

3 半桥式栅极驱动 IC

FAN7888



SOIC-20, 300 mils
CASE 751BJ-01

说明

FAN7888 是单片三通道半桥栅极驱动 IC，设计用于高压、高速驱动 MOSFET 和 IGBT，工作电压高达 +200 V。

onsemi 的高电压处理和共模噪声消除技术可以保证高端驱动器在高 dv/dt 噪声环境下稳定工作。

先进的电平转换电路使高端栅极驱动器在 $V_{BS} = 15\text{ V}$ 时可耐受高达 $V_S = -9.8\text{ V}$ (典型值) 仍然正常工作。

当 V_{DD} 和 V_{BS} 小于指定阈值电压时，欠压闭锁 (UVLO) 电路可防止发生故障。

输出驱动器的拉电流 / 灌电流典型值分别为 350 mA/650 mA，适用于电机驱动系统的三相半桥应用。

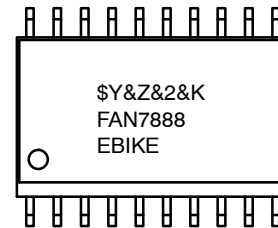
特性

- 自举工作通道浮动电压达到 +200 V
- 所有通道的拉电流 / 灌电流驱动能力为 350 mA/650 mA (典型值)
- 3 半桥式栅极驱动器
- 对于 $V_{BS} = 15\text{ V}$ 时的信号传输，允许的负 V_S 摆幅扩展至 -9.8 V
- 匹配的最大传播延迟时间：50 ns
- 兼容 3.3 V 和 5 V 输入逻辑
- 所有通道都内置带 270 ns 典型死区时间的直通预防电路
- 内置共模 dv/dt 噪声消除电路
- 所有通道内置 NVLO 功能
- This Device is Pb-Free, Halide Free and is RoHS Compliant

应用

- 电池类的电机应用 (电动自行车、电动工具)
- 三相电机变频驱动器

MARKING DIAGRAM



\$Y	= Logo
&Z	= Assembly Plant Code
&2	= 2-Digit Date Code
&K	= 2-Digits Lot Run Traceability Code
FAN7888	= Specific Device Code
EBIKE	= 3 rd Line Marking

ORDERING INFORMATION

See detailed ordering and shipping information on page 13 of this data sheet.

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典型应用电路

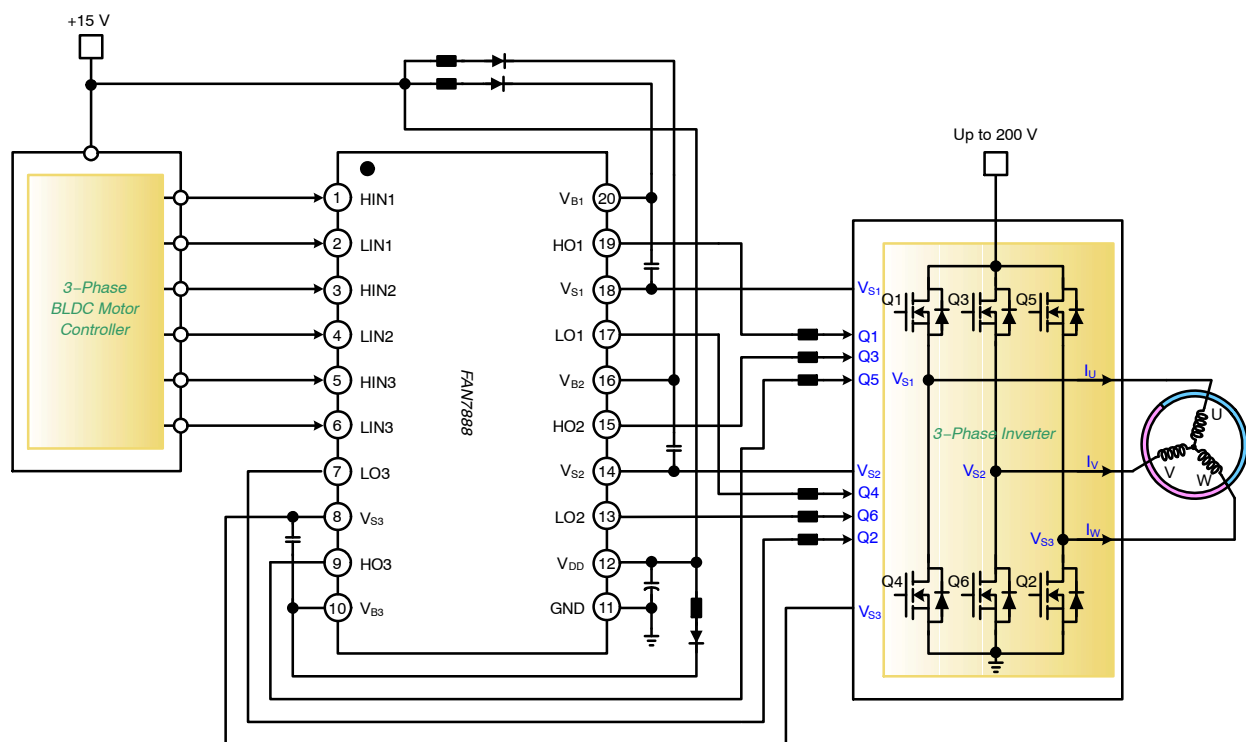


图 1. 三相无刷直流 (BLDC) 电动机驱动器的应用

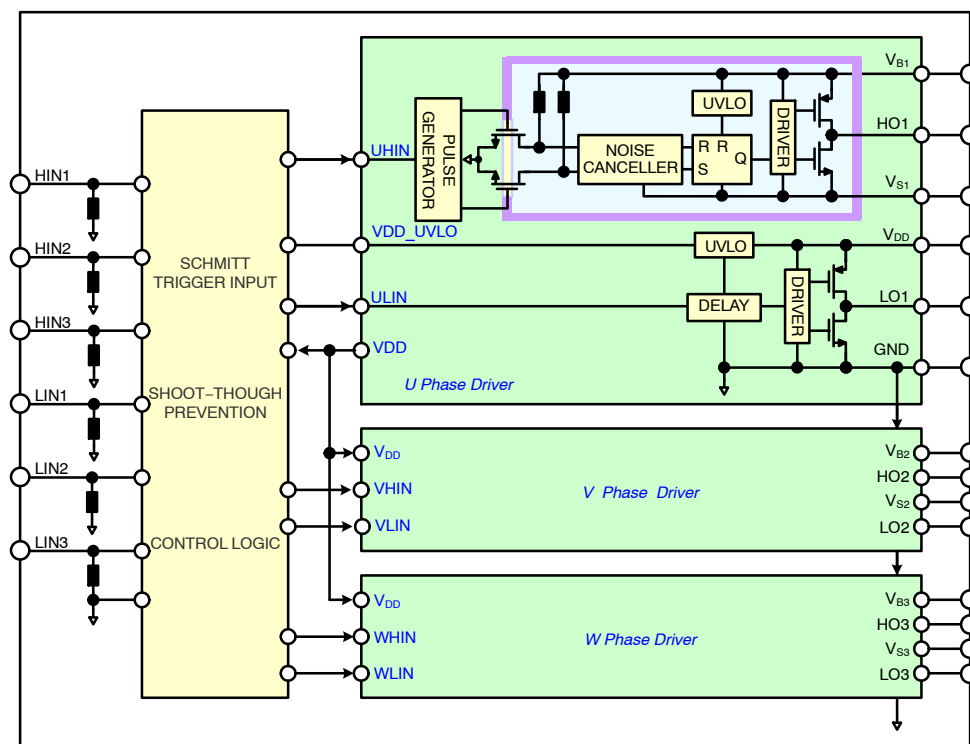


图 2. 功能框图

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引脚布局

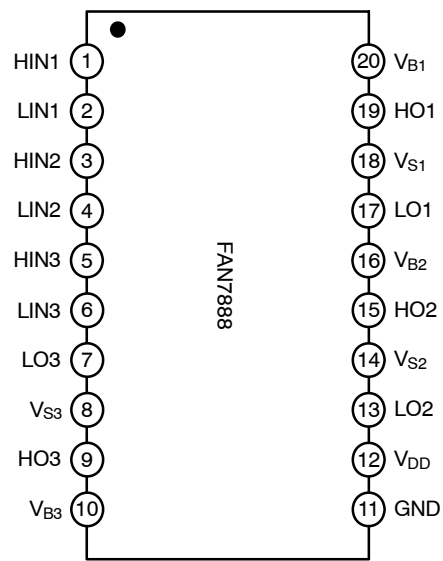


图 3. 引脚布局 (顶视图)

引脚说明

引脚号	名称	说明
1	HIN1	高端栅极 1 驱动器的逻辑输入 1
2	LIN1	低端栅极 1 驱动器的逻辑输入 1
3	HIN2	高端栅极 2 驱动器的逻辑输入 2
4	LIN2	低端栅极 2 驱动器的逻辑输入 2
5	HIN3	高端栅极 3 驱动器的逻辑输入 3
6	LIN3	低端栅极 3 驱动器的逻辑输入 3
7	LO3	低端栅极驱动器 3 输出
8	VS3	高端驱动器 3 的浮动电源偏置电压
9	HO3	高端驱动器 3 的栅极驱动输出
10	VB3	高端驱动器 3 的浮动电源电压
11	GND	接地
12	VDD	逻辑的和所有低端栅极驱动器的电源电压
13	LO2	低端栅极驱动器 2 的输出
14	VS2	高端驱动器 2 浮动电源偏置电压
15	HO2	高端驱动器 2 栅极驱动器输出
16	VB2	高端驱动器 2 的浮动电源电压
17	LO1	低端栅极驱动器 1 输出
18	VS1	高端驱动器 1 浮动电源偏置电压
19	HO1	高端驱动器 1 栅极驱动器输出
20	VB1	高端驱动器 1 的浮动电源电压

绝对最大额定值 (如无其它说明, $T_A = 25^{\circ}\text{C}$)

符号	参数	最小值	最大值	单位
V_B	$V_{B1,2,3}$ 高端浮动电源电压	-0.3	225.0	V
V_S	$V_{S1,2,3}$ 高端浮动电源偏置电压	$V_{B1,2,3} - 25$	$V_{B1,2,3} + 0.3$	V
$V_{HO1,2,3}$	高端浮动输出电压	$V_{S1,2,3} - 0.3$	$V_{B1,2,3} + 0.3$	V
V_{DD}	低端和固定逻辑源电压	-0.3	25.0	V
$V_{LO1,2,3}$	低端输出电压	-0.3	$V_{DD} + 0.3$	V
V_{IN}	逻辑输入电压 ($HIN1,2,3$ 和 $LIN1,2,3$)	-0.3	$V_{DD} + 0.3$	V
dV_S/dt	允许的偏置电压转换速率	-	50	V/ns
P_D	功耗 (注意 1) (注意 2) (注意 3)	-	1.47	W
θ_{JA}	结至环境热阻	-	85	$^{\circ}\text{C}/\text{W}$
T_J	结温	-	+150	$^{\circ}\text{C}$
T_{STG}	存储温度	-55	+150	$^{\circ}\text{C}$

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.

(参考译文)

如果电压超过最大额定值表中列出的值范围, 器件可能会损坏。如果超过任何这些限值, 将无法保证器件功能, 可能会导致器件损坏, 影响可靠性。

1. 安装到 76.2 x 114.3 x 1.6 mm PCB 板 (FR-4 环氧玻璃材料)。
2. 参考以下标准:
JESD51-2: 集成电路热测试方法环境条件 – 自然对流
JESD51-3: 含铅表面贴装封装的低有效导热系数测试板
3. 在任何情况下都不要超过 P_D 。

推荐工作条件

符号	参数	最小值	最大值	单位
$V_{B1,2,3}$	高端浮动电源电压	$V_{S1,2,3} + 10$	$V_{S1,2,3} + 20$	V
$V_{S1,2,3}$	高端浮动电源偏置电压	$6 - V_{DD}$	200	V
V_{DD}	电源电压	10	20	V
$V_{HO1,2,3}$	高端输出电压	$V_{S1,2,3}$	$V_{B1,2,3}$	V
$V_{LO1,2,3}$	低端输出电压	GND	V_{DD}	V
V_{IN}	逻辑输入电压 ($HIN1,2,3$ 和 $LIN1,2,3$)	GND	V_{DD}	V
T_A	环境温度	-40	+125	$^{\circ}\text{C}$

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.

(参考译文)

高于推荐工作范围表格中所列电压时, 不保证能够正常运行。长时间在推荐工作范围表格中规定范围以外的电压下运行, 可能会影响器件的可靠性。

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电气特性 ($V_{BIAS} (V_{DD}, V_{BS1,2,3}) = 15.0\text{ V}$, $T_A = 25^\circ\text{C}$, 除非另外说明VIN 和 IIN 参数以 GND 作为基准。VO 和 IO 参数以 GND 和 VS1,2,3 作为基准, 适用于各自的输出 LO1,2,3 和 HO1,2,3)

符号	特性	条件	最小值	典型值	最大值	单位
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低端电源部分

I_{QDD}	V_{DD} 电源静态电流	$V_{LIN1,2,3} = 0\text{ V}$ 或 5 V	–	160	350	μA
$I_{PDD1,2,3}$	每个通道的 V_{DD} 电源工作电流	$f_{LIN1,2,3} = 20\text{ kHz}$, RMS 值	–	500	900	μA
V_{DDUV+}	V_{DD} 电源欠压正向阈值	$V_{DD} = \text{Sweep}$, $V_{BS} = 15\text{ V}$	7.2	8.2	9.0	V
V_{DDUV-}	V_{DD} 电源欠压负向阈值	$V_{DD} = \text{Sweep}$, $V_{BS} = 15\text{ V}$	6.8	7.8	8.5	V
V_{DDHYS}	V_{DD} 电源欠压锁定滞环	$V_{DD} = \text{Sweep}$, $V_{BS} = 15\text{ V}$	–	0.4	–	V

自举电源部分

$I_{QBS1,2,3}$	每个通道的 V_{BS} 静态电流	$V_{HIN1,2,3} = 0\text{ V}$ 或 5 V	–	50	120	μA
$I_{PBS1,2,3}$	每个通道的 V_{BS} 电源工作电流	$f_{HIN1,2,3} = 20\text{ kHz}$, RMS 值	–	400	800	μA
V_{BSUV+}	V_{BS} 电源欠压正向阈值	$V_{DD} = 15\text{ V}$, $V_{BS} = \text{Sweep}$	7.2	8.2	9.0	V
V_{BSUV-}	V_{BS} 电源欠压负向阈值	$V_{DD} = 15\text{ V}$, $V_{BS} = \text{Sweep}$	6.8	7.8	8.5	V
V_{BSHYS}	V_{BS} 电源欠压锁定滞环	$V_{DD} = 15\text{ V}$, $V_{BS} = \text{Sweep}$	–	0.4	–	V
I_{LK}	偏置电源的漏电流	$V_{B1,2,3} = V_{S1,2,3} = 200\text{ V}$	–	–	10	μA

栅极驱动器输出部分

V_{OH}	高电平输出电压, $V_{BIAS}-V_O$	$I_O=20\text{ mA}$	–	–	1.0	V
V_{OL}	低电平输出电压, V_O	$I_O=20\text{ mA}$	–	–	0.6	V
I_{O+}	输出高短路脉冲电流 (注意 4)	$V_O = 0\text{ V}$, $V_{IN} = 5\text{ V}$, $PW < 10\text{ }\mu\text{s}$	250	350	–	mA
I_{O-}	低电平输出短路脉冲电流 (注意 4)	$V_O = 15\text{ V}$, $V_{IN} = 0\text{ V}$, $PW < 10\text{ }\mu\text{s}$	500	650	–	mA
V_S	IN 信号传输到 H_O 时允许的负向 V_S 引脚电压		–	–9.8	–7.0	V

逻辑输入部分 (HIN, LIN)

V_{IH}	逻辑 “1” 输入电压		2.5	–	–	V
V_{IL}	逻辑 “0” 输入电压		–	–	1.0	V
I_{IN+}	逻辑 “1” 输入偏置电流	$V_{IN} = 5\text{ V}$	–	25	50	μA
I_{IN-}	逻辑 “0” 输入偏置电流 (注意 4)	$V_{IN} = 0\text{ V}$	–	–	2.0	μA
R_{IN}	输入下拉电阻		100	200	300	$\text{k}\Omega$

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.

(参考译文)

除非另有说明, “电气特性”表格中列出的是所列测试条件下的产品性能参数。如果在不同条件下运行, 产品性能可能与“电气特性”表格中所列性能参数不一致。

4. 参数由设计者提供

动态电气特性 ($T_A = 25^\circ\text{C}$, $V_{BIAS} (V_{DD}, V_{BS1,2,3}) = 15.0\text{ V}$, $V_{S1,2,3} = \text{GND}$, $C_{Load} = 1000\text{ pF}$ 如无其他说明)

符号	参数	条件	最小值	典型值	最大值	单位
t_{ON}	导通传播延时	$V_{S1,2,3} = 0\text{ V}$	–	130	220	ns
t_{OFF}	关断传播延时	$V_{S1,2,3} = 0\text{ V}$	–	150	240	ns
t_R	导通上升时间		–	50	120	ns
t_F	关断下降时间		–	30	80	ns
MT1	导通延时匹配 $ t_{ON(H)} - t_{OFF(L)} $		–	–	50	ns
MT2	关断延时匹配 $ t_{OFF(H)} - t_{ON(L)} $		–	–	50	ns
DT	死区时间		100	270	440	ns
MDT	死区时间匹配 $ t_{DT1} - t_{DT2} $		–	–	60	ns

典型特性

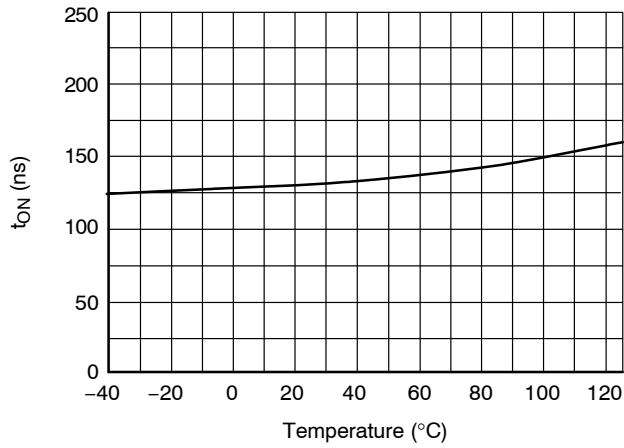


图 4. 导通传播延时 vs. 温度

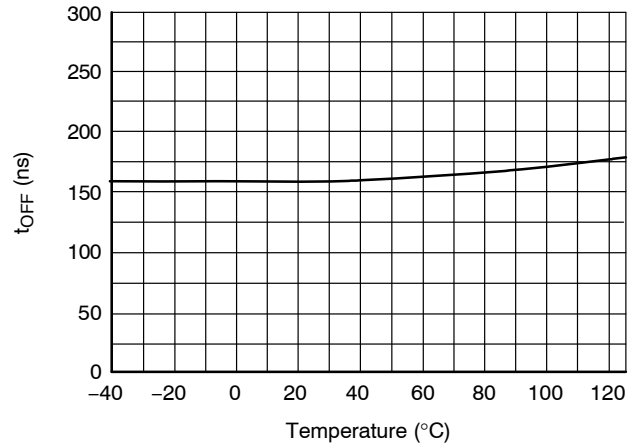


图 5. 关断传播延时 vs. 温度

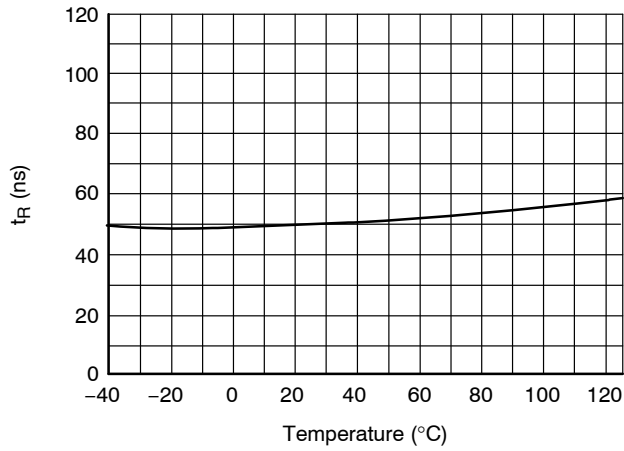


图 6. 导通上升时间 vs. 温度

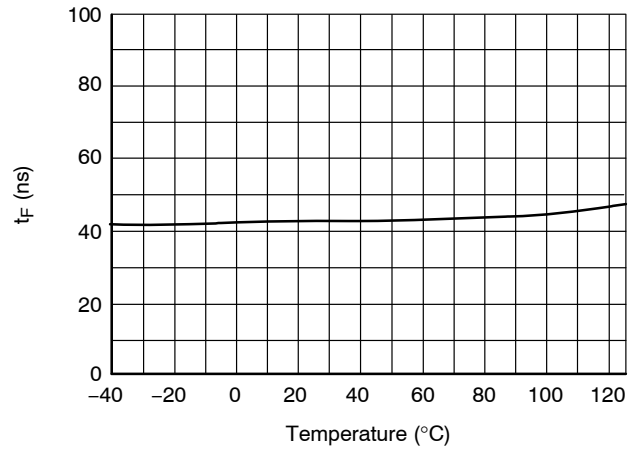


图 7. 关断下降时间 vs. 温度

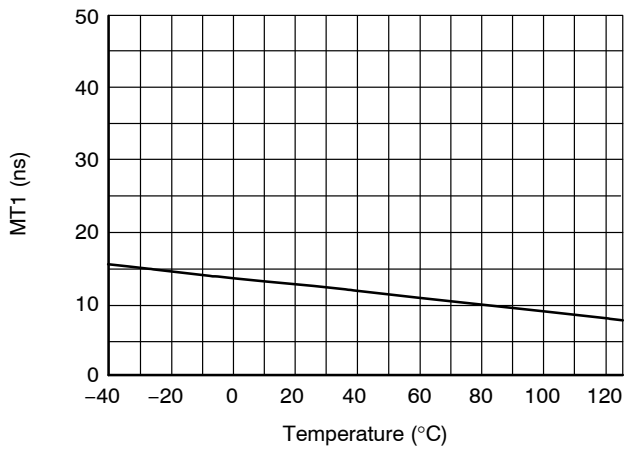


图 8. 导通延时匹配 vs. 温度

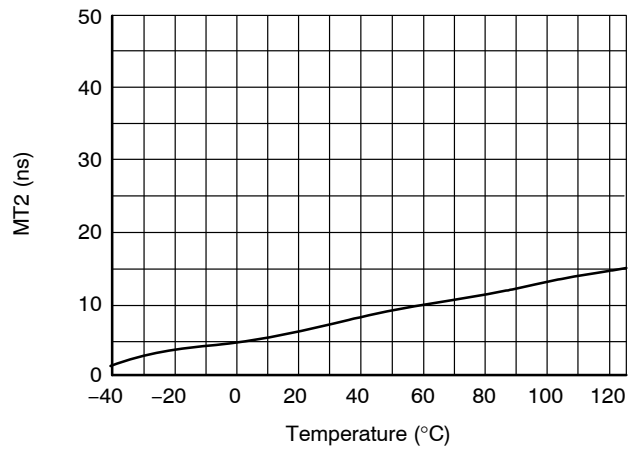


图 9. 关断延时匹配 vs. 温度

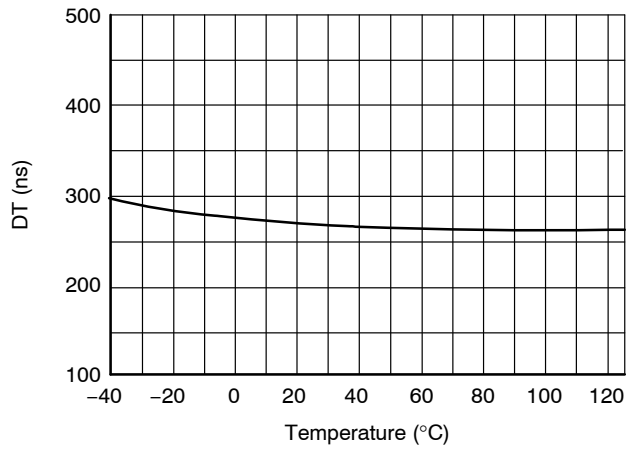


图 10. 死区时间 vs. 温度

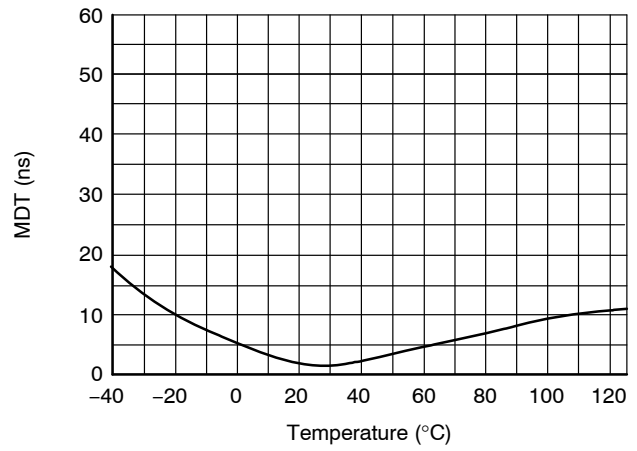
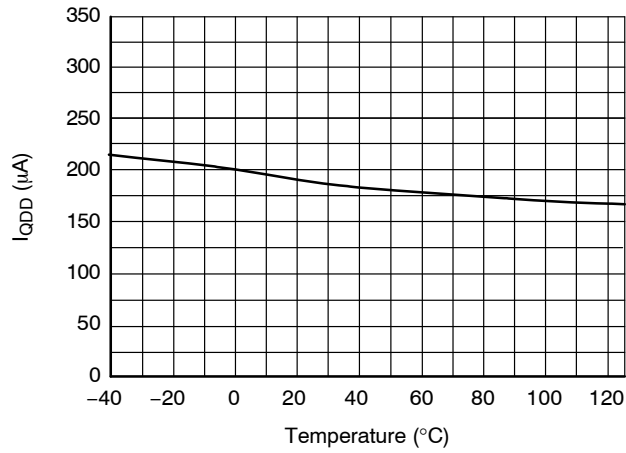
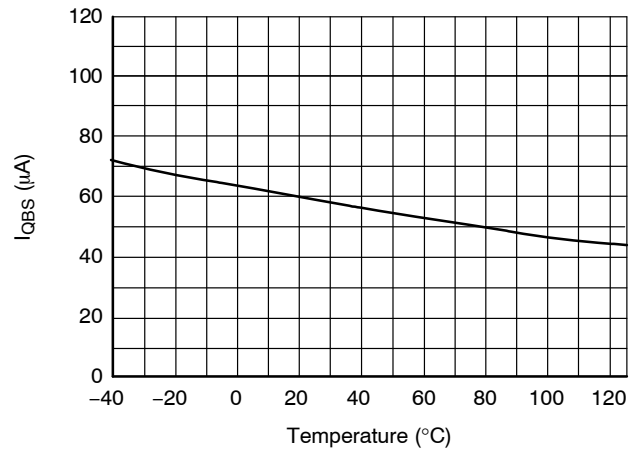
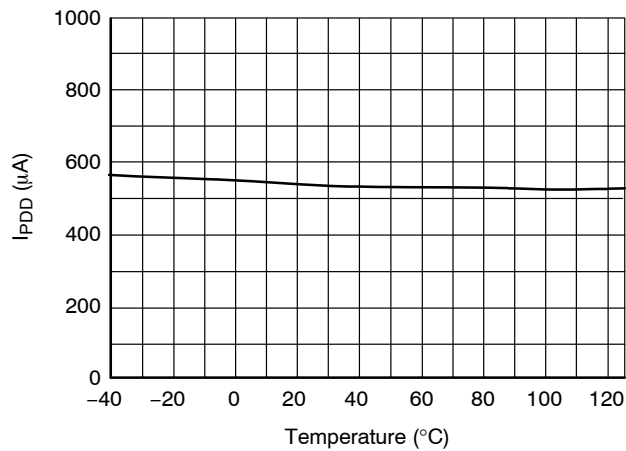
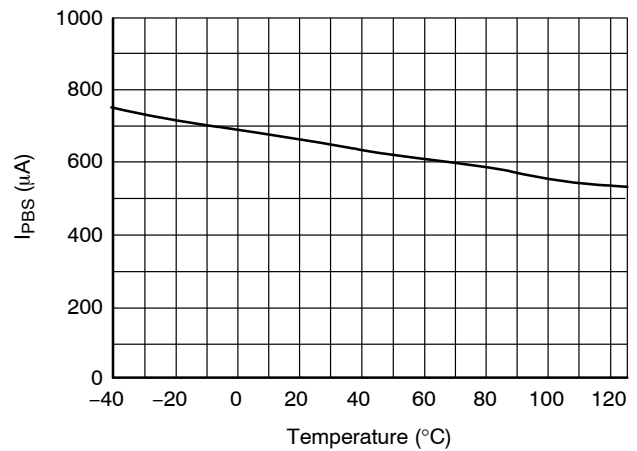


图 11. 死区时间匹配 vs. 温度

图 12. 静态 V_{DD} 电源电流与温度的关系图 13. 静态 V_{BS} 电源电流与温度的关系图 14. 工作 V_{DD} 电源电流与温度的关系图 15. 工作 V_{BS} 电源电流与温度的关系

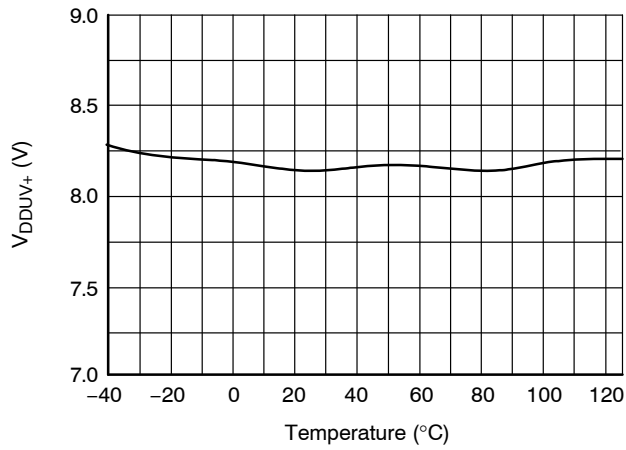
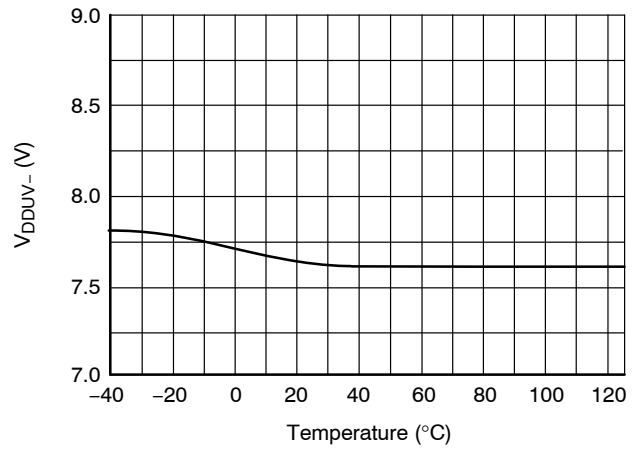
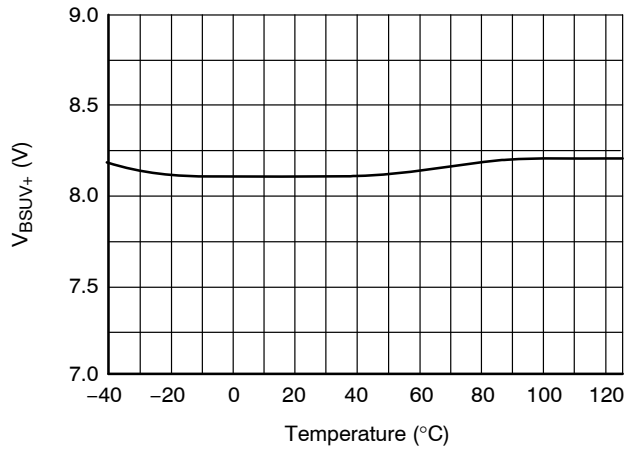
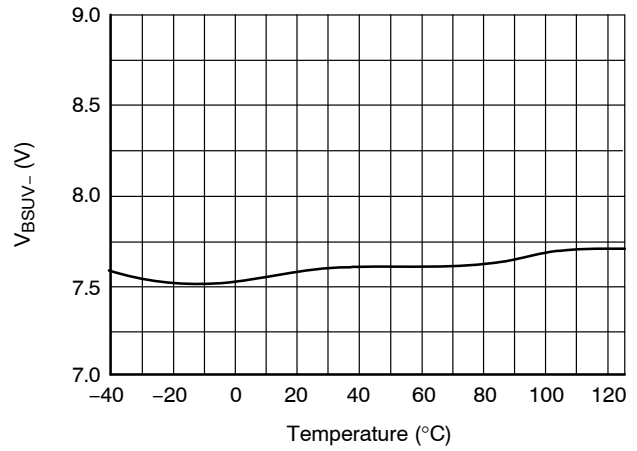
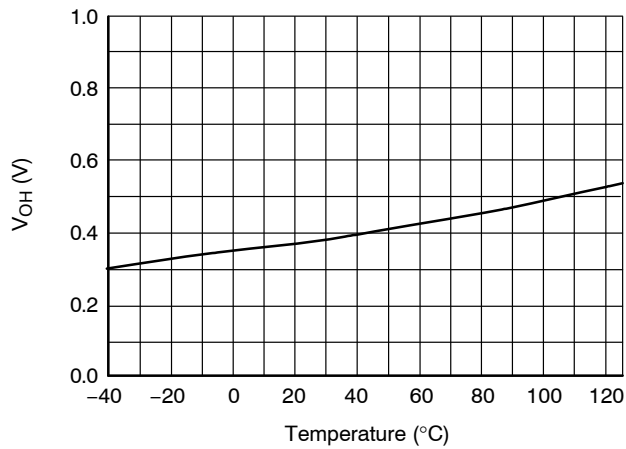
图 16. V_{DD} UVLO+ 与温度的关系图 17. V_{DD} UVLO- 与温度的关系图 18. V_{BS} UVLO+ 与温度的关系图 19. V_{BS} UVLO- 与温度的关系

图 20. 高位输出电压 vs. 温度

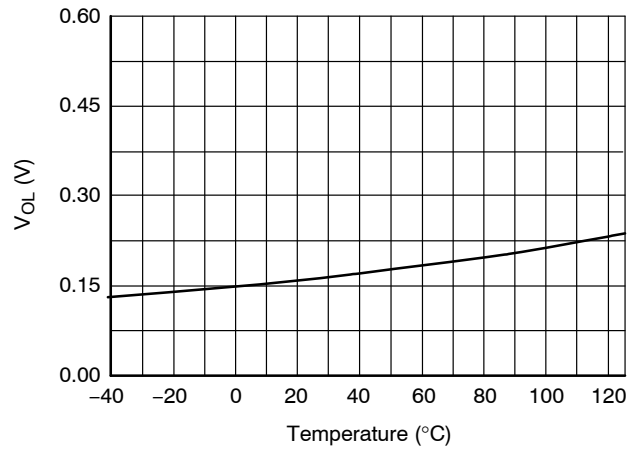


图 21. 低位输出电压 vs. 温度

典型特性 (续)

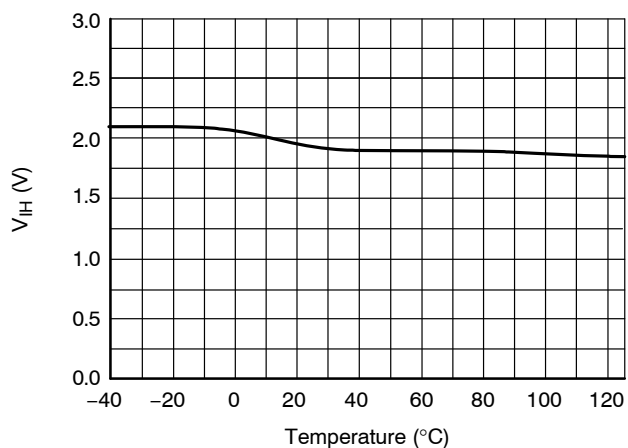


图 22. 逻辑高输入电压 vs. 温度

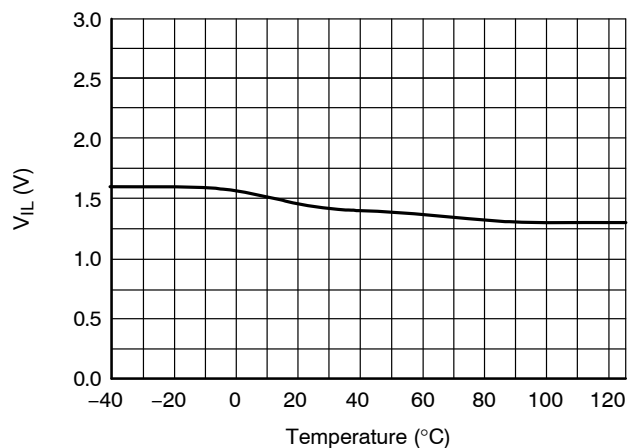


图 23. 逻辑低输入电压 vs. 温度

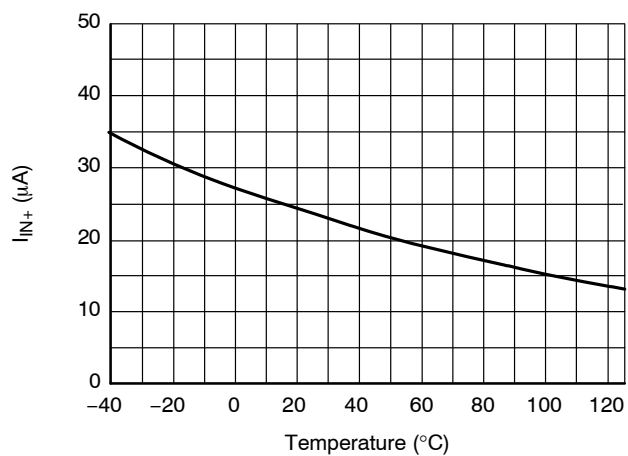


图 24. 逻辑输入高偏置电流 vs. 温度

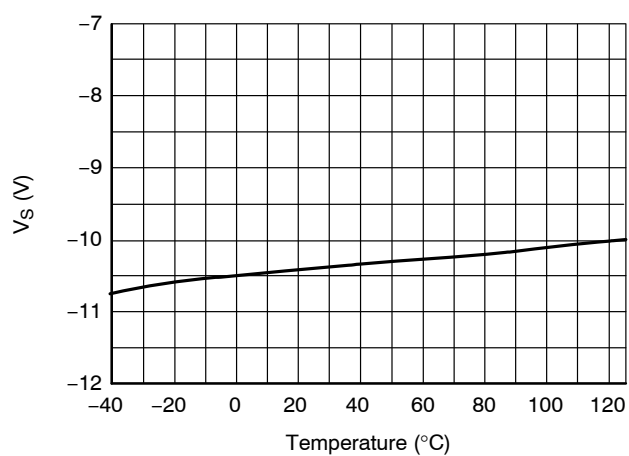
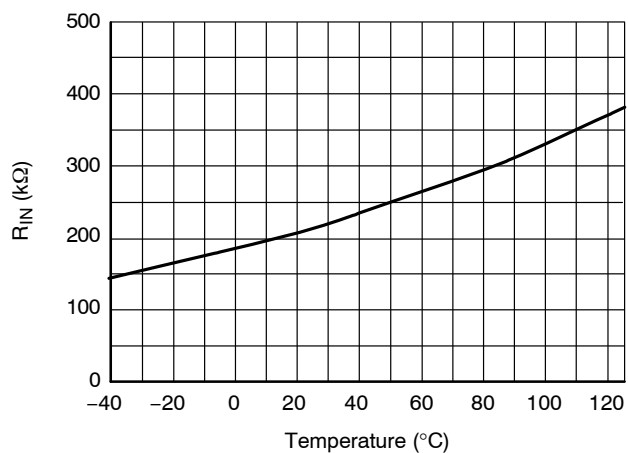
图 25. 允许的负向 V_S 电压与温度的关系

图 26. 输入下拉电阻 vs. 温度

保护功能

欠压锁定 (UVLO)

每个通道的高端和低端驱动器都有欠压锁定 (UVLO) 保护电路，能够独立地监测电源电压 (V_{DD}) 和自举电容电压 ($V_{BS1,2,3}$)。当 V_{DD} 和 $V_{BS1,2,3}$ 低于指定的阈值电压时，UVLO 电路能够预防故障。UVLO 滞环防止电源转换过程中的抖动。

贯通预防功能

FAN7888 拥有贯通预防电路，监控高端和低端控制输入。它被设计用来防止高端输出和低端输出同时开通，如和 28 所示图 27。

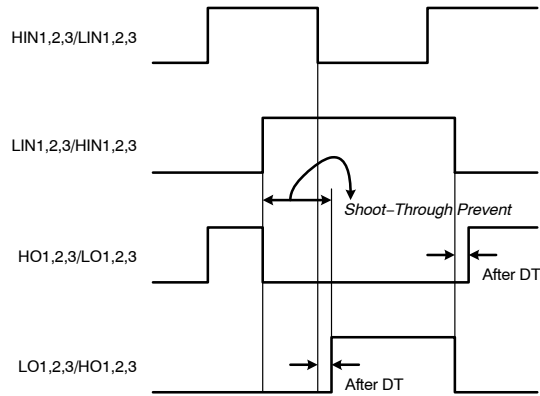


图 27. 贯通预防波形

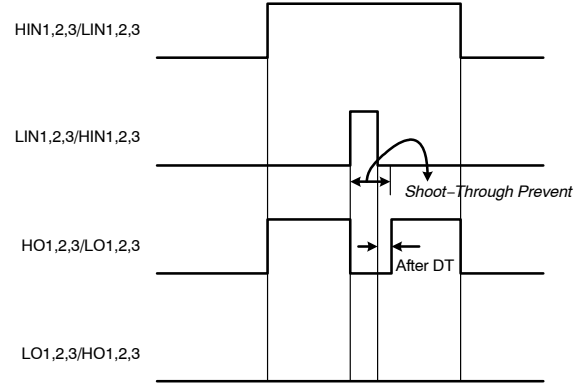


图 28. 贯通预防波形

操作说明

FAN7888 是一款三相半桥栅极驱动器，内置有典型 270 ns 的死区时间，适用于三相无刷直流 (BLDC) 电机驱动系统，如图 1 所示。

图 29 说明了一个三相 BLDC 电机驱动系统实现 120 整流器的开关次序。理想化波形：假设生成的 back EMF 波形是梯形，顶部平滑且有足够的宽度，只要线电流是完整的 120 电角度的矩形，开关次序如所示，就能产生恒定扭矩。图 29 星型连接电路的工作波形显示，每经过 60 度电角度，则一个 60° 部分“换相”到另一相，如图 29 所示。

FAN7888

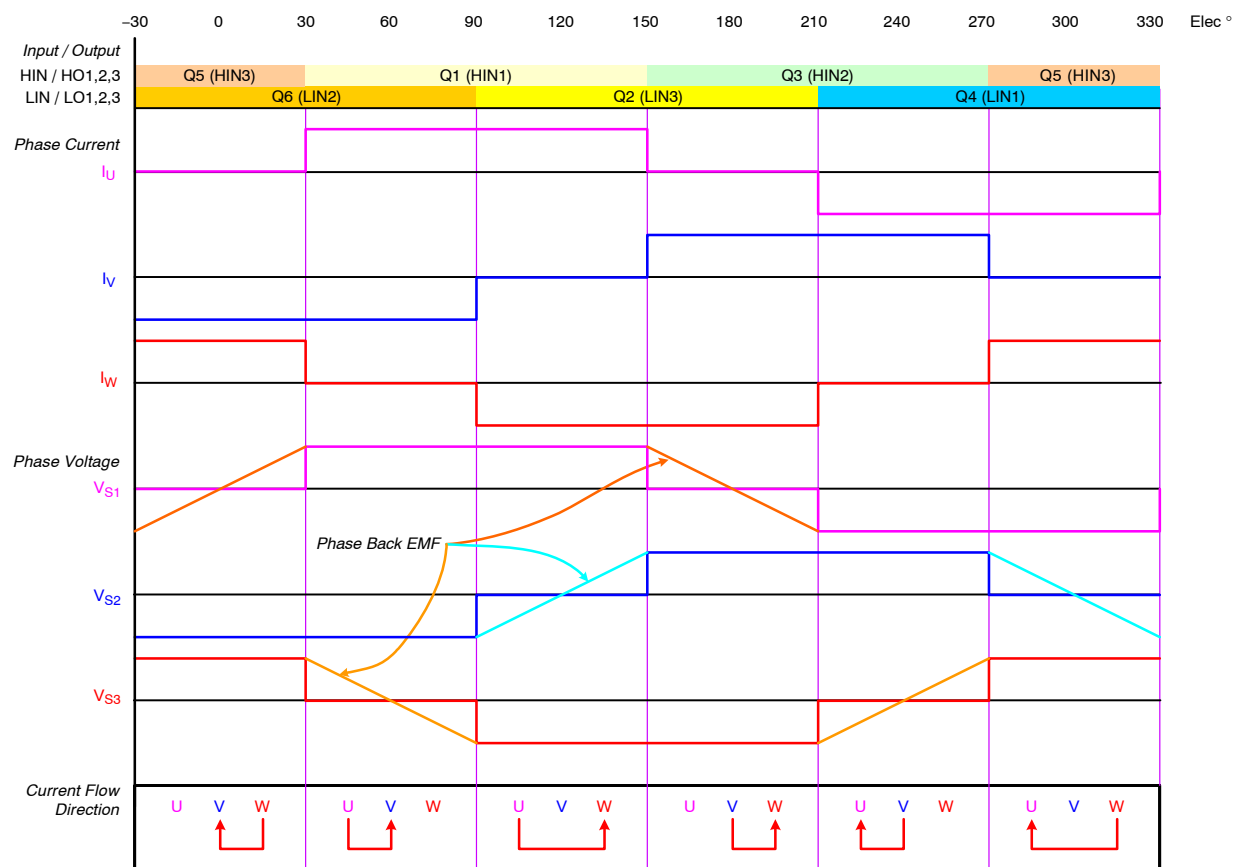


图 29. 120 度

开关时间图

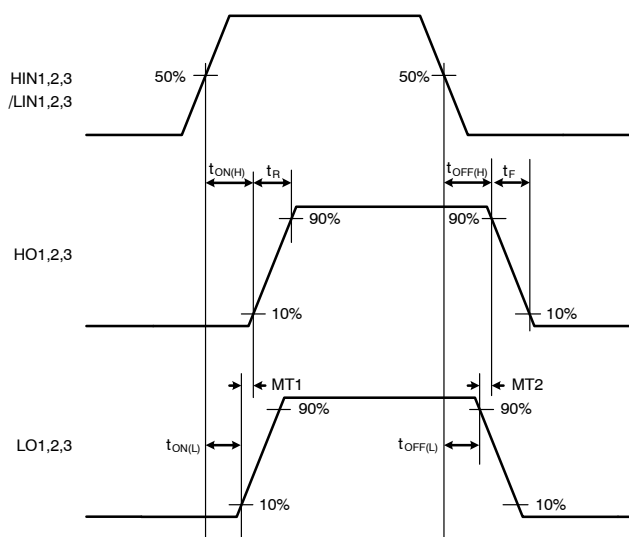


图 30. 开关时间定义

FAN7888

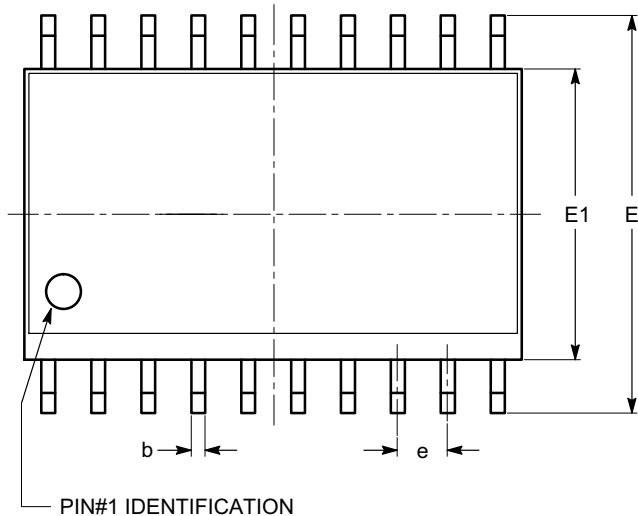
订购信息

部件编号	封装	工作温度范围	Shipping [†]
FAN7888MX	SOIC-20, 300 mils (Pb-Free, Halide Free)	-40°C to +125°C	1000 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

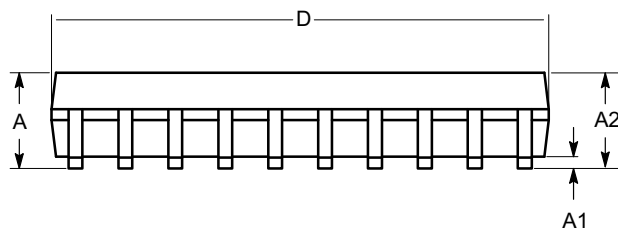
SOIC-20, 300 mils
CASE 751BJ
ISSUE O

DATE 19 DEC 2008

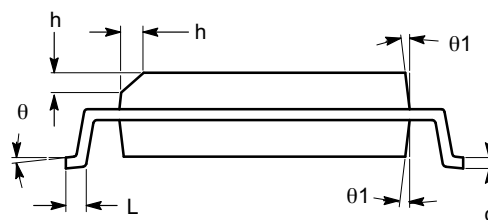


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	2.36	2.49	2.64
A1	0.10		0.30
A2	2.05		2.55
b	0.31	0.41	0.51
c	0.20	0.27	0.33
D	12.60	12.80	13.00
E	10.01	10.30	10.64
E1	7.40	7.50	7.60
e	1.27 BSC		
h	0.25		0.75
L	0.40	0.81	1.27
θ	0°		8°
$\theta 1$	5°		15°



SIDE VIEW



END VIEW

Notes:

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-013.

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DESCRIPTION:	SOIC-20, 300 MILS	PAGE 1 OF 1

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