SOLID STATE OPTRONICS

SG6504

1A Output Current
IGBT Gate Drive Optocoupler

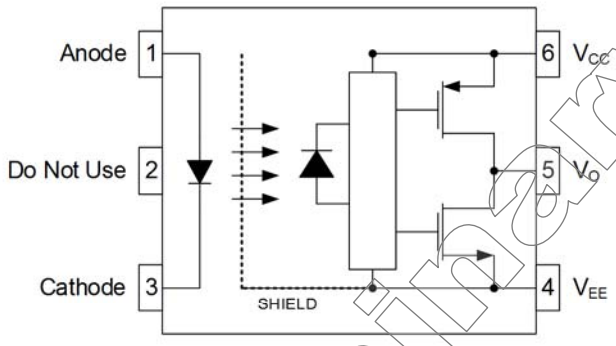
Description

The SG6504 is an optically coupled 1A Output Current Gate Driver, designed to drive most 1200V / 50A IGBTs and MOSFETs. It is intended for driving high power IGBTs and MOSFETs used in motor control inverter applications. For IGBTs or MOSFETs with higher ratings, the SG6504 can be used to drive a discrete power stage which in turn will drive the IGBT or MOSFET gate.

The circuit consists of an infrared input LED optically coupled to an integrated circuit which utilizes a high speed driver.

The SG6504 comes in a wide body S0-6 package, available in either a standard toe-to-toe width (9.7mm, order code "P") or in a stretched toe-to-toe width (11.5mm, order code "W").

Schematic Diagram



SG6504

Truth Table (Positive Logic)

LED	High Side	Low Side	V_O
OFF	OFF	ON	LOW
ON	ON	OFF	HIGH

** A 0.1µF bypass Capacitor must be connected between pins 4 & 6 (V_{EE} & V_{CC}) – reference Note 8 on page 4

Applications

- IGBT / MOSFET Gate Drives
- AC & Brushless DC Motor Drives
- Industrial Inverters
- Uninterruptable Power Supplies (UPS)
- Switch Mode Power Supplies

Features

- High Common Mode Rejection: 25kV/µS minimum @ V_{CM} = 1500V
- 1A Maximum Peak Output Current
- Fast Switching Speeds
  - 500nS Maximum Propagation Delay
  - 300nS Maximum Propagation Delay Difference
- I_{CC}=3.5mA Maximum Supply Current
- Wide Supply Voltage (V_{CC}) Range (10V to 30V)
- Under Voltage Lockout Protection (UVLO) with Hysteresis
- Broad Temperature Performance Range (-40°C to 100°C)
- Rail-to-Rail Output Voltage
- High Input to Output Isolation (5kV_{RMS})
- RoHS / Pb-Free / REACH Compliant

Agency Approvals

- UL/C-UL Approval - Pending
- VDE (EN60747-5-5) Approval - Pending

Ordering Information

Part Number	Description
SG6504-P	Wide body SO-6, standard lead spacing (100/Tube)
SG6504-W	Wide body SO-6, stretched lead spacing (100/Tube)
SG6504-(x)TR	Wide body SO-6, Tape and Reel (1000/Reel)

NOTES:

- **Suffixes listed above are not included in marking on device for part number identification**
- **For lead spacing details, reference package dimensions on page 7**

Preliminary Datasheet

Absolute Maximum Ratings, T_A = 25°C (unless otherwise specified)

The values indicated are absolute stress ratings. Functional operation of the device is not implied at these or any conditions in excess of those defined in electrical characteristics section of this document. Exposure to absolute Maximum Ratings may cause permanent damage to the device and may adversely affect reliability.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
General Maximum Ratings								
Storage Temperature	T_{ST}	-55	-	125	°C			
Operating Temperature	T_A	-40	-	100	°C			
Isolation Voltage	V_{ISO}	5000	-	-	V_{RMS}			
Supply Voltage	V_{CC}	0	-	35	V			
Solder Temperature – Wave (10 sec)	T_{SOL}	-	-	260	°C			9
Total Power Dissipation	P_T	-	-	295	mW			
Input Maximum Ratings								
Average Forward Input Current	$I_{F(AVG)}$	-	-	25	mA			
Reverse Input Voltage	V_R	-	-	5	V			
Peak Transient Input Current	$I_{F(TRAN)}$	-	-	1	A	<1µS pulse width, 300pps		
Input Current (Rise / Fall Time)	$t_{r(IN)}$ / $t_{f(IN)}$	-	-	500	nS			
Input Power Dissipation	P_I	-	-	45	mW			
Output Maximum Ratings								
"High" Peak Output Current	$I_{OH(PEAK)}$	1	-	-	A			1
"Low" Peak Output Current	$I_{OL(PEAK)}$	1	-	-	A			1
Output Voltage	V_O	-	-	V_{CC}	V			
Output Power Dissipation	P_O	-	-	250	mW			
Total Power Dissipation	P_T	-	-	295	mW			

Recommended Operating Conditions

The values indicated are recommended for steady, consistent operation with optimal performance across the operating temperature range.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
Recommended Specifications								
Operating Temperature	T_A	-40	-	100	°C			
Supply Voltage	V_{CC}	10	-	30	V			
Input Current (ON)	$I_{FL(ON)}$	8	-	16	mA			
Input Voltage (OFF)	$V_{F(OFF)}$	-3.0	-	0.8	V			

Preliminary Datasheet

Electrical Characteristics, T_A = 25°C, V_{EE} = Ground and V_{CC} = 10V to 30V (unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
Input Specifications								
LED Forward Voltage	V_F	1.2	1.4	1.8	V	I_F = 10mA		
LED Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$	-	-1.24	-	mV/°C	I_F = 10mA		
LED Reverse Voltage	BV_R	5	-	-	V	I_R = 10µA		
Input Threshold Current (Low to High)	I_{FLH}	-	-	5	mA	V_O > 5V, I_O = 0A		
Input Threshold Voltage (High to Low)	V_{FHL}	0.8	-	-	V	V_O < 5V, I_O = 0A		
Input Capacitance	C_{IN}	-	33	-	pF	f = 1MHz, V_F = 0V		
Output Specifications								
High Level Supply Current	I_{CCH}	-	-	3.5	mA	Open V_O, I_F = 7 to 16mA		
Low Level Supply Current	I_{CCL}	-	-	3.5	mA	Open V_O, V_F = -3 to +0.8V		
High Level Output Current	I_{OH}	-	-	-0.8	A	V_O = (V_{CC} – 2.5V)		1
		-	-	-1.0		V_O = (V_{CC} – 15V)		
Low Level Output Current	I_{OL}	0.8	-	-	A	V_O = (V_{EE} + 2.5V)		1
		1.0	-	-		V_O = (V_{EE} + 15V)		
High Level Output Voltage	V_{OH}	V_{CC}-0.25	-	-	V	I_F = 10mA, I_O = -100mA		
Low Level Output Voltage	V_{OL}	-	-	V_{EE}+0.25	V	I_F = 0mA, I_O = 100mA		
Isolation Specifications								
Withstand Insulation Test	V_{ISO}	5000	-	-	V	RH ≤ 40-60%, t = 1 min		2,3
Input-Output Resistance	R_{I-O}	-	10^{12}	-	Ω	V_{I-O} = 500V_{DC}		2
Input-Output Capacitance	C_{I-O}	-	0.9	-	pF	f =1MHz		2

Preliminary Datasheet

Electrical Characteristics, continued… T_A = 25°C, V_{EE} = Ground and V_{CC} = 30V (unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
Switching Specifications								
Propagation Delay Time to High Output Level	t_{PLH}	100	-	500	nS	I_F = 7 to 16mA V_{CC} = 10 to 30V V_{EE} = Ground Rg = 47Ω Cg = 3nF f = 10kHz Duty Cycle = 50%	01	
Propagation Delay Time to Low Output Level	t_{PHL}	100	-	500				
Pulse Width Distortion	PWD	-	-	100				
Propagation Delay Difference Between Any Two Parts	PDD	-300	-	300				4
Output Rise Time (10 to 90%)	t_r	-	50	-			01	
Output Fall Time (90 – 10%)	t_f	-	50	-				
UVLO Turn On Delay	$t_{UVLO\ ON}$	-	0.8	-	µS	I_F = 10mA, V_O > 5V		
UVLO Turn Off Delay	$t_{UVLO\ OFF}$	-	0.6	-	µS	I_F = 10mA, V_O < 5V		
Common Mode Transient Immunity at HIGH Level Output	$\lvert CM_H \rvert$	25	-	-	kV/µS	I_F = 7 to 16mA V_{CM} = 1000V T_A = 25°C V_{CC} = 30V	02	5
Common Mode Transient Immunity at LOW Level Output	$\lvert CM_L \rvert$	25	-	-	kV/µS	V_F = 0V V_{CM} = 1000V T_A = 25°C V_{CC} = 30V		6

Notes

1. Maximum pulse width = 10µS, maximum duty cycle = 0.2%
2. Device is considered a two-terminal device: pins 1, 2, and 3 are shorted together, and pins 4, 5, and 6 are shorted together
3. In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage ≥5250 V_{RMS} for one second (leakage current less than 10 µA)
4. The difference between T_{PHL} and T_{PLH} between any two SG6504 devices under the same test conditions
5. Common mode transient immunity in HIGH stage is the maximum tolerable negative dV_{CM}/dt on the trailing edge of the common mode impulse signal, V_{CM}, to assure that the output will remain HIGH
6. Common mode transient immunity in LOW stage is the maximum tolerable positive dV_{CM}/dt on the leading edge of the common mode impulse signal, V_{CM}, to assure that the output will remain LOW
7. Pulse Width Distortion is defined as $|T_{PHL} - T_{PLH}|$ for any given device
8. It is recommended to place a 1µF multi-layer ceramic capacitor across pins 4 and 6. In order to optimize performance, an additional larger capacitor (>1µF) can be placed in parallel.
9. 260°C for 10 seconds. Refer to the lead free solder reflow profile for more information

Preliminary Datasheet

SG6504 Electrical Test Circuits, continued…

Figure 01: *Rise Time (t_r), Fall Time (t_f), and Propagation Delay Times (t_{PLH} and t_{PHL}) Test Circuit & Waveforms*

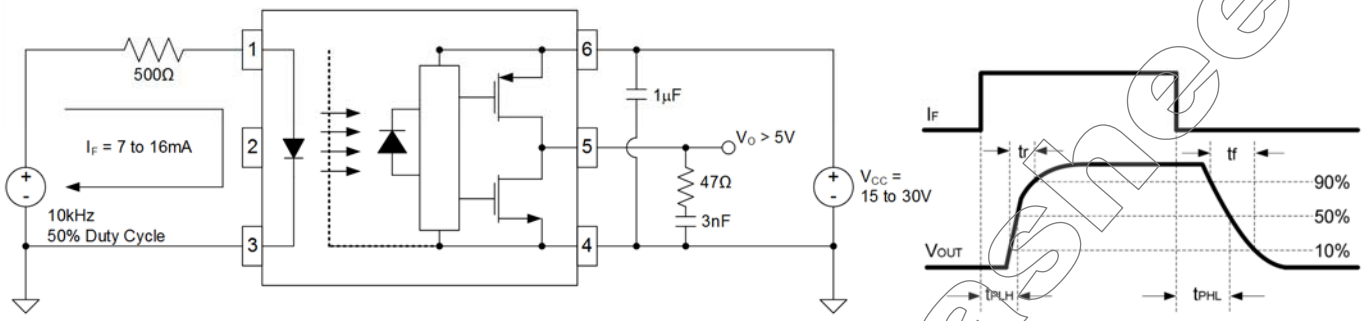
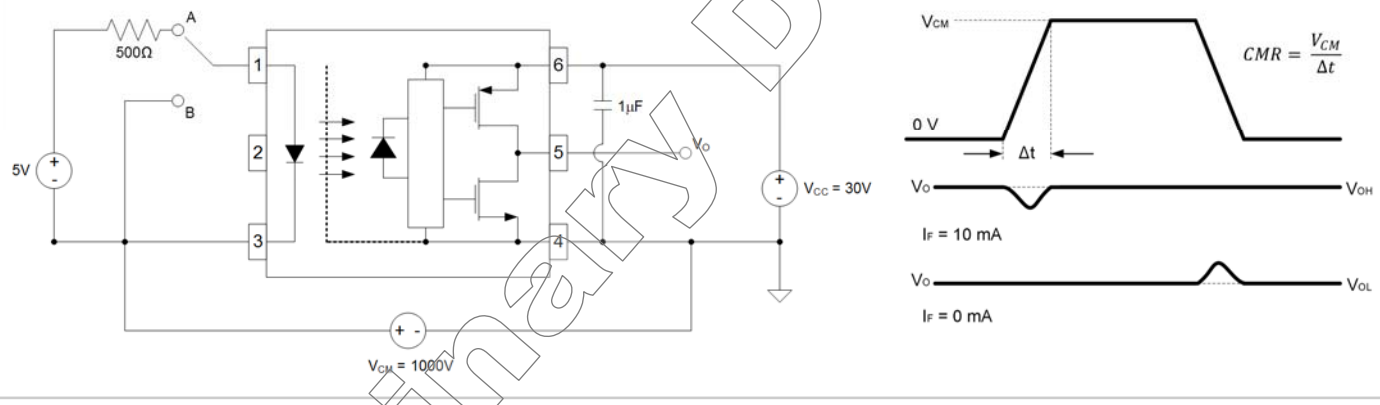


Figure 02: *CMR Test Circuit & Waveforms*

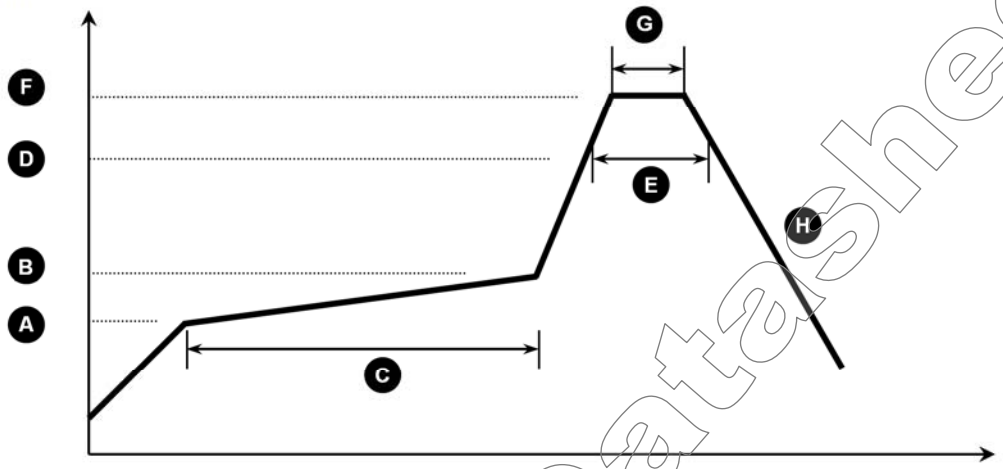


Preliminary Datasheet

SG6504 Solder Reflow Temperature Profile Recommendations

(1) *Infrared Reflow:*

Refer to the following figure as an example of an optimal temperature profile for single occurrence infrared reflow. Soldering process should not exceed temperature or time limits expressed herein. Surface temperature of device package should not exceed 250ºC:



Process Step	Description	Parameter
A	Preheat Start Temperature (ºC)	150ºC
B	Preheat Finish Temperature (ºC)	180ºC
C	Preheat Time (s)	90 - 120s
D	Melting Temperature (ºC)	230ºC
E	Time above Melting Temperature (s)	30s
F	Peak Temperature at Terminal (ºC)	260ºC
G	Dwell Time at Peak Temperature (s)	10s
H	Cool-down (ºC/s)	<6ºC/s

(2) *Wave Solder:*

Maximum Temperature:	260ºC (at terminal)
Maximum Time:	10s
Pre-heating:	100 - 150ºC (30 - 90s)
Single Occurrence	

(3) *Hand Solder:*

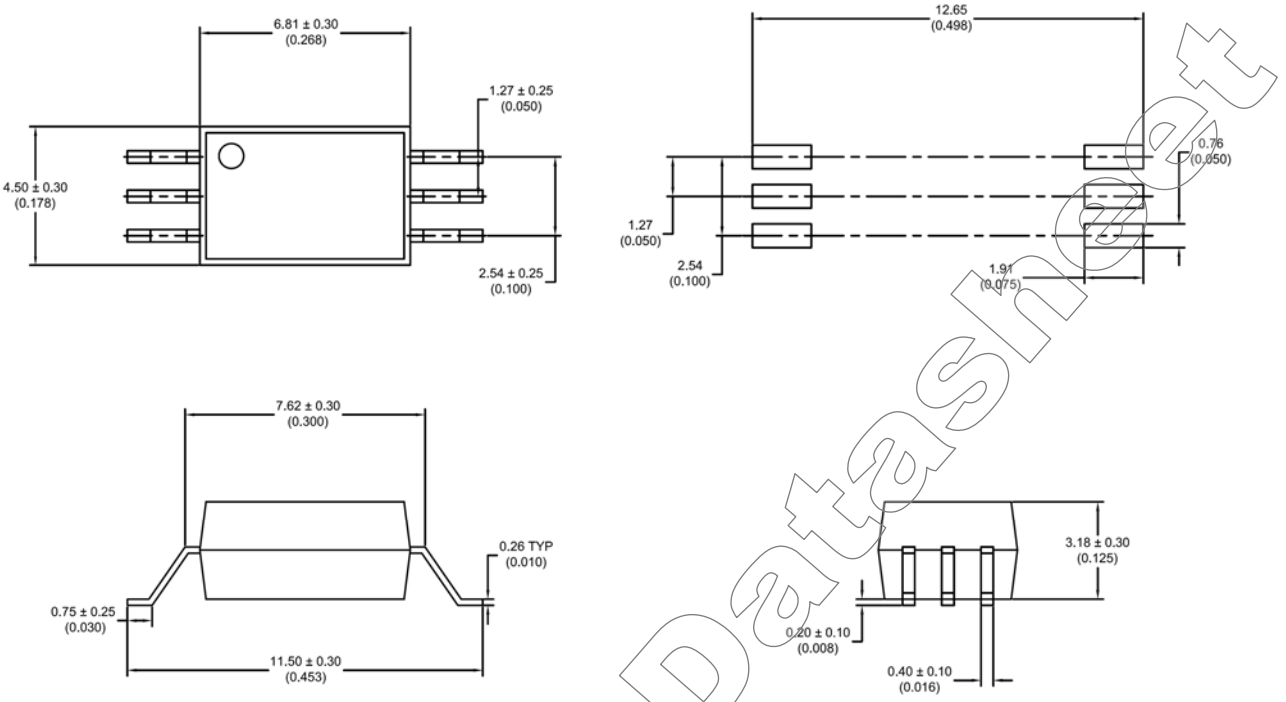
Maximum Temperature:	350ºC (at tip of soldering iron)
Maximum Time:	3s
Single Occurrence	

Preliminary Datasheet

SG6504 Package Dimensions

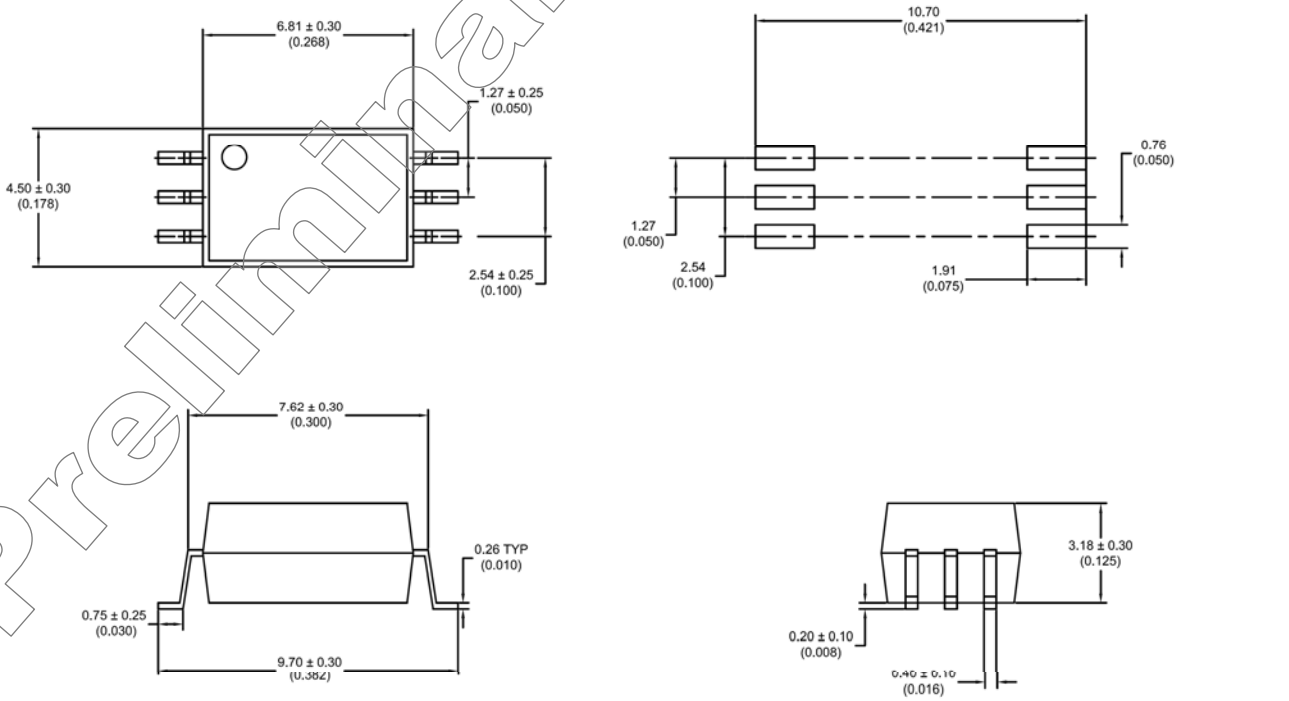
SO-6 Package Stretched Lead Spacing (-W)

Note: *All dimensions in millimeters [mm] with inches in parenthesis ()*



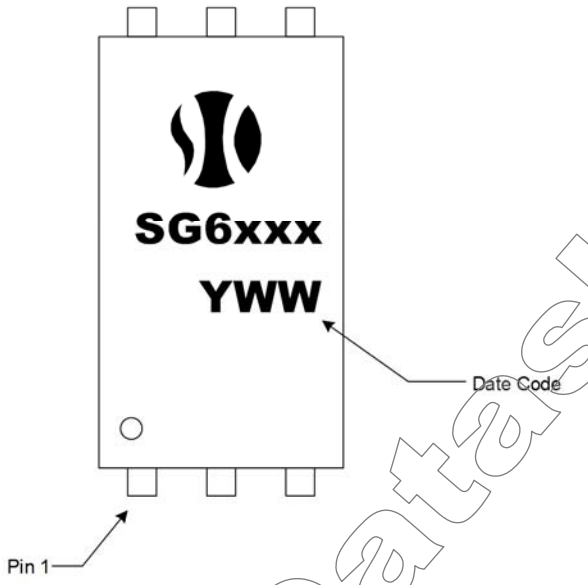
SO-6 Package Standard Lead Spacing (-P)

Note: *All dimensions in millimeters [mm] with inches in parenthesis ()*



Preliminary Datasheet

SG6504 Package Marking



Preliminary Datasheet

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