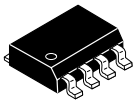
Self-Oscillated, High-Voltage Gate Driver

FAN7387



SOIC8
CASE 751EG

Description

The FAN7387 is a simple control IC for common half-bridge inverters, SMPS, and ballast for fluorescent and HID lamps. The FAN7387 has an oscillating circuit using an external resistor and capacitor.

The frequency variation is very stable across a wide temperature range. The FAN7387 has an external pin for dead-time control and shutdown. Using this resistor, the designer can choose the optimum dead time to reduce power loss on switching devices, such as transistors and MOSFETs.

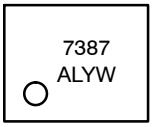
Features

- Internal Clock Using RCT
- External Sync Function Using RCT
- Dead Time Control Using Resistor
- Shut Down (Disable Mode)
- Internal Shunt Regulator
- UVLO Function, High and Low Side
- This Device is Pb-Free and Halide Free

Applications

- Half-Bridge Inverter
- SMPS
- Ballast Solution for High-Intensity Discharge (HID) Lamp
- Ballast for Fluorescent Lamp

MARKING DIAGRAM



7387	= Specific Device Code
A	= Assembly Site
L	= Wafer Lot Number
YW	= Assembly Start Week

ORDERING INFORMATION

See detailed ordering and shipping information on page 12 of this data sheet.

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TYPICAL APPLICATION CIRCUIT

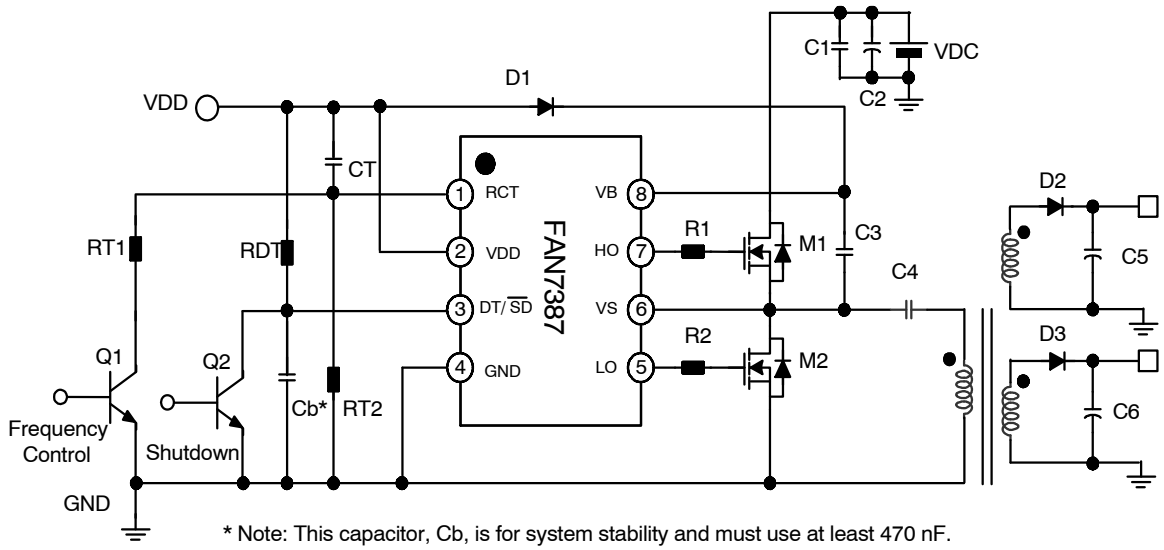


Figure 1. Typical Application Circuit for SMPS (Self Oscillation Method)

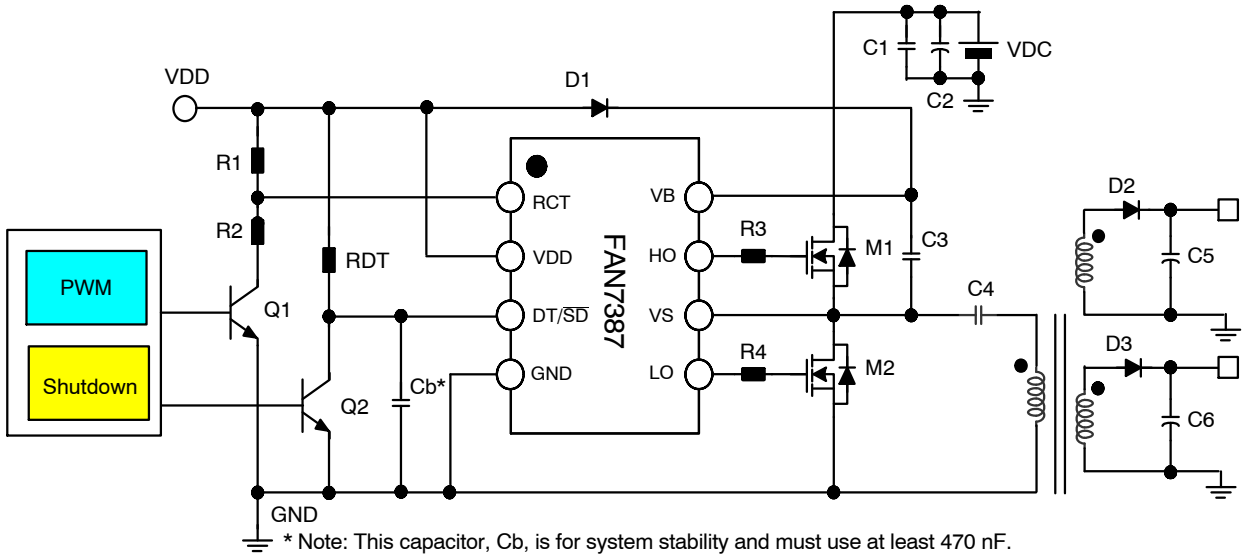
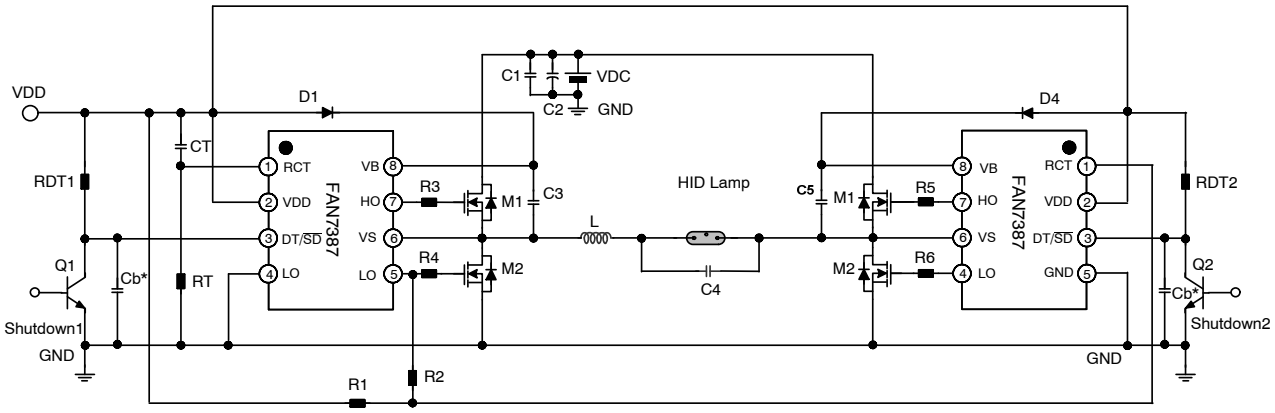


Figure 2. Typical Application Circuit for SMPS by Using External Signal

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TYPICAL APPLICATION CIRCUIT (continued)



* Note: This capacitor, Cb, is for system stability and must use at least 470 nF.

Figure 3. Typical Application Circuit for Full-Bridge Converter

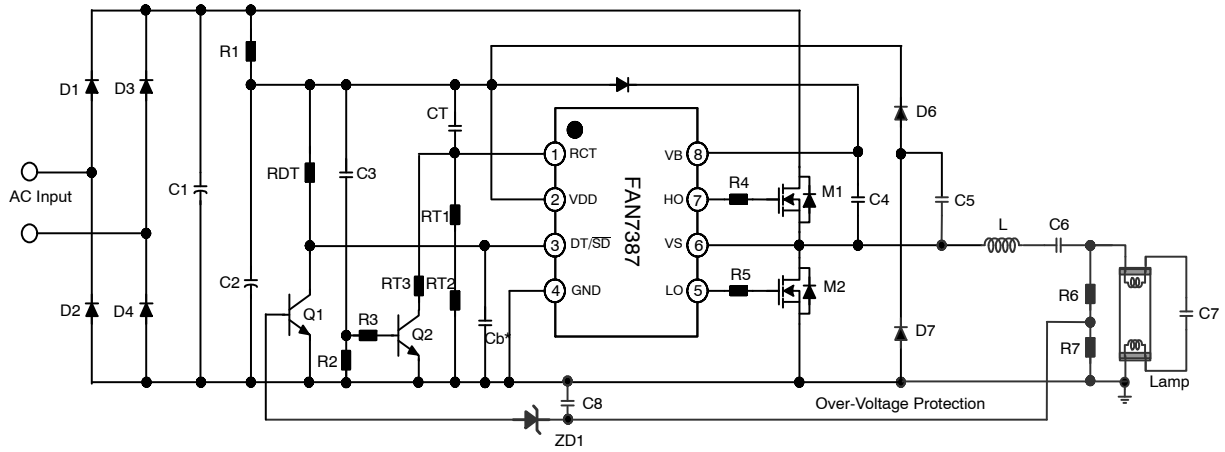


Figure 4. Typical Application Circuit for Fluorescent Lamp Ballast

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INTERNAL BLOCK DIAGRAM

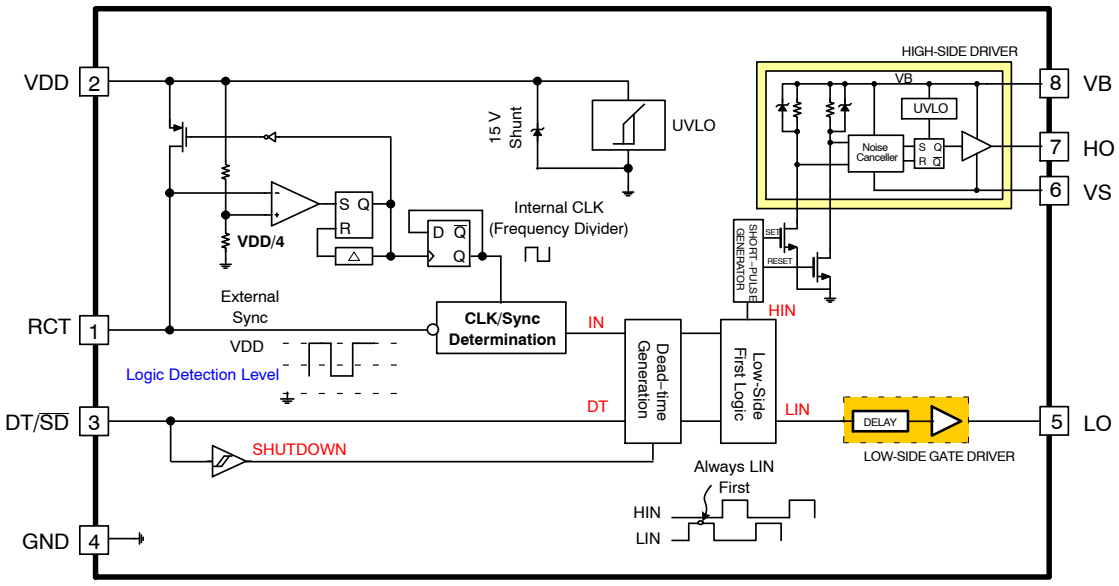


Figure 5. Functional Block Diagram

PIN CONFIGURATIONS

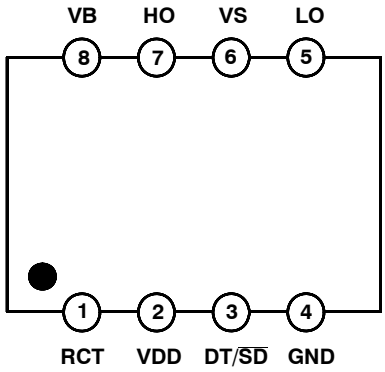


Figure 6. Pin Configurations (Top View)

PIN DEFINITIONS

Pin No.	Symbol	Description
1	RCT	Oscillator frequency set resistor and capacitor.
2	VDD	Supply Voltage.
3	DT/SD	Dead-time control and shutdown (active LOW).
4	GND	Signal Ground.
5	LO	Low-Side Output.
6	VS	High-Side floating supply return.
7	HO	High-Side output.
8	VB	High-Side floating supply.

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ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)

Symbol	Characteristics	Min	Typ	Max	Unit
V_B	High-Side Floating Supply Voltage	−0.3		625.0	V
V_S	High-Side Offset Voltage	−0.3		600.0	V
V_{RCT}	RCT Pins Input Voltage			V_{CL}	V
I_{CL}	Clamping Current Level (Note 1)			25	mA
dV_S/dt	Allowable Offset Voltage Slew Rate		50		V/ns
T_A	Operating Temperature Range	−40		+125	°C
T_{STG}	Storage Temperature Range	−65		+150	°C
P_D	Power Dissipation		0.625		W
θ_{JA}	Thermal Resistance (Junction-to-Air)		200		°C/W

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Do not supply a low-impedance voltage source to the internal clamping Zener diode between the GND and the VDD pin of this device.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_B	High-Side Floating Supply Voltage	V_S + 11	V_S + 14	V
V_S	High-Side Offset Voltage	6 − V_{DD}	600	V
V_{DD}	Low-Side Supply Voltage	11	14	V
V_{HO}	High-Side (HO) Output Voltage	GND	V_{DD}	V
V_{LO}	Low-Side (LO) Output Voltage	GND	V_{DD}	V
V_{IH}	Logic “1” Input Voltage of RCT	(3/4 V_{DD}) + 1		V
V_{IL}	Logic “0” Input Voltage of RCT		(3/5 V_{DD}) − 1	V
R_T	Timing Resistor Value of RCT	2		kΩ
C_T	Timing Capacitor Value of RCT	100		pF
T_A	Ambient Temperature	−40	+125	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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ELECTRICAL CHARACTERISTICS

V_{BIAS} (V_{DD}, V_B–V_S) = 14.0 V, C_L = 1 nF, R_T = 50 kΩ and C_T = 330 pF and T_A = 25 °C, unless otherwise specified.

Symbol	Characteristics	Test Condition	Min	Typ	Max	Unit
LOW-SIDE SUPPLY CHARACTERISTICS (V_{DD})						
VDD_{UV+}	V_{DD} Supply Under-Voltage Positive-Going Threshold	V_{DD} Increasing	9.50	11.00	12.50	V
VDD_{UV-}	V_{DD} Supply Under-Voltage Negative-Going Threshold	V_{DD} Decreasing	7.5	9.0	10.5	V
VDD_{UVH}	V_{DD} Supply Under-Voltage Lockout Hysteresis			2		V
V_{CL}	Supply Camping Voltage	I_{DD} = 10 mA	14.8	15.4		V
I_{QDD}	Low-Side Quiescent Supply Current	R_{DT} = 100 kΩ		220	500	μA
I_{ST}	Startup Supply Current	V_{DD} = 9 V		50	130	μA
I_{LK}	Offset Supply Leakage Current	V_B = V_S = 600 V			10	μA
I_{PDD}	Low-Side Dynamic Operating Supply Current			0.8		mA
HIGH-SIDE SUPPLY CHARACTERISTICS (V_B–V_S)						
VBS_{UV+}	V_{BS} Supply Under-Voltage Negative-Going Threshold	V_B–V_S Increasing	7.7	9.2	10.7	V
VBS_{UV-}		V_B–V_S Decreasing	7.1	8.6	10.1	V
VBS_{UVH}	V_{BS} Supply Under-Voltage Lockout Hysteresis			0.6		V
I_{QBS}	High-Side Quiescent Supply Current			50	130	μA
I_{PBS}	High-Side Dynamic Operating Supply Current			400	800	μA
OSCILLATOR CHARACTERISTICS						
f_{OSC1}	Oscillation Frequency 1	R_T = 50 kΩ, C_T = 330 pF	18	20	22	kHz
f_{OSC2}	Oscillation Frequency 2	R_T = 1 kΩ, C_T = 1 nF	210	250	290	kHz
D	Duty Cycle	Running Mode	47.5	49.0		%
V_{RCT+}	Upper Threshold Voltage of RCT			V_{DD}		V
V_{RCT-}	Lower Threshold Voltage of RCT			V_{DD}/4		V
V_{IH}	Logic “1” Input Voltage of RCT			3/4 V_{DD}		V
V_{IL}	Logic “0” Input Voltage of RCT				3/5 V_{DD}	V
t_D	Dead-Time	R_{DT} = 100 kΩ	500	600	700	ns
t_{DMIN}	Minimum Dead-Time	$V_{DT/SD}$ = V_{DD}	300	400	500	ns
OUTPUT CHARACTERISTICS						
I_{O+}	Output High, Short-Circuit Pulse Current (Note 2)	PW ≤ 10 μs		350		mA
I_{O-}	Output Low, Short-Circuit Pulse Current (Note 2)			650		mA
V_S	Allowable Negative V_S Pin Voltage for Input Signal (V_{RCT}) Propagation to HO			–9.8	–7.0	V
t_{ON}	Turn-On Propagation Time	V_{DD} = V_{BS} = 14 V, $V_{DT/SD}$ = V_{DD}, V_{RCT} = 4 V ~ V_{DD}, f_{OSC} = 20 kHz		550		ns
t_{OFF}	Turn-Off Propagation Time			160		ns
t_R	Turn-On Rising Time	C_L = 1000 pF		50	120	ns
t_F	Turn-Off Falling Time			30	70	ns
PROTECTION CHARACTERISTICS						
$/SD_+$	Shutdown “1” Input Voltage		2.7			V
$/SD_-$	Shutdown “0” Input Voltage				1	V
I_{SD}	Shutdown Current	$V_{DT/SD}$ = 0 after Running Mode		250		μA
t_{SD}	Shutdown Propagation Delay			180		ns

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. These parameters, although guaranteed, is not 100% tested in production.

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SWITCHING DEFINITIONS

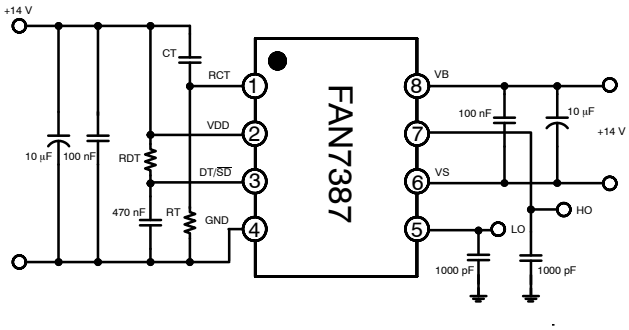


Figure 7. Test Circuit for Self-Oscillation Method

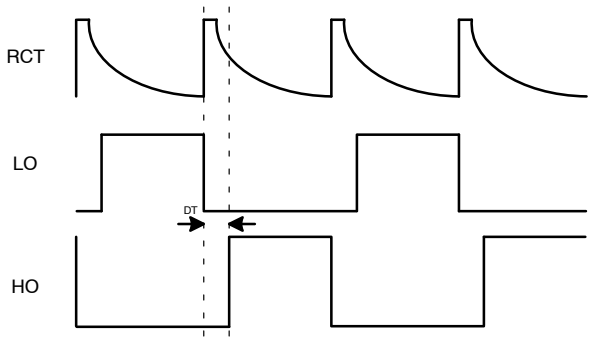


Figure 8. Basic Operating Waveforms of Self-Oscillation

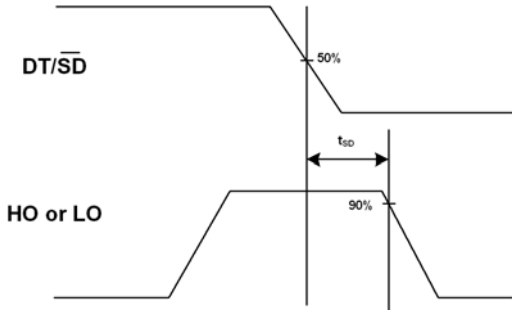


Figure 9. Shutdown Delay Definition

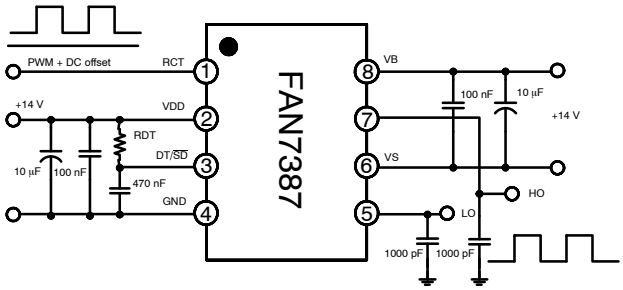


Figure 10. Test Circuit for Forced-Oscillation Method Using External Signal

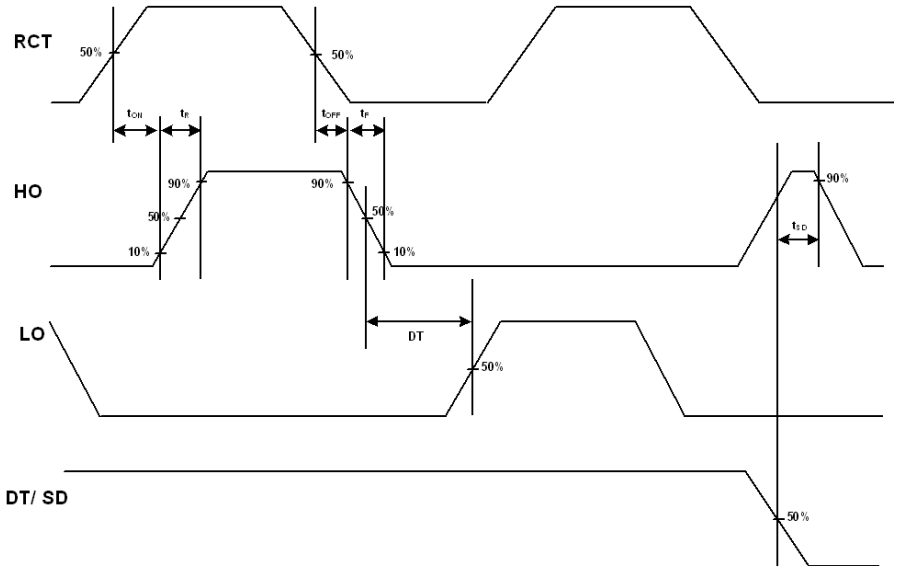


Figure 11. Basic Operation Waveforms of Forced-oscillation Method Using External Signal

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TYPICAL PERFORMANCE CHARACTERISTICS

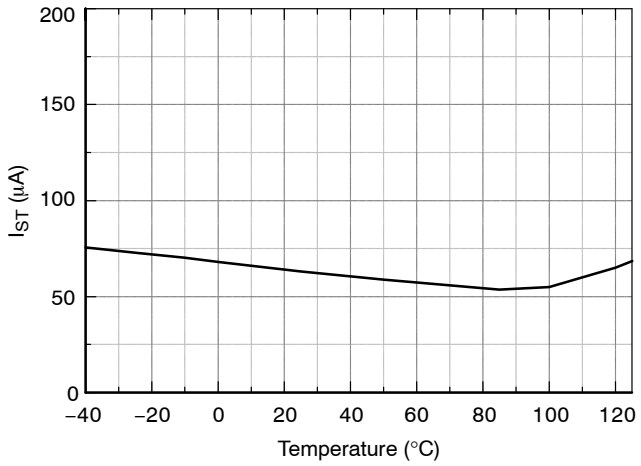


Figure 12. Startup Current vs. Temperature

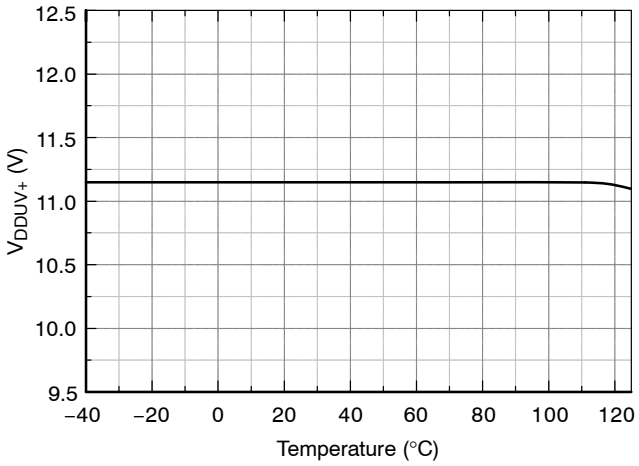


Figure 13. V_{DD} UVLO+ vs. Temperature

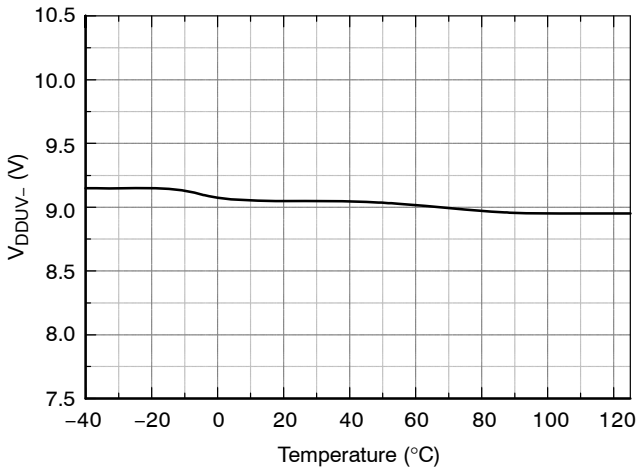


Figure 14. V_{DD} UVLO− vs. Temperature

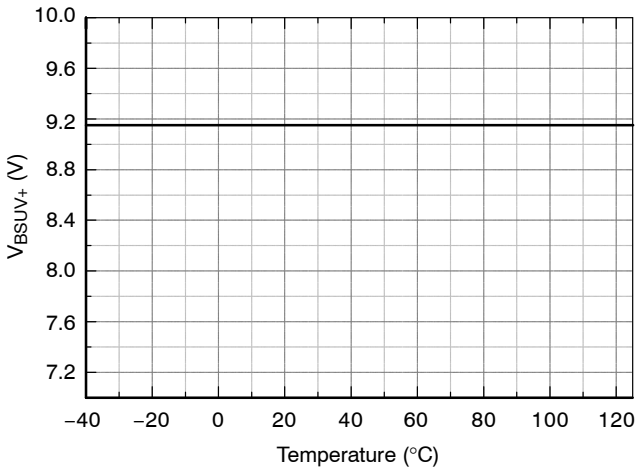


Figure 15. V_{BS} UVLO+ vs. Temperature

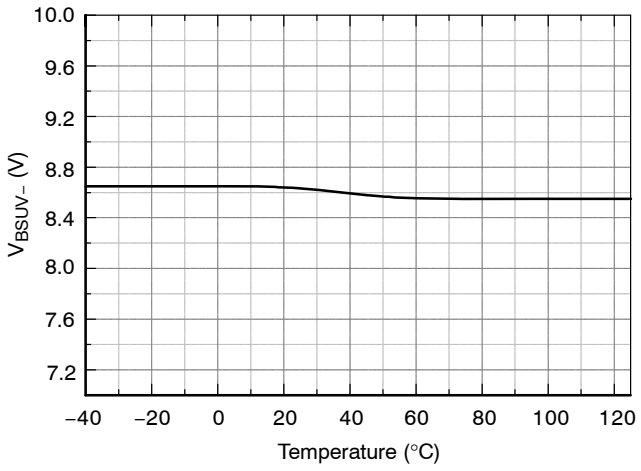


Figure 16. V_{BS} UVLO− vs. Temperature

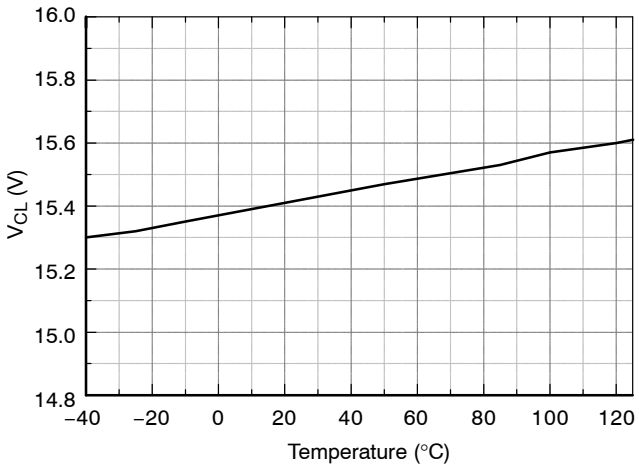


Figure 17. V_{CL} vs. Temperature

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TYPICAL PERFORMANCE CHARACTERISTICS (continued)

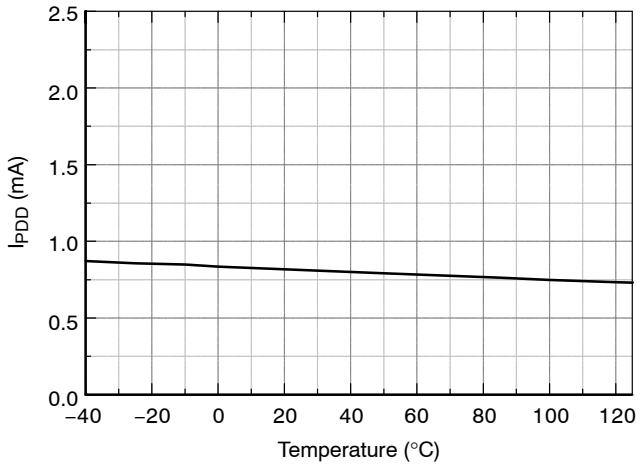


Figure 18. I_{PDD} vs. Temperature

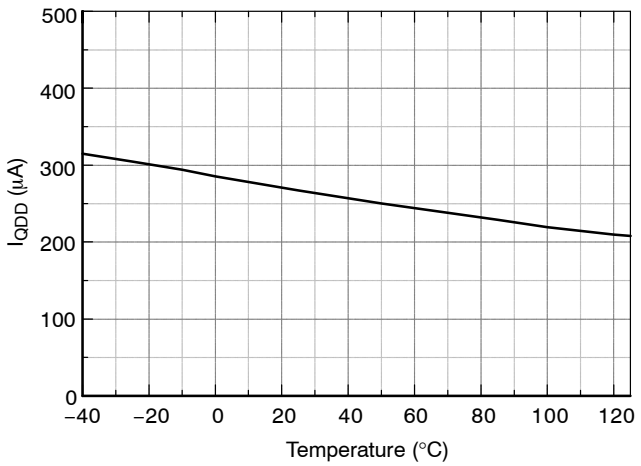


Figure 19. I_{QDD} vs. Temperature

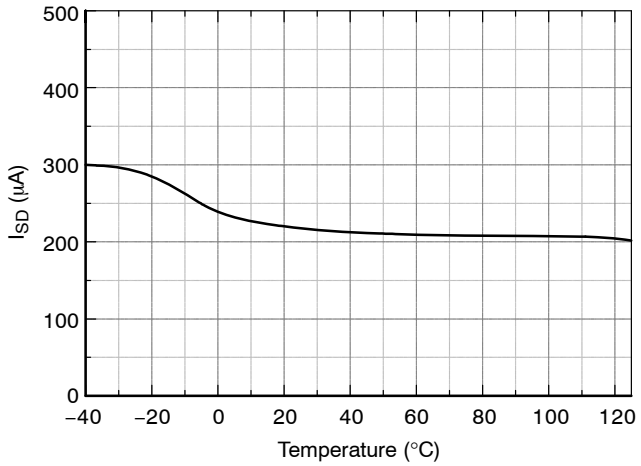


Figure 20. I_{SD} vs. Temperature

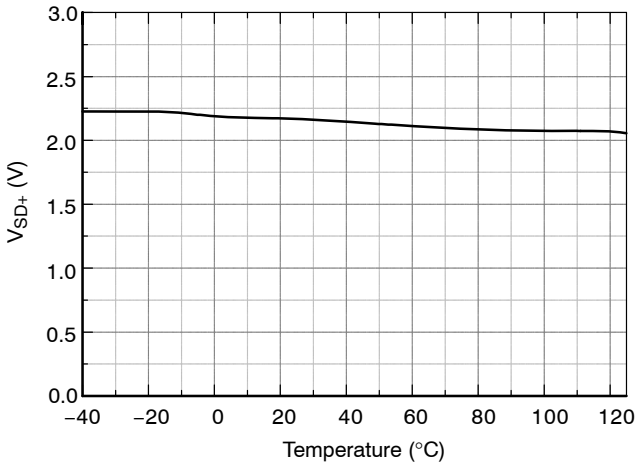


Figure 21. V_{SD}+ vs. Temperature

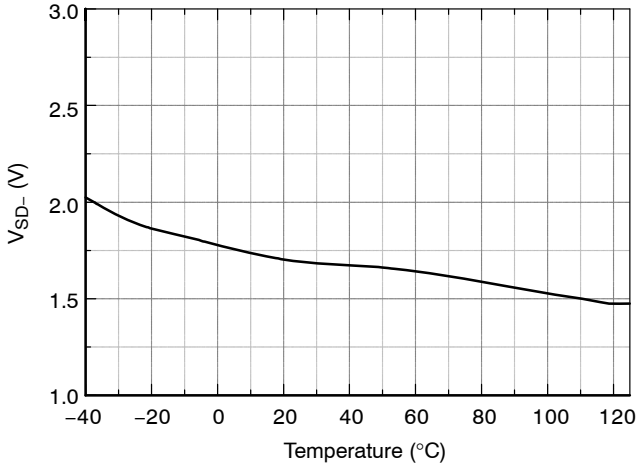


Figure 22. V_{SD}− vs. Temperature

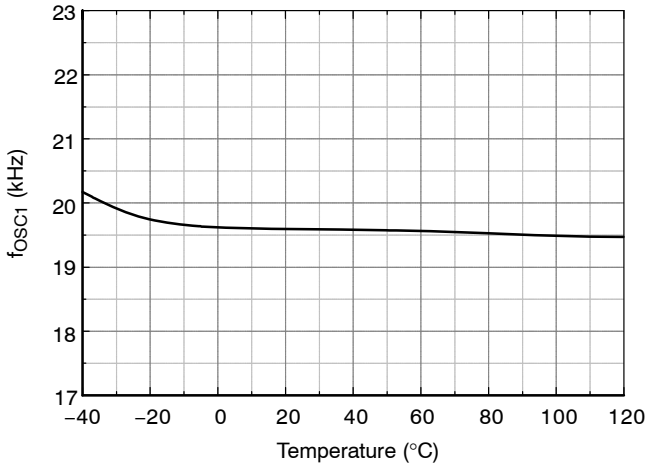


Figure 23. Operating Frequency 1 vs. Temperature

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TYPICAL PERFORMACE CHARACTERISTICS (continued)

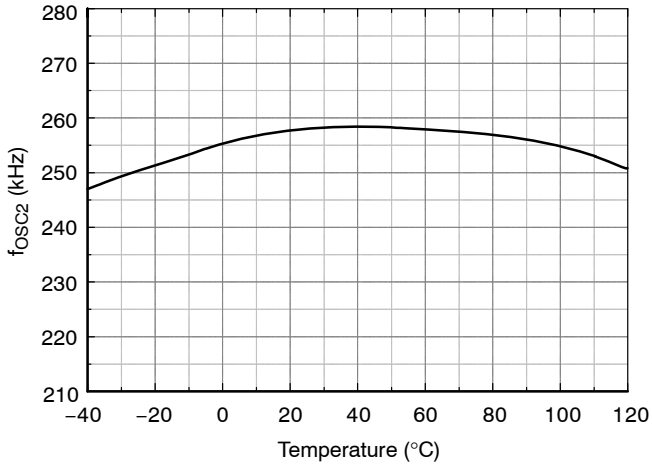


Figure 24. Operating Frequency 2 vs. Temperature

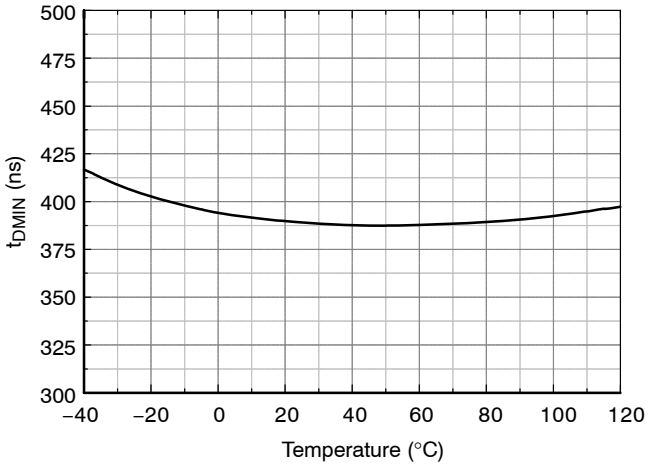


Figure 25. t_{DMIN} vs. Temperature

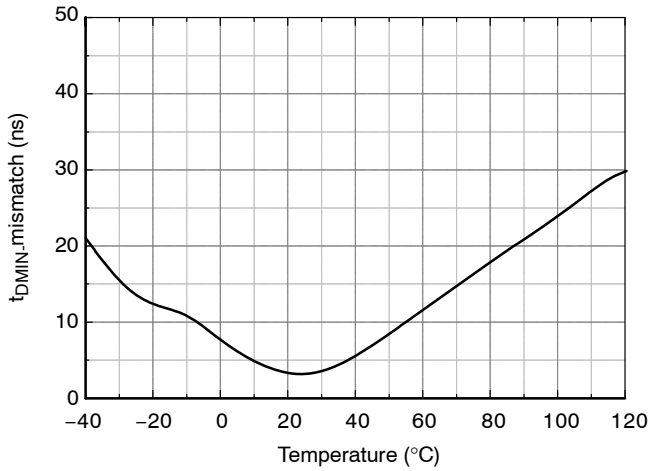


Figure 26. Dead-Time Mismatch vs. Temperature

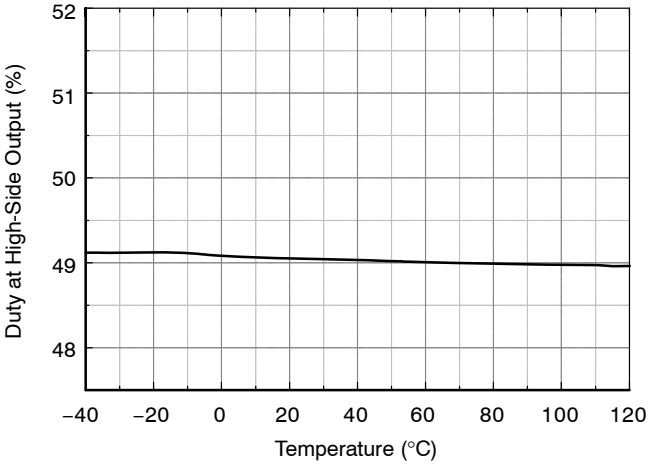


Figure 27. High-Side Duty Ratio vs. Temperature

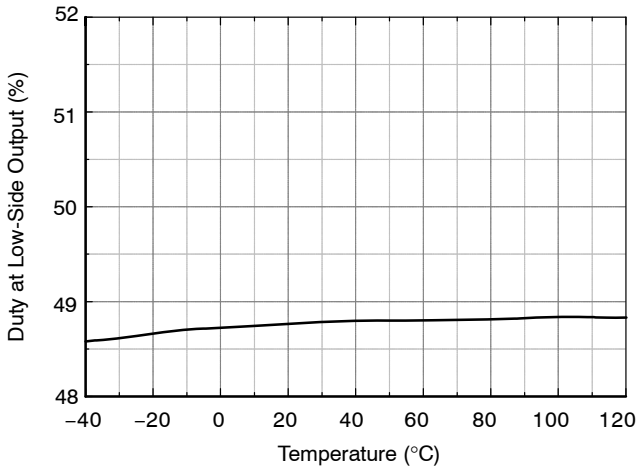


Figure 28. Low-Side Duty Ratio vs. Temperature

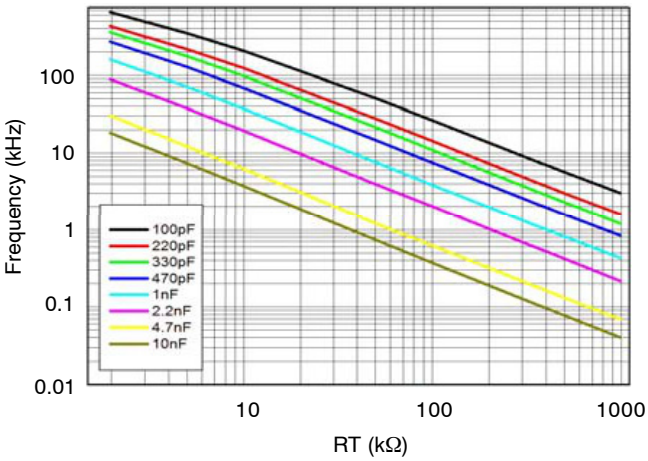


Figure 29. Frequency vs. RT

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FUNCTIONAL DESCRIPTION

Under-Voltage Lockout (UVLO) Function

FAN7387 has a UVLO circuit for a low-side and high-side block. When V_{DD} reaches to the $VDD_{UV}+$, the UVLO circuit is released and the FAN7387 operates normally. At UVLO condition, the FAN7387 has a low supply current of less than 130 μA. Once UVLO is released, FAN7387 operates normally until V_{DD} goes below $VDD_{UV}-$, the UVLO hysteresis.

FAN7387 also has a high-side gate driver. The supply for the high-side driver is applied between V_B and V_S. To prevent malfunction at low supply voltage between V_B and V_S, FAN7387 provides an additional UVLO circuit. If V_B-V_S is under $VBS_{UV}+$, the driver holds LOW state to turn off the high-side switch. Once the voltage of V_B-V_S is higher than VBS_{UVH}, after V_B-V_S exceeds $VBS_{UV}-$, the operation of driver resumes.

Oscillator

The running frequency is determined by an external timing resistor (R_T) and timing capacitor (C_T). The charge time of capacitor C_T from 1/4 V_{DD} to V_{DD} determines the running frequency of LO and HO gate driver output. Figure 30 shows connection configuration.

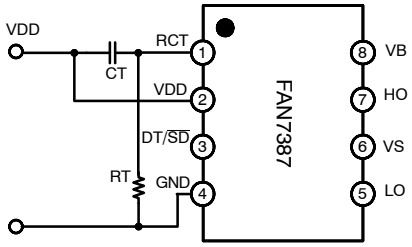


Figure 30. Typical Connection Method

Figure 31 shows the typical waveforms of RCT, LO, and HO. From the circuit analysis, the discharging time of RCT, t, is given by Equation 1:

$$V_{RCT} = V_{DD} \times \ln\left(\frac{-t}{R_t \times C_t}\right) \qquad \text{(eq. 1)}$$

Equation 1 enables calculation of discharging time, t, from V_{DD} to 1/4 V_{DD} by substituting $V_{RCT(t)}$ with 1/4 V_{DD}.

$$t = 1.38 \times R_t \times C_t \qquad \text{(eq. 2)}$$

The running frequency of IC is determined by 1/T and is approximately given as:

$$f_{running} = \frac{1}{T} = \frac{1}{2(t + T_{fix})} \qquad \text{(eq. 3)}$$

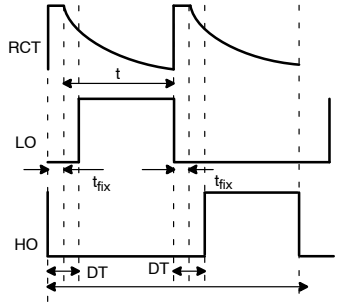


Figure 31. Typical Waveforms of RCT, LO and HO

where, t is the discharging time of the RCT voltage and t_{fix} is constant value about 450 ns of IC.

Programming Dead-Time Control/Shutdown

A multi-function pin controls dead-time using an external resistor (R_{DT}) and protects abnormal condition using an external switch. This pin should be connected to an external capacitor to maintain stable operation.

If the voltage of DT/SD is decreased under 1 V by an external switch, such as the TR or MOSFET, the FAN7387 enters shutdown mode. In this mode, the FAN7387 doesn't have any output signal.

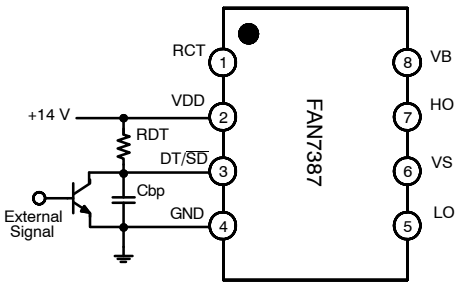


Figure 32. External Shutdown Circuit

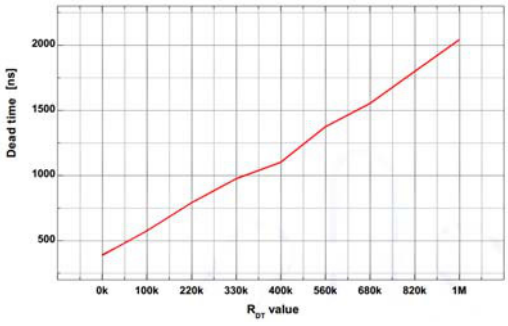


Figure 33. Adjustable Dead Time

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Gate Driver Operation

The FAN7387 has a two operating modes. One is the self-oscillation mode by using external timing resistor (R_T) and external timing capacitor (C_T) and the other is the forced oscillation mode by external PWM signal comes from U-com and the other devices.

Figure 33 shows operation of the IC using an external PWM circuit with additional resistors (R1 and R2) for internal limitation of the IC. The input signal range from an external circuit must be within 3/5 V_{DD} and 3/4 V_{DD}. The external signal produces the HO and LO output and HO signal is in-phase with the external input signal.

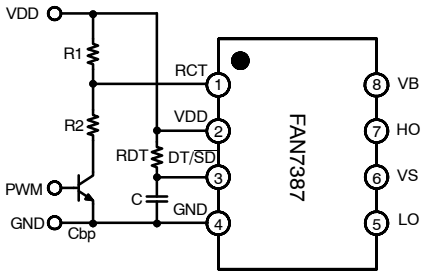


Figure 34. Gate Driver Using External PWM Signal

ORDERING INFORMATION

Device	Package	Operating Temperature Range	Shipping†
FAN7387MX (Note 3)	SOIC8 (Pb-Free, Halide Free)	−40 °C to +125 °C	3000 / Tape & Reel

3. These device passed wave soldering test by JESD22A-111.

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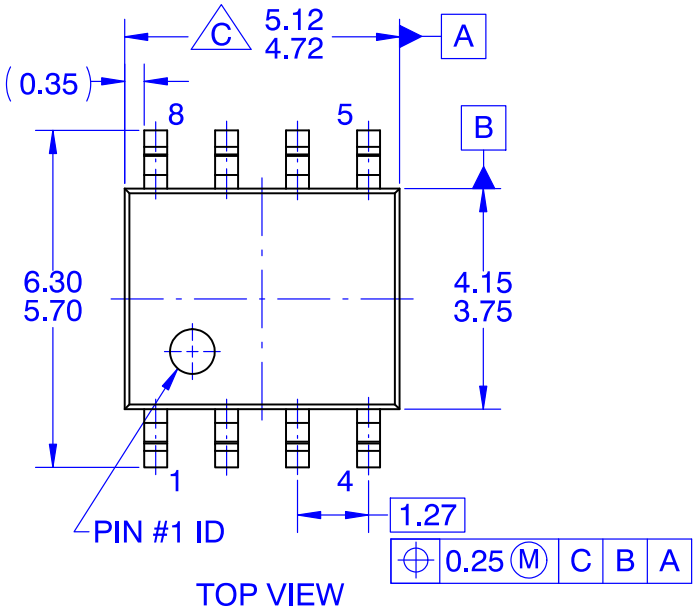
REVISION HISTORY

Revision	Description of Changes	Date
3	Document converted to **onsemi** format.	5/20/2026

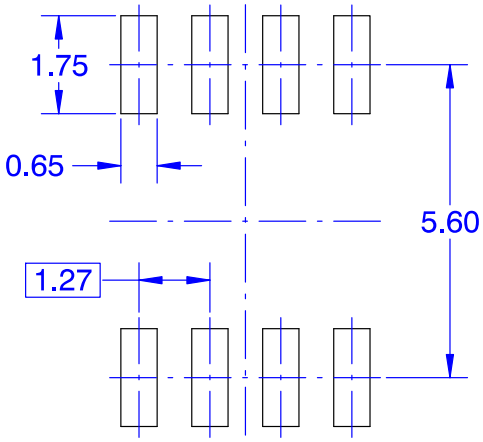
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SOIC8
CASE 751EG
ISSUE O

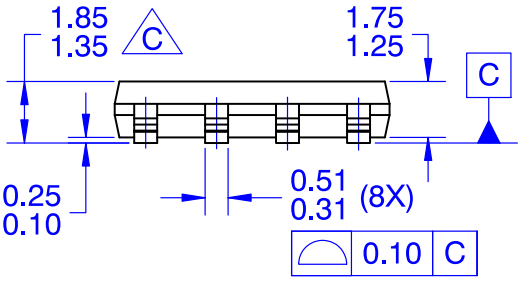
DATE 30 SEP 2016



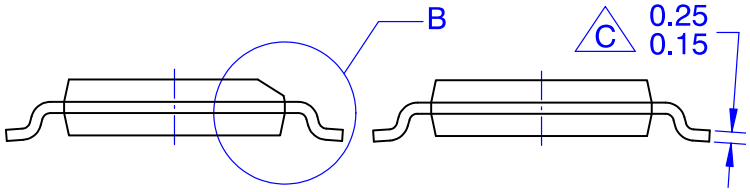
TOP VIEW



LAND PATTERN RECOMMENDATION



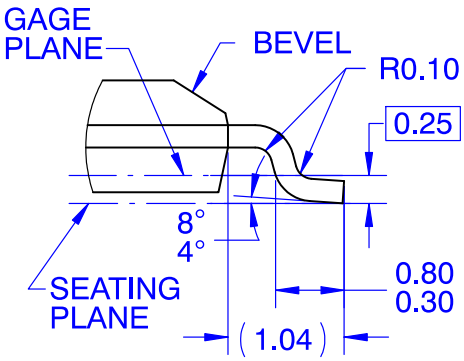
FRONT VIEW



OPTION A
BEVEL EDGE

OPTION B
NON–BEVEL EDGE

SIDE VIEW



DETAIL "B"
SCALE 2:1

NOTES: UNLESS OTHERWISED SPECIFIED

A. THIS PACKAGE CONFORMS TO JEDEC MS–012 VARIATION A EXCEPT WHERE NOTED.
B. ALL DIMENSIONS ARE IN MILLIMETERS
C OUT OF JEDEC STANDARD VALUE
D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
E. LAND PATTERN AS PER IPC SOIC127P600X175–8M

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