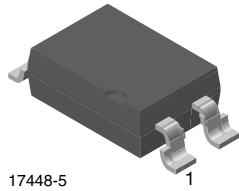
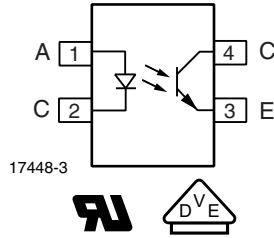


# Optocoupler, Phototransistor Output, High Reliability, 5300 V<sub>RMS</sub>



17448-5



## 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
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC


**RoHS**  
COMPLIANT

## 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.

The coupler is end-stackable with 2.54 mm lead spacing. Creepage and clearance distances of > 8 mm are achieved with option 6. This version complies with IEC 60950 (DIN VDE0805) for reinforced insulation up to an operation voltage of 400 V<sub>RMS</sub> or DC. Specifications subject to change.

## APPLICATIONS

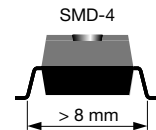
- Switchmode power supply
- Telecom
- Battery powered equipment

## AGENCY APPROVALS

- UL1577, file no. E52744 system code H or J, double protection
- DIN EN 60747-5-5 (VDE0884) available with option 1

## ORDERING INFORMATION

S	F	H	6	1	5	6	#	#	-	X	0	0	1	T
PART NUMBER										PACKAGE OPTION				TAPE AND REEL
CTR BIN														



AGENCY CERTIFIED/PACKAGE	CTR (%)		
	10 mA		
UL, cUL, BSI	40 to 80	63 to 125	100 to 200
SMD-4, 100 mil, pitch	SFH6156-1 SFH6156-1T	SFH6156-2 SFH6156-2T	SFH6156-3 SFH6156-3T
VDE, UL, cUL, BSI	40 to 80	63 to 125	100 to 200
SMD-4, 100 mil, pitch	SFH6156-1X001 SFH6156-1X001T	SFH6156-2X001 SFH6156-2X001T	-

<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		$V_R$	6	V
DC forward current		$I_F$	60	mA
Surge forward current	$t_p \leq 10\text{ }\mu\text{s}$	$I_{FSM}$	2.5	A
<b>OUTPUT</b>				
Collector emitter voltage		$V_{CEO}$	70	V
Emitter collector voltage		$V_{ECO}$	7	V
Collector current		$I_C$	50	mA
	$t_p \leq 1\text{ ms}$	$I_C$	100	mA
<b>COUPLER</b>				
Isolation test voltage between emitter and detector	$t = 1\text{ s}$	$V_{ISO}$	5300	$V_{RMS}$
Creepage distance			$\geq 7$	mm
Clearance distance			$\geq 7$	mm
Insulation thickness between emitter and detector			$\geq 0.4$	mm
Comparative tracking index per DIN IEC112/VDE0303 part 1		CTI	$\geq 175$	
Isolation resistance	$V_{IO} = 500\text{ V}, T_{amb} = 25\text{ }^{\circ}\text{C}$	$R_{IO}$	$\geq 10^{12}$	$\Omega$
	$V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$	$R_{IO}$	$\geq 10^{11}$	$\Omega$
Storage temperature range		$T_{stg}$	- 55 to + 150	$^{\circ}\text{C}$
Ambient temperature range		$T_{amb}$	- 55 to +100	$^{\circ}\text{C}$
Soldering temperature <sup>(1)</sup>	max. 10 s, dip soldering distance to seating plane $\geq 1.5\text{ mm}$	$T_{sld}$	260	$^{\circ}\text{C}$

**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.
- (1) Refer to reflow profile for soldering conditions for surface mounted devices (SMD).

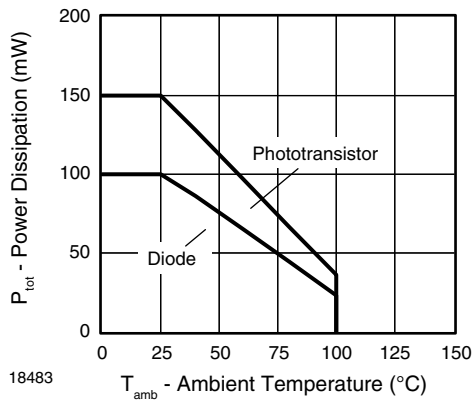
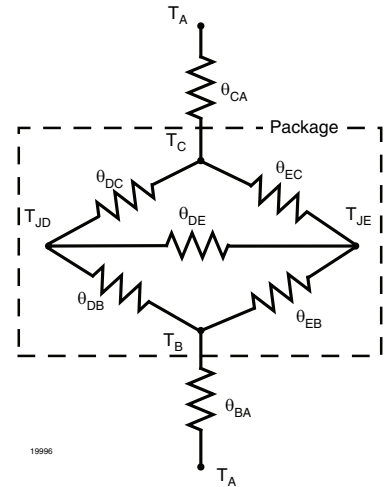


Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature

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

ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25\text{ °C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>							
Forward voltage	$I_F = 60\text{ mA}$		$V_F$		1.25	1.65	V
Reverse current	$V_R = 6\text{ V}$		$I_R$		0.01	10	$\mu\text{A}$
Capacitance	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$		$C_O$		13		pF
<b>OUTPUT</b>							
Collector emitter capacitance	$V_{CE} = 5\text{ V}$ , $f = 1\text{ MHz}$		$C_{CE}$		5.2		pF
Collector emitter leakage current	$V_{CE} = 10\text{ V}$	SFH6156-1	$I_{CEO}$		2	50	nA
		SFH6156-2	$I_{CEO}$		2	50	nA
		SFH6156-3	$I_{CEO}$		5	100	nA
		SFH6156-4	$I_{CEO}$		5	100	nA
<b>COUPLER</b>							
Collector emitter saturation voltage	$I_F = 10\text{ mA}$ , $I_C = 2.5\text{ mA}$		$V_{CEsat}$		0.25	0.4	V
Coupling capacitance			$C_C$		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
$I_C/I_F$	$I_F = 10 \text{ mA}, V_{CE} = 5 \text{ V}$	SFH6156-1	CTR	40		80	%
		SFH6156-2	CTR	63		125	%
		SFH6156-3	CTR	100		200	%
		SFH6156-4	CTR	160		320	%
	$I_F = 1 \text{ mA}, V_{CE} = 5 \text{ V}$	SFH6156-1	CTR	13	30		%
		SFH6156-2	CTR	22	45		%
		SFH6156-3	CTR	34	70		%
		SFH6156-4	CTR	56	90		%

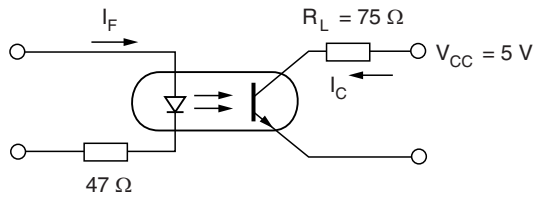
SWITCHING CHARACTERISTICS							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>NON-SATURATED</b>							
Rise time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 75 \text{ } \Omega$		$t_r$		2		$\mu\text{s}$
Fall time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 75 \text{ } \Omega$		$t_f$		2		$\mu\text{s}$
Turn-on time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 75 \text{ } \Omega$		$t_{on}$		3		$\mu\text{s}$
Turn-off time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 75 \text{ } \Omega$		$t_{off}$		2.3		$\mu\text{s}$
Cut-off frequency	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 75 \text{ } \Omega$		$f_{ctr}$		250		kHz
<b>SATURATED</b>							
Rise time	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 20 \text{ mA}$	SFH6156-1	$t_r$		2		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 10 \text{ mA}$	SFH6156-2	$t_r$		3		$\mu\text{s}$
		SFH6156-3	$t_r$		3		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 5 \text{ mA}$	SFH6156-4	$t_r$		4		$\mu\text{s}$
Fall time	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 20 \text{ mA}$	SFH6156-1	$t_f$		11		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 10 \text{ mA}$	SFH6156-2	$t_f$		14		$\mu\text{s}$
		SFH6156-3	$t_f$		14		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 5 \text{ mA}$	SFH6156-4	$t_f$		15		$\mu\text{s}$
Turn-on time	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 20 \text{ mA}$	SFH6156-1	$t_{on}$		3		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 10 \text{ mA}$	SFH6156-2	$t_{on}$		4.2		$\mu\text{s}$
		SFH6156-3	$t_{on}$		4.2		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 5 \text{ mA}$	SFH6156-4	$t_{on}$		6		$\mu\text{s}$
Turn-off time	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 20 \text{ mA}$	SFH6156-1	$t_{off}$		18		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 10 \text{ mA}$	SFH6156-2	$t_{off}$		23		$\mu\text{s}$
		SFH6156-3	$t_{off}$		23		$\mu\text{s}$
	$V_{CC} = 5 \text{ V}, T_A = 25 \text{ }^\circ\text{C}, R_L = 1 \text{ k}\Omega, I_F = 5 \text{ mA}$	SFH6156-4	$t_{off}$		25		$\mu\text{s}$

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		
$V_{IOTM}$			10 000			$V_{peak}$	
$V_{IORM}$			890			$V_{peak}$	
$P_{SO}$					400	mW	
$I_{SI}$					275	mA	
$T_{SI}$					175	$^\circ\text{C}$	
Creepage distance			7			mm	
Clearance distance			7			mm	
Insulation thickness, reinforced rated	per IEC 60950 2.10.5.1		0.4			mm	

**Note**

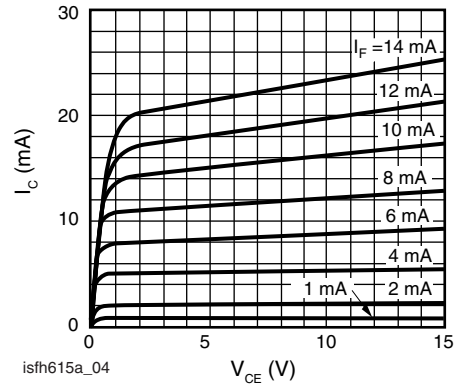
- As per IEC 60747-5-5, § 7.4.3.8.1, this optocoupler is suitable for "safe electrical insulation" only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)



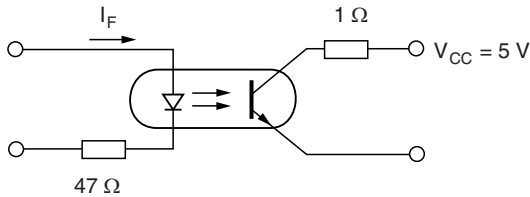
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Fig. 2 - Linear Operation (without Saturation)



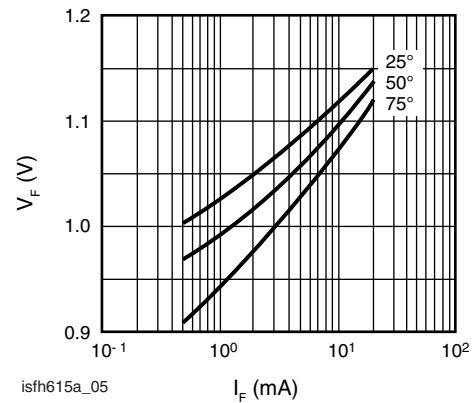
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Fig. 5 - Output Characteristics (Typ.) Collector Current vs. Collector Emitter Voltage



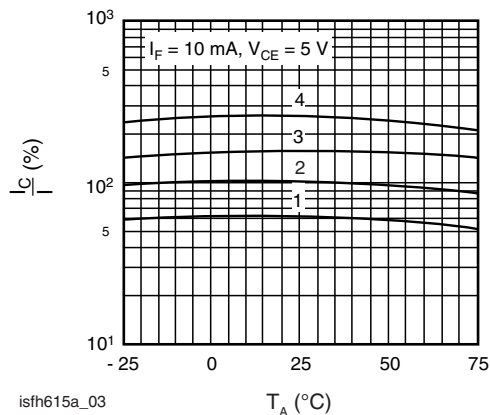
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Fig. 3 - Switching Operation (with Saturation)



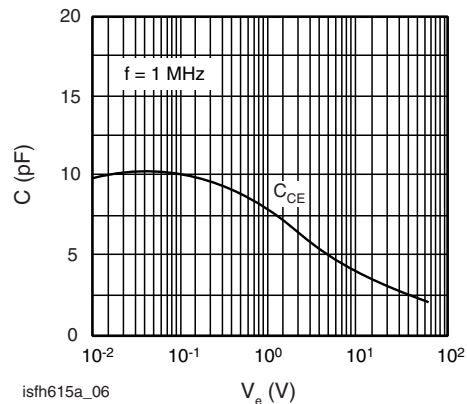
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Fig. 6 - Diode Forward Voltage (Typ.) vs. Forward Current



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



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

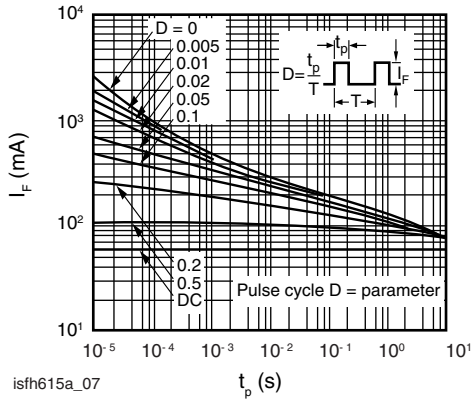
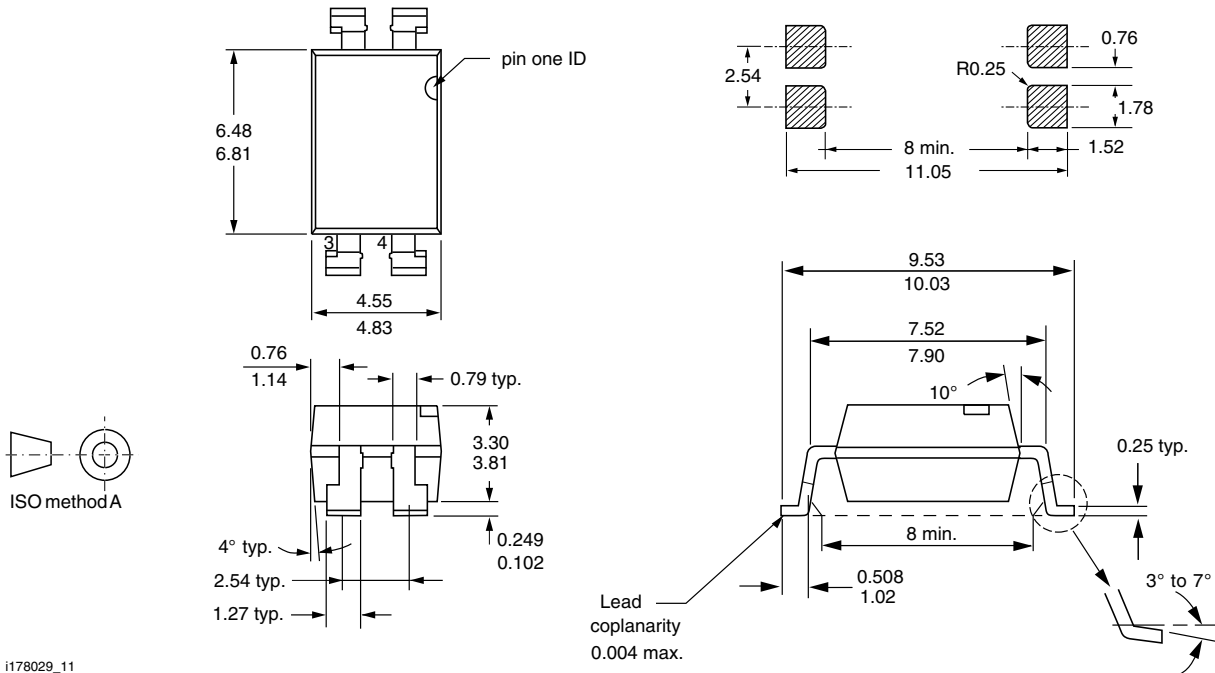


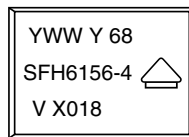
Fig. 8 - Permissible Pulse Handling Capability Forward Current vs. Pulse Width

**PACKAGE DIMENSIONS** millimeters



i178029\_11

**PACKAGE MARKING**



This is an example of the marking used on the SFH6156-4X018T.



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