

FAN8800 (KA3162)

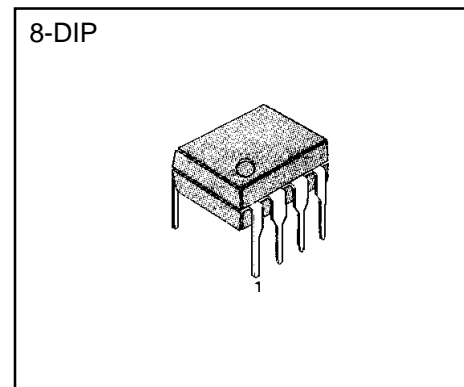
Single IGBT Gate Driver

Features

- High Current Output: 1.0A Source and 2.0A Sink
- Protection against Overcurrent and Short circuit
- CMOS Compatible Input and Fault Status Indicator
- Programmable Fault-Out Duration Time
- Built in Slow Turn-off Circuit Under Fault Condition
- Undervoltage Lockout Optimized for IGBTs
- Negative Gate Drive Capability
- Suitable for Integration in Power Modules
- -40 to 105°C Operating Temperature

Description

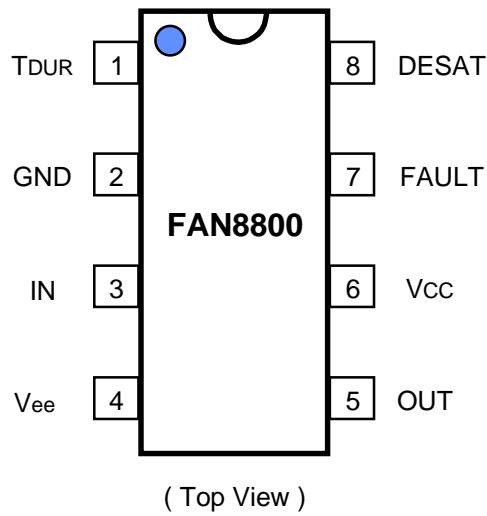
The FAN8800 is a monolithic integrated circuit designed for driving single IGBT with De-saturation and undervoltage protection. It is suitable for driving discrete and module IGBTs, and further, it offers a cost effective solution for driving power MOSFETs. The integrated fault feedback notifies the controller when the IGBT is shutdown due to a De-saturation or a over current condition.



Typical Applications

- Gate drive for single insulated gate bipolar TR
- Gate drive for single MOSFET

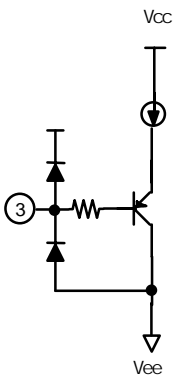
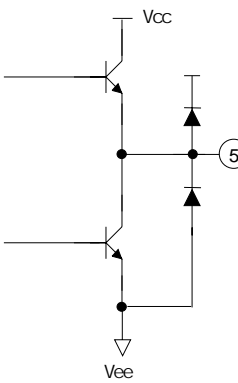
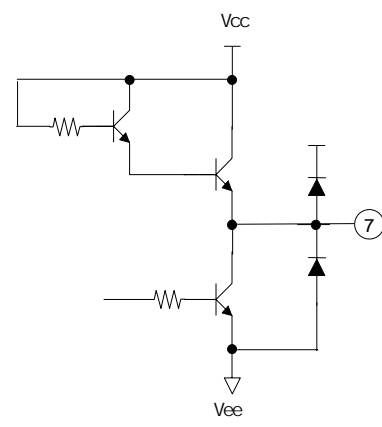
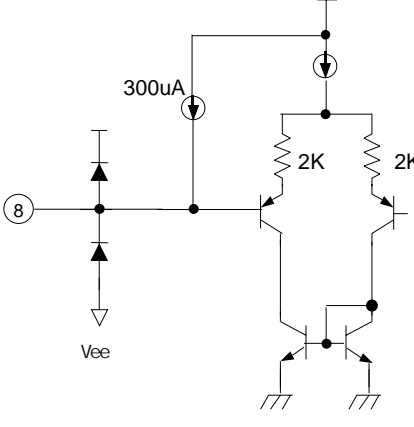
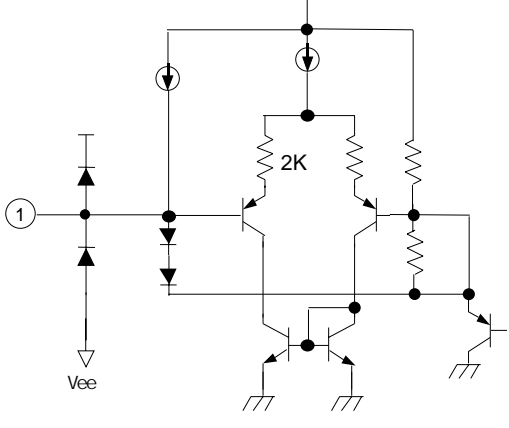
Pin Assignments



Pin Definitions

Pin Number	Pin Name	Pin Function Description
1	TDUR	Fault Output Duration(Adjustment Capacitor for Fault-Out Duration)
2	GND	Ground
3	IN	Inverting gate drive voltage output (Vout) control input
4	Vee	Gate drive voltage output
5	OUT	Output supply voltage (Negative)
6	VCC	Output supply voltage (Positive)
7	FAULT	Fault Output. FAULT changes from a logic low state to a logic high output when a fault condition is detected.
8	DESAT	De-saturation voltage input. When the voltage on DESAT exceeds an internal reference voltage of 6.5v while the IGBT is on, FAULT output is changed from a logic low state to a logic high state.

Equivalent Circuits

Driver Input	Driver Output
	
Fault Out	Desat
	
TDUR	
	

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Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Value	Unit
Power Supply Voltage	VCC - Vee	36	V
Output Source Current	IO	1.0	A
Output Sink Current		2.0	
Fault Output Source Current	IFo	25	mA
Fault Output Sink Current		10	
Input Voltage	Vin	Vee - 0.3 to VCC	V
De-saturation Voltage	VDESAT	-0.3 to VCC	V
Power Dissipation and Thermal Characteristics Maximum Power Dissipation @Ta =25°C	PD	0.56	W
Operating Ambient Temperature Range	TOPR	-40 to 105	°C
Storage Temperature Range	TSTG	-55 to 150	°C

Recommended Operating Conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max	Unit
Total Supply Voltage	VCC	+13	+15	+18	V
Operating Power Supply Voltage	Vee	-13	-15	-18	V
Operating Ambient Temperature	Ta	-40	25	105	°C

Electrical Characteristics (Ta = 25°C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	
LOGIC INPUT							
High Input Threshold Voltage	V _{IH}	-	-	2.7	3.2	V	
Low Input Threshold Voltage	V _{IL}	-	1.2	2.3	-		
DRIVE OUTPUT							
Low Output Voltage	V _{OL}	I _{sink} =1.0A	-	2.0	2.4	V	
High Output Voltage	V _{OH}	I _{source} =500mA	12	14	-		
FAULT OUTPUT							
Low Fault Output Voltage	V _{FL}	I _{sink} =5.0A	-	0.2	1.0	V	
High Fault Output Voltage	V _{FH}	I _{source} =20mA	11	13.5	-		
UVLO							
Start-up Voltage	V _{CCST}	-	11	11.5	12	V	
Disable Voltage	V _{CCDI}	-	10	10.5	11	V	
UVLO Hysteresis	HY	-	0.9	1.0	11.1	V	
DESATURATION INPUT							
De-saturation Current Source	I _{CHG}	V _{in} =0V, V _{DESAT} =0V	210	300	380	μA	
Discharge Current	I _{DSCHG}	V _{in} =V _{cc} , V _{DESAT} =V _{cc}	1.0	2.5	-	mA	
OCP and SCP							
OCP Voltage Reference	V _{OCP}	-	4.0	4.5	5.0	μA	
SCP Voltage Reference	V _{SCP}	-	5.8	6.5	7.3	mA	
POWER SUPPLY							
Standby Current	I _{CCST}	V _{in} = High, Output open	-	14	20	mA	
Operating Current	I _{CCOP}	CL=1.0nF, f=20kHz	-	20	30	mA	
Propagation Delay Time to High Output Level	T _{PLH}	R _g =0, CL=1.0nF f=10kHz, Duty Cycle=50%	-	0.35	0.7	μs	
Propagation Delay Time to Low Output Level	T _{PHL}		-	0.35	0.7	μs	
Rise Time	T _r		-	50	100	ns	
Fall Time	T _f		-	50	100	ns	
OCP Delay Time	T _{OCP}		50	80	120	μs	
SCP Delay Time	T _{SCP}		-	0.3	1.0	μs	
Fault Output Duration Time	T _{DUR}		C _{dur} =2.7nF	100	170	320	μs
Slow turn-off time	T _{SLOW}		CL=4.7nF	0.8	2.0	5.0	μs

Application Information

1. FAULT-OUT DURATION TIME (T_{DUR})

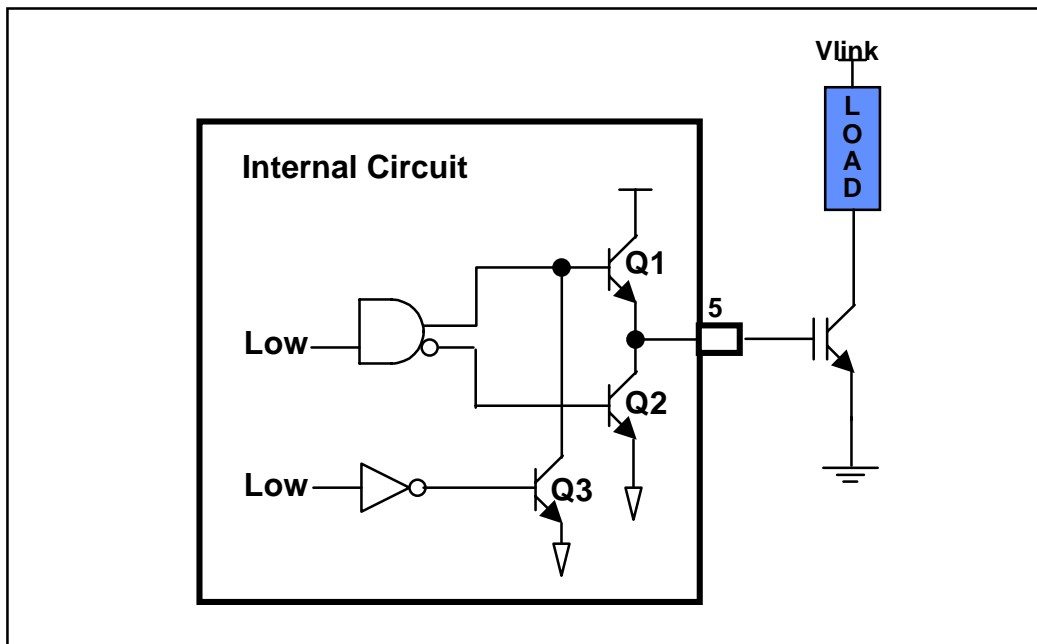
1) Two modes in Fault-Out Duration.

- OCP mode
Fault-Out Duration operates after T_{OCP}.
- SCP mode
If V_{pin8} is over 6.5V, Fault-Out Duration will operate after T_{SCP}.

2) T_{DUR} (It can be adjusted by external capacitor (C_{DUR}) is

$$\begin{aligned} T_{DUR} &= C_{DUR} / 55\mu\text{A} \times (5\text{V} - 1.4\text{V}) \\ &= 2.7\text{nF} / 55\mu\text{A} \times (5\text{V} - 1.4\text{V}) \\ &= 176\mu\text{s} \end{aligned}$$

2. SLOW TURN-OFF (T_{SLOW})



- 1) When SCP (Short Circuit Protection) is operated, Q3 turns on and Q2 turns on.
- 2) In the upper condition, Q2 flows the constant current of 35mA.
- 3) The capacitance of IGBT as the load is discharging by 35mA, that is Slow Turn-off.
- 4) Slow Turn-off time is

$$\begin{aligned} T_{SLOW} &= C_{IGBT} / 35\text{mA} \times (V_{5\text{max}} - V_{5\text{min}}) \\ &= 4.7\text{nF} / 35\text{mA} \times (15\text{V} - 1\text{V}) \\ &= 1.9\mu\text{s} \end{aligned}$$

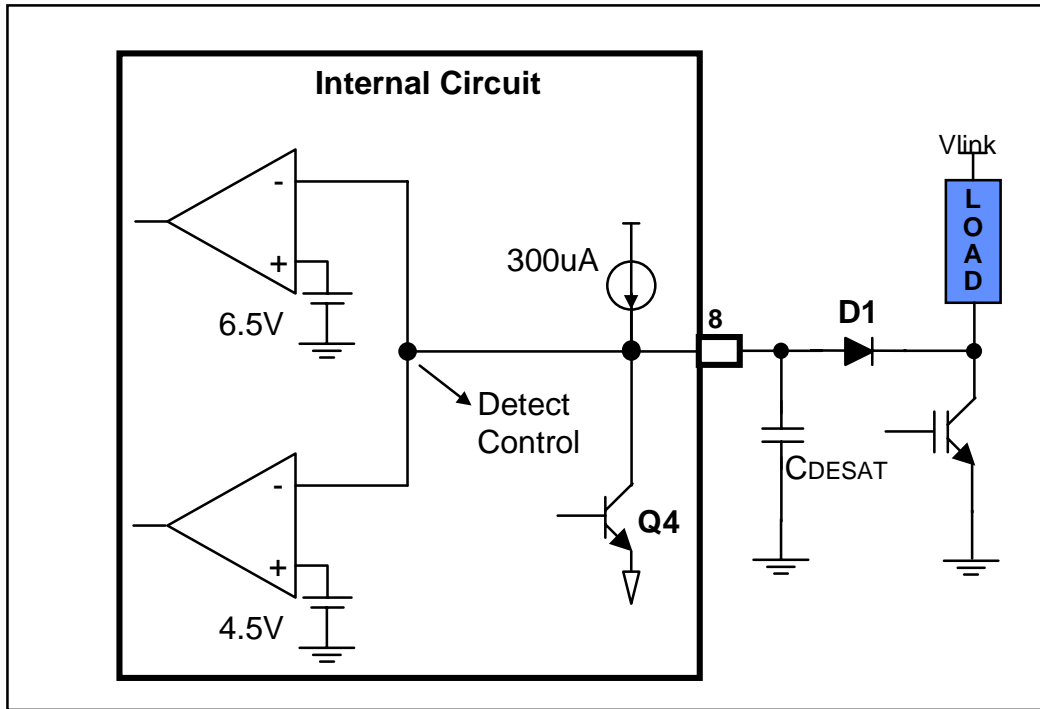
3. OCP DELAY TIME (T_{OCP})

- 1) If the saturation detector (DESAT or V_{pin8}) is $4.5V < V_{pin8} < 6.5V$, the Fault-Out signal will be high after T_{OCP}.
- 2) T_{OCP} (This value is fixed internally) is

$$T_{OCP} = 50pF / 3\mu A \times 5V$$

$$= 83\mu s$$

4. CHARGE TIME IN THE DE-SATURATION DETECTION



- 1) When the signal of Drive Output (V_{pin5}) is high, Q4 turns on and it is operated De-saturation Detection Mode in upper figure. In this mode, when it detects the voltage of collector- emitter terminal of IGBT through D1.

If $V_{ce(sat)} + V_f$ of D1 $\geq 4.5V$, it is operated OCP Mode.
 If $V_{ce(sat)} + V_f$ of D1 $\geq 6.5V$, it is operated SCP Mode.

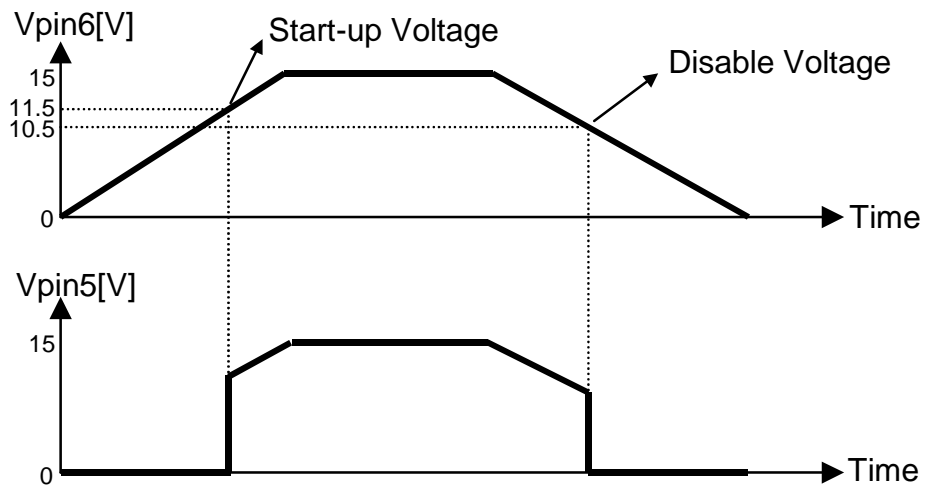
When the input signal of IGBT is from low-state to high-state, Q4 turns off and it is operated De-saturation Detection Mode. On this times, the voltage of collector-emitter terminal of IGBT is not saturation-state yet. This period is said On Time Delay (T_d (on)). Here, the operation of C_{DESAT} is following ; When C_{DESAT} is charged by current source of 300uA and so it prevents operating error for T_d (on) of IGBT.

- 2) Slope of V_{pin8} is

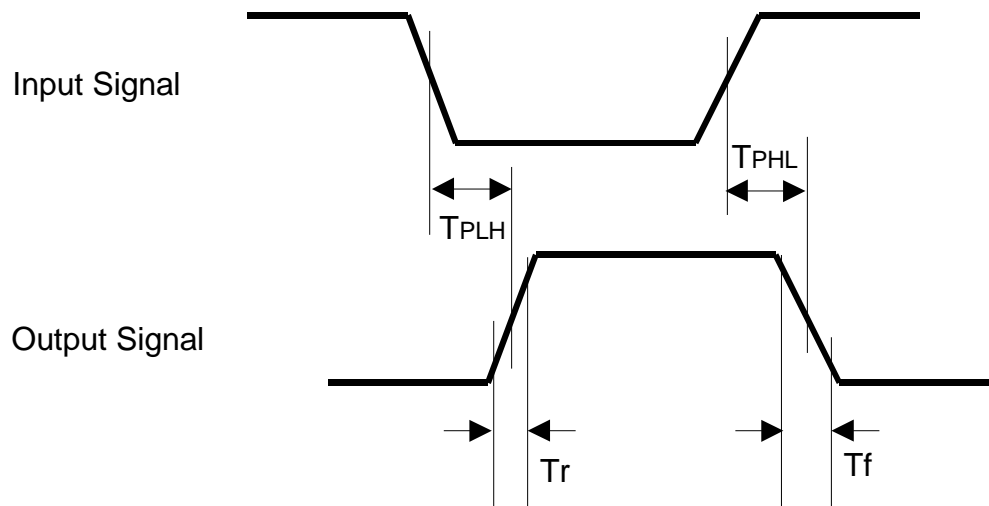
$$\Delta V / \Delta T = 300\mu A / C_{DESAT}$$

Timing Chart

UVLO Operation



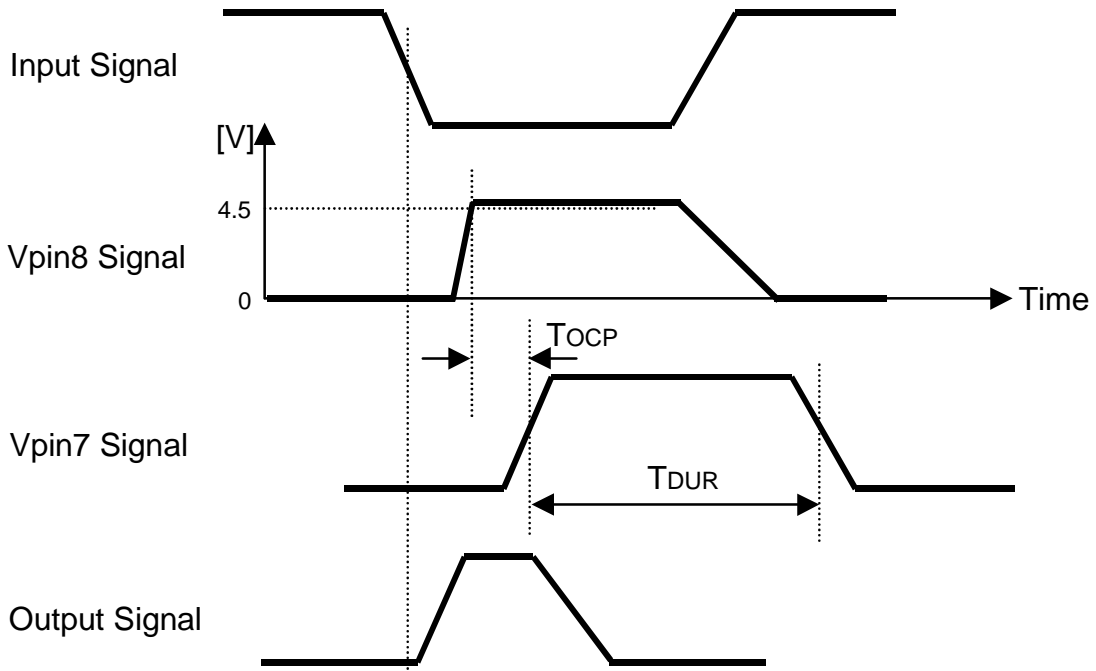
Input and Output Signal



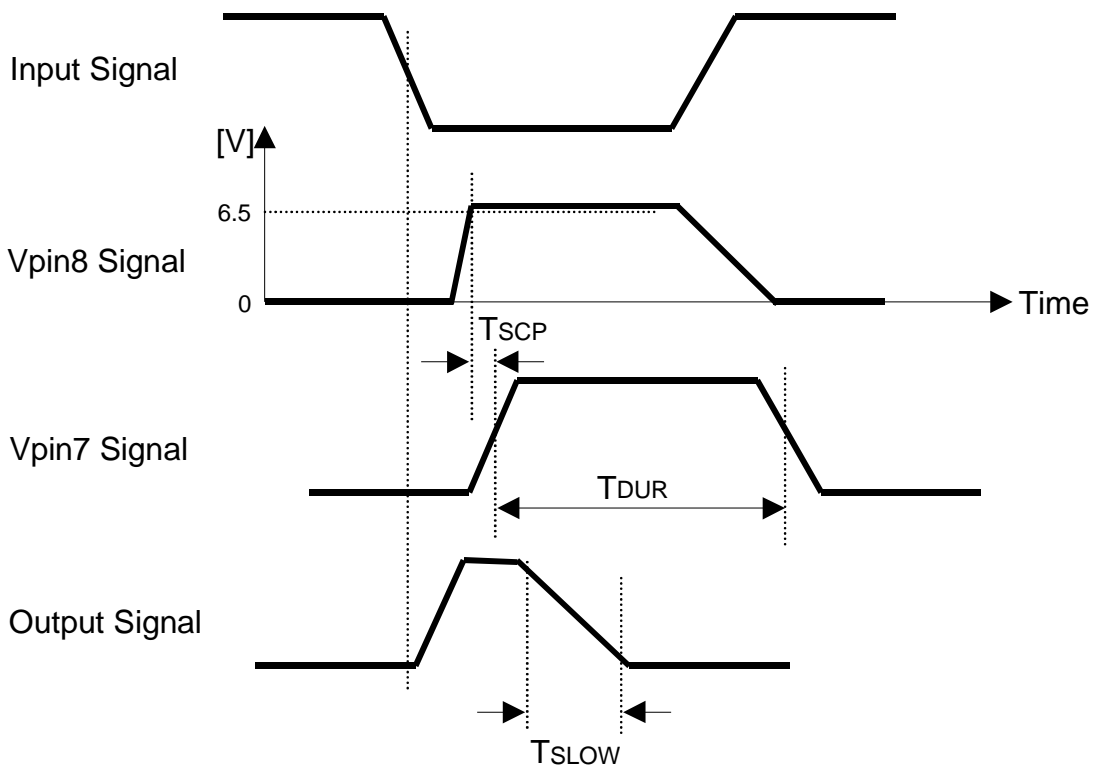
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Timing Chart (Continued)

OCP Delay time

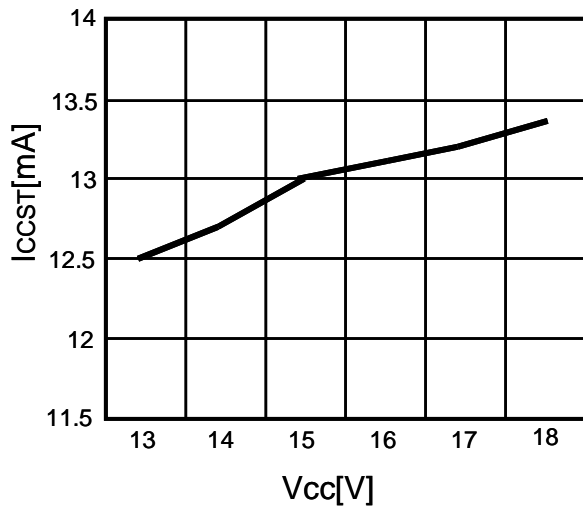


SCP Delay time

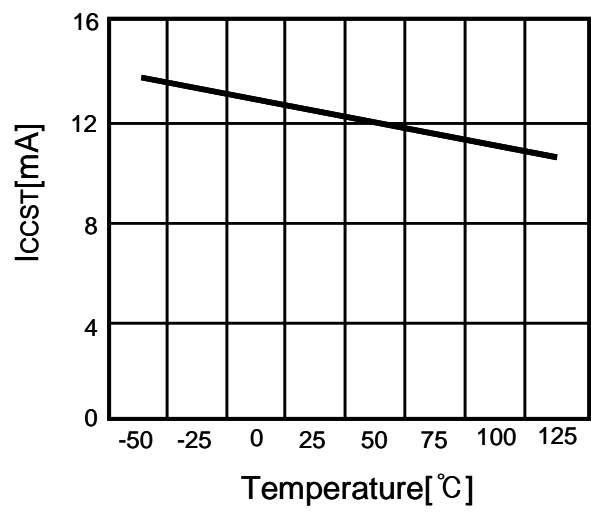


Typical Performance Characteristics

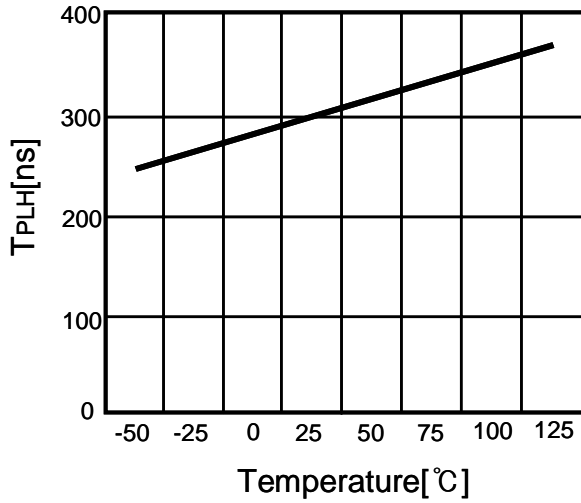
1. Vcc vs. Icc



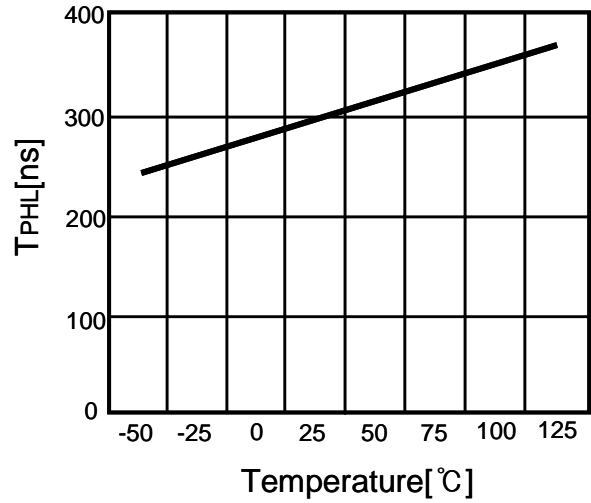
2. Temperature vs. IccST



3. Temperature vs. TPLH

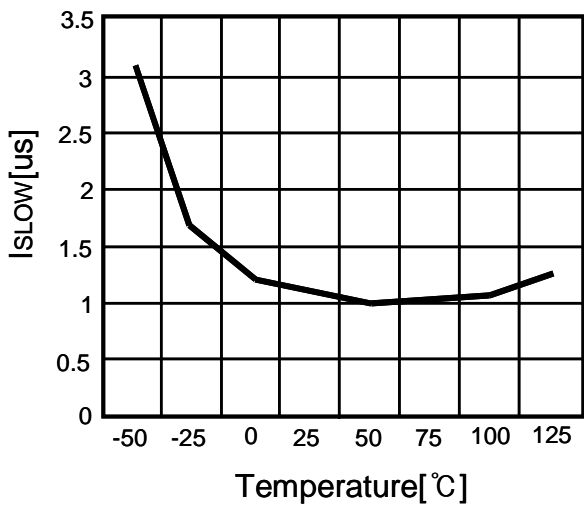


4. Temperature vs. TPHL

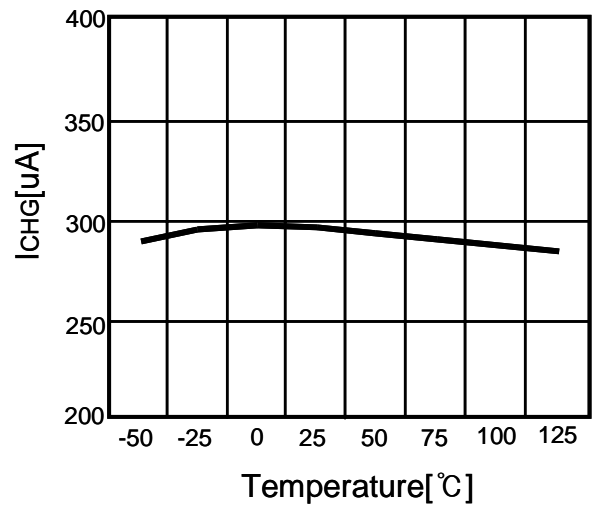


Typical Performance Characteristics (Continued)

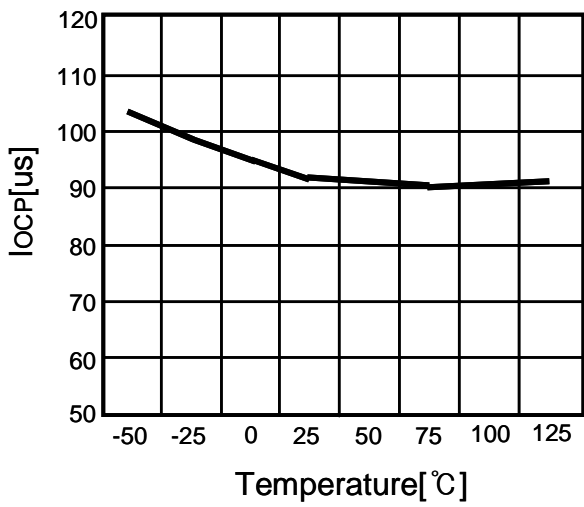
5. Temperature vs. T_{SLOW}



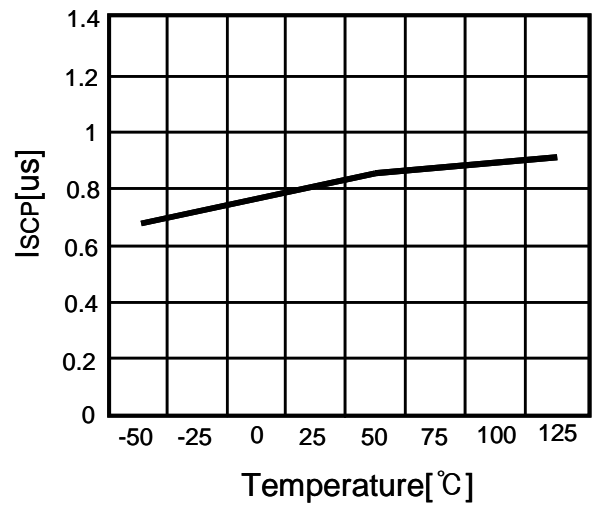
6. Temperature vs. I_{CHG}



7. Temperature vs. T_{OCP}



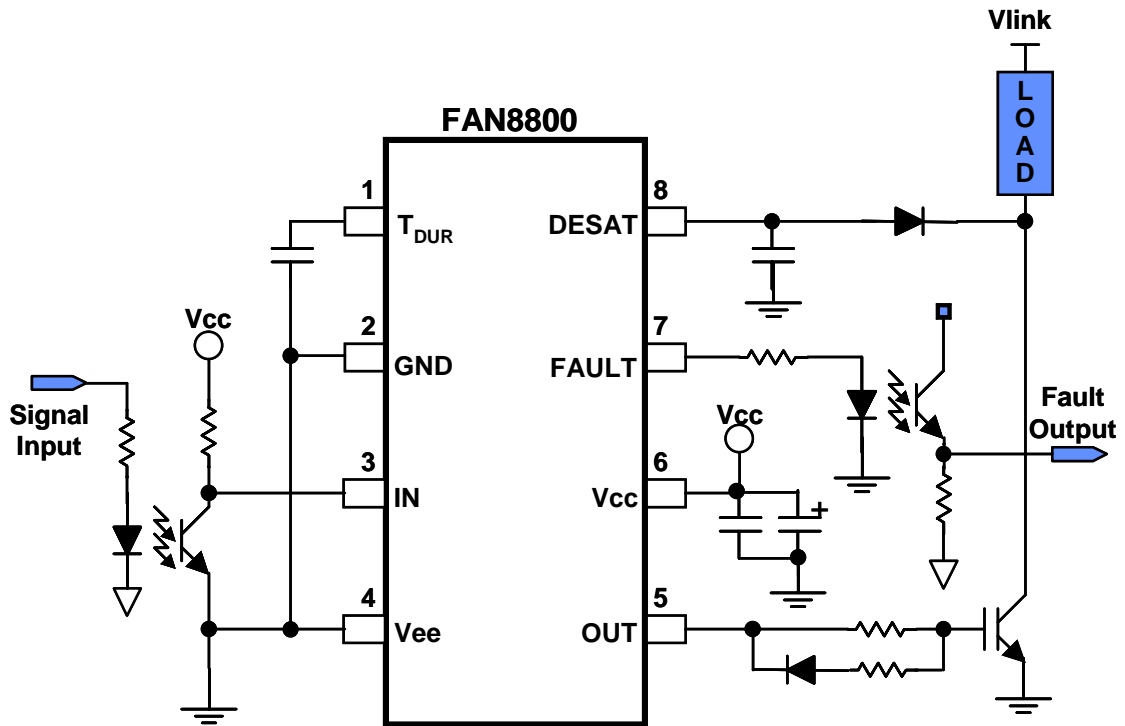
8. Temperature vs. T_{SCP}



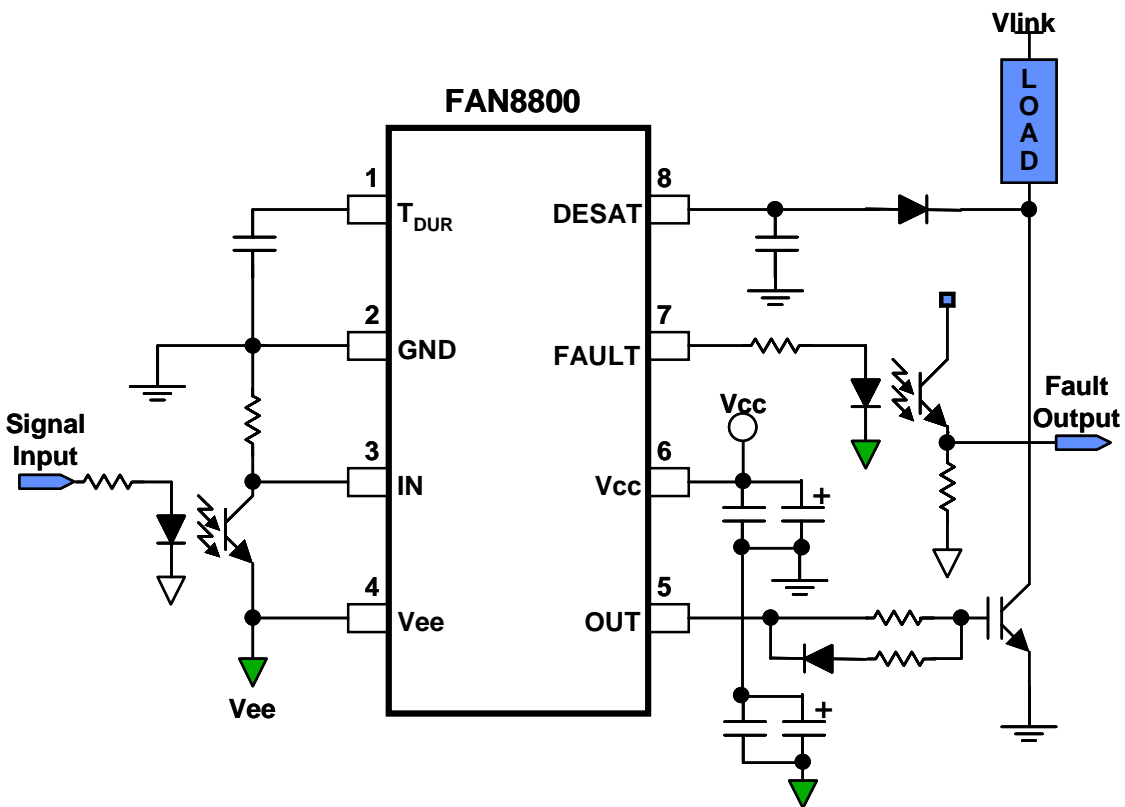
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Typical Application Circuits

Single Power Supply Application



Dual Power Supply Application



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Ordering Information

Device	Package	Operating Temperature
FAN8800	8-DIP	-40°C ~ +105°C

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