

FAN7085_F085 **High Side Gate Driver with Recharge FET**

Features

- Qualified to AEC Q100
- Floating channel designed for bootstrap operation fully operational up to 300V.
- Tolerance to negative transient voltage on VS pin
- dv/dt immune.
- Gate drive supply range from 4.5V to 20V
- Under-voltage lockout
- CMOS Schmitt-triggered inputs with pull-down and pull-up
- High side output out of phase with input (Inverted input)
- Reset input
- Internal recharge FET for bootstrap refresh

Typical Applications

- Diesel and gasoline injectors/valves
- MOSFET and IGBT high side driver applications

Description

The FAN7085_F085 is a high-side gate drive IC with reset input and built-in recharge FET. It is designed for high voltage and high speed driving of MOSFET or IGBT, which operates up to 300V. Fairchild's high-voltage process and common-mode noise cancellation technique provide stable operation in the high side driver under high-dV/dt noise circumstances. Logic input is compatible with standard CMOS outputs. The UVLO circuits prevent from malfunction when VCC and VBS are lower than the specified threshold voltage. It is available with space saving SOIC-8 Package. Minimum source and sink current capability of output driver is 250mA and 250mA. Built-in recharge FET to refresh bootstrap circuit is very useful for circuit topology requiring switches on low and high side of load.

SOIC-8

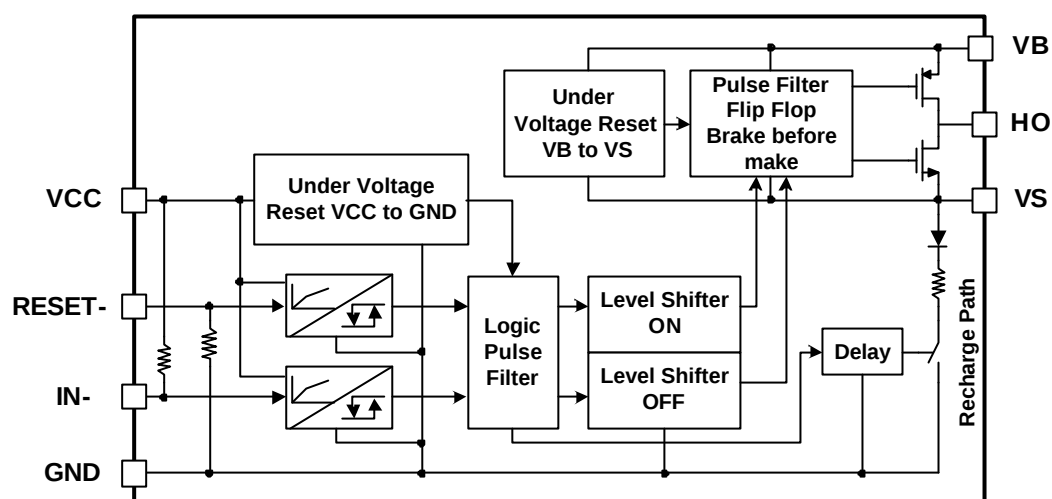


Ordering Information

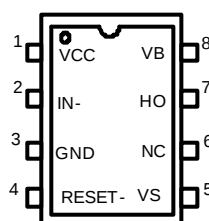
Device	Package	Operating Temp.
FAN7085CM	SOIC-8	-40 °C ~ 125 °C
FAN7085CMX	SOIC-8	-40 °C ~ 125 °C

X : Tape & Reel type

Block Diagrams



Pin Assignments



Pin Definitions

Pine Number	Pin Name	I/O	Pin Function Description
1	VCC	P	Driver supply voltage, typically 5V
2	IN-	I	Driver control signal input (Negative Logic)
3	GND	P	Ground
4	RESET-	I	Driver enable input signal (Negative Logic)
5	VS	P	High side floating offset for MOSFET Source connection
6	NC	-	No connection (No Bond wire)
7	HO	A	High side drive output for MOSFET Gate connection
8	VB	P	Driver output stage supply

Absolute Maximum Ratings

Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to GND.

Parameter	Symbol	Min.	Max.	Unit
High side floating supply voltage	V _{BS}	-0.3	25	V
High side driver output stage voltage Neg. transient: 0.5 ms, external MOSFET off	V _B	-5	325	V
High side floating supply offset voltage Neg. transient 0.2 us	V _S	-25	300	V
High side floating output voltage	V _{HO}	V _S -0.3	V _B +0.3	V
Supply voltage	V _{CC}	-0.3	25	V
Input voltage for IN-	V _{IN}	-0.3	V _{CC} +0.3	V
Input voltage for RESET-	V _{RES}	-0.3	V _{CC} +0.3	V
Power Dissipation ¹⁾	P _d		0.625	W
Thermal resistance, junction to ambient ¹⁾	R _{thja}		200	°C/W
Electrostatic discharge voltage (Human Body Model)	V _{ESD}	1.5K		V
Charge device model	V _{CDM}	500		V
Junction Temperature	T _j		150	°C
Storage Temperature	T _S	-55	150	°C

Note: 1) The thermal resistance and power dissipation rating are measured bellow conditions;

JESD51-2: Integrated Circuit Thermal Test Method Environmental Conditions - Natural condition(StillAir)

JESD51-3: Low Effective Thermal Conductivity Test Board for Leadless Surface Mount Package

Recommended Operating Conditions

For proper operation the device should be used within the recommended conditions. -40° C ≤ Ta ≤ 125° C

Parameter	Symbol	Min.	Max.	Unit
High side floating supply voltage(DC) Transient:-10V@ 0.2 us	V _B	V _S +4.5	V _S +20	V
High side floating supply offset voltage(DC) @ V _{BS} =7V	V _S	-3	300	V
High side floating supply offset voltage(Transient) 0.2us @ V _{BS} <25V	V _S	-25	300	V
High side floating output voltage	V _{HO}	V _S	V _B	V
Allowable offset voltage Slew Rate ¹⁾	dV/dt	-	50	V/ns
Supply voltage for logic part	V _{CC}	4.5	20	V
Input voltage for IN-	V _{IN}	0	V _{CC}	V
Input voltage for RESET-	V _{RESET}	0	V _{CC}	V
Switching frequency ²⁾	F _S		200K	Hz
Minimum low input width ³⁾	t _{IN(Low,min)}	1000	-	ns
Minimum high input width ³⁾	t _{IN(High,min)}	60	-	ns
Minimum operating voltage of V _B related to GND	V _{B(MIN)} ⁴⁾	4	-	V
Ambient temperature	T _a	-40	125	°C

Note: 1) Guaranteed by design.

2) Duty = 0.5, V_{BS} ≥ 7V

3) Guaranteed by design. Pulse widths below the specified values, may be ignored. Output will either follow the input signal or will ignore it.

No false output state is guaranteed when minimum input width is smaller than t_{in}

4) Guaranteed by design

Statics Electrical Characteristics

Unless otherwise specified, $-40^{\circ}\text{C} \leq T_a \leq 125^{\circ}\text{C}$, $V_{CC} = 5\text{V}$, $V_{BS} = 7\text{V}$, $V_S = 0\text{V}$, $V_{RESET} = 5\text{V}$, $R_L = 50\Omega$, $C_L = 2.5\text{nF}$.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
VCC and VBS Supply Characteristics						
VCC and VBS supply under voltage positive going threshold	V_{CCUV+} V_{BSUV+}	VCC and VBS rising from 0V	-	3.7	4.3	V
VCC and VBS supply under voltage negative going threshold	V_{CCUV-} V_{BSUV-}	VCC and VBS dropping from 5V	2.8	3.4	-	V
VCC and VBS under voltage hysteresis	V_{CCUVH} V_{BSUVH}	-	0.02	0.3	-	V
Under voltage lockout response time	t_{dUVCC} t_{dUVBS}	VCC: 6.5V->2.4V or 2.4V->6.5V VBS: 6.5V->2.4V or 2.4V->6.5V	0.5 0.5		20 20	μs μs
Offset supply leakage current	I_{LK}	$V_B = V_S = 300\text{V}$	-	-	200	μA
Quiescent VCC supply current	I_{QCC}	$V_{CC} = 20\text{V}$	-	-	500	μA
Quiescent VBS supply current	I_{QBS1}	Static mode, $V_{BS} = 7\text{V}$, $V_{IN} = 0$ or 5V			100	μA
Quiescent VBS supply current	I_{QBS2}	Static mode, $V_{BS} = 16\text{V}$, $V_{IN} = 0$ or 5V			200	μA
VBS drop due to output turn-on (Design guaranty)	ΔV_{BS}	$V_{BS} = 7\text{V}$, $C_{BS} = 1\mu\text{F}$, $t_{dG-IN} = 3\mu\text{s}$, $t_{TEST} = 100\mu\text{s}$			210	mV
Input Characteristics						
High logic level input voltage for IN-	V_{IH}		$0.6V_{CC}$	-	-	V
Low logic level input voltage for IN-	V_{IL}		-	-	$0.28V_{CC}$	V
Low logic level input bias current for IN-	I_{IN-}	$V_{IN} = 0$	5	25	60	μA
High logic level input bias current for IN-	I_{IN+}	$V_{IN} = 5\text{V}$	-	-	5	μA
Full up resistance at IN	R_{IN}		83	200	1000	$\text{k}\Omega$
High logic level input voltage for RESET-	V_{RH}		$0.6V_{CC}$	-	-	V
Low logic level input voltage for RESET-	V_{RL}				$0.28V_{CC}$	V
High logic level input current for RESET-	I_{RES+}	$V_{RESET} = 5\text{V}$	5	25	60	μA
Low logic level input bias current for RESET-	I_{RES-}	$V_{RESET} = 0$			5	μA
Full down resistance at RESET-	R_{RES}		83	200	1000	$\text{k}\Omega$
Output characteristics						
High level output voltage, V_B - VHO	V_{OH}	$I_O = 0$	-	-	0.1	V
Low level output voltage, VHO-GND	V_{OL}	$I_O = 0$	-	-	0.1	V
Peak output source current	I_{O+}	$V_{IN} = 5\text{V}$	250	450	-	mA
Peak output sink current	I_{O-}	$V_{IN} = 0$	250	450	-	mA
Equivalent output resistance	R_{OP}			15.5	28	Ω
	R_{ON}			15.5	28	Ω
Recharge Characteristics						
Recharge TR turn-on propagation delay	T_{on_rech}		4	7.9	9.8	μs
Recharge TR turn-off propagation delay	T_{off_rech}			0.2	0.4	μs
Recharge TR on-state voltage drop	V_{RECH}	$I_S = 1\text{mA}$, $V_{IN} = 5\text{V}$ @ 125°C			1.2	V
Dead Time Characteristics						
High side turn-off to recharge gate turn-on	D_{THOFF}	$V_{CC} = 5\text{V}$, $V_S = 7\text{V}$	4	7.8	9.8	μs
Recharge gate turn-off to high side turn-on	D_{THON}	$V_{CC} = 5\text{V}$, $V_S = 7\text{V}$	0.1	0.4	0.7	μs

Note: The input parameter are referenced to GND. The VO and IO parameters are referenced to GND.

Dynamic Electrical Characteristics

Unless otherwise specified, $-40^{\circ}\text{C} \leq T_a \leq 125^{\circ}\text{C}$, $V_{CC} = 5\text{V}$, $V_{BS} = 7\text{V}$, $V_S = 0\text{V}$, $V_{RESET} = 5\text{V}$, $R_L = 50\Omega$, $C_L = 2.5\text{nF}$.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input-to-output turn-on propagation delay	t_{plh}	50% input level to 10% output level, $V_S = 0\text{V}$		0.56	1	μs
Input-to-output turn-off propagation delay	t_{phl}	50% input level to 90% output level $V_S = 0\text{V}$	-	0.15	0.5	μs
RESET-to-output turn-off propagation delay	t_{phl_res}	50% input level to 90% output level	-	0.17	0.5	μs
RESET-to-output turn-on propagation delay	t_{plh_res}	50% input level to 10% output level	-	0.56	1	μs
Output rising time	t_{r1}	$T_J = 25^{\circ}\text{C}$	-	65	200	ns
	t_{r2}			-	400	ns
	t_{r3}	$T_J = 25^{\circ}\text{C}$, $V_{BS} = 16\text{V}$		65	200	ns
	t_{r4}	$V_{BS} = 16\text{V}$		-	400	ns
Output falling time	t_{f1}	$T_J = 25^{\circ}\text{C}$	-	25	200	ns
	t_{f2}			-	300	ns
	t_{f3}	$T_J = 25^{\circ}\text{C}$, $V_{BS} = 16\text{V}$		25	200	ns
	t_{f4}	$V_{BS} = 16\text{V}$		-	300	ns

Application Information

1. Logic Tables

VCC	VBS	RESET-	IN-	Ho	RechFET
< VCCUVLO-	X	X	X	OFF	ON
X	X	LOW	X	OFF	ON
X	X	X	HIGH	OFF	ON
> VCCUVLO+	> VBSUVLO+	HIGH	LOW	ON	OFF
> VCCUVLO+	< VBSUVLO-	HIGH	LOW	OFF	OFF

Notes:

X means independent from signal

IN=LOW indicates that the high side NMOS is ON

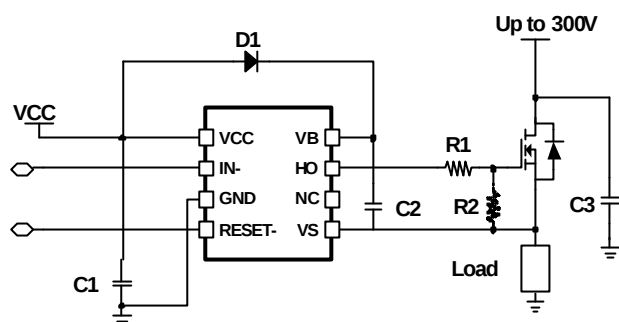
IN=HIGH indicates that the high side NMOS is OFF

RechFET =ON indicates that the recharge MOSFET is ON

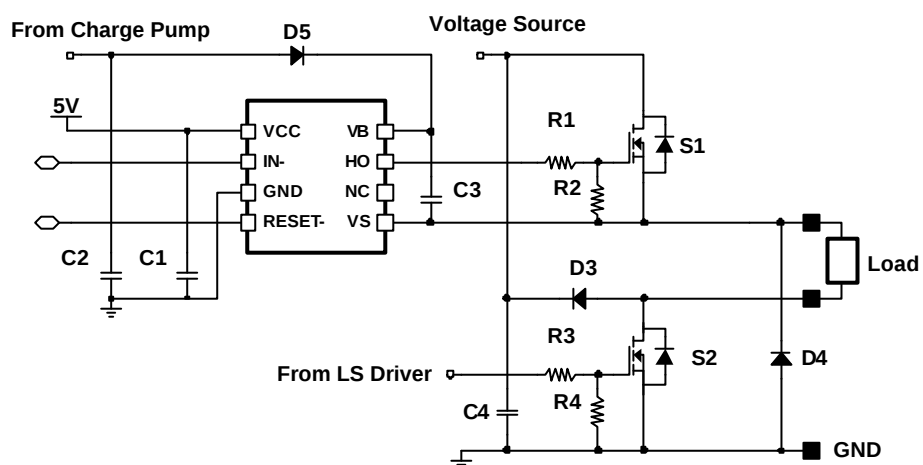
RechFET =OFF indicates that the recharge MOSFET is OFF

Typical Application Circuit

1. Typical Application Circuit



2. Application Example



Input-Output Waveforms

1. Input/Output Timing Diagrams

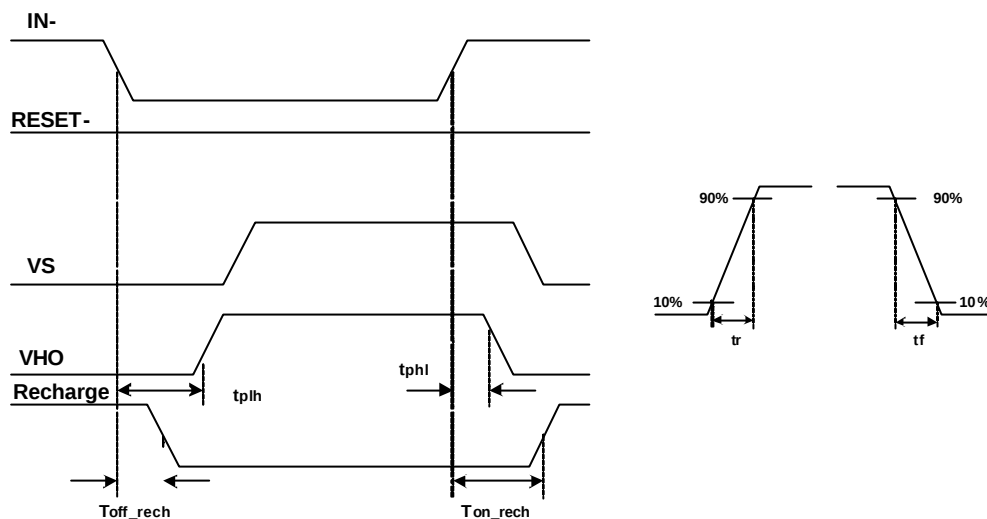


Figure.1 Input and Output Timing Diagram and Switching Time Waveform Definition

2. Reset Timing Diagrams

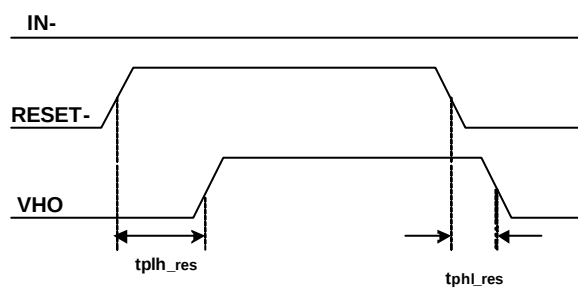


Figure.2 Reset and Output Timing Diagram

3.VB Drop Voltage Diagram

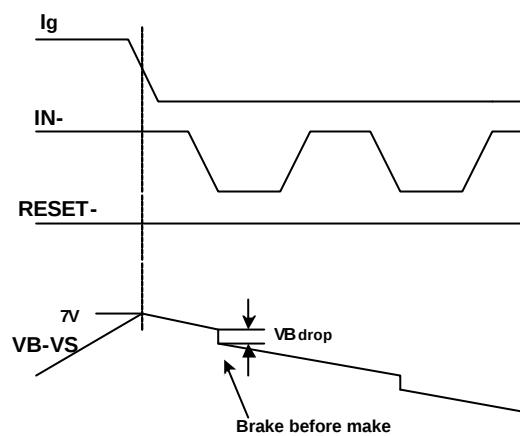


Figure3.a VB Drop Voltage Diagram

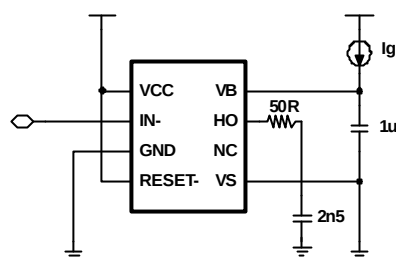


Figure3.b VB Drop Voltage Test Circuit

Performance Graphs

This performance graphs based on ambient temperature $-40^{\circ}\text{C} \sim 125^{\circ}\text{C}$

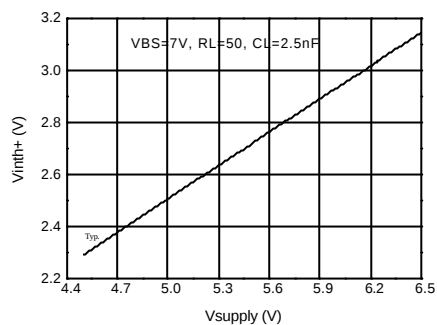


Figure 4a. Positive IN and RESET Threshold vs VCC Supply

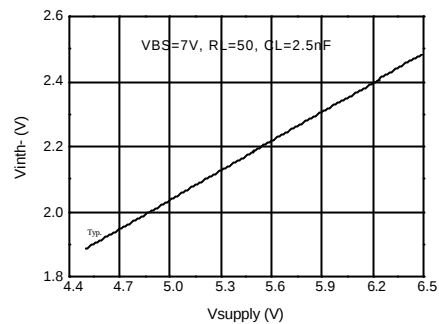


Figure 4b. Negative IN and RESET Threshold vs VCC Supply

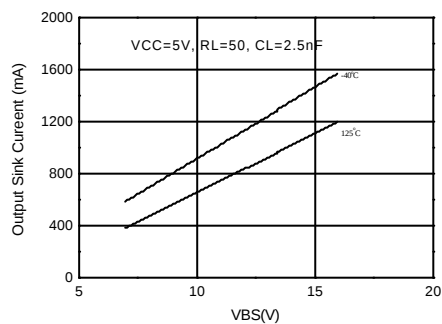


Figure 5a. Output Sink Current vs VBS Supply

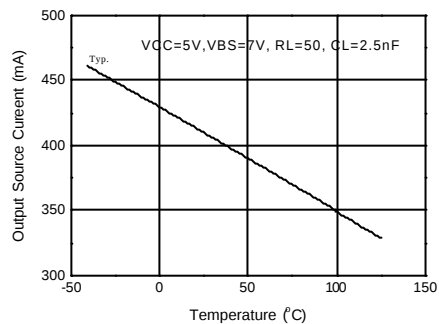


Figure 5b. Output Source Current vs Temperature

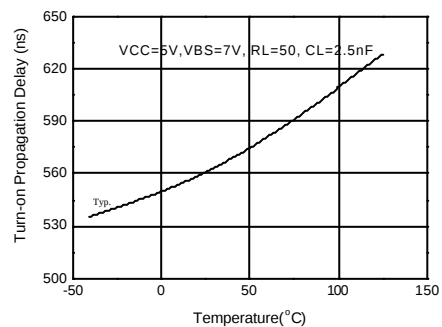


Figure 6a. Turn-On Propagation Delay Time vs Temperature

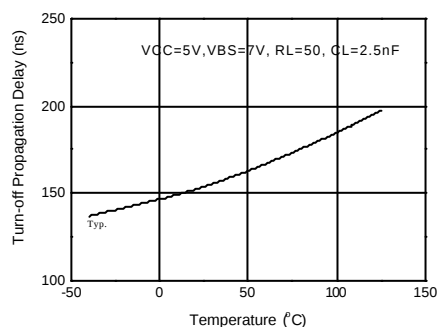


Figure 6b. Turn-Off Propagation Delay Time vs Temperature

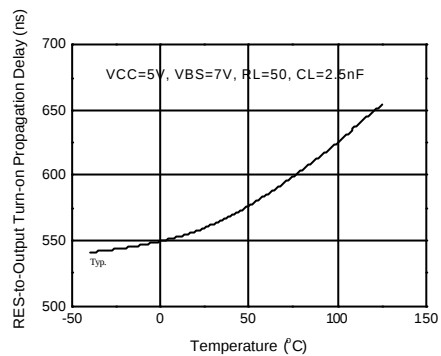


Figure 7a. RES to Output Turn-On Propagation Delay vs Temperature

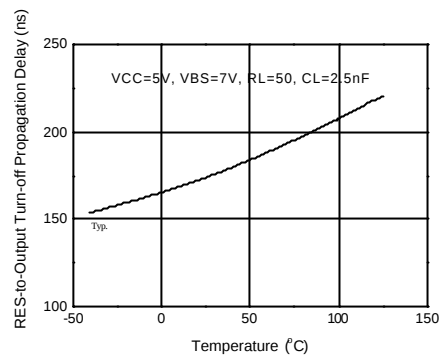


Figure 7b. RES to Output Turn-Off Propagation Delay vs Temperature

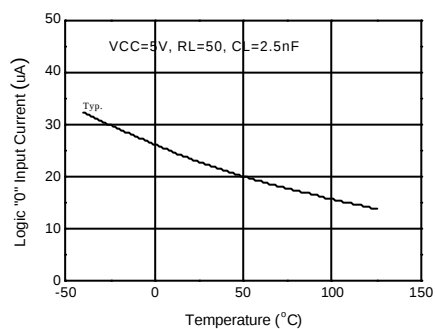


Figure 8. Logic "0" IN Input Current vs Temperature

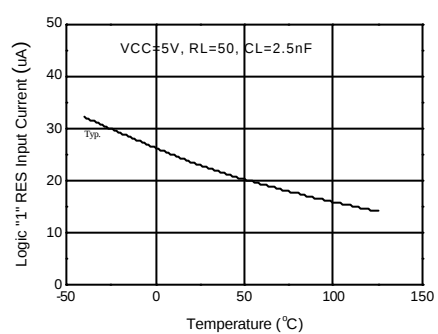


Figure 9. Logic "1" RESET Input Current vs Temperature

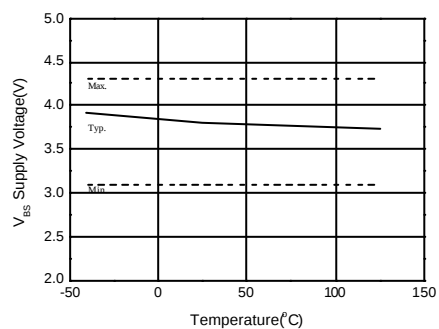


Figure 10a. VBS Under Voltage Threshold(+) vs Temperature

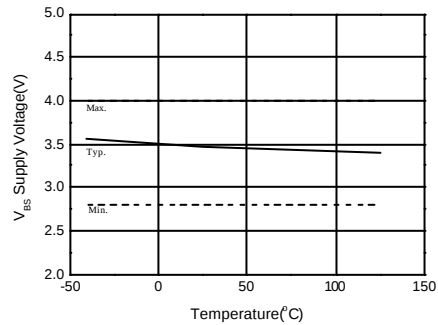


Figure 10b. VBS Under Voltage Threshold(-) vs Temperature

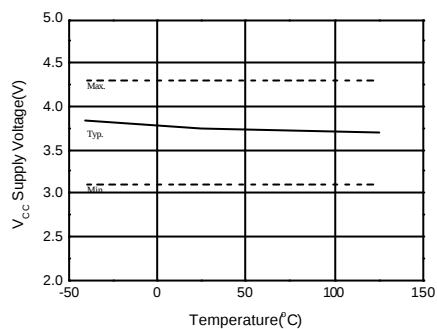


Figure 11a. VCC Under Voltage Threshold(+) vs Temperature

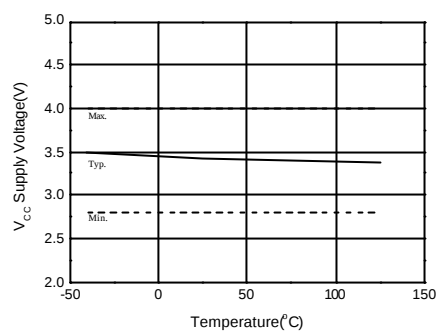


Figure 11b. VCC Under Voltage Threshold(-) vs Temperature

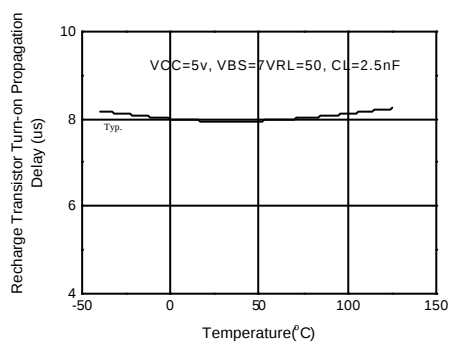


Figure 12. Recharge FET Turn-on Delay time

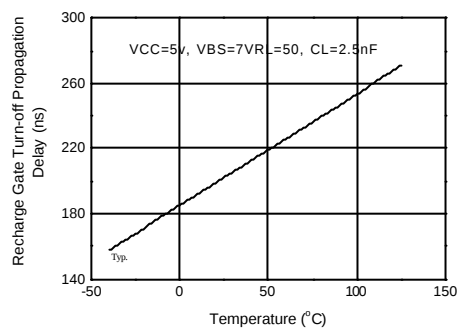


Figure 12. Recharge FET Turn-off Delay time

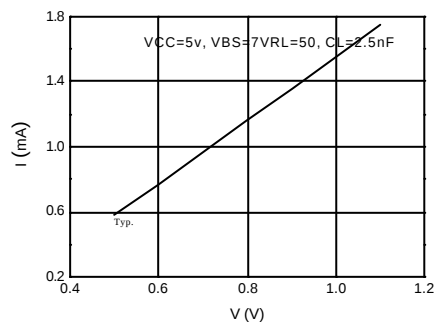


Figure 14. Recharge FET I-V curve

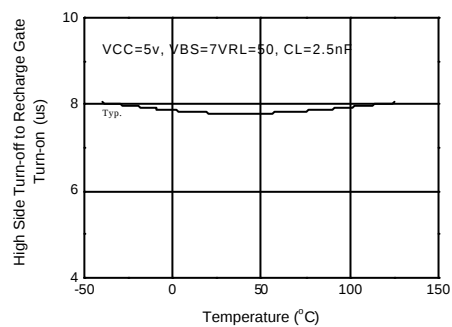


Figure 15. High Side Turn-off to Recharge FET turn-on VS Temperature

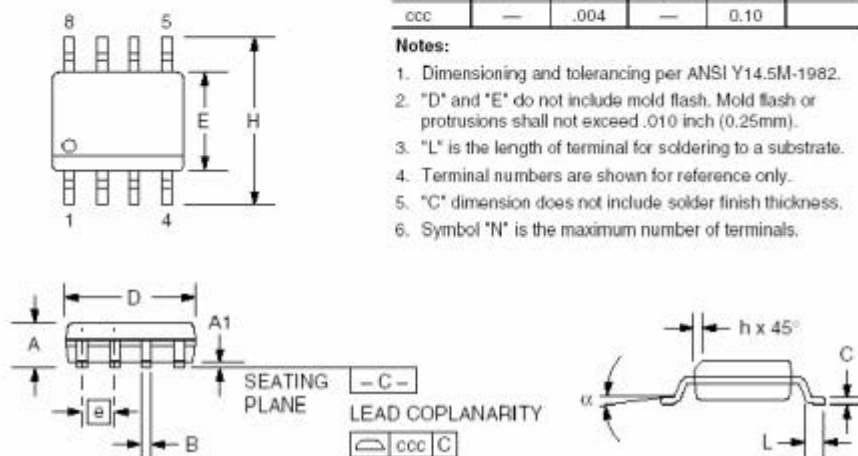
Package Dimensions

8-SOP

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.053	.069	1.35	1.75	
A1	.004	.010	0.10	0.25	
B	.013	.020	0.33	0.51	
C	.0075	.010	0.20	0.25	5
D	.189	.197	4.80	5.00	2
E	.150	.158	3.81	4.01	2
e	.050 BSC		1.27 BSC		
H	.228	.244	5.79	6.20	
h	.010	.020	0.25	0.50	
L	.016	.050	0.40	1.27	3
N	8		8		6
α	0°	8°	0°	8°	
ccc	—	.004	—	0.10	

Notes:

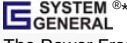
1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. "D" and "E" do not include mold flash. Mold flash or protrusions shall not exceed .010 inch (0.25mm).
3. "L" is the length of terminal for soldering to a substrate.
4. Terminal numbers are shown for reference only.
5. "C" dimension does not include solder finish thickness.
6. Symbol "N" is the maximum number of terminals.





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