General Description

EC4230 is a compact, inductor-less, offline linear regulator. It steps down the AC line voltage to 3.3V/ 5V. It is a simple solution to provide a bias voltage in offline applications. EC4230 integrates a 500V power MOSFET, startup controller, voltage control circuit, AC synchronous circuit, low dropout regulator, etc. EC4230 also integrates smart control system uses AC line power when necessary, thus minimizing device losses to achieve good efficiency. EC4230 can help system designs meeting new standby power specifications. EC4230 integrates functions and protections of Under Voltage Lockout (UVLO), VDD over Voltage Protection (VDD OVP), On Chip Thermal Shutdown (OTP), etc.

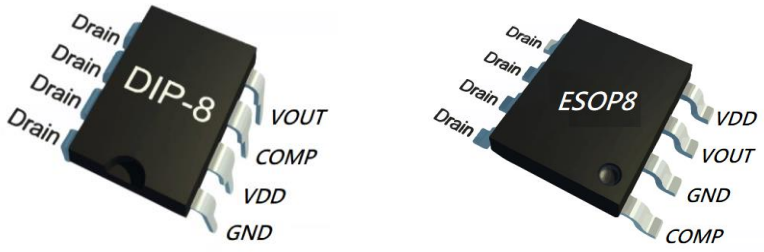
Features

◆High Output Voltage Accuracy: 2%
◆Fixed Output: 3.3V/5V
◆Smart Control to Maximize Efficiency
◆Universal Input Range: 80~305VAC
◆No Inductor Required
◆No Bulk Capacitor Required
◆Less Components and Low Cost
◆Fast Line and Load Transient Response
◆Short Load Protection
◆On Chip Thermal Shutdown (OTP)
◆Provide Power Good Signal
◆Available with DIP8、ESOP8 Package

Applications

◆Non Isolation AC/DC Converter
◆Home Appliance
◆Wall Switches and Dimmers

Pin Configuration



Ordering / Marking Information

EC4230 XX XX X

R：Tape and Reel
T：Tube

Voltage：
3.3V=33
5.0V=50

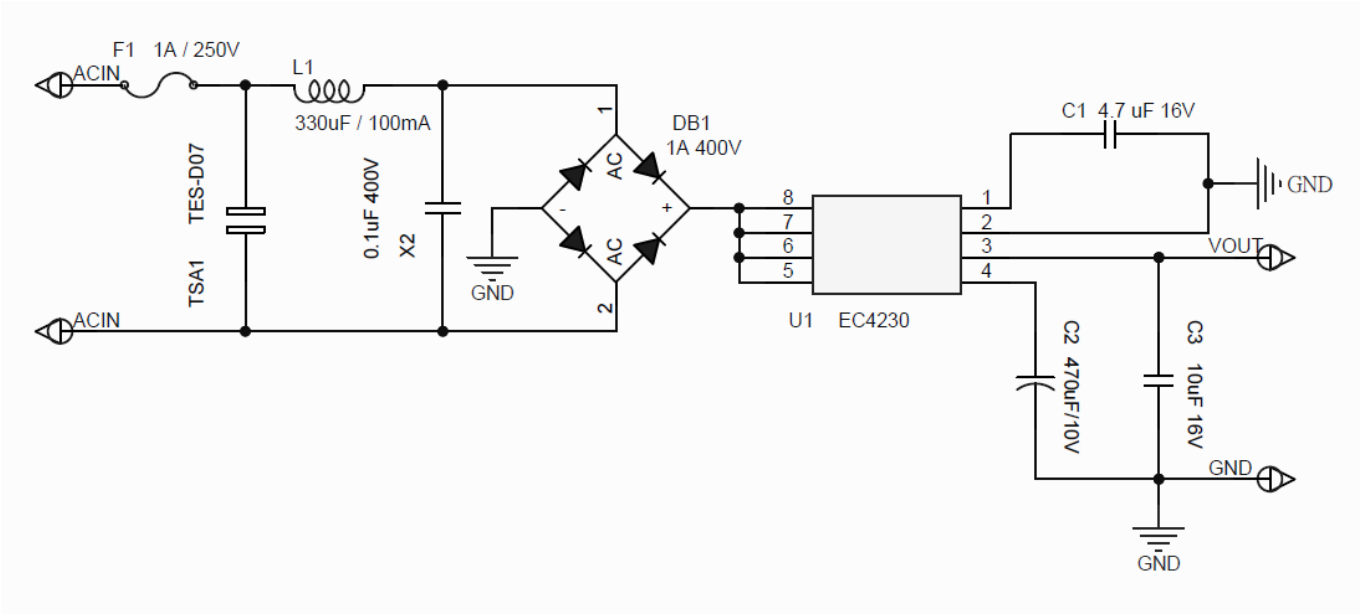
Package：
P1：DIP-8
MH：ESOP8

Ordering Number	Marking	Package	Marking Information
EC4230XXMHR	EC4230 LLLLL YYWW	ESOP8	LLLL：Lot No YYWW：Date Code
EC4230XXP1T	EC4230P LLLLL YYWW	DIP-8	P：DIP LLLL：Lot No YYWW：Date Code

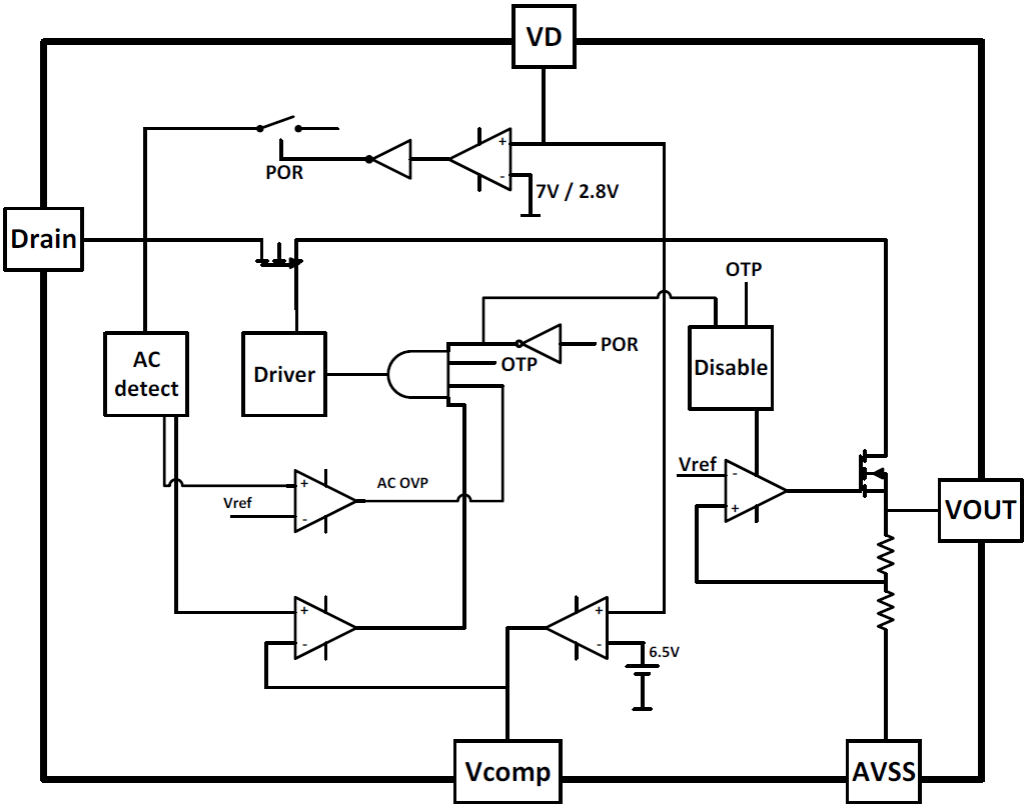
Pin Description

Pin Number	Pin Name	I/O	Description
1	COMP	I	Compensation for load
2	GND	P	The ground of the IC
3	VOUT	O	LDO output pin
4	VDD	P	Energy storage. Connect to GND with a capacitor to buffer energy for the output LDO stage.
5,6,7,8	Drain	P	Internal power MOSFET drain pin. Provide energy when the voltage falls within the charging window.

Typical Application Circuit



Block Diagram



Absolute Maximum Ratings (Note 1)

Parameter	Value	Unit
Drain Voltage	500	V
VDD DC Supply Voltage	9	V
VDD DC Clamp Current	10	mA
VOUT, COMP Voltage Range	-0.3 to 7	V
Package Thermal Resistance (ESOP8)	100	˚C/W
Maximum Junction Temperature	150	˚C
Operating Temperature Range	-40 to 85	˚C
Storage Temperature Range	-65 to 150	˚C
Lead Temperature (Soldering, 10sec.)	260	˚C
ESD Capability, HBM (Human Body Model)	2	KV
ESD Capability, MM (Machine Model)	400	V

Recommended Operation Conditions (Note 2)

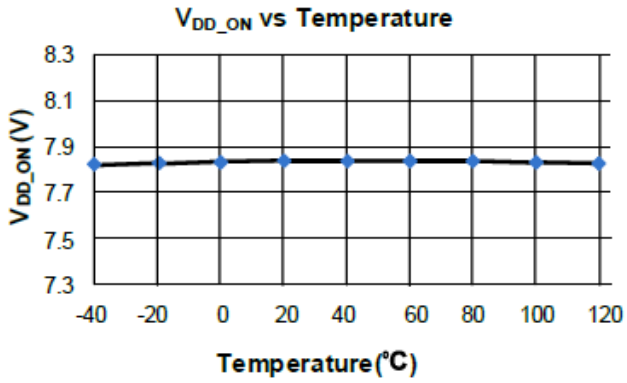
Parameter	Value	Unit
Operating Ambient Temperature	-40 to 85	˚C

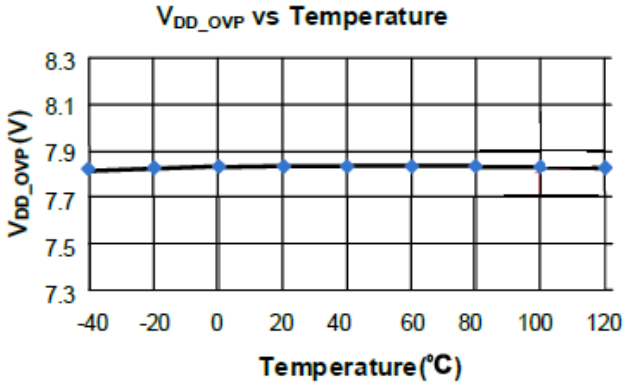
Electrical Characteristics (T_A = 25°C, if not otherwise noted)

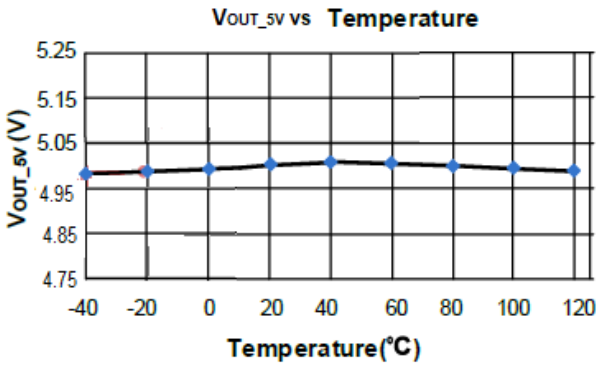
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
High Voltage Startup Section (Drain Pin)						
IHV	HV Current Source	HV=500V, VDD=3V, IOUT=1mA	5	10		mA
VBR	Power MOSFET Drain Source Breakdown Voltage		500			V
Supply Voltage Section (VDD Pin)						
IVDD_Op	Operation Current	Iout=1mA		1.4		mA
VDD_ON	VDD Under Voltage Lockout Exit		7.6	7.8	8	V
VDD_OFF	VDD Under Voltage Lockout Enter			2.8		V
VDD_OVP	VDD OVP Threshold		7.6	7.8	8	V
VOUT Section (VOUT Pin)						
VOUT_3.3V	Output Voltage	Iout=2mA	3.234	3.3	3.366	V
VOUT_5V			4.9	5.0	5.1	
ΔVOUT(VIN)	Line Regulation dVout/dVin	Iout=100uA		0.2		%/V
PSRR	Power Supply Rejection Ratio	Iout=30mA, Cout=4.7uF, f=10Hz to 60KHz		60		dB
On-Chip Thermal Shutdown						
TSD	Thermal Shutdown	(Note 3)	---	160	--	℃
TRC	Thermal Recovery	(Note 3)		80	--	℃

Note1. Stresses listed as the above "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 maximum rating conditions for extended periods may remain possibility to affect device reliability.
Note2. The device is not guaranteed to function outside its operating conditions.
Note3. Guaranteed by the Design.

Characterization Plot







Operation Description

EC4230 is a compact, inductor free, and highly monolithic AC/DC linear converter which is designed for non-isolated AC/DC converter and home appliances. EC4230 covers universal AC voltage input to provide programmable DC output voltage with current limit for the non-isolated AC/DC converter.

Startup Current

During EC4230 startup, the internal high voltage current source (10mA) charges the VDD capacitor though the rectifier and Drain pin. EC4230 remains off until the VDD voltage is larger than VDD ON and the output voltage is built up at the same time. After the IC turns on, the internal high voltage current source is disabled by the control loop. The major energy path changes from the high voltage current source to the inner power MOSFET.

VDD Over Voltage Protection (VDD OVP)

After startup, EC4230 turns on the OVP function. During conduction angle interval, the VDD voltage has two kinds of behavior. One is that if the VDD capacitor recharges to OVP trigger point (7.8V typical), EC4230 turns off the internal power MOSFET to limit the maximum VDD voltage. The other is that if the voltage of VDD cannot recharge to the OVP level during the conduction interval, the power MOSFET is turned off by AC synchronous signal and continuously recharges VDD capacitor at next duration. Using this technique, energy is drawn from the AC mains only during the low voltage portions of each half cycle. During the power MOSFET turn-on, the current provided by the commutated AC voltage is used to supply the loads and to charge the VDD capacitor. In this way, when the power MOSFET switches off, the loads receive the required currents by the capacitor discharge. For the VDD capacitor selection, during the conduction angle interval, the energy is drawn from commutated AC bus, which not only meets the output load requirement but also recharges the VDD capacitor to OVP level. Outside of conduction angle, the VDD capacitor can is determined by the maximum loading current:

$$C_{VDD} \approx 0.01 \times I_{LOAD} \left(\text{unit} = \text{F}\right)$$

Surge Protection

When Surge happens, AC voltage couples a very high spike voltage. If this spike voltage is higher than 100Vdc and occurs within the AC charging window, Surge Protection is triggered, the power MOSFET shuts down quickly and enters Auto-Restart progress.

On Chip Thermal Shutdown (OTP)

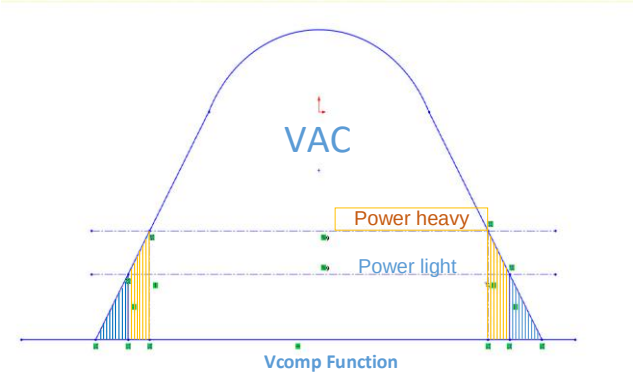
When EC4230's temperature is over 160˚C, it shuts down. Only when the temperature drops to 80˚C, EC4230 will enter Auto-Restart progress.

Protections with Auto-Restart

In the event of protections such as OTP, Surge Protection, EC4230 enters auto-restart and an internal timer begins counting, where in the power MOSFET is disabled. When VDD<2.8V, EC4230 will reset and start up the system again. However, if the fault still exists, the system will experience the above-mentioned process.

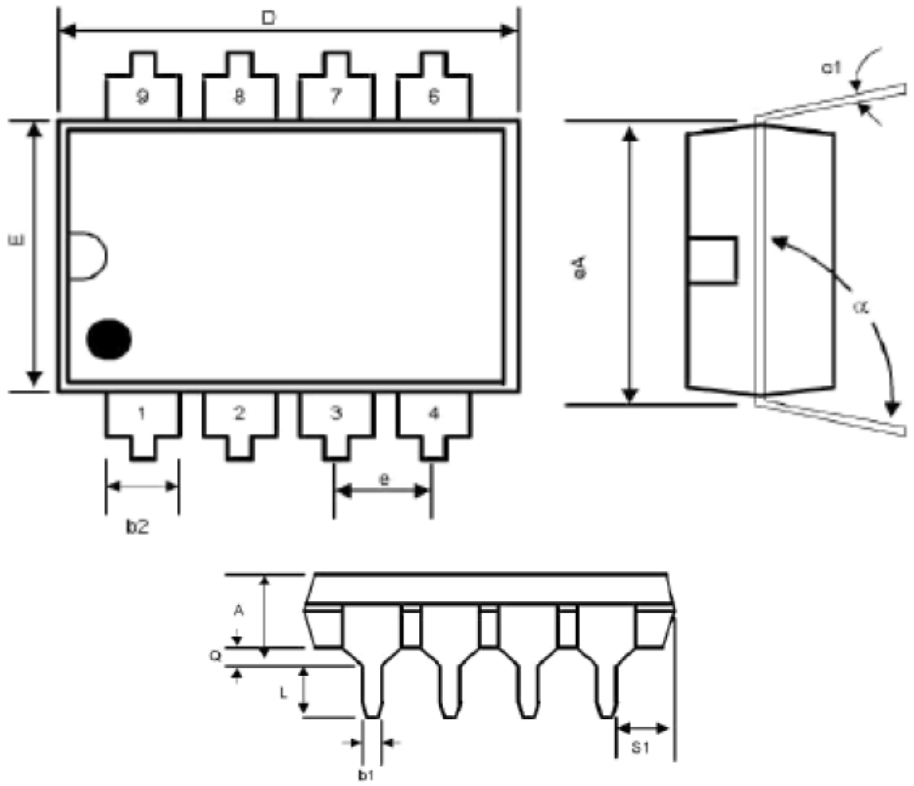
Auto Power Compensation (VCOMP)

When the loading is changed, EC4230 can adjust Vac accordingly for the changes in Output Power. It can achieve best efficiency.



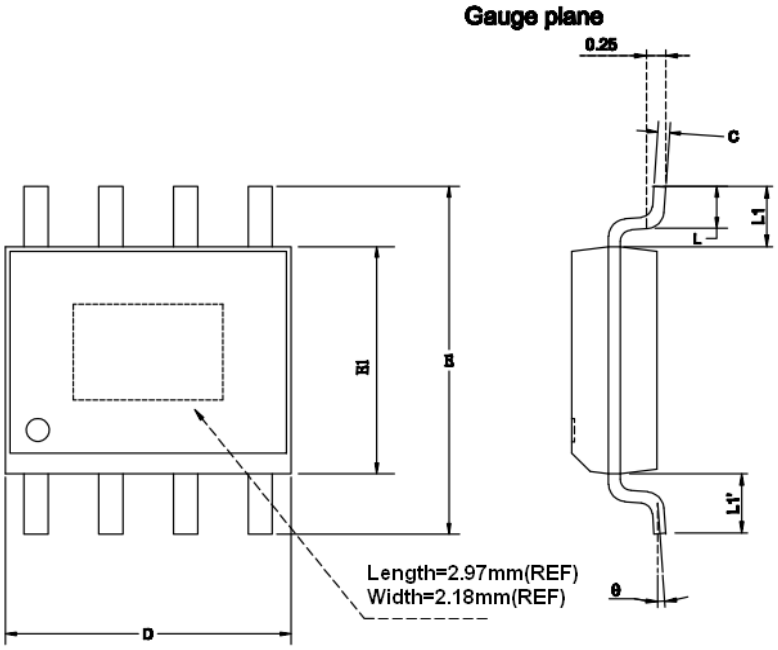
Package Dimension

DIP8



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.200	-	5.08	-
b1	0.014	0.023	0.36	0.58	-
b2	0.045	0.065	1.14	1.65	-
c1	0.008	0.015	0.20	0.38	-
D	0.355	0.400	9.02	10.16	-
E	0.220	0.310	5.59	7.87	-
e	0.100 BSC		2.54 BSC		-
eA	0.300 BSC		7.62 BSC		
L	0.125	0.200	3.18	5.08	-
Q	0.015	0.060	0.38	1.52	-
s1	0.005	-	0.13	-	-
α	90^0	105^0	90^0	105^0	-

ESOP8



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.60	0.055	0.059	0.063
A1	0.00	—	0.10	0.000	—	0.004
A2	—	1.45	—	—	0.057	—
B	0.33	—	0.51	0.013	—	0.020
C	0.19	—	0.25	0.007	—	0.010
D	4.80	—	5.00	0.189	—	0.197
E1	3.80	3.90	4.00	0.150	0.153	0.157
e	—	1.27	—	—	0.050	—
E	5.80	6.00	6.20	0.228	0.236	0.244
L	0.40	—	1.27	0.016	—	0.050
y	—	—	0.10	—	—	0.004
θ	0°	—	8°	0°	—	8°
|L1-L1'|	—	—	0.12	—	—	0.005
L1	1.04REF			0.041REF		