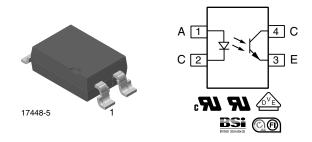


**Vishay Semiconductors** 

# Optocoupler, Phototransistor Output, High Reliability, 5300 V<sub>RMS</sub>



### DESCRIPTION

The SFH6156 features a variety of transfer ratios, low coupling capacitance and high isolation voltage. This coupler has a GaAs infrared diode emitter, which is optically coupled to a silicon planar phototransistor detector, and is incorporated in a plastic SMD package.

The coupling devices are designed for signal transmission between two electrically separated circuits.

### FEATURES

- Excellent CTR linearity depending on forward current
- Isolation test voltage, 5300 V<sub>RMS</sub>
- Fast switching times
- Low CTR degradation
- Low coupling capacitance
- Material categorization: For definitions of compliance please see <u>www.vishay.com/doc?99912</u>

### **APPLICATIONS**

- Switchmode power supply
- Telecom
- Battery powered equipment

### AGENCY APPROVALS

- UL1577, file no. E52744 system code H or J, double protection
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- cUL tested to CSA 22.2 bulletin 5A
- BSI IEC 60950, IEC 60065
- FIMKO EN6005, EN60950-1

ORDERING INFORMATION									
S F H 6 1 5 6 - # X 0 0 1 T   PART NUMBER PART NUMBER CTR PACKAGE OPTION TAPE AND SMD-4   PART NUMBER O O I I T FAPE AND   PART NUMBER O O I I T FAPE AND   PART NUMBER O O I I I I I I   PART NUMBER O O I									
AGENCY CERTIFIED/PACKAGE		CTR (%)							
	10 mA								
UL, cUL, BSI, FIMKO	40 to 80	40 to 80 63 to 125 100 to 200		160 to 320					
CMD 4 100 mil nitab	SFH6156-1	SFH6156-2	SFH6156-3	SFH6156-4					
SMD-4, 100 mil, pitch	SFH6156-1T	SFH6156-2T	SFH6156-3T	SFH6156-4T					
VDE, UL, cUL, BSI, FIMKO 40 to 80		63 to 125	100 to 200	160 to 320					
SMD-4, 100 mil, pitch	SFH6156-1X001	SFH6156-2X001	-	SFH6156-4X001					
	SFH6156-1X001T	SFH6156-2X001T	-	SFH6156-4X001T					

RoHS

COMPLIANT

Document Number: 83671



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SFH6156

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
INPUT	•			
Reverse voltage		V <sub>R</sub>	6	V
DC forward current		١ <sub>F</sub>	60	mA
Surge forward current	$t_p \le 10 \ \mu s$	I <sub>FSM</sub>	2.5	А
OUTPUT	•			
Collector emitter voltage		V <sub>CEO</sub>	70	V
Emitter collector voltage		V <sub>ECO</sub>	7	V
Collector current		Ι <sub>C</sub>	50	mA
Collector current	t <sub>p</sub> ≤ 1 ms	Ι <sub>C</sub>	100	mA
COUPLER	· · · · · · · · · · · · · · · · · · ·	•		
Isolation test voltage between emitter and detector	t = 1 s	V <sub>ISO</sub>	5300	V <sub>RMS</sub>
Creepage distance			≥7	mm
Clearance distance			≥7	mm
Insulation thickness between emitter and detector			≥ 0.4	mm
Comparative tracking index per DIN IEC112/VDE0303 part 1		СТІ	≥ 175	
	V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 25 °C	R <sub>IO</sub>	≥ 10 <sup>12</sup>	Ω
Isolation resistance	V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 100 °C	R <sub>IO</sub>	≥ 10 <sup>11</sup>	Ω
Storage temperature range		T <sub>stg</sub>	- 55 to + 150	°C
Ambient temperature range		T <sub>amb</sub>	- 55 to +100	°C
Soldering temperature <sup>(1)</sup>	max. 10 s	T <sub>sld</sub>	260	°C

Notes

• Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

<sup>(1)</sup> Refer to reflow profile for soldering conditions for surface mounted devices (SMD).

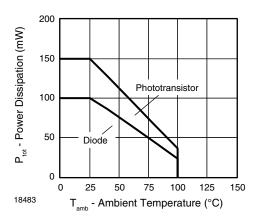


Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature



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## **Vishay Semiconductors**

SFH6156

THERMAL CHARACTERISTICS			
PARAMETER	SYMBOL	VALUE	UNIT
LED power dissipation	P <sub>diss</sub>	100	mW
Output power dissipation	P <sub>diss</sub>	150	mW
Maximum LED junction temperature	T <sub>jmax.</sub>	125	°C
Maximum output die junction temperature	T <sub>jmax.</sub>	125	°C
Thermal resistance, junction emitter to board	$\theta_{EB}$	173	°C/W
Thermal resistance, junction emitter to case	$\theta_{\text{EC}}$	149	°C/W
Thermal resistance, junction detector to board	$\theta_{DB}$	111	°C/W
Thermal resistance, junction detector to case	$\theta_{\text{DC}}$	127	°C/W
Thermal resistance, junction emitter to junction detector	$\theta_{ED}$	95	°C/W
Thermal resistance, board to ambient (1)	$\theta_{BA}$	195	°C/W
Thermal resistance, case to ambient <sup>(1)</sup>	$\theta_{CA}$	3573	°C/W

#### Notes

 The thermal model is represented in the thermal network below. Each resistance value given in this model can be used to calculate the temperatures at each node for a given operating condition. The thermal resistance from board to ambient will be dependent on the type of PCB, layout and thickness of copper traces. For a detailed explanation of the thermal model, please reference Vishay's thermal characteristics of optocouplers application note.

<sup>(1)</sup> For 2 layer FR4 board (4" x 3" x 0.062")

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb}$ = 25 °C, unless otherwise specified)									
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT		
INPUT									
Forward voltage	I <sub>F</sub> = 60 mA		V <sub>F</sub>		1.25	1.65	V		
Reverse current	V <sub>R</sub> = 6 V		I <sub>R</sub>		0.01	10	μA		
Capacitance	V <sub>R</sub> = 0 V, f = 1 MHz		Co		13		pF		
OUTPUT									
Collector emitter capacitance	V <sub>CE</sub> = 5 V, f = 1 MHz		C <sub>CE</sub>		5.2		pF		
		SFH6156-1	I <sub>CEO</sub>		2	50	nA		
Collector emitter leakage current	V <sub>CE</sub> = 10 V	SFH6156-2	I <sub>CEO</sub>		2	50	nA		
		SFH6156-3	I <sub>CEO</sub>		5	100	nA		
		SFH6156-4	I <sub>CEO</sub>		5	100	nA		
COUPLER									
Collector emitter saturation voltage	$I_F = 10 \text{ mA}, I_C = 2.5 \text{ mA}$		V <sub>CEsat</sub>		0.25	0.4	V		
Coupling capacitance			C <sub>C</sub>		0.4		pF		

#### Note

 Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

CURRENT TRANSFER RATIO									
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT		
	I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 5 V	SFH6156-1	CTR	40		80	%		
		SFH6156-2	CTR	63		125	%		
		SFH6156-3	CTR	100		200	%		
I <sub>C</sub> /I <sub>F</sub>		SFH6156-4	CTR	160		320	%		
	I <sub>F</sub> = 1 mA, V <sub>CE</sub> = 5 V	SFH6156-1	CTR	13	30		%		
		SFH6156-2	CTR	22	45		%		
		SFH6156-3	CTR	34	70		%		

Rev. 2.5, 23-May-13

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For technical questions, contact: <u>optocoupleranswers@vishay.com</u> THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT <u>www.vishay.com/doc?91000</u>



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# SFH6156

## **Vishay Semiconductors**

SWITCHING CHARACTERISTICS								
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT	
NON-SATURATED					•			
Rise time	$I_{F}$ = 10 mA, $V_{CC}$ = 5 V, $T_{A}$ = 25 °C, $R_{L}$ = 75 $\Omega$		t <sub>r</sub>		2		μs	
Fall time	$I_F$ = 10 mA, $V_{CC}$ = 5 V, $T_A$ = 25 °C, $R_L$ = 75 $\Omega$		t <sub>f</sub>		2		μs	
Turn-on time	$I_F$ = 10 mA, $V_{CC}$ = 5 V, $T_A$ = 25 °C, $R_L$ = 75 $\Omega$		t <sub>on</sub>		3		μs	
Turn-off time	$I_{F}$ = 10 mA, $V_{CC}$ = 5 V, $T_{A}$ = 25 °C, $R_{L}$ = 75 $\Omega$		t <sub>off</sub>		2.3		μs	
Cut-off frequency	$I_F$ = 10 mA, $V_{CC}$ = 5 V, $T_A$ = 25 °C, $R_L$ = 75 $\Omega$		f <sub>ctr</sub>		250		kHz	
SATURATED								
	$V_{CC}$ = 5 V, $T_A$ = 25 °C, $R_L$ = 1 k $\Omega$ , $I_F$ = 20 mA	SFH6156-1	t <sub>r</sub>		2		μs	
Rise time	$V_{CC} = 5 \text{ V}, \text{ T}_{A} = 25 \text{ °C}, \text{ R}_{L} = 1 \text{ k}\Omega, \text{ I}_{F} = 10 \text{ mA}$	SFH6156-2	t <sub>r</sub>		3		μs	
		SFH6156-3	t <sub>r</sub>		3		μs	
	$V_{CC} = 5 \text{ V},  \text{T}_{\text{A}} = 25 ^{\circ}\text{C},  \text{R}_{\text{L}} = 1  \text{k}\Omega,  \text{I}_{\text{F}} = 20  \text{mA}$	SFH6156-1	t <sub>f</sub>		11		μs	
Fall time	$V_{CC} = 5 V. T_{A} = 25 °C. R_{I} = 1 k\Omega. I_{E} = 10 mA$	SFH6156-2	t <sub>f</sub>		14		μs	
	$V_{CC} = 5 V, T_A = 25 C, R_L = 1 R_{S2}, F = 10 IIIA$	SFH6156-3	t <sub>f</sub>		14		μs	
	$V_{CC} = 5 \text{ V},  \text{T}_{\text{A}} = 25 ^{\circ}\text{C},  \text{R}_{\text{L}} = 1  \text{k}\Omega,  \text{I}_{\text{F}} = 20  \text{mA}$	SFH6156-1	t <sub>on</sub>		3		μs	
Turn-on time	$V_{CC} = 5 \text{ V},  \text{T}_{A} = 25 ^{\circ}\text{C},  \text{R}_{I} = 1  \text{k}\Omega,  \text{I}_{\text{F}} = 10  \text{mA}$	SFH6156-2	t <sub>on</sub>		4.2		μs	
	$v_{CC} = 5 v$ , $I_A = 25 C$ , $R_L = 1 k_{S2}$ , $I_F = 10 IIIA$	SFH6156-3	t <sub>on</sub>		4.2		μs	
	$V_{CC} = 5 \text{ V},  \text{T}_{\text{A}} = 25 ^{\circ}\text{C},  \text{R}_{\text{L}} = 1  \text{k}\Omega,  \text{I}_{\text{F}} = 20  \text{mA}$	SFH6156-1	t <sub>off</sub>		18		μs	
Turn-off time	$V_{CC} = 5 \text{ V},  \text{T}_{A} = 25 ^{\circ}\text{C},  \text{R}_{I} = 1  \text{k}\Omega,  \text{I}_{\text{F}} = 10  \text{mA}$	SFH6156-2	t <sub>off</sub>		23		μs	
	$v_{CC} = 5 v, r_A = 25 C, n_L = 1 k_{22}, r_F = 10 \text{ IIIA}$	SFH6156-3	t <sub>off</sub>		23		μs	

SAFETY AND INSULATION RATINGS									
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT			
Climatic classification (according to IEC 68 part 1)				55/100/21					
Comparative tracking index		CTI	175		399				
V <sub>IOTM</sub>		V <sub>IOTM</sub>	10 000			V <sub>peak</sub>			
V <sub>IORM</sub>		V <sub>IORM</sub>	890			V <sub>peak</sub>			
P <sub>SO</sub>		P <sub>SO</sub>			400	mW			
I <sub>SI</sub>		I <sub>SI</sub>			275	mA			
T <sub>SI</sub>		T <sub>SI</sub>			175	°C			
Creepage distance			7			mm			
Clearance distance			7			mm			
Insulation thickness, reinforced rated	per IEC 60950 2.10.5.1		0.4			mm			

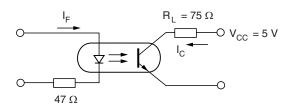
Note

• As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for "safe electrical insulation" only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

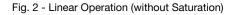


**Vishay Semiconductors** 

## TYPICAL CHARACTERISTICS (T<sub>amb</sub> = 25 °C, unless otherwise specified)



isfh615a\_01



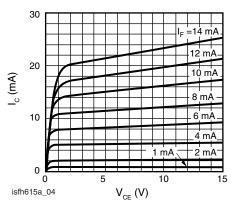
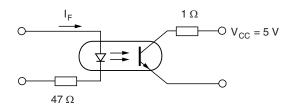


Fig. 5 - Output Characteristics (Typ.) Collector Current vs. Collector Emitter Voltage



isfh615a\_02

Fig. 3 - Switching Operation (with Saturation)

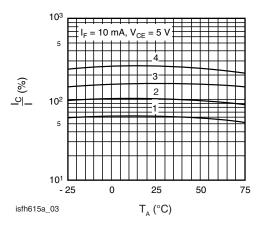


Fig. 4 - Current Transfer Ratio (Typ.) vs. Temperature

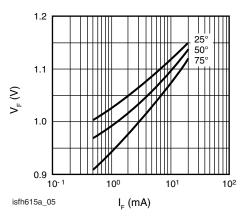


Fig. 6 - Diode Forward Voltage (Typ.) vs. Forward Current

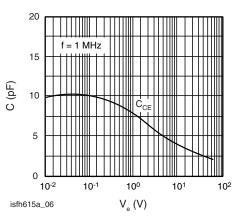


Fig. 7 - Transistor Capacitance (Typ.) vs. Collector Emitter Voltage

Alternative Device Available



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SFH6156

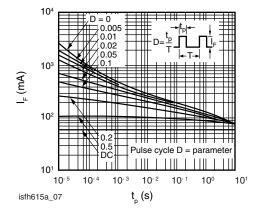
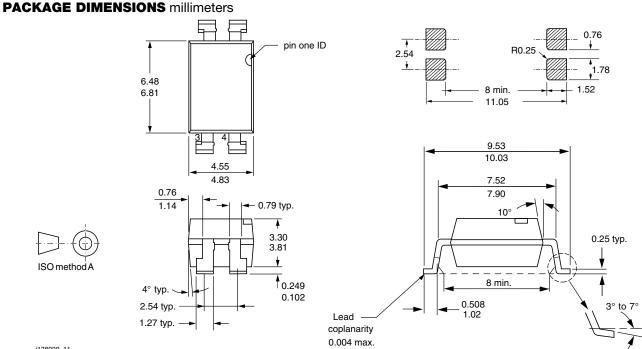
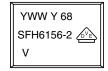


Fig. 8 - Permissible Pulse Handling Capability Forward Current vs. Pulse Width



i178029\_11

PACKAGE MARKING (example of SFH6156-2X001T)



### Notes

- VDE logo is only marked on option 1 parts.
- Tape and reel suffix (T) is not part of the package marking. •

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