照明电器专题

两款采用新型控制器的节能灯电子镇流器

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摘 要 两款新型控制器（FAN7387V 和 FAN7710V）都是将控制电路和半桥功率开关（MOSFET）集成在同一芯片上的新型节能灯电子镇流器控制器。基于新型控制器（FAN7387V 和 FAN7710V）的节能灯镇流器，具有电路简单、元件数量少和参数可由外部元件编程及性能可靠等特点。

关键词 控制器（FAN7387V/FAN7710V） 节能灯 镇流器 参数可编程

紧凑型节能灯（CFL）灯管与电子镇流器是一体化的，安装和更换电子节能灯像白炽灯泡一样方便。对节能灯电子镇流器的基本要求是电路简单，元件数量少，在印制电路板（PCB）上的占位面积和空间小，性能稳定，安全可靠。某半导体公司采用高压工艺制作的新型控制器（FAN7387V 和 FAN7710V），是为满足节能灯电子镇流器的要求而设计的。

1 基于控制器（FAN7387V）控制 IC 的节能灯电子镇流器

1.1 关于控制器（FAN7387V）的一般介绍

控制器（FAN7387V）芯片集成了镇流器控制电路、半桥高端和低端驱动器及作为开关的高端和低端功率开关（MOSFET）。图 1 所示为 FAN7387V 的芯片电路组成框图。

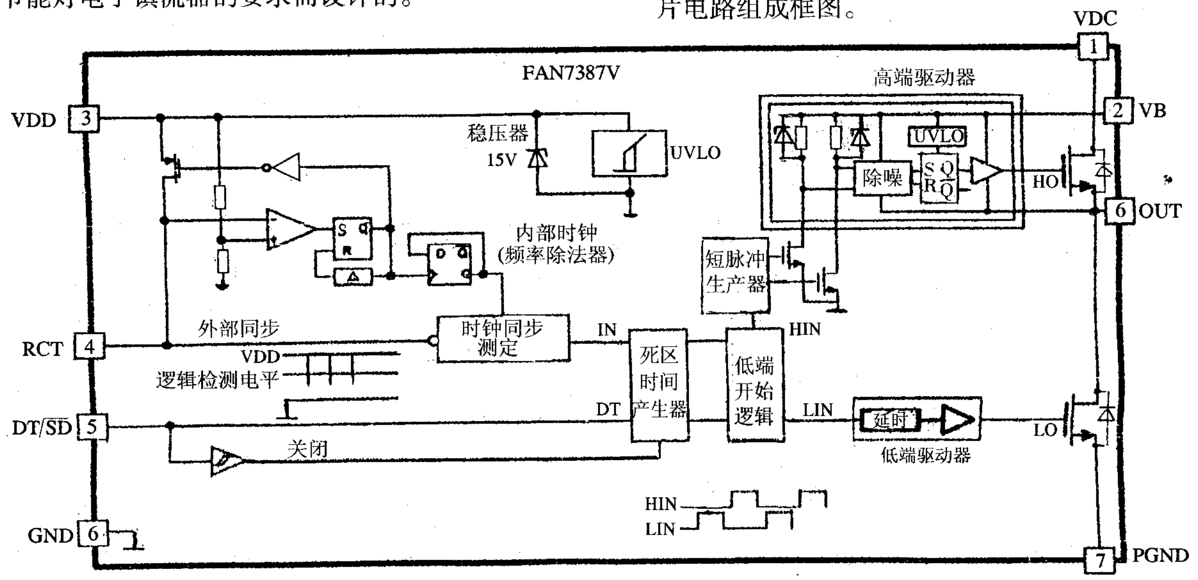

图 1 FAN7387 V 芯片电路组成框图

FAN7387V 采用符合欧盟 ROSH 指令的 8 引脚 DIP 无铅封装(引脚排列参见图 2)，各个引脚功能如表 1 所示。

表 1 FAN7387 V 引脚功能

引脚号	引脚名称	功能
1	VDC	DC 电压输入端，DC 电压值达 440 V 以上
2	VB	高端浮置电源电压输入，最大电压值达 465 V
3	VDD	IC 低压 DC 电源正输入端，内部钳位电压为 15 V
4	RCT	振荡器频率设置电阻和电容连接端
5	DT/$\overline{SD}$	死区时间设置和关闭端
6	GND	信号地
7	PGND	电源和功率级地
8	OUT	半桥输入和高端浮置电源回复端

FAN7387V 的电源电压 V_{DD} 典型值是 14 V，启动电流仅约 60 μA，动态工作电流典型值为 0.6 mA。引脚VDD导通门限电压是 11 V,欠压关闭门限是 8.8 V。

FAN7387V 内部每个功率开关（MOSFET）的耐压达 440 V 以上，导通态电阻为 4.6 Ω。MOSFET 漏极与源极之间的续流二极管正向电流 I_F=380 mA(脉冲电流达 3.04 A)，正向压降 $V_F \leqslant 1.2$ V（@0.38 A)。

FAN7387V 高端和低端两路驱动信号之间的死区(即非交迭)时间及振荡器频率可利用外部元件来设定。

1.2 由 FAN7387V 组成的节能灯电子镇流器电路

由控制器FAN7387V 组成的节能灯电子镇流器电路如图 2 所示。

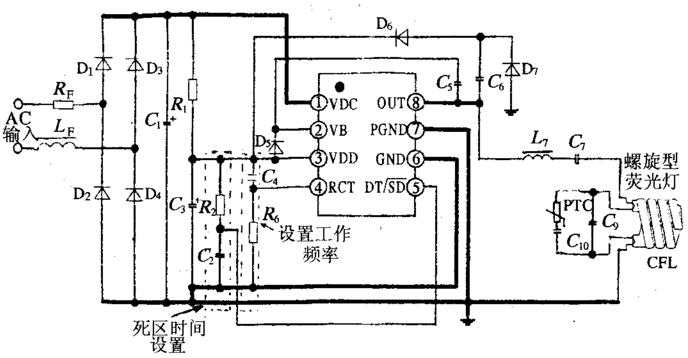

图 2 由控制器 FAN7387V 组成的节能灯电子镇流器电路

图 2 中，R_F 是可熔电阻，L_F 是输入电磁干扰(EMI)滤波电感器，二极管 D_1～D_4 和电容 C_1 组成桥式整流和滤波电路，R_1 是 IC（FAN7387V）引脚 VDD 上的启动电阻，C_3 既是 IC 启动电容同时又是 VDD 引脚上的退耦电容，D_5 和 C_5 分别是自举二极管和自举电容，IC 引脚 RCT 上连接的 R_6 和 C_4 用作设定开关频率，IC 引脚 DT/$\overline{SD}$ 与 VDD 之间的电阻 R_2 用作设置死区时间，D_6、D_7 和 C_6 组成电荷泵电路，L_1 和 C_9 等组成输出谐振槽路，C_7 是耦合电容，PTC 热敏电阻是灯丝预热元件。

在接通 220 V 的交流电源后，桥式整流滤波电路输出约 300 V 的 DC 电压加至 IC 的 VDC 引脚，同时通过 R_1 对 C_3 充电。一旦 IC 引脚 VDD 上的电压超过 11 V，IC 振荡器则启动，半桥电路开始工作。图 3 为 IC 引脚 RCT 和内部驱动信号（LO/HO）电压波形。

图 3 中，t 为 IC 引脚 RCT 上的放电时间，它由 R_6 和 C_4 决定，其值为：

$$t=1.38\times R_6\times C_4$$

开关周期 T 为：

$$T=2\times(t+t_{flx})$$

上式中，t_{flx}=450 ns，为一固定时间。

开关频率 f_{sw} 则为：

$$f_{sw}=\frac{1}{T}=\frac{1}{2\times(t+t_{flx})}=\frac{1}{2\times(1.38\times R_6\times C_4+450\,\mathrm{ns})}$$

若选择 R_6=39 kΩ，C_4=220 pF，开关频率 f_{sw}=41 kHz。

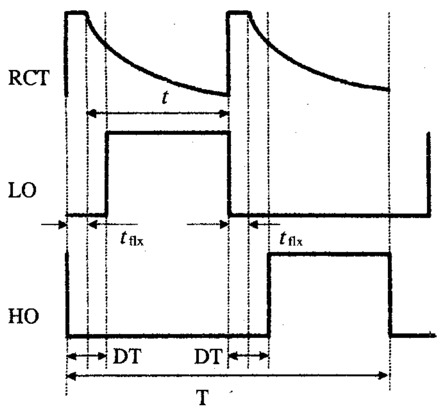

图 3 IC 引脚 RCT 和内部驱动信号（LO/HO）电压波形

图 3 中的 DT 为死区时间，它由 R_2（见图 2）设定。如果选择 R_2=100 kΩ，死区时间则为 540 ns。电容 C_2 对 IC 操作起稳定作用。

自举操作的原理是：当 IC 中低端 MOSFET（见图 1）导通时，V_{DD} 电压通过 D_5 对 C_5 充电。当 C_5 上的充电电压达到 9 V 时，IC 中低端 MOSFET 关断，高端 MOSFET 导通，C_5 则放电。只要 IC 引脚 VB 上的电压因 C_5 放电降至 8.5 V 以下，高端 MOSFET 关断，低端 MOSFET 将再一次导通。如此周而复始，半桥电路中两个 MOSFET 轮流导通，输出占空因数为 50% 的方波电压。经输出网络，加在灯管上的高频电流为正弦波。

当 IC 启动在引脚 OUT 上产生高频输出后，IC 引脚 VDD 则由 D_6、D_7 和 C_6 组成的电荷泵辅助电源供电。这样，就可以使用低功率的启动电阻 R_1(0.25 W)，从而减小 R_1 的功率损耗。在半桥输出电压的斜升沿上，输出信号经 C_6 耦合，经过二极管 D_6 对电容 C_3 充电；在输出电压斜降沿上，D_6 阻断，电流通过 D_7 和 C_6 放电。电荷泵电路可以简单理解为是一种高频整流滤波电路。

FAN7387 V 引脚 DT/$\overline{SD}$ 上的电压利用外部开关将其拉低到 1 V 以下，IC 将进入关闭模式，不再产生输出信号。

如果图 2 所示的镇流器电路所配接的灯管功率是 20 W，元件的选取参见表 2。

表 2　用 FAN7387V 作控制器的 20 W 节能灯镇流器元件

元　件	数值或型号	元　件	数值或型号	元　件	数值或型号
RF	0.5 Ω，0.5 W	R_2	100 kΩ，1/4 W	C_6	470 pF/1 kV
LF	1 mH	C_2	100 nF/25 V	L_1	2.5 mH（280 匝）
D_1～D_4	IN4007，1 kV/1 A	C_4	330 pF/25 V	C_7	47 nF/400 V
R_1	470 kΩ，1/4 W	R_6	50 kΩ，1/4 W	C_9	4.7 nF/1 kV
C_1	22 μF/400 V	D_5～D_7	UF4007，1 kV/ 1A	C_{10}	100 nF/630 V
C_3	10 μF/50 V	C_5	100 nF/50 V	PTC 元件	R_{25}=100 Ω，T_C=100 ℃

表 2 中，L_1 采用 EE1916S 磁心，共 280 匝（漆包线线径 0.2 mm）；PTC 热敏元件常温（25 ℃）电阻 R_{25}=100 Ω，居里点温度 T_C=100 ℃，灯丝预热时间约 1:5 s。

2 基于控制器（FAN7710V）的节能灯电子镇流器

2.1 控制器（FAN7710）简介

FAN7710V 与 FAN7387V 一样，采用 8 引脚 DIP 无铅封装，引脚排列如图 4 所示。

与 FAN7387V 比较，FAN7710V 引脚 4 和引脚 5 的名称和功能不同，而其它引脚名称和功能与 FAN7387V 是一样的。

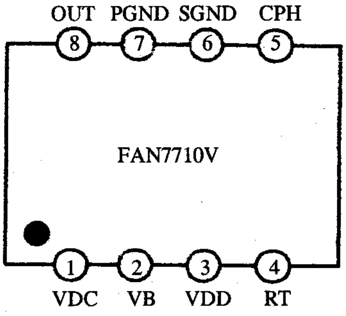

图 4　FAN7710V 引脚排列

FAN7710V 的引脚 4（RT）是振荡器频率设置电阻连接端，利用单个电阻（R_T）就可以设定开关频率，而不需要连接定时电容（C_T）。FAN7710V 的引脚 5（CPH）是预热时间设置电容（C_{PH}）连接端，而 FAN7387V 的引脚 5（DT/$\overline{SD}$）是死区时间设置和关闭端。FAN7710V 的高/低端驱动器和功率 MOSFET 输出级与 FAN7387V 是一样的，MOSFET 的参数也基本相同。

FAN7710V 提供灯阴极预热功能，而 FAN7387V 不具有这一功能。因此，基于 FAN7387V 的节能灯镇流器，需加 PTC 热敏电阻才能实现预热启动。

FAN7710V 在灯触发（点火）模式后，能够利用内部有源零电压开关（ZVS）电路检测开关操作。FAN7710V 还提供灯开路保护。因此，FAN7710 在功能方向优于 FAN7387V。

2.1 基于 FAN7710V 的节能灯电子镇流器电路

采用 FAN7710V 作控制器的节能灯电子镇流器电路如图 5 所示。由于 FAN7710V 与 FAN7387V 一样，集成了半桥高/低端功率 MOSFET，使得镇流器电路非常简单。

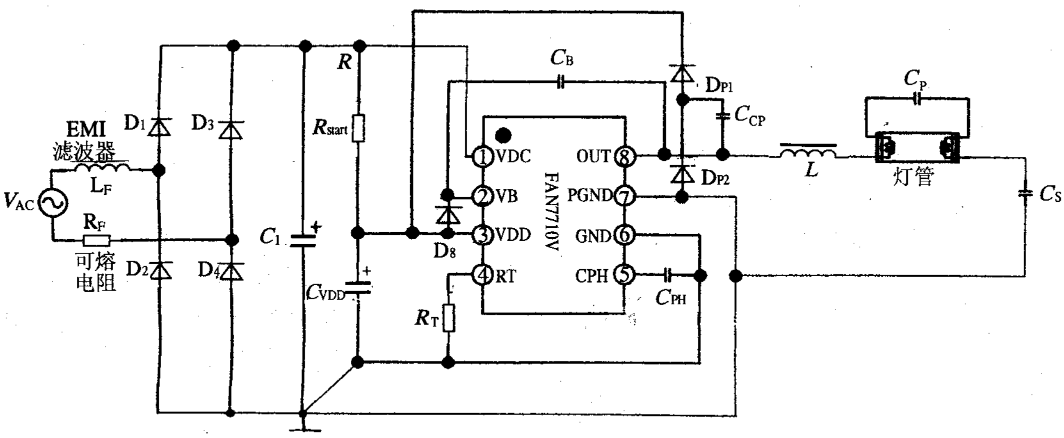

图 5　采用 FAN7710V 的节能灯电子镇流器电路

与图 2 所示的镇流器电路比较，图 5 所示的采用 FAN7710V 的镇流器电路基本相同，所不同的是

FAN7710V 引脚 4 和 5 上的电路元件与 FAN7387V 不同，并且灯管上无需连接 PTC 热敏电阻预热元件。

基于 FAN7710V 的镇流器有 4 种工作模式，见图 6 说明。

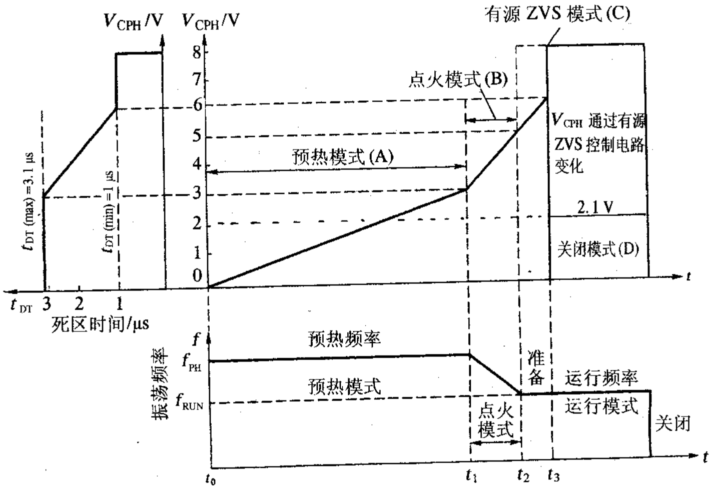

图 6 基于 FAN7710V 的镇流器工作模式

(1) 预热模式 ($t_0 \sim t_1$)

在系统加电 FAN7710V 启动后，IC 内部一个 2 μA 的电流源 I_{PH} 从 IC 引脚 5 流出，对外部电容 C_{PH} 充电。C_{PH} 上的电压从 0 V 线性增加到 3 V 所需要的时间即为灯丝预热时间 t_{PH}（即 $t_0 \sim t_1$），计算公式为：

$$t_{PH} = (3\ V \times C_{PH}) / I_{PH} = (3\ V \times C_{PH}) / 2\ \mu A \qquad (1)$$

预热频率 f_{PH} 为运行频率 f_{RUN} 1.6 倍，它主要由 IC 引脚 4 上的电阻 R_T 确定，计算公式为：

$$f_{PH} = 1.6\ f_{RUN} = 1.6 \times (4 \times 10^9 / R_T) \qquad (2)$$

式中，R_T 单位是Ω，f_{PH} 单位为 Hz。

在预热模式，死区时间 $t_{DT} = t_{DT\ (max)} = 3.1$ μs（见图 6 左部）

(2) 点火（即触发）模式（$t_1 \sim t_2$）

预热结束后，对电容 C_{PH} 的充电电流 I_{IGN} 增加到 12 μA，C_{PH} 上的电压 V_{CPH} 升高速率增大，振荡器频率衰减，向运行频率 f_{RUN} 斜偏。当扫描频率接近镇流器输出 L 和 C_S 串联电路的固有频率时，则发生谐振，在电容 C_S 上产生一个高压脉冲施加到灯管上，将灯管击穿而点亮。

电压 V_{CPH} 从 3 V 增加到 5 V 的时间为点火时间 t_{IGN}，计算公式为：

$$t_{IGN} = (2\ V \times C_{PH}) / 12\ \mu A \qquad (3)$$

(3) 运行模式（$t_2 \sim$）和有源零电压开关（ZVS）模式（$t_3 \sim$）

在点火结束时，当 V_{CPH} 超过 5 V 时，镇流器进入运行模式（$t_2 \sim$），工作频率由 R_T 固定在一个不变的值上，计算公式为：

$$f_{RUN} = 4 \times 10^9 / R_T \qquad (4)$$

V_{CPH} 从 5～6 V（$t_2 \sim t_3$）是为有源 ZVS 操作作准备。一旦 V_{CPH} 达到 6 V（t_3），死区时间达到最小值（1 μs），有源 ZVS 控制电路被激活，FAN7710V 通过控制死区时间来满足 ZVS 条件，以使 IC 中功率 MOSFET 有最小的开关损耗，降低芯片结温并提高系统效率。

（4）关闭模式

如果 FAN7710V 结温超过 160℃，将会进入关闭模式。若利用图 7 所示的外部电路，使 IC 引脚 CPH 上的电压 V_{CPH} 降至 2.1 V 以下，也将进入关闭模式。在关闭模式，IC 振荡器截止，不再产生输出信号，仅消耗 250 μA 的电流。

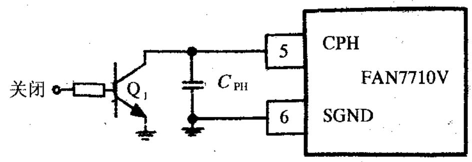

图 7　外部关闭控制电路

一旦出现灯开路，LC 谐振电路将会失效，破坏 ZVS 条件，使 FAN7710V 的功耗增加，有可能使其损坏。FAN7710V 能够自动检测灯开路故障，并提供灯开路或灯未接入 保护。

如果灯管功率是 20 W，运行频率 $f_{RUN} = 44$ kHz，

灯阴极预热时间 $t_{PH} = 0.75$ s，根据（4）式，R_T 值为：$R_T = f_{RUN} / 4 \times 10^9 = 44\ kHz / 4 \times 10^9 = 90.9\ k\Omega$

选择 $R_T = 90$ kΩ。在此情况下，$f_{RUN} = 44.4$ kHz。预热频率 f_{PH} 根据（2）式计算：

$$f_{PH} = 1.6 \times 44.4\ kHz \approx 71\ kHz$$

根据（1）式，预热电容 C_{PH} 的电容量为：

$$C_{PH} = (t_{PH} \times 2\ \mu A) / 3\ V = (0.75\ s \times 2\ \mu A) / 3\ V = 0.5\ \mu F$$

选 $C_{PH} = 0.47$ μF。

其它元件的选择与图 2 所示电路是一样的(见表 2)。

3 结束语

采用 FAN7387V 和 FAN7710V 设计节能灯电子镇流器，仅约外加 20 个元件，电路简单，易于设计，成本低，工作频率等参数可由 IC 外部阻容元件根据需要来设定。系统工作稳定，安全可靠。

参考文献

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[2] 毛兴武，[redacted]．新型电子镇流器原理与设计 [M]．北京：人民邮电出版社，2007

FAIRCHILD SEMICONDUCTOR®

July 2009

FAN7387V
Ballast Control IC for Compact Fluorescent Lamp

Features

- Integrated Half-Bridge MOSFET
- Internal Clock Using RCT
- Enable External Sync Function Using RCT
- Dead-Time Control by using Resistor
- Shut Down (Disable Mode)
- Internal Shunt Regulator
- UVLO Function High and Low Side

Applications

- Compact Fluorescent Lamp Ballast

Description

The FAN7387V, developed using Fairchild's unique high-voltage process and system-in-package (SiP) concept, is a ballast-control integrated circuit (IC) for a compact fluorescent lamp (CFL). The FAN7387V has a simple oscillating circuit using an external resistor and capacitor so the frequency variation is stable across the temperature range. FAN7387V has a external pin for dead time control and shutdown. By using this resistor, a designer can choose the optimum dead time to reduce the power loss on internal switching devices (MOSFETs).

8-DIP

Ordering Information

Part Number	Operating Temperature	Eco Status	Package	Packing Method
FAN7387VN	-40 to +125°C	RoHS	8-Lead, Dual-In-line Package (DIP)	Tube

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Typical Applications Diagrams

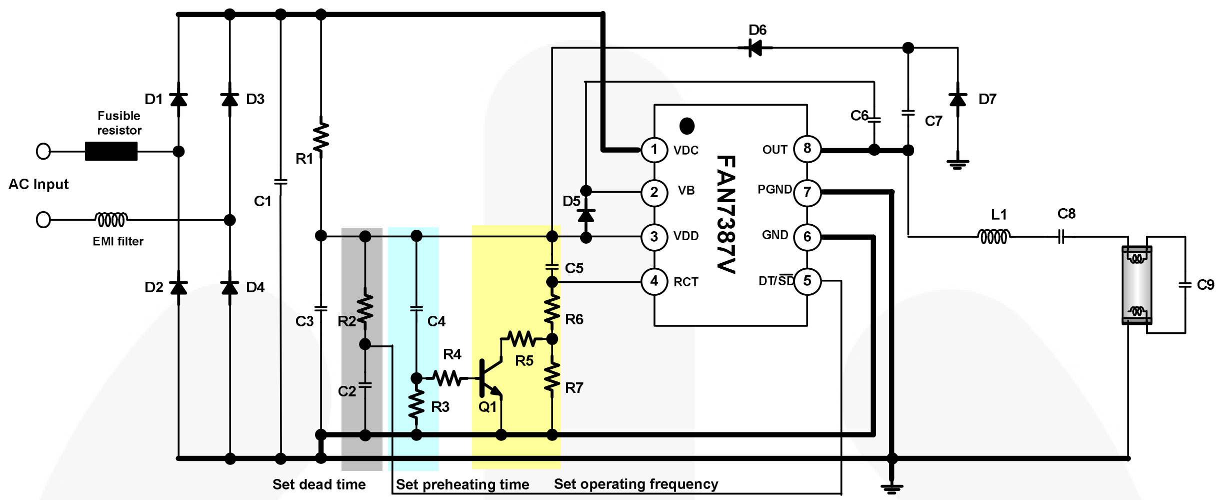


Figure 1. Typical Application Circuit for Fluorescent Lamp (Rapid Starting Method without PTC)

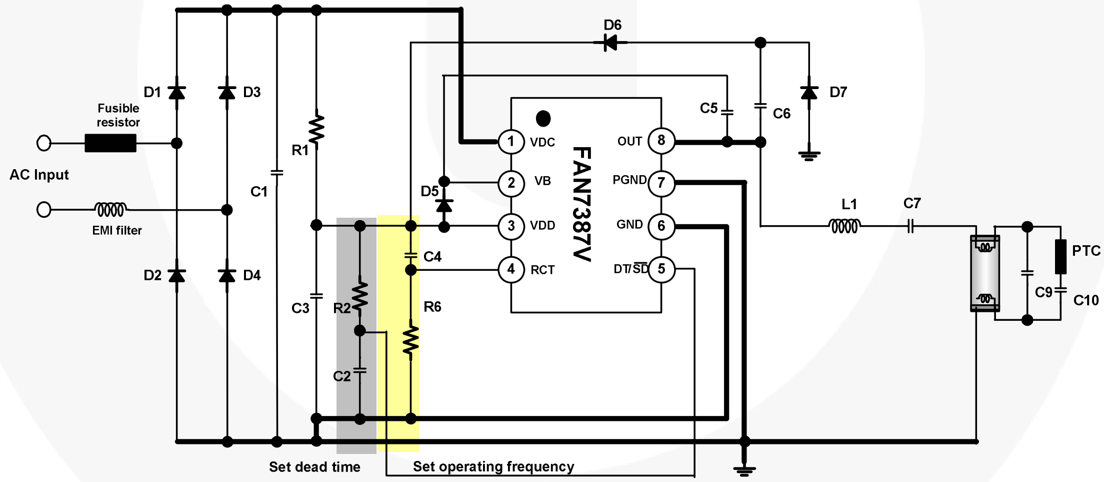


Figure 2. Typical Application Circuit for Fluorescent Lamp (Rapid Starting Method with PTC)

Internal Block Diagram

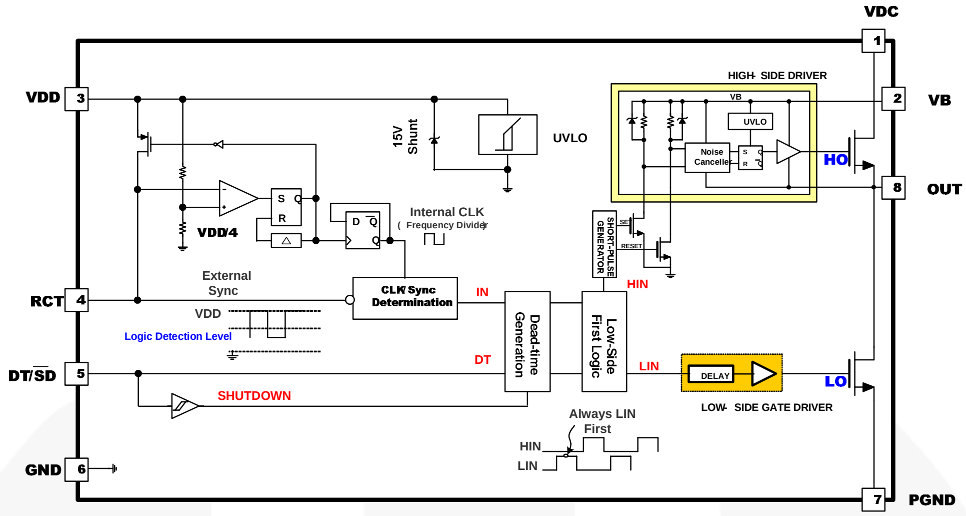


Figure 3. Functional Block Diagram

Pin Configuration

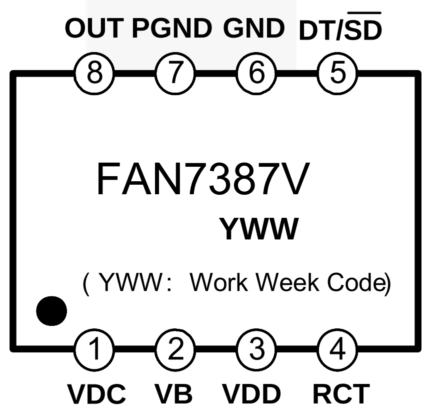


Figure 4. Pin Configurations (Top View)

Pin Definitions

Pin #	Name	Description
1	VDC	High-voltage Supply
2	VB	High-Side Floating Supply
3	VDD	Supply Voltage
4	RCT	Oscillator Frequency Set Resistor and Capacitor
5	DT/SD	Dead Time Set Resistor
6	GND	Signal Ground
7	PGND	Power Ground
8	OUT	High-Side Floating Supply Return

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. T_A=25°C unless otherwise specified.

Symbol	Parameter	Min.	Typ.	Max.	Unit
VB	High-Side Floating Supply	-0.3		465.0	V
V_{OUT}	High-Side Floating Supply Return	-0.3		440.0	V
V_{RCT}	RCT Pins Input Voltage		V_{DD}		V
I_{CL}	Clamping Current Level[(1)]			25	mA
dV_{OUT}/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		2.1		W
Θ_{JA}	Thermal Resistance (Junction-to-Air)		70		°C/W

Note:

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.

Electrical Characteristics

V_{BIAS} (V_{DD}, V_B -V_{OUT})=14.0V, T_A=25°C, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
High Voltage Supply Section						
V_{DC}	High Voltage Supply Voltage		440			V
Low-Side Supply Characteristics (V_{DD})						
VDD_{UV+}	V_{DD} UVLO Positive-Going Threshold	V_{DD} Increasing	9	11	13	V
VDD_{UV-}	V_{DD} UVLO Negative-Going Threshold	V_{DD} Decreasing	7.8	8.8	9.8	V
VDD_{UHY}	V_{DD}-Side UVLO Hysteresis			2.2		V
V_{CL}	Supply Camping Voltage	I_{DD}=10mA	14.4	15.4		V
I_{ST}	Startup Supply Current	V_{DD}=9V		60	90	µA
I_{QDD}	Low-Side Quiescent Supply Current	R_{DT}=100kΩ		230	380	µA
I_{DD}	Dynamic Operating Supply Current	20kHz, C_L=1nF		0.6		mA
High-Side Supply Characteristics (VB-V_{OUT})						
V_{HSUV+}	High-Side UVLO Positive-Going Threshold	V_B-V_{OUT} Increasing	8	9	10	V
V_{HSUV-}	High-Side UVLO Negative-Going Threshold	V_B-V_{OUT} Decreasing	7.5	8.5	9.5	V
V_{HSUHY}	V_{BS} Supply UVLO Hysteresis			0.5		V
I_{QHS}	High-Side Quiescent Supply Current			50	90	µA
I_{PBS}	High-Side Dynamic Operating Supply Current	20kHz, C_L=1nF		130	180	µA
Oscillator Characteristics						
f_{osc}	Oscillation Frequency	R_T=50kΩ, C_T=330pF	18	20	22	kHz
D	Duty Cycle	Running Mode	47.5	49.0		%
V_{RCT+}	Upper Threshold Voltage of RCT	Running Mode		V_{DD}		V
V_{RCT-}	Lower Threshold Voltage of RCT	Running Mode		V_{DD}/4		V
V_{IH}	Logic "1" Input Voltage of RCT	Running Mode		3/4 V_{DD}		V
V_{IL}	Logic "0" Input Voltage of RCT	Running Mode			3/5 V_{DD}	V
t_D	Dead Time	R_{DT}=100kΩ	440	540	640	ns
t_{DMIN}	Minimum Dead Time	$V_{DT/\overline{SD}}$=V_{DD}	280	400	520	ns
Protection Characteristics						
V_{SD+}	Shutdown "1" Input Voltage	$V_{SD/\overline{DT}}$=0 After Run Mode	2.5			V
V_{SD-}	Shutdown "0" Input Voltage	$V_{SD/\overline{DT}}$=0 After Run Mode			1	V
I_{SD}	Shutdown Current	$V_{SD/\overline{DT}}$=0 After Run Mode			350	µA
t_{SD}	Shutdown Propagation Delay			180		Ns
Internal MOSFET Section						
I_{LKMOS}	Internal MOSFET Leakage Current	V_{DS}=400V			50	µA
R_{ON}	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=190mA		4.6	6.0	Ω
I_S	Maximum Continuous Drain-Source Diode Forward Current			0.38		A
I_{SM}	Maximum Pulsed Continuous Drain-Source Diode Forward Current			3.04		A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS}=0V, I_S=0.38A			1.2	V

Typical Performance Characteristics

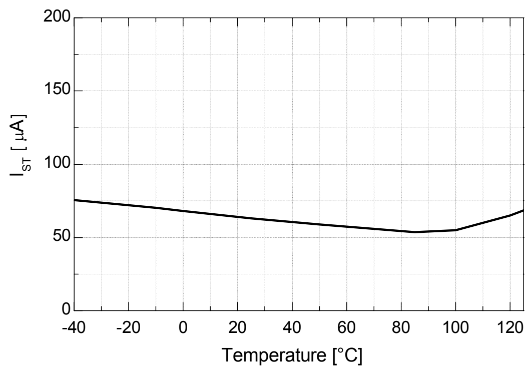


Figure 5. Startup Current vs. Temperature

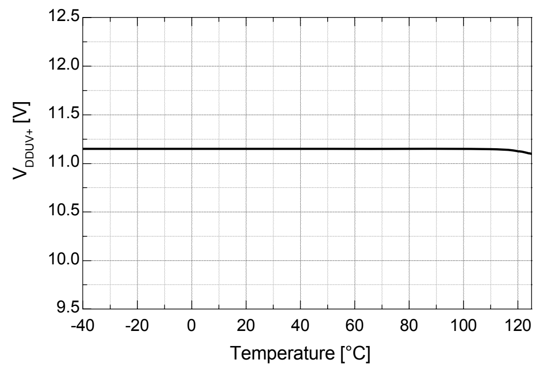


Figure 6. V_{DD} UVLO+ vs. Temperature

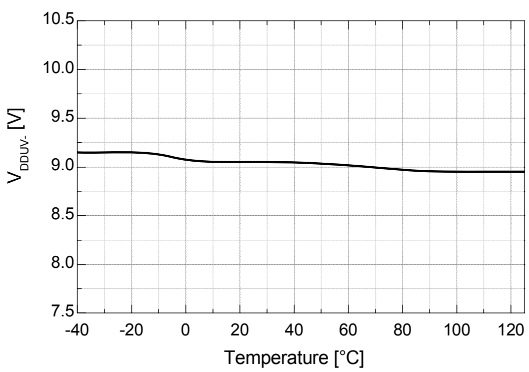


Figure 7. V_{DD} UVLO- vs. Temperature

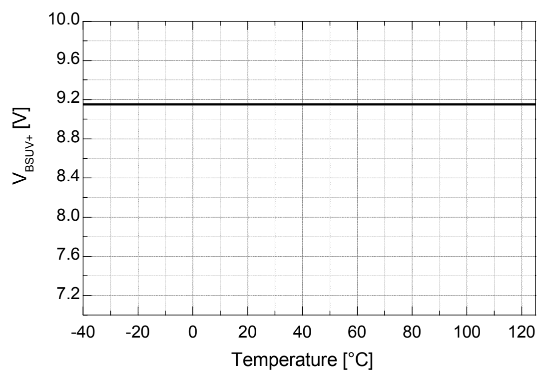


Figure 8. VB.V_{OUT} UVLO+ vs. Temperature

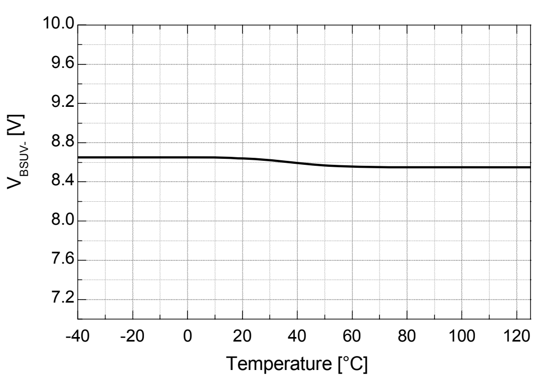


Figure 9. VB.V_{OUT} UVLO- vs. Temperature

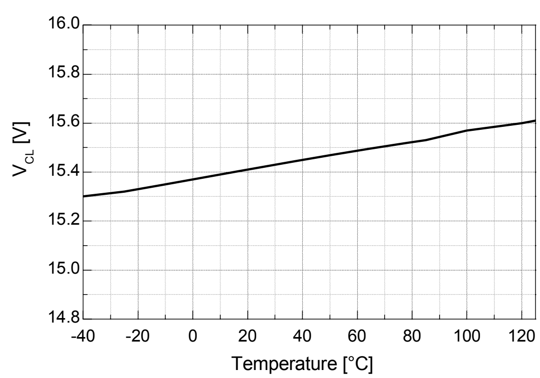


Figure 10. V_{CL} vs. Temperature

Typical Performance Characteristics (Continued)

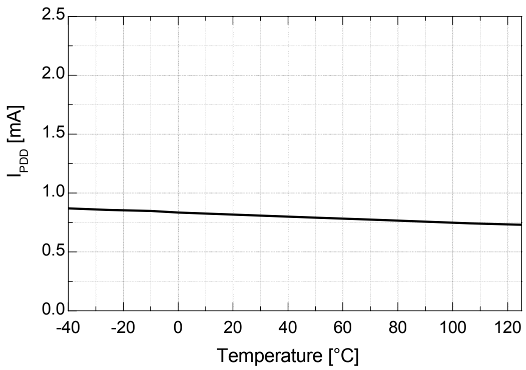


Figure 11. I_{PDD} vs. Temperature

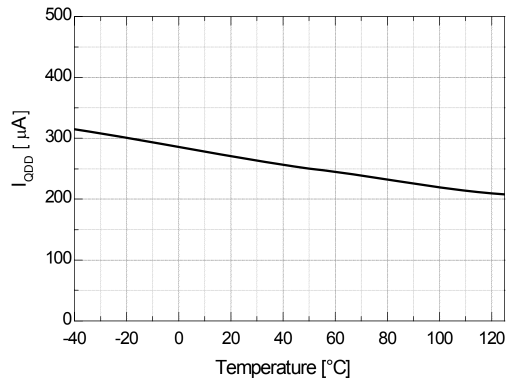


Figure 12. I_{QDD} vs. Temperature

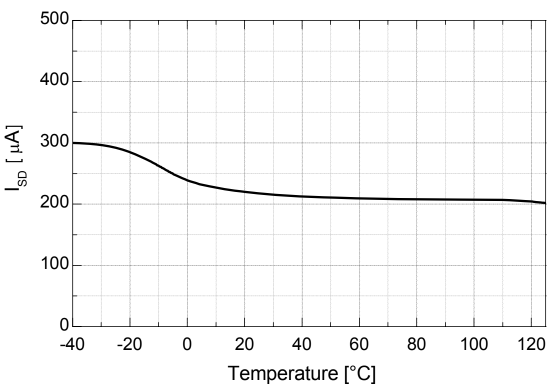


Figure 13. I_{SD} vs. Temperature

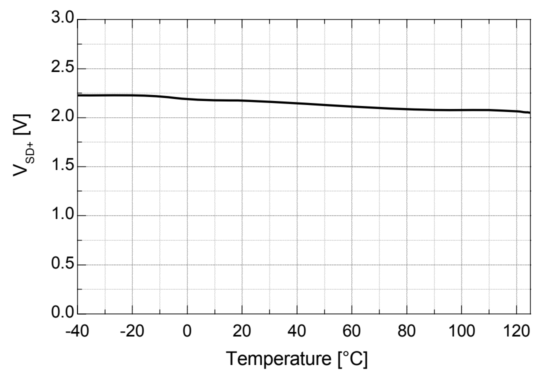


Figure 14. V_{SD}+ vs. Temperature

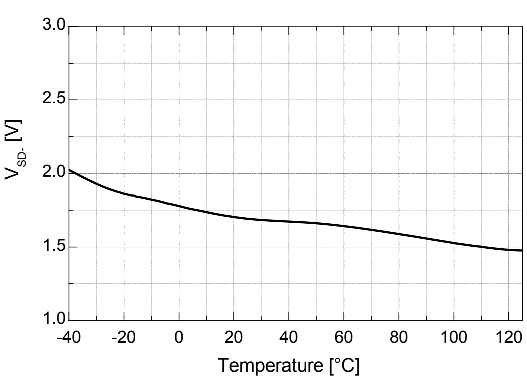


Figure 15. V_{SD}- vs. Temperature

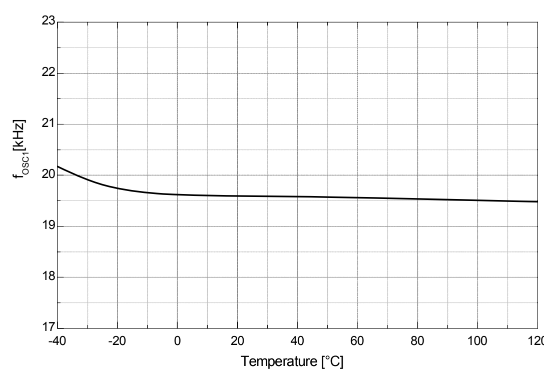


Figure 16. Operating Frequency vs. Temperature

Typical Performance Characteristics (Continued)

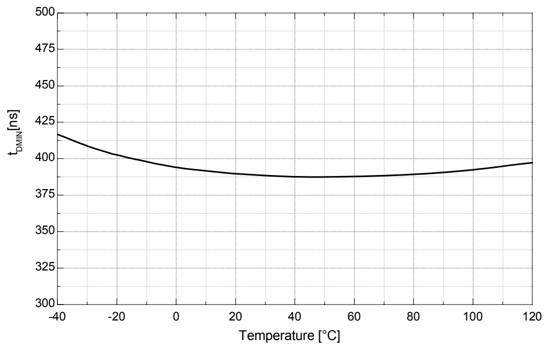


Figure 17. t_{DMIN} vs. Temperature

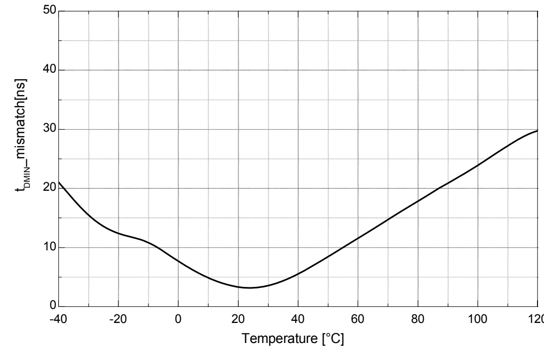


Figure 18. Dead-Time Mismatch vs. Temperature

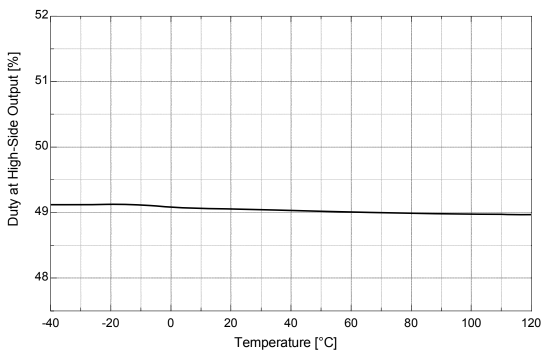


Figure 19. High-Side Duty Ratio vs. Temperature

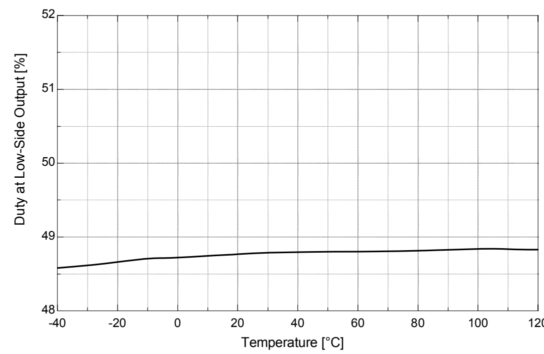


Figure 20. Low-Side Duty Ratio vs. Temperature

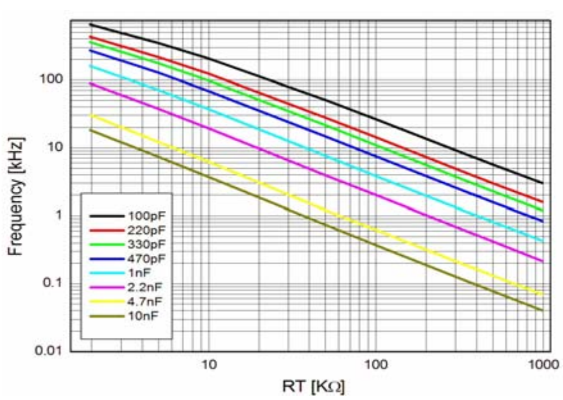


Figure 21. Frequency vs. R_T

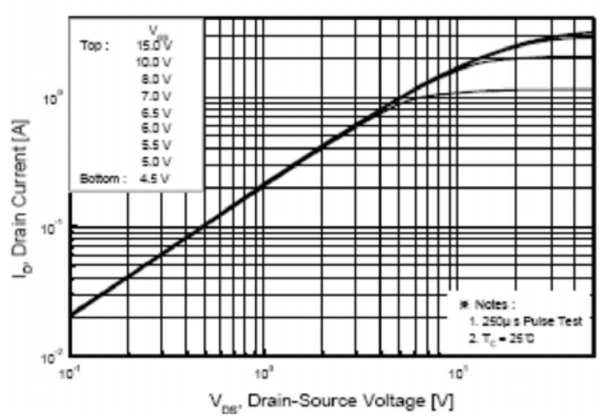


Figure 22. On-Region Characteristics

Typical Performance Characteristics (Continued)

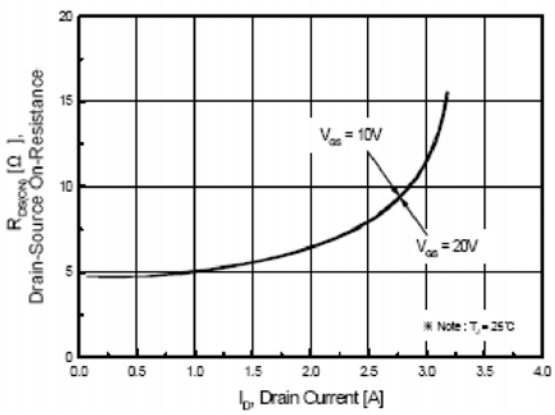


Figure 23. On-Resistance Variation vs. Drain Current and Gate Voltage

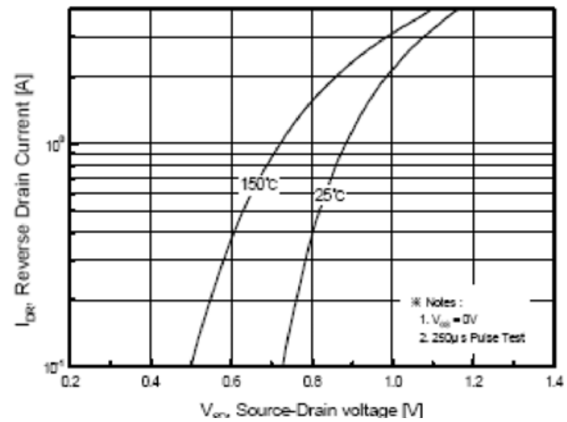


Figure 24. Body Diode Forward Voltage Variation vs. Source Current and Temperature

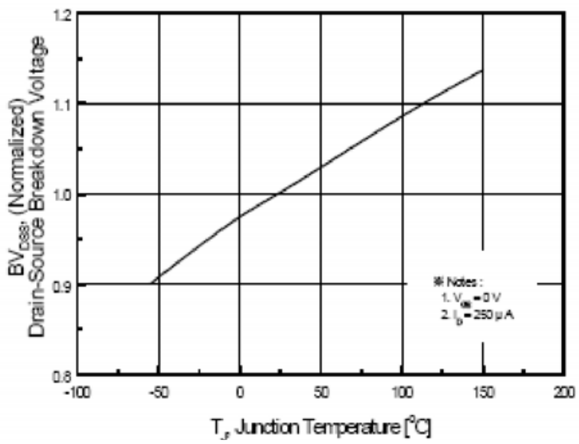


Figure 25. Breakdown Voltage Variation vs. Temperature

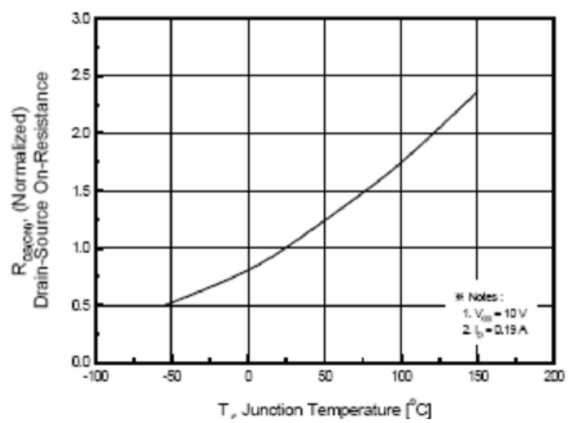


Figure 26. On-Resistance Variation vs. Temperature

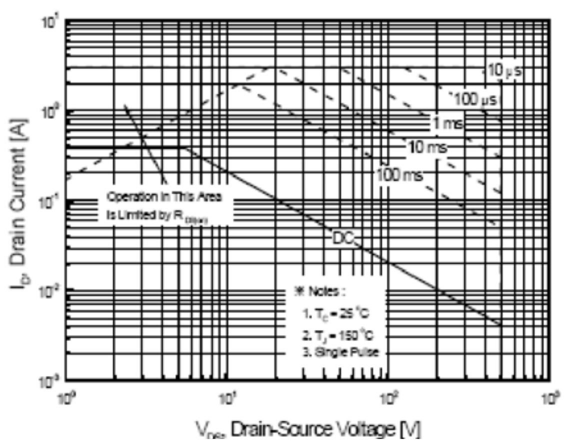


Figure 27. Maximum Safe Operating Area

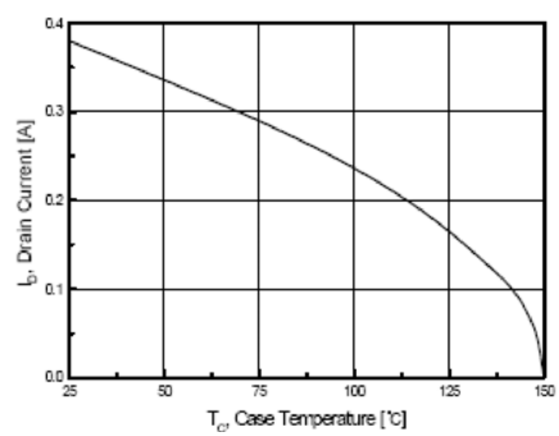


Figure 28. Maximum Drain-Current vs. Case Temperature

Application Information

1. Under-Voltage Lockout (UVLO) Function

FAN7387V 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 FAN7387V operates normally. At UVLO condition, the FAN7387V has a low supply current of less than 130µA. Once UVLO is released, FAN7387V operates normally until V_{DD} goes below VDD_{UV}-, the UVLO hysteresis. FAN7387V also has a high-side gate driver. The supply for the high-side driver is applied between VB and V_{OUT}. To prevent malfunction at low supply voltage between VB and V_{OUT}, FAN7387V provides an additional UVLO circuit. If VB-V_{OUT} is under V_{HSUV}+, the driver holds LOW state to turn off the high-side switch. Once the voltage of VB-V_{OUT} is higher than V_{HSUV+}, after VB-V_{OUT} exceeds V_{HSUV}-, the operation of driver resumes.

2. 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 gate driver output (V_{OUT}).

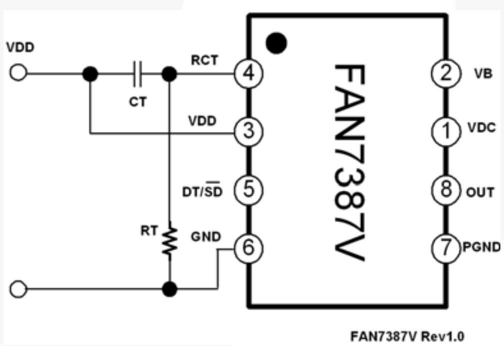


Figure 29. Typical Connection Method

Figure 30 shows the typical waveforms of RCT and internal signals (LO and HO) of IC. From the circuit analysis, the discharging time of RCT, t, is given by:

$$V_{RCT}(t) = V_{DD} \times \ln\left(\frac{-t}{R_T \bullet C_T}\right) \quad (1)$$

From Equation 1, it is possible to calculate the discharging time, t, from V_{DD} to one quarter (1/4) of V_{DD} by substituting $V_{RCT(t)}$ with 1/4 V_{DD}.

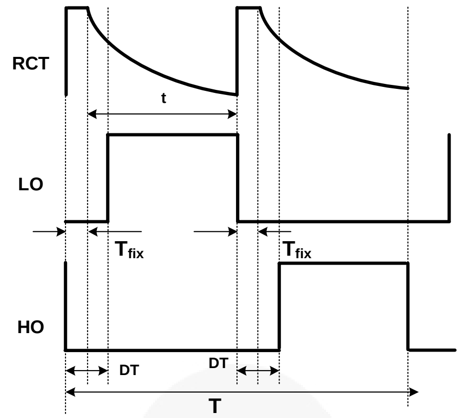


Figure 30. Typical Waveforms of RCT and Internal Signal (LO, HO) of IC

$$t = 1.38 \bullet R_T \bullet C_T \quad (2)$$

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

$$f_{running} = \frac{1}{t} = \frac{1}{2(t + t_{fix})} \quad (3)$$

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

3. 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 to under 1V by an external switch, such as the TR or MOSFET, the FAN7387V enters shutdown mode. In this mode, the FAN7387V doesn't have any output signal.

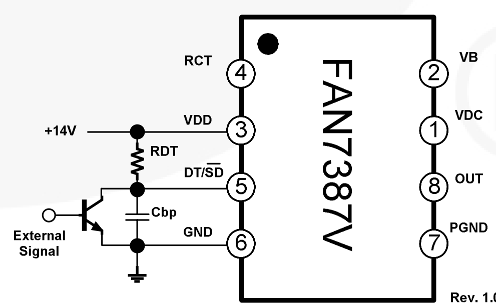
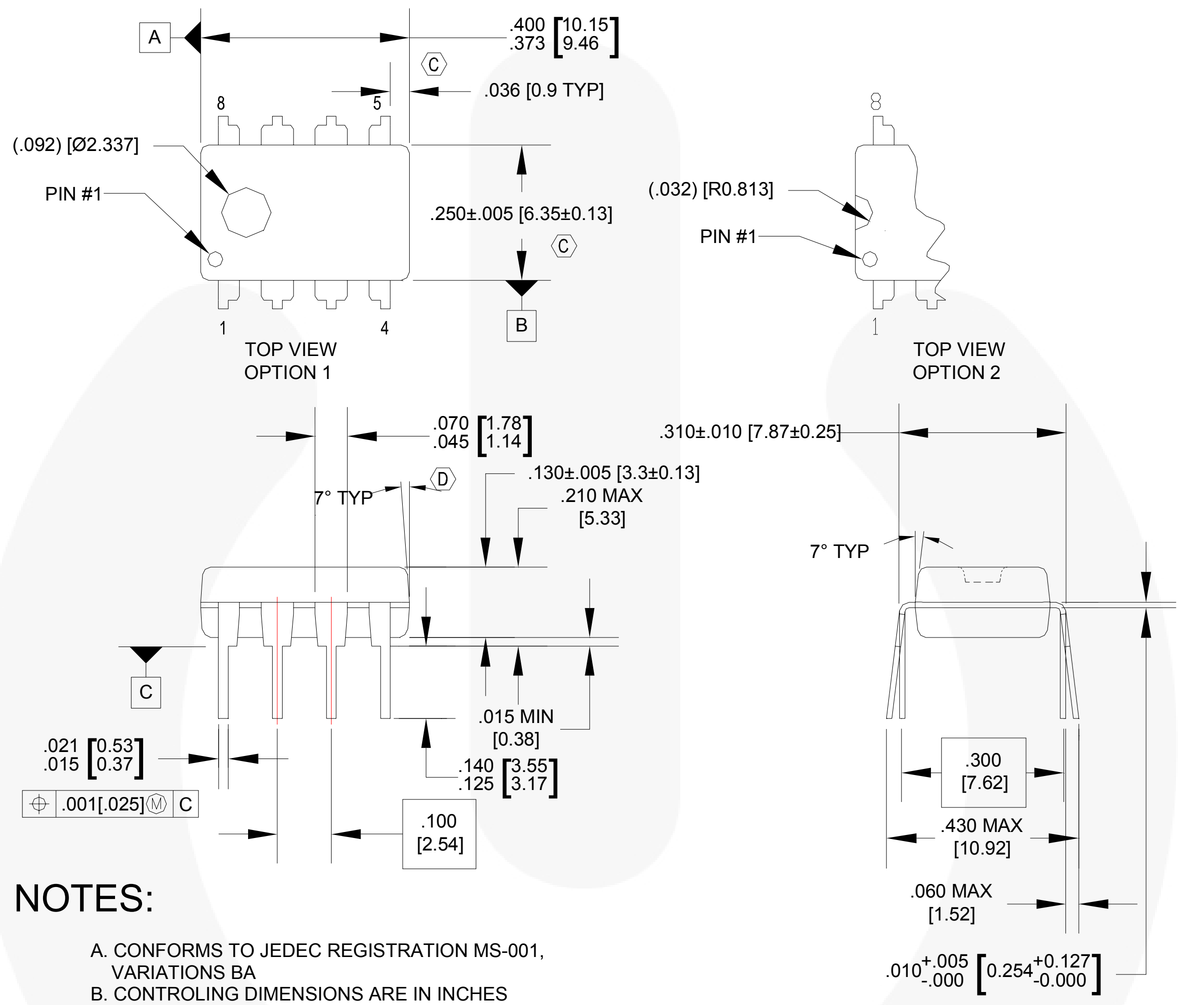


Figure 31. External Shutdown Circuit

Physical Dimensions



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B. CONTROLING DIMENSIONS ARE IN INCHES REFERENCE DIMENSIONS ARE IN MILLIMETERS
C. DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCHES OR 0.25MM.
D. DOES NOT INCLUDE DAMBAR PROTRUSIONS. DAMBAR PROTRUSIONS SHALL NOT EXCEED .010 INCHES OR 0.25MM.
E. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

N08EREVG

Figure 32. 8-Lead Dual Inline Package (DIP)

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Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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