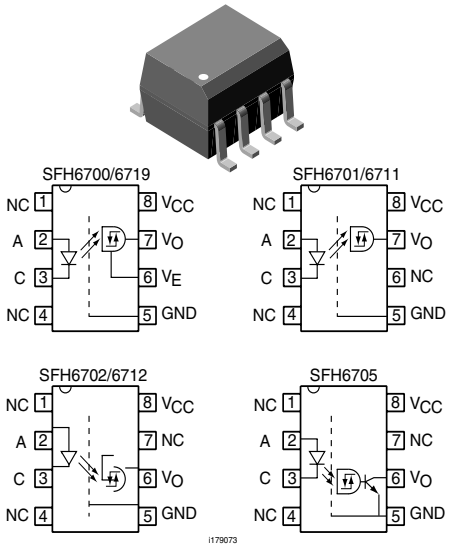
High Speed Optocoupler, 5 MBd, 1 kV/µs dV/dt



Features

- Data Rate 5.0 MBits/s
  (2.5 MBit/s over Temperature)
- Buffer
- Isolation Test Voltage, 5300 V RMS for 1.0 s
- TTL, LSTTL and CMOS Compatible
- Internal Shield for Very High Common Mode Transient Immunity
- Wide Supply Voltage Range (4.5 to 15 V)
- Low Input Current (1.6 mA to 5.0 mA)
- Three State Output (SFH6700/ 19)
- Totem Pole Output (SFH6701/ 02/ 11/ 12)
- Open Collector Output (SFH6705)
- Specified from 0 °C to 85 °C

Agency Approvals

- UL - File No. E52744 System Code H or J

- DIN EN 60747-5-2(VDE0884)
  DIN EN 60747-5-5 pending
  Available with Option 1

Applications

Industrial Control
Replace Pulse Transformers
Routine Logic Interfacing
Motion/Power Control
High Speed Line Receiver
Microprocessor System Interfaces
Computer Peripheral Interfaces

Description

The SFH67xx high speed optocoupler series consists of a GaAlAs infrared emitting diode, optically coupled with an integrated photo detector. The detector incorporates a Schmitt-Trigger stage for improved noise immunity. Using the Enable input, the output can switched to the high ohmic state, which is necessary for data bus applications. A Faraday shield provides a common mode transient immunity of 1000 V/µ at V_{CM} = 50 V for SFH6700/ 01/ 02/ 05 and 2500 V/µ at V_{CM} = 400 V for SFH6711/ 12/ 19.

The SFH67xx uses an industry standard DIP-8 package.With standard lead bending, creepage distance and clearance of ≥ 7.0 mm with lead bending options 6, 7, and 9 ≥ 8 mm are achieved.

Order Information

Part	Remarks
SFH6700	Three State Output, DIP-8
SFH6701	Totem Pole Output, DIP-8
SFH6702	Totem Pole Output, DIP-8
SFH6705	Open Collector Output, DIP-8
SFH6711	Totem Pole Output, DIP-8
SFH6712	Totem Pole Output, DIP-8
SFH6719	Three State Output, DIP-8
SFH6700-X009	Three State Output, SMD-8 (option 9)
SFH6701-X006	Totem Pole Output, DIP-8 400 mil (option 6)
SFH6701-X007	Totem Pole Output, SMD-8 (option 7)
SFH6701-X009	Totem Pole Output, SMD-8 (option 9)
SFH6705-X006	Open Collector Output, DIP-8 400 mil (option 6)
SFH6705-X007	Open Collector Output, SMD-8 (option 7)
SFH6711-X007	Totem Pole Output, SMD-8 (option 7)

For additional information on the available options refer to Option Information.

Truth Table (Positive Logic)

	IR Diode	Enable	Output
SFH6700	on	H	Z
	off	H	Z
SFH6719	on	L	H
	off	L	L
SFH6701	on		H
	off		L
SFH6702	on		H
	off		L
SFH6705	on		H
	off		L
SFH6711	on		H
	off		L
SFH6712	on		H
	off		L

Absolute Maximum Ratings

T_{amb} = 25 °C, unless otherwise specified

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 Rating for extended periods of the time can adversely affect reliability.

Input

Parameter	Test condition	Symbol	Value	Unit
Reverse voltage		V_R	3.0	V
DC Forward current		I_F	10	mA
Surge forward current	t ≤ 1.0 µs	I_{FSM}	1.0	A
Power dissipation		P_{diss}	20	mW

Output

Parameter	Test condition	Symbol	Value	Unit
Supply voltage		V_{CC}	- 0.5 to + 15	V
Three state enable voltage (SFH6700/19 only)		V_{EN}	- 0.5 to + 15	V
Output voltage		V_O	- 0.5 to + 15	V
Average output current		I_O	25	mA
Power dissipation		P_{diss}	100	mW

Coupler

Parameter	Test condition	Symbol	Value	Unit
Storage temperature range		T_{stg}	- 55 to + 125	°C
Ambient temperature range		T_{amb}	- 40 to + 85	°C
Lead soldering temperature	t = 10 s	T_{sld}	260	°C
Isolation test voltage		V_{ISO}	5300	V_{RMS}
Pollution degree			2.0	
Creepage distance and clearance	Standard lead bending		7.0	mm
	Options 6, 7, 9		8.0	mm

Parameter	Test condition	Symbol	Value	Unit
Comparative tracking index per DIN IEC 112/VDE 0303, part 1			175	
Isolation resistance	V_{IO} = 500 V, T_{amb} = 25 °C	R_{IO}	10^{12}	Ω
	V_{IO} = 500 V, T_{amb} = 100 °C	R_{IO}	10^{11}	Ω

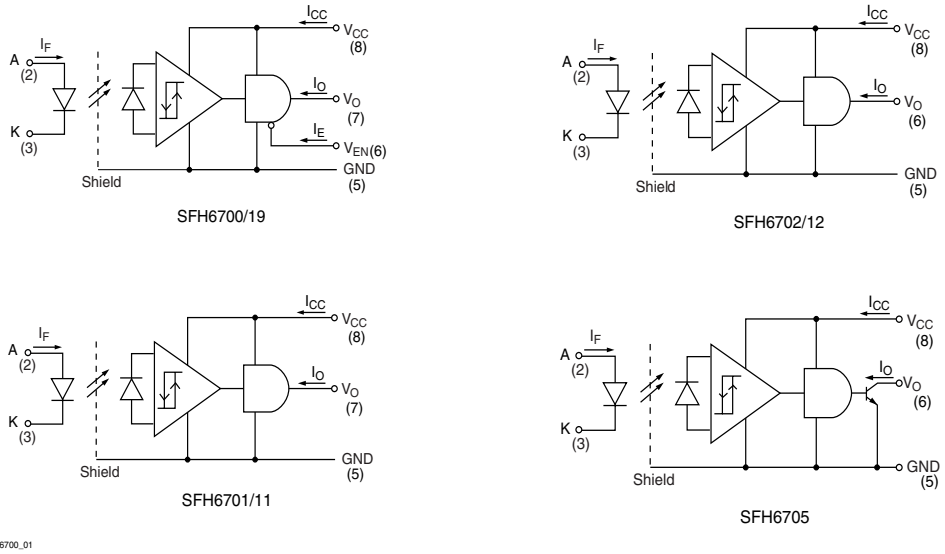


Fig. 1 Schematics

Recommended Operating Conditions

A 0.1 µF bypass capacitor connected between pins 5 and 8 must be used.

Parameter	Test condition	Part	Symbol	Min	Typ.	Max	Unit
Supply voltage			V_{CC}	4.5		15	V
Enable voltage high		SFH6700	V_{EH}	2.0		15	V
		SFH6719	V_{EH}	2.0		15	V
Enable voltage low		SFH6700	V_{EL}	0		0.8	V
		SFH6719	V_{EL}	0		0.8	V
Forward input current			I_{Fon}	1.6 (1)		5.0	mA
			I_{Foff}			0.1	mA
Operating temperature			T_A	0		85	°C
Output pull-up resistor		SFH6705	R_L	350		4	kΩ
Fan Output	R_L = 1.0 kΩ	SFH6705	N			16	LS TTL Loads

(1) We recommended using a 2.2 mA to permit at least 20 % CTR degradation guard band.

Electrical Characteristics

T_{amb} = 25 °C, unless otherwise specified
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.

Input

0 °C ≤ T_{amb} ≤ 85 °C; 4.5 V ≤ V_{CC} ≤ 15 V; 1.6 mA ≤ I_{Fon} ≤ 5.0 mA; 2.0 ≤ V_{EH} ≤ 15 V; 0 ≤ V_{EL} ≤ 0.8 V; 0 mA ≤ I_{Foff} ≤ 0.1 mA;
Typical values: T_{amb} = 25 °C; V_{CC} = 5.0 V; I_{Fon} = 3.0 mA unless otherwise specified

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Forward voltage	I_F = 5.0 mA	V_F		1.6	1.75	V
	I_F = 5.0 mA,	V_F			1.8	V
Input current hysteresis	V_{CC} = 5.0 V, I_{HYS} = I_{Fon}-I_{Fon}	I_{HYS}		0.1		mA
Reverse current	V_R = 3.0 V	I_R		0.5	10	µA
Capacitance	V_R = 0 V, f = 1.0 MHz;	C_O		60		pF
Thermal resistance		R_{thja}		700		K/W

Output

0 °C ≤ T_{amb} ≤ 85 °C; 4.5 V ≤ V_{CC} ≤ 15 V; 1.6 mA ≤ I_{Fon} ≤ 5.0 mA; 2.0 ≤ V_{EH} ≤ 15 V; 0 ≤ V_{EL} ≤ 0.8 V; 0 mA ≤ I_{Foff} ≤ 0.1 mA;
Typical values: T_{amb} = 25 °C; V_{CC} = 5.0 V; I_{Fon} = 3.0 mA unless otherwise specified

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Logic low output voltage	I_{OL} = 6.4 mA	V_{OL}			0.5	V
Logic high output voltage (except SFH6705)	I_{OH} = 2.6 mA, V_{OH} = V_{CC}-1.8 V		2.4			V
Output leakage current (V_{OUT}>V_{CC}) (except SFH6705)	V_O = 5.5 V, V_{CC} = 4.5 V, I_F = 5.0 mA	I_{OHH}		0.5	100	µA
	V_O = 15 V, V_{CC} = 4.5 V, I_F = 5.0 mA	I_{OHH}		1.0	500	µA
Output leakage current (SFH705 only)	V_O = 5.5 V, V_{CC} = 5.5 V, I_F = 5.0 mA	I_{OHH}		0.5	100	µA
	V_O = 15 V, V_{CC} = 15 V, I_F = 5.0 mA	I_{OHH}		1.0	500	µA
Logic high enable voltage (SFH6700/19 only)		V_{EH}	2.0			V
Logic low enable voltage (SFH6700/19 only)		V_{EL}			0.8	V
Logic high enable current (SFH6700/19 only)	V_{EN} = 2.7 V	I_{EH}			20	µA
	V_{EN} = 5.5 V	I_{EH}			100	µA
	V_{EN} = 15 V	I_{EH}		0.001	250	µA
Logic low enable current (SFH6700/19 only)	V_{EN} = 0.4 V	I_{EL}	- 320	- 50		µA
High impedance state output current (SFH6700/19 only)	V_O = 0.4 V, V_{EN} = 2.0 V, I_F = 5.0 mA	I_{OZL}	- 20			µA
	V_O = 2.4 V, V_{EN} = 2.0 V, I_F = 0 mA	I_{OZH}			20	µA
	V_O = 5.5 V, V_{EN} = 2.0 V, I_F = 0 mA	I_{OZH}			100	µA
		I_{OZH}		0.001	500	µA
Logic low supply current	V_{CC} = 5.5 V, I_F = 0	I_{CCL}		3.7	6.0	mA
	V_{CC} = 15 V, I_F = 0	I_{CCL}		4.1	6.5	mA
Logic high supply current	V_{CC} = 5.5 V, I_F = 5.0 mA	I_{CCH}		3.4	4.0	mA
	V_{CC} = 15V, I_F = 5.0 mA	I_{CCH}		3.7	5.0	mA
Logic low short circuit output current [2]	V_O = V_{CC} = 5.5 V, I_F = 0	I_{OSL}	25			mA
	V_O = V_{CC} = 15 V, I_F = 0	I_{OSL}	40			mA
Logic high short circuit output current [2]	V_{CC} = 5.5 V, V_O = 0 V, I_F = 5.0 mA	I_{OSL}			- 10	mA
	V_{CC} = 15 V, V_O = 0 V, I_F = 5.0 mA	I_{OSL}			- 25	mA
Thermal resistance		R_{thja}		300		K/W

[2] Output short circuit time ≤ 10ms.

Coupler

0 °C ≤ T_{amb} ≤ 85 °C; 4.5 V ≤ V_{CC} ≤ 15 V; 1.6 mA ≤ I_{Fon} ≤ 5.0 mA; 2.0 ≤ V_{EH} ≤ 15 V; 0 ≤ V_{EL} ≤ 0.8 V; 0 mA ≤ I_{Foff} ≤ 0.1 mA;
Typical values: T_{amb} = 25 °C; V_{CC} = 5.0 V; I_{Fon} = 3.0 mA unless otherwise specified

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Capacitance (input-output)	f = 1.0 MHz, pins 1-4 and 5-8 shorted together	C_{IO}		0.6		pF
Isolation resistance	V_{IO} = 500 V, T_{amb} = 25 °C	R_{IO}	10^{12}			Ω
	V_{IO} = 500 V, T_{amb} = 100 °C	R_{IO}	10^{11}			Ω

Switching Characteristics

0 °C ≤ T_{amb} ≤ 85 °C; 4.5 V ≤ V_{CC} ≤ 15 V; 1.6 mA ≤ I_{Fon} ≤ 5.0 mA; 2.0 ≤ V_{EH} ≤ 15 V (SFH6700/19); 0 ≤ V_{EL} ≤ 0.8 V (SFH6700/19); 0 mA ≤ I_{Foff}≤ 0.1 mA
Typical values: T_{amb} = 25 °C; V_{CC} = 5.0 V; I_{Fon} = 3.0 mA unless otherwise specified. (3)

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Propagation delay time to logic low output level, SFH6700/01/ 02/11/12/19	Without peaking capacitor	t_{PHL}		120		ns
	With peaking capacitor	t_{PHL}		115	300	ns
		t_{PLH}		125		ns
		t_{PLH}		90	300	ns
Output enable time to logic high (SFH6700/19)		t_{PZH}		20		ns
Output enable time to logic low (SFH6700/19)		t_{PZL}		25		ns
Output disable time from logic low (SFH6700/19)		t_{PLZ}		50		ns
Output rise time	10 % to 90 %	t_r		40		ns
Output fall time	90 % to 10 %	t_f		10		ns

(3) A 0.1 µF bypass capacitor connected between pins 5 and 8 must be used

Typical values: T_{amb} = 25 °C, V_{CC} = 5.0 V; I_{Fon} = 3.0 mA; R_L = 390 Ω unless otherwise specified (3)

Parameter	Test condition	Part	Symbol	Min	Typ.	Max	Unit
Propagation delay time to logic low output level	Without peaking capacitor	SFH6705	t_{PHL}		115		ns
	With peaking capacitor	SFH6705	t_{PHL}		105	300	ns
	Without peaking capacitor	SFH6705	t_{PLH}		125		ns
	With peaking capacitor	SFH6705	t_{PLH}		90	300	ns
Output rise time	10 % to 90 %		t_r		25		ns
	90 % to 10 %		t_r		4		ns

Common Mode Transient Immunity

T_{amb} = 25 °C, V_{CC} = 5.0 V (4)

Parameter	Test condition	Part	Symbol	Min	Typ.	Max	Unit
Logic High Common Mode Transient Immunity	$\|V_{CM}\|$ = 50 V, I_F = 1.6 mA	SFH6700	$\|CM_H\|$ (4)	1000			V/µs
		SFH6701	$\|CM_H\|$ (4)	1000			V/µs
		SFH6702	$\|CM_H\|$ (4)	1000			V/µs
		SFH6705	$\|CM_H\|$ (4)	1000			V/µs
	$\|V_{CM}\|$ = 400 V, I_F = 1.6 mA	SFH6711	$\|CM_H\|$ (4)	2500			V/µs
		SFH6712	$\|CM_H\|$ (4)	2500			V/µs
		SFH6719	$\|CM_H\|$ (4)	2500			V/µs
Logic Low Common Mode Transient Immunity	$\|V_{CM}\|$ = 50V, I_F = 0 mA	SFH6700	$\|CM_L\|$ (4)	1000			V/µs
	$\|V_{CM}\|$ = 50 V, I_F = 0 mA	SFH6701	$\|CM_L\|$ (4)	1000			V/µs
		SFH6702	$\|CM_L\|$ (4)	1000			V/µs
		SFH6705	$\|CM_L\|$ (4)	1000			V/µs
	$\|V_{CM}\|$ = 400 V, I_F = 0 mA	SFH6711	$\|CM_L\|$ (4)	2500			V/µs
		SFH6712	$\|CM_L\|$ (4)	2500			V/µs
		SFH6719	$\|CM_L\|$ (4)	2500			V/µs

(4) CM_H is the maximum slew rate of a common mode voltage V_{CM} at which the output voltage remains at logic high level (V_O > 2.0 V)
CM_L is the maximum slew rate of a common mode voltage V_{CM} at which the output voltage remains at logic high level (V_O < 0.8 V)

Typical Characteristics (T_{amb} = 25 °C unless otherwise specified)

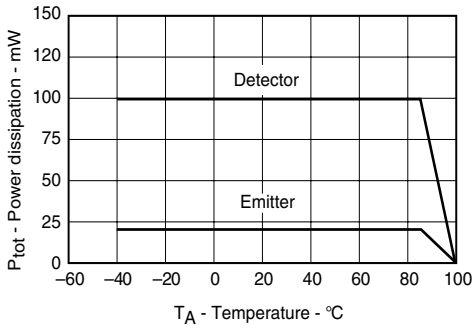


Fig. 2 Permissible Total Power Dissipation vs. Temperature

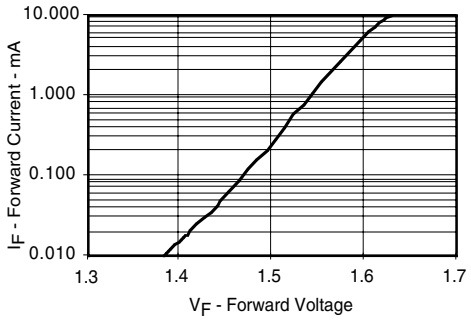


Fig. 3 Typical Input Diode Forward Current vs. Forward Voltage

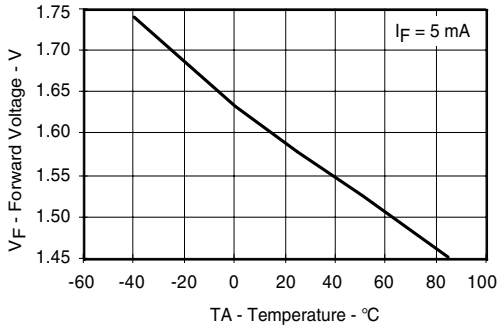


Fig. 4 Typical Forward Input Voltage vs. Temperature

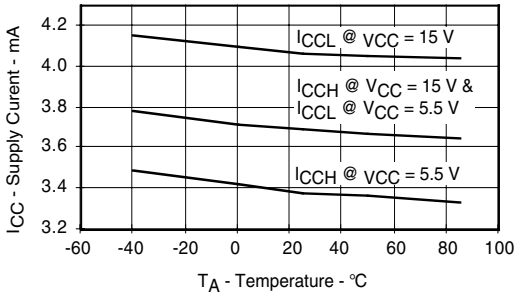


Fig. 7 Typical Supply Current vs. Temperature

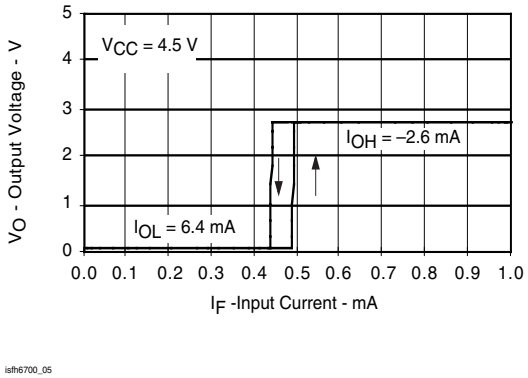


Fig. 5 Typical Output Voltage vs. Forward Input Current (except SFH6705)

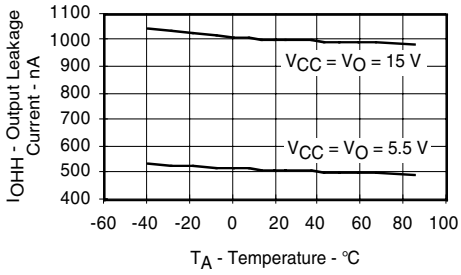


Fig. 8 Typical Output Leakage Current vs. Temperature

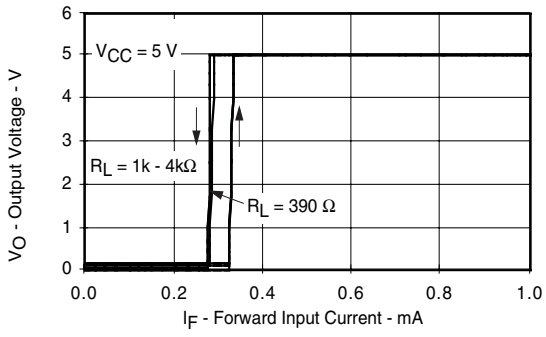


Fig. 6 Typical Output Forward Voltage vs. Forward Input Current (only SFH6705)

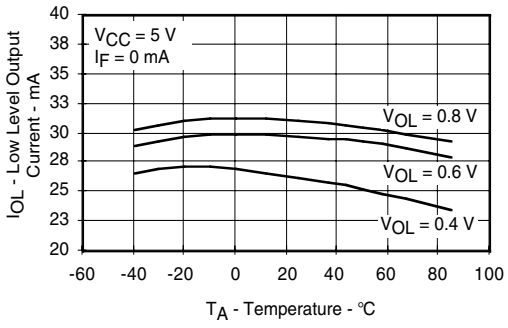


Fig. 9 Typical Low Level Output Current vs. Temperature

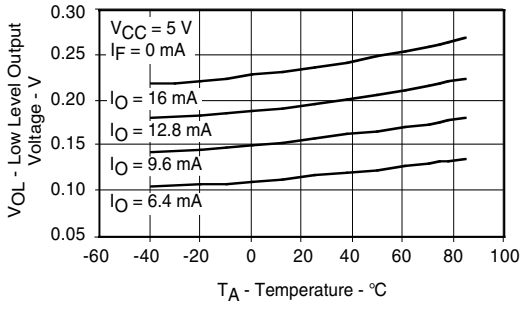


Fig. 10 Typical Low Level Output Voltage vs. Temperature

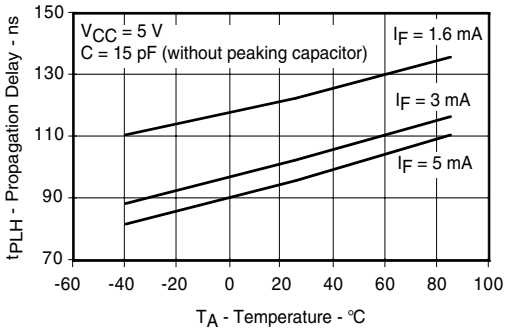


Fig. 13 Typical Propagation Delay to Logic High vs. Temperature (except SFH6705)

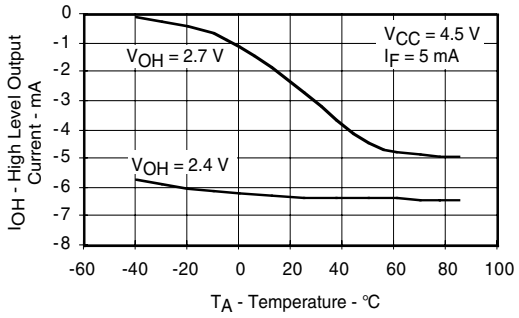


Fig. 11 Typical High Level Output Current vs. Temperature (except SFH6705

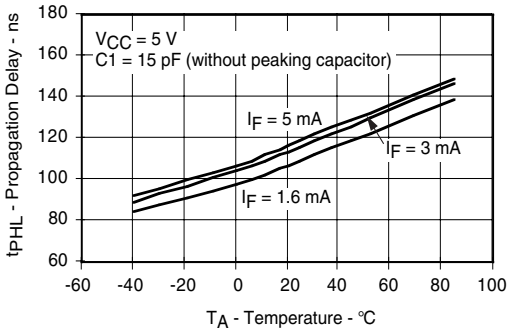


Fig. 14 Typical Propagation Delay to Logic LOw vs. Temperature (except SFH6705)

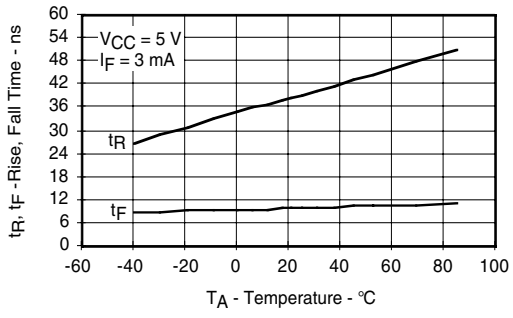


Fig. 12 Typical Rise, Fall Time vs. Temperature (except SFH6705)

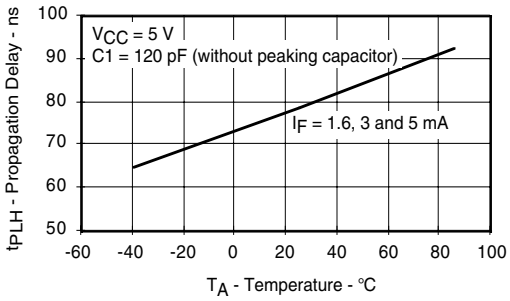


Fig. 15 Typical Propagation Delays to Logic High vs. Temperature (except SFH6705)

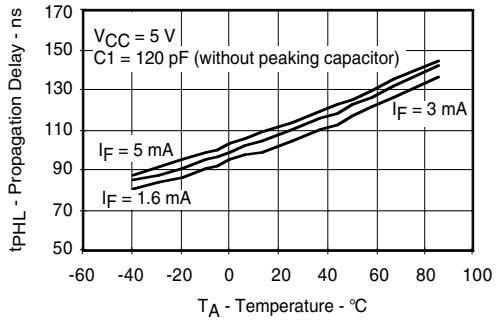


Fig. 16 Typical Propagation Delay to Logic Low vs. Temperature

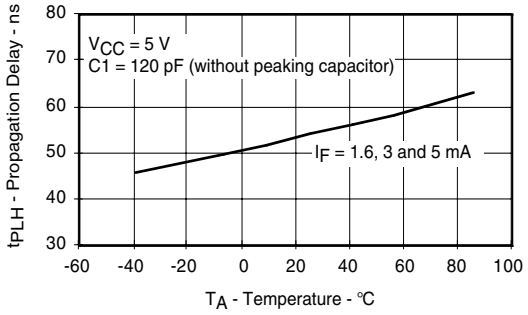


Fig. 19 Typical Propagation Delays to Logic High vs. Temperature

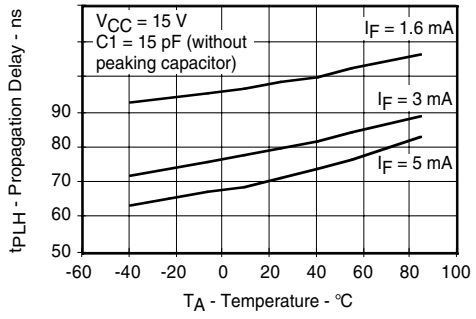


Fig. 17 Typical Propagation Delays to Logic High vs. Temperature

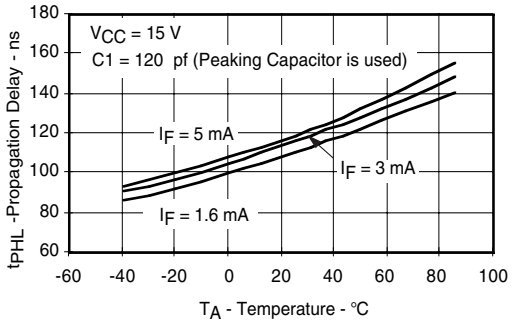


Fig. 20 Typical propagation delays to Logic Low vs. temperature (except SFH6705)

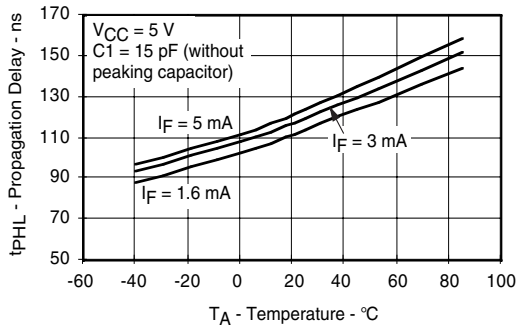


Fig. 18 Typical Propagation Delays to Logic Low vs.Temperature

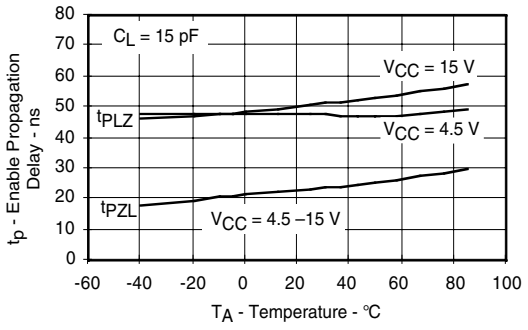


Fig. 21 Typical Logic Low Enable Propagation Delays vs. Temperature (only SFH6700/11)

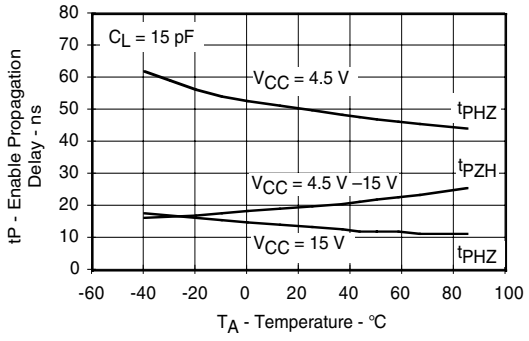


Fig. 22 Typical Logic High Enable Propagation Delays vs. Temperature (only SFH6700/11)

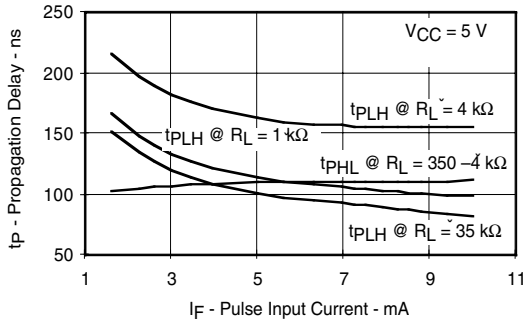


Fig. 23 Typical Propagation Delays vs. Pulse Input Current (only SFH6705)

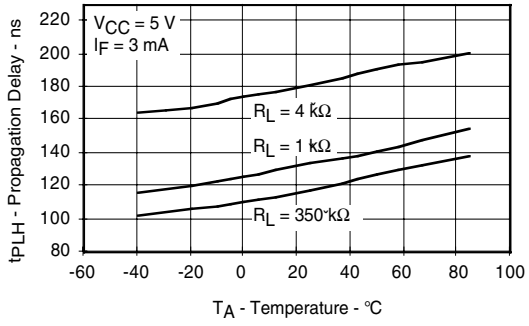


Fig. 24 Typical Propagation Delays to High Level vs. Temperature (only SFH6705)

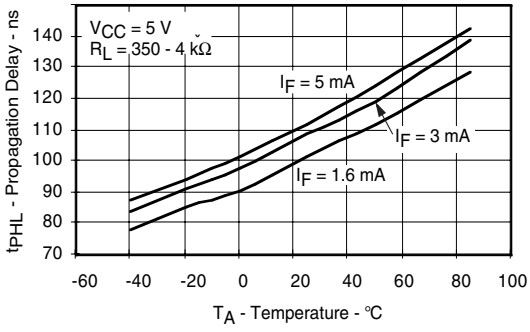


Fig. 25 Typical Propagation Delays to Low Level vs. Temperature (only SFH6705)

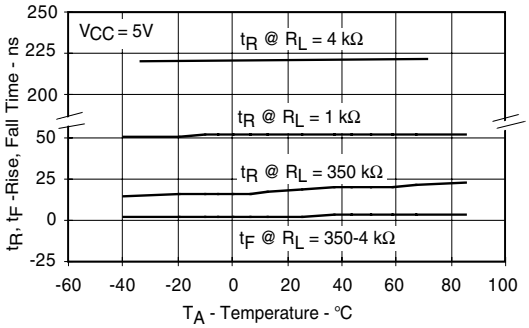
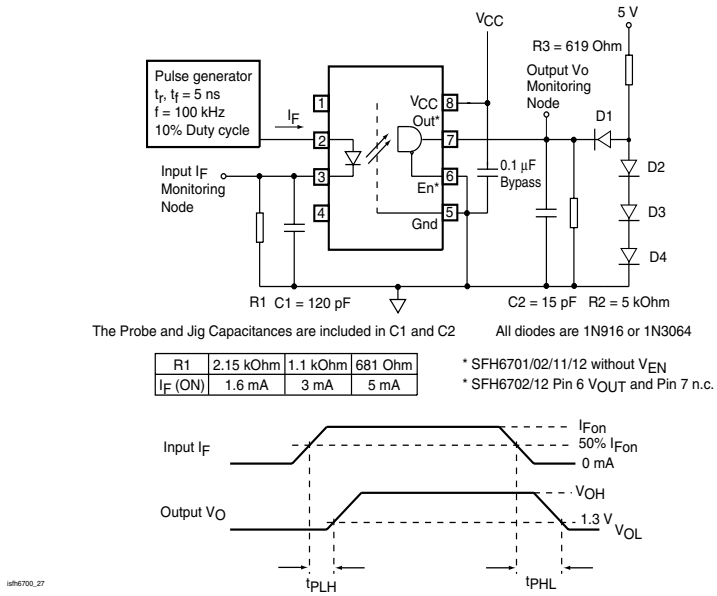
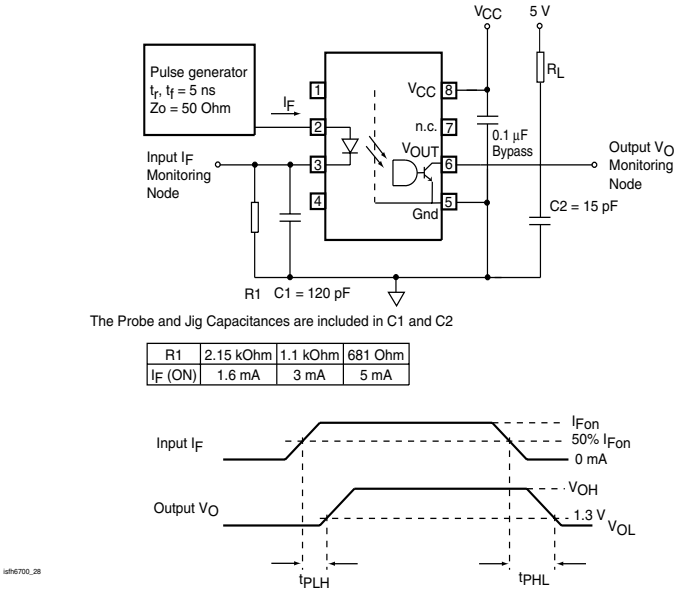


Fig. 26 Typical Rise, Fall Time vs. Temperature (only SFH6705)



R1	2.15 kOhm	1.1 kOhm	681 Ohm
I_F (ON)	1.6 mA	3 mA	5 mA

Fig. 27 Test Circuit for t_{PLH}, t_{PHL}, t_r and t_f



R1	2.15 kOhm	1.1 kOhm	681 Ohm
I_F (ON)	1.6 mA	3 mA	5 mA

Fig. 28 Test Circuit for t_{PLH}, t_{PHL}, t_r and - SFH6705

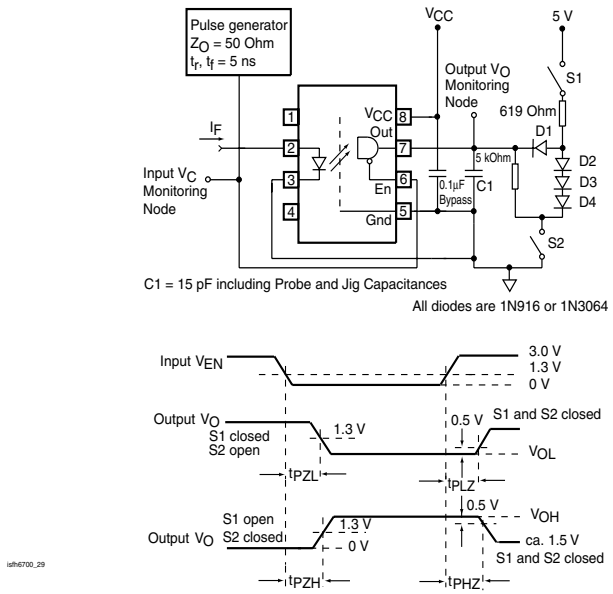


Fig. 29 Test Circuit for t_{PHZ}, t_{PZH}, t_{PLZ} and t_{PZL}-SFH6700/19

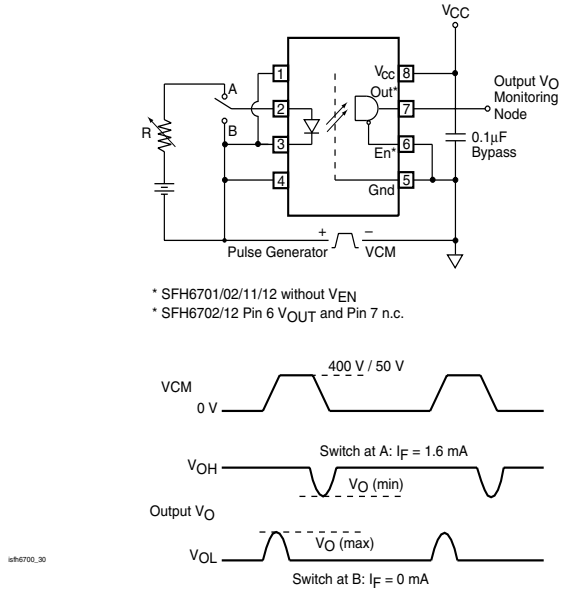


Fig. 30 Test Circuit for Common Mode Transient Immunity and Typical Waveforms-SFH6700/01/02/11/12/19

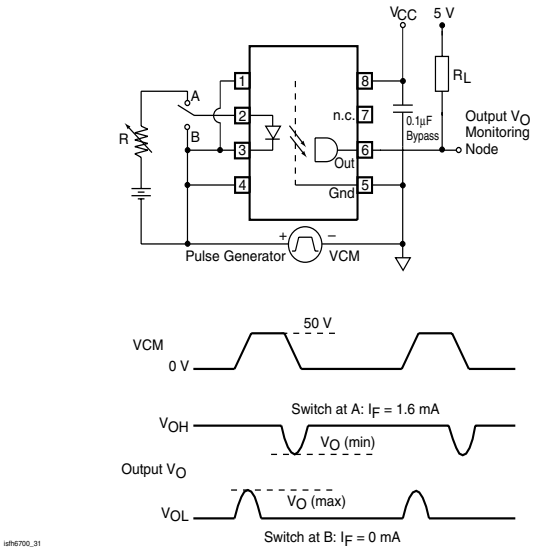
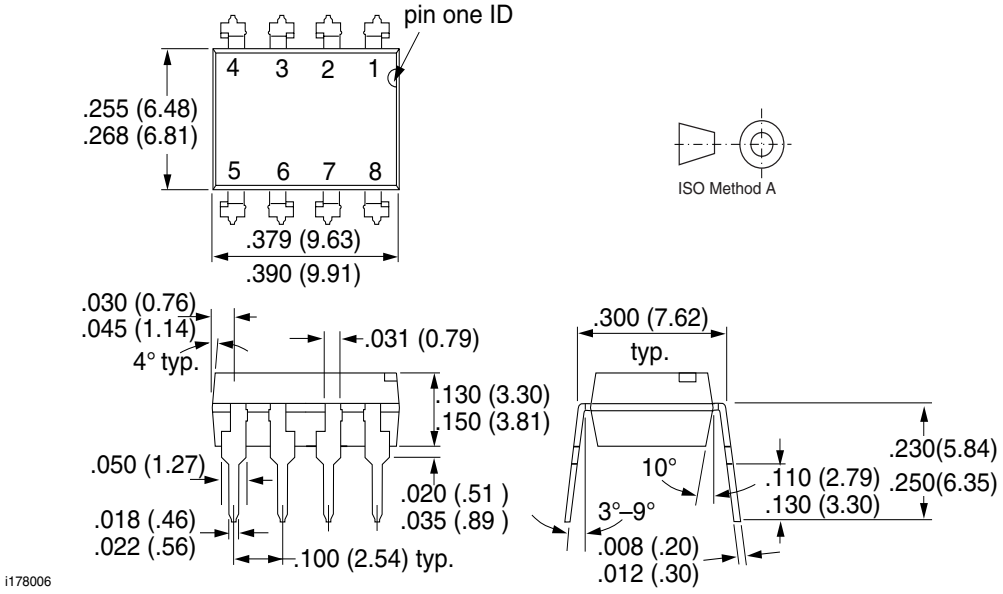
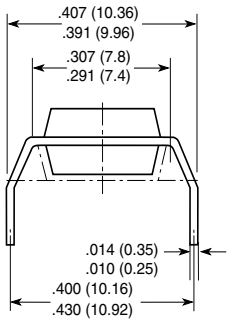


Fig. 31 Test Circuit for Common Mode Transient Immunity and Typical Waveforms-SFH6705

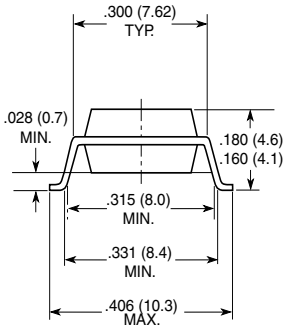
Package Dimensions in Inches (mm)



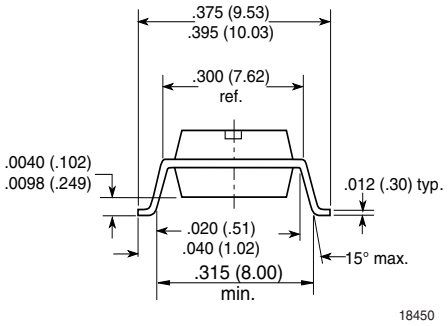
Option 6



Option 7



Option 9



Ozone Depleting Substances Policy Statement

It is the policy of **Vishay Semiconductor GmbH** to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operatingsystems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany
Telephone: 49 (0)7131 67 2831, Fax number: 49 (0)7131 67 2423