Integrated Dual LDO And Low-Dropout LED Driver

■ General Description

The LN5071 series of internal integration of two highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The device used in portable electronic products drive main or vice screen backlight modules and the provision of low-voltage system voltage source. LN5071 can drive four LEDs, each LED currents up to 20mA, through the PWM signal can adjust average brightness, the constant current can also be adjusted by a one-time input pulse count signal, a total of 32 level linear current. LN5071 integrated two voltage regulator has a separate enable pin, and each one voltage regulator can be adjusted independently through the repair of the output voltage, voltage output range of 1.3V to 5.0V, the maximum current up to 300mA.

As the built-in transistor with low on-resistance, so dropout voltage is low, access to a larger output current. In order to make load current does not exceed the output transistor current capacity, built-in overload current protection circuit, short circuit protection circuit. Except input and output filter capacitor, LN5071 basically do not need any other external components, greatly reducing system development costs.

■ Applications

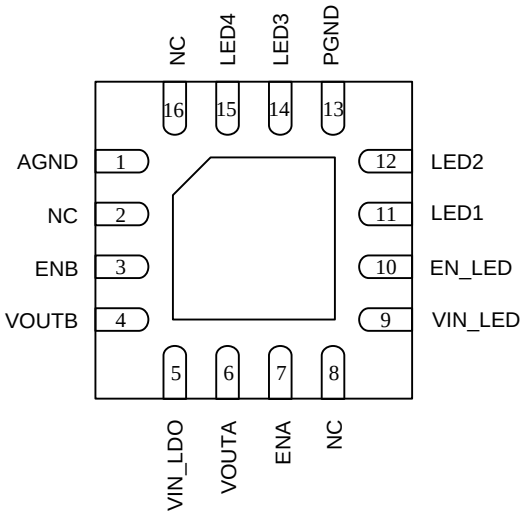
- Mobile phones
- MP3,MP4,MP5
- Cordless phones and radio communications equipment
- Camera, video recording equipment
- PC camera
- Playstation portable
- Portable AV equipment
- PDAs

■ Features

- 4 roads of 20ma current source can be used as main or vice LED Driver
- PWM average current control
- Single-wire interface configuration, 32 Level Linear current brightness control
- Ultra Low LED Dropout: 200mV at 20mA (TYP)
- Dual 300mA linear regulators
- 1.3V to 6V output voltage range, stepping to 0.05 V
- High output voltage accuracy up to ± 2.0%
- LDO input and output low dropout voltage, 200 mV typical (3.0V output, I_{OUT} = 100ma)
- Maximum output current up to 300mA (V_{IN} ≥ V_{OUT} +1 V)
- Standby current is less than 0.1μA
- Operating current is only 250μA
- 2.7V to 5.5V wide voltage operating range
- Built-in overcurrentand short circuit protection circuit (LDO)
- Compact package QFN3X3-16, as well as customer requirements

■ Package

- QFN3×3-16



QFN3*3-16
(Top View)

■ Ordering Information

LN5071 ①②③④⑤⑥⑦⑧

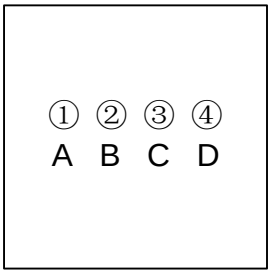
Item	Description	Symbol	Description
①	Voltage regulator1，EN type	E	With pull-down resistor, high active
		F	Without pull-down resistor, high active
		G	With pull-up resistor, low active
		H	Without pull-up resistor, low active
②	Voltage regulator 2，EN type	E	With pull-down resistor, high active
		F	Without pull-down resistor, high active
		G	With pull-up resistor, low active
		H	Without pull-up resistor, low active
③④	Voltage regulator 1 Output voltage	01～	eg：30 represents output voltage is 3.0V 33 represents output voltage is 3.3V
⑤⑥	Voltage regulator 2 Output voltage	01～	eg：30 represents output voltage is 3.0V 33 represents output voltage is 3.3V
⑦	Package type	Q	QFN3×3-16
⑧	Device orientation	R	Embossed Tape :Standard Feed
		L	Embossed Tape :Reverse Feed

■ Pin Assignment

Pin Number QFN3×3-16	Pin Name	Function
1	AGND	Analog gnd
2	NC	Not connect
3	ENB	LDO enable pin B
4	VOUTB	LDO output B
5	VIN_LDO	LDO power supply
6	VOUTA	LDO output A
7	ENA	LDO enable pin A
8	NC	Not connect
9	VIN_LED	LED power supply
10	EN_LED	LED enable pin
11	LED1	LED current pin 1
12	LED2	LED current pin 2
13	PGND	Power gnd
14	LED3	LED current pin 3
15	LED4	LED current pin 4
16	NC	Not connect

■ Marking Rule

- QFN3×3-16



QFN3*3-16
(Top View)

①②③④ Represents the product lot

Marking symbol	Product Description
5071	LN5071◆◆◆◆◆◆◆◆

AB Represents the output voltage

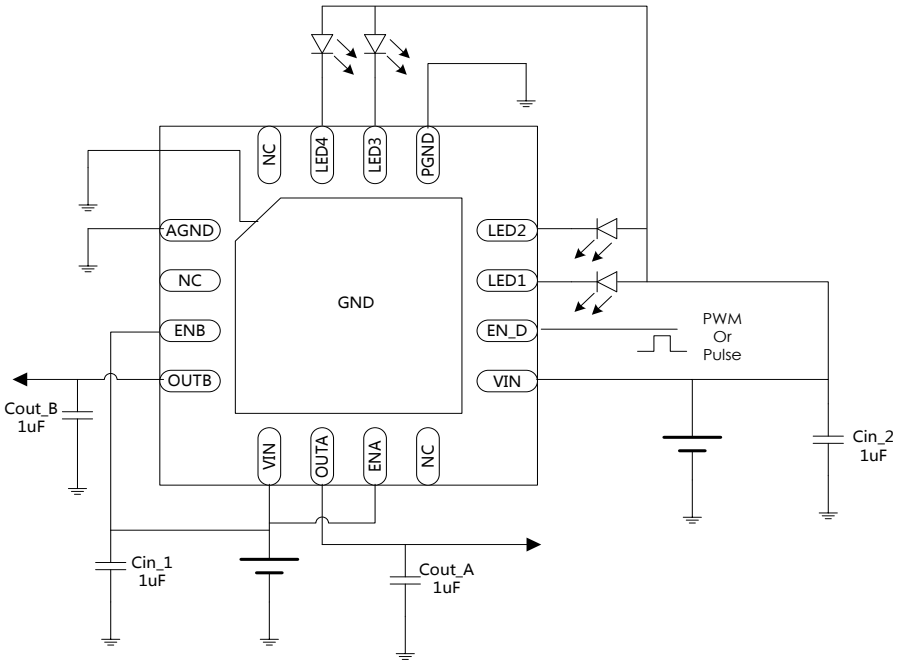
Symbol	Output Voltage（V）			
0	-	3.1	-	3.15
1	-	3.2	-	3.25
2	-	3.3	-	3.35
3	-	3.4	-	3.45
4	-	3.5	-	3.55
5	-	3.6	-	3.65
6	-	3.7	-	3.75
7	-	3.8	-	3.85
8	-	3.9	-	3.95
9	1.0	4.0	1.05	4.05
A	1.1	4.1	1.15	4.15
B	1.2	4.2	1.25	4.25
C	1.3	4.3	1.35	4.35
D	1.4	4.4	1.45	4.45
E	1.5	4.5	1.55	4.55

Symbol	Output Voltage（V）			
F	1.6	4.6	1.65	4.65
H	1.7	4.7	1.75	4.75
K	1.8	4.8	1.85	4.85
L	1.9	4.9	1.95	4.95
M	2.0	5.0	2.05	5.05
N	2.1	-	2.15	-
P	2.2	-	2.25	-
R	2.3	-	2.35	-
S	2.4	-	2.45	-
T	2.5	-	2.55	-
U	2.6	-	2.65	-
V	2.7	-	2.75	-
X	2.8	-	2.85	-
Y	2.9	-	2.95	-
Z	3.0	-	3.05	-

CD Represents the product lot

Numbers 0-9, A-Z, to write down numbers 0-9, A-Z, and then repeat (except G, I, J, O, Q, W)

■ Typical Application Circuit



Note: The above connection diagram and constant will not guarantee the circuit is based on the actual application circuit requests on the basis of carrying out a full set of measured parameters

■ Condition Of Use

Input capacitor (CIN): 1.0μF or more

Output capacitor (CL): 1.0μF or more (tantalum capacitor)

Note: In general, linear regulated power supply due to selection of different external components may cause oscillation. Make sure the capacitor before use does not occur in the application of circuit oscillation.

■ Function Description

LN5071 LED pins act as well matched current source driving LED diode to ground. An EN pin is used to turn on and turn off LN5071.When applying a lower frequency (less than 2kHz) PWM waveform to EN pin, the average LED current will be duty× 20mA(typical). Refer to Fig.1

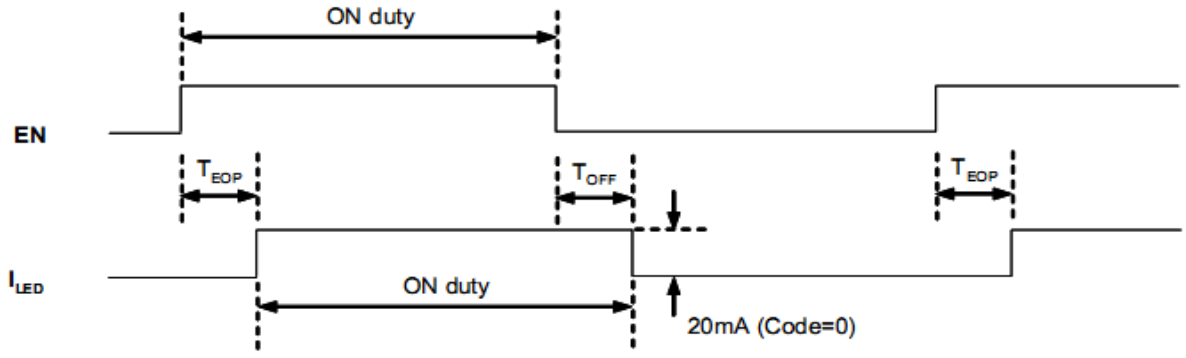


Fig1. Turn On To PWM Dimming

If the application is not suitable to apply such a low frequency PWM dimming waveform, this EN pin can be negatively pulsed to set continuous LED current. When no negative pulse is input to EN pin (Code=0), the internal register will latched to set the maximum LED current, typically 20mA. Whenever input N negative pulses to the EN pin, it will get a LED current corresponding to Code N. In this manner, LED current will changed from previous value to new value after the last pulse for typical 80μs (TEOP). Please refer to Fig.2

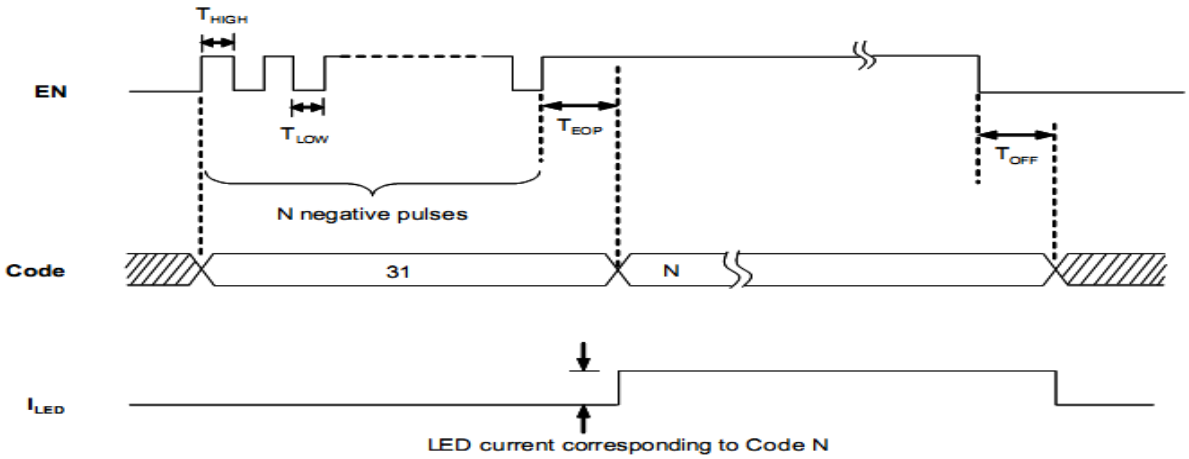
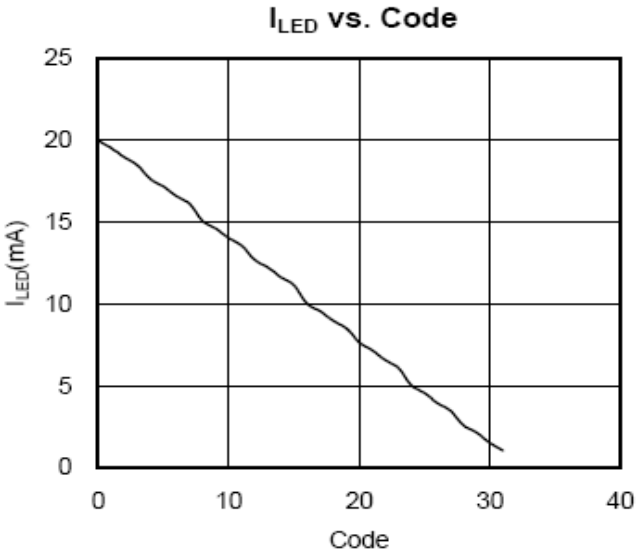


Fig2. Turn On And Configure Code N

Note: once after the input, must ensure that the EN pin keep high level, or setting brightness will change. Maintain a high level of EN after a period of time, the internal counter has cleared, but the latches maintain the LEDs brightness have not unchanged. If you want to adjust current , please input from CODE = 0. The EN pin maintain low-level longer than a certain time Toff, the chip off into save electricity mode.

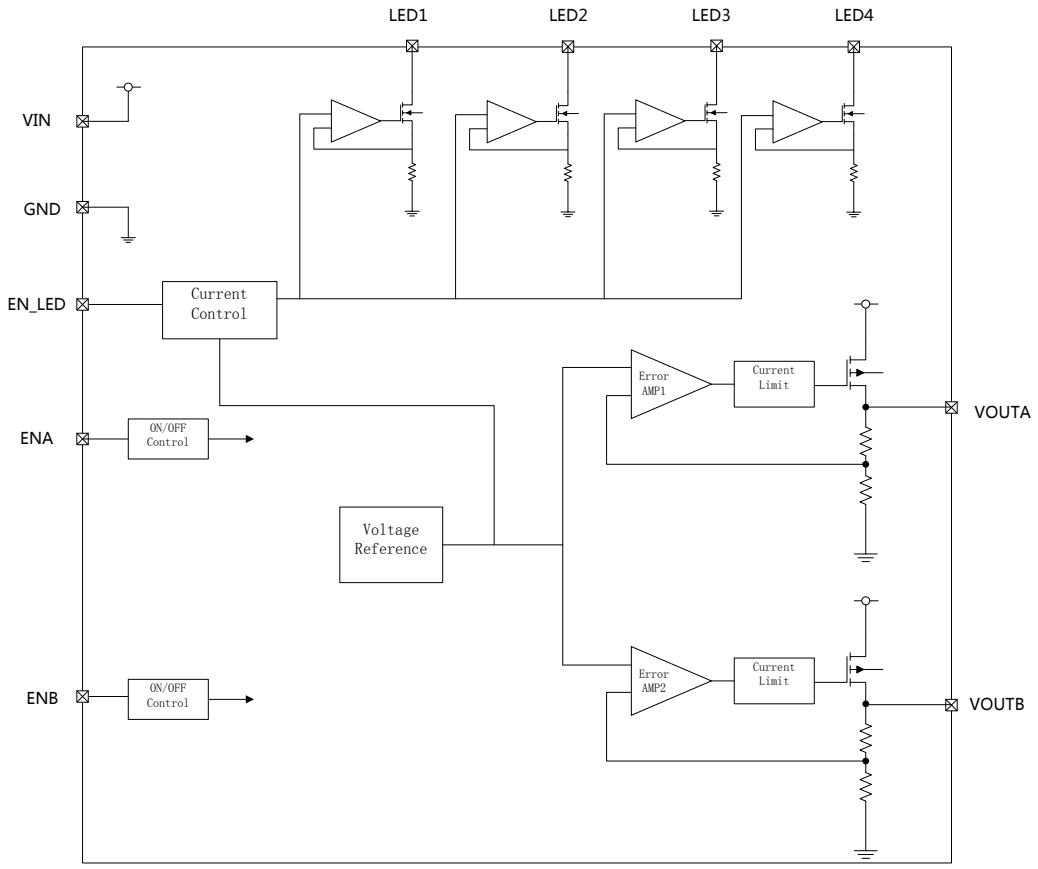
Code And Current Trend Of Corresponding Table

CODE	I（mA）	CODE	I（mA）
0	20.0	16	10.0
1	19.375	17	9.375
2	18.75	18	8.75
3	18.125	19	8.125
4	17.5	20	7.5
5	16.875	21	6.875
6	16.25	22	6.25
7	15.625	23	5.625
8	15.0	24	5.0
9	14.375	25	4.375
10	13.75	26	3.75
11	13.125	27	3.125
12	12.5	28	2.5
13	11.875	29	1.875
14	11.25	30	1.25
15	10.625	31	0.625



Above current and code corresponding relation is a design, individual differences between the different temperature, voltage and current inaccurate will lead to the Current is not accurate. Please use the actual measurement results.

■ Function Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol	Maximum Rating		Unit
Input Voltage	V_{IN}	V_{SS}-0.3～V_{SS}+7		V
	V_{EN}	V_{SS}-0.3～V_{IN}+0.3		
Output voltage	V_{OUT}	V_{SS}-0.3～V_{IN}+0.3		
Output current	I_{OUT1}+I_{OUT2}	700		mA
LED current	$\sum I_{LED}$	100		mA
Power dissipation	P_D	QFN3×3-16	350	mW
Operating Temperature Range	Topr	-40～+85		°C
Storage Temperature Range	Tstg	-40～+150		
Reflow Temperature (soldering, 10sec)	T_{SOLD}	260		°C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

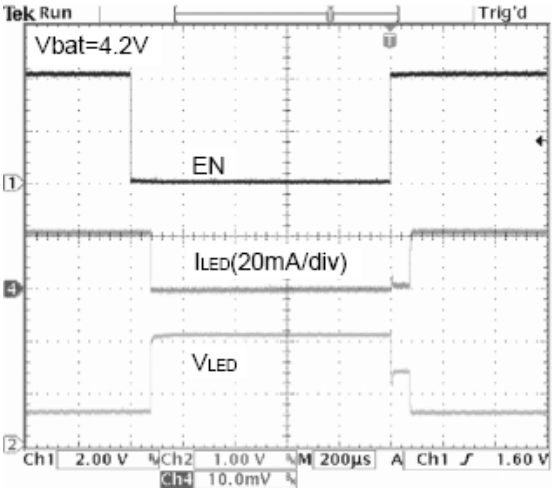
■ Electrical Characteristics

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Operating current	I_{SS1}	$V_{IN}=V_{OUT(S)}+1.0$ V	—	200	250	μA
Shutdown current	I_{STB}	$V_{IN}=V_{EN}=V_{OUT(T)}+1V$ ， V_{EN}=VSS	—	0.01	0.1	μA
Input current	V_{IN}	——	2.7	—	7	V
LED current	I_{LED}	Vin=3.6V, EN=3.6V,	18	20	22	mA
LED matching	I_{MATCH}		-5	—	+5	%
LED Pin Voltage Dropout	$V_{LED-DROP}$	Dropped to 90% of the current		180	200	mV
LDO output voltage	$V_{OUT(E)}$	V_{IN} =$V_{OUT(S)}$+1.0 V, I_{OUT}=30 mA	$V_{OUT(S)}$ ×0.98	$V_{OUT(S)}$	$V_{OUT(S)}$ ×1.02	V
LDO output current	I_{OUT}	$V_{IN}\geq V_{OUT(S)}+1.0$ V	300	—	—	mA
LDO Dropout Voltage	V_{drop}	I_{OUT}=50 mA	—	0.06	0.10	V
		I_{OUT}=100 mA	—	0.20	0.30	
LDO Line Regulations	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	$V_{OUT(S)}$+0.5 V ≤V_{IN}≤8 V I_{OUT}=30 mA	—	0.01	0.20	%/V
LDO Load Regulation	ΔV_{OUT2}	$V_{IN}=V_{OUT(S)}+1.0$ V 1.0 mA ≤I_{OUT} ≤100 mA	—	15	50	mV
LDO Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	$V_{IN}=V_{OUT(S)}+1.0$ V, I_{OUT}=10 mA -40°C ≤Ta ≤85°C	—	±100	—	ppm/℃
LDO power supply Ripple-Rejection	|PSRR|	$V_{IN}=V_{OUT(S)}+1.0$ V， f=1 kHz Vrip=0.5 Vrms, I_{OUT}=30 mA	—	70	—	dB
LDO short-circuit current	I_{short}	$V_{IN}=V_{OUT(S)}+1.0$ V, $V_{IN}=V_{EN}$	—	45	—	mA
LDO current limit	Ilim	$V_{IN}=V_{EN}=V_{OUT(T)}+1V$	-	450	-	mA
EN Pin Input Voltage High	V_{CEH}		1.10	—	VIN	V
EN Pin Input Voltage Low	V_{CEL}		—	—	0.8	V
EN pin high current	I_{CEH}	$V_{IN}=V_{EN}=V_{OUT(T)}+1V$	-0.1	—	0.1	μA
EN pin low current	I_{CEL}	$V_{IN}=V_{EN}=V_{OUT(T)}+1V$ ， V_{EN}=VSS	-0.1	—	0.1	μA
EN_LED off timeout	T_{OFF}		40	80	200	μS
EN_LED End of Pulse Timeout	T_{OEP}		40	80	200	μS
EN_LED Pulse High Time	T_{HIGH}		5	—	30	μS
EN_LED Pulse Low Time	T_{LOW}		5	—	30	μS

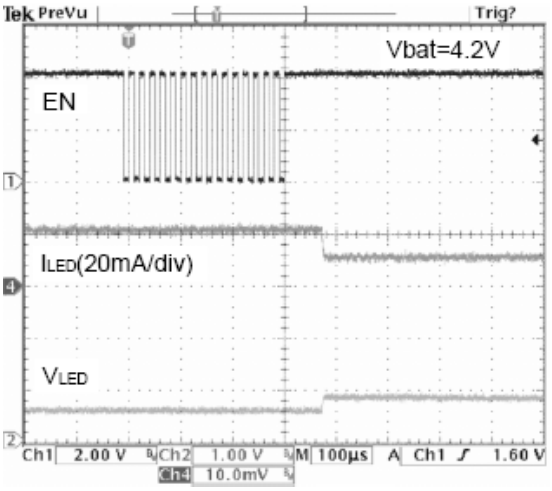
■ Typical Performance Characteristics

(The following parameters unless otherwise specified, are in the VIN = 3.6V, EN = 3.6v, measured at 25 ℃)

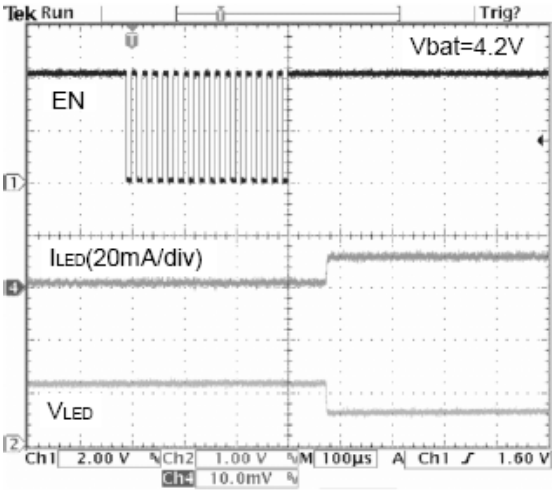
PWM Diming Waveform



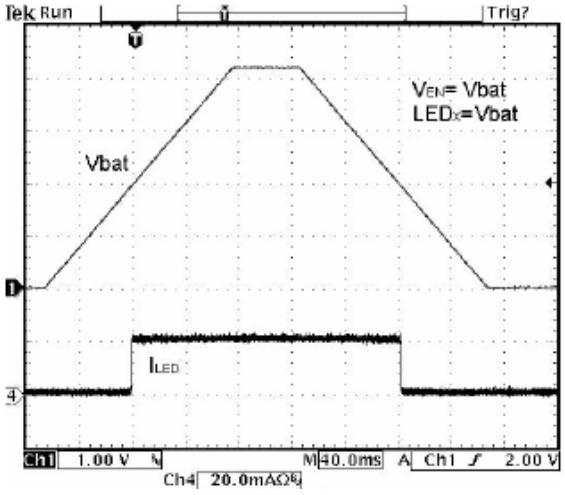
Linear Dimming Waveform I



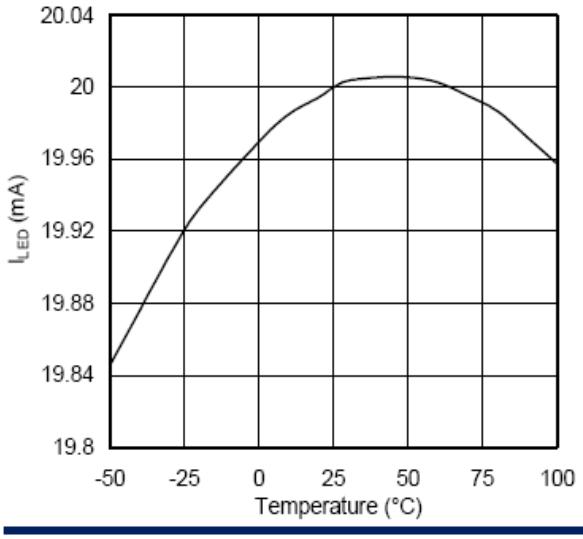
Linear Dimming Waveform II



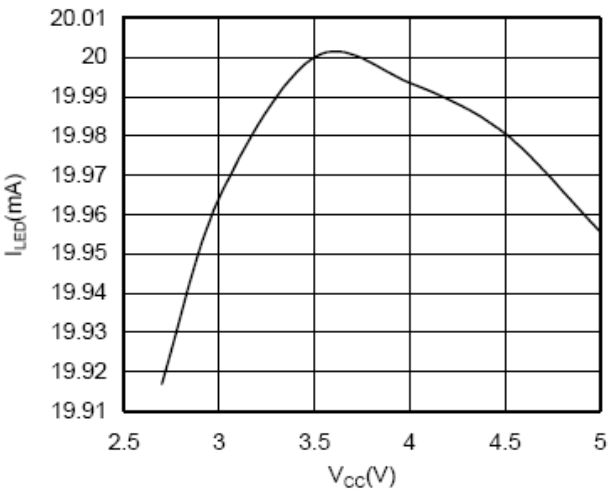
Input Voltage UVLO



I_{LED} vs. Temperature

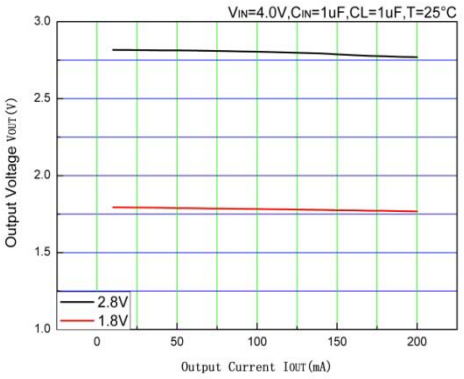


I_{LED} vs. V_{CC}

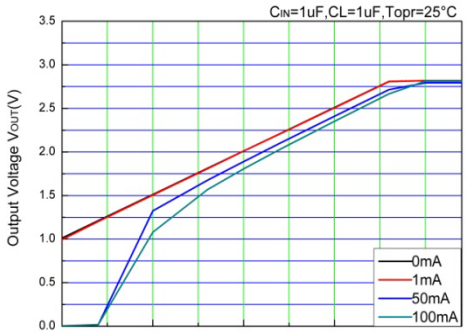


(Output Voltage:2.8V、1.8V)

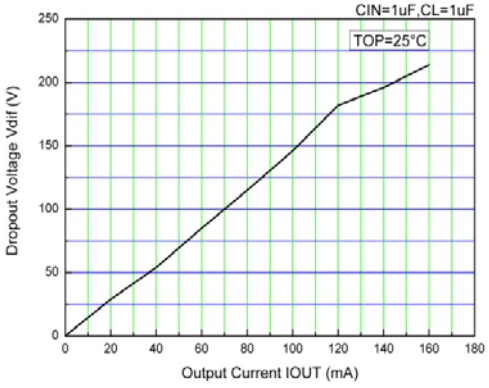
Output Voltage-Output Current



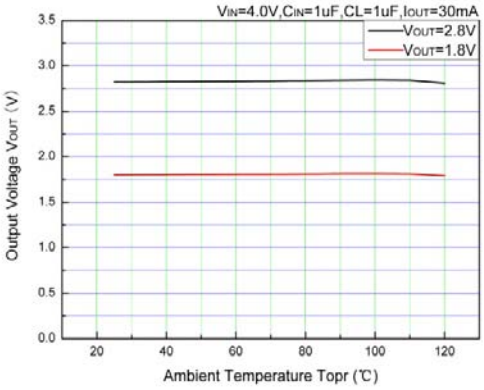
Output Voltage-Input Voltage



Dropout Voltage-Output Current

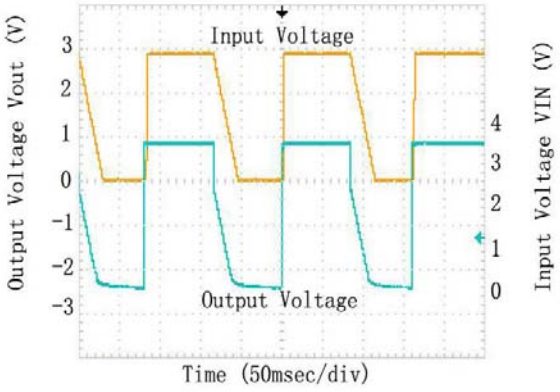


Output Voltage-Temperature

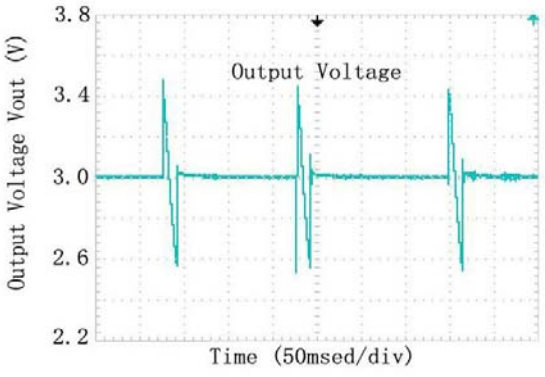


Transient Response

Input transient response characteristics

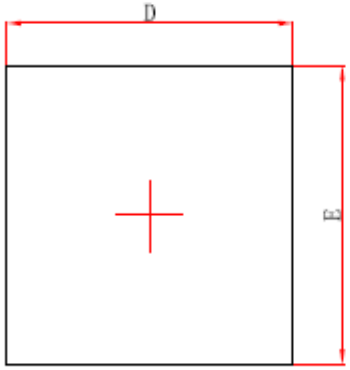


Load-response characteristics of the transitional type

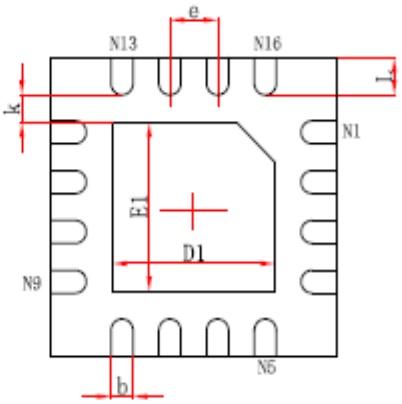


■ Package Information

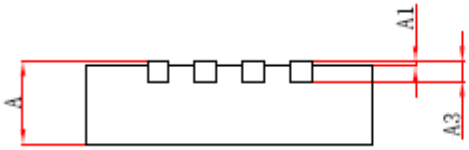
- **QFN3×3-16**



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.180	0.300	0.007	0.012
e	0.500TYP.		0.020TYP.	
L	0.300	0.500	0.012	0.020