General Description

QX9920 is a highly stable and reliable constant-current LED driver with high efficiency. It is especially suited to drive several high power and high luminance LEDs in series.

QX9920 uses fixed off-time and peak current control mode and its operating frequency can vary up to 1MHz, which not only reduces the dimensions of inductor, capacitor and PCB but also improves efficiency. The minimum off-time is 620ns and the off-time can be adjusted by changing the external capacitor, and the operating frequency also can be adjusted according to the need of customers. QX9920 regulates the current flowing through LEDs to set the luminance of LEDs by changing the external resistor, and the current can vary from tens of mA to 2.5A, on the other hand, the luminance of LEDs also can be regulated by a PWM signal applied to EN pin.

Features

- Wide Range Input Voltage:2.5V to 100V
- High Efficiency: Up to 90%
- Maximum Operating Frequency: 1MHz
- UVLO Voltage: 2.5V
- Peak Current Sense Voltage: 250mV
- Adjustable Luminance With PWM Signal Applied to EN Pin
- Adjustable Off-time
- Internal Current Sampling Leading Edge Blanking Circuit

Applications

- LED Backlight of Flat Panel Display
- Bike Light
- LED Spotlight
- Very Bright Flashlight

Typical Application

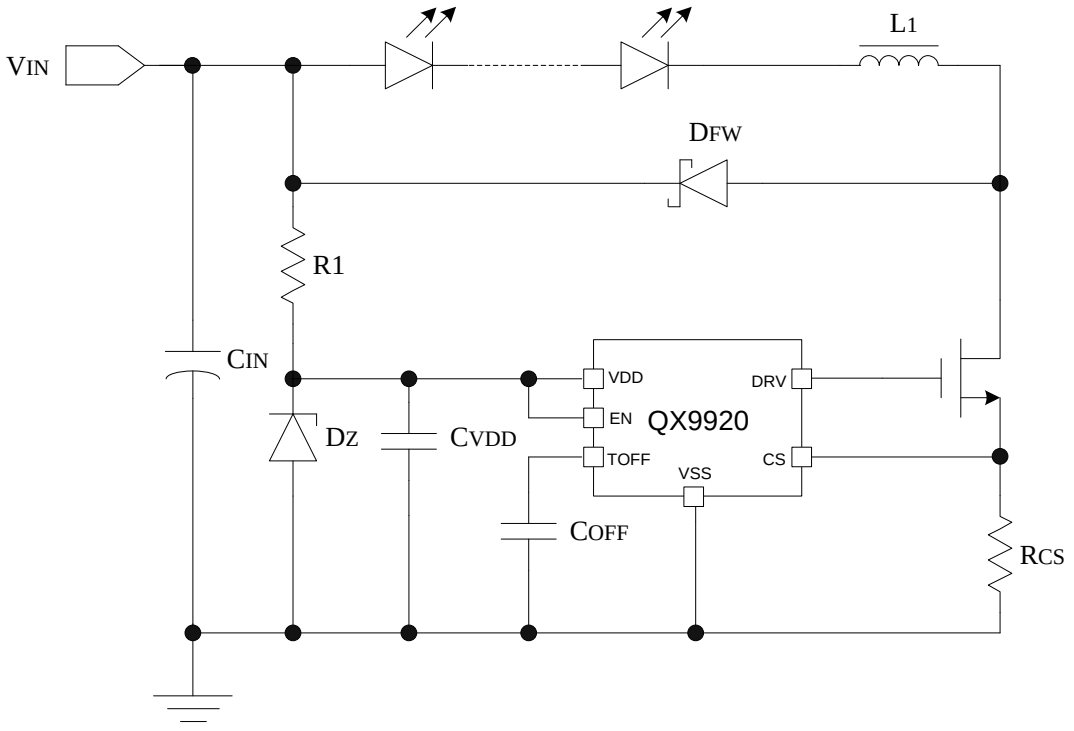


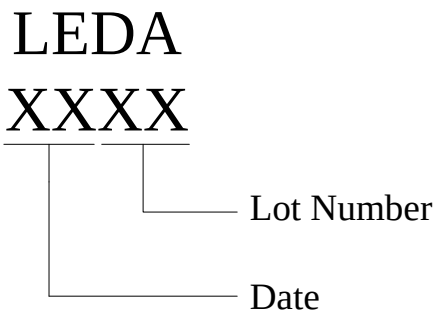
Figure 1：Typical Application Circuit Diagram of QX9920

Ordering Information

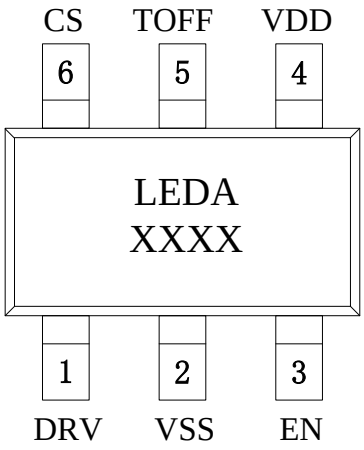
Type Number

QX9920

Package Marking



Pin Assignment



SOT23-6

Pin Description

Pin	Pin Name	Pin Type	Description
1	DRV	Output	Driving Pin
2	VSS	Ground	Ground
3	EN	Input	Chip Enable Pin（Active High）
4	VDD	Supply	Power Supply
5	TOFF	Input	Off-time Setting Pin
6	CS	Input	Output Current Sense

Functional Block Diagram

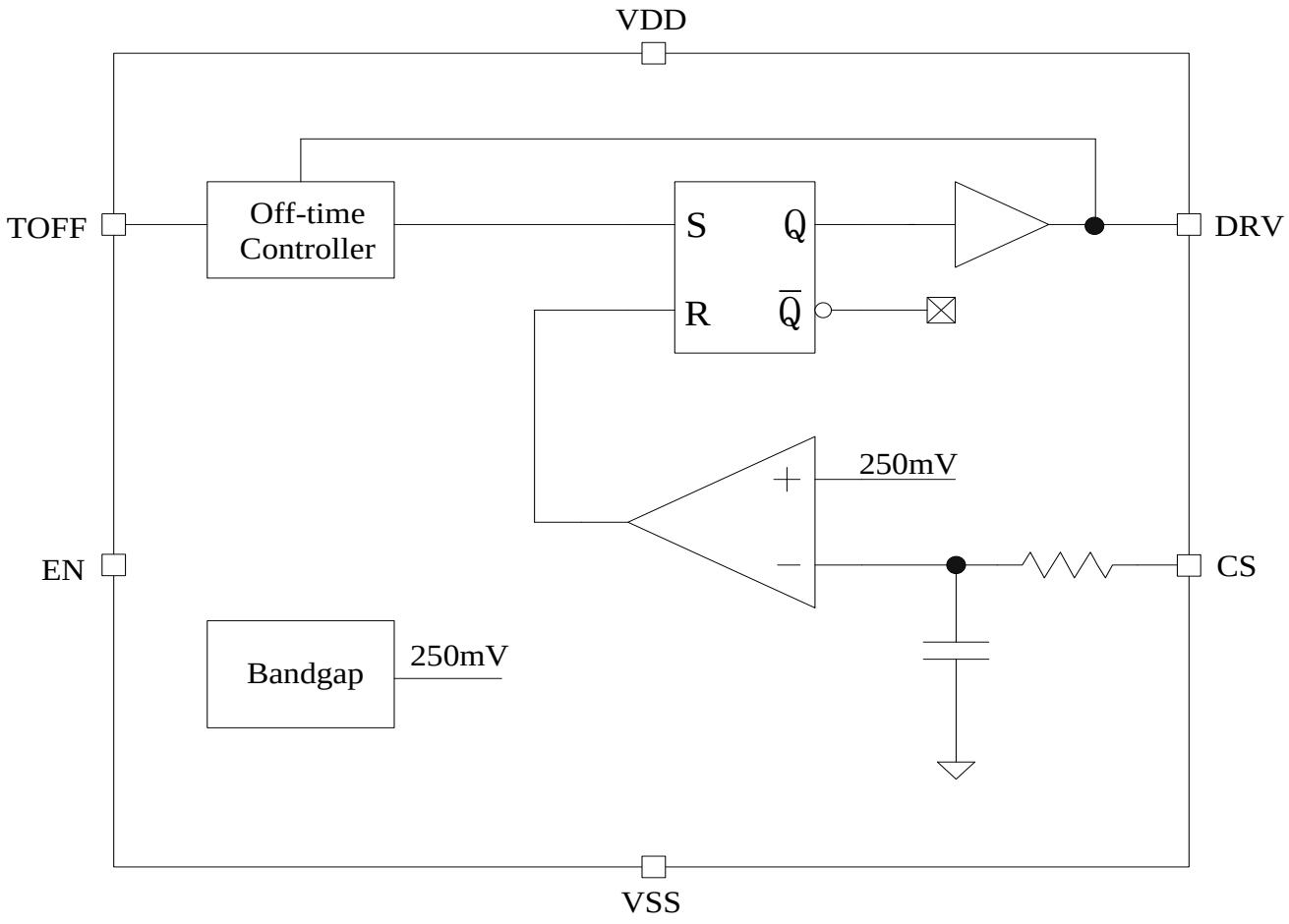


Figure 2：Functional Block Diagram of QX9920

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Description	Min	Max	Unit
Voltage	V_{MAX}	Maximum Voltage On VDD Pin		7	V
	V_{MIN_MAX}	Maximum Voltage On EN, DRV, CS and TOFF Pins	-0.3	V_{DD}+0.3	V
Power Dissipation	$P_{SOT23-6}$	Maximum Power Dissipation for SOT23-6 Package		0.3	W
Thermal	T_J	Junction Temperature Range	-20	125	^oC
	T_A	Operating Temperature Range	-20	85	^oC
	T_{STG}	Storage Temperature Range	-40	125	^oC
	T_{SD}	Soldering Temperature Rang（less than 30 sec）		240	^oC
ESD	V_{ESD}	ESD Voltage for Human Body Mode		2000	V

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions (Note 2)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	2.5	5	5.5	V
Operating Frequency	F_{OP}			1000	KHz
Dim Frequency	F_{PWM}		250	1000	Hz

Note 2: The Recommended Operating Conditions are required in order to ensure the normal operation of the IC, but does not guarantee completely meeting the individual performance characteristics.

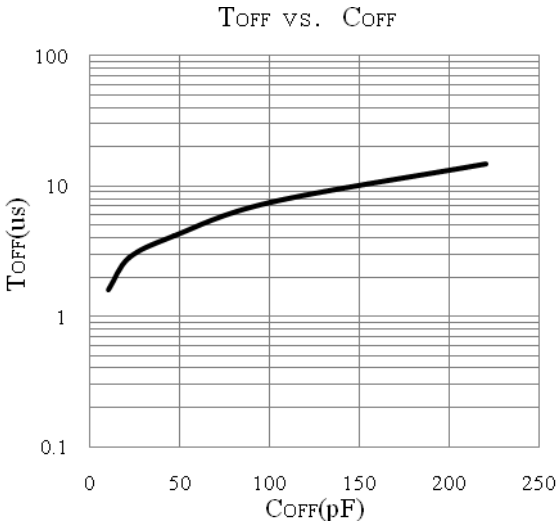
Electronic Characteristics

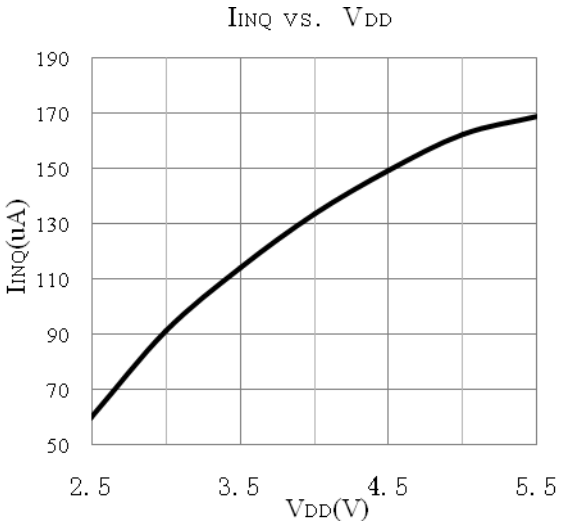
V_{DD} =5V, T_A =25 °C, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage						
Maximum Input Voltage	V_{DD}			5	6	V
UVLO Voltage	V_{DD_UVLO}	V_{DD} Rising		2.5		V
Supply Current						
Operating Current	I_{OP}	F_{OP}=200KHz		1.3		mA
Standby Input Current	I_{INQ}	Without Load，EN='Low'		160		uA
Current Sensing						
Current Detection Threshold Voltage	V_{CS_TH}		240	250	260	mV
IC Cutoff Delay	T_D			61		ns
Switch Frequency						
Maximum Operating Frequency	F_{MAX}				1000	KHz
Cutoff Time						
Minimum Cutoff Time	T_{OFF_MIN}	TOFF Pin without Capacitor		620		ns
Enable Input On EN Pin						
"High" Voltage Level On EN Pin			0.4*V_{DD}			V
"Low" Voltage Level On EN Pin					0.2	V

Typical Electrical Curves

V_{IN} =5V, T_A =25 °C, unless otherwise specified





Applications Information

Detailed Description

QX9920 is a highly efficient constant current driver for high luminance LED with built-in high accuracy comparator, fixed off-time controller and constant current driver etc.

QX9920 uses fixed off-time and peak current control mode, and the system of circuit operates with a switching transistor in the turn-on or turn-off states.

In Fig.1, when the MOS transistor is in the turn-on state, the supply current charges the inductor L_1 by passing through LEDs, the inductor L_1, the switching transistor and the current-sense resistor R_{CS}, therefore, the current of inductor gradually increases, when the voltage drop across R_{CS} reaches the Current Detection Threshold Voltage V_{CS_TH}, the DRV pin outputs low level to turn off the MOS transistor.

When the transistor is off, the inductor L_1 is discharged and the discharging current passes through the circuit loop composed of LEDs, the freewheeling diode D_{FW} and the inductor L_1. After the MOS transistor remains off for one Cutoff Time T_{OFF}, it returns to the turn-on states again.

The process described above goes round and begins again, moves in circles.

T_{OFF} Setting

The fixed off-time can be set by the capacitor C_{OFF} connected to the pin TOFF:

$$T_{OFF} = 0.51 * 150K\Omega * (C_{OFF} + 7.3pF) + T_D$$

where T_D equals 61ns.

The off-time is 620ns without C_{OFF}.

Output Current Setting

The LED current is determined by the formula below:

$$I_{LED} = \frac{0.25}{R_{CS}} - \frac{V_{LED} * T_{OFF}}{2L_1}$$

where V_{LED} is the forward voltage drop across LEDs, and L_1 is the inductance.

Inductor Selection

To ensure the system output constant current, the inductor must operate in CCM mode, the minimum inductance needed is

$$L_1 > 4V_{LED} * T_{OFF} * R_{CS}$$

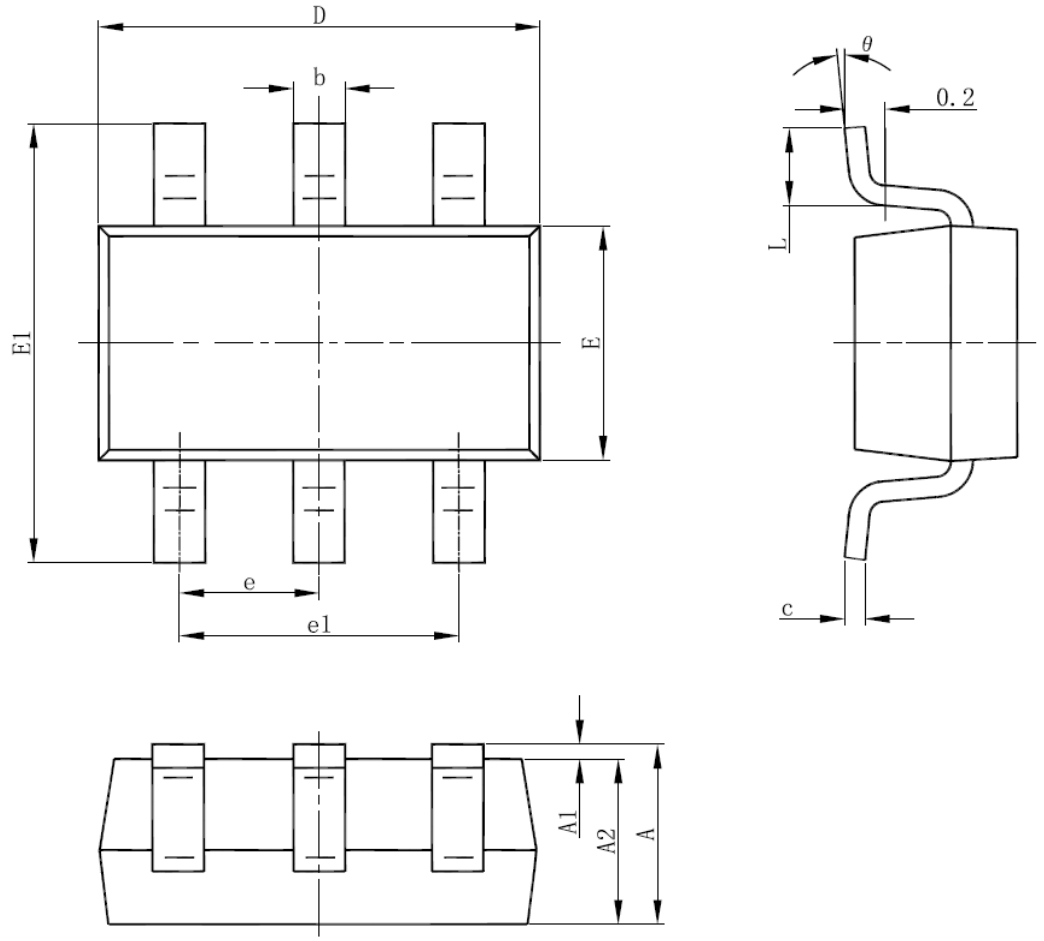
Operating Frequency of System

The operating frequency of system is determined by the formula below:

$$F_S = \frac{V_{IN} - V_{LED}}{V_{IN} * T_{OFF}}$$

Package Information

Physical Dimensions for SOT23-6 Package:



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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