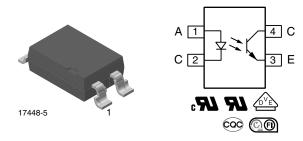


# Optocoupler, Phototransistor Output, High Reliability, 5300 V<sub>RMS</sub>



#### **LINKS TO ADDITIONAL RESOURCES**



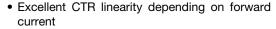


#### **DESCRIPTION**

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**





- 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 www.vishay.com/doc?99912

#### **APPLICATIONS**

- Switchmode power supply
- Telecom
- Battery powered equipment

#### **AGENCY APPROVALS**

The safety application model number covering all products in this datasheet is SFH615A. This model number should be used when consulting safety agency documents.

- UL 1577
- cUL
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- BSI
- CQC
- FIMKO

ORDERING INFORMATION							
S F H 6 1 5 6 - # X 0 0 1 T  PART NUMBER  CTR PACKAGE OPTION TAPE AND REEL  > 8 mm							
AGENCY CERTIFIED/PACKAGE CTR (%)			R (%)				
	10 mA						
UL, cUL, BSI, FIMKO, CQC	40 to 80	63 to 125	100 to 200	160 to 320			
CMD 4 100 mil nitoh	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, CQC 40 to 80		63 to 125	100 to 200	160 to 320			
	SFH6156-1X001	SFH6156-2X001	SFH6156-3X001	-			
SMD-4, 100 mil, pitch	SFH6156-1X001T	SFH6156-2X001T	SFH6156-3X001T	SFH6156-4X001T			
	-	-	SFH6156-3X001T1 <sup>(1)</sup>	-			

#### Notes

- Additional options may be possible, please contact sales office
- (1) T1 rotation in tape and reel packaging



<b>ABSOLUTE MAXIMUM RATINGS</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)							
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT			
INPUT							
Reverse voltage		$V_R$	6	V			
DC forward current		I <sub>F</sub>	60	mA			
Surge forward current	t <sub>p</sub> ≤ 10 μs	I <sub>FSM</sub>	2.5	Α			
OUTPUT							
Collector emitter voltage		V <sub>CEO</sub>	70	V			
Emitter collector voltage		V <sub>ECO</sub>	7	V			
Collector current		I <sub>C</sub>	50	mA			
Collector current	t <sub>p</sub> ≤ 1 ms	I <sub>C</sub>	100	mA			
COUPLER							
Storage temperature range		T <sub>stg</sub>	-55 to +150	°C			
Ambient temperature range		T <sub>amb</sub>	-55 to +100	°C			
Soldering temperature (1)	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
- (2) Refer to reflow profile for soldering conditions for surface mounted devices (SMD)

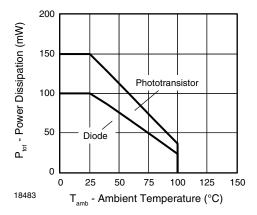


Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature



THERMAL CHARACTERISTICS			
PARAMETER	SYMBOL	VALUE	UNIT
LED power dissipation	P <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	$\theta_{\sf EC}$	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 (1)	$\theta_{BA}$	195	°C/W
Thermal resistance, case to ambient (1)	$\theta_{CA}$	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
- (1) For 2 layer FR4 board (4" x 3" x 0.062")

<b>ELECTRICAL CHARACTERISTICS</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
INPUT							
Forward voltage	$I_F = 60 \text{ mA}$		$V_{F}$	-	1.25	1.65	V
Reverse current	$V_R = 6 V$		I <sub>R</sub>	-	0.01	10	μΑ
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
	V <sub>CE</sub> = 10 V	SFH6156-1	I <sub>CEO</sub>	=	2	50	nA
Collector emitter legkage gurrent		SFH6156-2	I <sub>CEO</sub>	=	2	50	nA
Collector emitter leakage current		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	ı	80	%	
		SFH6156-2	CTR	63	ı	125	%	
		SFH6156-3	CTR	100	-	200	%	
1-7-		SFH6156-4	CTR	160	-	320	%	
I <sub>C</sub> /I <sub>F</sub>		SFH6156-1	CTR	13	30	-	%	
		SFH6156-2	CTR	22	45	-	%	
	$I_F = 1 \text{ mA, } V_{CE} = 5 \text{ V}$	SFH6156-3	CTR	34	70	-	%	
		SFH6156-4	CTR	56	90	-	%	

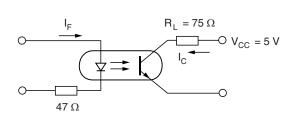
PARAMETER	ARACTERISTICS (T <sub>amb</sub> = 25 °C,	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
NON-SATURATED	1201 CONDITION	TAIL	OTHER			MI-OC.	O. T.
	1 10 mA V 5 V B 75 O	<u> </u>	. I				_
Turn-on time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, R_L = 75 \Omega$		t <sub>on</sub>	-	3	-	μs
Rise time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, R_L = 75 \Omega$		t <sub>r</sub>	-	2	-	μs
Turn-off time	$I_F = 10 \text{ mA}, V_{CC} = 5 \text{ V}, R_L = 75 \Omega$		t <sub>off</sub>	-	2.3	-	μs
Fall time	$I_F$ = 10 mA, $V_{CC}$ = 5 V, $R_L$ = 75 $\Omega$		t <sub>f</sub>	-	2	-	μs
Cut-off frequency	$I_F$ = 10 mA, $V_{CC}$ = 5 V, $R_L$ = 75 $\Omega$		f <sub>CO</sub>	=	250	-	kHz
SATURATED							
	I <sub>F</sub> = 20 mA	SFH6156-1	t <sub>on</sub>	-	3	-	μs
<b>-</b>	$I_{\rm F} = 10  \rm mA$	SFH6156-2	t <sub>on</sub>	-	4.2	-	μs
Turn-on time		SFH6156-3	t <sub>on</sub>	-	4.2	-	μs
	I <sub>F</sub> = 5 mA	SFH6156-4	t <sub>on</sub>	-	6	-	μs
	I <sub>F</sub> = 20 mA	SFH6156-1	t <sub>r</sub>	-	2	-	μs
Diag time	I <sub>F</sub> = 10 mA	SFH6156-2	t <sub>r</sub>	-	3	-	μs
Rise time		SFH6156-3	t <sub>r</sub>	-	3	-	μs
	I <sub>F</sub> = 5 mA	SFH6156-4	t <sub>r</sub>	-	4	-	μs
	I <sub>F</sub> = 20 mA	SFH6156-1	t <sub>off</sub>	-	18	-	μs
T (1) (1)	1 10	SFH6156-2	t <sub>off</sub>	-	23	-	μs
Turn-off time	I <sub>F</sub> = 10 mA	SFH6156-3	t <sub>off</sub>	-	23	-	μs
	I <sub>F</sub> = 5 mA	SFH6156-4	t <sub>off</sub>	-	25	-	μs
	I <sub>F</sub> = 20 mA	SFH6156-1	t <sub>f</sub>	-	11	-	μs
E		SFH6156-2	t <sub>f</sub>	-	14	-	μs
Fall time	I <sub>F</sub> = 10 mA	SFH6156-3	t <sub>f</sub>	-	14	-	μs
	I <sub>F</sub> = 5 mA	SFH6156-4	t <sub>f</sub>	-	15	-	μs

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SAFETY AND INSULATION RATINGS							
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT			
Climatic classification	According to IEC 68 part 1		55/100/21				
Comparative tracking index		CTI	175				
Maximum rated withstanding isolation voltage	t = 1 min	V <sub>ISO</sub>	4420	V <sub>RMS</sub>			
Maximum transient isolation voltage		V <sub>IOTM</sub>	10 000	V			
Maximum repetitive peak isolation voltage		$V_{IORM}$	890	V			
Isolation resistance	$V_{IO} = 500 \text{ V}, T_{amb} = 25 \text{ °C}$	R <sub>IO</sub>	≥ 10 <sup>12</sup>	Ω			
	V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 100 °C	R <sub>IO</sub>	≥ 10 <sup>11</sup>	Ω			
Output safety power		$P_{SO}$	400	mW			
Input safety current		I <sub>SI</sub>	275	mA			
Input safety temperature		T <sub>SI</sub>	175	°C			
Creepage distance			≥ 7	mm			
Clearance distance			≥ 7	mm			
Insulation thickness		DTI	≥ 0.4	mm			

#### Note

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



isfh615a\_01

Fig. 2 - Linear Operation (without saturation)

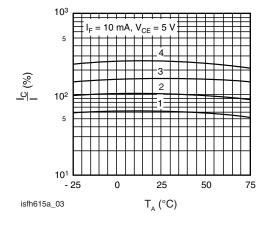
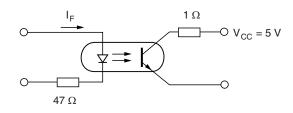


Fig. 4 - Current Transfer Ratio (typ.) vs. Temperature



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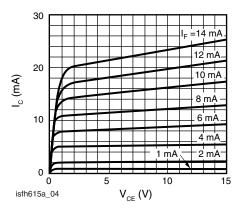


Fig. 3 - Switching Operation (with saturation)

Fig. 5 - Output Characteristics (typ.) Collector Current vs.

Collector Emitter Voltage

<sup>•</sup> 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



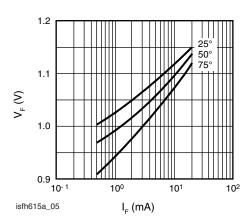


Fig. 6 - Diode Forward Voltage (typ.) vs. Forward Current

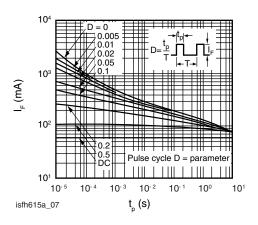


Fig. 8 - Permissible Pulse Handling Capability Forward Current vs. Pulse Width

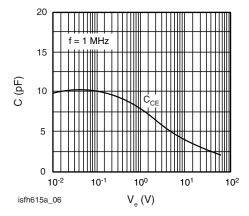
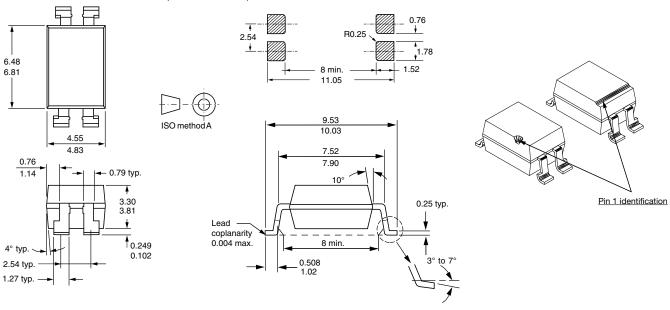


Fig. 7 - Transistor Capacitance (typ.) vs. Collector Emitter Voltage

### **PACKAGE DIMENSIONS** (in millimeters)



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### PACKAGE MARKING (example of SFH6156-2X001T)



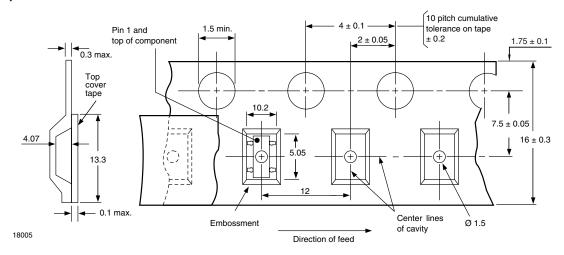
#### Notes

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

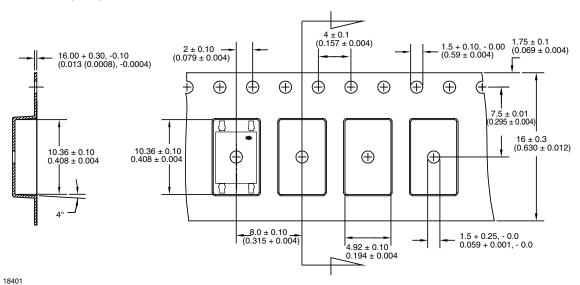
#### TAPE AND REEL PACKAGING (in millimeters)

The tape is 16 mm and is wound on a 33 cm reel. There are 1000 parts per reel. Taped and reeled 4 pin optocouplers conform to EIA-481-2 and IEC60286-3.

#### SMD-4 ("T")



#### SMD-4, 90° Rotation ("T1")





### **SOLDER PROFILES**

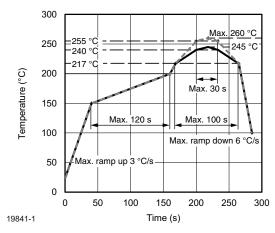


Fig. 9 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

### HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2 Floor life: unlimited

Conditions:  $T_{amb}$  < 30 °C, RH < 85 %

Moisture sensitivity level 1, according to J-STD-020



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