FAN8800 (KA3162)

Single IGBT Gate Drive IC

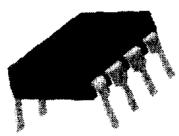
Features

- 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.

8-DIP



Typical Applications

- Gate drive for single insulated gate bipolar TR (IGBT)
- Gate drive for single MOSFET

Ordering Information

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

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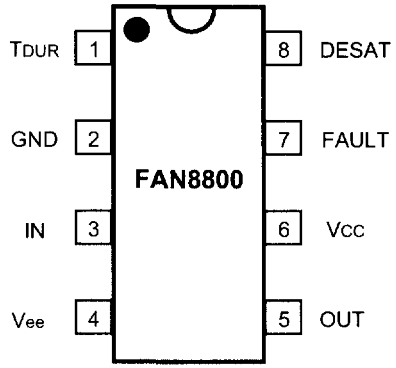
Rev. 1.0.1
February 2000.

Pin Assignments

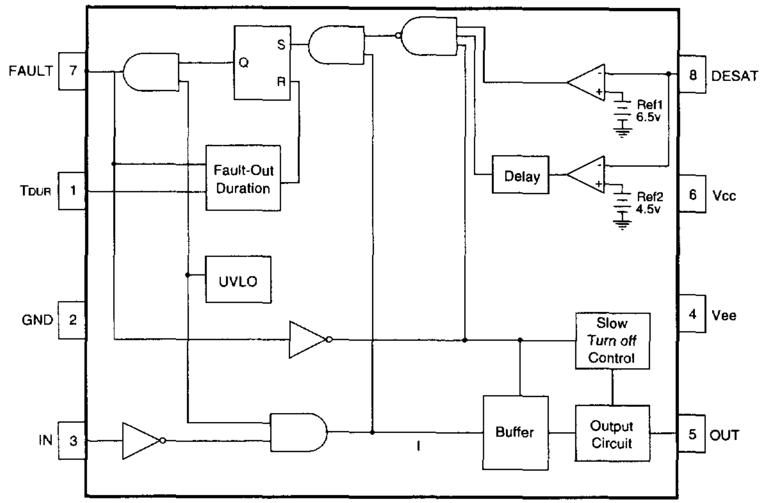


(Top View)

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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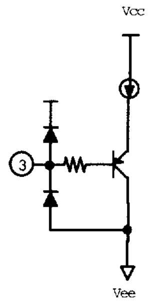
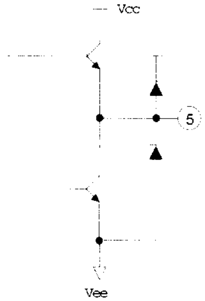
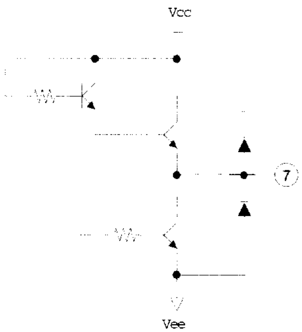
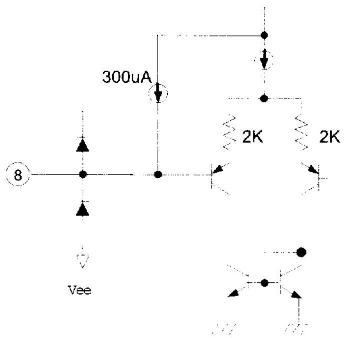
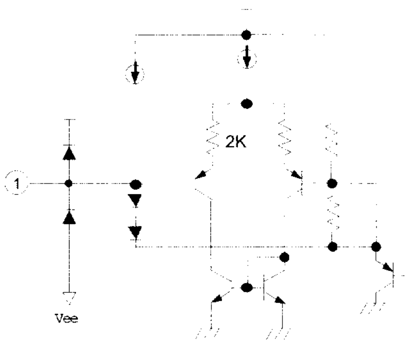
Equivalent Circuits

Driver Input	Driver Output
	
Fault Out	Desat
	
TDUR	
	

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Value	Unit
Power Supply Voltage	V_{CC} - Vee	36	V
Output Source Current Output Sink Current	I_O	1.0 2.0	A
Fault Output Source Current Fault Output Sink Current	I_{FO}	25 10	mA
Input Voltage	Vin	Vee - 0.3 ~ V_{CC}	V
De-saturation Voltage	V_{DESAT}	-0.3 ~ V_{CC}	V
Maximum Power Dissipation	P_D	0.56	W
Operating Ambient Temperature Range	T_{OPR}	-40 ~ 105	°C
Storage Temperature Range	T_{STG}	-55 ~ 150	°C

Recommened Operating Conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max	Unit
Total Supply Voltage	V_{CC}	+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}	Isink=1.0A	-	2.0	2.4	V
High Output Voltage	V_{OH}	Isource=500mA	12	14	-	
FAULT OUTPUT						
Low Fault Output Voltage	V_{FL}	Isink=5.0A	-	0.2	1.0	V
High Fault Output Voltage	V_{FH}	Isource=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	H_Y	-	0.9	1.0	11.1	V
DESATURATION INPUT						
De-saturation Current Source	I_{CHG}	Vin=0V, V_{DESAT}=0V	210	300	380	μA
Discharge Current	I_{DSCHG}	Vin=Vcc, V_{DESAT}=Vcc	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}	Vin = 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}	Rg=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	Tr		-	50	100	ns
Fall Time	Tf		-	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}	Cdur=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})

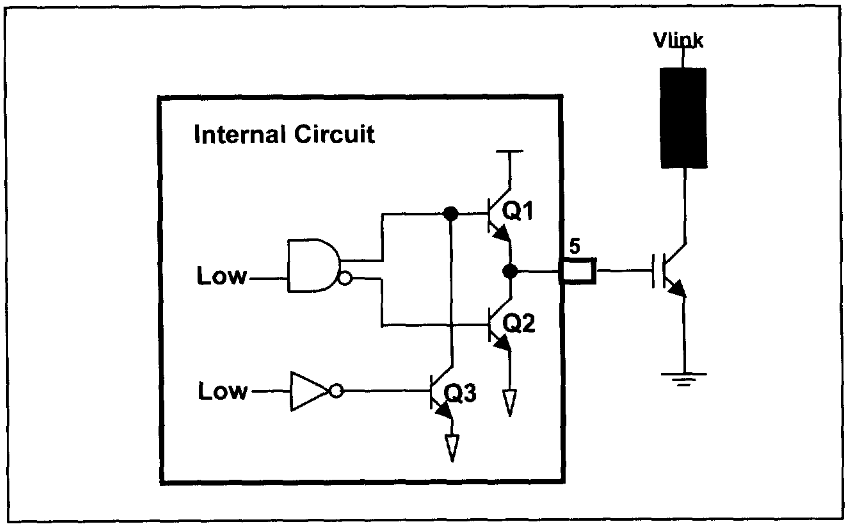
1) Two modes in Fault-Out Duration.

- OCP mode
  Fault-Out Duration operates after T_{OCP}.
- SCP mode
  If Vpin8 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

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

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



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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

$$T_{SLOW} = C_{IGBT}/35mA \times (V5max - V5min)$$
$$= 4.7nF/35mA \times (15V - 1V)$$
$$= 1.9\mu s$$

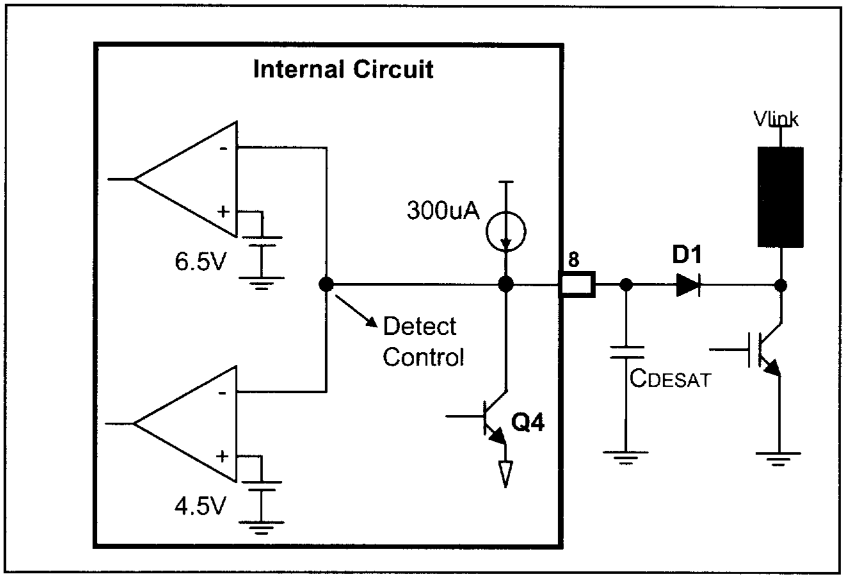
3. OCP DELAY TIME (T_{OCP})

1) If the saturation detector(DESAT or Vpin8) is 4.5V < Vpin8 < 6.5V, the Fault-Out signal will be high after T_{OCP}.

2) T_{COP} (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 (Vpin5) 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 Vce(sat) + Vf of D1 ≥ 4.5V, it is operated OCP Mode.
If Vce(sat) + Vf of D1 ≥ 6.5V, it is operated SCP Mode.

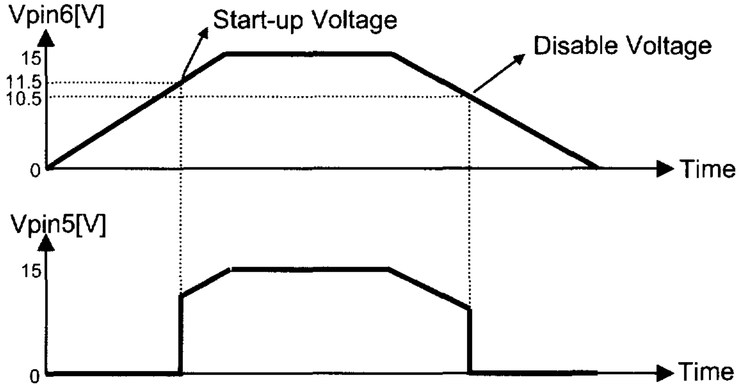
When the input signal of IGBT is from low-state to high-state, Q4 turns off and it is operated De-saturation Detection Mode. On this times, the voltage of collector-emitter terminal of IGBT is not saturation-state yet.
This period is said On Time Delay (Td (on)).
Here, the operation of C_{DESAT} is following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

2) Slope of Vpin8 is

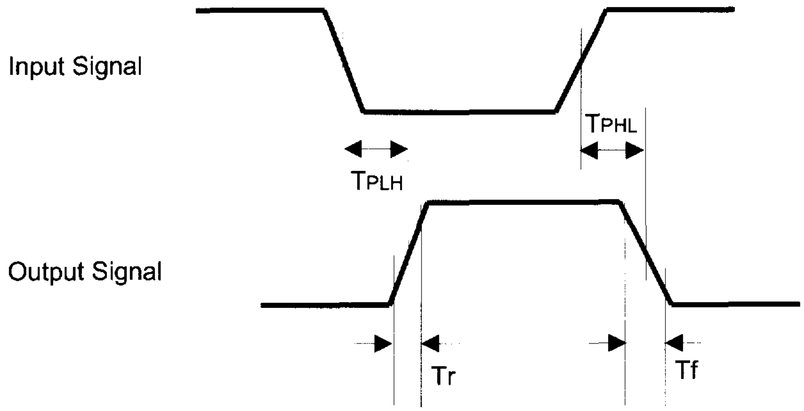
$$\Delta V/\Delta T = 300\mu A/C_{DESAT}$$

Timing Chart

UVLO Operation



Input and Output Signal



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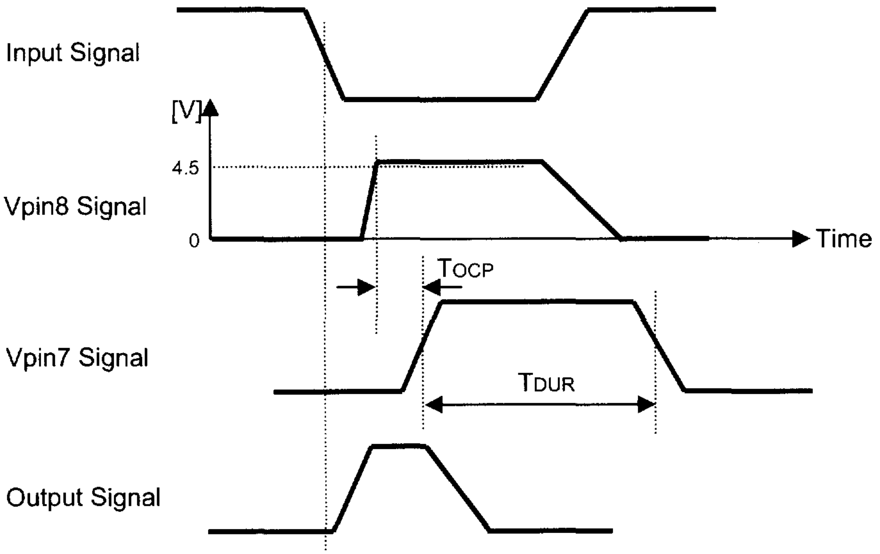
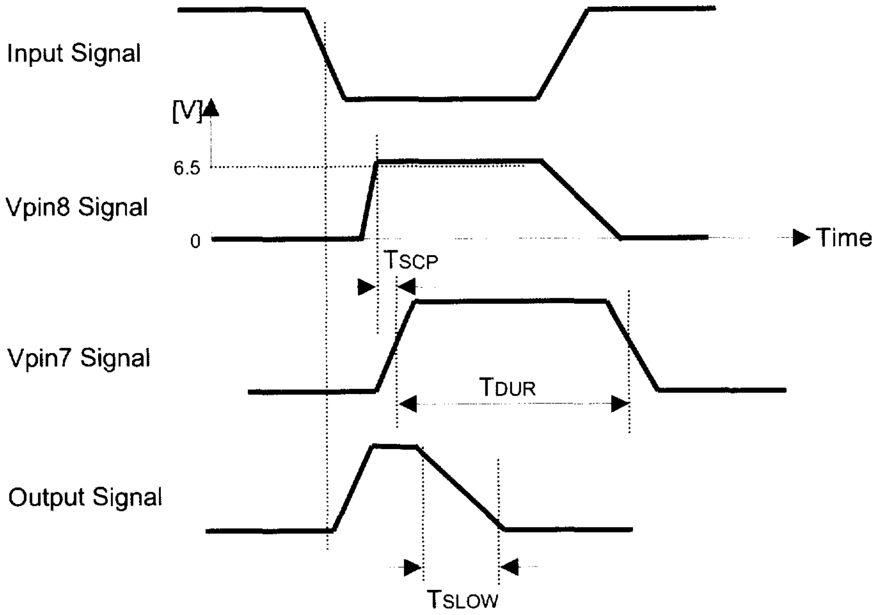
Timing Chart (Continued)

OCP Delay time

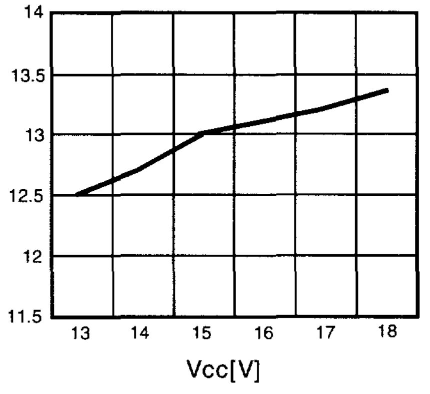


SCP Delay time

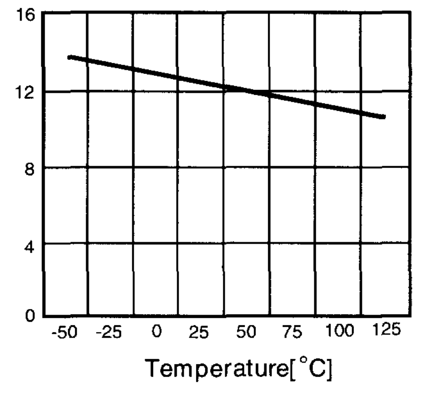


Typical Perfomance Characteristics

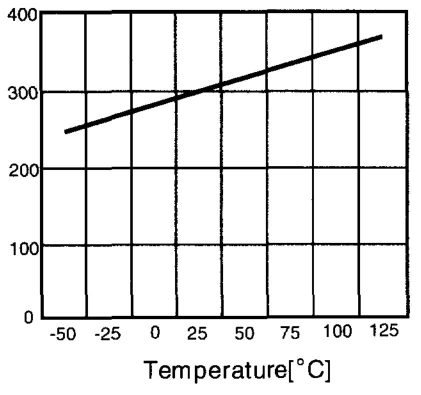
1. Vcc vs. Icc



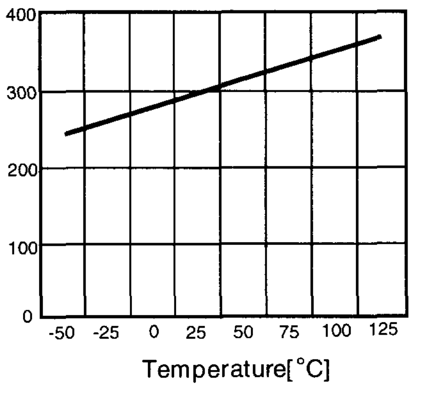
2. Temperature vs. ICCST



3. Temperature vs. TPLH

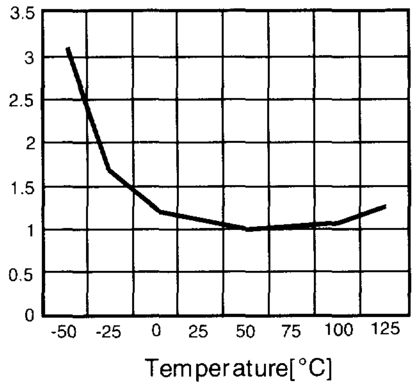


4. Temperature vs. TPHL

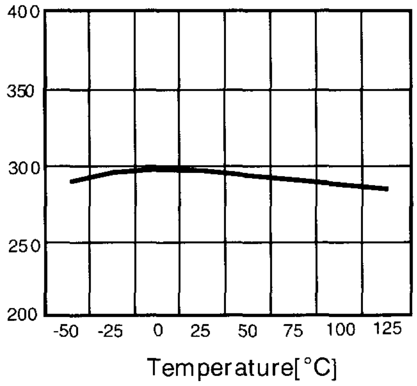


Typical Perfomance Characteristics (Continued)

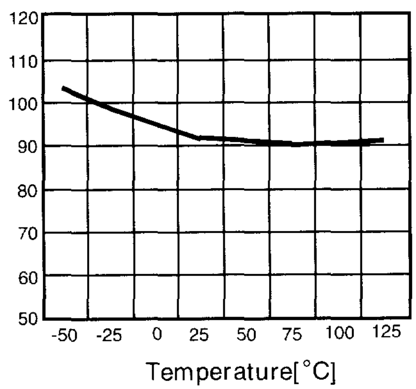
5. Temperature vs. TSLOW



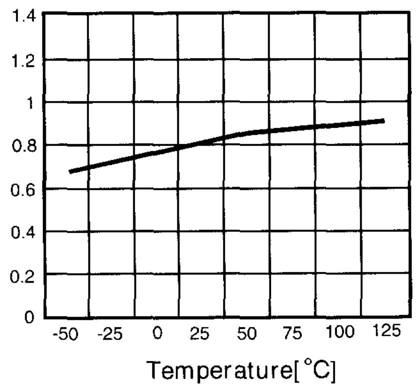
6. Temperature vs. I CHG



7. Temperature vs. TOCP

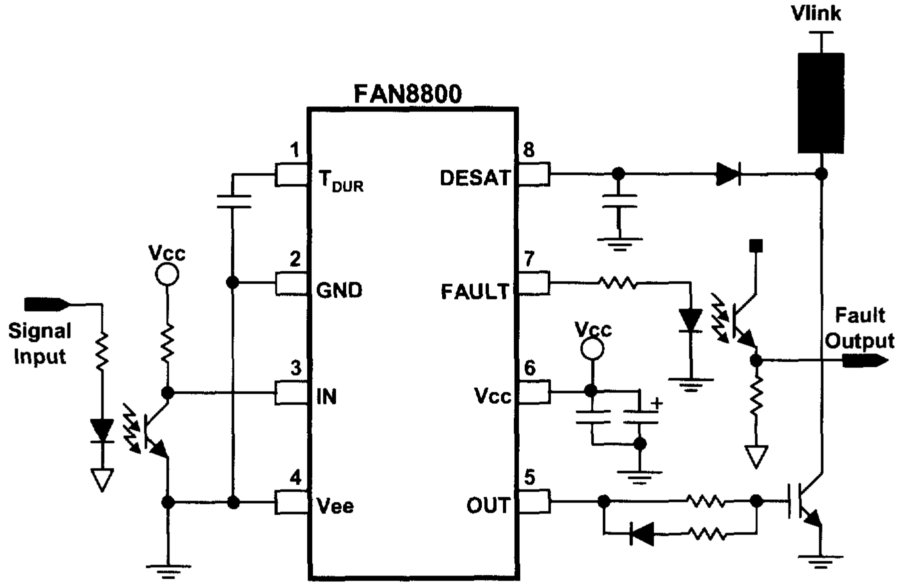


8. Temperature vs. T SCP

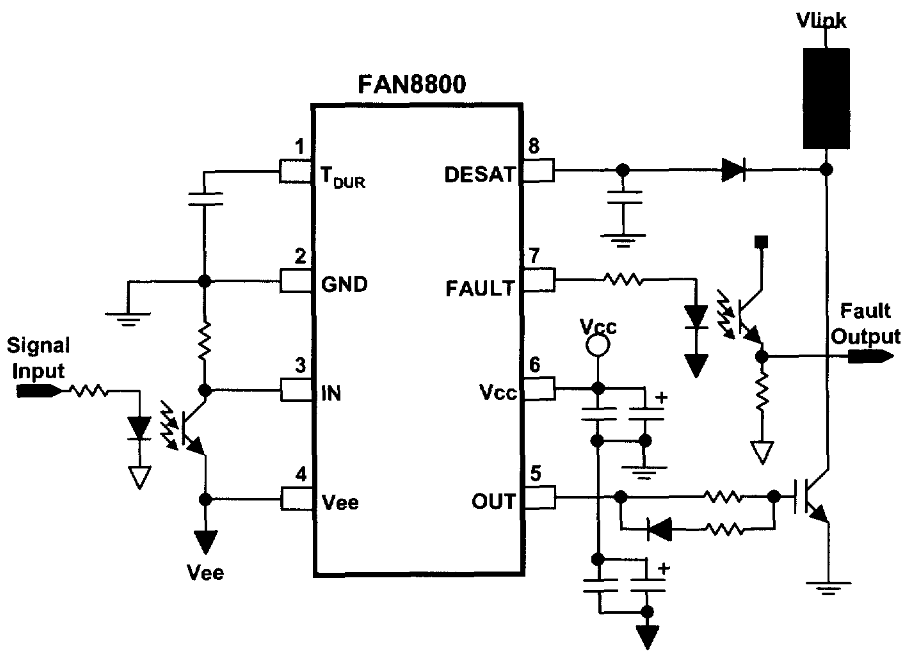


Typical Application Circuits

Single Power Supply Application



Dual Power Supply Application



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