

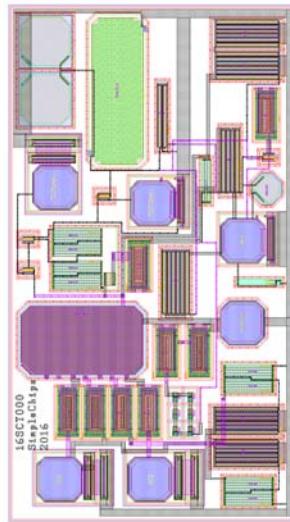
# 16SCT000 TRANSFORMER-COUPLED MOSFET / IGBT GATE DRIVER

16SCT000 - PRELIMINARY SPECIFICATION - REVISION MAY 29, 2017

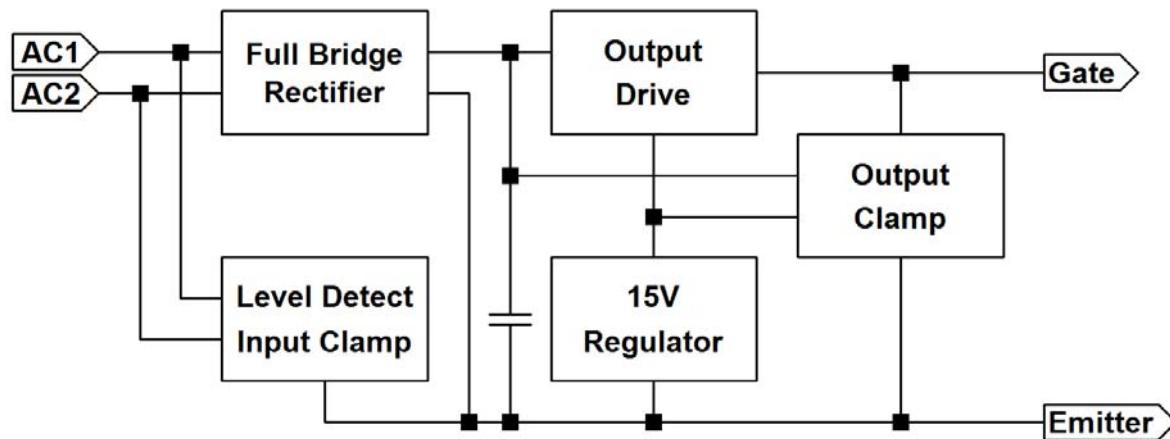
- Maximum Voltage . . . 30 V;
- Transformer Drive provides HV isolation;
- No other external components required;
- Fast IGBT Turn-On & Turn-Off Times.

## Description

The 16SCT000 is an IGBT/MOSFET gate driver (15V nominal  $V_g$ ) chip to control the conduction state of a high-side switch from the secondary of a small high-voltage isolation transformer. The 16SCT000 will drive the gate of the HV switch above the emitter/source while the secondary winding of the transformer drives the complementary input signals. Upon cessation of the input drive signals, the 16SCT000 quickly clamps the gate to the emitter/source terminal to ensure fast turns off.



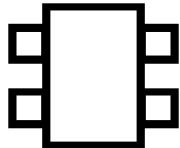
## Block diagram



## Concept of operation

In normal operation an square wave alternating signal is applied between AC1 and AC2. This signal is rectified by the Full Bridge and the resulting voltage is stored on the integrated capacitor. The rectified DC voltage is then applied to the 15V Regulator and fed to the Gate via the Output Drive circuit. This voltage saturates on the IGBT/MOSFET into a low resistance conduction state.

After the AC drive signal is removed, the voltage stored on the integrated capacitor falls. When it falls below the voltage on the Gate, the Output Clamp shunts the Gate and various internal nodes, rapidly turning off the IGBT/MOSFET. The Clamp Circuit has a time constant of several tens of microseconds, ensuring that the Gate and internal nodes are clamped solidly for that duration. The Output Clamp circuit also acts to prevent false triggering when voltages change rapidly.



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## Absolute maximum ratings

Input Voltage (AC1 - AC2) .....	+/-30 V	
Operating temperature .....	0 C to 80 C	
Storage temperature .....	-65 C to 125 C	

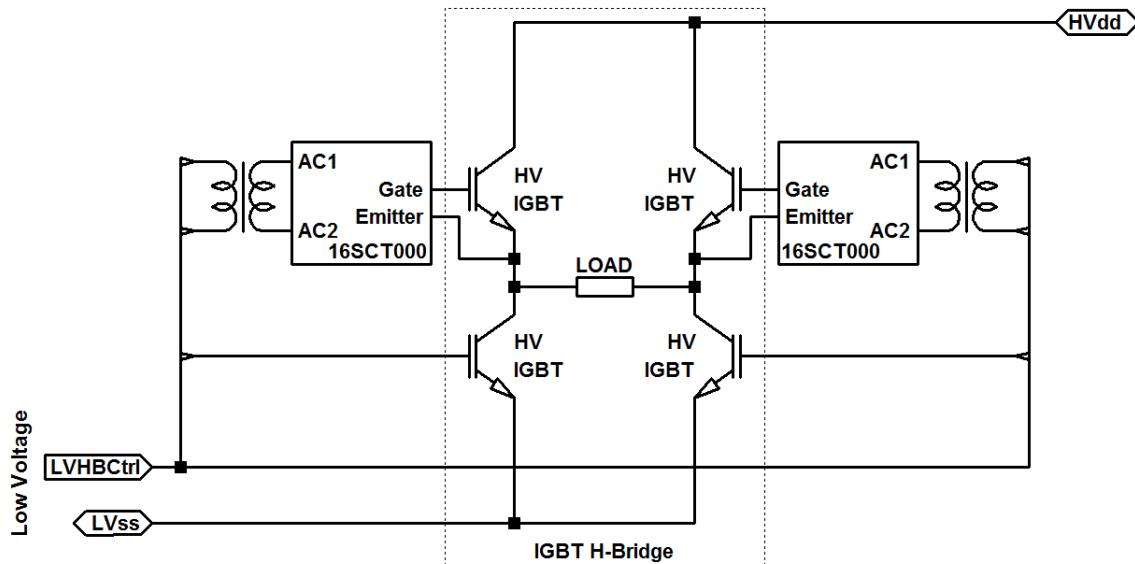
## Recommended operating conditions

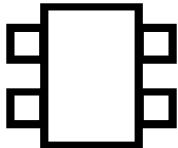
PARAMETER	MIN	MAX	UNIT
Operating temperature	0	80	°C
Operating voltage, AC1 - AC2, peak, complementary phase		25	V <sub>ac</sub>
Operating frequency, AC1 - AC2	0.40	5.0	MHz
Continuous power dissipation (AC1 - AC2 drive signal applied)	25	300	mW

## Pin definitions

SYMBOL	DESCRIPTION
AC1	AC input drive signal
AC2	AC input drive signal
Gate	Gate terminal of the high-side IGBT/MOSFET
Emitter/Source	Emitter/Source terminal of the high-side IGBT/MOSFET

## Typical application





# 16SCT000

## TRANSFORMER-COUPLED MOSFET / IGBT GATE DRIVER

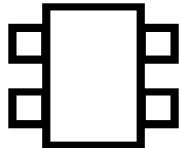
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### Static electrical characteristics( $37^{\circ}\text{C} \pm 2^{\circ}\text{C}$ unless specified)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{ge15NL}$	Output Voltage, No Load	$V_{AC1/2}=15\text{V}$ , $V_{AC2/1}=0\text{V}$	12.52	13.38	14.05	V
$V_{ge25NL}$	Output Voltage, No Load	$V_{AC1/2}=25\text{V}$ , $V_{AC2/1}=0\text{V}$	14.55	15.44	16.16	V
$V_{ge15}$	Output Voltage, -2mA Load	$V_{AC1/2}=15\text{V}$ , $V_{AC2/1}=0\text{V}$	11.75	12.53	13.18	V
$V_{ge25}$	Output Voltage, -2mA Load	$V_{AC1/2}=25\text{V}$ , $V_{AC2/1}=0\text{V}$	14.00	14.88	15.63	V
$V_{geCL}$	Gate Clamping V, Low Current	$V_{AC1/2}=0\text{V}$ , $I_{ge}=0.5\text{mA}$	1.18	1.57	1.94	V
$I_{ge3.5}$	Gate Clamping Current	$V_{AC1/2}=0\text{V}$ , $V_{ge}=3.5$	13.0	26.0	40.0	mA
$R_{ge}$	Gate-Emitter/Source Resistance	$V_{ge}=0.4\text{V}$	183	440	707	k $\Omega$
$R_{AC1/2L}$	Input Resistance; Low Voltage	$V_{AC1/2}=0.25\text{V}$ , $V_{AC2/1}=0\text{V}$	64.0	81.1	95.9	k $\Omega$
$R_{AC1/2M}$	Input Resistance; Med Voltage	$V_{AC1/2}=[4-8]\text{V}$ , $V_{AC2/1}=0\text{V}$	37.3	47.2	57.9	k $\Omega$
$R_{AC1/2H}$	Input Resistance; Above 18V	$V_{AC1/2}=[30-18]\text{V}$ , $V_{AC2/1}=0\text{V}$	11.1	16.4	19.3	k $\Omega$
$\Delta_R$	Resistance Matching Above 18V	$V_{AC1/2}=[30-18]$	-10	0	+10	%

### Dynamic electrical characteristics ( $37^{\circ}\text{C} \pm 2^{\circ}\text{C}$ )

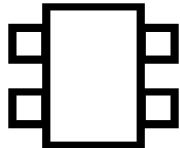
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{cd1.0}$	Gate Charge Delay 1.0nF	$C_{Load}=1.0\text{nF}$ , 0 to 20V pulse on AC1 - AC2, $t_{cd1.0}$ measured at $V_{ge}=2\text{V}$		65		nS
$t_{ct1.0}$	Gate Charge Time 1.0nF	$C_{Load}=1.0\text{nF}$ , 0 to 20V pulse on AC1 - AC2, $t_{ct1.0}$ measured from $V_{ge}=2\text{V}$ to 12V		325		nS
$t_{dd1.0}$	Gate Discharge Delay 1.0nF	$C_{Load}=1.0\text{nF}$ , 20 to 0V pulse on AC1 - AC2, $t_0$ when $V_{AC1/2}=15\text{V}$ , $t_{dd1.0}$ when $V_{ge}=12\text{V}$	0.80	1.33	2.50	$\mu\text{s}$
$t_{dt1.0}$	Gate Discharge Time 1.0nF	$C_{Load}=1.0\text{nF}$ , 20 to 0V pulse on AC1 - AC2, $t_0$ when $V_{AC1/2}=12\text{V}$ , $t_{dt1.0}$ when $V_{ge}=2\text{V}$	0.05	0.10	0.20	$\mu\text{s}$
$t_{cd3.3}$	Gate Charge Delay 3.3nF	$C_{Load}=3.3\text{nF}$ , 0 to 20V pulse on AC1 - AC2, $t_{cd3.3}$ measured at $V_{ge}=2\text{V}$		150		nS
$t_{ct3.3}$	Gate Charge Time 3.3nF	$C_{Load}=3.3\text{nF}$ , 0 to 20V pulse on AC1 - AC2, $t_{ct3.3}$ measured from $V_{ge}=2\text{V}$ to 12V		1000		nS



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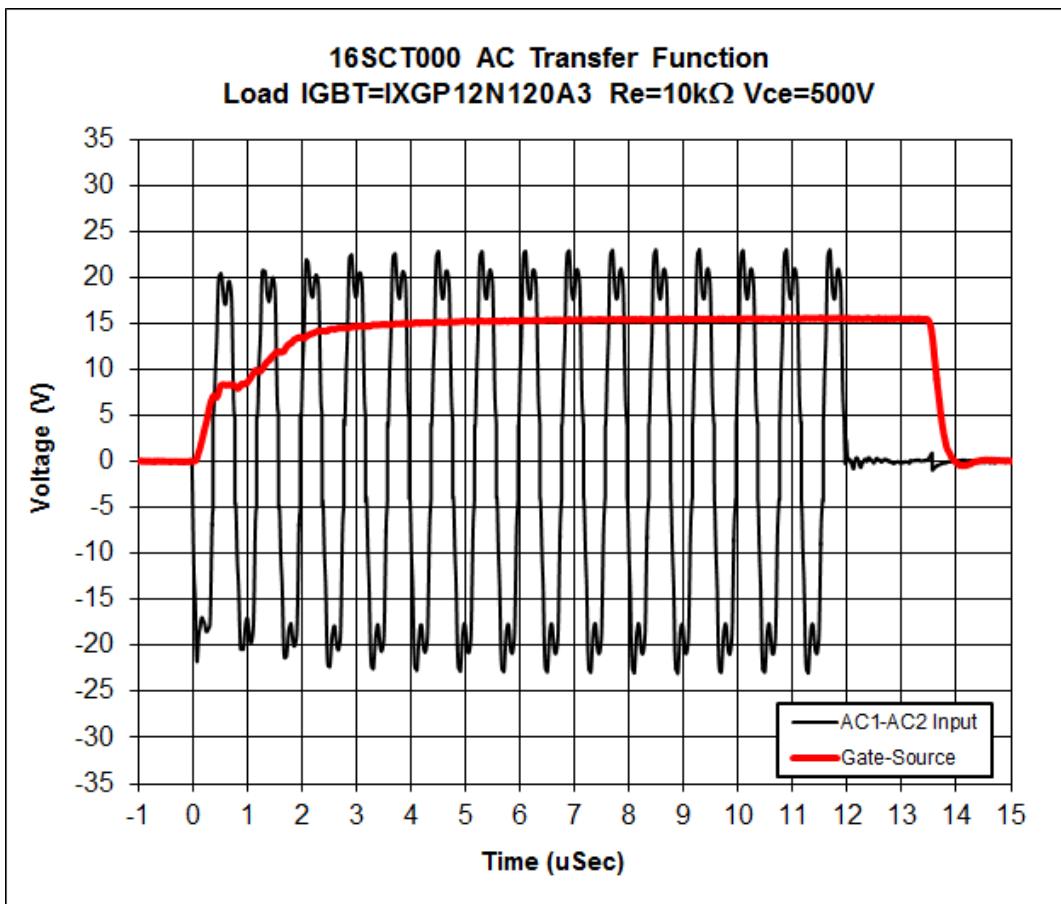
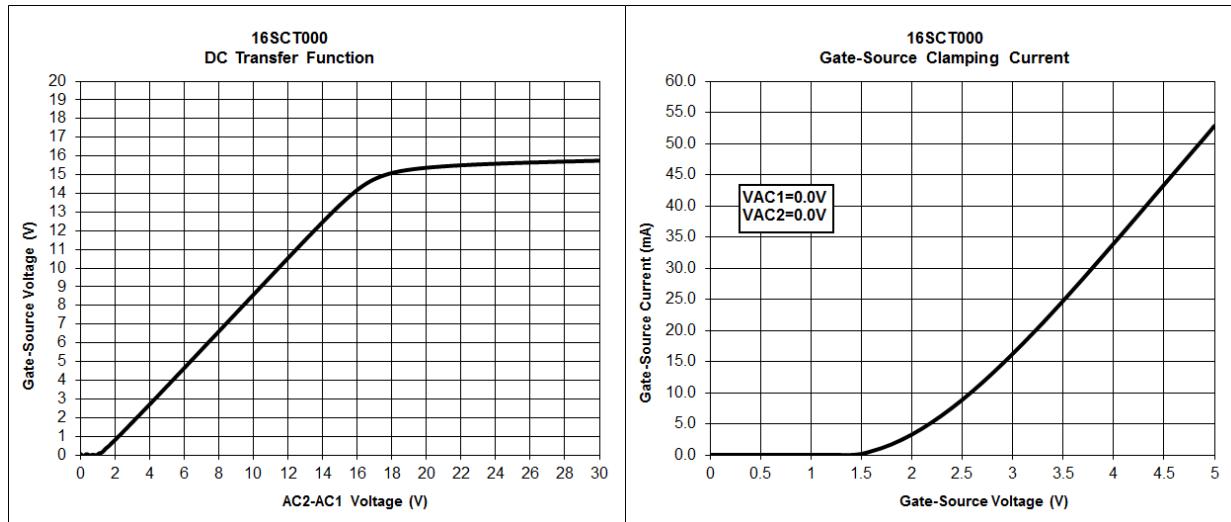
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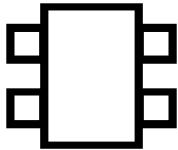
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{dd3.3}$	Gate Discharge Delay 3.3nF	$C_{Load}=3.3nF$ , 20 to 0V pulse on AC1 - AC2, $t_0$ when $V_{AC1/2}=15V$ , $t_{dd3.3}$ when $V_{ge}=12V$	0.8	1.33	2.5	$\mu S$
$t_{dt3.3}$	Gate Discharge Time 3.3nF	$C_{Load} = 3.3nF$ , 20 to 0V pulse on AC1 - AC2, $t_0$ when $V_{AC1/2}=12V$ , $t_{dt3.3}$ when $V_{ge}=2V$	0.145	0.25	0.338	$\mu S$



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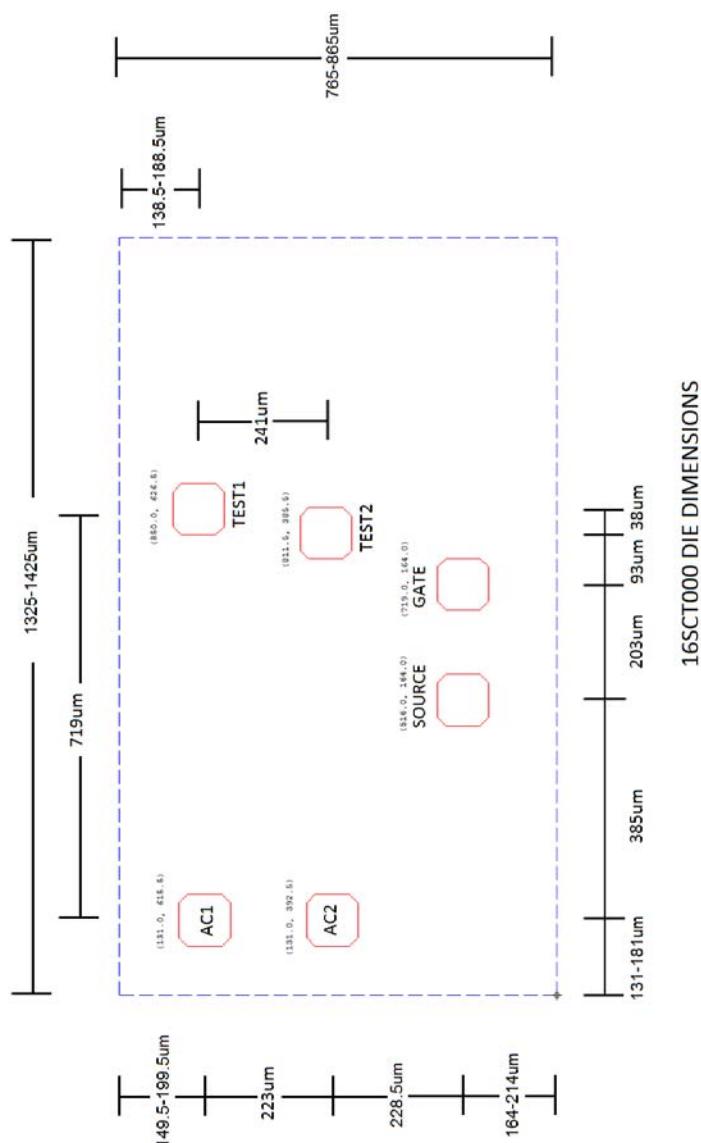
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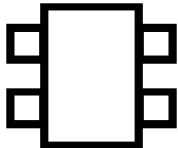
## TRANSFORMER-COUPLED MOSFET / IGBT GATE DRIVER

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### Die Dimensions

PARAMETER		MIN	TYP	MAX	UNIT
Y <sub>SIZE</sub>	Long Side Dimensions	1325	1375	1425	μm
X <sub>SIZE</sub>	Short Side Dimensions	765	815	865	μm
Z <sub>SIZE</sub>	Die Thickness	260	285	310	μm





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## Visual inspection

PARAMETER	Lot Sampled	Sample Size	Fails Allowed	UNIT
100% Visual Inspection per MIL STD 883H Method 2010 Condition B.	ALL	100%	n/a	n/a

## Product qualification tests

PARAMETER	Lot Sampled	Sample Size	Fails Allowed	UNIT
Static burn-in 504hrs @ $V_{HV}=1000V$ ; MIL STD 883 method 1015	3	22	0	n/a
Physical dimensions	3	11	0	n/a
Wire Bond Evaluation (Gold Ball Bond) per MIL STD 883 method 2011	3	20	1	n/a

## Lot acceptance tests

PARAMETER	Lot Sampled	Sample Size	Fails Allowed	UNIT
Static burn-in 168hrs @ $V_{HV}=1000V$ ; MIL STD 883 method 1015	each	22	0	n/a
Physical dimensions	each	11	0	n/a
Wire Bond Evaluation (Gold Ball Bond) per MIL STD 883 method 2011	each	20	1	n/a

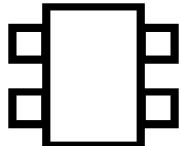
Product qualification tests are performed on 3 lots while a Lot Acceptance Test (LAT) is performed on each "diffusion lot". LAT is considered complete if the lot was used for product qualification.

All samples used for qualification and LAT burn-in test are assembled in a open cavity ceramic DIL package with a dielectric silicone gel filling the cavity. The chip is mounted to provide isolation between the wirebonds and the substrate and to eliminate surface conduction and polarization as possible means of unwanted failure.

## Application notes

To make best use of the 16SCT000, the chip should be molded before high voltage is applied to it. This can either be done with a standard mold compound or with silicone gel. Care should be taken when selecting an encapsulant to ensure proper dielectric strength and resistance. We recommend that the dielectric strength of the dielectric used be greater than 10kV/mm at a thickness of 50um.

Care should also be taken to properly isolate the chip's substrate which is biased at about half  $V_{HV}$ . In no circumstance should the chip be mounted over layers providing less than 1kV of dielectric isolation. It is also strongly recommended to use non-conducting epoxy for attaching the chip.



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Ball bonding should be used for attaching conductors to the chip's pad. Wedge bonding is not recommended because of the shorter distance between the wirebond and the chip's edge, increasing the risk of arcing. When using ball bonding the wire should extend vertically for at least 150um before going horizontal toward the substrate or package pad.