ON Semiconductor

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ON Semiconductor®

FAN7085-GF085
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

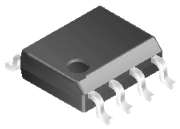
Typical Applications

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

Description

The FAN7085-GF085 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. ON Semiconductor'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 cir-cuits 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.
FAN7085M-GF085	SOIC-8	-40 °C ~ 125 °C
FAN7085MX-GF085	SOIC-8	-40 °C ~ 125 °C

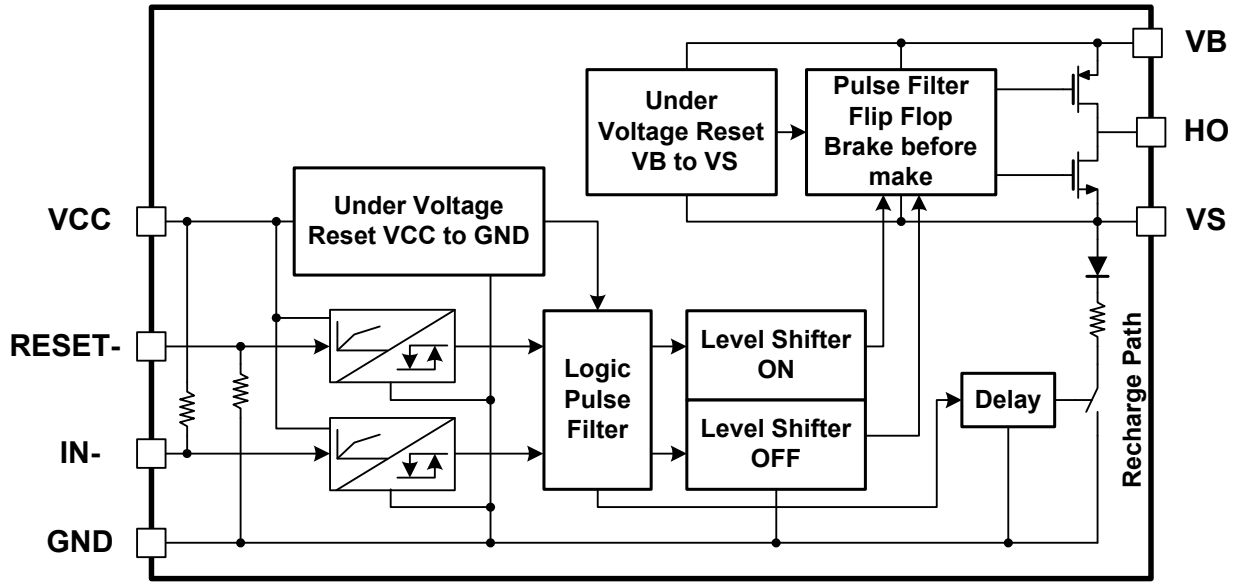
X : Tape & Reel type

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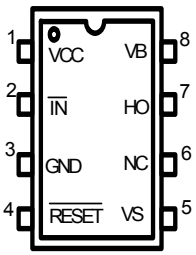
Publication Order Number:
FAN7085M-GF085/D

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Block Diagrams



Pin Assignments



Pin Definitions

Pin 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

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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	Vs	-25	300	V
High side floating output voltage	V_{HO}	VS-0.3	VB+0.3	V
Supply voltage	V_{CC}	-0.3	25	V
Input voltage for IN-	V_{IN}	-0.3	Vcc+0.3	V
Input voltage for RESET-	V_{RES}	-0.3	Vcc+0.3	V
Power Dissipation [1)]	Pd		0.625	W
Thermal resistance, junction to ambient [1)]	Rthja		200	°C/W
Electrostatic discharge voltage (Human Body Model)	V_{ESD}	1.5K		V
Charge device model	V_{CDM}	500		V
Junction Temperature	Tj		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 Leaded 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	VS+4.5	VS+20	V
High side floating supply offset voltage(DC) @VBS=7V	V_S	-3	300	V
High side floating supply offset voltage(Transient) 0.2us @VBS<25V	V_S	-25	300	V
High side floating output voltage	V_{HO}	Vs	VB	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	Vcc	V
Input voltage for RESET-	V_{RESET}	0	Vcc	V
Switching frequency [2)]	Fs		200K	Hz
Minimum low input width [3)]	$t_{IN(low,min)}$	560	-	ns
Minimum high input width [3)]	$t_{IN(high,min)}$	60	-	ns
Minimum operating voltage of VB related to GND	$V_{B(MIN)}$ [4)]	4	-	V
Ambient temperature	Ta	-40	125	°C

Note: 1) Guaranteed by design.

2) Duty = 0.5, VBS >=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 tin

4) Guaranteed by design

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Statics Electrical Characteristics

Unless otherwise specified, -40°C <= Ta <= 125°C, V_{CC} = 5V, V_{BS} = 7V, V_S = 0V, V_{RESET} = 5V, R_L = 50Ω, C_L = 2.5nF.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
VCC and VBS Supply Characteristics						
V_{CC} and V_{BS} supply under voltage positive going threshold	V_{CCUV+} V_{BSUV+}	V_{CC} and V_{BS} rising from 0V	-	3.7	4.3	V
V_{CC} and V_{BS} supply under voltage negative going threshold	V_{CCUV-} V_{BSUV-}	V_{CC} and V_{BS} dropping from 5V	2.8	3.4	-	V
V_{CC} and V_{BS} under voltage hysteresis	V_{CCUVH} V_{BSUVH}	-	0.02	0.3	-	V
Under voltage lockout response time	tduvcc tduvbs	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	us us
Offset supply leakage current	I_{LK}	VB=VS=300V	-	-	200	uA
Quiescent Vcc supply current	I_{QCC}	Vcc=20V	-	-	500	uA
Quiescent VBS supply current	I_{QBS1}	Static mode, V_{BS}=7V, V_{IN}=0 or 5V			100	uA
Quiescent VBS supply current	I_{QBS2}	Static mode, V_{BS}=16V, V_{IN}=0 or 5V			200	uA
VBS drop due to output turn-on (Design guaranty)	ΔVBS	V_{BS}=7V, Cbs=1uF, td_{IG-IN} =3uS, t_{TEST}=100uS			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	uA
High logic level input bias current for IN-	I_{IN+}	V_{IN}=5V	-	-	5	uA
Full up resistance at IN	R_{IN}		83	200	1000	KΩ
High logic level input voltage for RESET-	V_{RH}		0.6Vcc	-	-	V
Low logic level input voltage for RESET-	V_{RL}				0.28Vcc	V
High logic level input current for RESET-	I_{RES+}	V_{RESET}=5V	5	25	60	uA
Low logic level input bias current for RESET-	I_{RES-}	V_{RESET}=0			5	uA
Full down resistance at RESET-	R_{RES}		83	200	1000	KΩ
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}=5V	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	Ton_rech		4	7.9	9.8	us
Recharge TR turn-off propagation delay	Toff_rech			0.2	0.4	us
Recharge TR on-state voltage drop	V_{RECH}	Is=1mA, VIN=5V @125°C			1.2	V
Dead Time Characteristics						
High side turn-off to recharge gate turn-on	D_{THOFF}	Vcc=5V, V_S=7V	4	7.8	9.8	us
Recharge gate turn-off to high side turn-on	D_{THON}	Vcc=5V, V_S=7V	0.1	0.4	0.7	us

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

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Dynamic Electrical Characteristics

Unless otherwise specified, -40°C <= Ta <= 125°C, V_{CC} = 5V, V_{BS} = 7V, V_S = 0V, V_{RESET} = 5V, R_L = 50Ω, C_L = 2.5nF.

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 = 0V		0.56	1	us
Input-to-output turn-off propagation delay	t_{phl}	50% input level to 90% output level V_S = 0V	-	0.15	0.5	us
RESET-to-output turn-off propagation delay	t_{phl_res}	50% input level to 90% output level	-	0.17	0.5	us
RESET-to-output turn-on propagation delay	t_{plh_res}	50% input level to 10% output level	-	0.56	1	us
Output rising time	tr1	Tj=25°C	-	65	200	ns
	tr2			-	400	ns
	tr3	Tj=25°C,V_{BS}=16V		65	200	ns
	tr4	V_{BS}=16V		-	400	ns
Output falling time	tf1	Tj=25°C	-	25	200	ns
	tf2			-	300	ns
	tf3	Tj=25°C,V_{BS}=16V		25	200	ns
	tf4	V_{BS}=16V		-	300	ns

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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

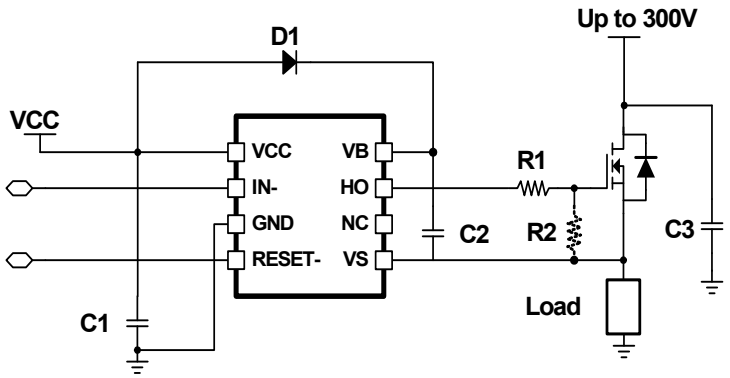
RechFET =ON indicates that the recharge MOSFET is ON

RechFET =OFF indicates that the recharge MOSFET is OFF

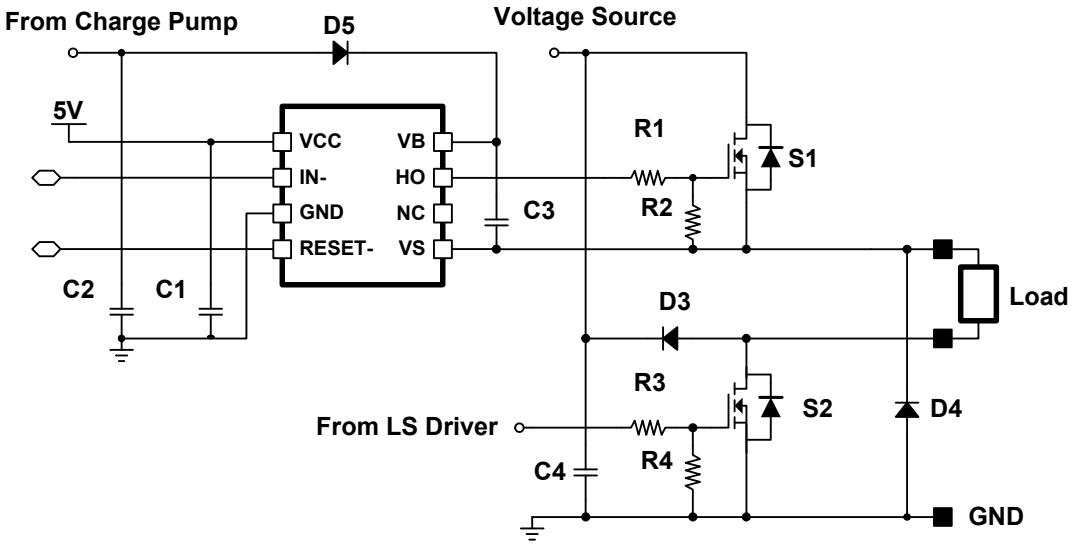
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Typical Application Circuit

1. Typical Application Circuit



2. Application Example



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Input-Output Waveforms

1. Input/Output Timing Diagrams

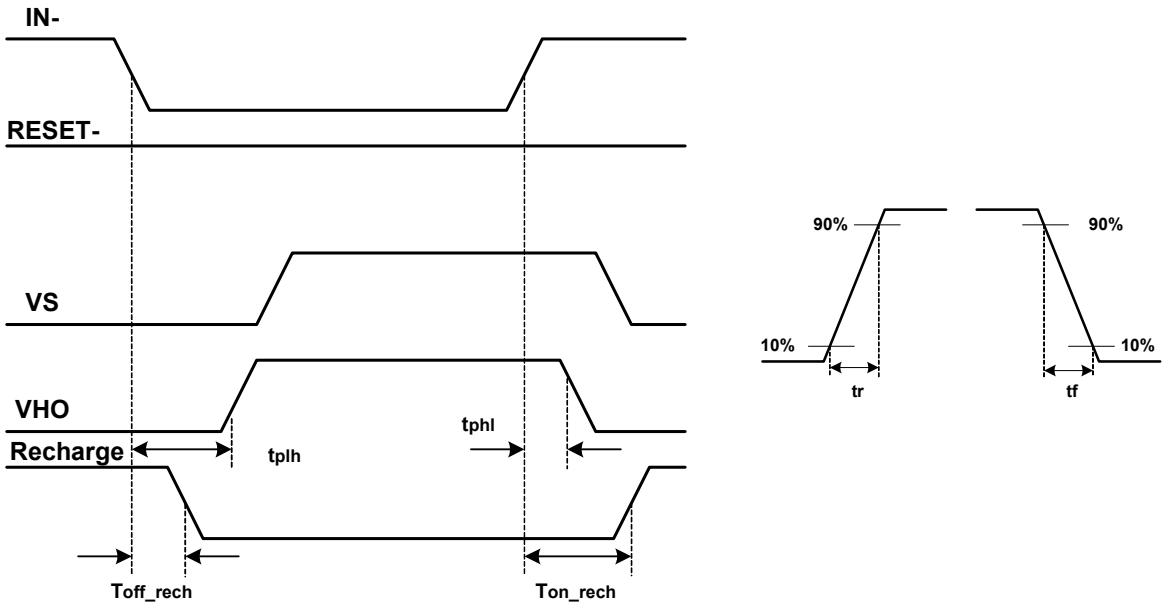


Figure.1 Input and Output Timing Diagram and Switching Time Waveform Definition

2. Reset Timing Diagrams

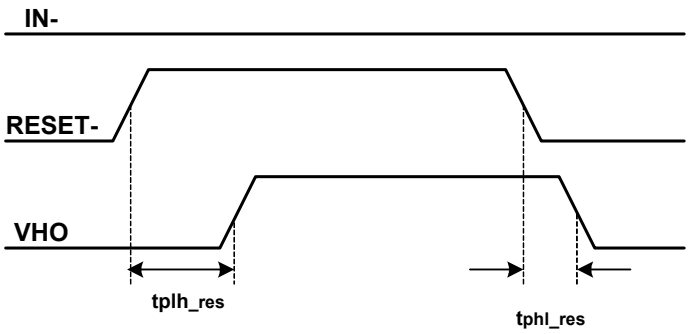


Figure.2 Reset and Output Timing Diagram

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3.VB Drop Voltage Diagram

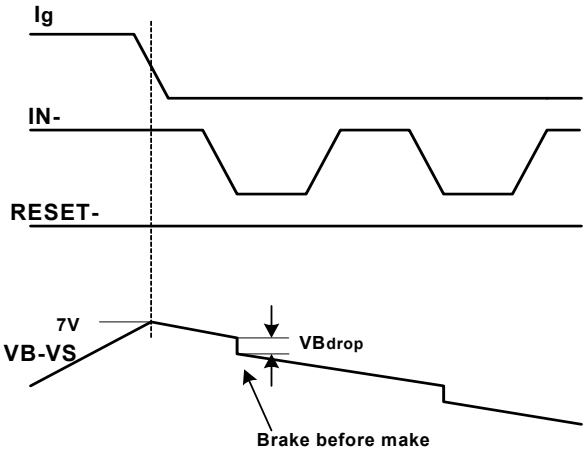


Figure3.a VB Drop Voltage Diagram

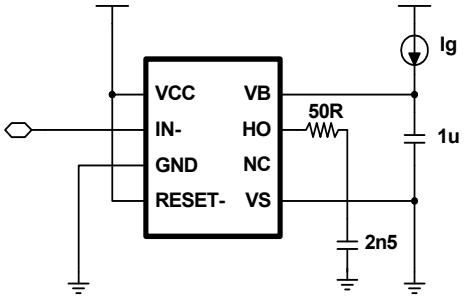


Figure3.b VB Drop Voltage Test Circuit

4.Recommendation Min. Short Pulse Width

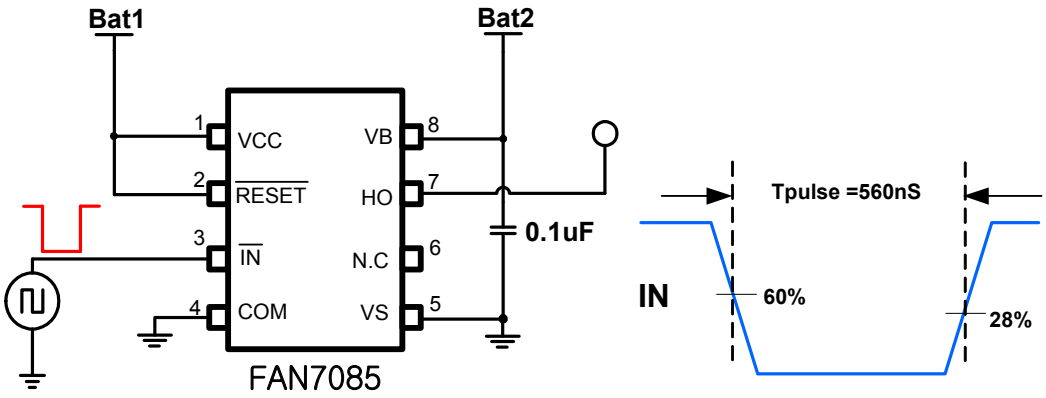


Figure 4a.Short Pulse Width Test Circuit and Pulse Width Waveform

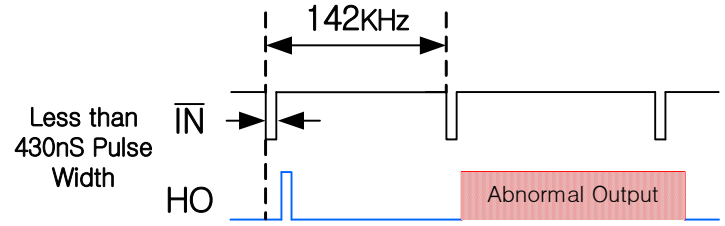


Figure 4b. Abnormal Output Waveform with short pulse width

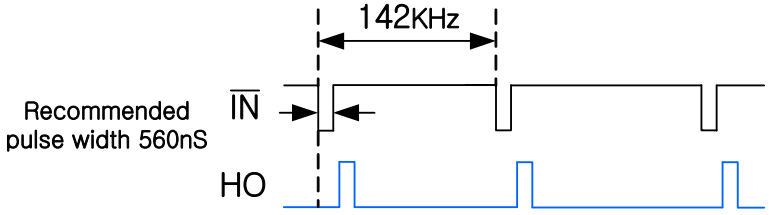


Figure 4c. Recommendation of pulse width Output Waveform

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Performance Graphs

This performance graphs based on ambient temperature -40°C ~125°C

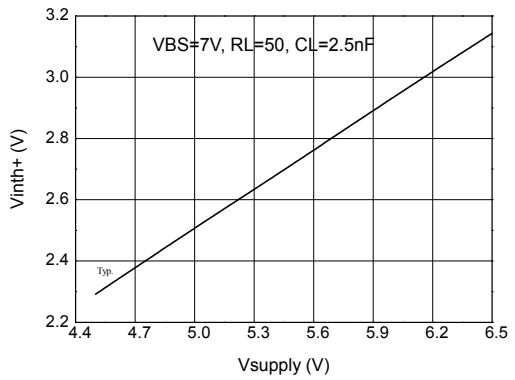


Figure 5a. Positive IN and RESET Threshold vs VCC Supply

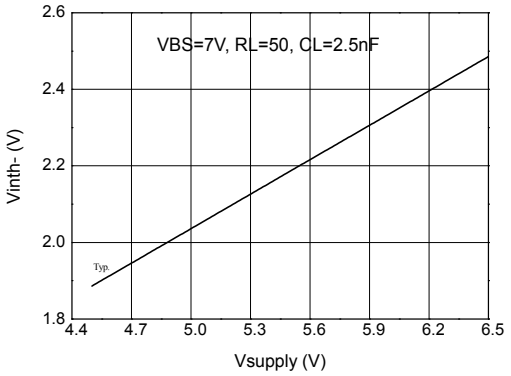


Figure 5b. Negative IN and RESET Threshold vs VCC Supply

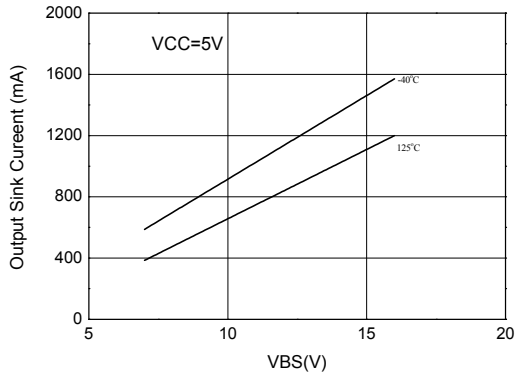


Figure6a. Output Sink Current vs VBS Supply

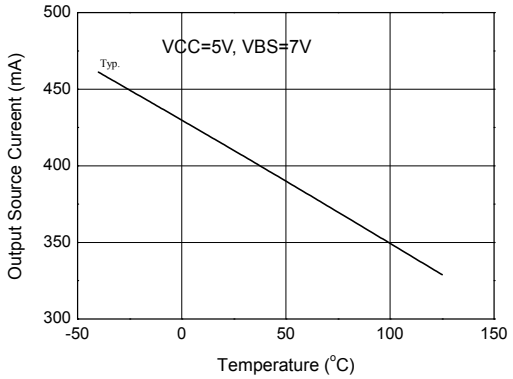


Figure6b. Output Source Current vs Temperature

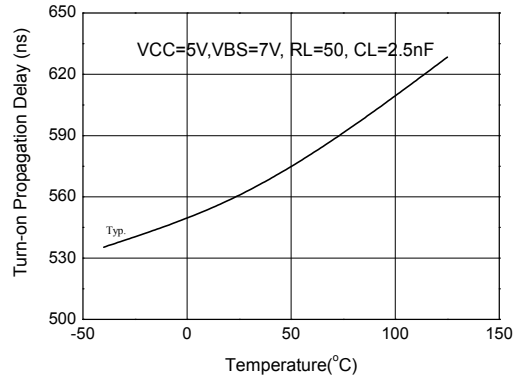


Figure 7a. Turn-On Propagation Delay Time vs Temperature

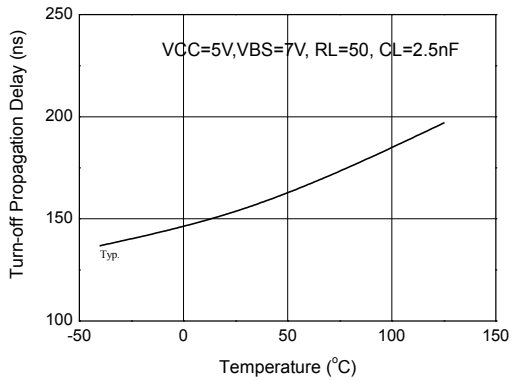


Figure 7b. Turn-Off Propagation Delay Time vs Temperature

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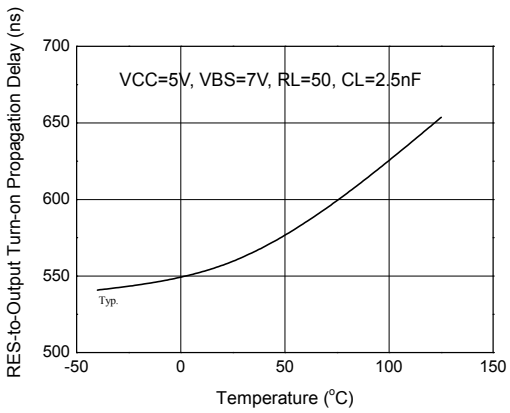


Figure 8a. RES to Output Turn-On Propagation Delay vs Temperature

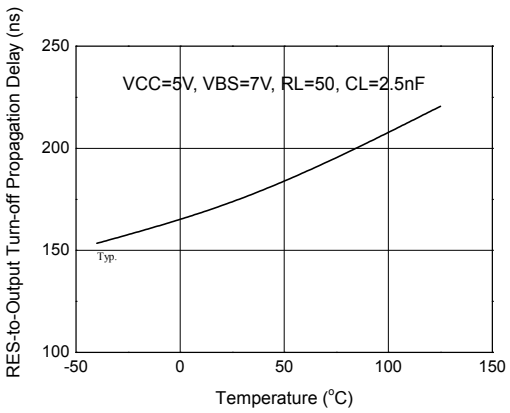


Figure 8b. RES to Output Turn-Off Propagation Delay vs Temperatur

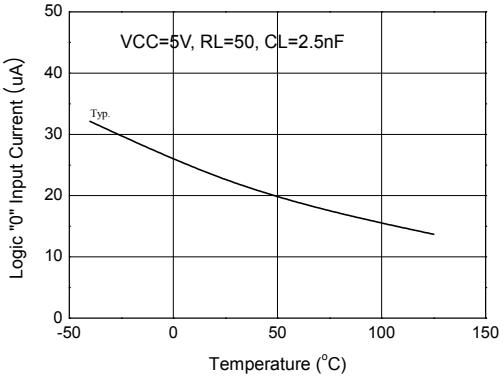


Figure 9. Logic “0” IN Input Current vs Temperature

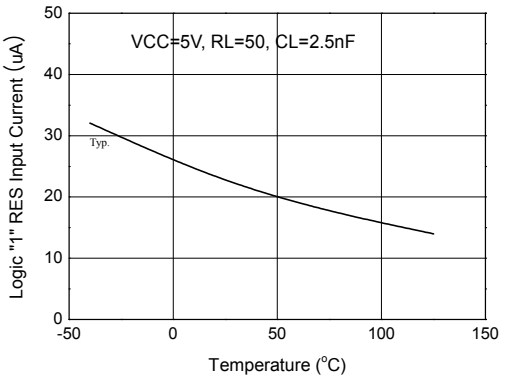


Figure 10. Logic “1” RESET Input Current vs Temperature

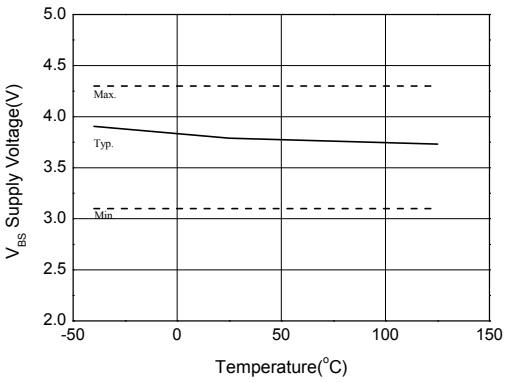


Figure 11a. VBS Under Voltage Threshold(+) vs Temperature

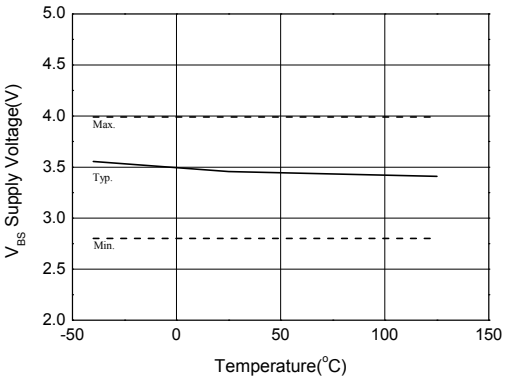


Figure 11b. VBS Under Voltage Threshold(-) vs Temperature

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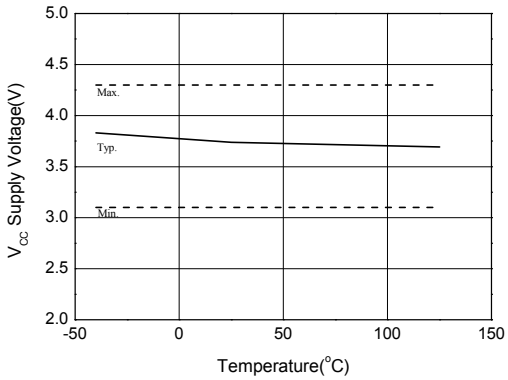


Figure 12a. VCC Under Voltage Threshold(+) vs Temperature

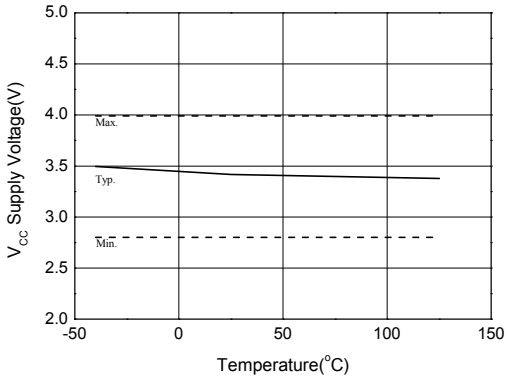


Figure 12b. VCC Under Voltage Threshold(-) vs Temperature

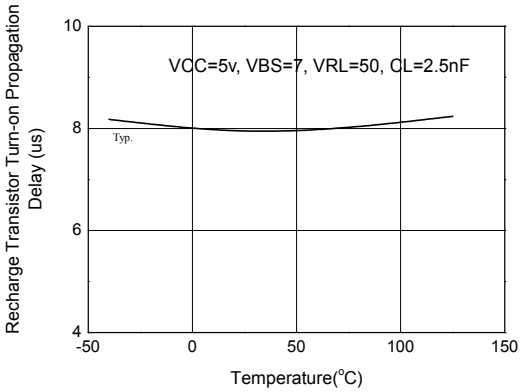


Figure 13. Recharge FET Turn-on Delay time

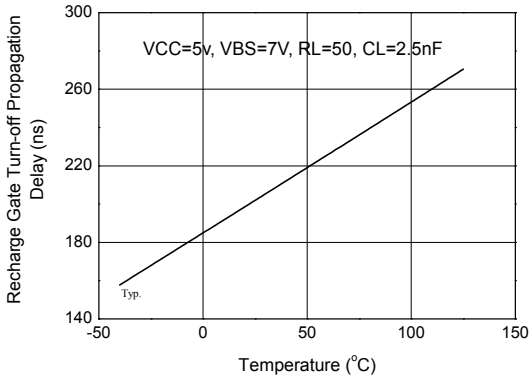


Figure 14. Recharge FET Turn-off Delay time

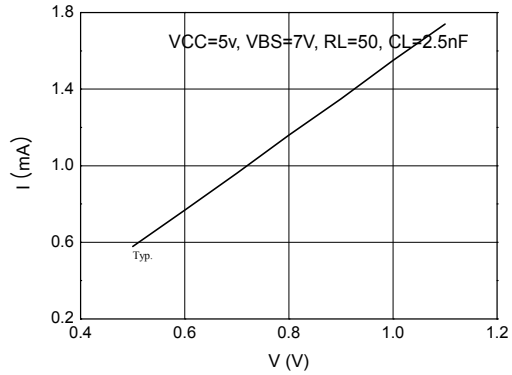


Figure 15. Recharge FET I-V curve

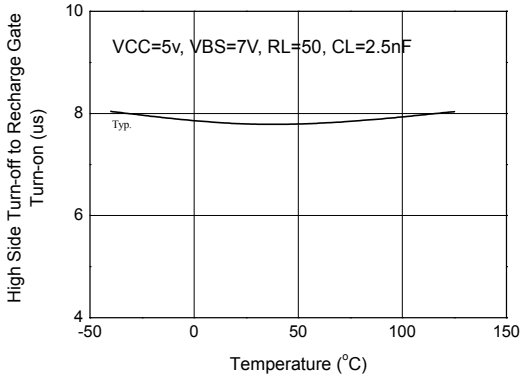


Figure 16. High Side Turn-off to Recharge FET turn-on VS Temperature

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