

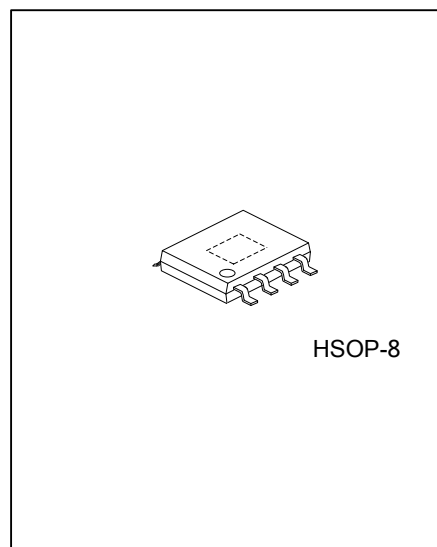


## UD36241

Preliminary

CMOS IC

### 2.4A, 36V, 100KHZ ASYNCHRONOUS STEP-DOWN CONVERTER WITH LOAD LINE COMPENSATION



#### DESCRIPTION

**UD36241** is a high-efficiency, monolithic asynchronous stepdown DC/DC converter that can deliver up to 2.4A output current from a 9V to 36V input supply. The **UD36241**'s current mode architecture with internal compensation is optimized for 5V car charger application over a wide range of loads and output capacitors. Cycle-by-cycle current limit provides protection against shorted outputs and soft-start eliminates input current surge during start-up. The **UD36241** also provides output over voltage protection output under voltage protection and thermal shutdown protection. The low current (<10mA) shutdown mode provides output disconnect, enabling easy power management in battery-powered systems.

#### FEATURES

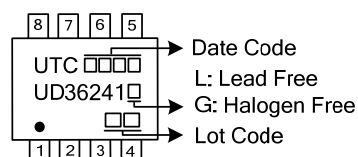
- \* 9V to 36V Input Voltage Range.
- \* 2.4A Continuous Output Current (2.7A Peak).
- \* CC/CV Mode Control
- \* Adjustable Load Line Compensation
- \* Integrated N-MOSFET Switches
- \* Current Mode Control
- \* Fixed Frequency Operation : 100kHz
- \* Programmable Output Current Limit
- \* 200mΩ Internal Power MOSFET Switch
- \* Low EMI signature
- \* Cycle-by-Cycle Over Current Protection
- \* Input Under Voltage Lockout
- \* Thermal Shutdown Protection

#### ORDERING INFORMATION

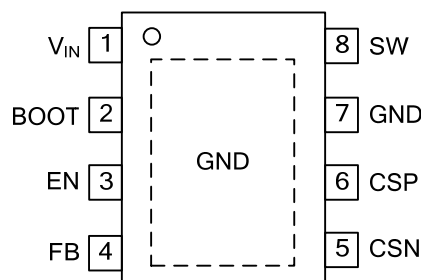
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UD36241L-SH2-R	UD36241G-SH2-R	HSOP-8	Tape Reel

<p>UD36241G-SH2-R</p> <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Green Package</p>	<p>(1) R: Tape Reel</p> <p>(2) SH2: HSOP-8</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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#### MARKING



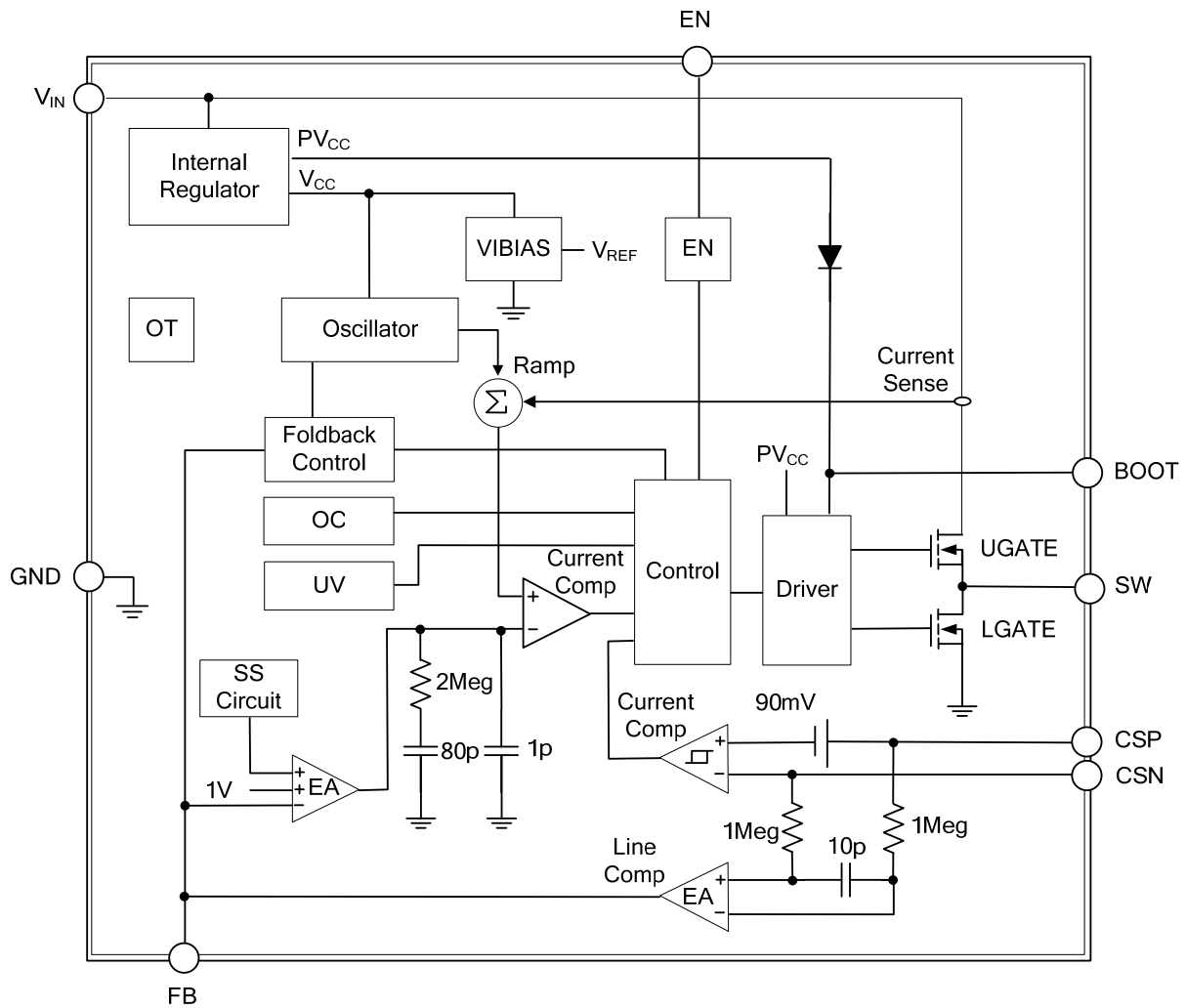
## ■ PIN CONFIGURATION



## ■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	V <sub>IN</sub>	Input Supply Voltage, 9V to 36V. Must bypass with a suitably large ceramic capacitor.
2	BOOT	Bootstrap for High-Side Gate Driver. Connect 0.1μF or greater ceramic capacitor from BOOT to SW pins.
3	EN	Enable Input Pin. A logic high enables the converter; a logic low forces the UD36241 into shutdown mode reducing the supply current to less than 10mA. Attach this pin to V <sub>IN</sub> with a 100k pull up resistor for automatic startup.
4	FB	Feedback Input Pin. This pin is connected to the converter output. It is used to set the output of the converter to regulate to the desired value via an external resistive voltage divider. For an adjustable output, an external resistive divider is connected to this pin.
5	CSN	Current Sense Negative Input. It is used for load current limiting and load line drop compensation.
6	CSP	Current Sense Positive Input. It is used for load current limiting and load line drop compensation.
7	GND	Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation. (Connect the exposed pad to Pin 7)
8	SW	Switch Output -- Connect to external L-C filter and Schottky diode.

## ■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ( $T_A=25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Input Voltage	$V_{IN}$	40	V
SW Voltage	$V_{SW}$	$V_{IN}+0.3$	V
VBOOT to $V_{SW}$	$V_{BOOT}$	6.0	V
EN,FB,CSP,CSN	$I_{CC}$	6.0	V
Storage Temperature Range	$T_{STG}$	-65 ~ +150	$^{\circ}\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	$\theta_{JA}$	90	$^{\circ}\text{C/W}$
Junction to Case	$\theta_{JC}$	45	$^{\circ}\text{C/W}$

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Input Voltage	$V_{IN}$	9 ~ 36	V
Operating Ambient Temperature Range	$T_A$	-40 ~ +85	$^{\circ}\text{C}$
Operating Junction Temperature Range	$T_J$	-40 ~ +125	$^{\circ}\text{C}$

Note: Range over which the device is functional and parameter limits are guaranteed.

■ ELECTRICAL CHARACTERISTICS ( $V_{IN}=12\text{V}$ ,  $V_{OUT}=5\text{V}$ , TEMPER=  $25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Shutdown Supply Current	$I_{SD}$	$V_{EN}=0\text{V}$		1.5	3	$\mu\text{A}$
Supply Current	$I_Q$	$V_{EN}=3\text{V}$		4		mA
Feedback Voltage	$V_{FB}$	$9\text{V} \leq V_{IN} \leq 36\text{V}$		1		V
High-Side Switch On-Resistance	$R_{DS(ON) U}$			200		m $\Omega$
High-Side Switch Leakage Current	$I_{SWLEAK}$	$V_{EN}=0\text{V}, V_{SW}=0\text{V}$		0	10	$\mu\text{A}$
Upper Switch Current Limit	$I_{LIM}$			3.6		A
Load Line Compensation Gain	GLC	$V_{CSP}-V_{CSN}=90\text{mV}$ , check $I_{FB}$	15	20	25	$\mu\text{A/V}$
Current Sense Voltage	$V_{SENSE}$	$V_{CSP}-V_{CSN}$		90		mV
Oscillation Frequency	Fosc1		85	100	115	KHZ
EN Input Threshold Voltage	$V_{IH}$		2.7			V
	$V_{IL}$				0.3	V
Input Under Voltage Lockout Threshold	$V_{UVLO}$	$V_{IN}$ Rising		8.2		V
Input Under Voltage Lockout Hysteresis	$\Delta V_{UVLO}$			0.3	1	V
Soft-Start Period	$t_{SS}$			1.2		ms

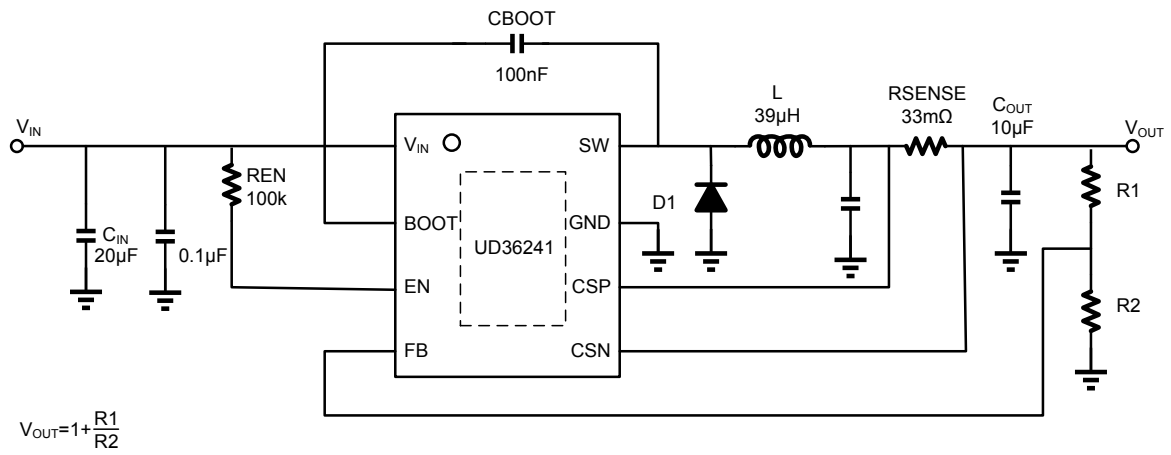
Notes: 1. Stresses beyond those listed "Absolute Maximum Rating" may cause permanent damage to the device.

These are stress ratings only, and 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 may affect device reliability.

2. Devices are ESD sensitive. Handling precaution recommended.

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

## ■ APPLICATION CIRCUIT



## ■ APPLICATION INFORMATION

### Application information

The **UD36241** is a constant frequency, current mode asynchronous step-down converter with CC and CV control. In normal operation, the high side N-MOSFET is turned on when the S-R latch is set by the oscillator and is turned off when the current comparator resets the S-R latch. While the N-MOSFET is turned off, the inductor current conducts through the external diode.

### Error Amplifier

After the system is powered up, the input voltage is charged on the OUT pin through the depleted MOS, and when the OUT. The error amplifier adjusts its output voltage by comparing the feedback signal ( $V_{FB}$ ) with the internal 1V reference. When the load current increases, it causes a drop in the feedback voltage relative to the reference, the error amplifier's output voltage then rises to allow higher inductor current to match the load current

### Oscillator

The internal oscillator runs at fixed frequency 100kHz. In short circuit condition, the controller is turn off the power MOSFET for low power consumption.

### Internal Regulator

The regulator provides low voltage power to supply the internal control circuits and the bootstrap power for high side gate driver.

### Over temperature adjustment function

**UD36241** has the function of over temperature adjustment, the output current is gradually reduced when the driving power is over, so that the output power and temperature rise is controlled, the power supply is maintained at the set value,

### Enable

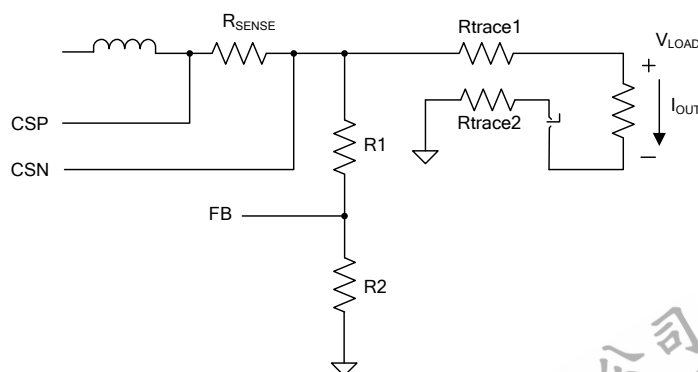
The converter is turned on when the EN pin is higher than 2V and turned off when the EN pin is lower than 0.3V. Attach this pin to  $V_{IN}$  with a 100k pull up resistor for automatic startup

### Soft-Start (SS)

An internal current source charges an internal capacitor to build a soft-start ramp voltage. The FB voltage will track the internal ramp voltage during soft-start interval. The typical soft-start time is 1.2ms.

### Output Line Drop Compensation

If the trace from **UD36241** output terminator to the load is too long, there will be a voltage drop on the long trace which is variable with load current. **UD36241** is capable of compensating the output voltage drop to keep a constant voltage at load, whatever the load current is. The output voltage is compensated by feeding a current to the top feedback resistance R1. The load line compensation gain can be programmed according to  $R_{SENSE}$  and  $R_{trace}$  values.



$$I_{OUT} \times R_{SENSE} \times 20\mu \times R1 = I_{OUT} \times R_{trace}$$

$$R1 = \frac{R_{trace}}{20\mu \times R_{SENSE}}$$

## ■ APPLICATION INFORMATION (Cont.)

**Under Voltage Lockout (UVLO)**

To avoid mis-operation at low input voltage, when input voltage falls below 8.2V, and under voltage lockout is induced and the device is disabled.

**Internal Current Limit Protection**

When the external RSENSE is too small and the external peak current is higher than 3.6A, the high-side switch will turn off immediately and then turn at the next clock cycle. The inductor's peak current will be limited at 3.6A by internal current limit.

**Output Short-Circuit Protection**

The IC provides V<sub>OUT</sub> the short-circuit protection function. When the V<sub>OUT</sub> is short (V<sub>FB</sub> < 0.3V), the controller will turn off the power MOSFET. This latch-up mode of operation does not allow circuit to resume until V<sub>IN</sub> drops to 8.2V followed by the rise to above 8.5V.

**External Current Limit Protection**

The external current limit is set by outside resistance (RSENSE). The average current is limited according to the following equation :

$$\text{Average Current Limit (A)} = \frac{90\text{mV}}{\text{RSENSE}}$$

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