

# FAN8800 (KA3162)

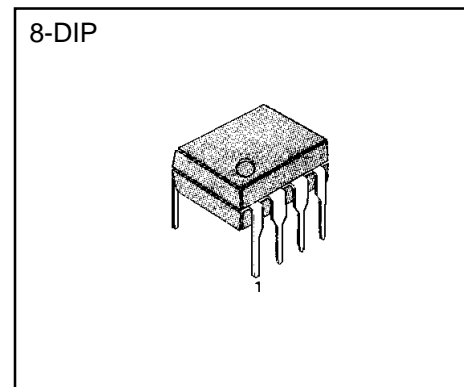
## Single IGBT Gate Driver

### 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

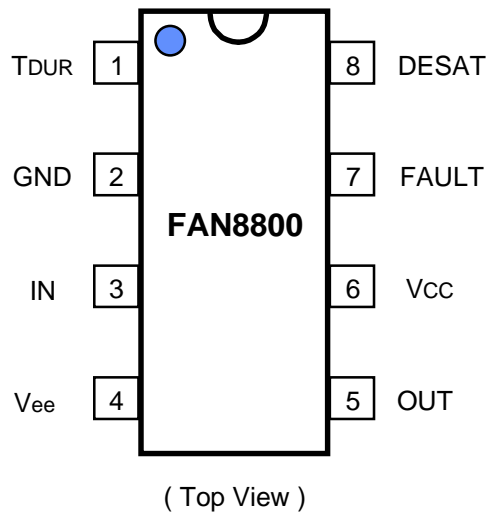
The FAN8800 is a monolithic integrated circuit designed for driving single IGBT with De-saturation and undervoltage protection. It is suitable for driving discrete and module IGBTs, and further, it offers a cost effective solution for driving power MOSFETs. The integrated fault feedback notifies the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

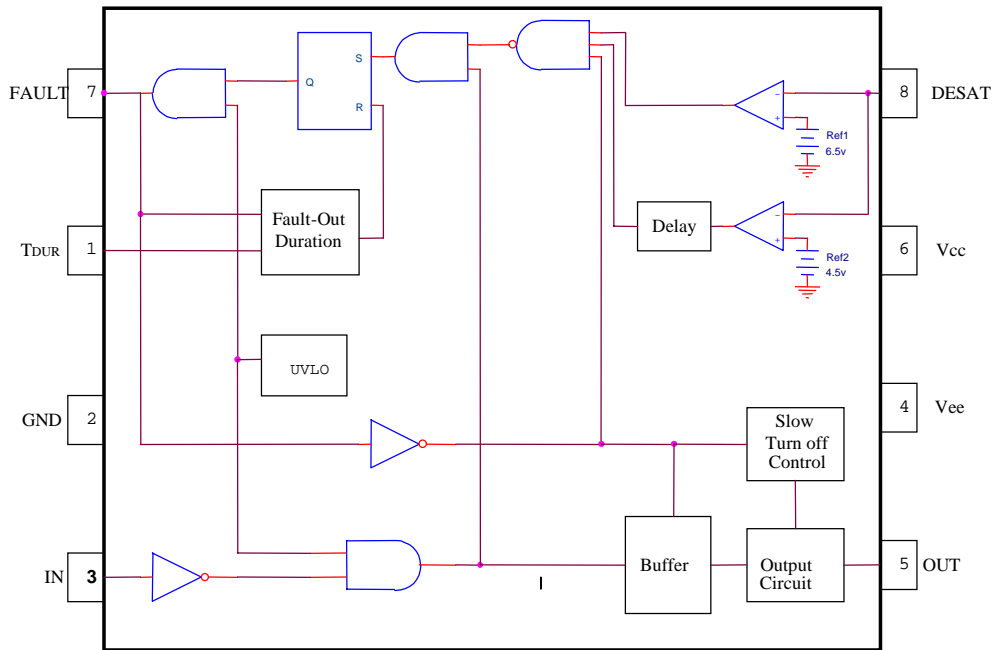
## Pin Assignments



## Pin Definitions

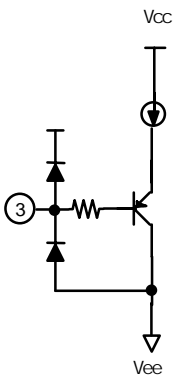
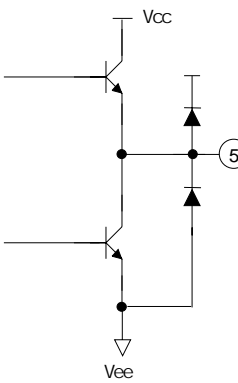
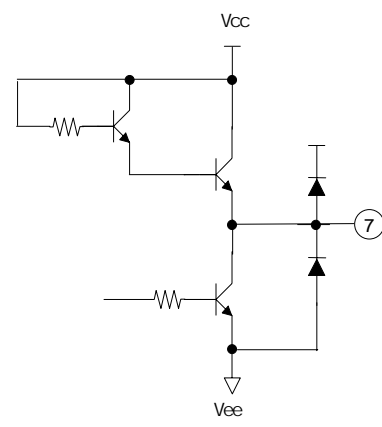
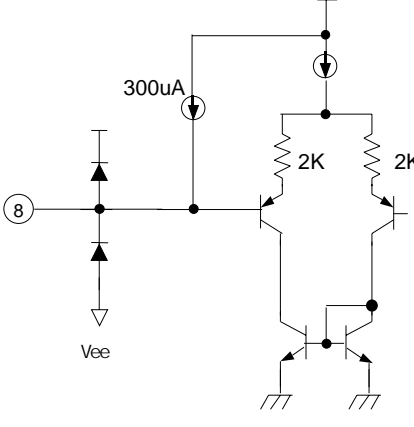
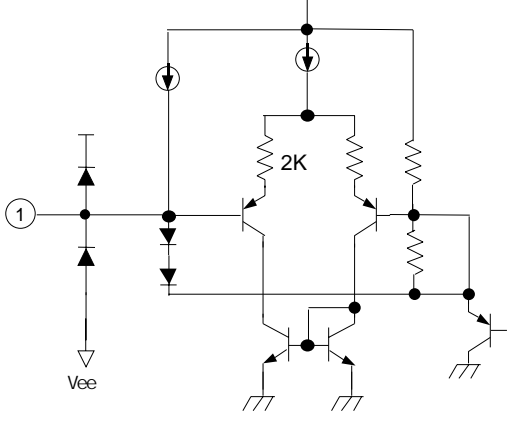
Pin Number	Pin Name	Pin Function Description
1	TDUR	Fault Output Duration(Adjustment Capacitor for Fault-Out Duration)
2	GND	Ground
3	IN	Inverting gate drive voltage output (Vout) control input
4	Vee	Gate drive voltage output
5	OUT	Output supply voltage (Negative)
6	VCC	Output supply voltage (Positive)
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.

# Internal Block Diagram



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## 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 Output Sink Current	IO	1.0 2.0	A
Fault Output Source Current Fault Output Sink Current	IFo	25 10	mA
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	
<b>LOGIC INPUT</b>							
High Input Threshold Voltage	V <sub>IH</sub>	-	-	2.7	3.2	V	
Low Input Threshold Voltage	V <sub>IL</sub>	-	1.2	2.3	-		
<b>DRIVE OUTPUT</b>							
Low Output Voltage	V <sub>OL</sub>	I <sub>sink</sub> =1.0A	-	2.0	2.4	V	
High Output Voltage	V <sub>OH</sub>	I <sub>source</sub> =500mA	12	14	-		
<b>FAULT OUTPUT</b>							
Low Fault Output Voltage	V <sub>FL</sub>	I <sub>sink</sub> =5.0A	-	0.2	1.0	V	
High Fault Output Voltage	V <sub>FH</sub>	I <sub>source</sub> =20mA	11	13.5	-		
<b>UVLO</b>							
Start-up Voltage	V <sub>CCST</sub>	-	11	11.5	12	V	
Disable Voltage	V <sub>CCDI</sub>	-	10	10.5	11	V	
UVLO Hysteresis	HY	-	0.9	1.0	11.1	V	
<b>DESATURATION INPUT</b>							
De-saturation Current Source	I <sub>CHG</sub>	V <sub>in</sub> =0V, V <sub>DESAT</sub> =0V	210	300	380	μA	
Discharge Current	I <sub>DSCHG</sub>	V <sub>in</sub> =V <sub>cc</sub> , V <sub>DESAT</sub> =V <sub>cc</sub>	1.0	2.5	-	mA	
<b>OCP and SCP</b>							
OCP Voltage Reference	V <sub>OCP</sub>	-	4.0	4.5	5.0	μA	
SCP Voltage Reference	V <sub>SCP</sub>	-	5.8	6.5	7.3	mA	
<b>POWER SUPPLY</b>							
Standby Current	I <sub>CCST</sub>	V <sub>in</sub> = High, Output open	-	14	20	mA	
Operating Current	I <sub>CCOP</sub>	CL=1.0nF, f=20kHz	-	20	30	mA	
Propagation Delay Time to High Output Level	T <sub>PLH</sub>	R <sub>g</sub> =0, CL=1.0nF f=10kHz, Duty Cycle=50%	-	0.35	0.7	μs	
Propagation Delay Time to Low Output Level	T <sub>PHL</sub>		-	0.35	0.7	μs	
Rise Time	T <sub>r</sub>		-	50	100	ns	
Fall Time	T <sub>f</sub>		-	50	100	ns	
OCP Delay Time	T <sub>OCP</sub>		50	80	120	μs	
SCP Delay Time	T <sub>SCP</sub>		-	0.3	1.0	μs	
Fault Output Duration Time	T <sub>DUR</sub>		C <sub>dur</sub> =2.7nF	100	170	320	μs
Slow turn-off time	T <sub>SLOW</sub>		CL=4.7nF	0.8	2.0	5.0	μs

## Application Information

### 1. FAULT-OUT DURATION TIME (T<sub>DUR</sub>)

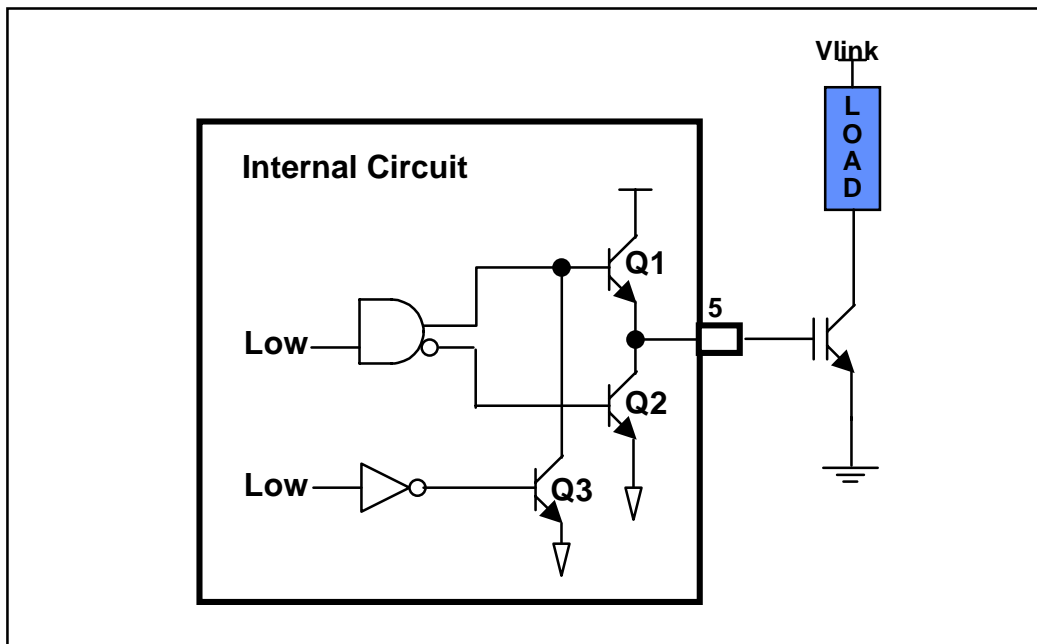
1) Two modes in Fault-Out Duration.

- OCP mode  
Fault-Out Duration operates after T<sub>OCP</sub>.
- SCP mode  
If V<sub>pin8</sub> is over 6.5V, Fault-Out Duration will operate after T<sub>SCP</sub>.

2) T<sub>DUR</sub> (It can be adjusted by external capacitor (C<sub>DUR</sub>) 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<sub>SLOW</sub>)



- 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

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

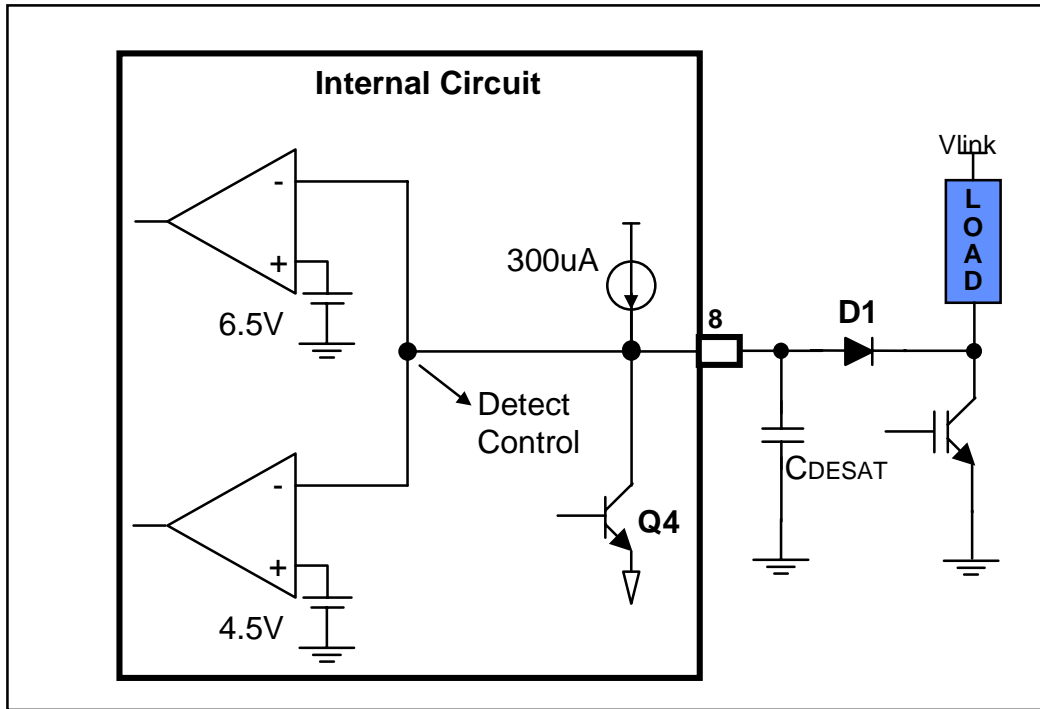
### 3. OCP DELAY TIME (T<sub>OCP</sub>)

- 1) If the saturation detector (DESAT or V<sub>pin8</sub>) is  $4.5V < V_{pin8} < 6.5V$ , the Fault-Out signal will be high after T<sub>OCP</sub>.
- 2) T<sub>OCP</sub> (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<sub>pin5</sub>) 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.

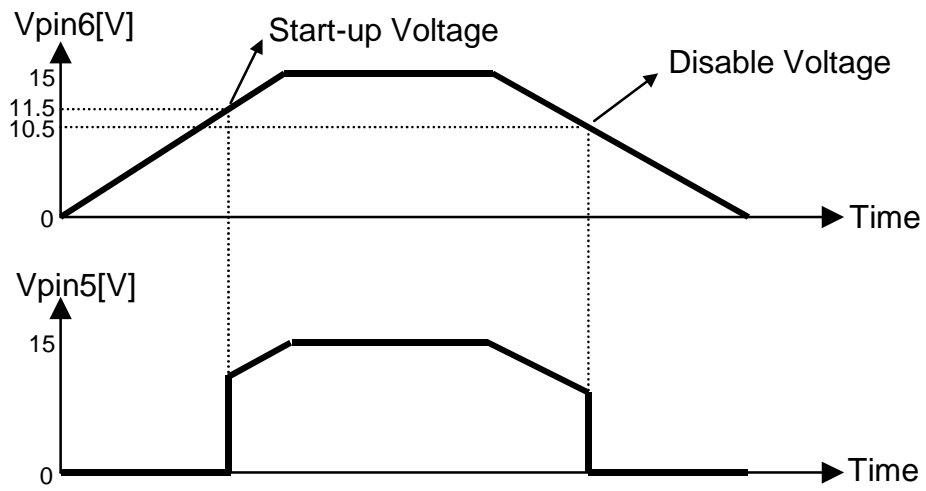
When the input signal of IGBT is from low-state to high-state, Q4 turns off and it is operated De-saturation Detection Mode. On this times, the voltage of collector-emitter terminal of IGBT is not saturation-state yet. This period is said On Time Delay (T<sub>d</sub> (on) ). Here, the operation of C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

- 2) Slope of V<sub>pin8</sub> is

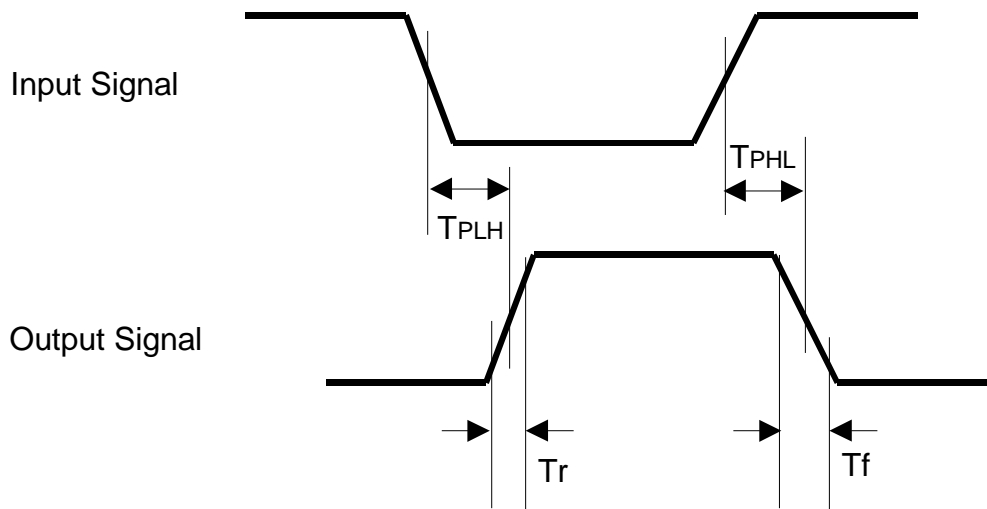
$$\Delta V / \Delta T = 300\mu A / C_{DESAT}$$

## Timing Chart

### UVLO Operation

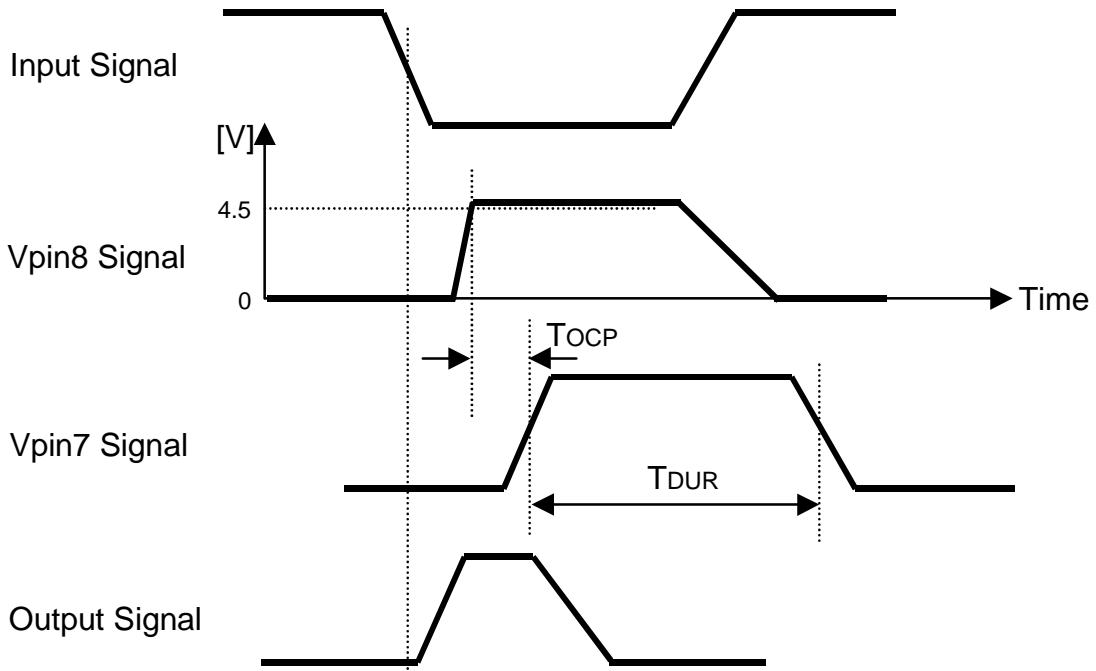


### Input and Output Signal

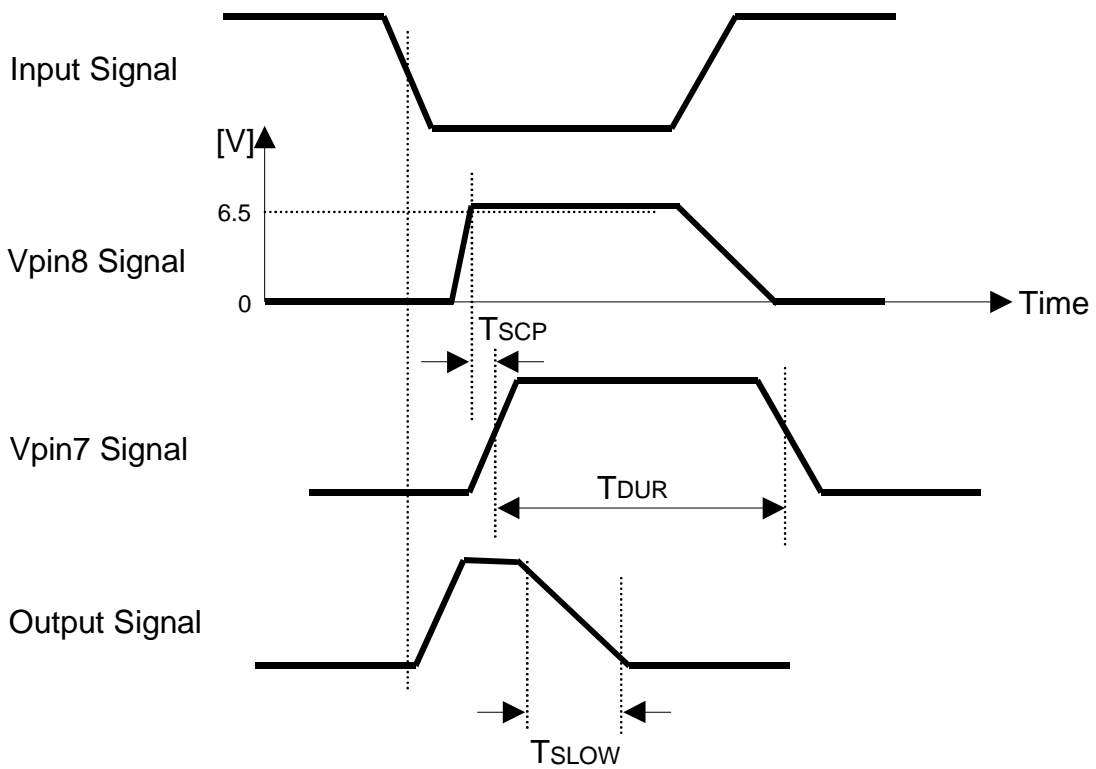


### Timing Chart (Continued)

#### OCP Delay time



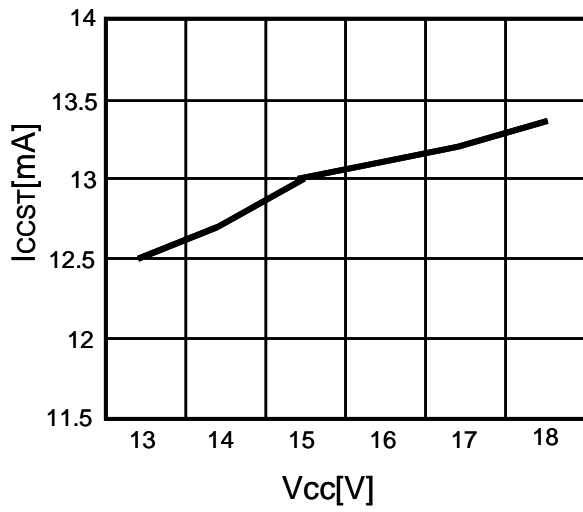
#### SCP Delay time



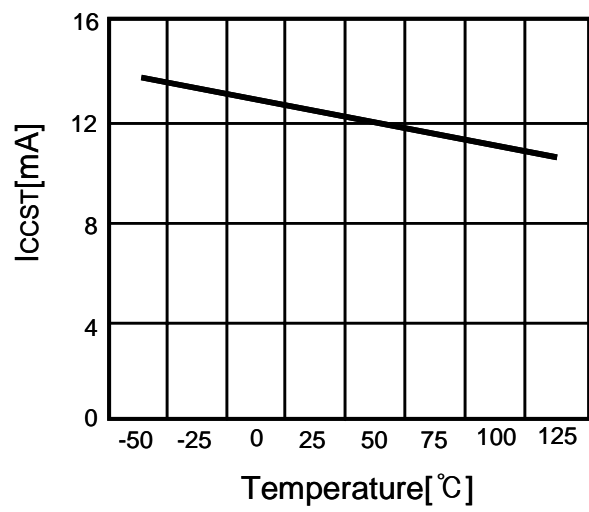
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## Typical Performance Characteristics

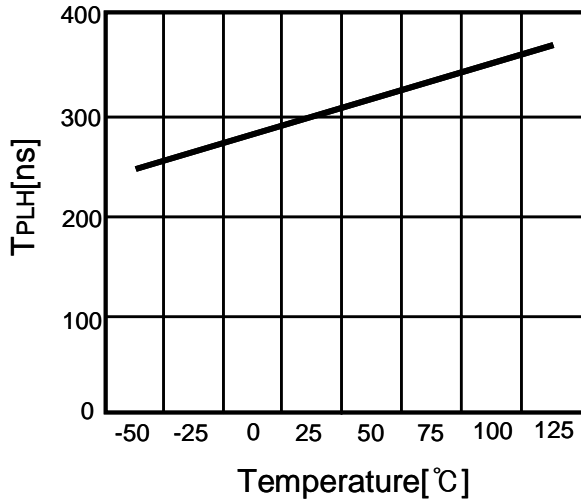
1. Vcc vs. Icc



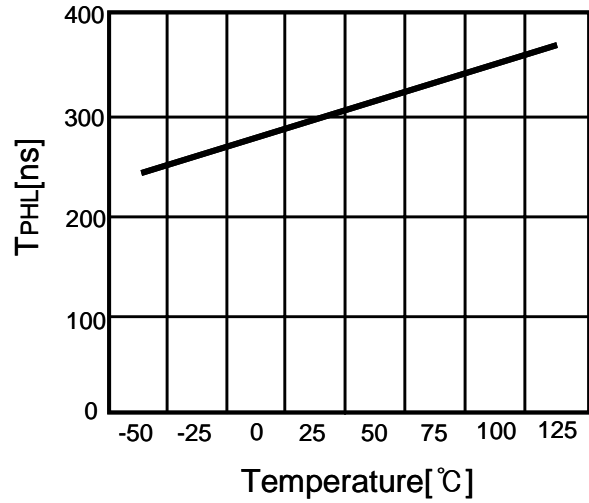
2. Temperature vs. IccST



3. Temperature vs. TPLH

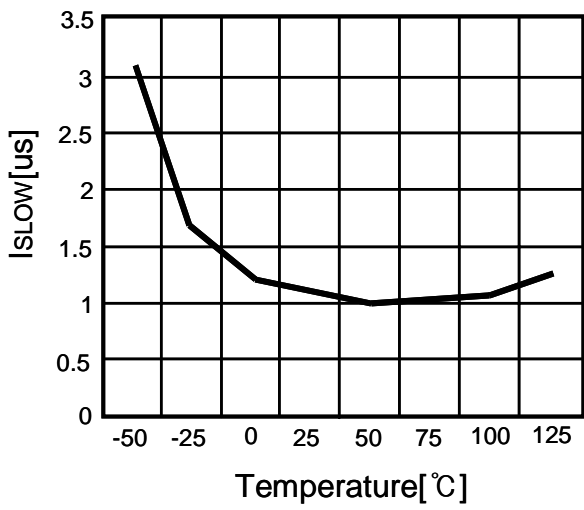


4. Temperature vs. TPHL

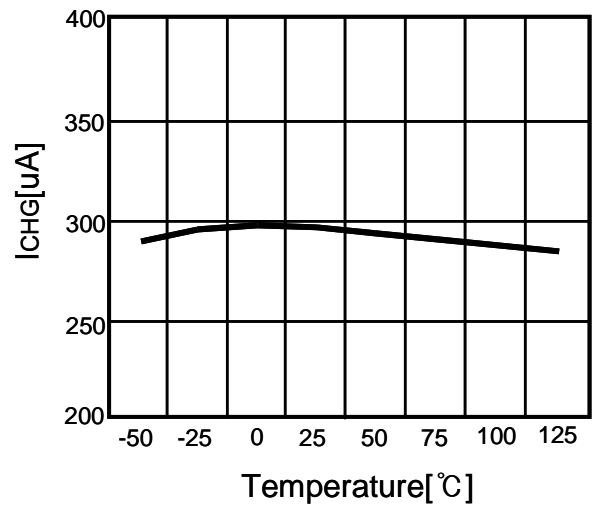


Typical Performance Characteristics (Continued)

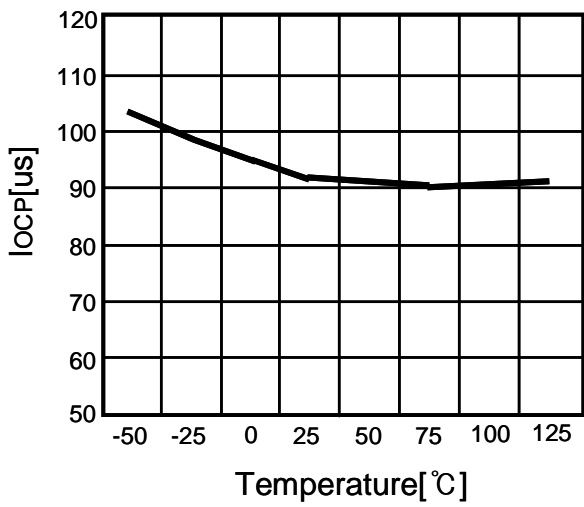
5. Temperature vs. T<sub>SLOW</sub>



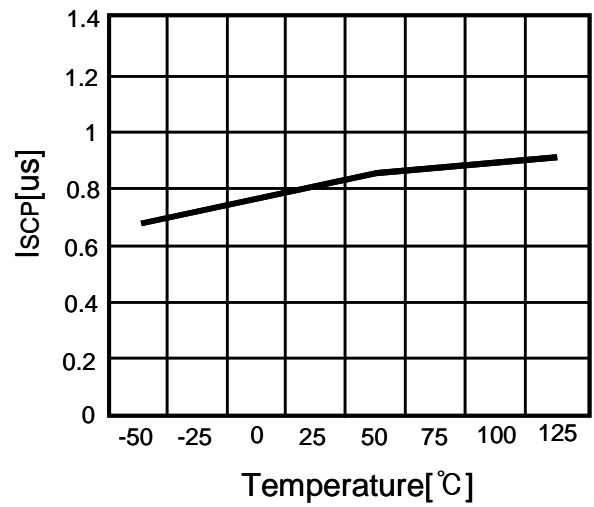
6. Temperature vs. I<sub>CHG</sub>



7. Temperature vs. T<sub>OCP</sub>



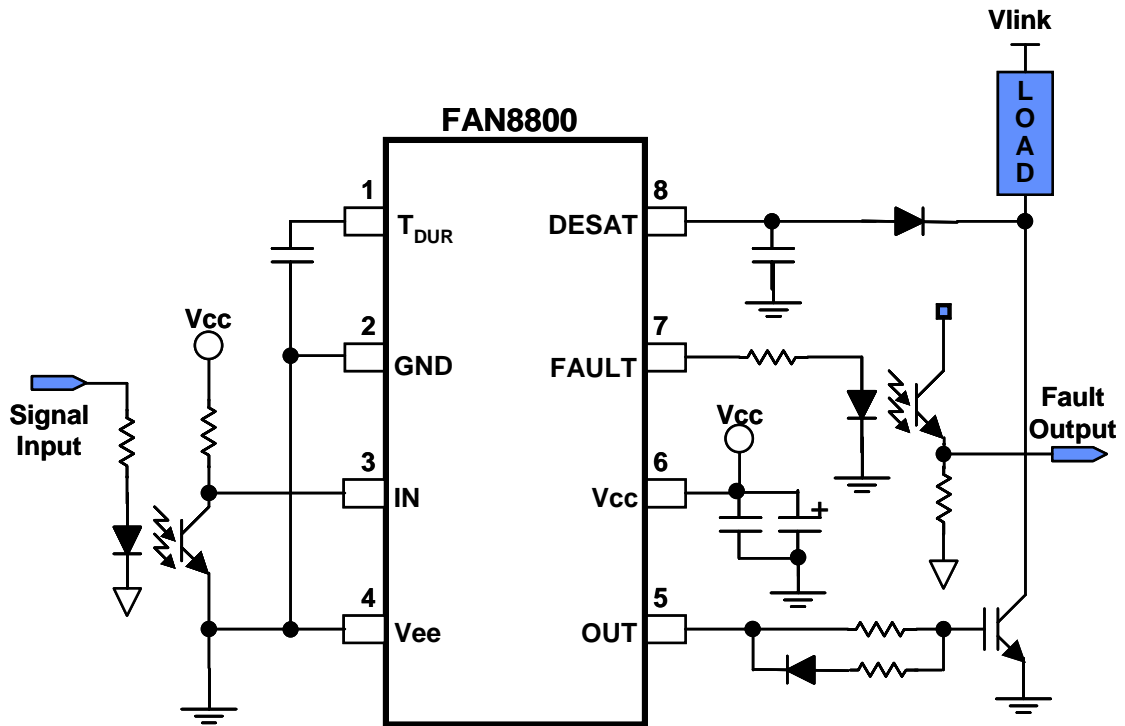
8. Temperature vs. T<sub>SCP</sub>



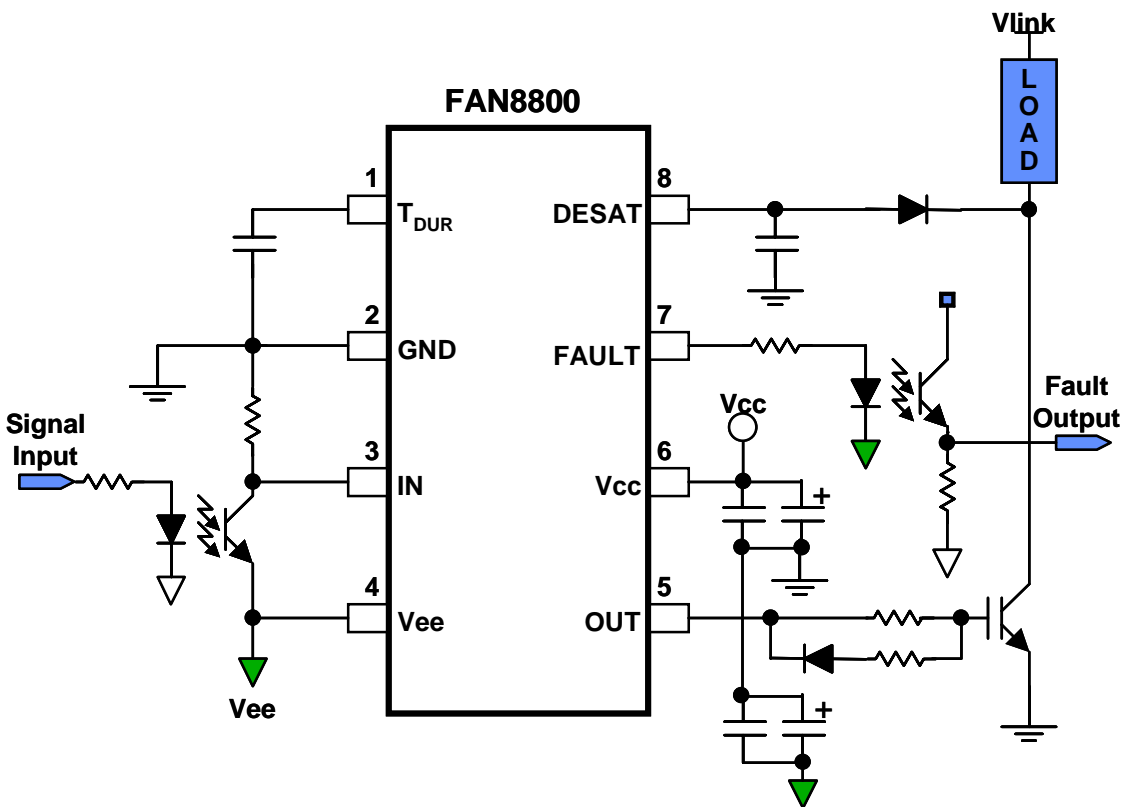
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## Typical Application Circuits

### 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

# ETC. DRIVE IC

ETC. DRIVE IC

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