

Integrated 12V N-Channel Gate Drivers with Two 60A N-Channel MOSFETs

General Description

The uP9636 is a single PWM, high voltage MOSFET driver integrated with two internal N-channel MOSFETs. The LX and LX_C are controlled by PWM.

The uP9636 features adaptive anti-shoot-through protection that prevents cross-conduction of the internal MOSFET. This part has an integrated bootstrap switch to help minimize the external component count. This device also supports supply input under voltage lockout. The uP9636 is available in thermally enhanced WQFN4x4-26L package.

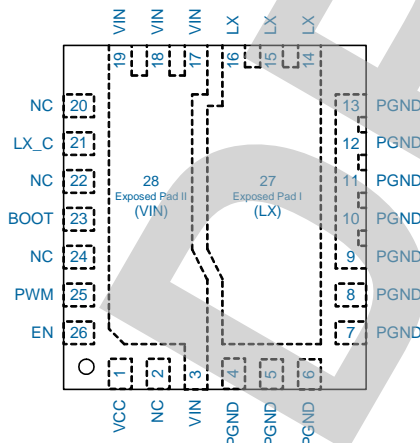
Ordering Information

Order Number	Package	Top Marking
uP9636PQMY	WQFN4x4 - 26L	uP9636P

Note:

- (1) Please check the sample/production availability with uPI representatives.
- (2) uPI products are compatible with the current IPC/JEDEC J-STD-020 requirements. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

Pin Configuration



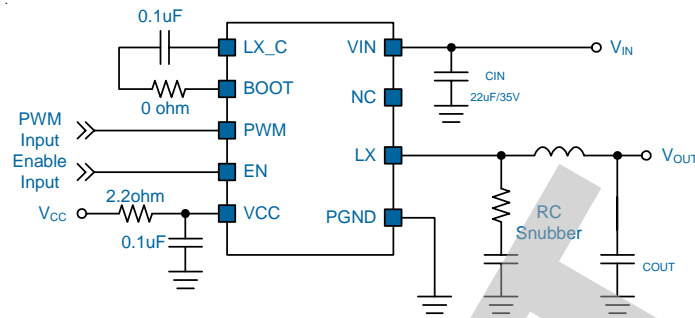
Features

- Wide Input Voltage Range: 2.5V to 25V
- Supply Driver VCC Voltage Range: 4.5V to 13.2V
- Integrated Two N-Channel MOSFETs
- Integrated Bootstrap Switch
- Two Independent Channels with High Current Drive
- 5V/3.3V Compatible Inputs
- Anti-Shoot-Through Protection Circuitry
- Under Voltage Lockout for Supply Input
- WQFN4x4-26L Package
- RoHS Compliant and Halogen Free

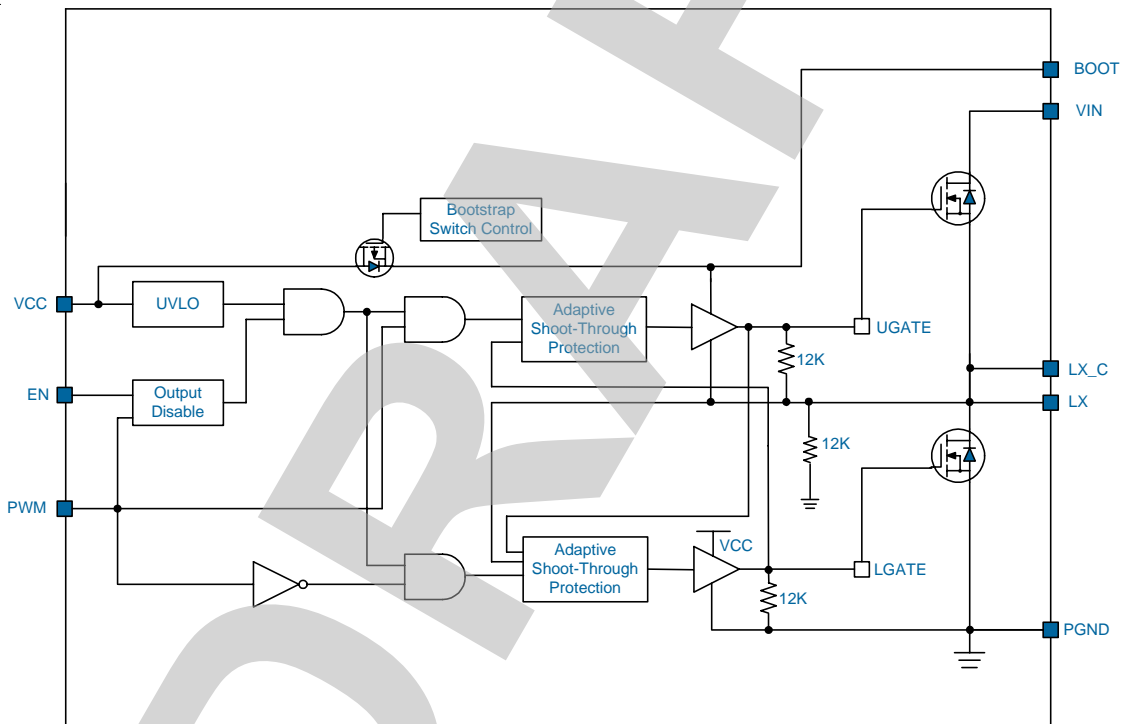
Applications

- High/Low Side Power Stage
- Synchronous Rectification
- Wireless Charger

Typical Application Circuit



Functional Block Diagram



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	VCC	Supply Voltage for the IC. This pin provides bias voltage for the IC. Connect this pin to 12V voltage source and bypass it with an R/C filter.
2,20,22,24	NC	Not Internally Connected.
3, 17-19	VIN	Power Supply Input. Input voltage that supplies current to the output voltage.
4-13	PGND	Power Ground for the IC. All voltage levels are measured with respect to this pin.
14-16	LX	LX Switch Node. This pin in the IC is the source of the upper MOSFET and the drain of the lower MOSFET.
21	LX_C	LX Switch Node. This pin in the IC is the source of the upper MOSFET and the drain of the lower MOSFET.
23	BOOT	Bootstrap Supply. For the floating upper gate driver. Connect the bootstrap capacitor C_{BOOT} between BOOT pin and the LX pin to form a bootstrap circuit. The bootstrap capacitor provides the charge to turn on the upper MOSFET. Make sure that C_{BOOT} is placed near the IC.
25	PWM	PWM Input. This pin receives logic level input and controls the LX and LX_C.
26	EN	Enable Control. This pin disables normal operation and forces LX and LX_C. There is no internal pull-up or pull-low mechanism to this pin.
27	LX Exposed Pad I	Switch Node. This pin in the IC is the source of the upper MOSFET and the drain of the lower MOSFET.
28	VIN Exposed Pad II	Power Supply Input. Input voltage that supplies current to the output voltage.

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Enable Control

The EN pin controls the LX and LX_C off. Logic input high to EN pin enables the LX and LX_C after a delay time $T_{PDH DEN}$ as shown in Figure 1. During this time period, the PWM pin stays at high input impedance state, the LX and LX_C outputs are kept low, and the internal control circuit does not respond to the PWM input voltage. After $T_{PDH DEN}$ expires, both LX and LX_C begin to respond to the PWM input.

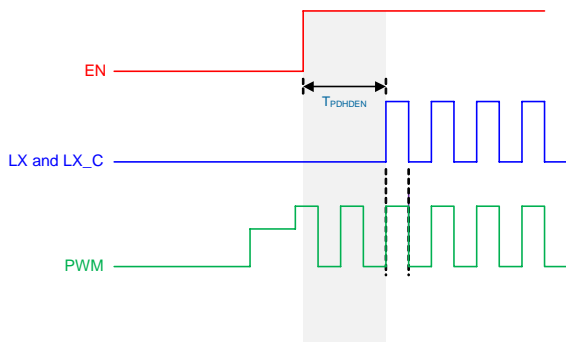


Figure 1. Enable Control, EN

Low-Side MOSFET

The low-side driver is designed to drive an internal ground referenced N-channel MOSFET. The bias to the low-side driver is internally connected to VCC supply and GND. The low-side driver output is out of phase with the PWM input when it is enabled. The low-side driver is held low if the EN pin is pulled low.

High-Side MOSFET

The high-side driver is designed to drive an internal floating N-channel MOSFET. The bias voltage to the high-side driver is internally connected to BOOT and LX pins. An integrated bootstrap diode that is connected between BOOT and VCC pins provides the bias current for the high side gate driver. The bootstrap capacitor CBOOT is charged to VCC when LX and LX_C pin is grounded by turning on the low-side MOSFET. The LX rises to VIN when the high-side MOSFET is turned on, forcing the BOOT pin voltage to VIN + VCC that provides voltage to hold the internal high side MOSFET on. The high-side gate driver output is in phase with the PWM input when it is enabled. The high side driver is held low if the EN pin is pulled low.

Absolute Maximum Rating

(Note 1)

Supply Input Voltage, VIN@VCC=5V	-----	-0.3V to +25V
Supply Input Voltage, VIN@VCC=12V	-----	-0.3V to +18V
Supply Input Voltage, VCC	-----	-0.3V to +15V
BOOT to LX	-----	-0.3V to +15V
LX to GND		
DC	-----	-0.7V to VIN ± 0.7V
< 200ns	-----	-8V to +30V
BOOT to GND		
DC	-----	-0.3V to (VCC +15V)
< 200ns	-----	-0.3V to +42V
PWM/EN	-----	-0.3V to +6V
Storage Temperature Range	-----	-65°C to +150°C
Junction Temperature	-----	150°C
Lead Temperature (Soldering, 10 sec)	-----	260°C
ESD Rating (Note 2)		
HBM (Human Body Mode)	-----	2kV

Thermal Information

Package Thermal Resistance (Note 3)

WQFN4x4-26L $\theta_{JA, \text{controller and HS}}$	-----	54°C/W
WQFN4x4-26L $\theta_{JA, \text{LS}}$	-----	38°C/W
WQFN4x4-26L $\theta_{JC, \text{controller and HS}}$	-----	21°C/W
WQFN4x4-26L $\theta_{JC, \text{LS}}$	-----	6°C/W
Power Dissipation, P _D @ T _A = 25°C		
WQFN4x4-26L P _{D, controller and HS}	-----	2.38W
WQFN4x4-26L P _{D, LS}	-----	2.63W

Recommended Operation Conditions

(Note 4)

Operating Junction Temperature Range	-----	-40°C to +125°C
Operating Ambient Temperature Range	-----	-40°C to +85°C
Supply Input Voltage, V _{CC}	-----	4.5V to 13.2V
Supply Input Voltage, V _{IN}	-----	2.5V to 25V
Supply Input Voltage, V _{IN} + V _{CC}	-----	≤ 30V

Note 1. Stresses listed as the above *Absolute Maximum Ratings* may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

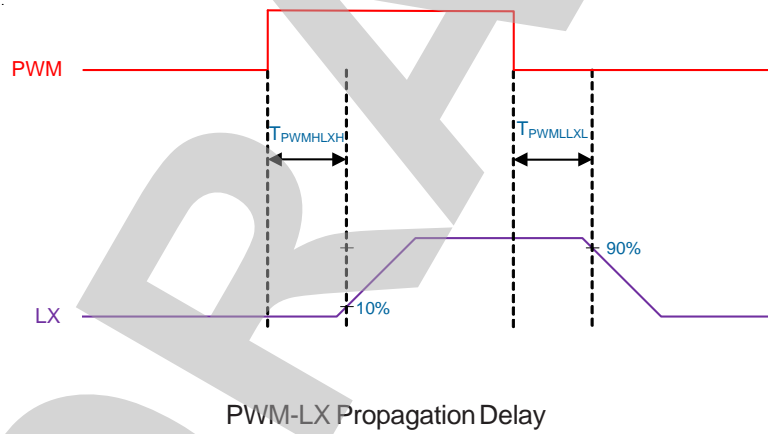
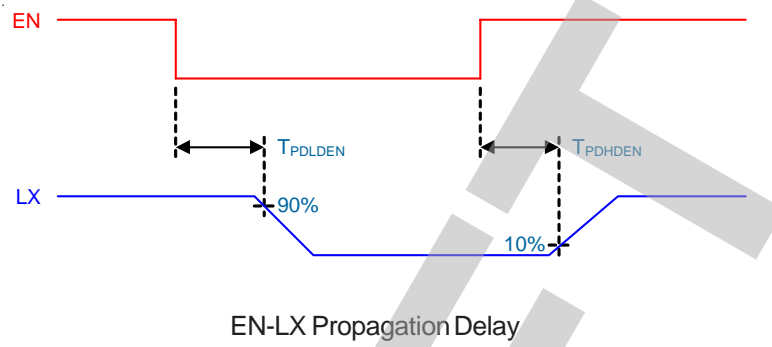
Note 3. θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Note 4. The device is not guaranteed to function outside its operating conditions.

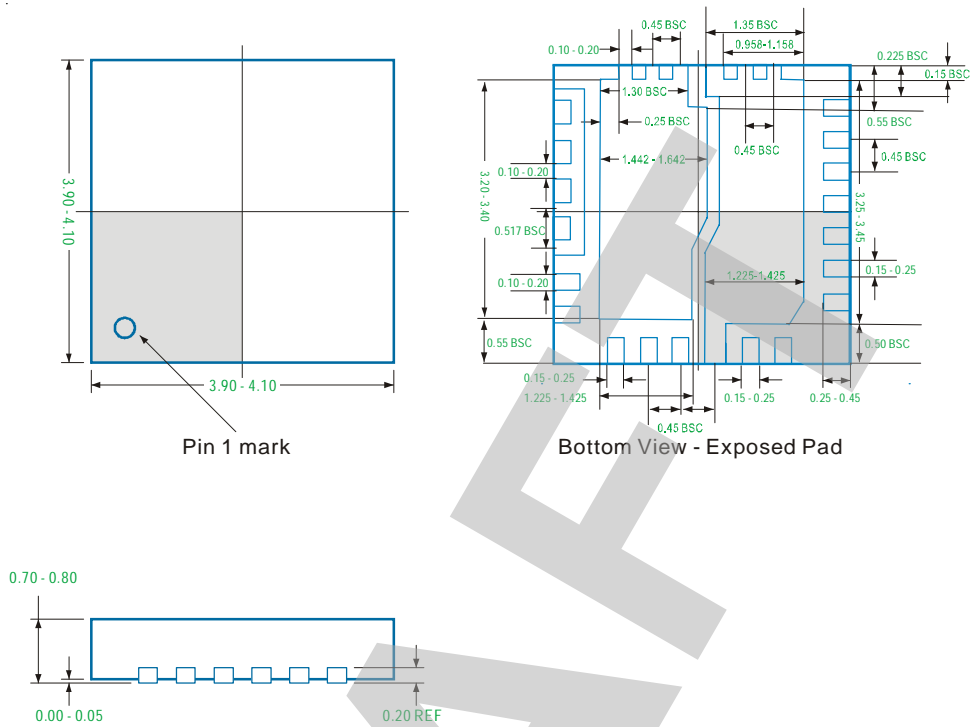
Electrical Characteristics

(VCC = 12V, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Input						
Input Voltage Range	V _{IN}		2.5	--	25	V
Supply Current	I _{CC}	PWM = 0V, V _{CC} = 12V	--	0.8	1.2	mA
VCC POR Rising Threshold	V _{CCRTH}	V _{CC} Rising	--	4.1	--	V
VCC Threshold Hysteresis	V _{CCHYS}		--	0.3	--	V
Power Switches						
Upper Switch Resistance	R _{HS,DSON}	V _{CC} = 12V, I _D = 15A	--	5.5	6.9	mΩ
Lower Switch Resistance	R _{LS,DSON}	V _{CC} = 12V, I _D = 15A	--	5.5	6.9	mΩ
HS Drain-Source Breakdown Voltage	BVDSS_HS	V _{CC} = 12V, V _{GS} = 0V, I _{DS} = 250uA	--	30	--	V
LS Drain-Source Breakdown Voltage	BVDSS_LS	V _{CC} = 12V, V _{GS} = 0V, I _{DS} = 250uA	--	30	--	V
HS Drain-Source Leakage Current	MDSS_HS	V _{CC} = 12V, V _{DS} = 24V, V _{GS} = 0V	--	--	1	uA
LS Drain-Source Leakage Current	MDSS_LS	V _{CC} = 12V, V _{DS} = 24V, V _{GS} = 0V	--	--	1	uA
PWM Input						
Input High Level	PWM _H		2.1	--	--	V
Input Low Level	PWM _L		--	--	0.4	V
Enable Control						
Input High	EN _H		2	--	--	V
Input Low	EN _L		--	--	0.6	V
Propagation Delay Time	T _{PDHLEN}		1	2	3	us
	T _{PDLLEN}		60	80	100	ns
Bootstrap Switch						
On Resistance	R _{DS(ON)}	Forward bias current = 10mA	--	40	--	Ω
High-Side MOSFET and Low-Side MOSFET						
Propagation Delay Time	T _{PWMHLXH}	V _{BOOT} - V _{LX} = 12V	--	40	65	ns
	T _{PWMLLXL}	V _{BOOT} - V _{LX} = 12V	--	40	65	



WQFN4x4 - 26L



Note

1. Package Outline Unit Description:

BSC: Basic. Represents theoretical exact dimension or dimension target

MIN: Minimum dimension specified.

MAX: Maximum dimension specified.

REF: Reference. Represents dimension for reference use only. This value is not a device specification.

TYP: Typical. Provided as a general value. This value is not a device specification.

2. Dimensions in Millimeters.

3. Drawing not to scale.

4. These dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm.

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uPI Semiconductor Corp.

9F.,No.5, Taiyuan 1st St. Zhubei City,
Hsinchu Taiwan, R.O.C.

TEL : 886.3.560.1666 FAX : 886.3.560.1888