SFH6700/6719
SFH6701/6711
SFH6702/6712
SFH6705

Low Input Current Logic Gate Optocoupler

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**

APPLICATIONS

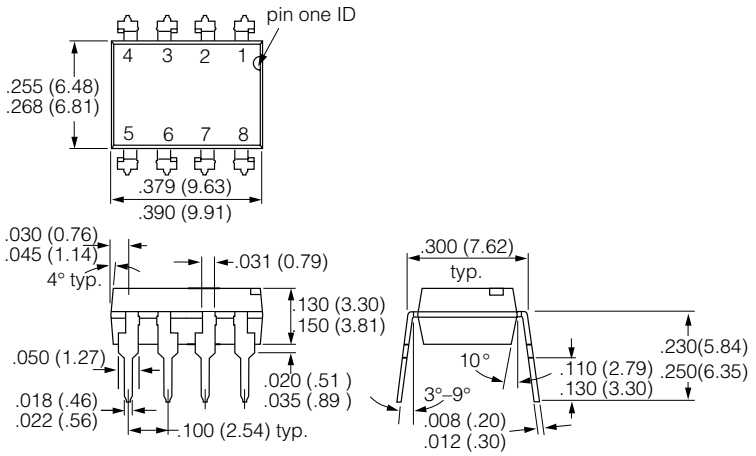
- **Industrial Control**
- **Replace Pulse Transformers**
- **Routine Logic Interfacing**
- **Motion/Power Control**
- **High Speed Line Receiver**
- **Microprocessor System Interfaces**
- **Computer Peripheral Interfaces**

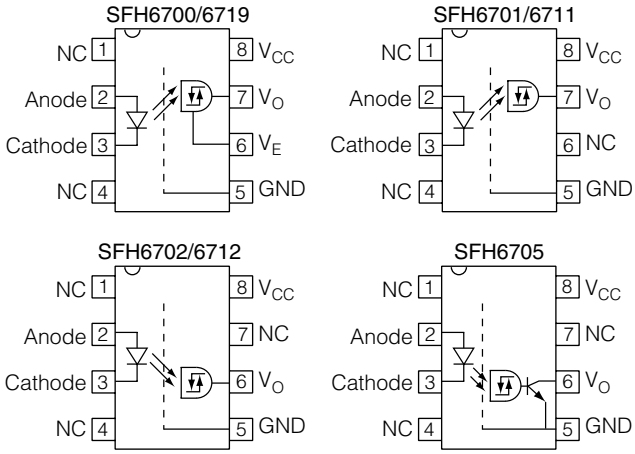
DESCRIPTION

The SFH67xx high speed optocoupler series consists of a GaAlAs infrared emitting diode, optically coupled with an integrated photodetector. The detector incorporates a Schmitt-Trigger stage for improved noise immunity. Using the Enable input, the output can be 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/µs at V_{CM}=50 V for SFH6700/01/02/05 and 2500 V/µs at V_{CM}=400 V for SFH6711/12/19.

The SFH67xx uses an industry standard DIP8 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.

Dimensions in Inches (mm)





Truth Table (Positive Logic)

SFH6700/19		
IR Diode	**Enable**	**Output**
on	H	Z
off	H	Z
on	L	H
off	L	L

SFH6701/11/02/12/05	
IR Diode	**Output**
on	H
off	L

Table 1. Maximum Ratings

Parameter		Sym.	Min.	Max.	Units
Emitter					
Reverse Voltage		V_R	—	3.0	V
DC Forward Current		I_F	—	10	mA
Surge Forward Current (tp≤1.0 µs, 300 pulses/s)		I_{FSM}	—	1.0	A
Total Power Dissipation		P_{tot}	—	20	mW
Detector					
Supply Voltage		V_{CC}	–0.5	15	V
Three State Enable Voltage (SFH6700/19 only)		V_{EN}	–0.5	15	V
Output Voltage		V_O	–0.5	15	V
Average Output Current		I_O	—	25	mA
Total Power Dissipation		P_{tot}	—	100	mW
Package					
Storage Temperature Range		T_{stg}	–55	125	°C
Ambient Temperature Range		T_A	–40	85	°C
Lead Soldering Temperature (t=10 s)		T_S	—	260	°C
Isolation Test Voltage (t=1.0 s)		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	—	
Comparative Tracking Index per DIN IEC112/ VDE 0303, part 1		—	175	400	—
Isolation Resistance	V_{IO}=500 V, T_A=25°C	R_{ISO}	10^{12}	—	Ω
	V_{IO}=500 V, T_A=100°C		10^{11}	—	

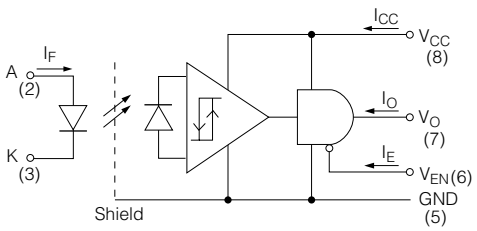
Table 2. Recommended Operating Conditions

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

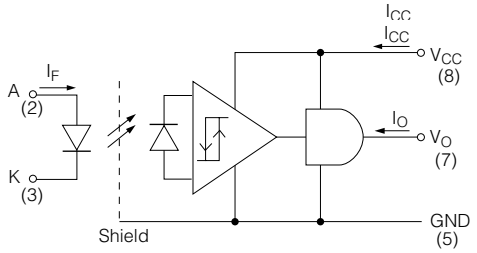
Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{CC}	4.5	15	V
Enable Voltage High (SFH6700/19)	V_{EH}	2.0	15	V
Enable Voltage Low (SFH6700/19)	V_{EL}	0	0.8	V
Forward Input Current	I_{Fon}	1.6(1)	5.0	mA
Forward Input Current	I_{Foff}	—	0.1	mA
Operating Temperature	T_A	0	85	°C
Output Pull-up Resistor (SFH6705 only)	R_L	350	4k	Ω
Fan Out (SFH6705 at R_L=1.0 kΩ)	N	—	16	LS TTL Loads

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

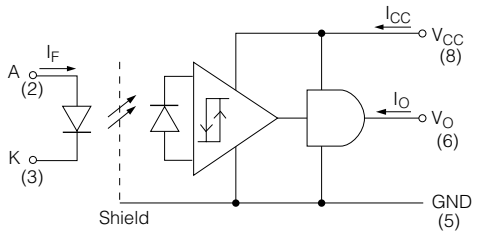
Figure 1. Schematics



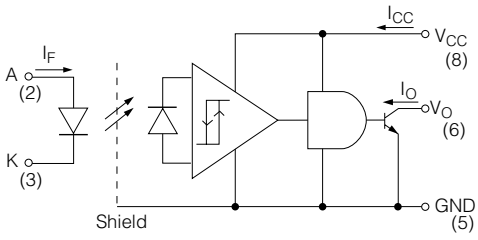
SFH6700/19



SFH6701/11



SFH6702/12



SFH6705

Characteristics

0°C≤ T_A≤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_A=25°C; V_{CC}=5.0 V; I_{Fon}=3.0 mA unless otherwise specified

Parameter	Sym.	Min.	Typ.	Max.	Unit	Test Condition
Emitter						
Forward Voltage	V_F	—	1.6	1.75	V	I_F=5.0 mA, T_A=25°C
		—	—	1.8	V	I_F=5.0 mA
Input Current Hysteresis	I_{HYS}	—	0.1	—	mA	V_{CC}=5.0 V, I_{HYS}=I_{Fon}–I_{Foff}
Reverse Current	I_R	—	0.5	10	µA	V_R=3.0 V, T_A=25°C
Capacitance	C_0	—	60	—	pF	V_R=0 V, f=1.0 MHz, T_A=25°C
Thermal Resistance	R_{thJA}	—	700	—	K/W	—
Detector						
Logic Low Output Voltage	V_{OL}	—	—	0.5	V	I_{OL}=6.4 mA
Logic High Output Voltage (except SFH6705)	V_{OH}	2.4	*	—	V	I_{OH}=–2.6 mA, *V_{OH}=V_{CC}–1.8 V
Output Leakage Current (V_{OUT}>V_{CC}) (except SFH6705)	I_{OHH}	—	0.5	100	µA	V_O=5.5 V, V_{CC}=4.5 V, I_F=5.0 mA
		—	1.0	500	µA	V_O=15 V, V_{CC}=4.5 V, I_F=5.0 mA
Output Leakage Current (SFH6705 only)	I_{OHH}	—	0.5	100	µA	V_O=5.5 V, V_{CC}=5.5 V, I_F=5.0 mA
		—	1.0	500	µA	V_O=15 V, V_{CC}=15 V, I_F=5.0 mA
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)	I_{EH}	—	—	20	µA	V_{EN}=2.7 V
		—	—	100	µA	V_{EN}=5.5 V
		—	0.001	250	µA	V_{EN}=15 V
Logic Low Enable Current (SFH6700/19 only)	I_{EL}	–320	–50	—	µA	V_{EN}=0.4 V
High Impedance State Output Current (SFH6700/19 only)	I_{OZL}	–20	—	—	µA	V_O=0.4 V, V_{EN}=2.0 V, I_F=5.0 mA
	I_{OZH}	—	—	20	µA	V_O=2.4 V, V_{EN}=2.0 V, I_F=0
		—	—	100	µA	V_O=5.5 V, V_{EN}=2.0 V, I_F=0
		—	0.001	500	µA	V_O=15 V, V_{EN}=2.0 V, I_F=0
Logic Low Supply Current	I_{CCL}	—	3.7	6.0	mA	V_{CC}=5.5 V, I_F=0
		—	4.1	6.5	mA	V_{CC}=15 V, I_F=0
Logic High Supply Current	I_{CCH}	—	3.4	4.0	mA	V_{CC}=5.5 V, I_F=5.0 mA
		—	3.7	5.0	mA	V_{CC}=15 V, I_F=5.0 mA
Logic Low Short Circuit Output Current	I_{OSL}(2)	25	—	—	mA	V_O=V_{CC}=5.5 V, I_F=0
		40	—	—	mA	V_O=V_{CC}=15 V, I_F=0
Logic High Short Circuit Output Current (except SFH6705)	I_{OSH}(2)	—	—	–10	mA	V_{CC}=5.5 V, V_O=0 V, I_F=5.0 mA
		—	—	–25	mA	V_{CC}=15 V, V_O=0 V, I_F=5.0 mA
Thermal Resistance	R_{thJA}	—	300	—	K/W	—
Package						
Coupling Capacitance	C_{IO}	—	0.6	—	pF	f=1.0 MHz, pins 1–4 and 5–8 shorted together
Isolation Resistance	R_{ISO}	10^{12}	—	—	Ω	V_{IO}=500 V, T_A=25°C
		10^{11}	—	—	Ω	V_{IO}=500 V, T_A=100°C

2. Output short circuit time ≤10 ms.

Table 3. Switching Times [3]

0°C≤ T_A≤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_A=25°C; V_{CC}=5.0 V; I_{Fon}=3.0 mA unless otherwise specified

Parameter, SFH6700/01/02/11/12/19	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Propagation Delay Time to Logic Low Output Level	t_{PHL}	—	120	—	ns	Without Peaking Capacitor
		—	115	300		With Peaking Capacitor
Propagation Delay Time to Logic Low Output Level	t_{PLH}	—	125	—	ns	Without Peaking Capacitor
		—	90	300		With Peaking Capacitor
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 High (SFH6700/19)	t_{PHZ}	—	50	—	ns	—
Output Disable Time from Logic Low (SFH6700/19)	t_{PLZ}	—	50	—	ns	—
Output Rise Time	t_r	—	40	—	ns	10% to 90%
Output Fall Time	t_f	—	10	—	ns	90% to 10%

Switching Times [3]

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

Parameter, SFH6705	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Propagation Delay Time to Logic Low Output Level	t_{PHL}	—	115	—	ns	Without Peaking Capacitor
		—	105	300		With Peaking Capacitor
Propagation Delay Time to Logic Low Output Level	t_{PLH}	—	125	—	ns	Without Peaking Capacitor
		—	90	300		With Peaking Capacitor
Output Rise Time	t_r	—	25	—	ns	10% to 90%
Output Fall Time	t_f	—	4	—	ns	90% to 10%

Common Mode Transient Immunity T_A=25°C, V_{CC}=5.0 V[4]

Parameter	Device	Symbol	Min.	Unit	Test Condition
Logic High Common Mode Transient Immunity	SFH6700/01/02/05	$\|CM_H\|$[4]	1000	V/µs	$\|V_{CM}\|$=50 V, I_F=1.6 mA
	SFH6711/12/19		2500	V/µs	$\|V_{CM}\|$=400 V, I_F=1.6 mA
Logic Low Common Mode Transient Immunity	SFH6700/01/02/05	$\|CM_L\|$[4]	1000	V/µs	$\|V_{CM}\|$=50 V, I_F=0
	SFH6711/12/19		2500	V/µs	$\|V_{CM}\|$=400 V, I_F=0

3. A 0.1 µF bypass capacitor connected between pins 5 and 8 must be used.
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 low level (V_O<0.8 V).

Figure 2. Permissible Total Power Dissipation vs. Temperature

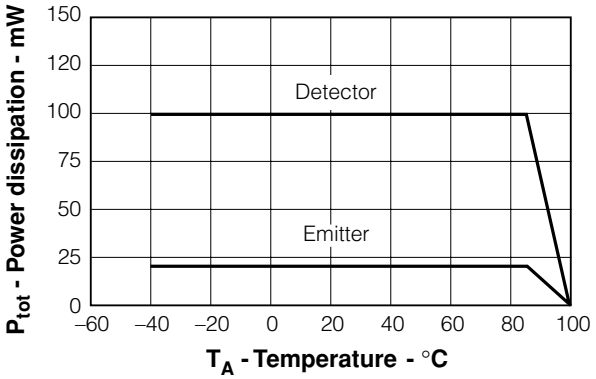


Figure 3. Typical Input Diode Forward Current vs. Forward Voltage

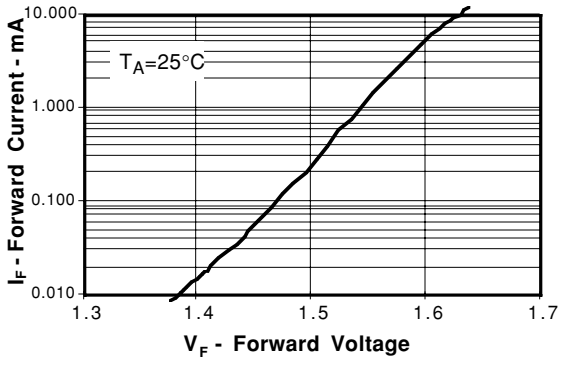


Figure 4. Typical Forward Input Voltage vs. Temperature

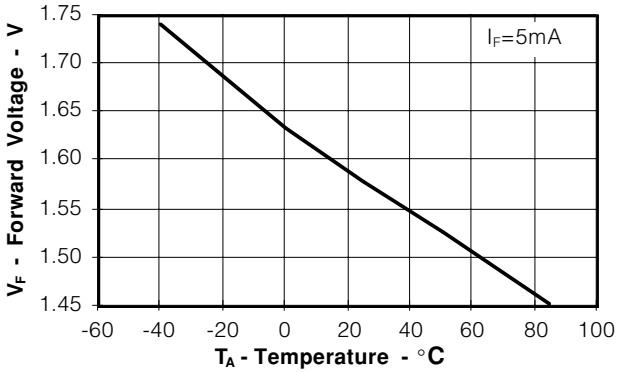


Figure 5. Typical Output Voltage vs. Forward Input Current (except SFH6705)

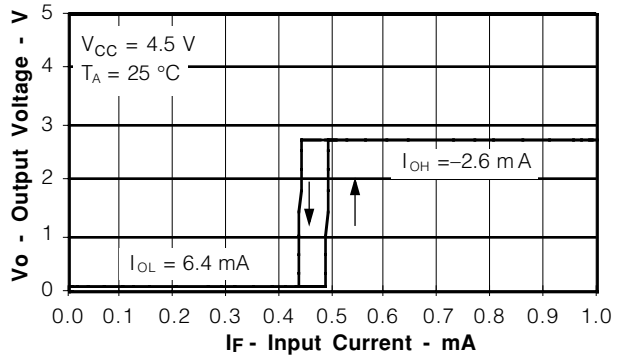


Figure 6. Typical Output Forward Voltage vs. Forward Input Current (only SFH6705)

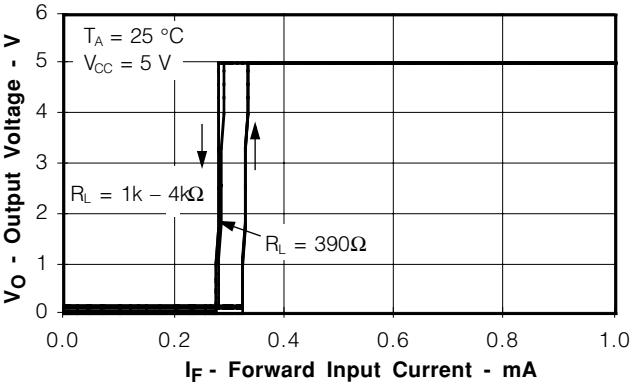


Figure 7. Typical Supply Current vs. Temperature

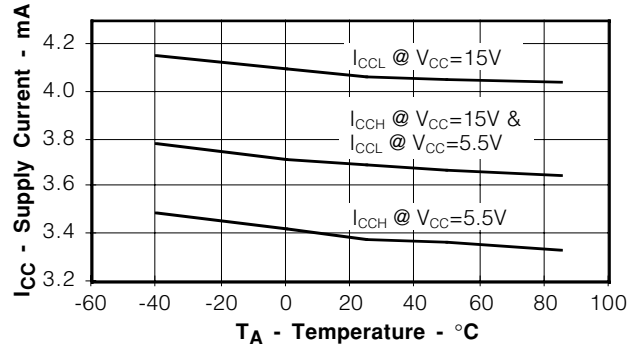


Figure 8. Typical Output Leakage Current vs. Temperature

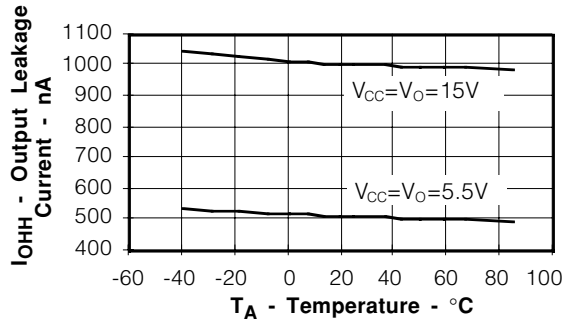


Figure 9. Typical Low Level Output Current vs. Temperature

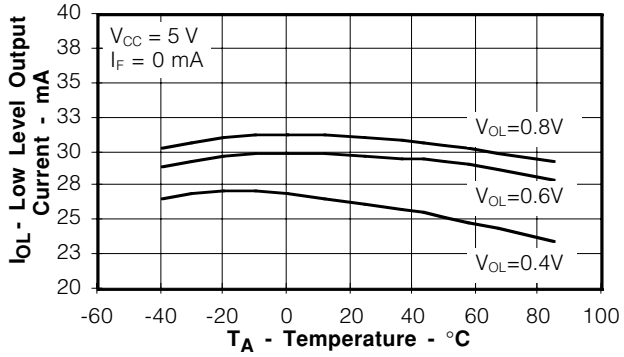


Figure 10. Typical Low Level Output Voltage vs. Temperature

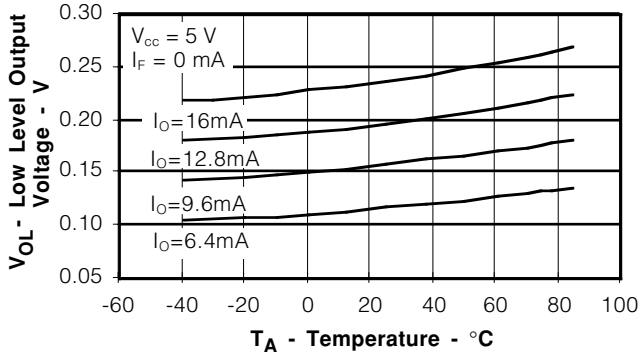


Figure 11. Typical High Level Output Current vs. Temperature (except SFH6705)

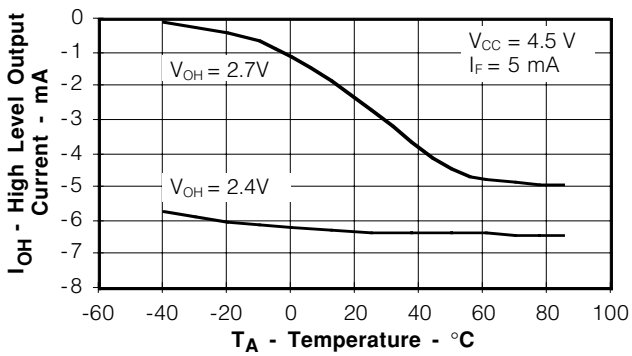


Figure 12. Typical Rise, Fall Time vs. Temperature (except SFH6705)

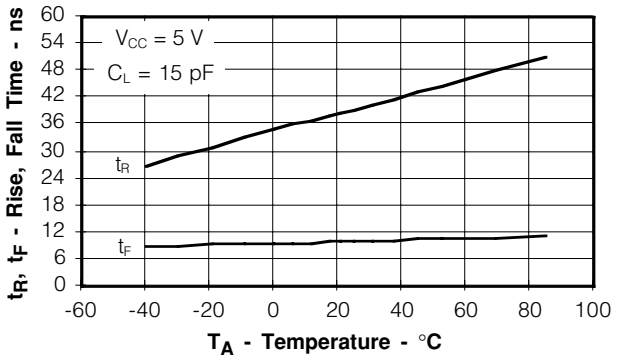


Figure 13. Typical Propagation Delays to Logic High vs. Temperature (except SFH6705)

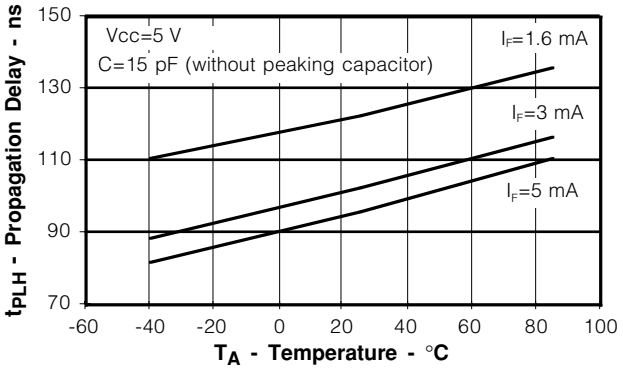


Figure 14. Typical Propagation Delays to Logic Low vs. Temperature (except SFH6705)

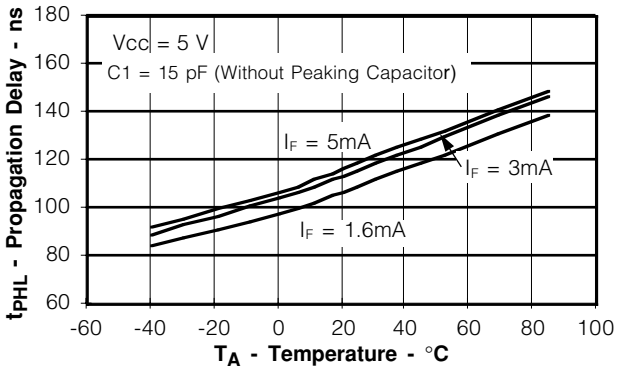


Figure 15. Typical Propagation Delays to Logic High vs. Temperature (except SFH6705)

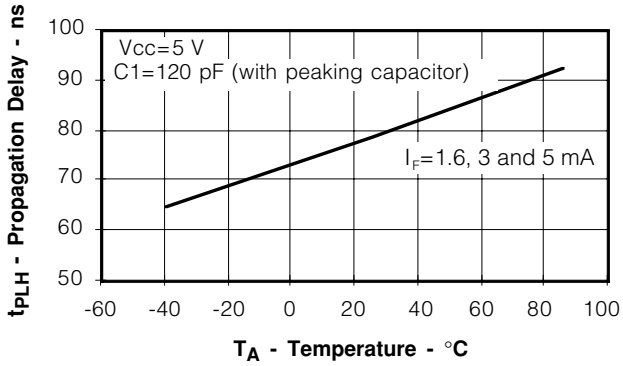


Figure 16. Typical Propagation Delays to Logic Low vs. Temperature

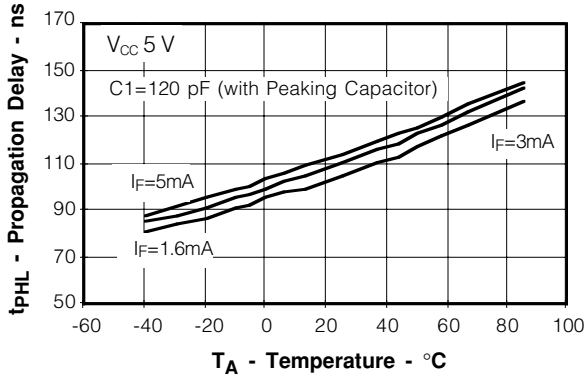


Figure 17. Typical Propagation Delays to Logic High vs. Temperature

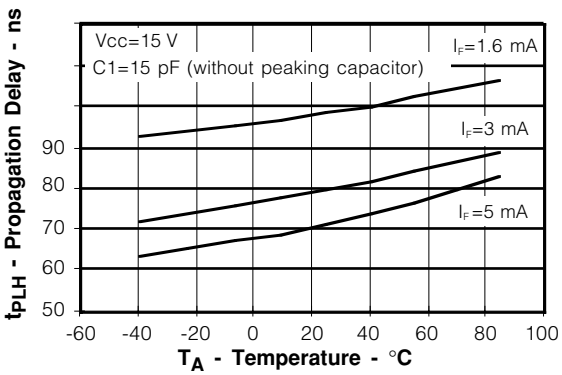


Figure 18. Typical Propagation Delays to Logic Low vs. Temperature

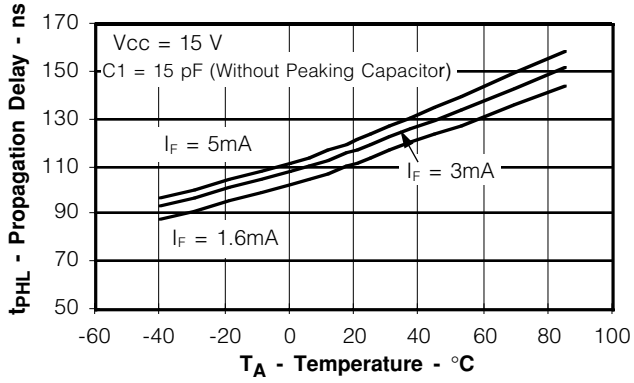


Figure 19. Typical Propagation Delays to Logic High vs. Temperature

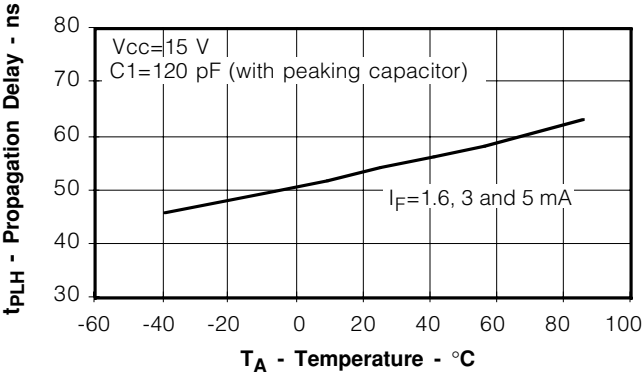


Figure 20. Typical Propagation Delays to Logic Low vs. Temperature (except SFH6705)

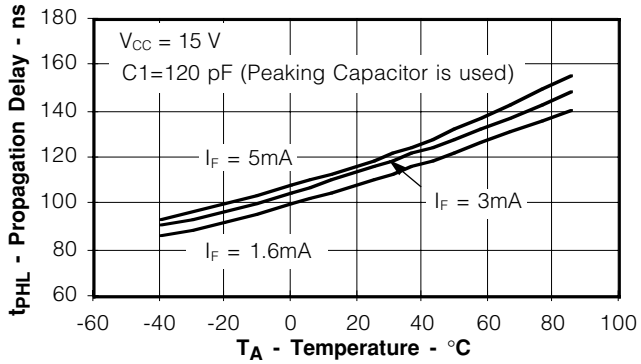


Figure 21. Typical Logic Low Enable Propagation Delays vs. Temperature (only SFH6700/11)

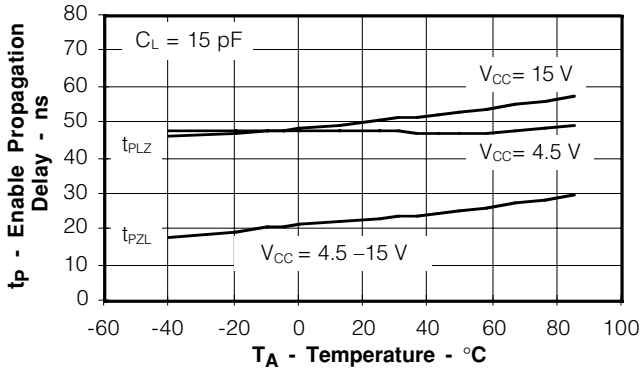


Figure 22. Typical Logic High Enable Propagation Delays vs. Temperature (only SFH6700/11)

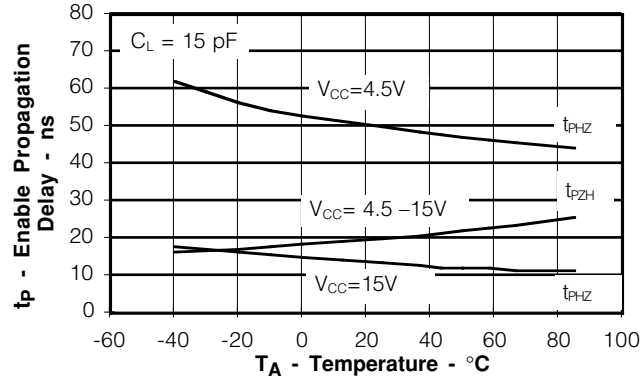


Figure 23. Typical Propagation Delays vs. Pulse Input Current (only SFH6705)

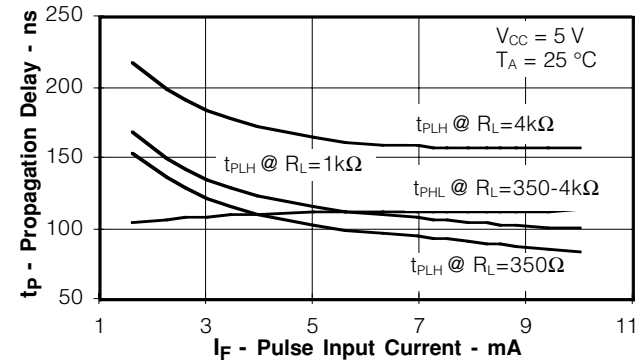


Figure 24. Typical Propagation Delays to High Level vs. Temperature (only SFH6705)

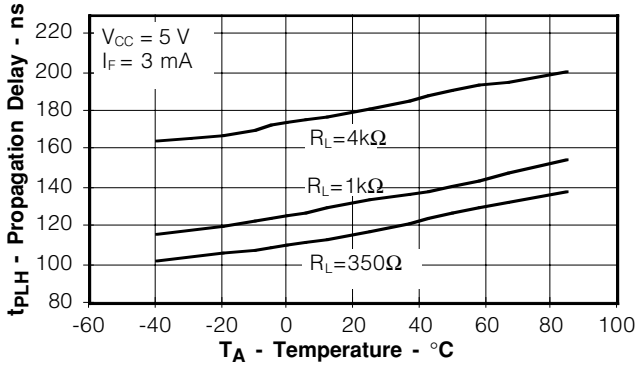


Figure 25. Typical Propagation Delays to Low Level vs. Temperature (only SFH6705)

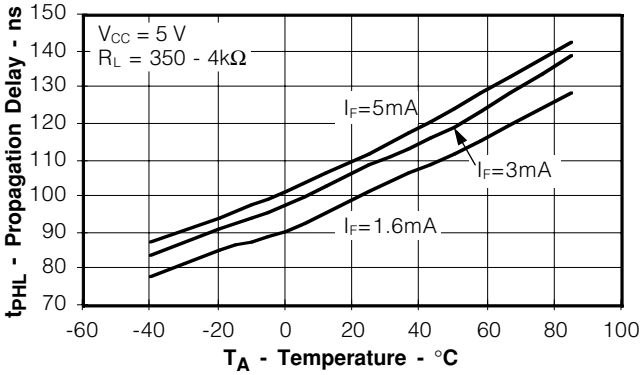


Figure 26. Typical Rise, Fall Time vs. Temperature (only SFH6705)

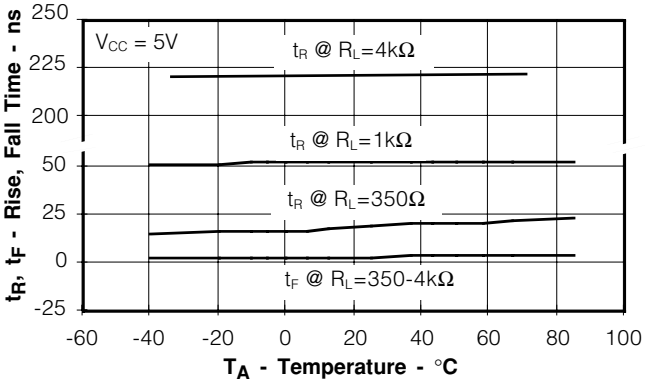
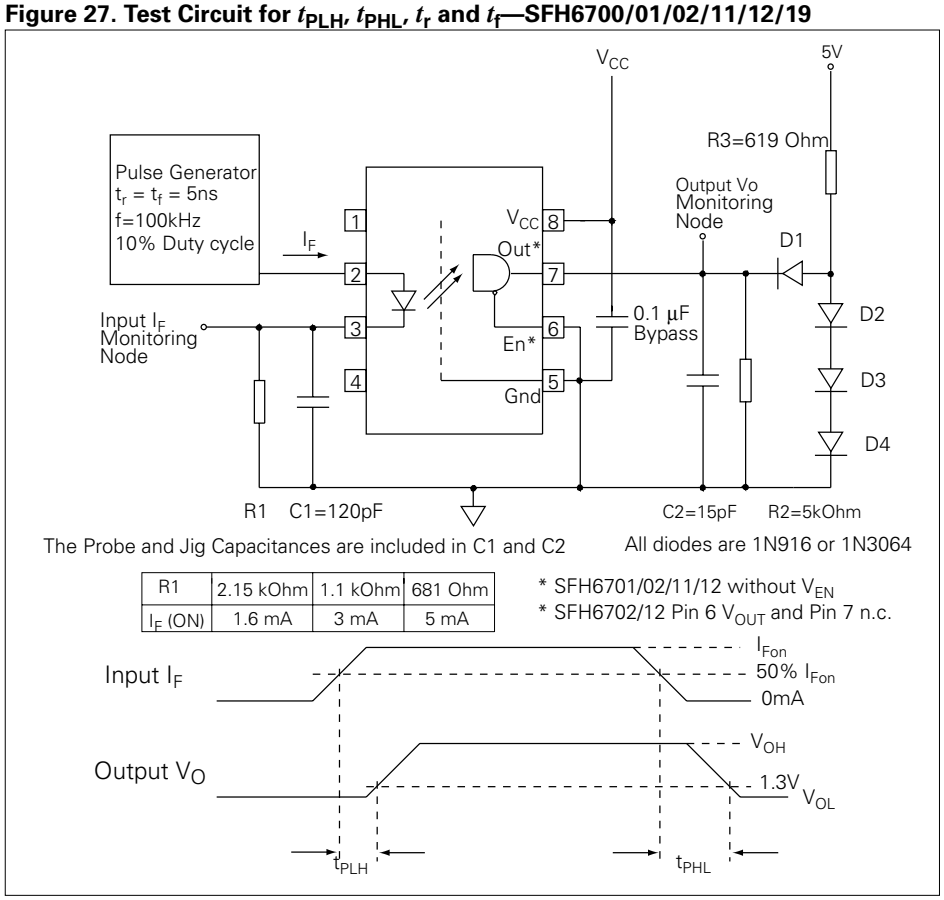
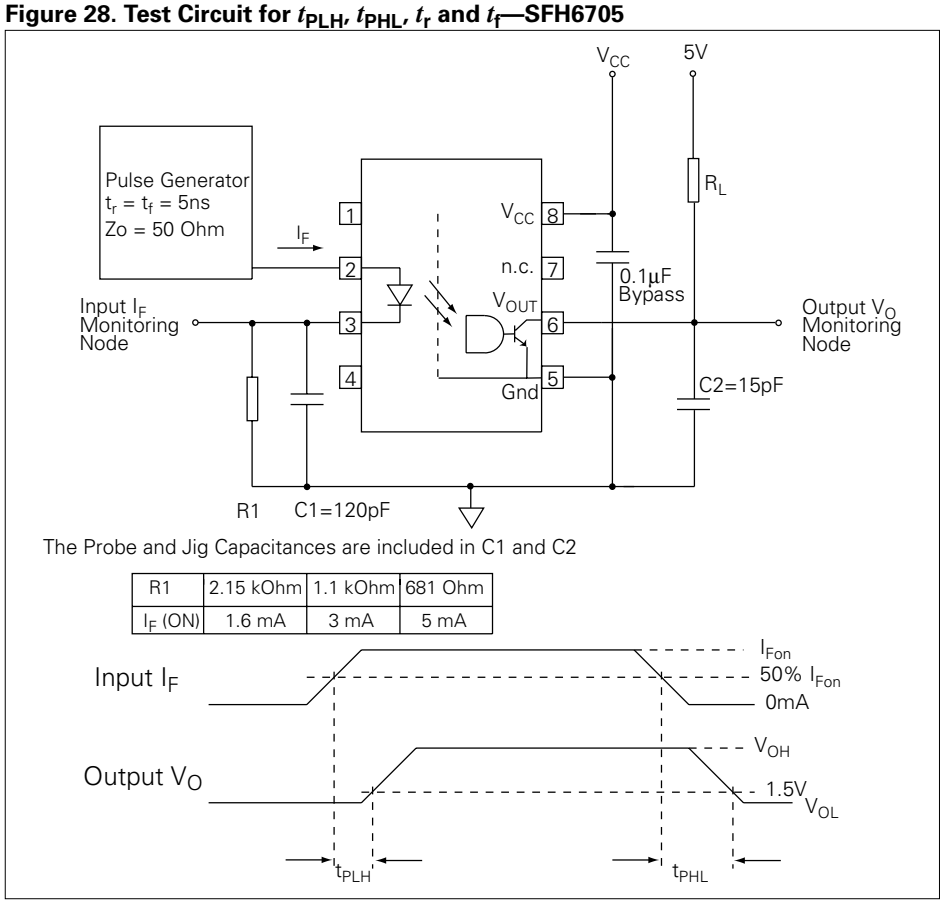


Figure 27. Test Circuit for t_{PLH}, t_{PHL}, t_r and t_f—SFH6700/01/02/11/12/19



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

Figure 28. Test Circuit for t_{PLH}, t_{PHL}, t_r and t_f—SFH6705



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

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

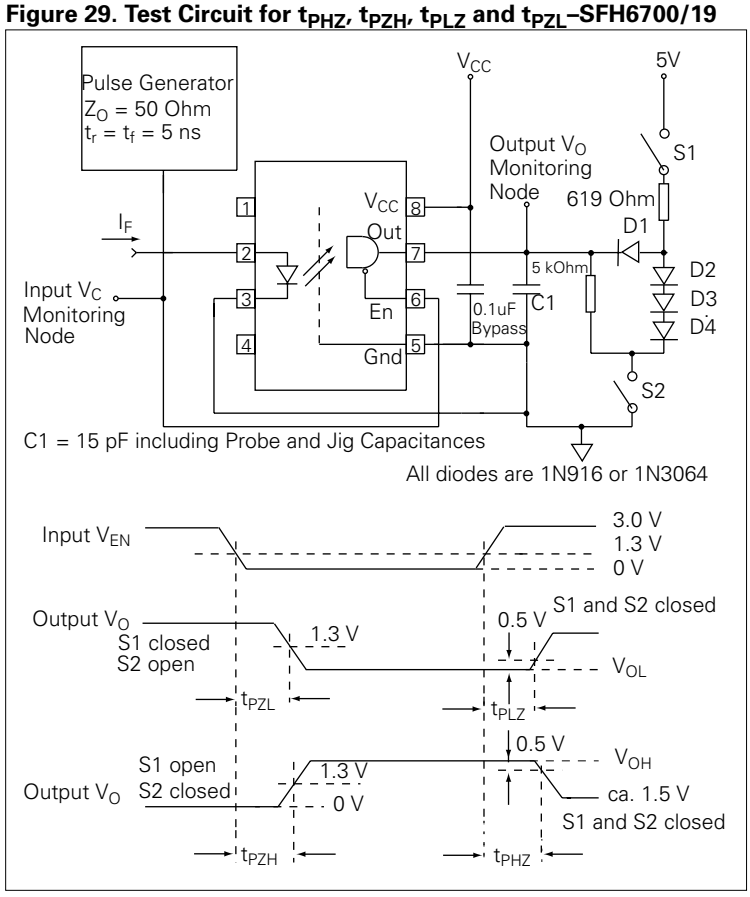


Figure 30. Test Circuit for Common Mode Transient Immunity and Typical Waveforms—SFH6700/01/02/11/12/19

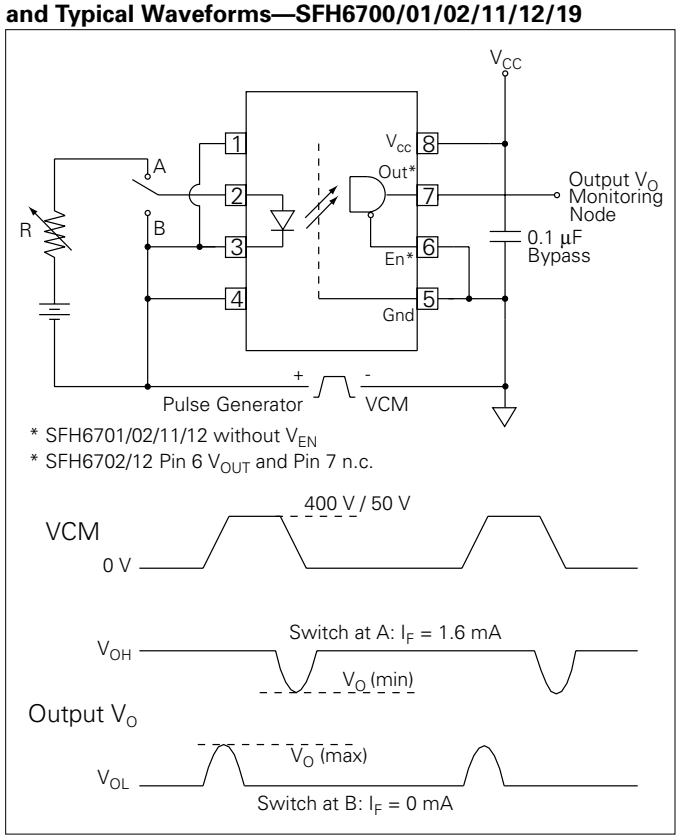


Figure 31. Test Circuit for Common Mode Transient Immunity and Typical Waveforms—SFH6705