带有单线数字接口的线性 LED 驱动器

FAN5622, FAN5624, FAN5626

说明

FAN5622、FAN5624 和 FAN5626 分别为2−、4−、6−电流阱线性 LED 驱动器，用于移动设备，如手机的液晶显示屏或键盘的背光照明。

压差仅为 50 mV，因而无需电感或开关电容即可驱动LED。LED 输出的亮度等级通过单线数字控制接口来编制。用户可编制32级线性调光等级，并通过施加数字脉冲打开或关闭LED。

FAN562x 系列因其 LED 驱动器的低压差而实现的更高的效率。通过整个32级调光获得LED输出的不同通道之间的良好匹配。LED 驱动器还集成了短路检测、欠压以及过热保护功能，从而获得了更为稳定的解决方案。

FAN5622、FAN5624和FAN5626 都采用了非常小巧的封装：分别为 6−pin Super SOT23、10−lead UMLP 以及 10−lead MicroPak™ MLP。

产品特性

- 三个线性电流阱 LED 驱动器，可支持2、4或6个LED输出
- 每个 LED 输出的电流阱：
  - 30 mA 最大输出电流
  - 50 mV 压差 @ 15 mA
  - 通道间匹配优于30%
  - 外接 R_{SET}
- 灵活编程的单线数字控制接口
  - 32级线性调光控制
- 低于 1 μA 关断电流
- 短路、欠压以及热保护
- 宽输入范围：2.7 至 5.5 V
- 小型封装：
  - FAN5622: 6−Pin Super SOT23
  - FAN5624: 10−Lead 1.4x1.8x0.55 mm UMLP
  - FAN5626: 10−Lead 1.6x2.1x0.55 mm MicroPak MLP
- 本产品是为无铅制程

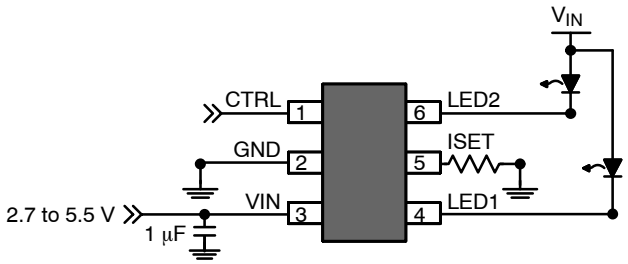

图 1. **FAN5622**的典型应用

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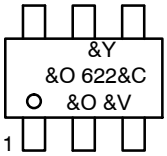
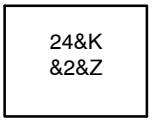
MARKING DIAGRAM

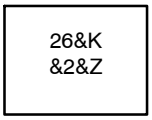
TSOT23 6−Lead
CASE 419BL



UQFN10 1.4x1.8, 0.4P
CASE 523BC



UQFN10 (MICROPAK),
1.6X2.1, 0.5P
CASE 523AZ



622, 24, 26	= Specific Device Code
&Y	= Binary Calendar Year Coding Scheme
&O	= Plant Code Identifier
&C	= Single Digit Die Run Code
&V	= Eight−Week Binary Datacoding Scheme
&K	= 2−Digits Lot Run Traceability Code
&2	= 2−Digit Date Code
&Z	= Assembly Plant Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

应用框图

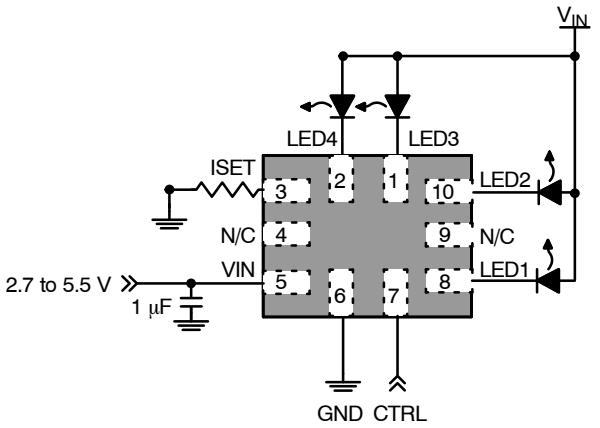


图 2. **FAN5624 4 LED** 的典型应用

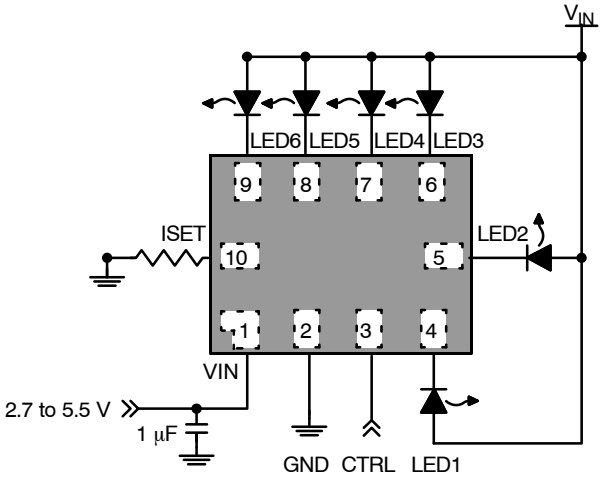


图 3. **FAN5626 6 LED** 的典型应用

框图

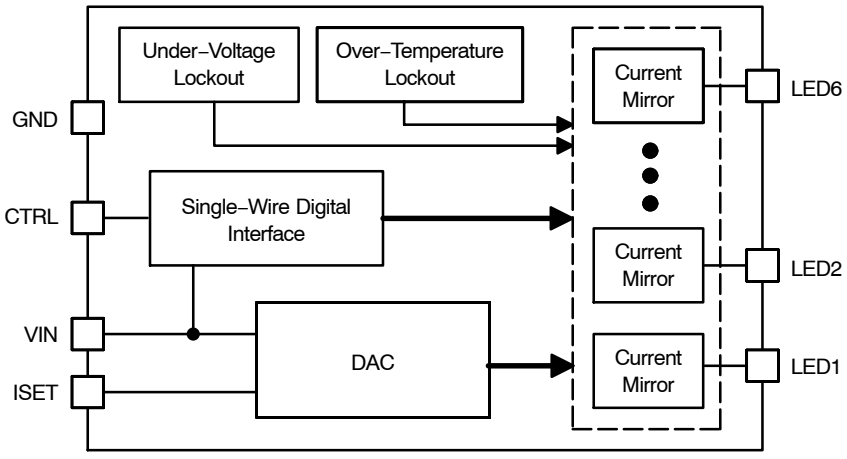


图 4. 框图

引脚布局

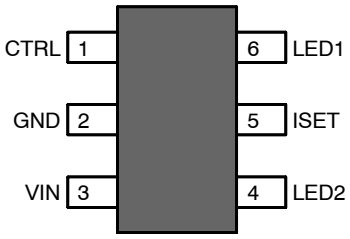


图 5. **FAN5622: 6−Pin SSOT23** 顶视图

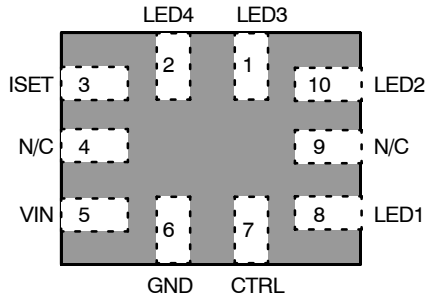


图 6. **FAN5624: 10−Lead UMLP** 顶视图

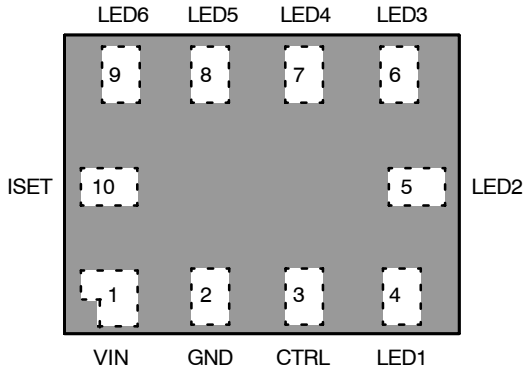


图 7. **FAN5626: 10−Lead MicroPak MLP** 顶视图

引脚说明

引脚号			名称	说明
FAN5622 SSOT23−6	**FAN5624 UMLP10**	**FAN5626 MicroPak MLP10**		
3	5	1	VIN	*输入电压*。连接至 2.7 − 5.5 VDC 输入电源。
2	6	2	GND	*接地*
5	3	10	ISET	*LED 电流设置*。通过将该引脚通过电阻(RSET)接地，可设置满量程 LED 电流。
1	7	3	CTRL	*控制*引脚。采用数字脉冲驱动该引脚可编制调光等级。 该引脚切勿悬浮。
6	8	4	LED1	*LED 阴极 #1*。LED电流阱输出。
4	10	5	LED2	*LED 阴极 #2*。LED电流阱输出。
	1	6	LED3	*LED 阴极 #3*。LED电流阱输出。
	2	7	LED4	*LED 阴极 #4*。LED电流阱输出。
		8	LED5	*LED 阴极 #5*。LED电流阱输出。
		9	LED6	*LED 阴极 #6*。LED电流阱输出。
	4, 9		N/C	*未定义*

绝对最大额定值

符号	参数		最小值	最大值	单位
V_{CC}	VIN 引脚		−0.3	6.0	V
	其他引脚 (说明 1)		−0.3	V_{IN} + 0.3	V
ESD	静电放电防护等级	人体模型满足JESD22−A114	3.0		kV
		充电器件模型满足JESD22−C101	1.5		kV
T_J	结温		−40	+150	°C
T_{STG}	存储温度		−65	+150	°C
T_L	引线焊接温度，10秒		−	+260	°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. 低于 6.0 V 或 V_{IN} + 0.3 V。

推荐工作条件

符号	参数	最小值	最大值	单位
V_{IN}	电源电压范围	2.7	5.5	V
T_A	工作环境温度范围	−40	+85	°C
T_J	工作结点温度范围	−40	+125	°C
$I_{LED(FS)}$	满量程 LED 电流	5	30	mA

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。

热性能 (结−环境之间热阻与具体应用和电路板布局有关。该数据由符合JESD51−JEDEC标准的测试板测得。特别注意的是，不要超过给定环境温度T_A时的结温 $T_{J(max)}$。)

符号	参数	典型值	单位
$\theta_{JA\_SSOT23-6}$	结−环境之间热阻，SSOT23−6 封装	235	°C/W
θ_{JA_UMPL10}	结−环境之间热阻，UMLP10 封装 (说明 2)	287	°C/W
$\theta_{JA\_MicroPAK\_MLP10}$	结−环境之间热阻，MicroPak MLP10 封装 (说明 3)	220	°C/W

2. 建议最大功耗不超过 132 mW。
3. 建议最大功耗不超过 198 mW。

电气规格 (V_{IN} = 2.7 V 至 5.5 V, R_{SET} = 19.10 kΩ, T_A = −40°C 至 +85°C, V_f = 2.5 V 至 [3.5 V 或 V_{IN} − 0.1 V], 相对较小。典型值测量条件为 T_A = 25°C，V_{IN} = 3.6 V 且 V_f = 3.2 V。)

符号	参数	工作条件	最小值	典型值	最大值	单位
电源						
I_{SD}	停机电源电流	V_{IN} = 3.6 V, CTRL = 0	–	0.3	1.0	μA
I_{IN}	工作电源电流	FAN5622: V_{IN} = 3.6 V, I_{LED} = 0 mA	–	0.4	0.8	mA
		FAN5624: V_{IN} = 3.6 V, I_{LED} = 0 mA	–	0.6	1.0	mA
		FAN5626: V_{IN} = 3.6 V, I_{LED} = 0 mA	–	0.8	1.2	mA
I_{IH}	控制引脚输入电流	CTRL = 1.8 V	–	1	250	nA
V_{UVLO}	欠压闭锁阈值	V_{IN} 升	–	2.50	2.70	V
		V_{IN} 降	2.10	2.30	2.50	V
调节						
$I_{FS\_LEDx\ (MAX)}$	满量程 LED 输出电流	I_{LEDx} = 30 mA；x = 1 至 6	5	–	30	mA
I_{LED}	绝对电流精度	V_{IN} = 2.85 V − 4.5 V；V_{CATH} = 0.15 至 (1.2 V 或 V_{IN} = 2.55 V, 其相对较小)；满量程电流 5 − 30 mA, T_A = 25°C	−10	–	+10	%
$I_{LED\ MATCH}$	LED 电流匹配 (说明 4)	I_{LEDx} = 15 mA; V_LEDx = 0.4 V, T_A = 25°C	−3	–	+3	%
V_{ISET}	I_{SET} 驱动电压	9.53 kΩ ≤ R_{SET} ≤ 56.2 kΩ	–	1.20	–	V
I_{RATIO}	ISET 引脚的电流镜像比	9.53 kΩ ≤ R_{SET} ≤ 56.2 kΩ	–	240	–	
ΔI_{OUT_LOAD}	I_{OUT} 负载调节	V_{IN} = 3.6 V, I_{LEDx} = 15 mA, LED V_F = 2.7 to 3.5 V	−3	–	+3	%
ΔI_{OUT_LINE}	I_{OUT} 电源调节	V_{IN} = 2.7 至 4.8 V, I_{LEDx} = 15 mA, V_{CATH} = 0.5 V	−4	–	+4	%
$V_{DROPOUT}$	压差	V_{IN} = 3.6 V；I_{LED} = 15 mA, −10% I_{LED} 跌落	–	50	–	mV
		V_{IN} = 3.6 V；I_{LED} = 30 mA, −10% I_{LED} 跌落	–	60	–	
TSD	热关闭	结点温度升高	–	150	–	°C
		滞环	–	20	–	
逻辑输入(CTRL)						
V_{IH}	输入电压高电平		1.2	–	–	V
V_{IL}	低电平输入电压		–	–	0.4	V
T_{LO}	CTRL LOW 调光时间	V_{IN} = 3.6 V；*参见* 图17	0.5	–	300	μs
T_{HI}	级间延时	V_{IN} = 3.6 V；*参见* 图17	0.5	–	–	μs
T_{ON}	CTRL 高电平 至导通延时	V_{IN} = 3.6 V；*参见* 图17	–	250	–	μs
T_{SD}	CTRL 低电平， 关断脉冲宽度	V_{IN} = 3.6 V；自CTRL的下降沿	1	–	–	ms

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. 分别为FAN5622、FAN5624以及 FAN5626 的2、4、6 LED 电流阱；以下对应于：2、4、6 LED 输出的最大电流阱 ()；2、4、6 LED 输出的 最小电流阱 (MIN)；以及平均电流阱(AVG)。对于所有的LED输出，计算两个匹配数值：(MAX − AVG) / AVG 和 (AVG − MIN) / AVG。选择给定部分的匹配值作为两个中的最高匹配值。既定部分的匹配值应为所有 LED 输出中匹配度最高的。提供的典型规格就是所有部分的最大可能匹配基准。

典型性能特征

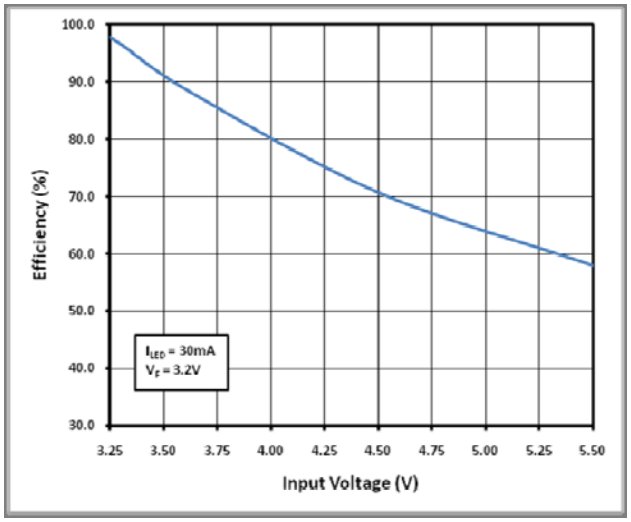


图 8. 效率 vs. 输入电压 LED V_F = 3.2 V

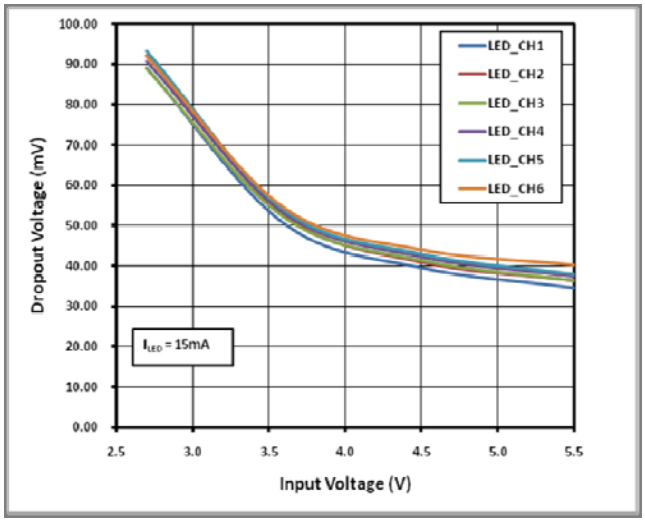


图 9. 压差 vs. 输入电压

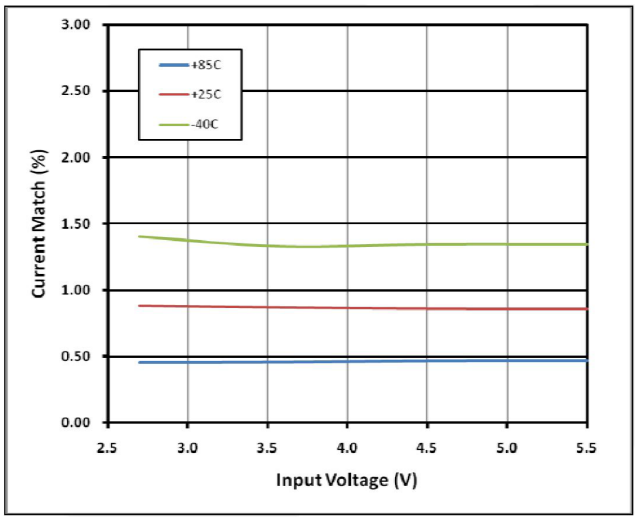


图 10. 通道的电流匹配 vs. 输入电压

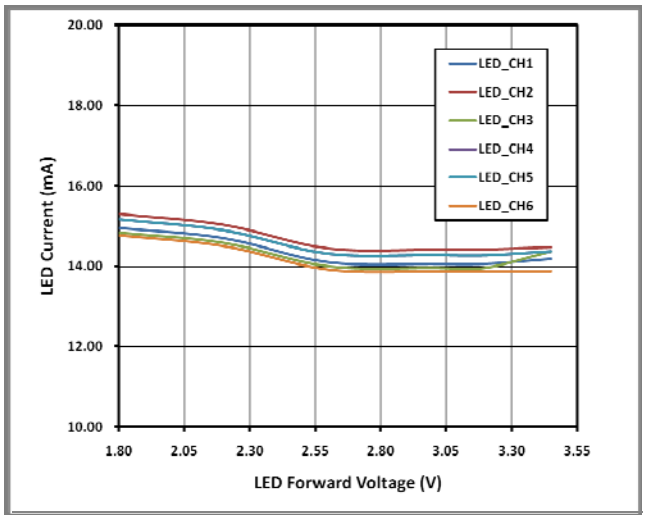


图 11. 15 mA 的负载调节/输出

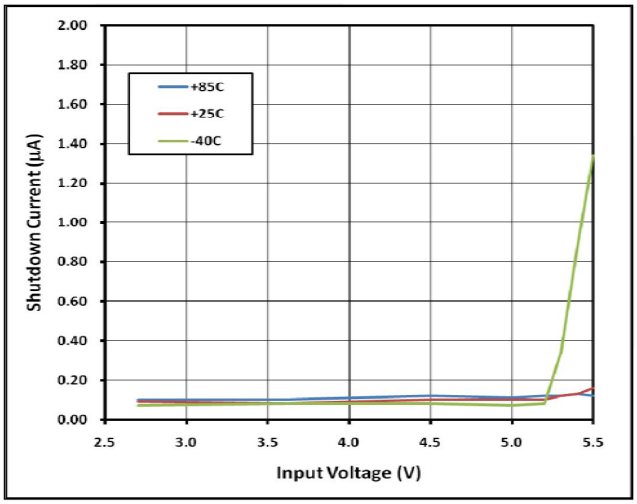


图 12. 停机电流 vs. 输入电压

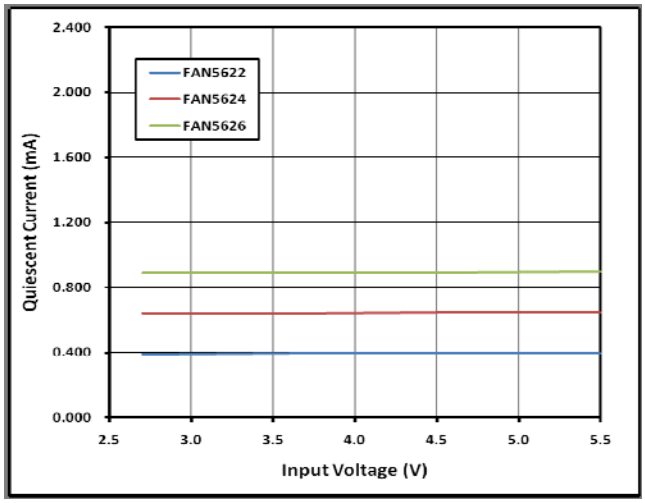


图 13. 静态电流 vs. 输入电压

典型性能特征

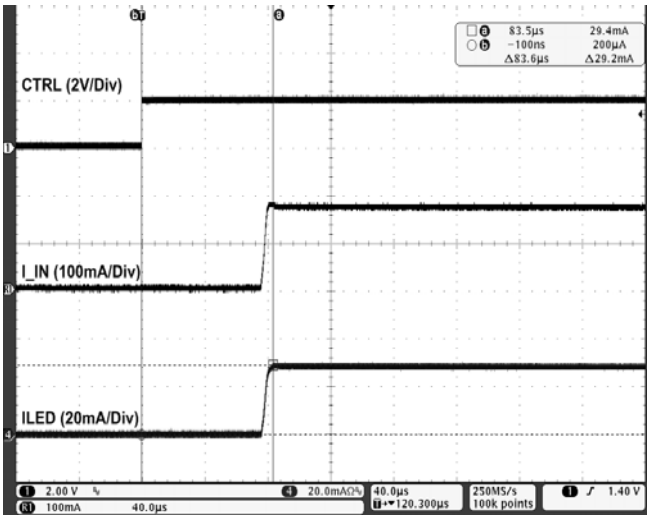


图 14. **FAN5626** 的启动波形

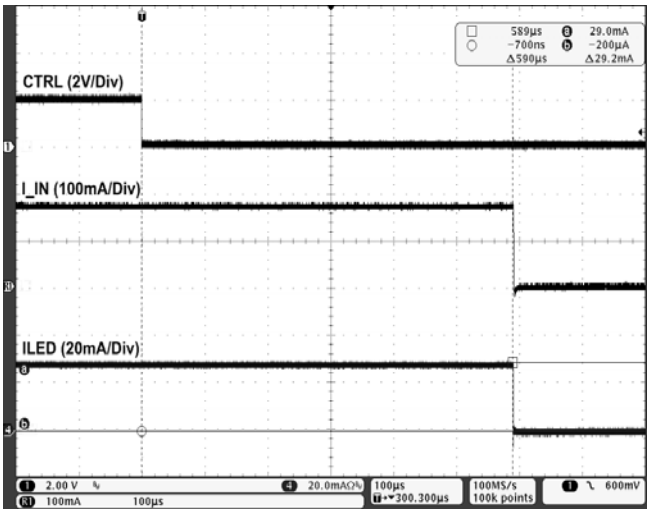


图 15. **FAN5626** 的关断波形

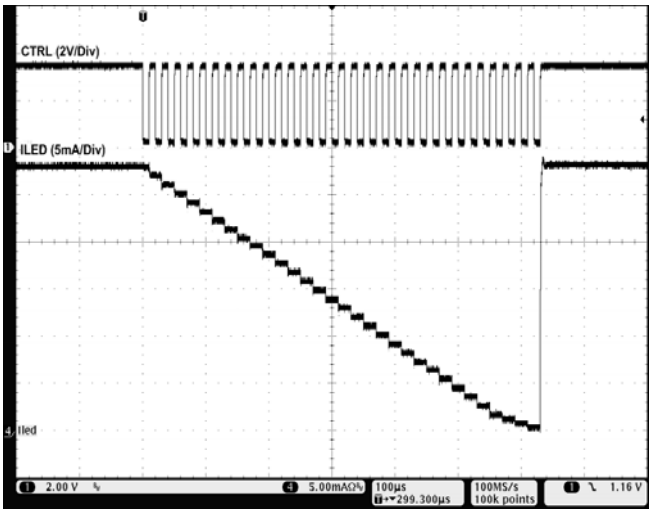


图 16. 调光操作

电路说明

FAN5622、FAN5624 和 FAN5626 系列为电流阱线性 LED 驱动器，该系列芯片分别可驱动2、4 或6个 LED。这三款器件使用 2.7 V 至 5.5 V 电源直接供电，所有的通道通过外部电源集成的电流阱来控制。设计采用了极低的压差，FAN562x 系列产品以接近输入电压的水平工作，无需额外的电感升压或电容开关电路。

这三款器件只需要两个额外的分立无源部件：一个 1 μF 陶瓷输入电容和电阻(R_{SET})，用来设置 LED 的最大电流。每个电流阱输出可提供恒定电流，并以最高可达 30 mA 的电流驱动 LED。安森美半导体的 TinyWire 单线数控接口，可让 LED 驱动器对LED的亮度进行32级线性调整。

设置最大电流

FAN5622、FAN5624 以及 FAN5626的最大 LED 电流使用叫做 RSET 的外接电阻来编制。三款 LED 驱动器的最大满量程 LED 电流为 30 mA，最低可达 5 mA。FAN562x 系列产品也可在低于 5 mA 满量程 LED 电流下工作，但需使用一个较大的 R_{SET}。但是，仍可确保 LED 通道的精度和匹配规格。表1显示多个满量程电流级别适用的 RSET 电阻值。

表 1. 使用电阻设置最大 LED 电流

I_{LED} (mA)	R_{SET} (kΩ)
5	56.20
10	28.70
15	19.10
20	14.30
25	11.50
30	9.53

数字接口和调光控制

FAN5622、FAN5624 和 FAN5626采用简单的单线数控接口，可通过数字脉冲对LED的亮度进行32级线性调整。为了保持一定调光等级下 LED 的亮度，施加在 CTRL 引脚上的数字脉冲信号的最后一个脉冲必须保持高电平。根据所需时间保持为高电平，在此期间 LED 照明为指定亮度等级。表 2 显示了调光等级，而图 17 显示如何改变调光等级。

表 2. 亮度控制等级 (R_{SET} = 19.10 kΩ)

调光等级	电流值	I_{LED} (mA)
1	1.67%	0.25
2	3.33%	0.50
3	5.00%	0.75
4	6.67%	1.00
5	10.00%	1.50
6	13.33%	2.00
7	16.67%	2.50
8	20.00%	3.00
9	23.33%	3.50
10	26.67%	4.00
11	30.00%	4.50
12	33.33%	5.00
13	36.67%	5.50
14	40.00%	6.00
15	43.33%	6.50
16	46.67%	7.00
17	50.00%	7.50
18	53.33%	8.00
19	56.67%	8.50
20	60.00%	9.00
21	63.33%	9.50
22	66.67%	10.00
23	70.00%	10.50
24	73.33%	11.00
25	76.67%	11.50
26	80.00%	12.00
27	83.33%	12.50
28	86.67%	13.00
29	90.00%	13.50
30	93.33%	14.00
31	96.67%	14.50
32	100.00%	15.00

数字调光控制

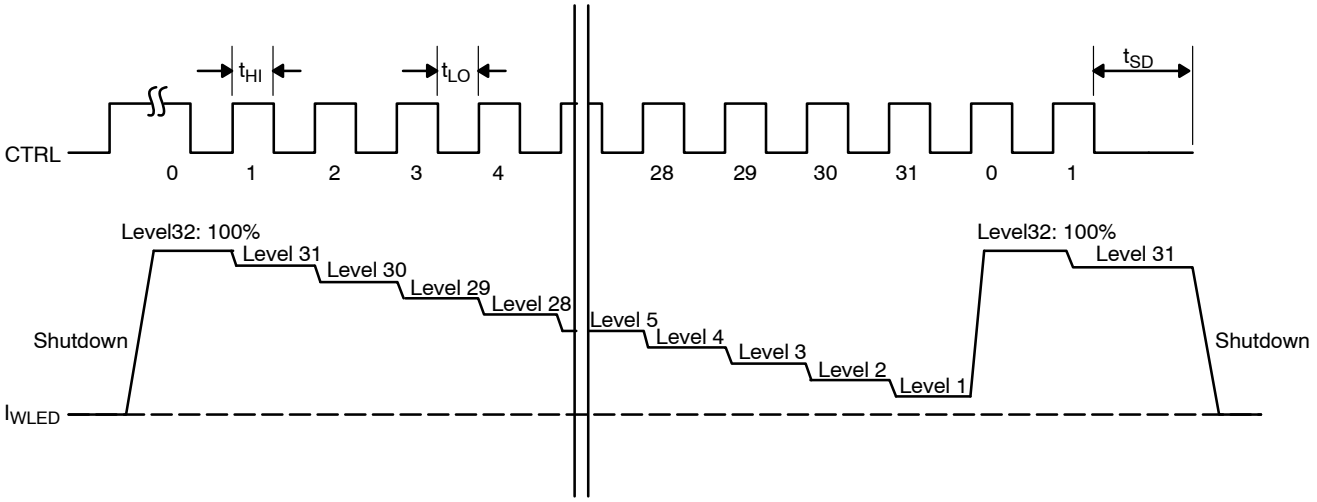


图 17. 数字脉冲调光控制图

订购信息

器件型号	通道号	温度范围	封装	包装†
FAN5622SX	2	−40 to 85°C	6−Lead, SSOT23 (Pb−Free)	3000 / 卷带
FAN5624UMPX	4	−40 to 85°C	10−Lead UMLP (Pb−Free)	5000 / 卷带
FAN5626LX	6	−40 to 85°C	10−Lead MicroPak MLP (Pb−Free)	5000 / 卷带

†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.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

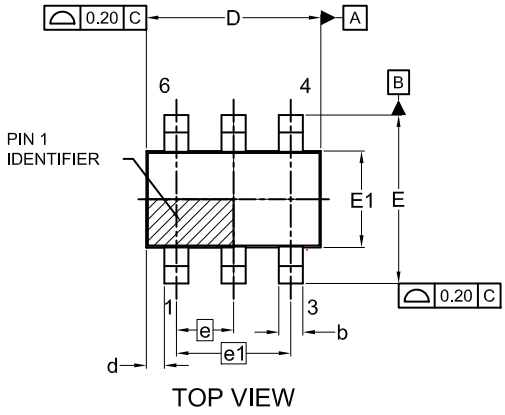
ON Semiconductor®

1

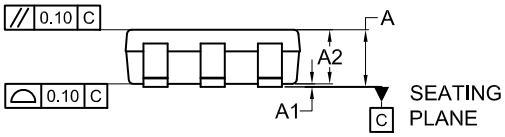
SCALE 2:1

TSOT23 6−Lead
CASE 419BL
ISSUE A

DATE 31 AUG 2020

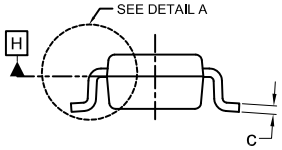


TOP VIEW

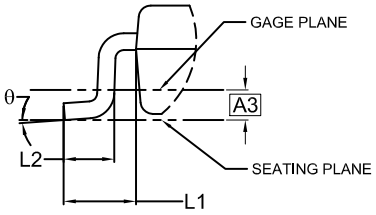


FRONT VIEW

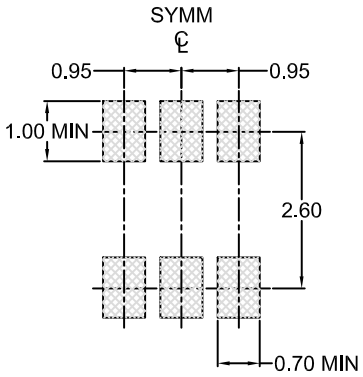
NOTE 4



SIDE VIEW



DETAIL A



LAND PATTERN
RECOMMENDATION

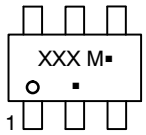
*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25MM PER END. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	0.05	0.10
A2	0.70	0.85	1.00
A3		0.25 BSC	
b	0.25	0.38	0.50
c	0.10	0.18	0.26
D	2.80	2.95	3.10
d		0.30 REF	
E	2.50	2.75	3.00
E1	1.30	1.50	1.70
e		0.95 BSC	
e1		1.90 BSC	
L1		0.60 REF	
L2	0.20	0.40	0.60
θ	0°	---	10°

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present. Some products may not follow the Generic Marking.

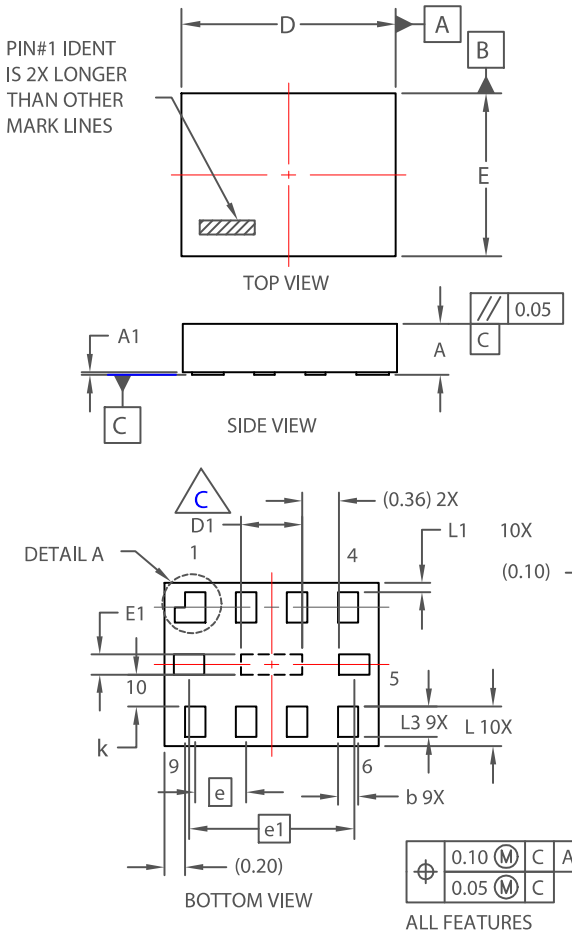
DOCUMENT NUMBER:	**98AON83292G**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**TSOT23 6−Lead**	**PAGE 1 OF 1**

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

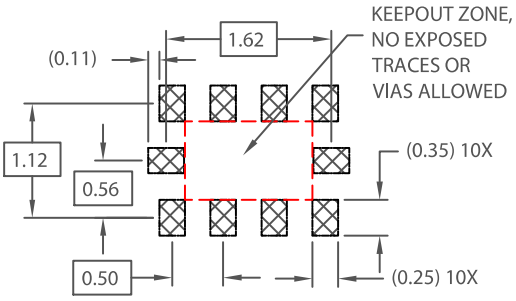
UQFN10 (MICROPAK™), 1.6X2.1, 0.5P
CASE 523AZ
ISSUE A

DATE 11 DEC 2019



NOTES:
A. PACKAGE CONFORMS TO JEDEC REGISTRATION MO-255, VARIATION UABD.
B. DIMENSIONS ARE IN MILLIMETERS.
C. PRESENCE OF CENTER PAD IS PACKAGE SUPPLIER DEPENDENT. IF PRESENT IT IS NOT INTENDED TO BE SOLDERED AND HAS A BLACK OXIDE FINISH.
D. DIMENSIONS WITHIN ( ) ARE UNCONTROLLED.

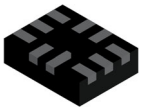
DIM	MIN.	NOM.	MAX.
A	0.50	0.55	0.65
A1	0.00	0.025	0.05
b	0.15	0.20	0.25
D	2.00	2.10	2.20
D1	0.55	0.60	0.65
E	1.50	1.60	1.70
E1	0.15	0.20	0.25
e	0.50 BSC		
e1	1.62 BSC		
k	0.20	--	--
L	0.25	0.30	0.42
L1	0.00	0.09	0.15
L3	0.25	0.30	0.35



RECOMMENDED
MOUNTING FOOTPRINT *

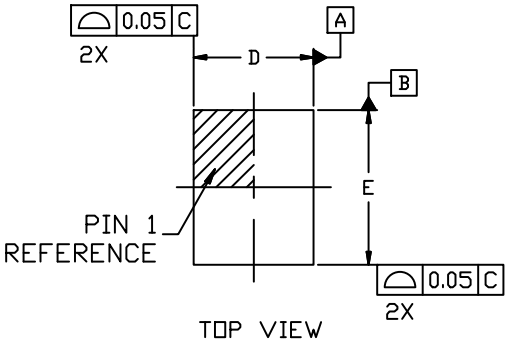
*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

DOCUMENT NUMBER:	**98AON13592G**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	**UQFN10 (MICROPAK™), 1.6X2.1, 0.5P**	**PAGE 1 OF 1**

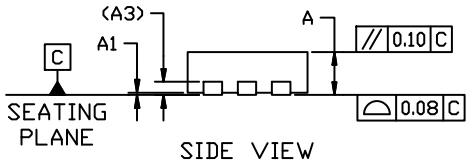


UQFN10 1.4x1.8, 0.4P
CASE 523BC
ISSUE B

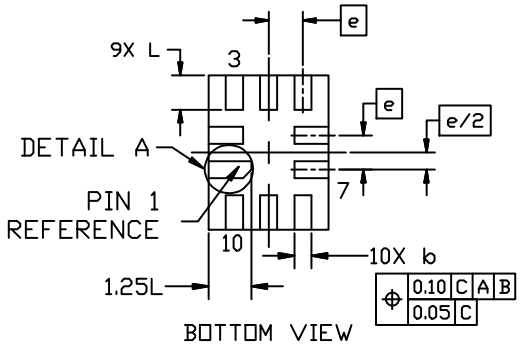
DATE 13 MAY 2022



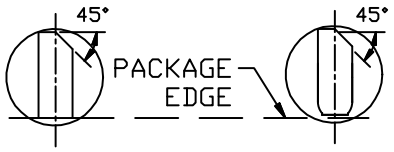
TOP VIEW



SIDE VIEW



BOTTOM VIEW



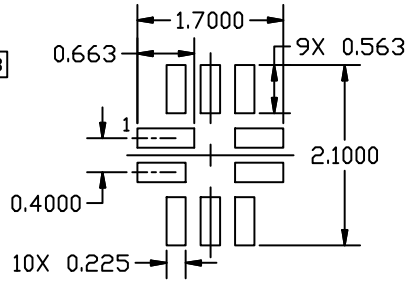
DETAIL A

OPTIONAL CONSTRUCTIONS

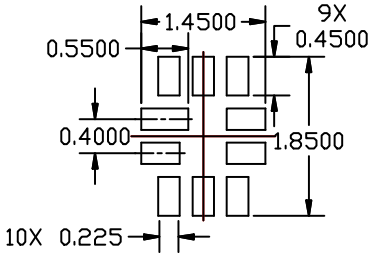
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5, 2018
2. ALL DIMENSIONS ARE IN MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINALS AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.45	0.50	0.55
A1	0.00	0.025	0.05
A3	0.152 REF		
b	0.15	0.20	0.25
D	1.35	1.40	1.45
E	1.75	1.80	1.85
e	0.40 BSC		
L	0.35	0.40	0.45



RECOMMENDED LAND PATTERN



OPTIONAL MINIMIAL TOE LAND PATTERN

RECOMMENDED MOUNTING FOOTPRINT

For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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DESCRIPTION:	**UQFN10 1.4x1.8, 0.4P**	**PAGE 1 OF 1**

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