3.81	–
E	–	.05	–	1.27	–
G	.10	.11	2.60	2.80	–
X	.02	.03	.60	.80	–
Y	–	.09	–	2.40	–
Z	–	.29	7.20	7.40	–

② GRID PLACEMENT COURTYARD IS 12x16 ELEMENTS
(6 mm X 8mm) IN ACCORDANCE WITH THE
INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.

① CONTROLLING DIMENSION: MILLIMETERS

Contact Information

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