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FAIRCHILD SEMICONDUCTOR®

July 2013

FAN5622 / FAN5624 / FAN5626
Linear LED Drivers with Single-Wire Digital Interface

Features

- Family of Three Linear Current-Sink LED Drivers that Support 2, 4, or 6 LED Outputs
- Current Sink Driver for Each LED Output:
  - 30 mA Maximum Output Current
  - 50 mV Drop-out at 15 mA I_{OUT}
  - Better than 3% Matching between Channels
  - External R_{SET}
- Single-Wire Digital Control Interface for Easy Programming
  - 32 Linear Steps of Dimming Control
- Less than 1 µA Shutdown Current
- Short-Circuit, Under-Voltage, and Thermal Protection
- Wide Input Voltage Range: 2.7 to 5.5 V
- Small Form-Factor Packages:
  - FAN5622: 6-Pin Super SOT23
  - FAN5624: 10-Lead 1.4x1.8x0.55 mm UMLP
  - FAN5626: 10-Lead 1.6x2.1x0.55 mm MicroPak™ MLP

Applications

- Mobile Handsets
- Mobile Internet Devices
- PMP and MP3 Players
- LCD Modules

Description

The FAN5622, FAN5624, and FAN5626 are two-, four-, and six-channel current-sink linear LED drivers used to backlight the main LCD displays or keypads in mobile electronics, such as cellular phone handsets.

A very low dropout of 50 mV allows driving LEDs without any inductors or switch capacitors. The brightness levels of the LED outputs are programmed through single-wire digital control interface. The user can program 32 linear dimming steps and turn on and off the LEDs through this interface by applying digital pulses.

The FAN562x family of linear LED drivers provides high efficiency due to the low drop-out voltage of the LED driver. Good matching between different channels of LED output is provided across the entire 32 dimming steps. These LED drivers also integrate short circuit, under-voltage, and thermal protection to ensure for a more robust solution.

The FAN5622, FAN5624, and FAN5626 are available in very small form-factor packages: 6-pin Super SOT23, 10-lead UMLP, and 10-lead MicroPak™ MLP, respectively.

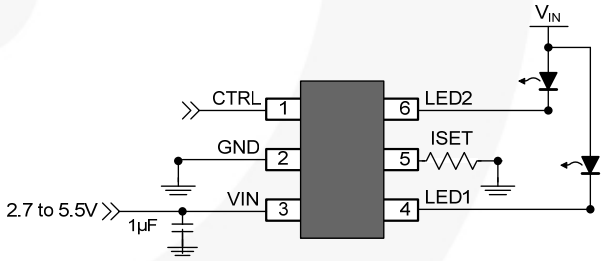

Figure 1. Typical Application of FAN5622

Ordering Information

Part Number	# of Channels	Temperature Range	Package	Packing
FAN5622SX	2	-40 to 85°C	6-Lead, SUPERSOT6, JEDEC MO-193, 1.6 mm Wide	Tape and Reel
FAN5624UMPX	4	-40 to 85°C	10-Lead, Ultrathin Molded Leadless Package (UMLP)	Tape and Reel
FAN5626LX	6	-40 to 85°C	10-Lead ,Micropak ,JEDEC MO255, 1.6 X 2.1 mm	Tape and Reel

Applications Diagrams

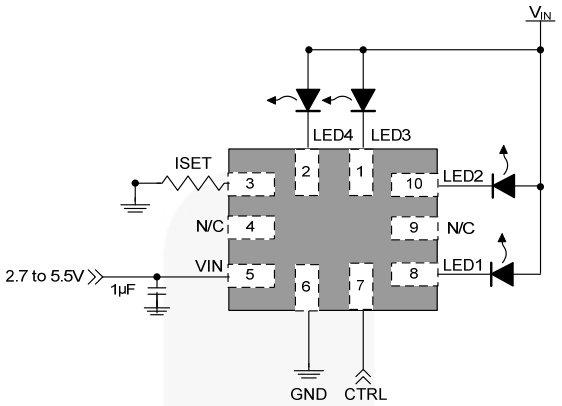

Figure 2. FAN5624 Typical Application for 4 LEDs

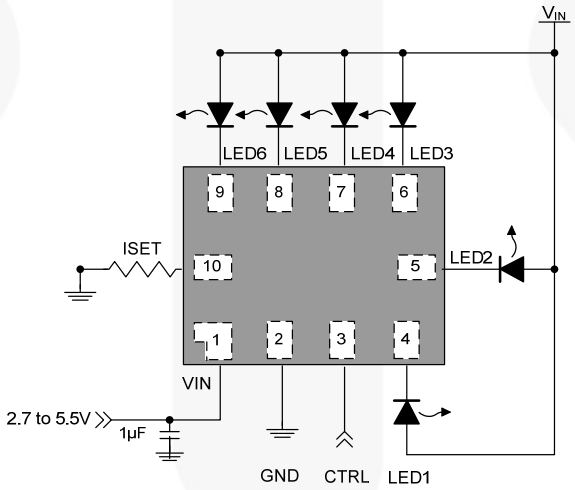

Figure 3. FAN5626 Typical Application for 6 LEDs

Block Diagram

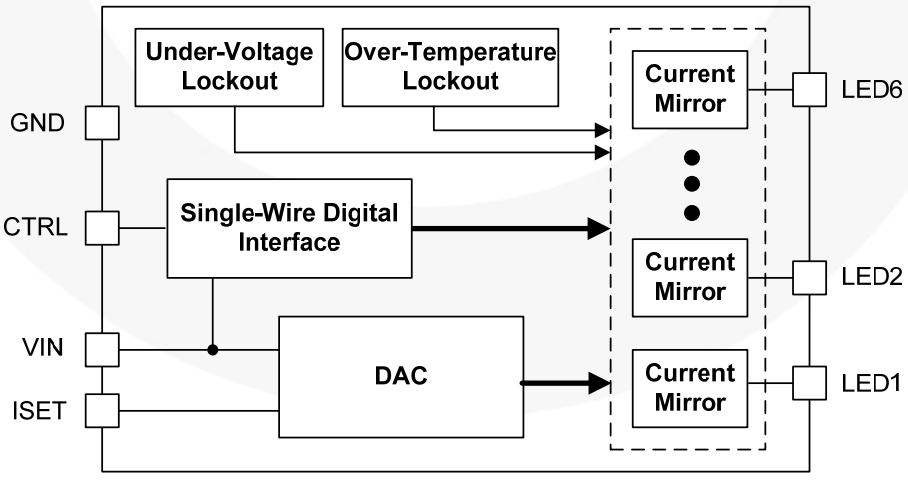

Figure 4. Block Diagram

Pin Configuration

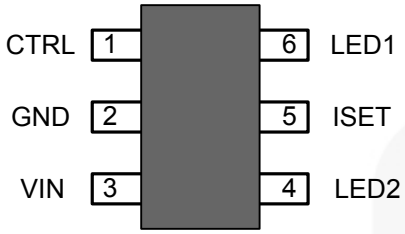

Figure 5. FAN5622: 6-Pin SSOT23, Top View

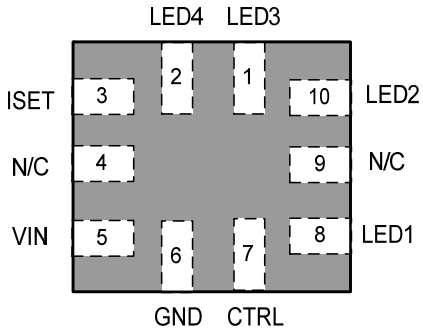

Figure 6. FAN5624: 10-Lead UMLP, Top View

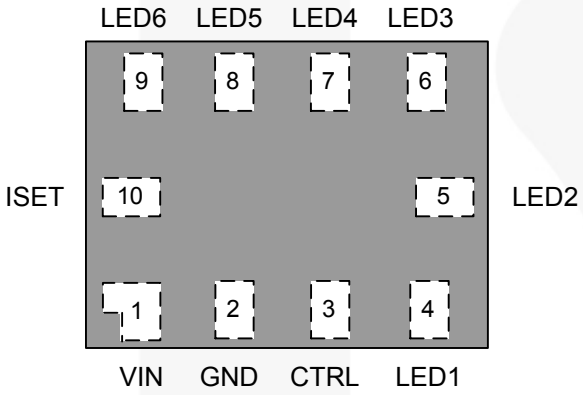

Figure 7. FAN5626: 10-Lead MicroPak™ MLP, Top View

Pin Definitions

Pin #			Name	Description
FAN5622 SSOT23-6	**FAN5624 UMLP10**	**FAN5626 MicroPak MLP10**		
3	5	1	VIN	**Input Voltage**. Connect to 2.7-5.5 V_{DC} input power source.
2	6	2	GND	**Ground**
5	3	10	ISET	**LED Current Setting**. Full-scale LED current is set by tying this pin through a resistor (R_{SET}) to GND.
1	7	3	CTRL	**Control** pin. Program dimming levels by driving pin with digital pulses. This pin cannot be left floating.
6	8	4	LED1	**LED Cathode #1**. LED current sink output.
4	10	5	LED2	**LED Cathode #2**. LED current sink output.
	1	6	LED3	**LED Cathode #3**. LED current sink output.
	2	7	LED4	**LED Cathode #4**. LED current sink output.
		8	LED5	**LED Cathode #5**. LED current sink output.
		9	LED6	**LED Cathode #6**. LED current sink output.
	4, 9		N/C	**No Connect**

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.

Symbol	Parameter		Min.	Max.	Unit
V_{CC}	VIN Pin		-0.3	6.0	V
	Other Pins[1]		-0.3	V_{IN} + 0.3	V
ESD	Electrostatic Discharge Protection Level	Human Body Model per JESD22-A114	3.0		kV
		Charged Device Model per JESD22-C101	1.5		kV
T_J	Junction Temperature		–40	+150	°C
T_{STG}	Storage Temperature		–65	+150	°C
T_L	Lead Soldering Temperature, 10 Seconds			+260	°C

Note:

1. Lesser of 6.0 V or V_{IN}+0.3 V.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Unit
V_{IN}	Power Supply Voltage Range	2.7	5.5	V
T_A	Operating Ambient Temperature Range	-40	+85	°C
T_J	Operating Junction Temperature Range	-40	+125	°C
$I_{LED(FS)}$	Full-Scale LED Current	5	30	mA

Thermal Properties

Junction-to-ambient thermal resistance is a function of application and board layout. This data is measured with boards in accordance to JEDEC standard JESD51. Special attention must be paid not to exceed junction temperature $T_{J(max)}$ at a given ambient temperature T_A.

Symbol	Parameter	Typical	Unit
θ_{JA}	Junction-to-Ambient Thermal Resistance, SSOT23-6 Package	235	°C/W
	Junction-to-Ambient Thermal Resistance, UMLP10 Package[2]	287	°C/W
	Junction-to-Ambient Thermal Resistance, MicroPak™ MLP10 package[3]	220	°C/W

Notes:

2. Recommended not to exceed 132 mW of maximum power dissipation.
3. Recommended not to exceed 198 mW of maximum power dissipation.

Electrical Specifications

V_{IN} = 2.7 V to 5.5 V, R_{SET} = 19.10 kΩ, T_A = -40°C to +85°C, V_f = 2.5 V to [3.5 V or V_{IN} – 0.1 V], whichever is smaller. Typical values are at T_A = 25°C, V_{IN} = 3.6 V, and V_f = 3.2 V.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Power Supplies						
I_{SD}	Shutdown Supply Current	V_{IN} = 3.6 V, CTRL = 0		0.3	1.0	µA
I_{IN}	Operating Supply Current	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}	Control Pin Input Current	CTRL = 1.8 V		1	250	nA
V_{UVLO}	Under-Voltage Lockout Threshold	V_{IN} Rising		2.50	2.70	V
		V_{IN} Falling	2.10	2.30	2.50	V
Regulation						
$I_{FS\_LEDx\ (MAX)}$	Full-Scale LED Output Current	I_{LEDx} = 30 mA; x = 1 to 6	5		30	mA
I_{LED}	Absolute Current Accuracy	V_{IN}=2.85 V – 4.5 V; V_{CATH} =0.15 to (1.2 V or V_{IN}=2.55 V, Whichever is Smaller); Full-Scale Current 5-30 mA, T_A = 25°C	-10		+10	%
$I_{LED\ MATCH}$	LED Current Matching[4]	I_{LEDx} = 15 mA; V_LEDx=0.4 V, T_A = 25°C	-3		+3	%
V_{ISET}	I_{SET} Drive Voltage	9.53 kΩ ≤ R_{SET} ≤ 56.2 kΩ		1.20		V
I_{RATIO}	Current Mirror Ratio from ISET Pin	9.53 kΩ ≤ R_{SET} ≤ 56.2 kΩ		240		
ΔI_{OUT_LOAD}	I_{OUT} Load Regulation	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} Line Regulation	V_{IN} = 2.7 to 4.8 V, I_{LEDx} = 15 mA, V_{CATH} = 0.5 V	-4		+4	%
$V_{DROPOUT}$	Dropout Voltage	V_{IN}=3.6 V; I_{LED} = 15 mA, -10% I_{LED} Drop		50		mV
		V_{IN}=3.6 V; I_{LED} = 30 mA, -10% I_{LED} Drop		60		
TSD	Thermal Shutdown	Rising Temperature at Junction		150		°C
		Hysteresis		20		
Logic Input (CTRL)						
V_{IH}	HIGH-Level Input Voltage		1.2			V
V_{IL}	LOW-Level Input Voltage				0.4	V
T_{LO}	CTRL LOW Time for Dimming	V_{IN} = 3.6 V; *See Figure 17*	0.5		300	µs
T_{HI}	Time Delay between Steps	V_{IN} = 3.6 V; *See Figure 17*	0.5			µs
T_{ON}	CTRL HIGH to Turn-On Delay	V_{IN} = 3.6 V; *See Figure 17*		250		µs
T_{SD}	CTRL LOW, Shutdown Pulse Width	V_{IN} = 3.6 V; from Falling Edge of CTRL	1			ms

Note:

4. For the two, four, and six LED current sinks of FAN5622, FAN5624, and FAN5626 respectively; the following are determined: the maximum sink current of the two, four, and six LED outputs (MAX); the minimum sink current of the two, four, and six outputs (MIN); and the average sink current (AVG). For all of the LED outputs, two matching numbers are calculated: (MAX-AVG)/ AVG and (AVG-MIN)/AVG. The largest number of the two (worst case) is considered the matching figure for the part. The matching figure for a given part is considered to be the highest matching figure of all LED outputs. The typical specification provided is the most likely norm of the matching figure for all parts.

Typical Performance Characteristics

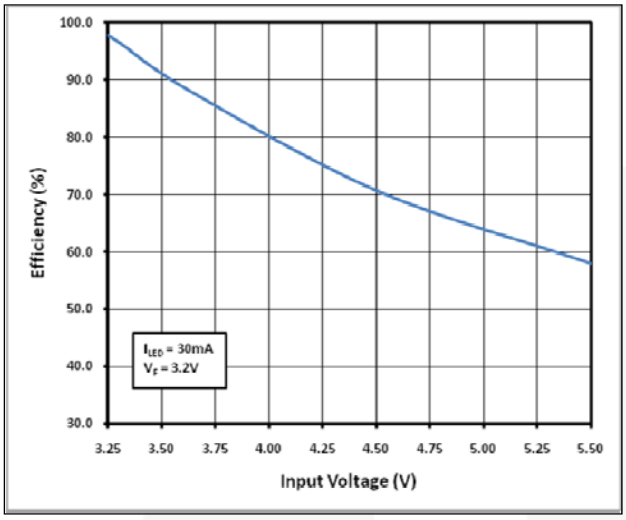

Figure 8. Efficiency vs. Input Voltage where LED V_F=3.2 V

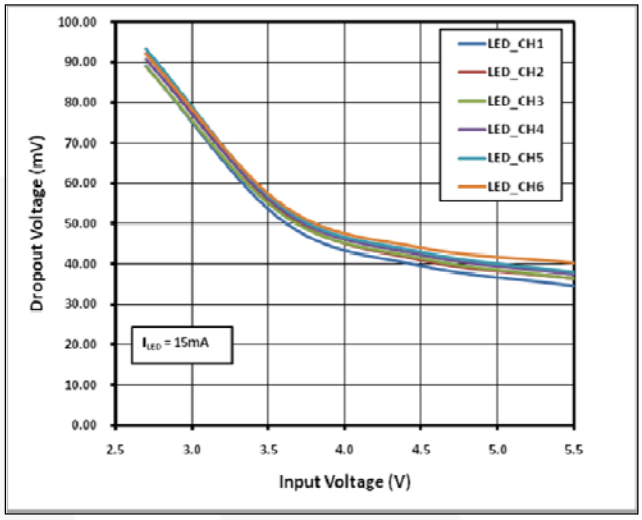

Figure 9. Dropout Voltage vs. Input Voltage

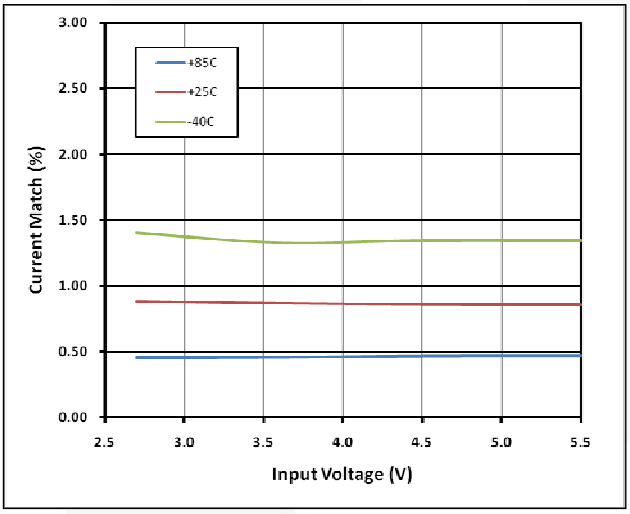

Figure 10. Current Match of Channels vs. Input Voltage

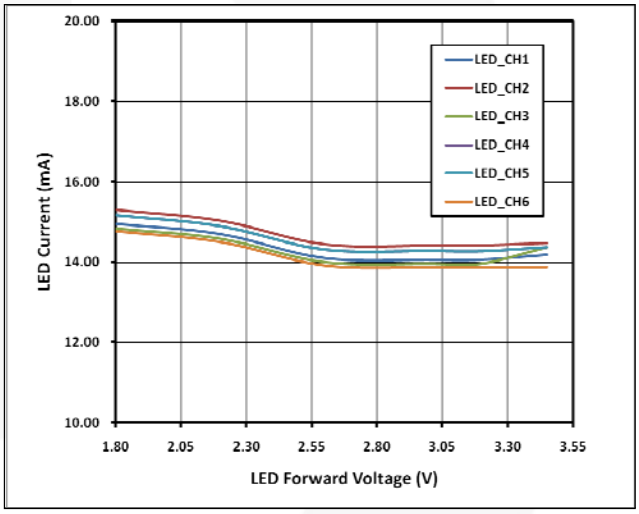

Figure 11. Load Regulation at 15 mA/Output

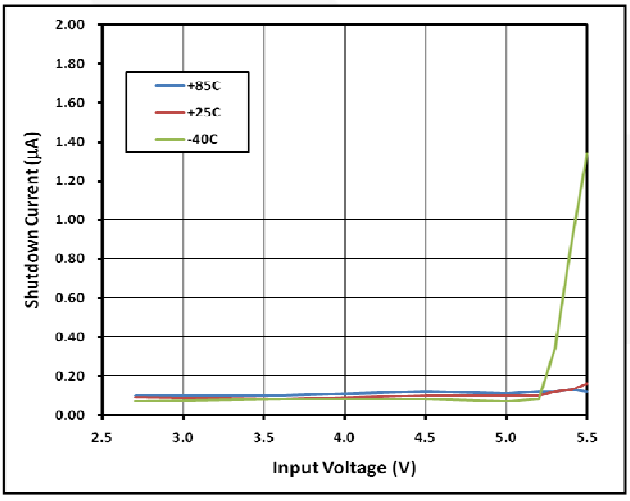

Figure 12. Shutdown Current vs. Input Voltage

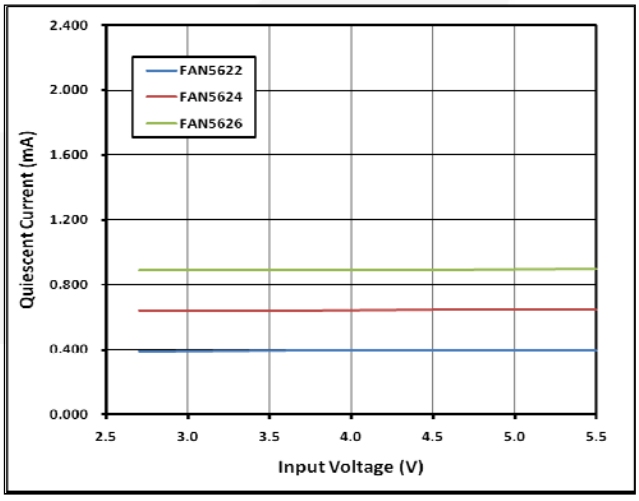

Figure 13. Quiescent Current vs. Input Voltage

Typical Performance Characteristics

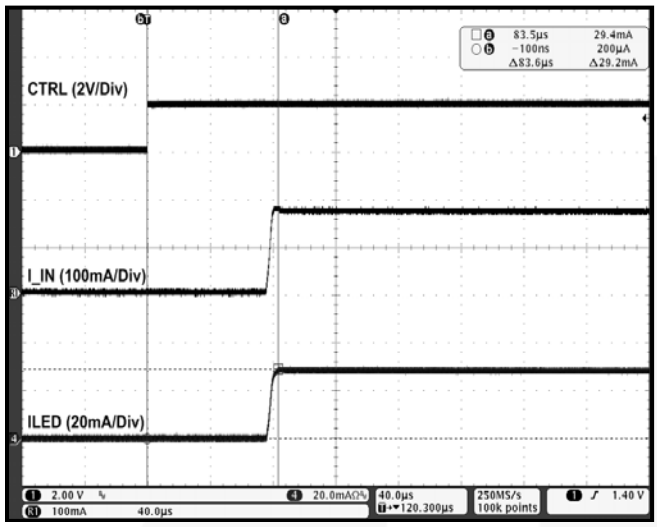

Figure 14. Startup Waveform for FAN5626

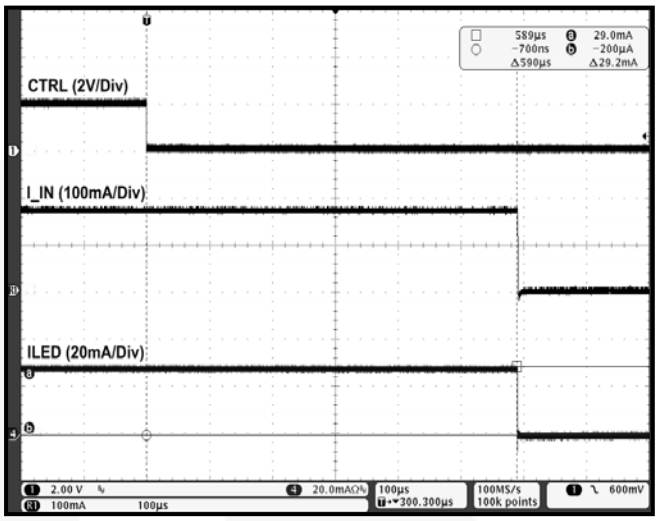

Figure 15. Shutdown Waveform for FAN5626

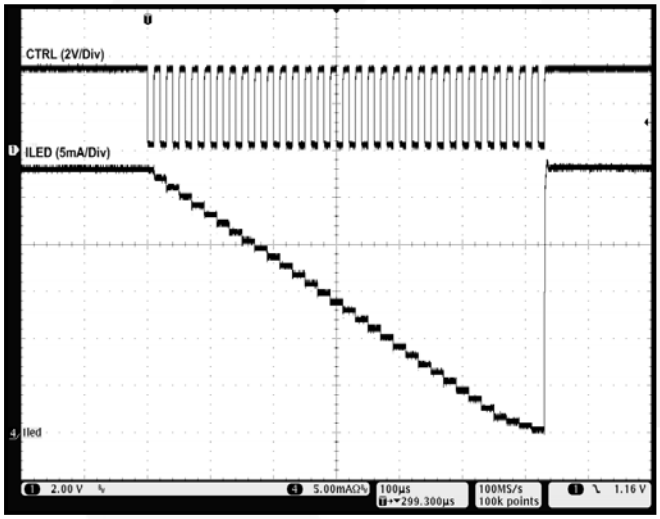

Figure 16. Dimming Operation

Circuit Description

The FAN5622, FAN5624, and FAN5626 are a family of current-sink linear LED driver ICs able to drive two, four, and six LEDs respectively. These three devices are powered directly from 2.7 V to 5.5 V supply and all the channels are controlled via the integrated current sinks from the external power source. Designed with a very low drop-out voltage, the FAN562x products can operate close to the input supply voltage without the need for additional inductive boost or capacitive switching circuitry.

All three devices require only two additional discrete passive components: a single 1 µF input ceramic capacitor and a resistor (R_{SET}) to set the maximum current for the LEDs. Each current-sink output provides constant current and can drive the LEDs up to 30 mA. Fairchild Semiconductor's TinyWire™ single-wire digital interface enables these LED drivers to program the brightness level of the LEDs in 32 linear steps.

Setting Maximum Current

The maximum LED current of the FAN5622, FAN5624, and FAN5626 is programmed by an external resistor called RSET. The maximum full-scale LED current for all three LED drivers is 30 mA and it can go as low as 5 mA. The FAN562x products also operate below 5 mA full-scale LED current by using a larger R_{SET} value. However, the LED channel accuracy and matching specifications are guaranteed. Table 1 shows the RSET resistor values for several full-scale current levels.

Table 1. Maximum LED Current Settings by Resistor

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

Digital Interface & Dimming Control

The FAN5622, FAN5624, and FAN5626 implement a simple single-wire digital interface to program the LED brightness to one of thirty two (32) levels spaced in linear steps. To maintain the brightness of the LEDs at a specific dimming level, the digital pulse signal to the CTRL pin should be held HIGH for that last pulse. It is held HIGH for as long as desired to keep the LEDs illuminated at that specific brightness level. Table 2 outlines the dimming levels while Figure 17 shows how to change the dimming levels.

Table 2. Brightness Control Levels (R_{SET} = 19.10 kΩ)

Dimming Level	Current Level	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

Digital Dimming Control

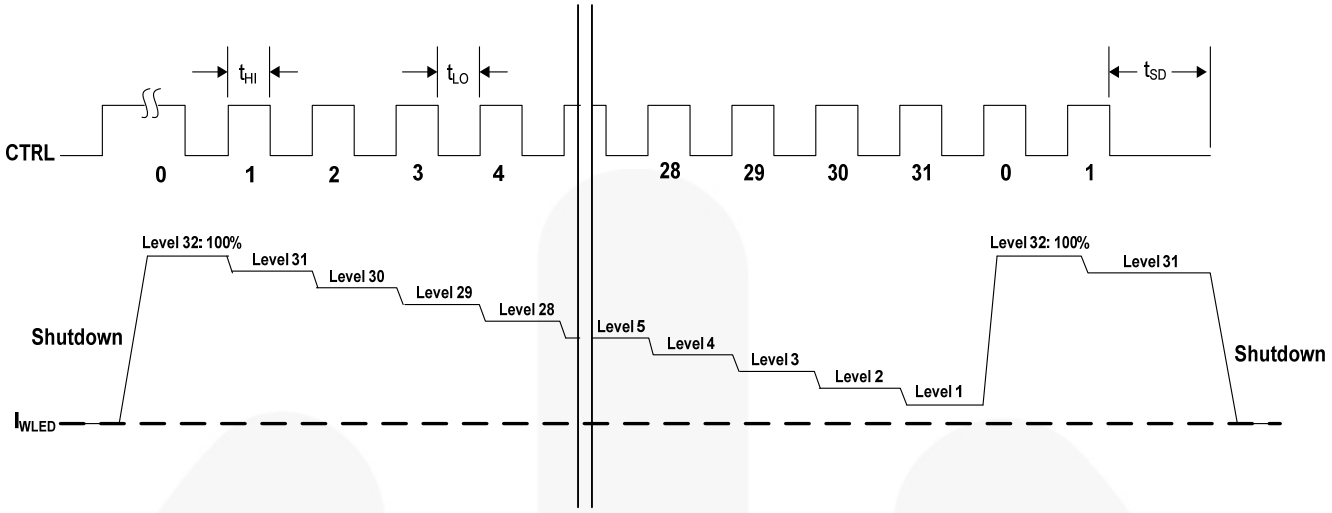

Figure 17. Digital Pulse Dimming Control Diagram

Physical Dimensions

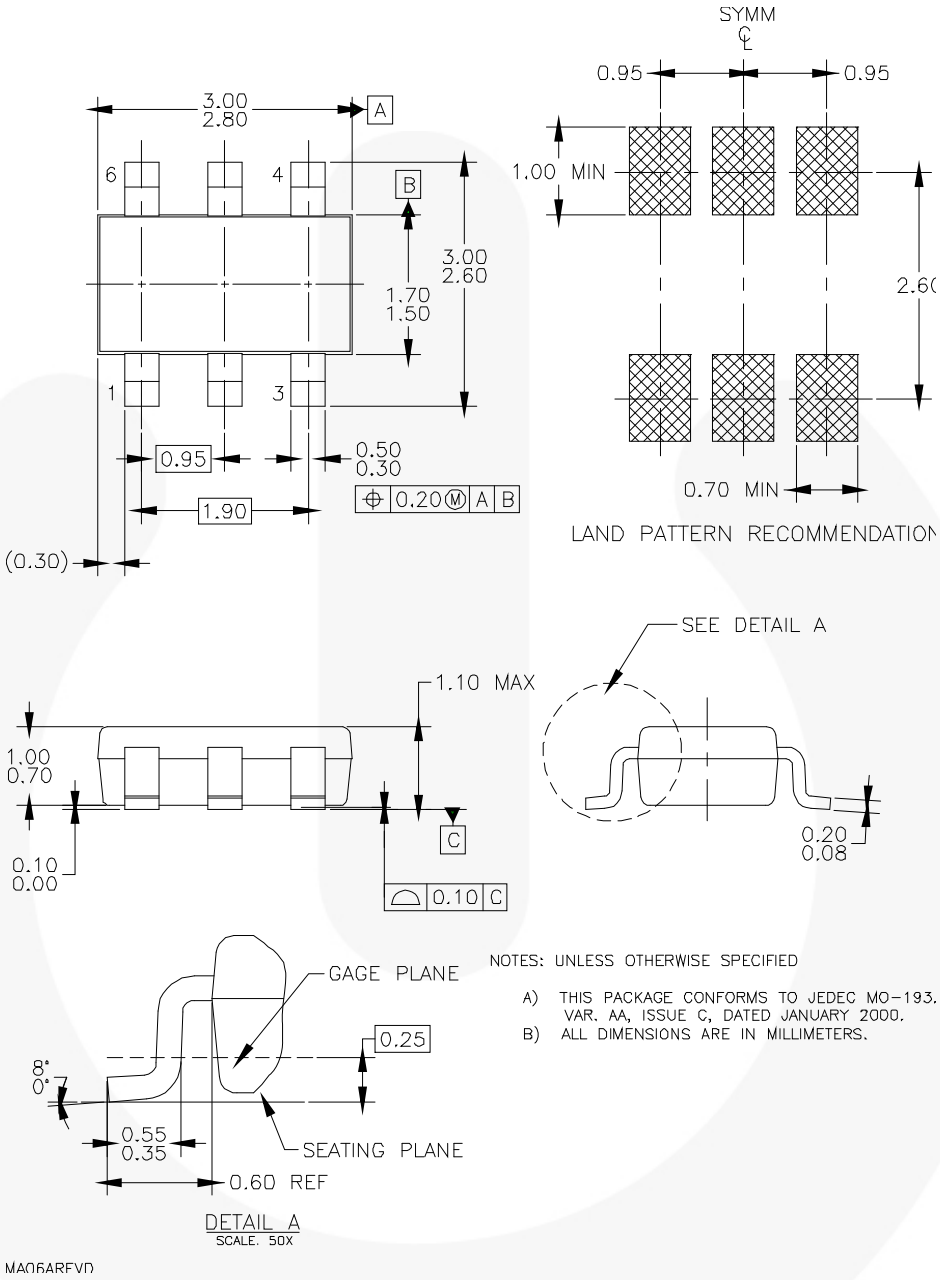

Figure 18. 6-Lead SSOT23

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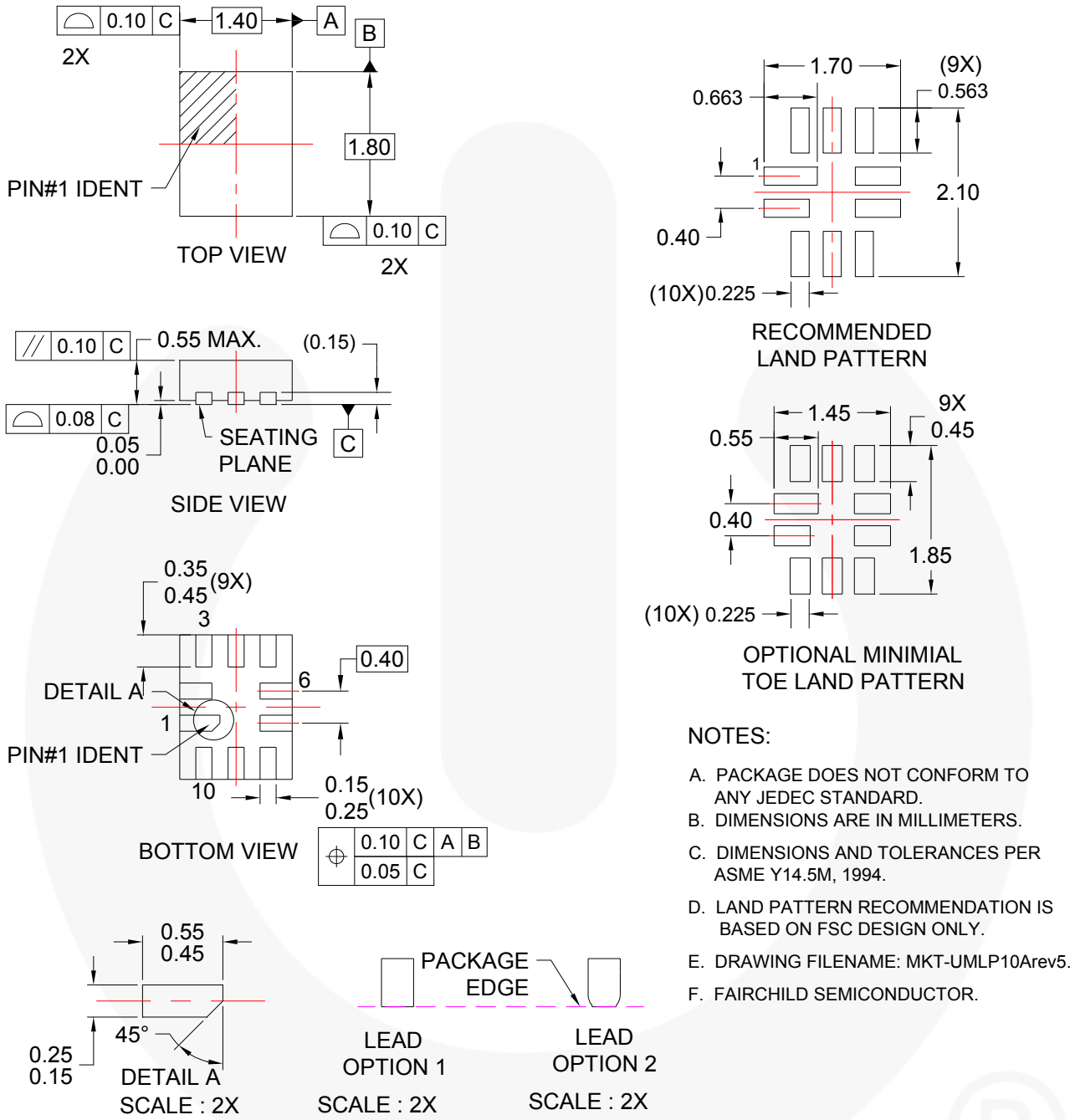
Physical Dimensions (Continued)



NOTES:

A. PACKAGE DOES NOT CONFORM TO ANY JEDEC STANDARD.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
D. LAND PATTERN RECOMMENDATION IS BASED ON FSC DESIGN ONLY.
E. DRAWING FILENAME: MKT-UMLP10Arev5.
F. FAIRCHILD SEMICONDUCTOR.

Figure 19. 10-Lead, Ultrathin Molded Leadless Package (UMLP)

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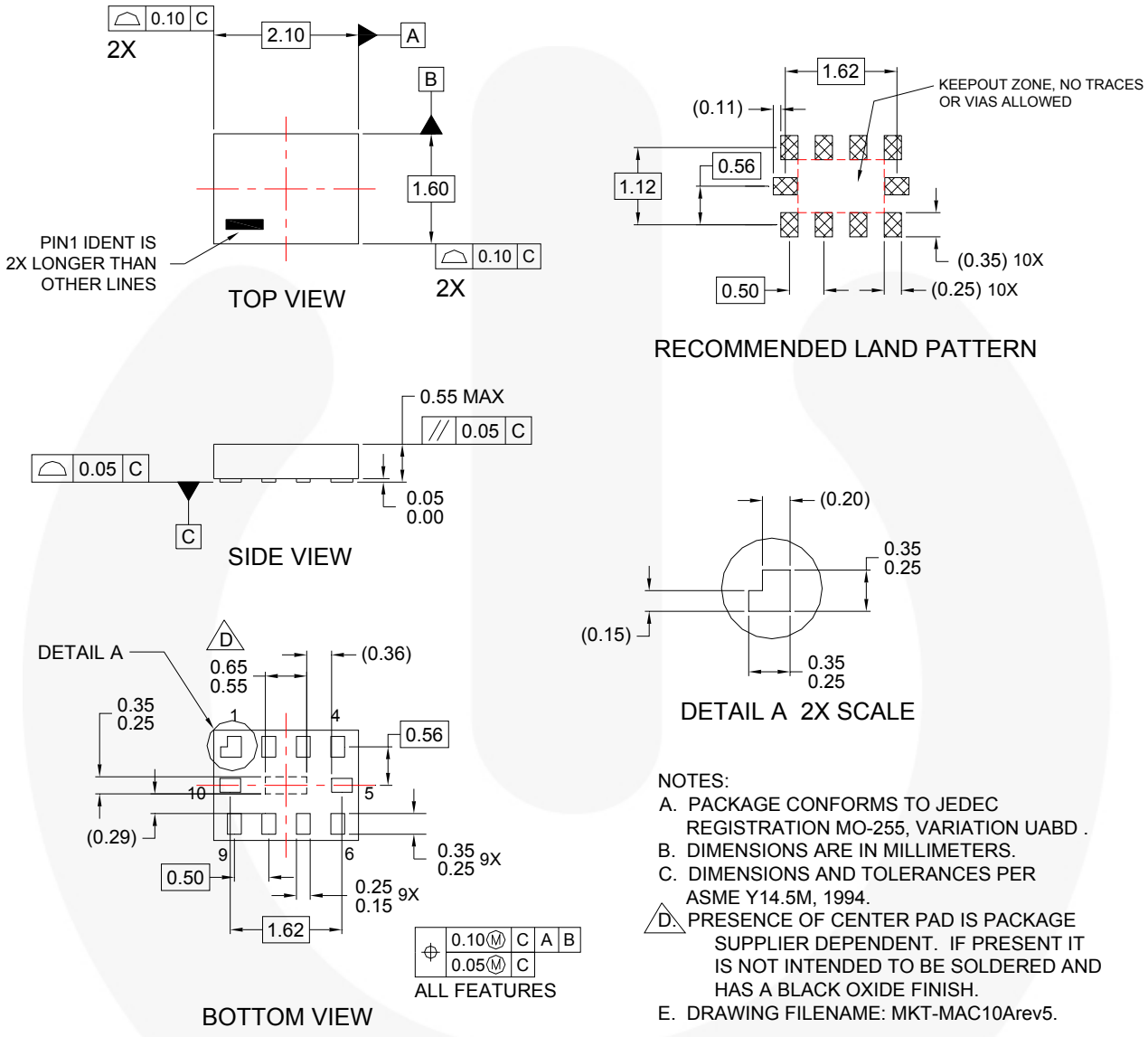
Physical Dimensions (Continued)



NOTES:

A. PACKAGE CONFORMS TO JEDEC REGISTRATION MO-255, VARIATION UABD .

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.

D. PRESENCE OF CENTER PAD IS PACKAGE SUPPLIER DEPENDENT. IF PRESENT IT IS NOT INTENDED TO BE SOLDERED AND HAS A BLACK OXIDE FINISH.

E. DRAWING FILENAME: MKT-MAC10Arev5.

Figure 20. 10-Lead MicroPak™ MLP

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Green FPS™ e-Series™
Gmax™
GTO™
IntelliMAX™
ISOPLANAR™
Making Small Speakers Sound Louder and Better™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
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OPTOPLANAR®
PowerTrench®
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Definition of Terms

Datasheet Identification	Product Status	Definition
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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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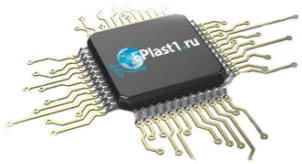

Как с нами связаться

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