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ANALOG DEVICES DC26 Programmable Quad Monolithic Boost LED Driver Instruction Manual

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Product Information

The DC2630A is a demo manual for the LT3966 I2C Programmable Quad Monolithic Boost LED Driver. It is designed to independently dim each channel by applying a PWM signal or CTRL voltage. In non-I2C mode, each channel can be dimmed by applying a PWM signal or CTRL voltage to the corresponding channel CTRL/PWM pin. In I2C mode, each channel has a maximum of 13 bits of PWM dimming resolution and 8 bits of analog dimming resolution. The driver uses small ceramic input and output capacitors to save space and cost. It also features open LED overvoltage protection and adjustable undervoltage lockout.

Product Usage Instructions

1. Make sure that the voltage applied to VIN does not exceed 50V.
2. **Non-I2C Mode**
   - Connect a string of up to 16 LEDs to the ILED1, ILED2, ILED3, and ILED4 terminals.
   - Connect the VIN power supply to the VIN terminal.
   - Turn on the power supply.
   - To change the brightness with analog dimming, attach an adjustable voltage source (0V to 1.5V) to the corresponding CTRL/PWM turrets.
   - To change brightness with external PWM dimming, attach a rectangular waveform with varying duty cycle to the corresponding CTRL/PWM turrets.
3. **I2C Mode**
   - Connect a string of up to 16 LEDs to the ILED1, ILED2, ILED3, and ILED4 terminals.
   - Connect the VIN power supply to the VIN terminal.
   - Turn on the power supply.
   - Connect the DC2630A to a Linduino One microcontroller board (DC2026C) and connect it to a PC via USB.
   - Launch Arduino IDE.
   - Download and install the necessary software libraries as instructed in the DC2026C Demo Manual.

DESCRIPTION

Demonstration circuit 2630A is an I2C programmable quad channel monolithic boost LED driver featuring the LT®3966. It drives four separate strings of LEDs (up
to 50V) at 125mA when VIN is between 9V and 18V. DC2630A runs at 2MHz switching frequency. Its four channels are capable of powering LED strings which can have different currents, voltages, or dimming ratios. Each channel can be independently controlled via I2C commu-nications or analog inputs. DC2630A can be configured to run in either mode by modifying the ADDR pin settings. It is protected against output overcurrent, overvoltage events, and reports open and short LED fault events by latching an alert pin. In I2C mode, faults can be enabled or disabled. A DC2026C Linduino® One demonstration circuit is used to interface with the board by directly connecting it with a QuikEval™ ribbon cable and provided command line interface code.

The LT3966 has an input voltage range from 3V to 60V. Each boost channel has an integrated 60V 1.6A low-side power switch. It has adjustable switching frequency between 300kHz and 2MHz and can be synchronized to an external clock source. Additionally, LT3966 can be pro-grammed to output its own master clock to sync other devices. The high side PWMTG MOSFET drivers assist with PWM dimming and fault protection. The LT3966 channels can be configured to operate as a ground-ref-erenced step-up (boost) LED driver, or as a floating output LED driver to perform step-down (buck mode) or step-up/step-down (buck-boost mode) operation.

Each channel of the LT3966 can be independently dimmed by applying a PWM signal or CTRL voltage to the corre-sponding channel CTRL/PWM pin while operating in non-I2C mode. In I2C mode, each channel has a maximum of 13 bits of PWM dimming resolution and 8 bits of analog dimming resolution.

Small ceramic input and output capacitors are used to save space and cost. The open LED overvoltage protection uses the IC's constant-voltage regulation loop to regu-late the output to approximately 57V if the LED string is opened.

Undervoltage lockout can be adjusted on the circuit with a few simple resistor choices. The output voltage (overvolt-age protection) can be adjusted by changing the feedback resistors for different string voltages. Other components may need to be changed to accommodate the change in output voltages as well.

The LT3966 data sheet gives a complete description of the device, operation and applications information. The data sheet must be read in conjunction with this demo manual for DC2630A. The LT3966EUJ is assembled in a 40-lead plastic 6mm × 6mm QFN package with a thermally enhanced ground.

Design files for this circuit board are available.

DEMO MANUAL DC2630A
PERFORMANCE SUMMARY Specifications are at TA = 25°C

PARAMETER	CONDITION	MIN MAX	TYP	M	UNIT
Input Voltage VIN Range	Operating Transient	9 36		18	V V
Switching Frequency (fSW)	R30 = 47.5kΩ, MPHASE = OFF	2			MHz
ILED1, ILED2, ILED3, ILED4	R3 = R16 = R22 = R26 = 2Ω	125			mA
Open LED Voltage VOUT	R4 = R17 = R23 = R27 = 1MΩ R5 = R18 = R24 = R28 = 21.5kΩ	57			V
Efficiency (100% PWM DC)	VIN = 12.0V, fSW = 2MHz, VLED = 50V ILED1 = ILED2 = ILED3 = ILED4 = 125mA	86.7%			
VLED Range	R4 = R17 = R23 = R27 = 1MΩ R5 = R18 = R24 = R28 = 21.5kΩ	40		56	V
I2C Minimum PWM Dimming Frequency	R30 = 47.5kΩ, SCL[2:0] = 0b111	244			Hz
VIN Undervoltage Lockout (UVLO) Falling	R2 = 499kΩ, R1 = 84.5kΩ	8.5			V
VIN Enable Turn-On (EN) Rising	R2 = 499kΩ, R1 = 84.5kΩ	9.7			V

QUICK START PROCEDURE
Note: Make sure that the voltage applied to VIN does not exceed 50V.

HOW TO OPERATE DC2630A IN NON-I2C MODE
The DC2630A is easy to set up to evaluate the perfor-mance of the LT3966 in non-I2C mode. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

1. With power off, connect a string of up to 16 LEDs between each channel's LED+ and GND turrets. Connect the EN/UVLO turret to GND to keep the cir-cuit shut down. With the power off, connect the input power supply to the VIN and GND terminals.
2. For non-I2C mode operation, set both JP1 and JP2 (ADDR1 and ADDR2) to 0. This address is for non-I2C mode, and all other settings are for I2C serial communications mode.
3. Adjust the input power supply voltage between 9V and 18V and enable its output.
4. Release the EN/UVLO-to-GND connection.
5. Observe the LED string running at the programmed LED current.
6. To change the brightness with analog dimming in non-I2C mode, attach an adjustable voltage source to the corresponding CTRL/PWM turrets and set the voltage between 0V and 1.5V. See data sheet for details.
7. To change brightness with external PWM dimming in non-I2C mode, attach a rectangular waveform with varying duty cycle to the corresponding CTRL/PWM turrets.

HOW TO OPERATE DC2630A WITH COMMAND LINE INTERFACE – I2C SERIAL COMMUNICATIONS MODE
The DC2630A works with a Linduino One microcontroller board (DC2026C) and can be connected to a PC via USB. This allows DC2630A to be controlled via serial port inter-face in Arduino IDE. Refer to the DC2026C Demo Manual for detailed instructions on installing and configuring the necessary software libraries.

1. Launch Arduino IDE.
2. Connect Linduino to computer via USB.
3. Connect a ribbon cable between the J1 serial communications connection and a Linduino One demo circuit.

QUICK START PROCEDURE

4. Download the Linduino code and library files from the DC2630A web page.
5. Upload the code to the connected Linduino demo circuit.
6. With power off, connect a string of up to 16 LEDs between each channel's LED+ and GND turrets. Connect the EN/UVLO turret to GND to keep the cir-cuit shut down. With the power off, connect the input power supply to the VIN and GND terminals.
7. For I2C serial communications, set JP1 (ADDR1) to 1 and JP2 (ADDR2) to 1. This is the chosen I2C address for the DC2630A command line interface.
8. Open up the serial monitor inside Arduino IDE.
9. Turn on 12V power to the VIN and GND pins of the DC2630A.
10. Use command line interface in serial monitor to eval-uate the performance of the LT3966 demo circuit.
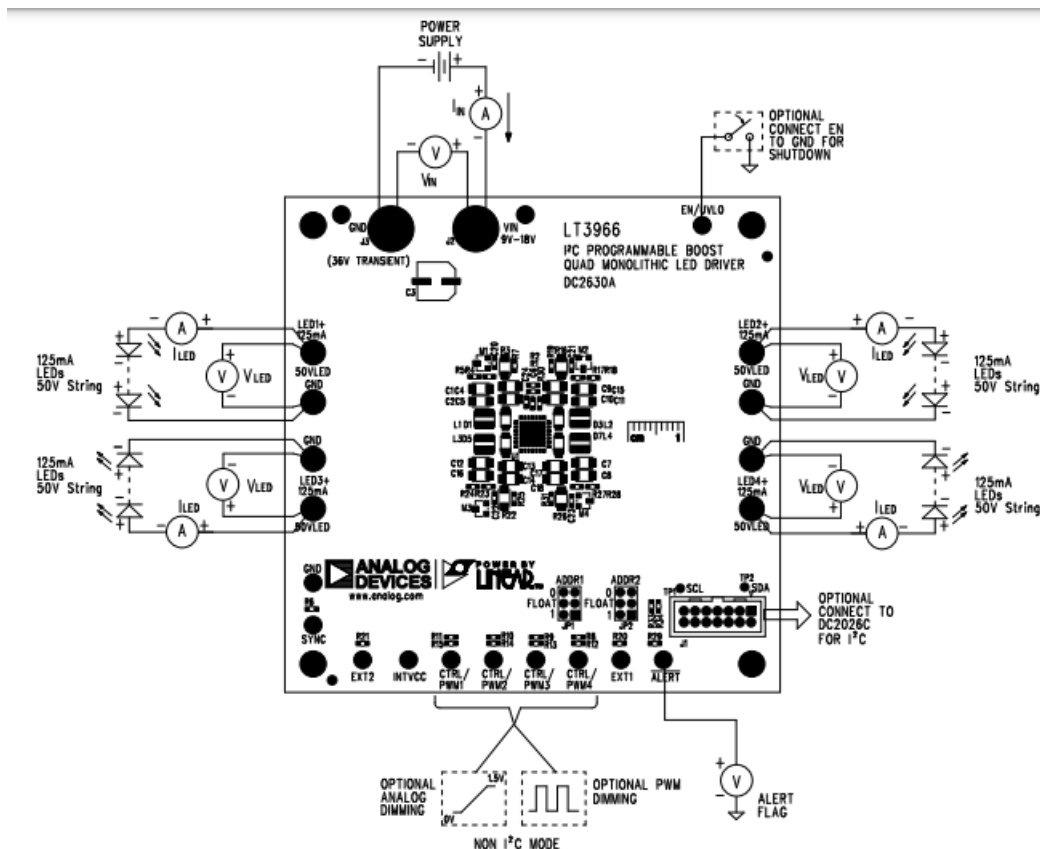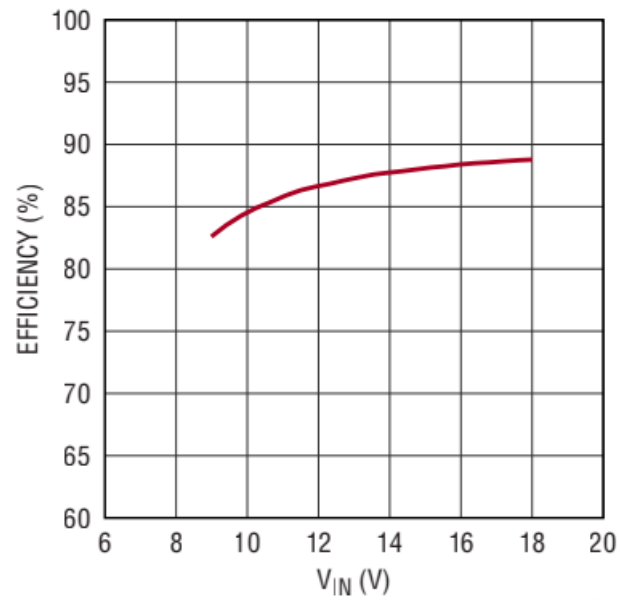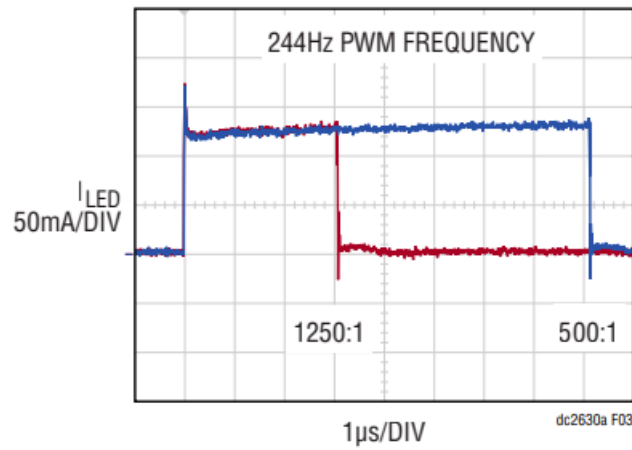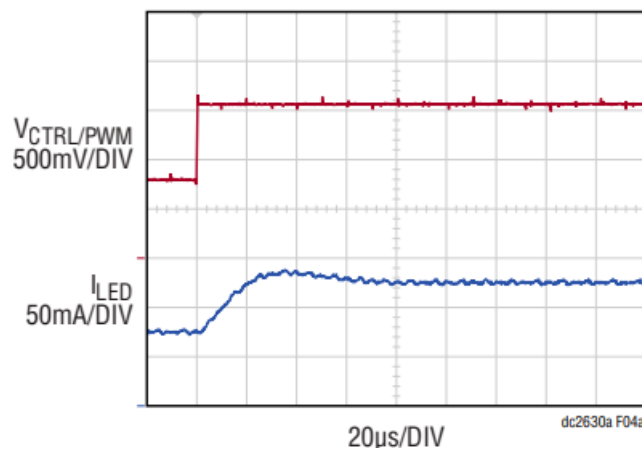

Figure 1. Test Setup Drawing for DC2630A

TEST RESULTS

Figure 2. DC2630A Input Voltage vs Efficiency – 4× Channels Powering 16 White LEDs Per Channel at 125mA

Figure 3. DC2630A PWM Dimming Using I2C Settings for 1250:1 and 500:1 Dimming Ratios

TEST RESULTS

(a) 50% to 100%

(b) 100% to 50%
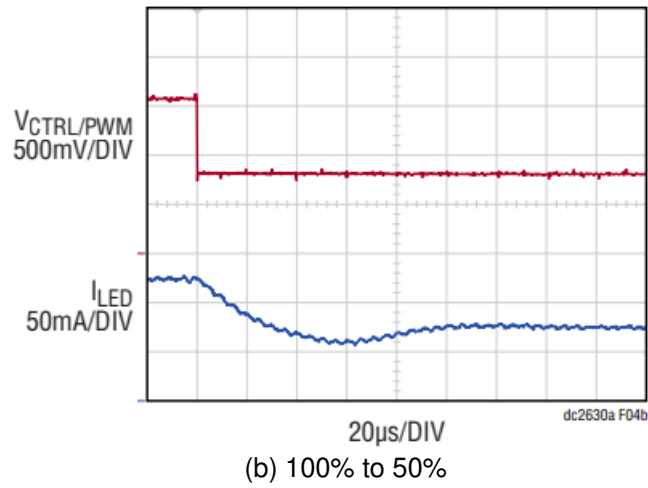
Figure 4. DC2630A Load Transient Response

PARTS LIST

| ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	8	C1, C2, C7, C8, C11, C12, C15, C16	CAP., X7R, 2.2µF, 50V, 10% 1206	AVX, 12065C225KAT2A
2	8	C4, C5, C9, C10, C13, C14, C17, C18	CAP., X7R, 2.2µF, 100V, 10% 1206	AVX, 12061C225KAT4A
3	1	C6	CAP., X5R, 4.7µF, 16V, 10% 0603	MURATA, GRM188R61C475KAAJD
4	1	C24	CAP., X7R, 1.0µF, 50V, 10% 0603	TAIYO YUDEN, UMK107AB7105KA-T
5	4	D1, D3, D5, D7	SCHOTTKY DIODES, PMEG6010CEH, SOD-123	NXP, PMEG6010CEH
6	4	L1, L2, L3, L4	IND., 10µH	WURTH ELEKTRONIK, 74438336100
7	4	R3, R16, R22, R26	RES., 2Ω, 1/2W, 1% 1206	SUSUMU, RL1632R-2R00-F
8	4	R4, R17, R23, R27	RES., 1M, 1/10W, 1% 0603	VISHAY, CRCW06031M00FKEA
9	4	R5, R18, R24, R28	RES., 22.6k, 1/10W, 1% 0603	VISHAY, CRCW060322K6FKEA
10	1	R30	RES., 47.5k, 1/10W, 1% 0603	VISHAY, CRCW060347K5FKEA
11	1	U1	IC., LT3966, QFN-40, 6mm × 6mm	ANALOG DEVICES., LT3966EUJ#PBF

Additional Demo Board Components

1	1	C3	CAP., ALUM., 47µF, 50V, 6.3×7.7 SIZE	WURTH ELEKTRONIK, 865080645012
2	0	C20–C23(OPT)	CAP., OPTION, 0603	
3	4	M1, M2, M3, M4	P-MOSFET, 60V, SOT-23	VISHAY, Si2309CDS-T1-GE3
4	1	R1	RES., 84.5k, 1/10W, 1% 0603	VISHAY, CRCW060384K5FKEA
5	1	R2	RES., 499k, 1/10W, 1% 0603	VISHAY, CRCW0603499KFKEA
6	0	R6, R7, R12, R13, R14, R15, R19, R20, R21, R25, R31, R33, R34	RES., OPTION, 0603	
7	5	R8, R9, R10, R11, R29	RES., 100k, 1/10W, 1% 0603	VISHAY, CRCW0603100KFKEA

Hardware: For Demo Board Only

1	8	E3, E4, E8, E11, E16, E17, E18, E20	TESTPOINT, TURRET, .094″ PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
2	13	E1, E2, E5, E6, E7, E9, E10, E12, E13, E14, E15, E19, E21	TESTPOINT, TURRET, .061″ PBF	MILL-MAX, 2308-2-00-80-00-00-07-0
3	2	JP1, JP2	HEADER 3-PIN 0.079 DOUBLE ROW	WURTH ELEKTRONIK, 62000621121
4	2	XJP1 ,XJP2	SHUNT, .079″ CENTER	WURTH ELEKTRONIK, 60800213421
5	1	J1	HEADER, 2×7 DUAL ROW	MOLEX, 87831-1420
6	2	J2, J3	JACK BANANA	KEYSTONE, 575-4
7	4	MH1–MH4	STAND-OFF, NYLON 6.4mm	WURTH ELEKTRONIK, 702931000

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITORS AND RESISTORS ARE 0603.
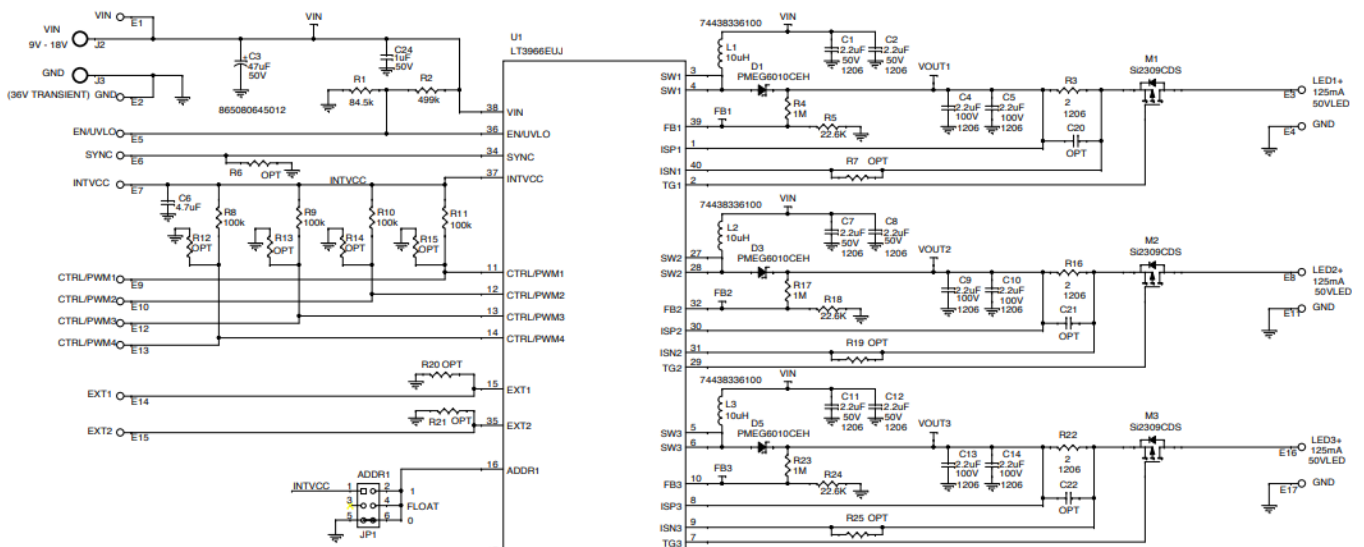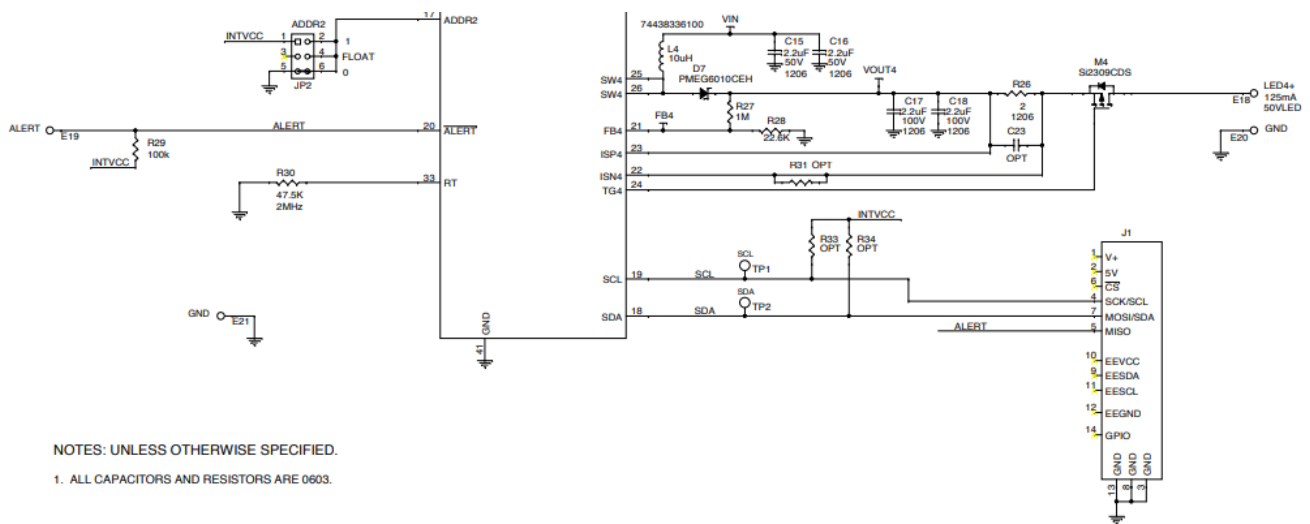
ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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Documents / Resources

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DC26 Programmable Quad Monolithic Boost LED Driver, DC26, Programmable Quad Monolithic Boost LED Driver, Quad Monolithic Boost LED Driver, Monolithic Boost LED Driver, Boost LED Driver, LED Driver, Driver

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