SEMTECH

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

POWER MANAGEMENT

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 is a one 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 ($\overline{SHDN}$) internally tied to VCC.

An under-voltage lockout 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 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

Typical Application Circuit
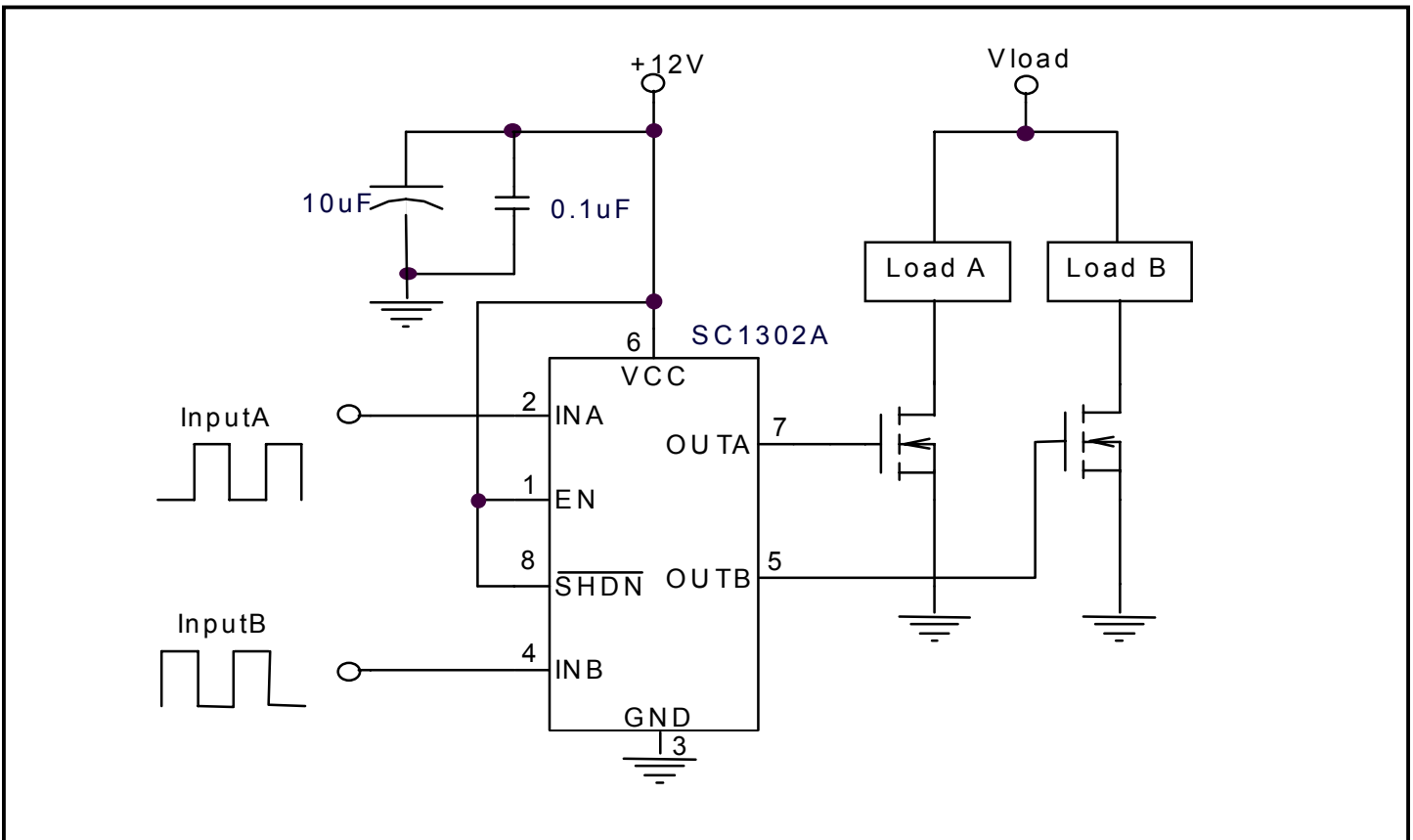
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Absolute Maximum Ratings

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. Exposure to Absolute Maximum rated conditions for extended periods of time may affect device reliability.

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 (SC1302A/B/C)	V_{EN}	-0.3 to V_{CC}	V
Shutdown Voltage (SC1302A/B/C)	$V_{\overline{SHDN}}$	-0.3 to V_{CC}	V
Continuous Power Dissipation	Pd	Internally limited	W
Operating Temperature Range	T_A	-40 to +125	°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 < 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

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DC Electrical Characteristics (Cont.)

Unless otherwise specified: -40°C < T_A < 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
Enable for SC1302A/B/C (Cont.)						
Delay to Output [1]	t_{D_EN}	EN for low to high		70		ns
Delay to Output [1]	t_{D_DIS}	EN from high to low		55		ns
Enable Input Current	IEN	$0 < V_{IN} < V_{CC}$	10	14	19	µA
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 [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 SC1302A/B/C (Cont.)						
$\overline{SHDN}$ 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

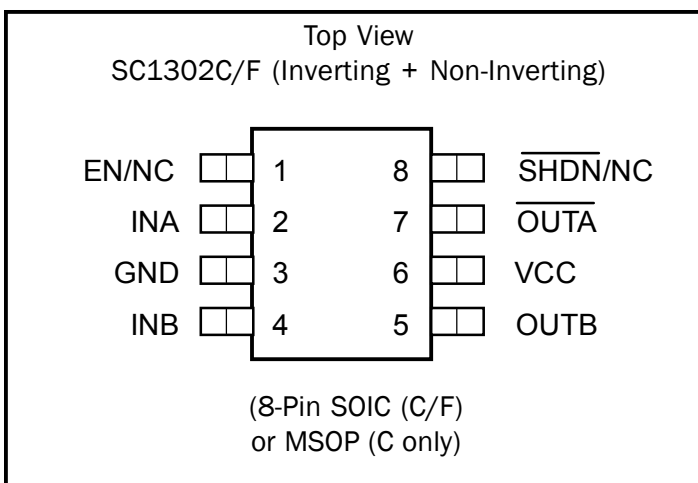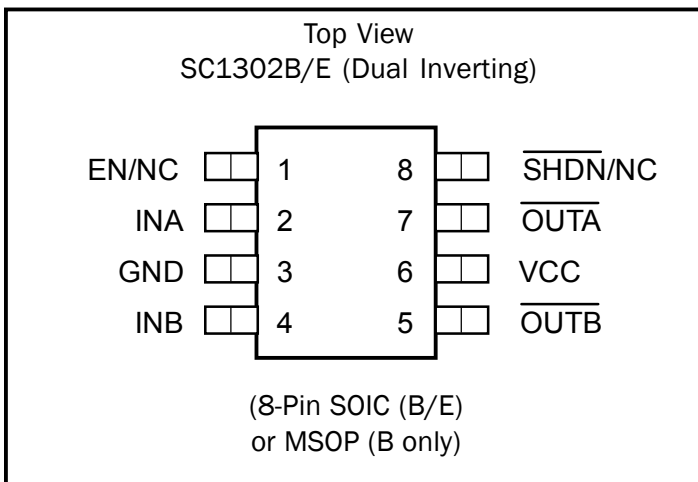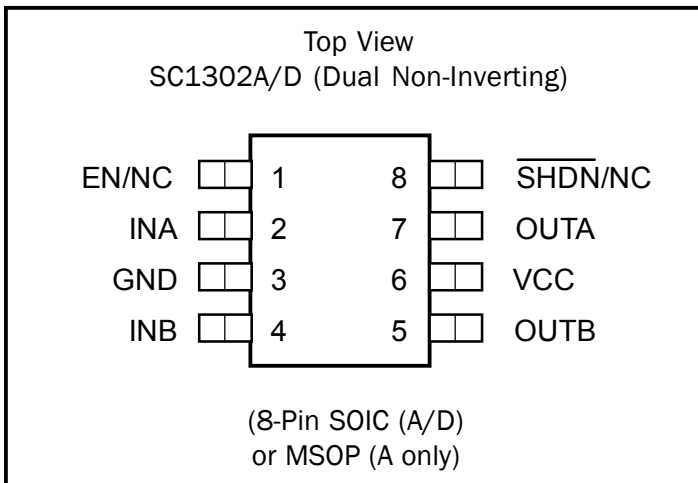| Parameter	Symbol	Conditions	Min	Typ	Max	Units
Rise time[1]	t_R	See Timing Diagram		20		ns
Fall time[1]	t_F	See Timing Diagram		20		ns
Propagation delay time[1]	t_{D1}	See Timing Diagram		53		ns
Propagation delay time[1]	t_{D2}	See Timing Diagram		41		ns

Notes:
(1) Guaranteed by design not tested in production.
(2) Negative sign indicates that the input current flows out of the device.

Timing Diagram
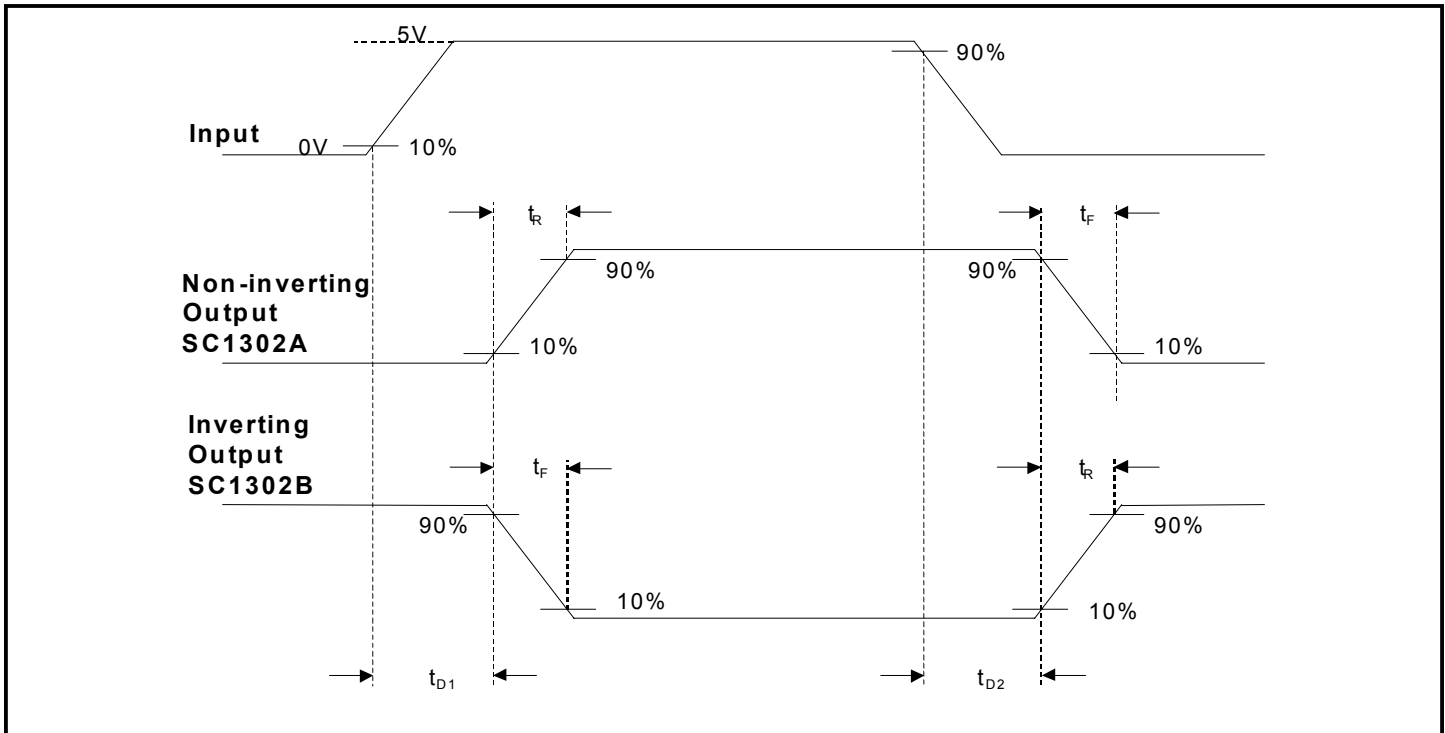
Pin Descriptions

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 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	$\overline{SHDN}$/NC	$\overline{SHDN}$/NC	$\overline{SHDN}$/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.

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Pin Configuration

Top View
SC1302A/D (Dual Non-Inverting)

```
EN/NC  ──1      8── SHDN/NC
INA    ──2      7── OUTA
GND    ──3      6── VCC
INB    ──4      5── OUTB
```

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

Top View
SC1302B/E (Dual Inverting)

```
EN/NC  ──1      8── SHDN/NC
INA    ──2      7── OUTA
GND    ──3      6── VCC
INB    ──4      5── OUTB
```

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

Top View
SC1302C/F (Inverting + Non-Inverting)

```
EN/NC  ──1      8── SHDN/NC
INA    ──2      7── OUTA
GND    ──3      6── VCC
INB    ──4      5── OUTB
```

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

Ordering Information

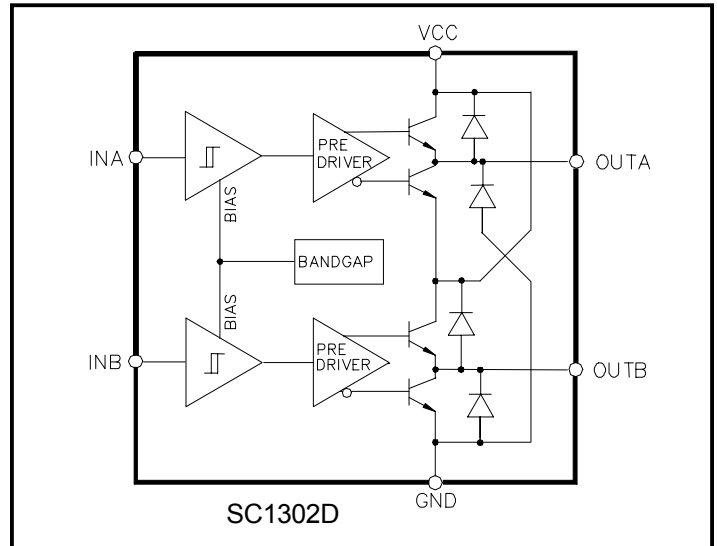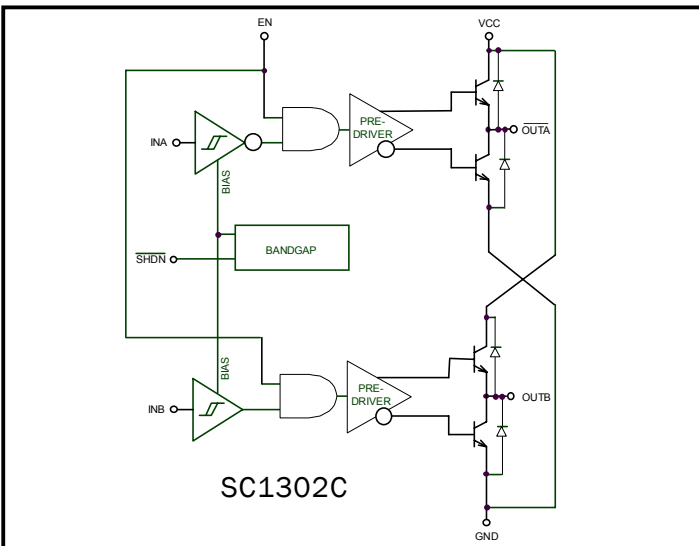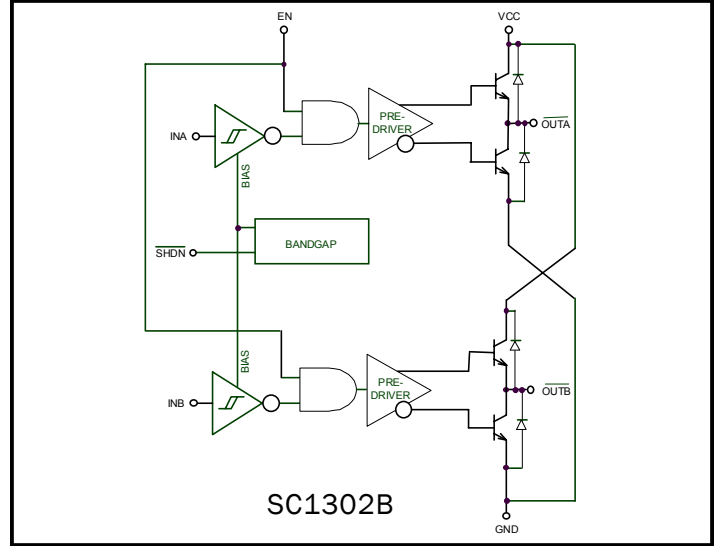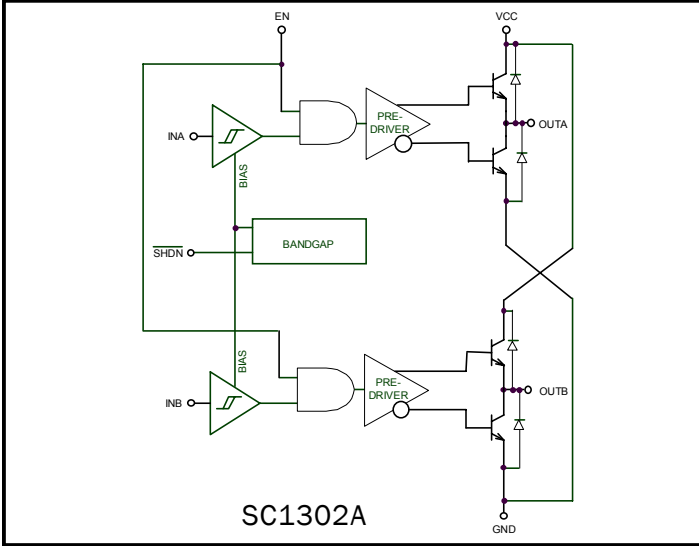| Part Number [2]	Package [1]	Temp. Range (T_A)
SC1302AISTRT		
SC1302BISTRT		
SC1302CISTRT	SOIC-8	-40°C to +125°C
SC1302DSTRT		
SC1302ESTRT		
SC1302FSTRT		
SC1302AIMSTRT		
SC1302BIMSTRT	MSOP-8	-40°C to +125°C
SC1302CIMSTRT		

Notes:
(1) Only available in tape and reel packaging. A reel contains 2500 devices.
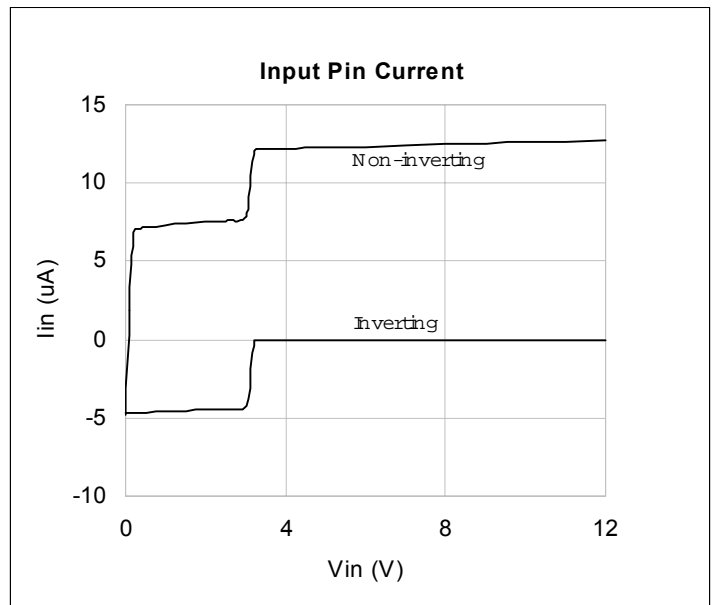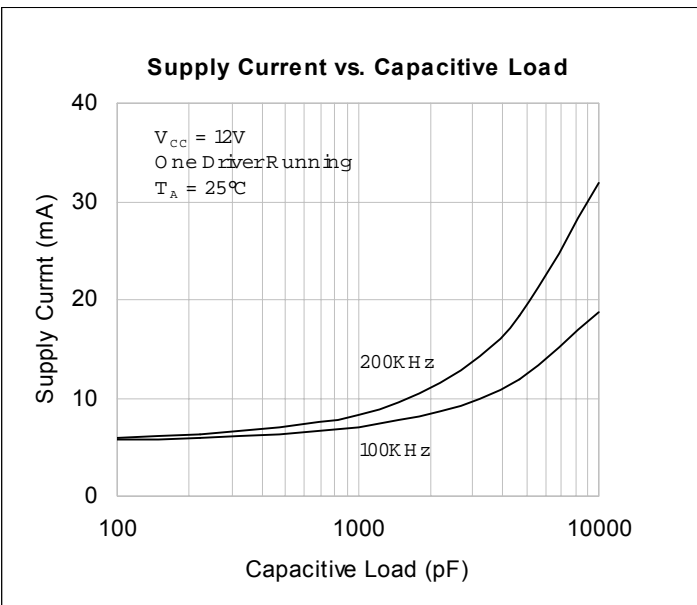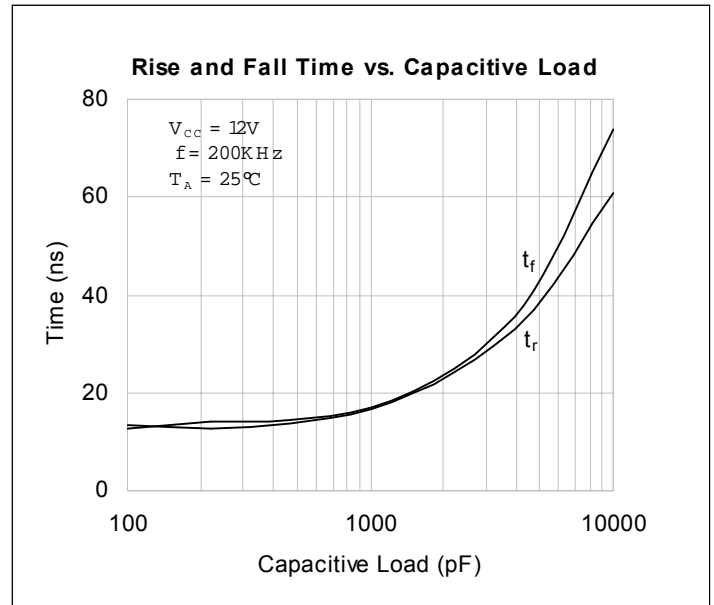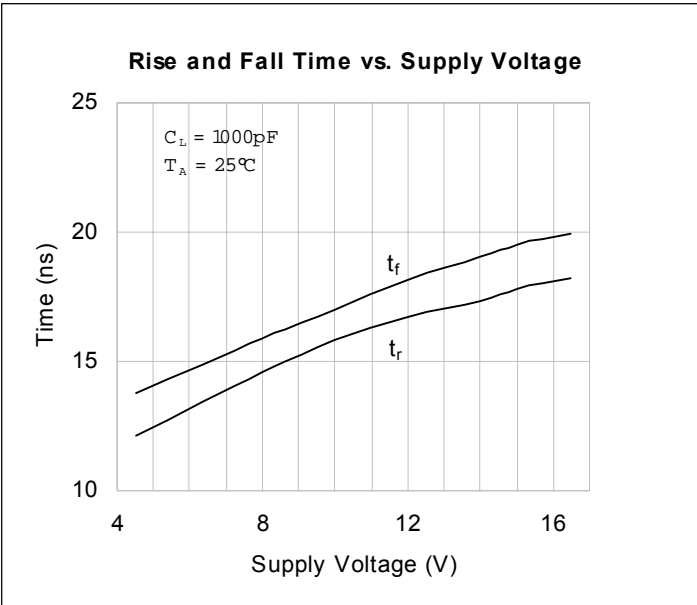(2) Lead free product.This product is fully WEEE and RoHS compliant.

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Block Diagrams

SC1302A

SC1302B

SC1302C

SC1302D

SC1302E

SC1302F

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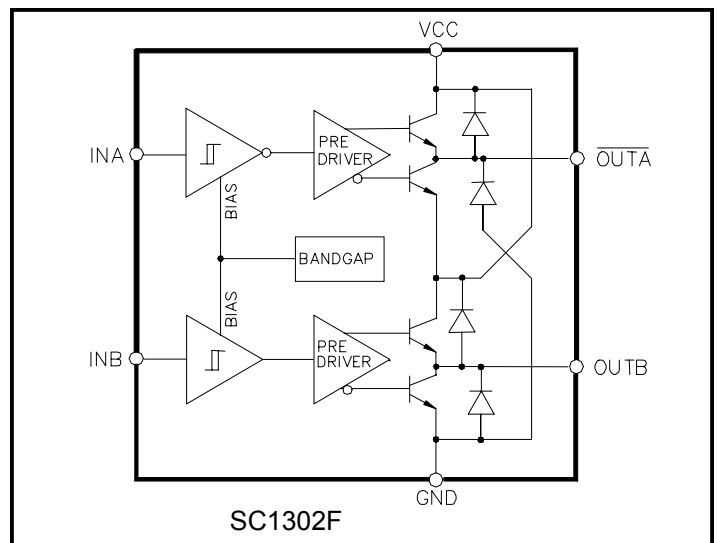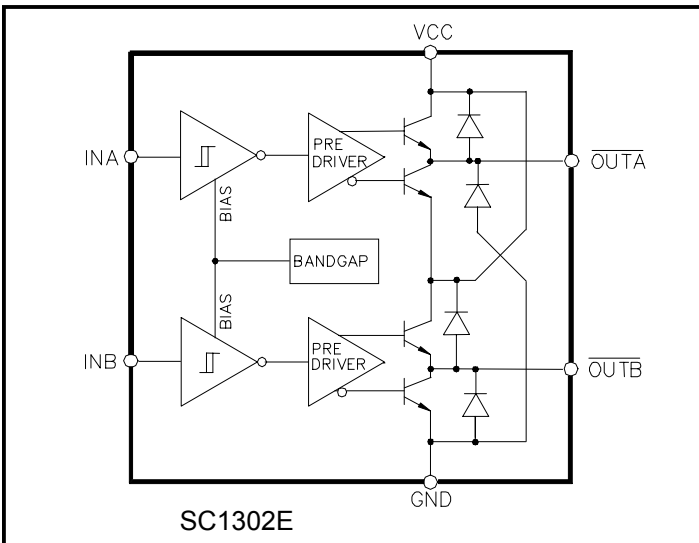
POWER MANAGEMENT

Typical Characteristics

Rise and Fall Time vs. Supply Voltage

C_L = 1000pF
T_A = 25°C

t_f

t_r

Time (ns) — Supply Voltage (V)

Rise and Fall Time vs. Capacitive Load

V_{CC} = 12V
f = 200KHz
T_A = 25°C

t_f

t_r

Time (ns) — Capacitive Load (pF)

Supply Current vs. Capacitive Load

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

200KHz

100KHz

Supply Curmt (mA) — Capacitive Load (pF)

Input Pin Current

Non-inverting

Inverting

Iin (uA) — Vin (V)

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 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/D/E/F 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/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 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/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, 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:

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

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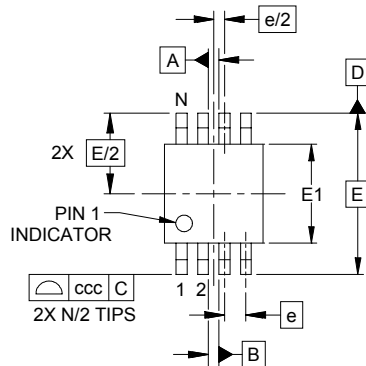
The power dissipation of the SC1302A/B/C/D/E/F should be derated according to the following formula:

$$Power\ Dissipation < \frac{125°C - T_A}{\theta jA}$$

where T_A = ambient temperature.

![SEMTECH logo]

POWER MANAGEMENT

Outline Drawing - MSOP-8

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		
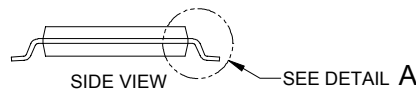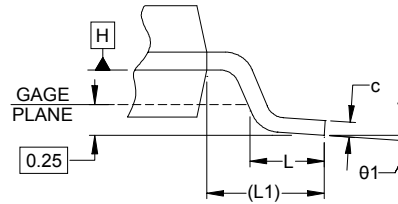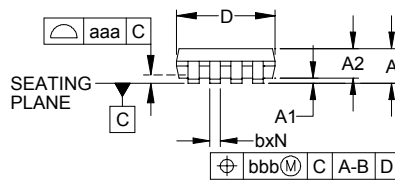
DETAIL A

SEE DETAIL A

SIDE VIEW

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.
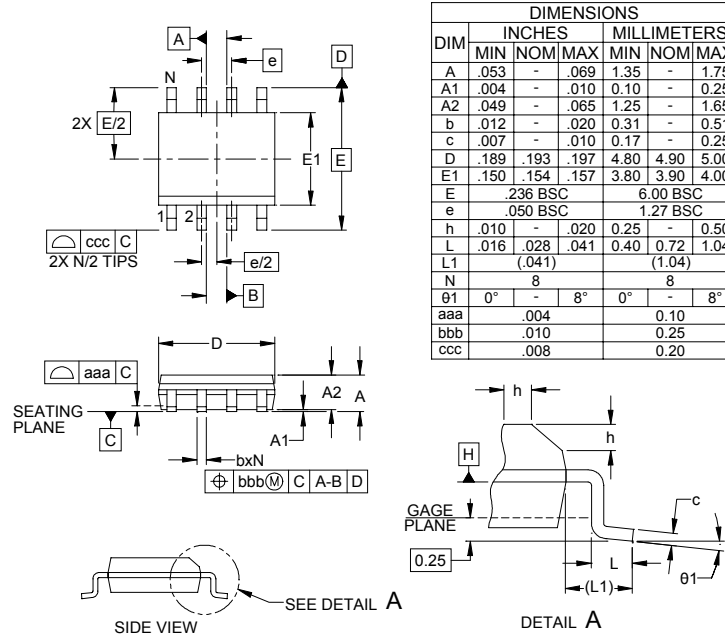
Land Pattern - MSOP-8
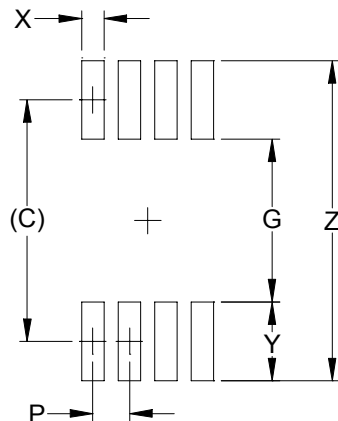
DIM	DIMENSIONS	
	INCHES	MILLIMETERS
C	(.161)	(4.10)
G	.098	2.50
P	.026	0.65
X	.016	0.40
Y	.063	1.60
Z	.224	5.70

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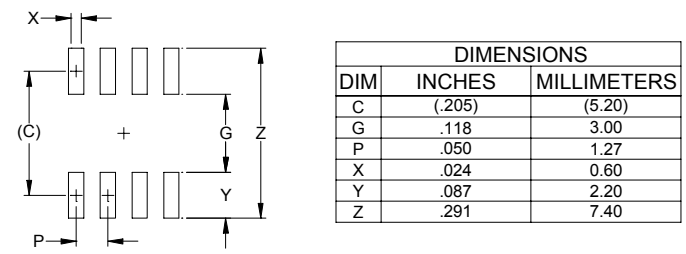
POWER MANAGEMENT

Outline Drawing - SO-8

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		
θ1	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.010			0.25		
ccc	.008			0.20		

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.

Contact Information

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