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November 2014

# FAN7081\_GF085 High Side Gate Driver

## Features

- Qualified to AEC Q100
- Floating channel designed for bootstrap operation up fully operational to + 600V
- Tolerance to negative transient voltage on VS pin
- dV/dt immune.
- Gate drive supply range from 10V to 20V
- Under-voltage lockout
- CMOS Schmit-triggered inputs with pull-up
- High side output out of phase with input (Inverted input)

## Typical Applications

- Diesel and gasoline Injectors/Valves
- MOSFET-and IGBT high side driver applications

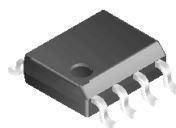


For Fairchild's definition of "green" Eco Status, please visit:  
[http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html)

## Description

The FAN7081\_GF085 is a high-side gate drive IC designed for high voltage and high speed driving of MOSFET or IGBT, which operates up to 600V. 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. An advanced level-shift circuit allows high-side gate driver operation up to VS=-5V (typical) at VBS=15V. 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 500mA respectively, which is suitable for magnetic- and piezo type injectors and general MOSFET/IGBT based high side driver applications.

### SOIC-8



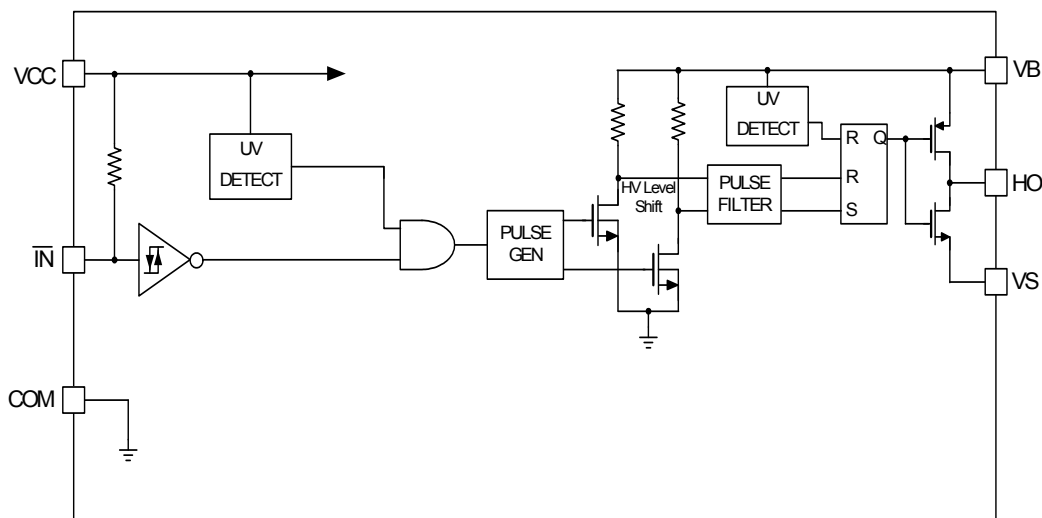
## Ordering Information

Device	Package	Operating Temp.
FAN7081M_GF085	SOIC-8	-40 °C ~ 125 °C
FAN7081MX_GF085	SOIC-8	-40 °C ~ 125 °C

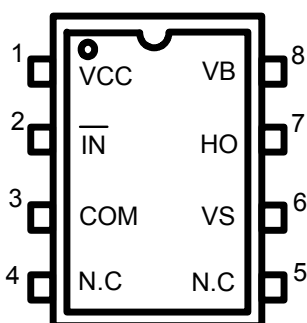
X : Tape & Reel type



## Block Diagrams



## Pin Assignments



## Pin Definitions

Pin Number	Pin Name	I/O	Pin Function Description
1	VCC	P	Driver supply voltage
2	$\overline{\text{IN}}$	I	Logic input for high side gate drive output, out of phase with HO
3	COM	P	Ground
4	NC	-	NC
5	NC	-	NC
6	VS	P	High side floating offset for MOSFET Source connection
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 COM.

Parameter	Symbol	Min.	Max.	Unit
High side floating supply offset voltage	VS	VB-25	VB+0.3	V
High side floating supply voltage	VB	-0.3	625	V
High side floating output voltage	VHO	VS-0.3	VB+0.3	V
Supply voltage	VCC	-0.3	25	V
Input voltage for $\overline{\text{IN}}$	VIN	-0.3	VCC+0.3	V
Power Dissipation <sup>1)</sup>	Pd		0.625	W
Thermal resistance, junction to ambient <sup>1)</sup>	Rthja		200	°C/W
Electrostatic discharge voltage (Human Body Model)	V <sub>ESD</sub>	1K		V
Charge device model	V <sub>CDM</sub>	500		V
Junction Temperature	T <sub>J</sub>		150	°C
Storage Temperature	T <sub>S</sub>	-55	150	°C

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

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

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

## Recommended Operating Conditions

For proper operations the device should be used within the recommended conditions.  $-40^{\circ}\text{C} \leq T_a \leq 125^{\circ}\text{C}$

Parameter	Symbol	Min.	Max.	Unit
High side floating supply voltage(DC) Transient:-10V@ 0.2 us	VB	VS + 10	VS + 20	V
High side floating supply offset voltage(DC)	VS	-4 (@VBS $\geq$ 10V) -5 (@VBS $\geq$ 11.5V)	600	V
High side floating supply offset voltage(Transient)	VS	-25 (~200ns) -20(200ns ~240ns) -7(240ns~400ns)	600	V
High side floating output voltage	VHO	VS	VB	V
Allowable offset voltage Slew Rate <sup>1)</sup>	dv/dt	-	50	V/ns
Supply voltage	VCC	10	20	V
Input voltage for $\overline{\text{IN}}$	VIN	0	VCC	V
Switching Frequency <sup>2)</sup>	Fs		200	KHz
Minimum Pulse Width <sup>(3)</sup>	T <sub>pulse</sub>	85	-	ns
Ambient Temperature	T <sub>a</sub>	-40	125	°C

Note: 1) Guaranteed by design.

2) Duty = 0.5

3) Guaranteed by design. Refer to Figure4a,4b and 4c on Page 8.

## Statics Electrical Characteristics

Unless otherwise specified,  $-40^{\circ}\text{C} \leq T_a \leq 125^{\circ}\text{C}$ ,  $V_{CC} = 15\text{V}$ ,  $V_{BS} = 15\text{V}$ ,  $V_S = 0\text{V}$ ,  $R_L = 50\Omega$ ,  $C_L = 2.5\text{nF}$ .

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>Vcc and VBS supply Characteristics</b>						
VCC and VBS supply under voltage positive going threshold	VCCUV+ VBSUV+		-	8.7	9.8	V
VCC and VBS supply under voltage negative going threshold	VCCUV- VBSUV-		7.4	8.2	-	V
VCC and VBS supply under voltage hysteresis	VCCUVH VBSUVH	-	0.2	0.5	-	V
Under voltage lockout response time	tduvcc tduvbs	VCC: 10V-->7.3V or 7.3V-->10V VBS: 10V-->7.3V or 7.3V-->10V	0.5 0.5		20 20	us us
Offset supply leakage current	ILK	VB=VS=600V	-	-	50	uA
Quiescent VBS supply current	IQBS	VIN=0	-	23	250	uA
Quiescent Vcc supply current	IQCC1	VIN= 0V	-	42	120	uA
Quiescent Vcc supply current	IQCC2	VIN=15V	-	25	100	uA
<b>Input Characteristics</b>						
High logic level input voltage	VIH		0.63VCC	-	-	V
Low logic level input voltage	VIL		-	-	0.4VCC	V
Low logic level input bias current for IN	IIN+	VIN=0	-	15	50	uA
High logic level input bias current for IN	IIN-	VIN=15V	-	0	1	uA
<b>Output characteristics</b>						
High level output voltage, VBIAS-VO	VOH	IO=0	-	-	0.1	V
Low level output voltage, VO	VOL	IO=0	-	-	0.1	V
Peak output source current	IO1+		250	-	-	mA
Peak output sink current	IO1-		500	-	-	mA
Equivalent output resistance	ROP			40	60	$\Omega$
	RON			20	30	$\Omega$

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

## Dynamic Electrical Characteristics

Unless otherwise specified,  $-40^{\circ}\text{C} \leq T_a \leq 125^{\circ}\text{C}$ ,  $V_{CC} = 15\text{V}$ ,  $V_{BS} = 15\text{V}$ ,  $V_S = 0\text{V}$ ,  $R_L = 50\Omega$ ,  $C_L = 2.5\text{nF}$ .

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input-to-output turn-on propagation delay	$t_{plh}$	50% input level to 10% output level, $V_S = 0\text{V}$		130	300	ns
Input-to-output turn-off propagation delay	$t_{phl}$	50% input level to 90% output level $V_S = 0\text{V}$	-	140	300	ns
Output rising time	$t_{r1}$	10% to 90%, $T_j = 25^{\circ}\text{C}$ , $V_{BS} = 15\text{V}$	-	15	400	ns
	$t_{r2}$	10% to 90%		-	500	ns
Output falling time	$t_{f1}$	90% to 10%, $T_j = 25^{\circ}\text{C}$ , $V_{BS} = 15\text{V}$	-	10	150	ns
	$t_{f2}$	90% to 10%		-	500	ns

## Application Information

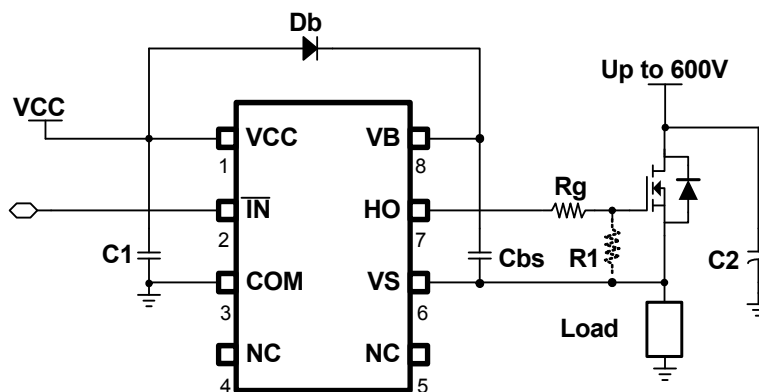
### 1. Relationship in input/output and supplies

Table.1 Truth table for Vcc, VBS,VIN, and VHO			
VCC	VBS	IN	HO
< VCCUVLO-	X	X	OFF
X	< VBSUVLO-	X	OFF
X	X	HIGH	OFF
> VCCUVLO+	> VBSUVLO+	LOW	ON

Notes:

X means independent from signal

## Typical Application Circuit



## Typical Waveforms

### 1. Input/Output Timing

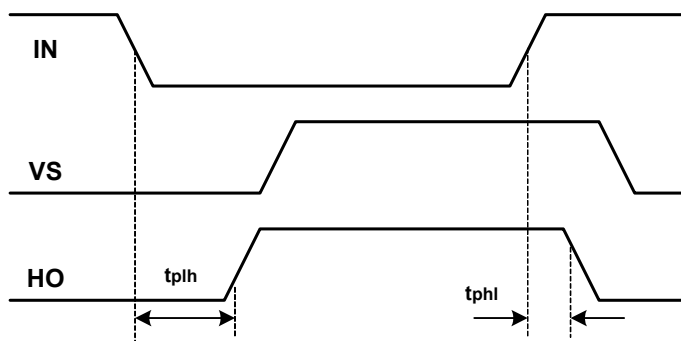


Figure 1. Input /output Timing Diagram

### 2. Output(HO) Switching Timing

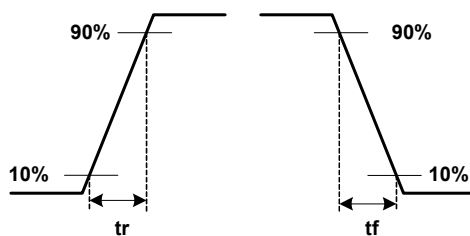


Figure 2. Switching Time Waveform Definitions



### 3.VB Drop Voltage Diagram

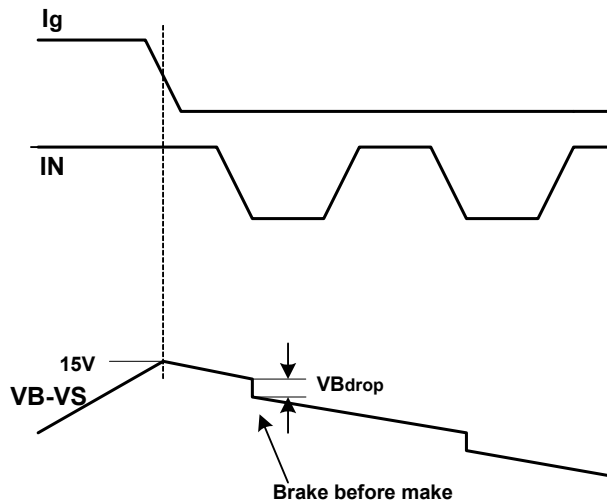


Figure 3a. VB Drop Voltage Diagram

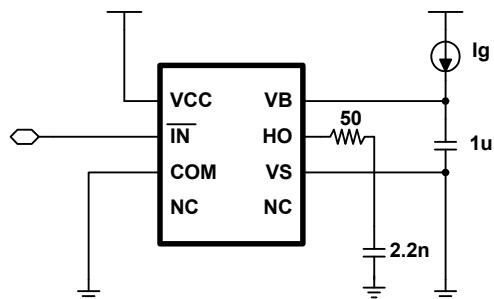


Figure3b. VB Drop Voltage Test Circuit

### 4.Recommendation Min. Short Pulse Width

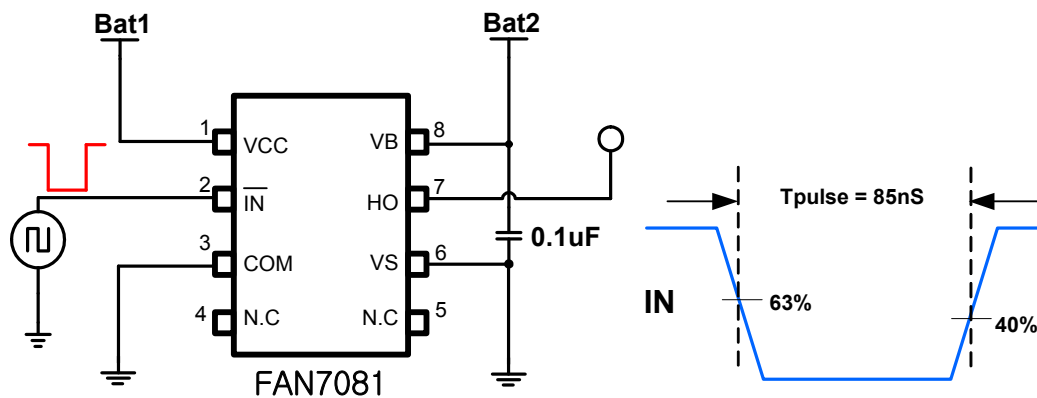


Figure 4a.Short Pulse Width Test Circuit and Pulse Width Waveform

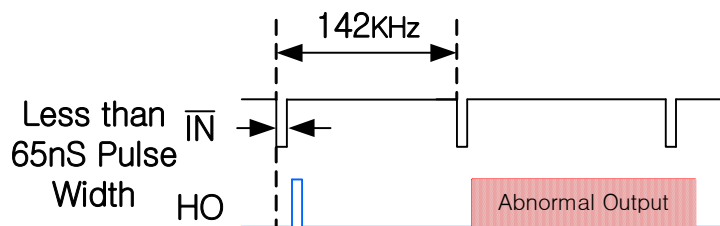


Figure 4b. Abnormal Output Waveform with short pulse width

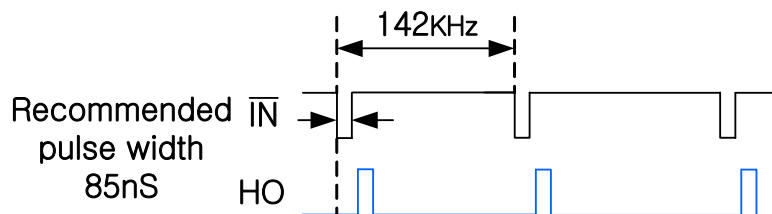


Figure 4c. Recommendation of pulse width Output Waveform

## Performance Graphs

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

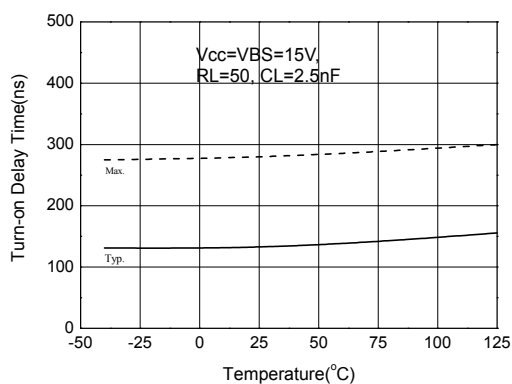


Figure 5a. Turn-On Delay Time vs Temperature

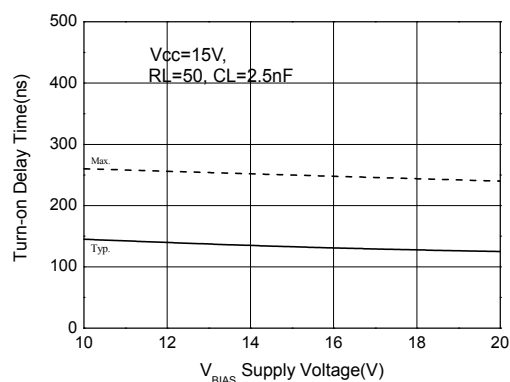


Figure 5b. Turn-On Delay Time vs VBS Supply Voltage

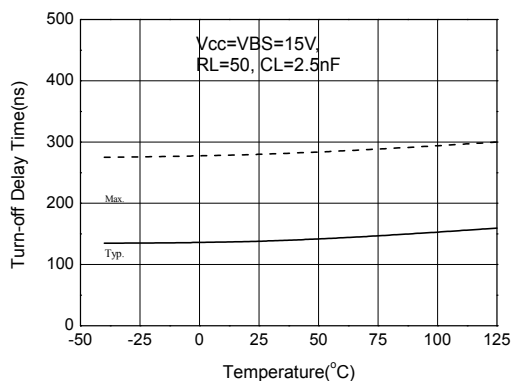


Figure 6a. Turn-Off Delay Time vs Temperature

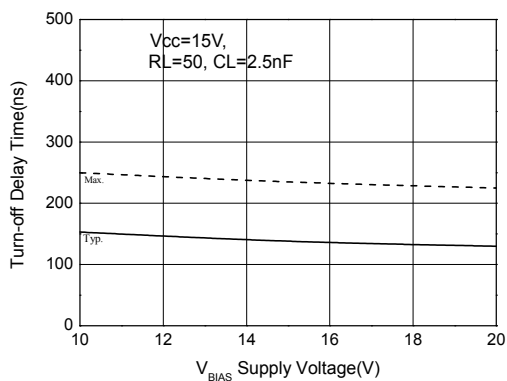


Figure 6b. Turn-Off Delay Time vs VBS Supply Voltage

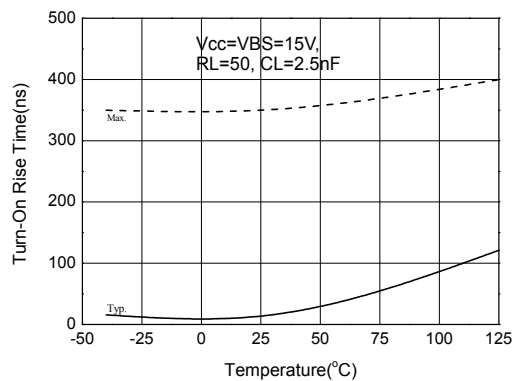


Figure 7a. Turn-On Rising Time vs Temperature

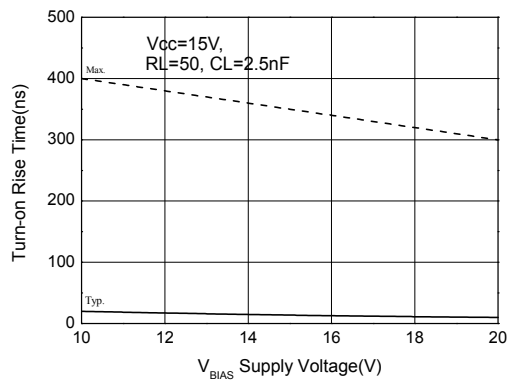


Figure 7b. Turn-ON Rising Time vs VBS Supply Voltage

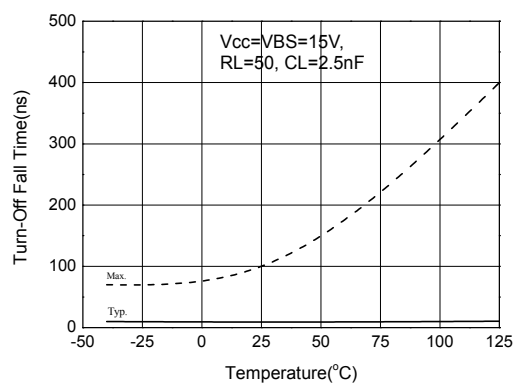


Figure 8a. Turn-Off Falling Time vs Temperature

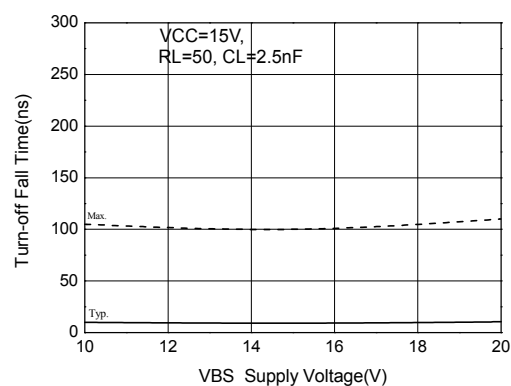


Figure 8b. Turn-Off Falling Time vs VBS Supply Voltage

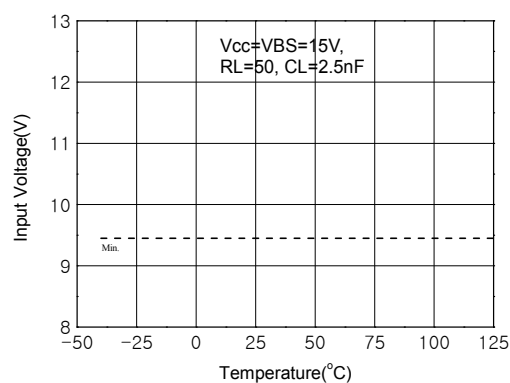


Figure 9a. Logic "1" IN Voltage vs Temperature

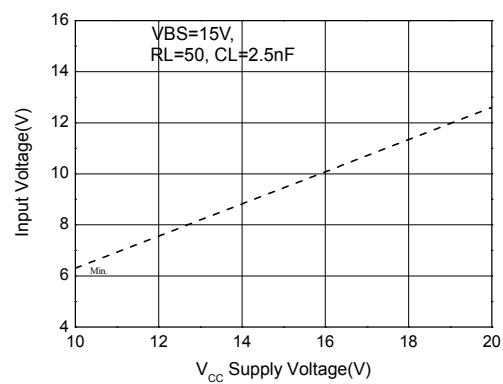


Figure 9b. Logic "1" IN Voltage vs VCC Supply Voltage

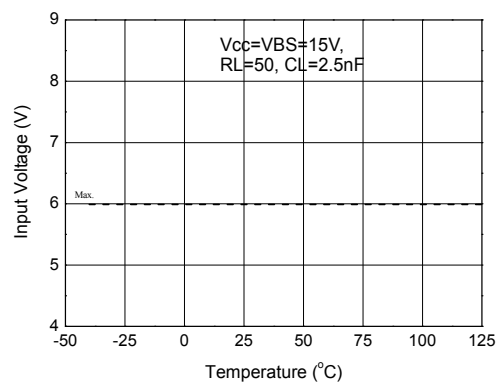


Figure 10a. Logic "0" IN Voltage vs Temperature

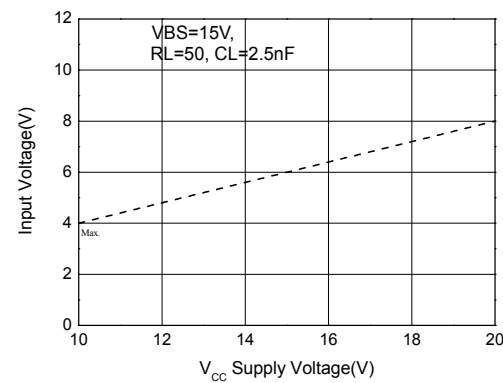


Figure 10b. Logic "0" IN Voltage vs VCC Supply Voltage

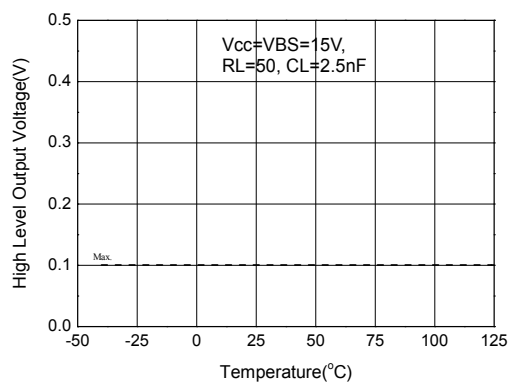


Figure 11a. High Level Output vs Temperature

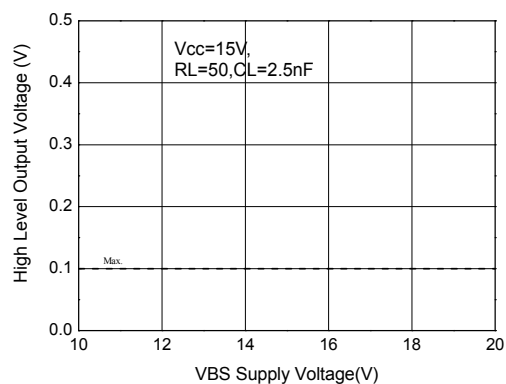


Figure 11b. High Level Output vs VBS Supply Voltage

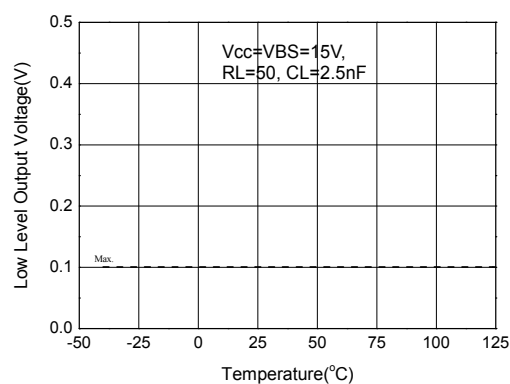


Figure 12a. Low Level Output vs Temperature

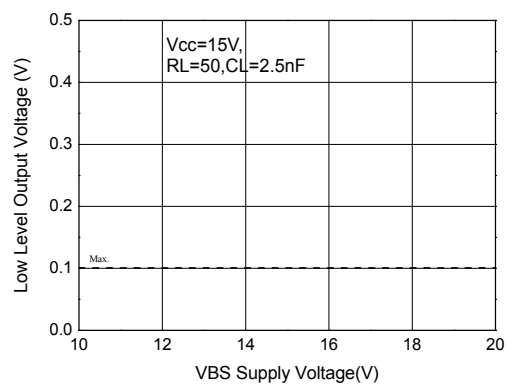


Figure 12b. Low Level Output vs VBS Supply Voltage

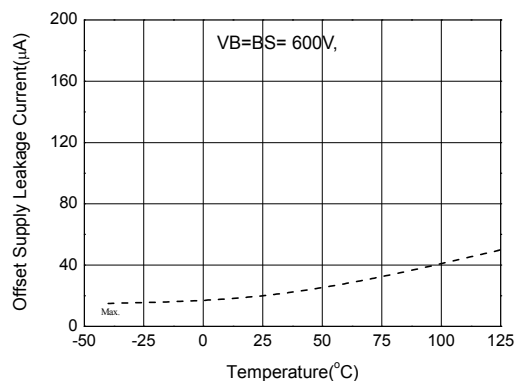


Figure 13a. Offset Supply Leakage Current vs Temperature

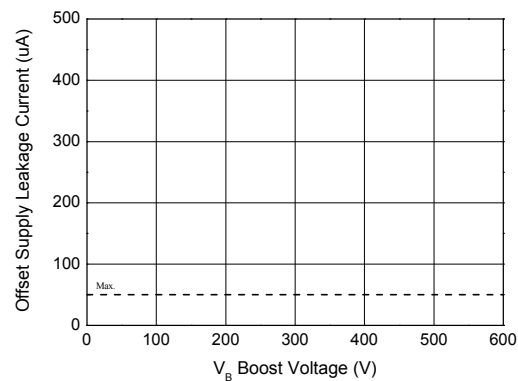


Figure 13b. Offset Supply Leakage Current vs VB Boost Voltage

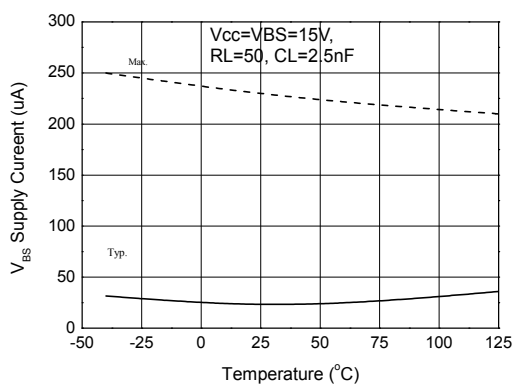


Figure 14a. VBS Supply Current vs Temperature

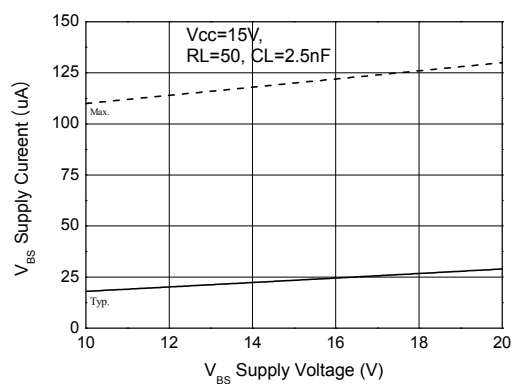


Figure 14b. VBS Supply Current vs VBS Supply Voltage

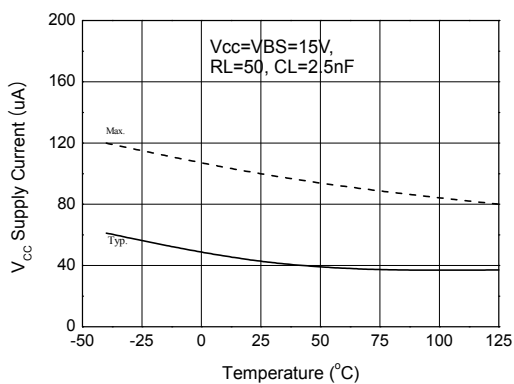


Figure 15a. VCC Supply Current vs Temperature

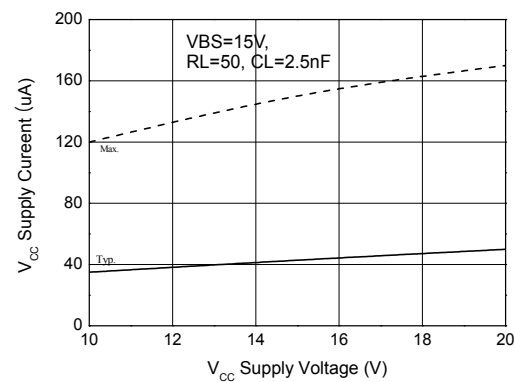


Figure 15b. VCC Supply Current vs VCC Supply Voltage

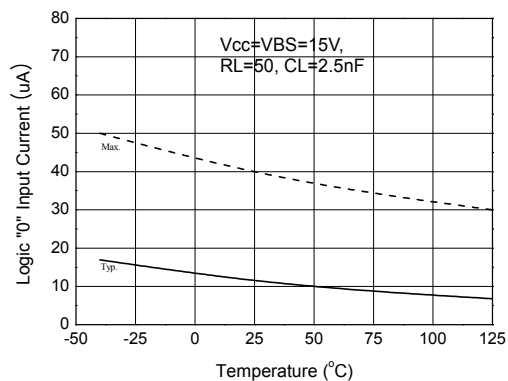


Figure 16a. Logic "0" IN Current vs Temperature

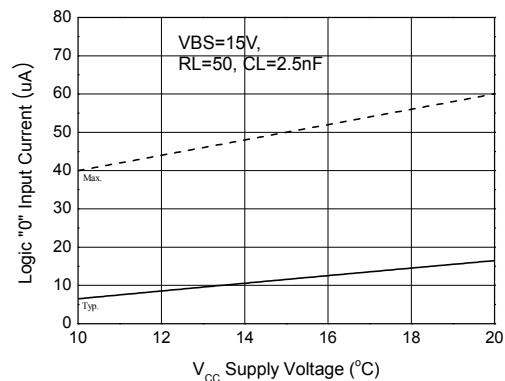


Figure 16b. Logic "0" IN Current vs VCC Supply Voltage

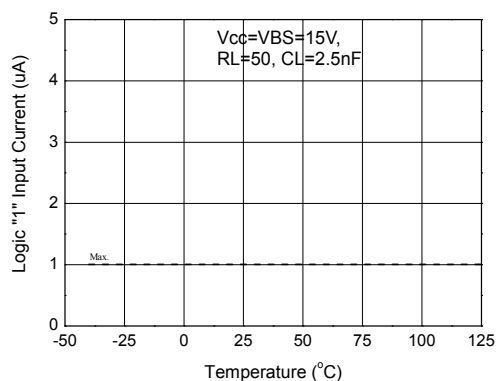


Figure 17a. Logic "1" IN Current vs Temperature

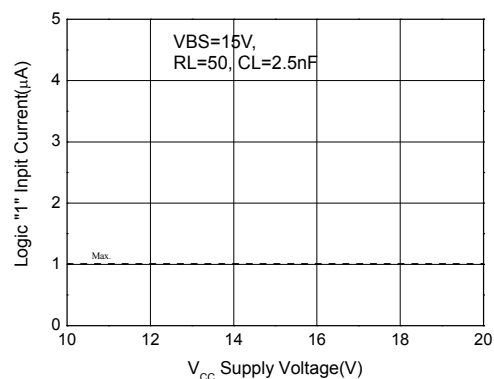


Figure 17b. Logic "1" IN Current vs VCC Supply Voltage

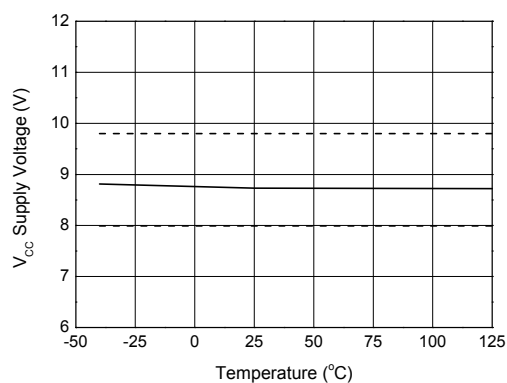


Figure 18a. VCC Under voltage Threshold(+) vs Temperature

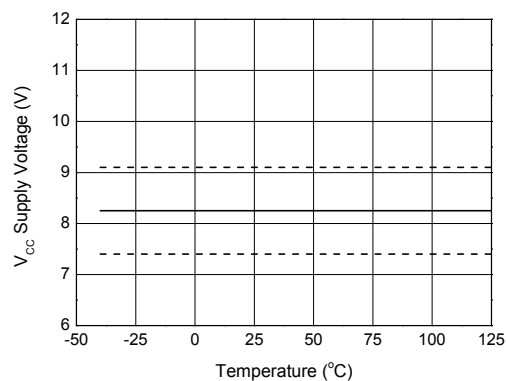


Figure 18b. VCC Under voltage Threshold(-) vs Temperature

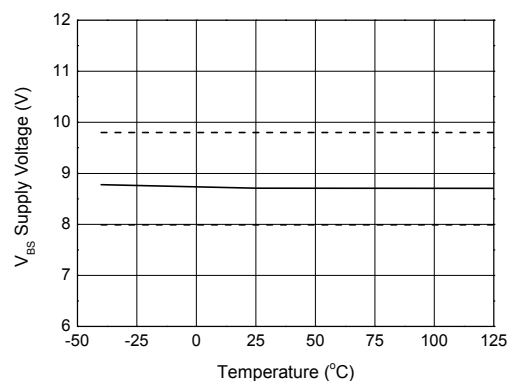


Figure 19a. VBS Under voltage Threshold(+) vs Temperature

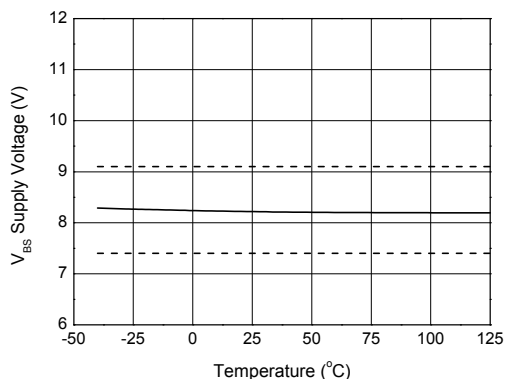


Figure 19b. VBS Under voltage Threshold(-) vs Temperature

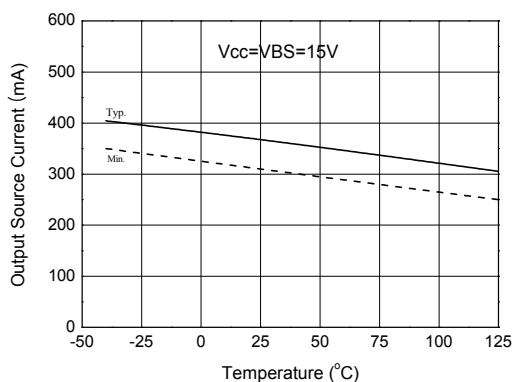


Figure 20a. Output Source Current vs Temperature

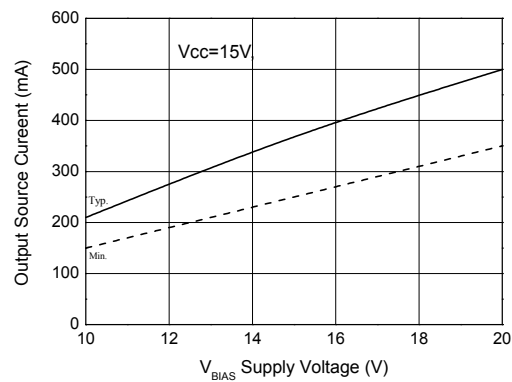


Figure 20b. Output Source Current vs VBS Supply Voltage

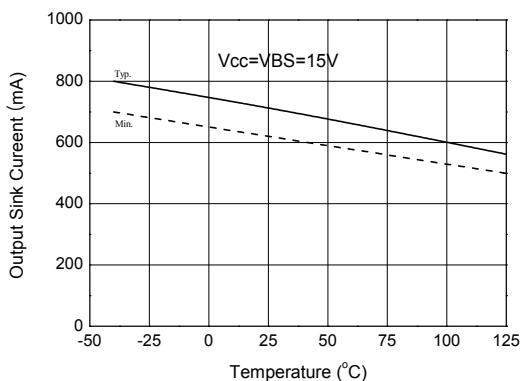


Figure 21a. Output Sink Current vs Temperature

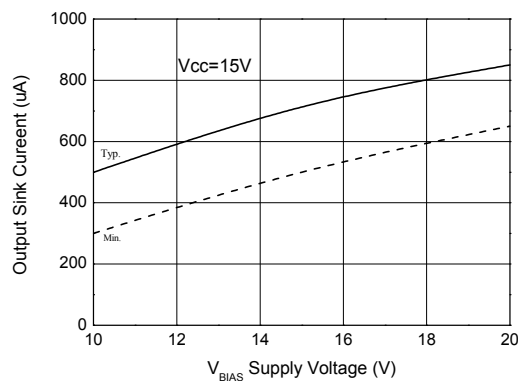


Figure 21b. Output Sink Current vs VBS Supply Voltage

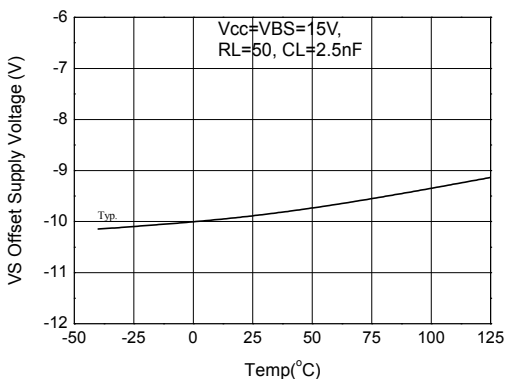


Figure 22a. Maximum VS Negative Voltage vs Temperature

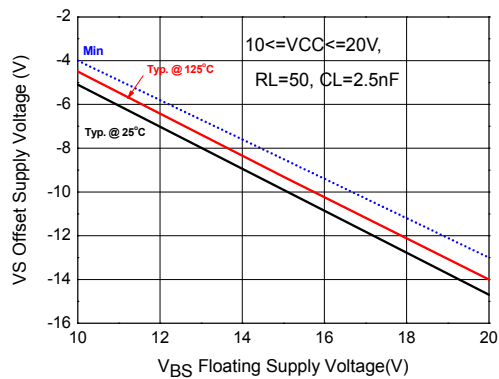


Figure 22b. Maximum VS Negative Voltage vs VBS Supply Voltage





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