Current Mode PWM Controller With Frequency Shuffling ME8107

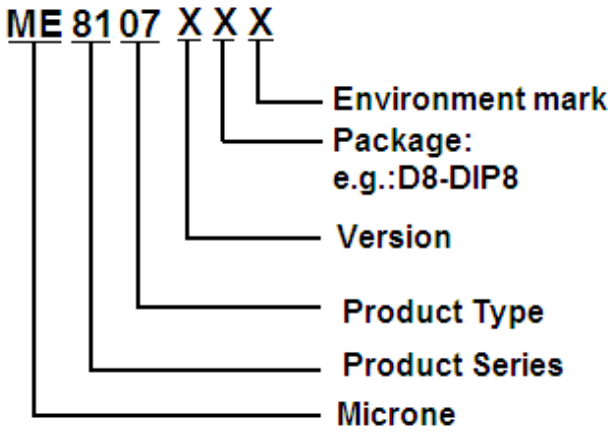
General Description

ME8107 integrates a PWM controller and high voltage power MOSFET of 600V. ME8107 has the features of very low standby power (<100mW) when AC power above 220Vac. and cost effective offline flyback converter applications in 18W range. ME8107 offers complete protection coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting (OCP), CS short protection, over load protection (OLP), and VDD under voltage lockout (UVLO) and latch feature including over voltage (fixed or adjustable) protection(OVP). Excellent EMI performance is achieved with frequency shuffling technique together with soft switching control at the totem pole gate drive output. Tone energy at below 20KHz is minimized in the design and audio noise is eliminated during operation.

Features

- ●Power on Soft Start Reducing MOSFET V_{DS} Stress
- ●Frequency shuffling for EMI
- ●Audio Noise Free Operation
- ●Extended Burst Mode Control For Improved Efficiency and Minimum Standby Power Design
- ●Internal Synchronized Slope Compensation
- ●Fixed 65KHz Switching Frequency
- ●Good protection coverage with auto self-recovery
  - * VDD Under Voltage Lockout with Hysteresis (UVLO)
  - * Cycle-by-cycle over current threshold setting for constant output power limiting over universal input voltage range
  - * Overload Protection (OLP) with auto-recovery
  - * VDD Over voltage Protection(OVP) with latch shut down
  - * Adjustable OVP through external Zener
  - * CS floating protection with auto-recovery
  - * CS short protection with auto-recovery
- ● Available in DIP8 package

Selection Guide



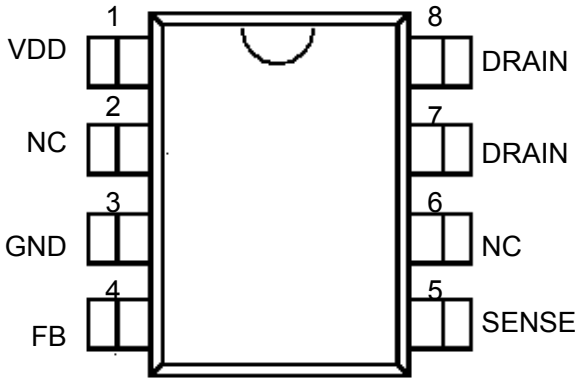
Typical Application

Offline AC/DC flyback converter for

- Switching AC/DC Power battery charge
- Digital cameras and camcorder adapter
- Set-top box power
- Auxiliary power supply for PC and server
- Open-frame SMPS

Pin Configuration

The ME8107 is offered in DIP8 packages shown as below.



PIN Assignments

Pin Num.	Symbol	Description
1	VDD	Chip DC power supply pin.
2	NC	
3	GND	Ground
4	FB	Voltage feedback pin, by connecting a photo-coupler to control the duty cycle
5	SENSE	Current sense input pin. Connected to MOSFET current sensing resistor node.
6	NC	
7,8	DRAIN	Drain of internal HV MOS

Absolute Maximum Ratings

Parameter	Range	Unit
VDD/VIN DC Supply Voltage	40	V
Drain Voltage	-0.3～600	V
VDD Zener Clamp Voltage Note	VDD_Clamp+0.1V	V
VDD DC Clamp Continuous Current	10	mA
V_{FB} ,V_{SENSE} (Voltage at FB,SENSE to GND)	-0.3 to 7	V
Power Dissipation	1.6	W
Min/Max Operating Junction Temperature T_J	-20 to 150	°C
Min/Max Storage Temperature Tstg	-55 to 150	°C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage.

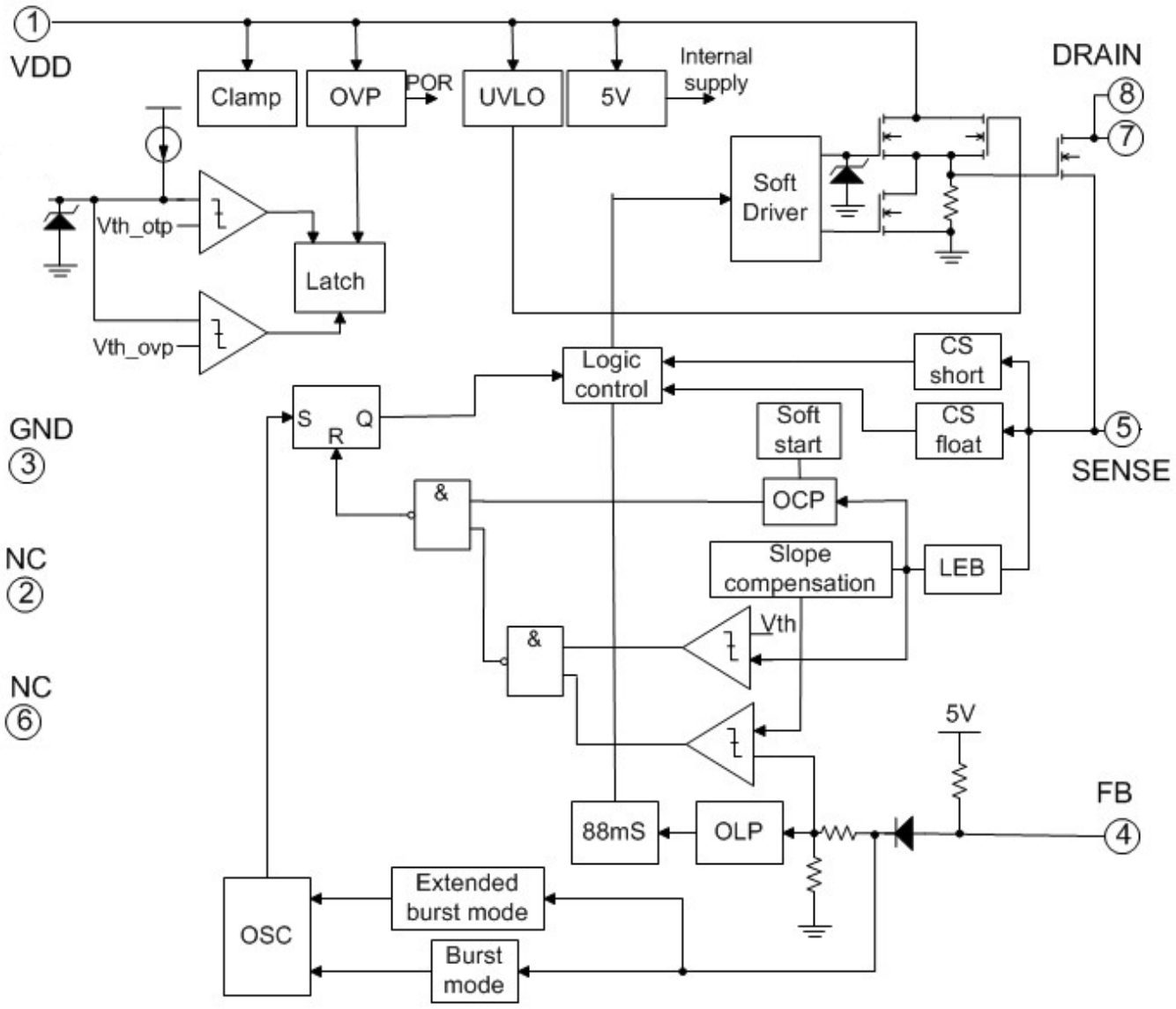
These values must therefore not be exceeded under any conditions.

Note: VDD_ Clamp has a nominal value of 32V.

Recommended Operating Condition

Parameter	Range	Unit
VDD Supply Voltage	10 to 30	V
T_A Operating Ambient Temperature	-20 to 85	°C

Block Diagram



Electrical Characteristics (T_A = 25°C, VDD=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD)						
$I_{Start-up}$	VDD Start up Current	VDD=11V, Measure leakage current into VDD	-	2	20	μA
$I_{VDD\_Operation}$	Operation Current	V_{FB}=3V	-	1.8	3	mA
$UVLO_{ON}$	VDD Under Voltage Lockout Enter		8	9	10	V
$UVLO_{OFF}$	VDD Under Voltage Lockout Exit (Recovery)		13	14	15.5	V
$V_{PULL-UP}$	Pull-up PMOS active		-	13	-	V
V_{DD_Clamp}		I_{VDD} = 10 mA	30	32	34	V
OVP_{ON}	VDD Over voltage protection enter	CS=0V,FB=3V Ramp up VDD until gate clock is off	24	26	28	V
V_{LATCH_REASE}	Latch release voltage		-	5	-	V
Feedback Input Section(FB Pin)						
AV_{CS}	PWM Input Gain $\Delta V_{FB}/\Delta V_{CS}$		-	2	-	V/V
Maximum duty cycle	Max duty cycle	V_{DD}=16V,V_{FB}=3V, V_{CS}=0V	75	80	85	%
V_{FB_Open}	V_{FB} Open Loop Voltage		3.9	4.2	-	V
I_{FB_Short}	FB pin short circuit current	Short FB pin to GND, measure current	-	0.3	-	mA
V_{REF_GREEN}	The threshold enter green mode		-	1.4	-	V
$V_{REF\_BURST\_H}$	The threshold exit burst mode		-	0.675	-	V
$V_{REF\_BURST\_L}$	The threshold enter burst mode		-	0.575	-	V
V_{TH_PL}	Power Limiting FB Threshold Voltage		-	3.7	-	V
T_{D_PL}	Power limiting Debounce Time		80	88	96	mS
Z_{FB_IN}	Input Impedance		-	4	-	KΩ
Current Sense Input(Sense Pin)						
Soft start time			-	4	-	mS
T_ blanking	Leading edge blanking time		-	220	-	nS
Z_{SENSE_IN}	Input Impedance		-	40	-	KΩ
T_{D_OC}	Over Current Detection and Control Delay	From over current occurs till the gate drive output start to turn off	-	120	-	nS
V_{TH_OC}	Internal current limiting threshold voltage	FB=3.3V	-	0.875	-	V
$V_{OCP\_CLAMPER}$	CS voltage clamper		-	0.95	-	V

Oscillator						
F_{OSC}	Normal Oscillation Frequency	VDD=16V,FB=3V,CS=0V	60	65	70	KHz
Δf_ OSC	Frequency jittering		-	±4	-	%
Δf_ Temp	Frequency Temperature Stability	-20°C to 100 °C	-	1	-	%
F_ shuffling	Shuffling frequency		-	32	-	Hz
Δf_ VDD	Frequency Voltage Stability		-	1	-	%
F_ Burst	Burst Mode Base Frequency		-	22	-	KHz
MOSFET SECTION (DRAIN Pin)						
BVdss	Drain-Source Voltage	Vgs=0	600	-	-	V
Ron	Static Drain-Source On-Resistance	V_{GS}=10V, Id=1.0A	-	-	4.4	Ω
Duty	Maximum duty cycle		75	80	85	%

Operation Description

The ME8107 is a low power off-line SMPS Switcher optimized for off-line flyback converter applications in 18W power range. The 'Extended burst mode' control greatly reduces the standby power consumption and helps the design easily to meet the international power conservation requirements.

●Start-up Current and Start up Control

Startup current of ME8107 is designed to be very low so that VDD could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet provides reliable startup in application. For a typical AC/DC adaptor with universal input range design, a 2 MΩ, 1/8 W startup resistor could be used together with a VDD capacitor to provide a fast start-up and low power dissipation design solution.

●Operating Current

The Operating current of ME8107 is low at 1.8mA. Good efficiency is achieved with ME8107 low operating current together with extended burst mode control features.

●Frequency shuffling for EMI improvement

The frequency Shuffling/jittering (switching frequency modulation) is implemented in ME8107. The oscillation frequency is modulated with a random source so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore reduces system design challenge.

●Extended Burst Mode Operation

At zero load or light load condition, majority of the power dissipation in a switching mode power supply is from switching loss on the MOSFET transistor, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy.

The switching frequency is internally adjusted at no load or light load condition. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The Gate drive output switches only when VDD voltage drops below a preset level and FB input is active to output an on state. Otherwise the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extend. The nature of high frequency switching also reduces the audio noise at any loading conditions.

●Oscillator Operation

The switching frequency of ME8107 is internally fixed at 65KHz. No external frequency setting components are required for PCB design simplification.

●Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in ME8107 current mode PWM control. The switch current is detected by a sense resistor into the sense pin. Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 220ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and cannot switch off the gate driver.

●Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp onto the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage.

●Protection Controls

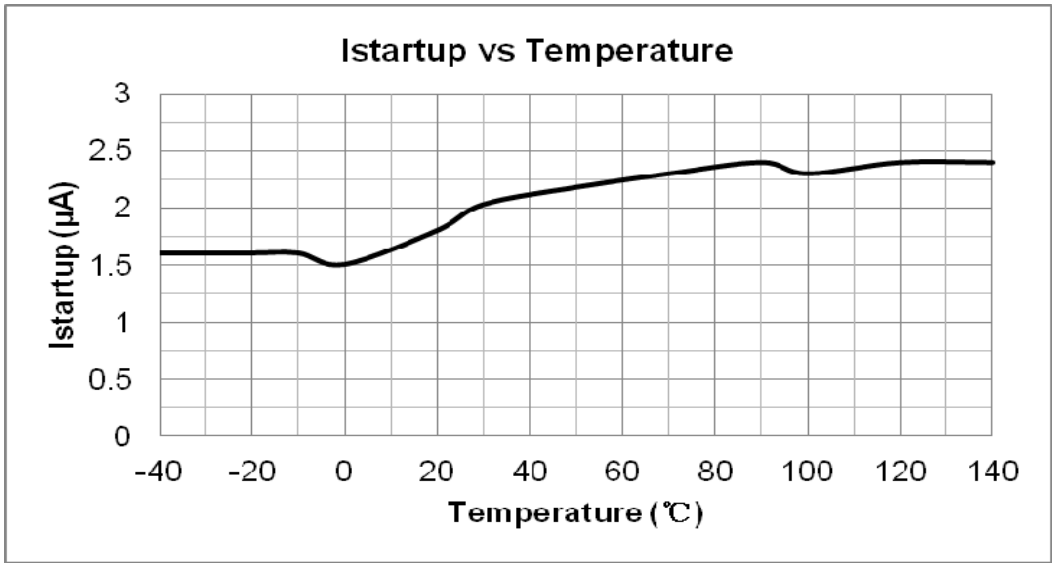
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), CS short protection, CS floating protection, and latch features including fixed or adjustable over voltage protection (OVP), and Under Voltage Lockout on VDD (UVLO).

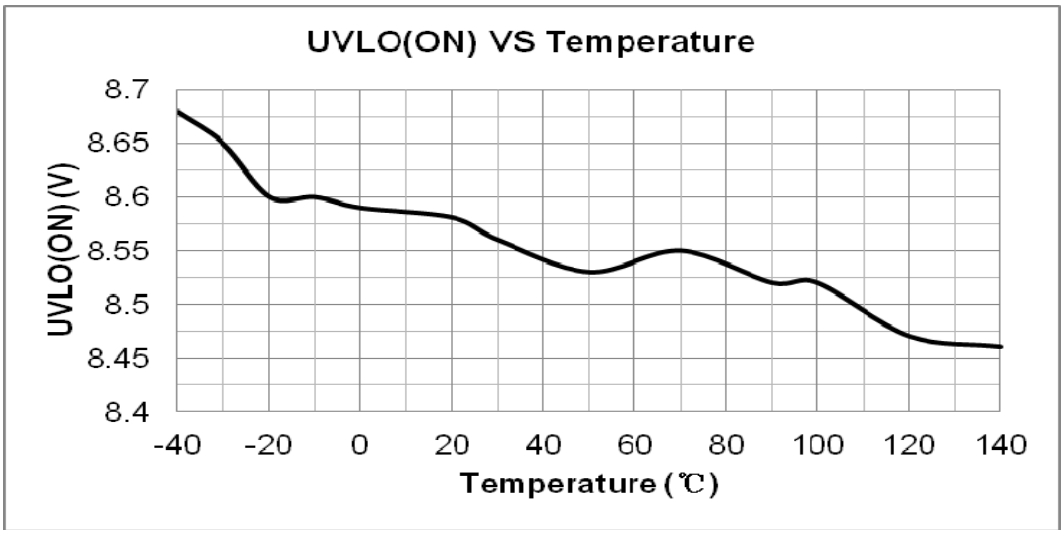
The OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

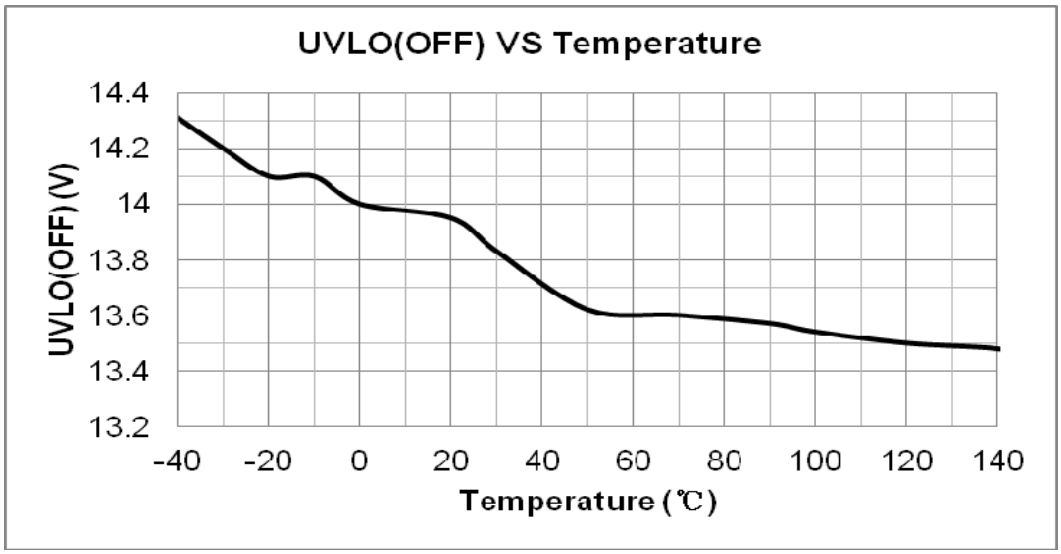
At overload condition, When FB input exceeds power limit threshold value for more than T_{D_PL}, control circuit reacts to shut down the output power MOSFET. Similarly, control circuit reacts to shut down the switcher. Switcher restarts when VDD voltage drops below UVLO limit. For latch mode, control circuit shutdowns (latch) the power MOSFET when an Over Voltage condition is detected until VDD drops below 5V (Latch release voltage) , and device enters power on restart-up sequence thereafter.

Typical performance characteristics

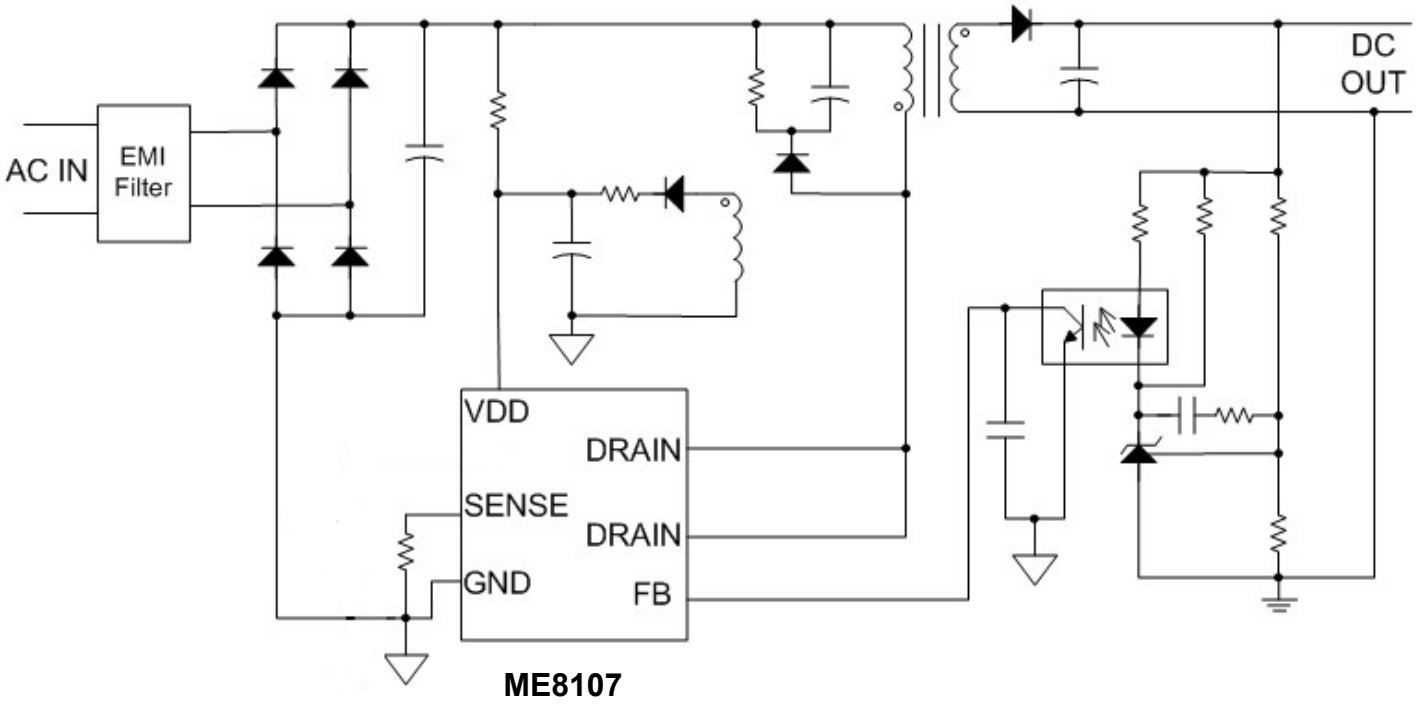
V_{DD} = 16V, T_A = 25℃ condition applies if not otherwise noted





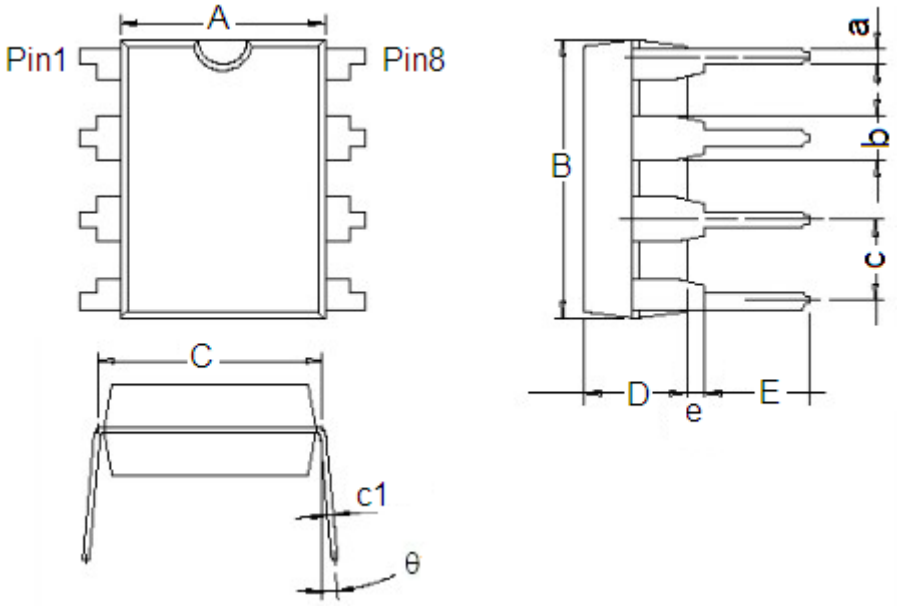


Typical Application



Packaging Information

Package type:DIP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	6.200	6.600	0.244	0.260
B	9.000	9.400	0.354	0.370
C	7.620(Typ.)		0.300(Typ.)	
D	3.200	3.600	0.126	0.142
E	3.000	3.600	0.118	0.142
a	0.360	0.560	0.014	0.022
b	1.524(Typ.)		0.060(Typ.)	
c	2.54(Typ.)		0.100(Typ.)	
c1	0.204	0.360	0.008	0.014
e	0.510(Min)		0.020(Min)	
θ	0^0	15^0	0^0	150

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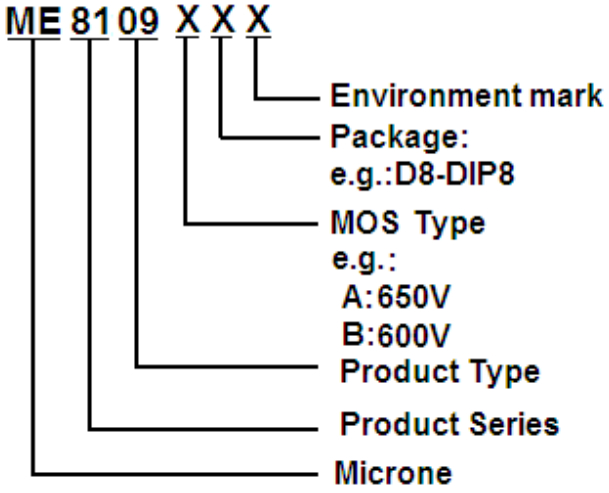
Current Mode PWM Controller With Frequency Shuffling ME8109

General Description

ME8109 integrates a PWM controller and high voltage power MOSFET of 600V or 650V. ME8109 has the features of very low standby power (<100mW) when AC power above 220Vac. and cost effective offline flyback converter applications in 18W range. ME8109 offers complete protection coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting (OCP), CS short protection, over load protection (OLP), and VDD under voltage lockout (UVLO) and latch feature including over temperature protection (OTP), over voltage (fixed or adjustable) protection(OVP). Excellent EMI performance is achieved with frequency shuffling technique together with soft switching control at the totem pole gate drive output. Tone energy at below 20KHz is minimized in the design and audio noise is eliminated during operation.

Selection Guide



Features

- Power on Soft Start Reducing MOSFET V_{DS} Stress
- Frequency shuffling for EMI
- Audio Noise Free Operation
- Extended Burst Mode Control For Improved Efficiency and Minimum Standby Power Design
- Internal Synchronized Slope Compensation
- Fixed 65KHz Switching Frequency
- Good protection coverage with auto self-recovery
  - * VDD Under Voltage Lockout with Hysteresis (UVLO)
  - * Over Temperature Protection (OTP) with latch shut down
  - * Cycle-by-cycle over current threshold setting for constant output power limiting over universal input voltage range
  - * Overload Protection (OLP) with auto-recovery
  - * VDD Over voltage Protection(OVP) with latch shut down
  - * Adjustable OVP through external Zener
  - * CS floating protection with auto-recovery
  - * CS short protection with auto-recovery
- Available in DIP8 package

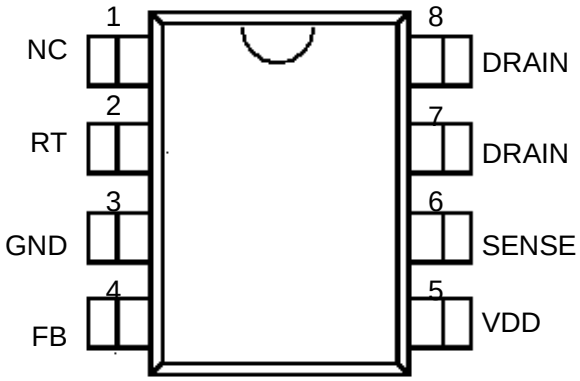
Typical Application

Offline AC/DC flyback converter for

- Switching AC/DC Power battery charge
- Digital cameras and camcorder adapter
- Set-top box power
- Auxiliary power supply for PC and server
- Open-frame SMPS

Pin Configuration

The ME8109 is offered in DIP8 packages shown as below.



PIN Assignments

Pin Num.	Symbol	Description
1	NC	
2	RT	Dual function PIN. Either connected through a NTC resistor to ground for over temperature shutdown/latch control or connected through Zener to VDD for adjustable over voltage protection.
3	GND	Ground
4	FB	Voltage feedback pin, by connecting a photo-coupler to control the duty cycle
5	VDD	Chip DC power supply pin.
6	SENSE	Current sense input pin. Connected to MOSFET current sensing resistor node.
7,8	DRAIN	Drain of internal HV MOS

Absolute Maximum Ratings

Parameter	Range		Unit
VDD/VIN DC Supply Voltage	40		V
Drain Voltage	ME8109A	-0.3～650	V
	ME8109B	-0.3～600	
VDD Zener Clamp Voltage[Note]	VDD_Clamp+0.1V		V
VDD DC Clamp Continuous Current	10		mA
V_{FB} ,V_{SENSE} ,V_{RT} (Voltage at FB,SENSE,RT to GND)	-0.3 to 7		V
Min/Max Operating Junction Temperature T_J	-20 to 150		°C
Min/Max Storage Temperature Tstg	-55 to 150		°C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage.

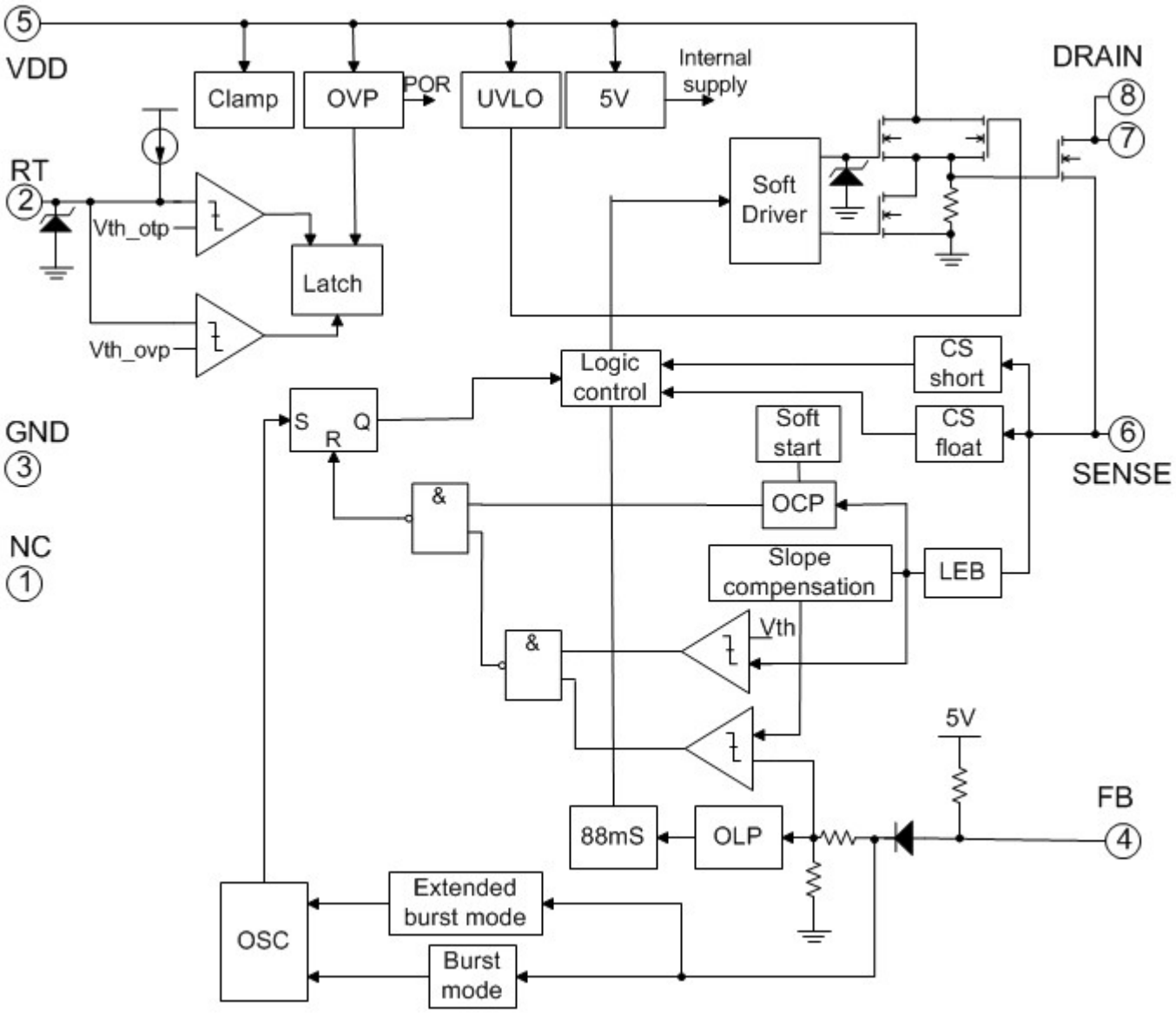
These values must therefore not be exceeded under any conditions.

Note: VDD_Clamp has a nominal value of 32V.

Recommended Operating Condition

Parameter	Range	Unit
VDD Supply Voltage	10 to 30	V
T_A Operating Ambient Temperature	-20 to 85	°C

Block Diagram



Electrical Characteristics(T_A = 25°C,VDD=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD)						
$I_{Startup}$	VDD Start up Current	VDD=11V, Measure leakage current into VDD	-	2	20	μA
$I_{VDD\_Operation}$	Operation Current	V_{FB}=3V	-	1.8	3	mA
$UVLO_{ON}$	VDD Under Voltage Lockout Enter		8	9	10	V
$UVLO_{OFF}$	VDD Under Voltage Lockout Exit (Recovery)		13	14	15.5	V
$V_{PULL-UP}$	Pull-up PMOS active		-	13	-	V
V_{DD_Clamp}		I_{VDD} = 10 mA	30	32	34	V
OVP_{ON}	VDD Over voltage protection enter	CS=0V,FB=3V Ramp up VDD until gate clock is off	24	26	28	V
V_{LATCH_REASE}	Latch release voltage		-	5	-	V
Feedback Input Section(FB Pin)						
AV_{CS}	PWM Input Gain $\Delta V_{FB}/\Delta V_{CS}$		-	2	-	V/V
Maximum duty cycle	Max duty cycle	V_{DD}=16V,V_{FB}=3V, V_{CS}=0V	75	80	85	%
V_{FB_Open}	V_{FB} Open Loop Voltage		3.9	4.2	-	V
I_{FB_Short}	FB pin short circuit current	Short FB pin to GND, measure current	-	0.3	-	mA
V_{REF_GREEN}	The threshold enter green mode		-	1.4	-	V
$V_{REF\_BURST\_H}$	The threshold exit burst mode		-	0.675	-	V
$V_{REF\_BURST\_L}$	The threshold enter burst mode		-	0.575	-	V
V_{TH_PL}	Power Limiting FB Threshold Voltage		-	3.7	-	V
T_{D_PL}	Power limiting Debounce Time		80	88	96	mS
Z_{FB_IN}	Input Impedance		-	4	-	KΩ
Current Sense Input(Sense Pin)						
Soft start time			-	4	-	mS
T_blanking	Leading edge blanking time		-	220	-	nS
Z_{SENSE_IN}	Input Impedance		-	40	-	KΩ
T_{D_OC}	Over Current Detection and Control Delay	From over current occurs till the gate drive output start to turn off	-	120	-	nS
V_{TH_OC}	Internal current limiting threshold voltage	FB=3.3V	-	0.875	-	V
$V_{OCP\_CLAMPER}$	CS voltage clamper		-	0.95	-	V
Oscillator						

F_{OSC}	Normal Oscillation Frequency	VDD=16V,FB=3V,CS=0V		60	65	70	KHz
Δf_OSC	Frequency jittering			-	±4	-	%
Δf_Temp	Frequency Temperature Stability	-20°C to 100 °C		-	1	-	%
F_shuffling	Shuffling frequency			-	32	-	Hz
Δf_VDD	Frequency Voltage Stability			-	1	-	%
F_Burst	Burst Mode Base Frequency			-	22	-	KHz
MOSFET SECTION (DRAIN Pin)							
BVdss	Drain-Source Voltage	Vgs=0	ME8109A	650	-	-	V
			ME8109B	600	-	-	
Ron	Static Drain-Source On-Resistance	V_{GS}=10V, Id=1.0A	ME8109A	-	-	6.25	Ω
			ME8109B	-	-	4.4	Ω
Duty	Maximum duty cycle			75	80	85	%
Over Temperature Protection							
I_{RT}	Output current of RT pin			95	100	105	μA
V_{OTP}	Threshold voltage for OTP			0.95	1	1.05	V
V_{OTP_FL}	Float voltage at RT pin			-	2.3	-	V
T_{D_OTP}	OTP De-bounce time			-	32	-	Cycle
V_{RT_OVP}	RT Pin open voltage			-	4	-	V

Operation Description

The ME8109 is a low power off-line SMPS Switcher optimized for off-line flyback converter applications in 18W power range. The 'Extended burst mode' control greatly reduces the standby power consumption and helps the design easily to meet the international power conservation requirements.

●Startup Current and Start up Control

Startup current of ME8109 is designed to be very low so that VDD could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet provides reliable startup in application. For a typical AC/DC adaptor with universal input range design, a 2 MΩ, 1/8 W startup resistor could be used together with a VDD capacitor to provide a fast startup and low power dissipation design solution.

●Operating Current

The Operating current of ME8109 is low at 1.8mA. Good efficiency is achieved with ME8109 low operating current together with extended burst mode control features.

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The frequency Shuffling/jittering (switching frequency modulation) is implemented in ME8109. The oscillation frequency is modulated with a random source so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore reduces system design challenge.

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At zero load or light load condition, majority of the power dissipation in a switching mode power supply is from switching loss on the MOSFET transistor, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy.

The switching frequency is internally adjusted at no load or light load condition. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The Gate drive output switches only when VDD voltage drops below a preset level and FB input is active to output an on state. Otherwise the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extend. The nature of high frequency switching also reduces the audio noise at any loading conditions.

●Oscillator Operation

The switching frequency of ME8109 is internally fixed at 65KHz. No external frequency setting components are required for PCB design simplification.

●Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in ME8109 current mode PWM control. The switch current is detected by a sense resistor into the sense pin. Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 220ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and cannot switch off the gate driver.

●Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp onto the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage.

●Over Temperature Protection

A NTC resistor in series with a regular resistor should connect between RT and GND for temperature sensing and protection.NTC resistor value becomes lower when the ambient temperature rises. With the fixed internal current I_{RT} flowing through the resistors, the voltage at RT pin becomes lower at high temperature. The internal OTP circuit is triggered and shutdown the MOSFET when the sensed input voltage is lower than V_{TH_OTP}.

●Protection Controls

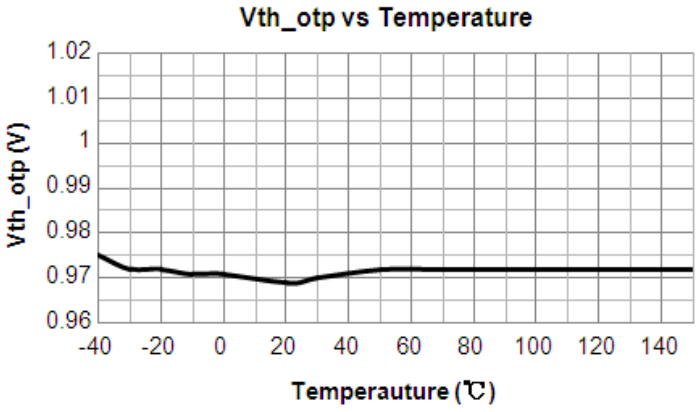
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), CS short protection, CS floating protection, and latch features including over temperature protection (OTP), fixed or adjustable over voltage protection (OVP), and Under Voltage Lockout on VDD (UVLO).

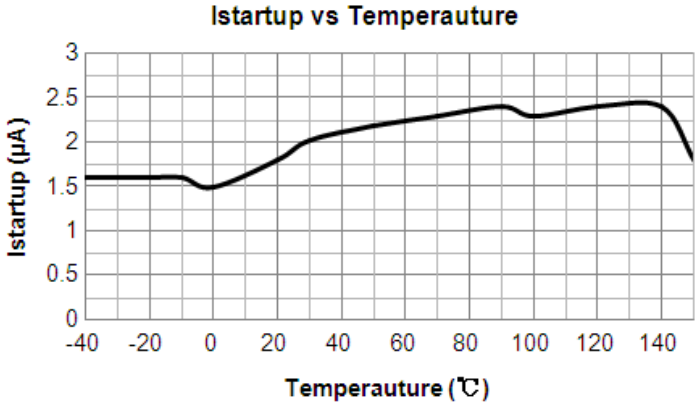
The OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

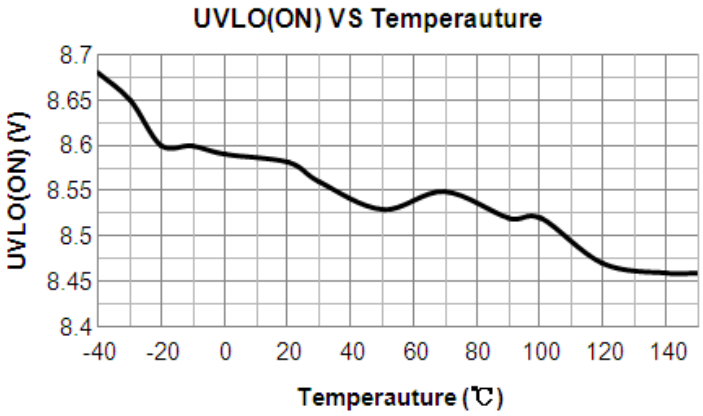
At overload condition, When FB input exceeds power limit threshold value for more than T_{D_PL}, control circuit reacts to shut down the output power MOSFET. Similarly, control circuit reacts to shut down the switcher. Switcher restarts when VDD voltage drops below UVLO limit. For latch mode, control circuit shutdowns (latch) the power MOSFET when an Over Temperature condition or Over Voltage condition is detected until VDD drops below 5V (Latch release voltage) , and device enters power on restart-up sequence thereafter.

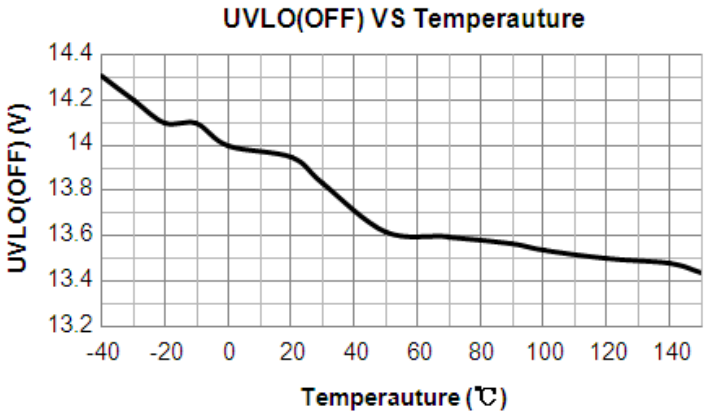
Typical performance characteristics

V_{DD} = 16V, T_A = 25℃ condition applies if not otherwise noted

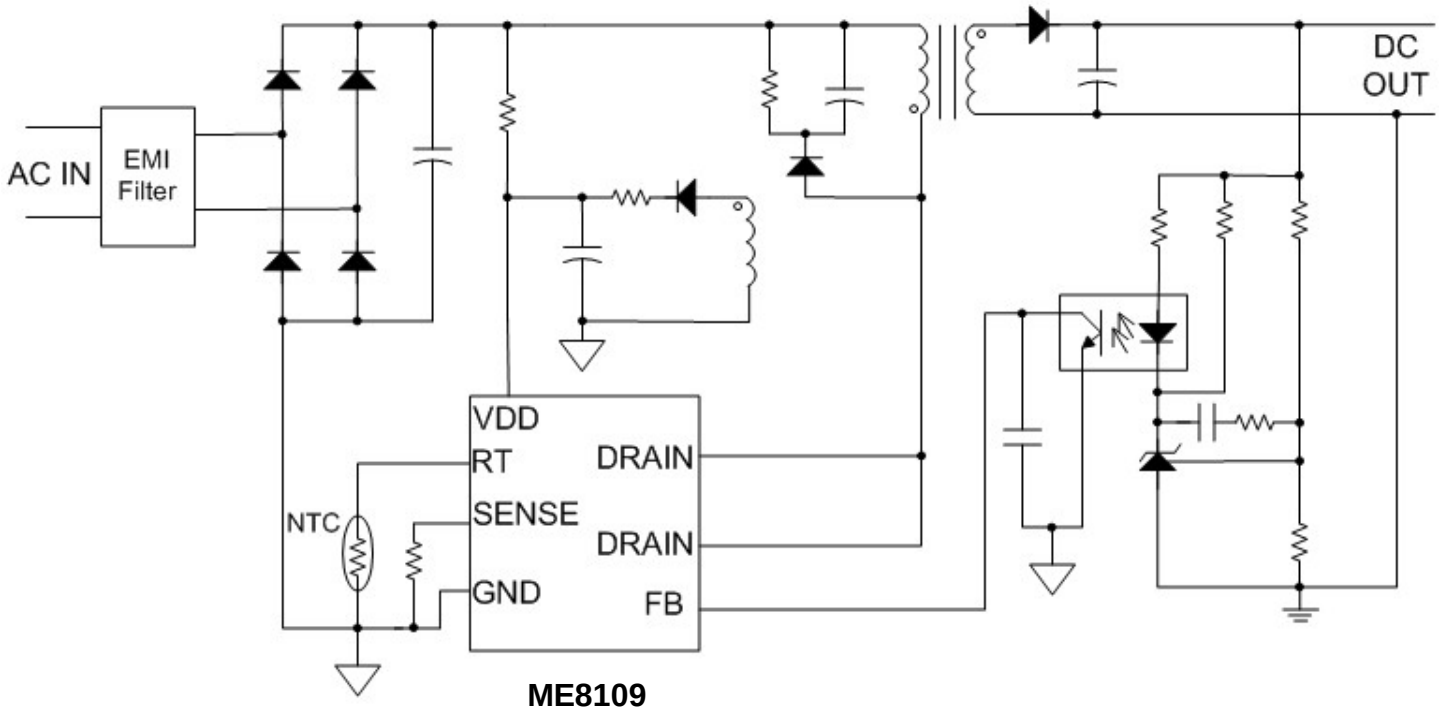






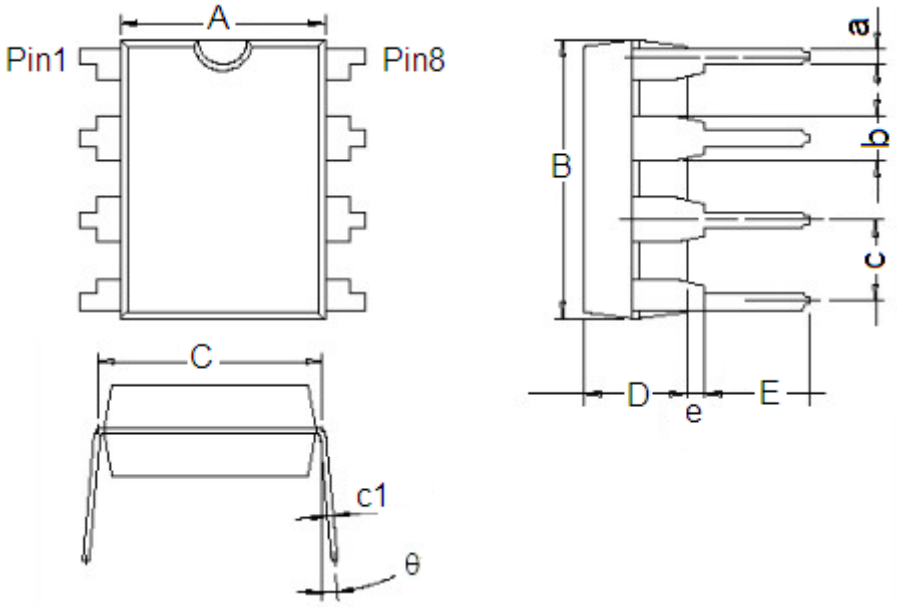


Typical Application



Packaging Information

Package type:DIP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	6.200	6.600	0.244	0.260
B	9.000	9.400	0.354	0.370
C	7.620(Typ.)		0.300(Typ.)	
D	3.200	3.600	0.126	0.142
E	3.000	3.600	0.118	0.142
a	0.360	0.560	0.014	0.022
b	1.524(Typ.)		0.060(Typ.)	
c	2.54(Typ.)		0.100(Typ.)	
c1	0.204	0.360	0.008	0.014
e	0.510(Min)		0.020(Min)	
θ	0^0	15^0	0^0	150

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Current Mode PWM Power Switch ME8110

General Description

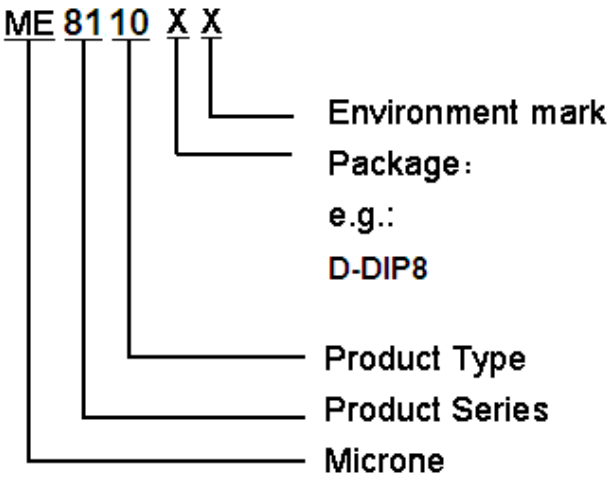
ME8110 integrates a PWM controller and high voltage power MOSFET of 650V. ME8110 has the features of very low startup current and current mode PWM control with green-mode function at light load. The integrated functions of ME8110 also include the leading-edge blanking of the current sensing, internal slope compensation, cycle-by--cycle peak current limiting and soft start. OCP, OVP and OLP provide protection performance for fault conditions. These functions enable the power supply to easily meet even the strictest power requirements.

ME8110 improves the performance and reduces the cost of power supplies.

Features

- Current Mode PWM
- Very low startup current
- Under-Voltage Lockout (UVLO)
- Non-Audible-Noise Green-Mode control
- Fixed 65KHz Switching Frequency
- Cycle-by-Cycle peak current limiting
- Internal leading-edge blanking
- Internal slope compensation
- Less than 0.1W of power saving
- Over-voltage protection (OVP) on VCC pin
- Over-load protection (OLP)
- Available in DIP8 package

Selection Guide

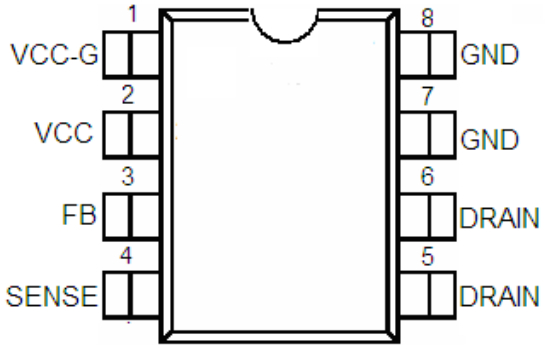


Typical Application

- Switching AC/DC Power battery charge
- Digital cameras
- PDA power supply
- Open-frame SMPS

Pin Configuration

The ME110 is offered in DIP8 packages shown as below.



PIN Assignments

Pin Num.	Symbol	Description
1	VCC-G	Power supply input for internal gate driver
2	VCC	Chip DC power supply pin
3	FB	Voltage feedback pin, by connecting a photo-coupler to control the duty cycle
4	SENSE	Current sense input pin. Connected to MOSFET current sensing resistor node.
5、6	DRAIN	Drain of internal HV MOS
7、8	GND	Ground

Absolute Maximum Ratings

Parameter	Range	Unit
VCC DC Supply Voltage	30	V
VCC-G	30	V
Drain Voltage	-0.3～650	V
V_{FB} ,V_{SENSE} (Voltage at FB,SENSE to GND)	-0.3 to 7	V
Max Operating Junction Temperature T_J	150	°C
Min/Max Operating Ambient Temperature	-20 to 85	°C
Min/Max Storage Temperature Tstg	-65 to 150	°C
Lead Temperature(All Pb free packages, soldering, 10sec)	260	°C
ESD Voltage protection, Human body mode	2000	V
ESD Voltage protection, Machine mode	200	V

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.

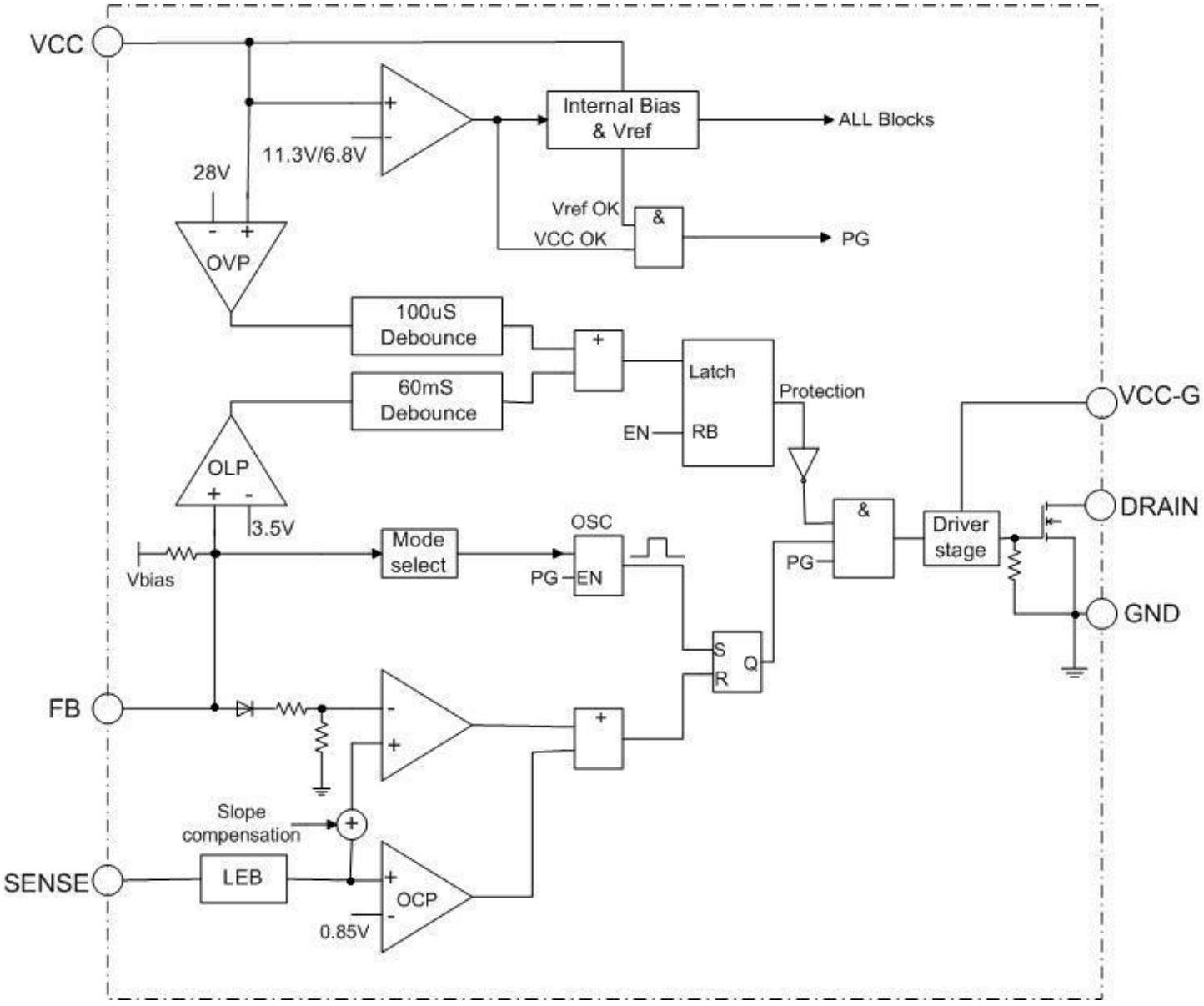
Recommended Operating Condition

Parameter	Range	Unit
VCC Supply Voltage	11 to 25	V
VCC-G pin series resistor	51 to 510	Ω
VCC pin series resistor	10 to 75	Ω
FB pin capacitor	1 to 100	nF

Note:

1. FB pin parallel one 6.5V Zener diode for safety regulation on abnormal test.
2. Sense pin resistor recommended to use SMD type for avoiding stray inductor interference issue.

Block Diagram



Electrical Characteristics(T_A = 25°C,VCC=15V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VCC)						
$I_{Startup}$	VCC Start up Current	VCC=10.8V, Measure leakage current into VCC	-	5	20	μA
$I_{Operation}$	Operation Current , with 1nF load on DRAIN pin	V_{FB}=0V, Measure current into VCC pin	400	800	1500	μA
$I_{VCC\_Operation}$	Operation Current	V_{FB}=2.5V, Measure current into VCC pin	-	1.8	-	mA
$UVLO_{OFF}$	VCC Under Voltage Lockout Enter	VCC Falling	6.3	6.8	7.3	V
$UVLO_{ON}$	VCC Under Voltage Lockout Exit (Recovery)	VCC Rising	10.8	11.3	11.8	V
OVP_{ON}	VCC Over voltage protection enter		27	28	29	V
Feedback Input Section(FB Pin)						
V_{FB_Open}	V_{FB} Open Loop Voltage	FB pin open	-	5.7	-	V
I_{FB_Short}	FB pin short circuit current	V_{FB}=0V, Short FB pin to GND, measure current	-	0.3	-	mA
Current Sense Input(Sense Pin)						
$V_{SENSE\ MAX}$	Maximum input voltage		0.8	0.85	0.9	V
T_blanking	Leading edge blanking time		-	350	-	nS
Z_{SENSE_IN}	Input Impedance		1	-	-	MΩ
T_{D_OC}	Delay to output		-	100	-	nS
Oscillator						
F_{OSC}	Normal Oscillation Frequency		60	65	70	KHz
Δf_OSC	Frequency jittering		-	±6	-	%
Δf_Temp	Frequency Temperature Stability	-40°C to 110 °C	-	5	-	%
Δf_VCC	Frequency Voltage Stability	VCC=11V to 25V	-	3	-	%
F_Green	Green Mode Frequency		-	22	-	KHz
MOSFET SECTION						
BVdss	Drain-Source Voltage	Vgs=0	600	-	670	V
Ron	Static Drain-Source On-Resistance	Id=1.0A	-	3.6	4.4	Ω
Duty	Maximum duty cycle		70	75	80	%
Over Load Protection (OLP)						
Tdelay	OLP Delay time		-	60	-	mS
V_{OLP}	OLP Trim level		-	3.45	-	V

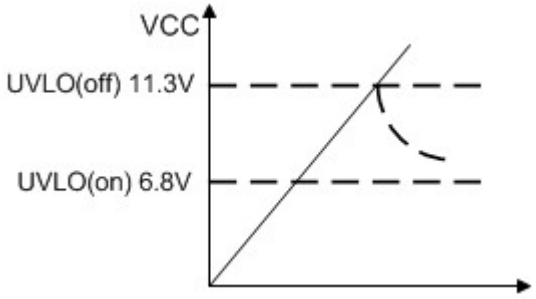
Operation Description

Startup Current

The typical start-up current is 8μA. Very low start-up current allows the PWM controller to increase the value of start-up resistor and then reduce the power dissipation on it.

Under-voltage Lockout (UVLO)

A hysteresis UVLO comparator is implemented in ME8110, then the turn-on and turn-off thresholds level are fixed on 11.3V and 6.8V respectively. This hysteresis shown in the following figure ensures that the start-up capacitor will be adequate to supply the chip during start-up.



Soft Start

During initial power on, ME8110 provides soft start function. It effectively suppresses the start up peak current to reduce the power MOSFET drain voltage especially at high line.

Oscillator

The frequency of the oscillator is fixed internally at about 65KHz. The maximum duty-cycle of internal oscillator is limited about 75% to avoid the transformer saturation.

Green Mode Operation

When the load decreases to an extent, the frequency of the controller will decrease so as to reduce the system power consumption. The minimum frequency is about 22KHz, which is outside the audio range.

Leading-edge Blanking (LEB)

Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 350ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and cannot switch off the gate driver.

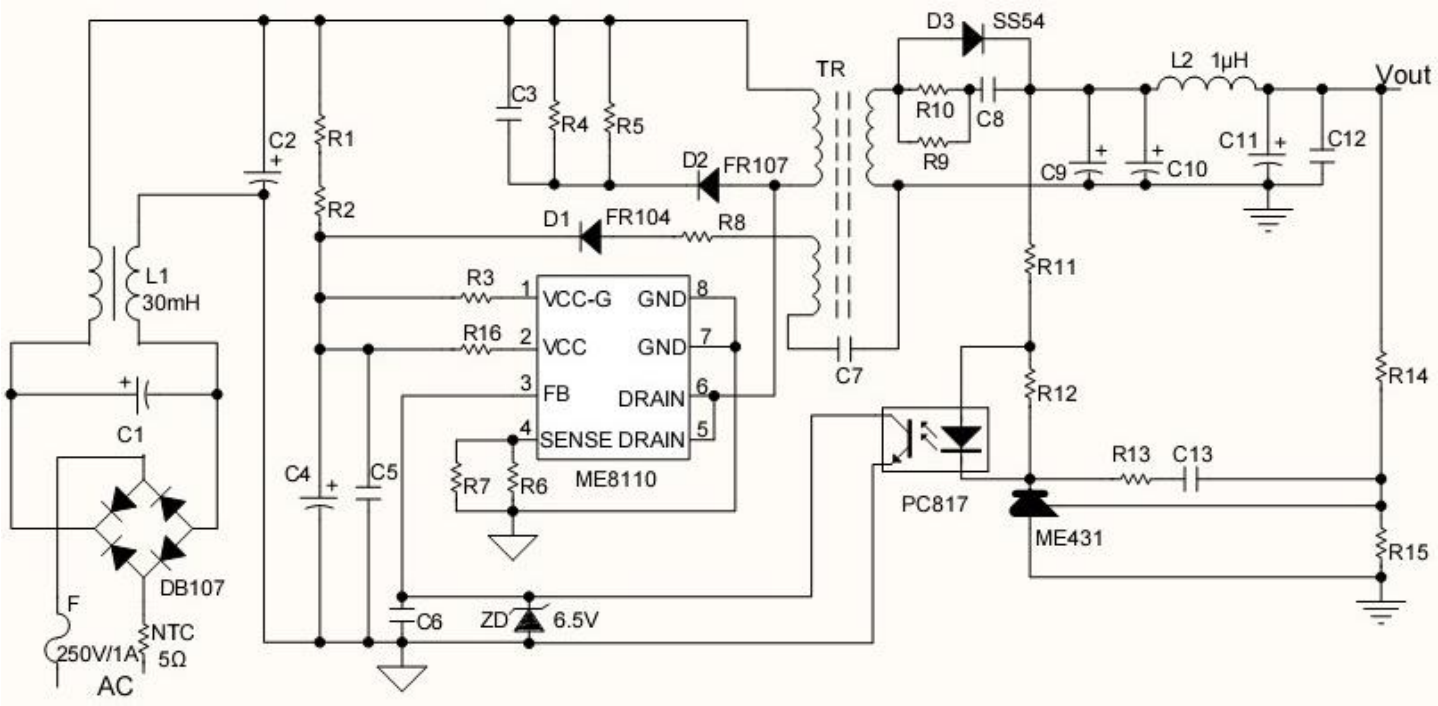
Over-load Protection (OLP)

The controller has over load protection function. An internal circuit detects the load level, when the load is larger than a threshold and the condition lasts more than 60ms, the gate output will keep low level. Then VCC decreases below UVLO off level, the controller resets again.

Over-voltage Protection (OVP) on VCC

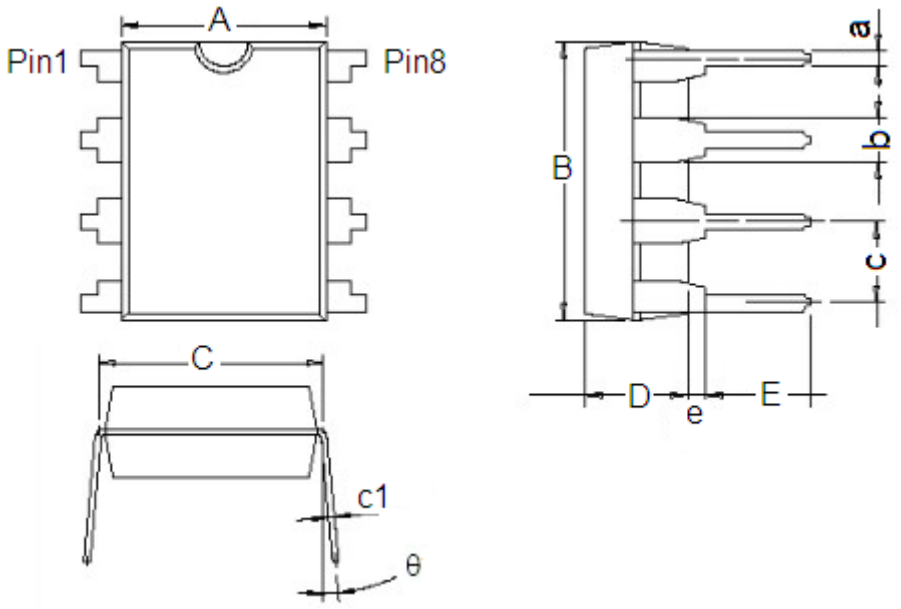
To prevent power MOSFET from being damaged, ME8110 is implemented an OVP function on VCC. When the VCC voltage is higher than the OVP threshold voltage, the output gate driver circuit will be shut down immediately to stop the switching of internal HV power MOSFET. The VCC OVP function is an Auto-recovery type protection. If OVP happens, the pulses will be stopped and recover at the next UVLO on. ME8110 is working in a hiccup mode. Gate Driver Driving capability can be adjusted by a resistor between VCC and VCC-G for EMI improvement. The resistor can decrease rising time of internal gate driver. But be attention that too large resistance could decrease system efficiency (especially at CCM condition).

Typical Application



Packaging Information

Package type:DIP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	6.200	6.600	0.244	0.260
B	9.000	9.400	0.354	0.370
C	7.620(Typ.)		0.300(Typ.)	
D	3.200	3.600	0.126	0.142
E	3.000	3.600	0.118	0.142
a	0.360	0.560	0.014	0.022
b	1.524(Typ.)		0.060(Typ.)	
c	2.54(Typ.)		0.100(Typ.)	
c1	0.204	0.360	0.008	0.014
e	0.510(Min)		0.020(Min)	
θ	0^0	15^0	0^0	150

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Current Mode PWM Controller With Frequency Shuffling ME8111

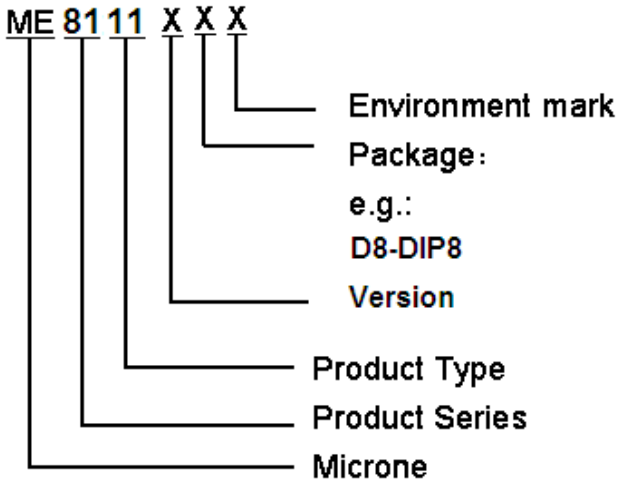
General Description

ME8111 integrates a PWM controller and high voltage power MOSFET of 600V/4A. ME8111 has the features of very low standby power (<100mW) when AC power above 220Vac. and cost effective offline flyback converter applications in 24W range. ME8111 offers complete protection coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting (OCP), CS short protection, over load protection (OLP), and VCC under voltage lockout (UVLO) and latch feature including over voltage (fixed or adjustable) protection(OVP). Excellent EMI performance is achieved with frequency shuffling technique together with soft switching control at the totem pole gate drive output. Tone energy at below 20KHz is minimized in the design and audio noise is eliminated during operation.

Features

- ●Power on Soft Start Reducing MOSFET V_{DS} Stress
- ●Frequency shuffling for EMI
- ●Audio Noise Free Operation
- ●Extended Burst Mode Control For Improved Efficiency and Minimum Standby Power Design
- ●Internal Synchronized Slope Compensation
- ●Fixed 65KHz Switching Frequency
- ●Good protection coverage with auto self-recovery
  - * VCC Under Voltage Lockout with Hysteresis (UVLO)
  - * Cycle-by-cycle over current threshold setting for constant output power limiting over universal input voltage range
  - * Overload Protection (OLP) with auto-recovery
  - * VCC Over voltage Protection(OVP) with latch shut down
  - * Adjustable OVP through external Zener
  - * CS floating protection with auto-recovery
  - * CS short protection with auto-recovery
- ● Available in DIP8 package

Selection Guide



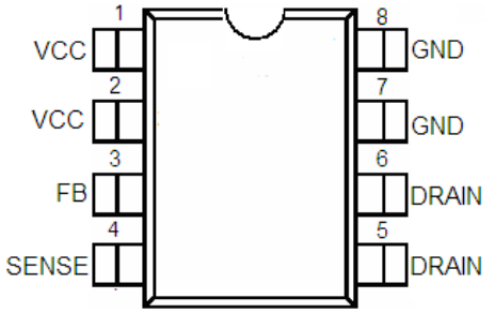
Typical Application

Offline AC/DC flyback converter for

- Switching AC/DC Power battery charge
- Digital cameras and camcorder adapter
- Set-top box power
- Auxiliary power supply for PC and server
- Open-frame SMPS

Pin Configuration

The ME8111 is offered in DIP8 packages shown as below.



PIN Assignments

Pin Num.	Symbol	Description
1;2	VCC	Chip DC power supply pin
3	FB	Voltage feedback pin, by connecting a photo-coupler to control the duty cycle
4	SENSE	Current sense input pin. Connected to MOSFET current sensing resistor node.
5、6	DRAIN	Drain of internal HV MOS
7、8	GND	Ground

Absolute Maximum Ratings

Parameter	Range	Unit
VCC/VIN DC Supply Voltage	40	V
Drain Voltage	-0.3～600	V
VCC Zener Clamp Voltage[Note]	VCC_Clamp+0.1V	V
VCC DC Clamp Continuous Current	10	mA
V_{FB} ,V_{SENSE} (Voltage at FB,SENSE to GND)	-0.3 to 7	V
Min/Max Operating Junction Temperature T_J	-20 to 150	°C
Min/Max Storage Temperature Tstg	-55 to 150	°C

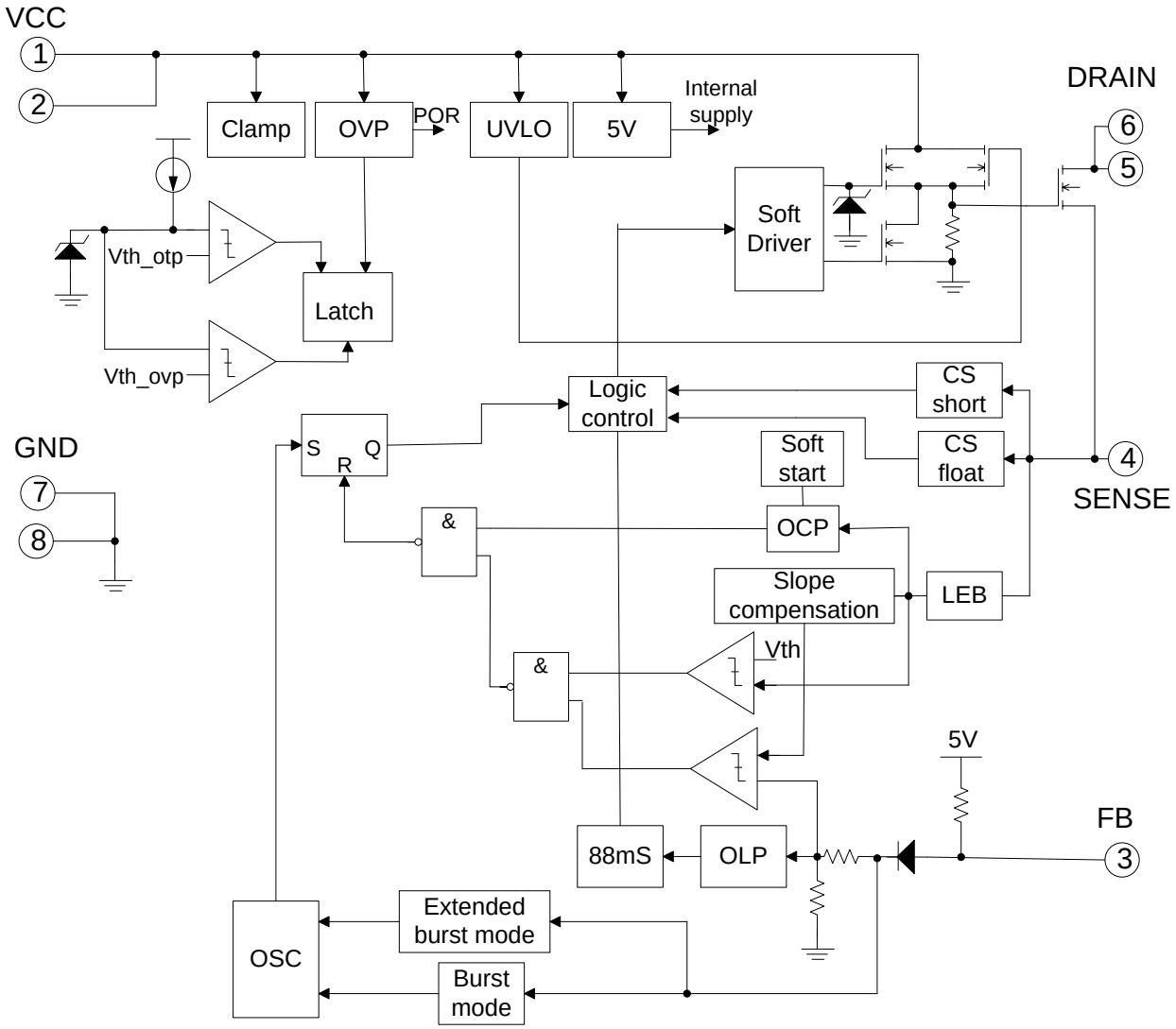
Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

Note: VCC_Clamp has a nominal value of 32V.

Recommended Operating Condition

Parameter	Range	Unit
VCC Supply Voltage	10 to 30	V
T_A Operating Ambient Temperature	-20 to 85	°C

Block Diagram



Electrical Characteristics(T_A = 25°C,VCC=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VCC)						
$I_{Startup}$	VCC Start up Current	VCC=11V, Measure leakage current into VCC	-	2	20	μA
$I_{VCC\_Operation}$	Operation Current	V_{FB}=3V	-	1.8	3	mA
$UVLO_{ON}$	VCC Under Voltage Lockout Enter		8	9	10	V
$UVLO_{OFF}$	VCC Under Voltage Lockout Exit (Recovery)		13	14	15.5	V
$V_{PULL-UP}$	Pull-up PMOS active		-	13	-	V
$VCC_{\_Clamp}$		I_{VCC} = 10 mA	30	32	34	V
OVP_{ON}	VCC Over voltage protection enter	CS=0V,FB=3V Ramp up VCC until gate clock is off	24	26	28	V
V_{LATCH_REASE}	Latch release voltage		-	5	-	V

Feedback Input Section(FB Pin)						
AV_{SENSE}	PWM Input Gain $\Delta V_{FB}/\Delta V_{SENSE}$		-	2	-	V/V
Maximum duty cycle	Max duty cycle	VCC=16V,V_{FB}=3V, V_{CS}=0V	75	80	85	%
V_{FB_Open}	V_{FB} Open Loop Voltage		3.9	4.2	-	V
I_{FB_Short}	FB pin short circuit current	Short FB pin to GND, measure current	-	0.3	-	mA
V_{REF_GREEN}	The threshold enter green mode		-	1.4	-	V
$V_{REF\_BURST\_H}$	The threshold exit burst mode		-	0.675	-	V
$V_{REF\_BURST\_L}$	The threshold enter burst mode		-	0.575	-	V
V_{TH_PL}	Power Limiting FB Threshold Voltage		-	3.7	-	V
T_{D_PL}	Power limiting Debounce Time		80	88	96	mS
Z_{FB_IN}	Input Impedance		-	4	-	KΩ
Current Sense Input(Sense Pin)						
Soft start time			-	4	-	mS
T_blanking	Leading edge blanking time		-	220	-	nS
Z_{SENSE_IN}	Input Impedance		-	40	-	KΩ
T_{D_OC}	Over Current Detection and Control Delay	From over current occurs till the gate drive output start to turn off	-	120	-	nS
V_{TH_OC}	Internal current limiting threshold voltage	FB=3.3V	-	0.875	-	V
$V_{OCP\_CLAMPER}$	CS voltage clamper		-	0.95	-	V
Oscillator						
F_{OSC}	Normal Oscillation Frequency	VCC=16V,FB=3V,CS=0V	60	65	70	KHz
Δf_OSC	Frequency jittering		-	±4	-	%
Δf_Temp	Frequency Temperature Stability	-20°C to 100 °C	-	1	-	%
F_shuffling	Shuffling frequency		-	32	-	Hz
Δf_VCC	Frequency Voltage Stability		-	1	-	%
F_Burst	Burst Mode Base Frequency		-	22	-	KHz
MOSFET SECTION (DRAIN Pin)						
BVdss	Drain-Source Voltage	Vgs=0	600	-	-	V
Ron	Static Drain-Source On-Resistance	V_{GS}=10V, Id=1.0A	-	-	3.3	Ω
I_D	Continuous drain current		-	-	4	A
Duty	Maximum duty cycle		75	80	85	%

Operation Description

The ME8111 is a low power off-line SMPS Switcher optimized for off-line flyback converter applications in 24W power range. The 'Extended burst mode' control greatly reduces the standby power consumption and helps the design easily to meet the international power conservation requirements.

Startup Current and Start up Control

Startup current of ME8111 is designed to be very low so that VCC could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet provides reliable startup in application. For a typical AC/DC adaptor with universal input range design, a 2 MΩ, 1/8 W startup resistor could be used together with a VCC capacitor to provide a fast startup and low power dissipation design solution.

Operating Current

The Operating current of ME8111 is low at 1.8mA. Good efficiency is achieved with ME8111 low operating current together with extended burst mode control features.

Frequency shuffling for EMI improvement

The frequency Shuffling/jittering (switching frequency modulation) is implemented in ME8111. The oscillation frequency is modulated with a random source so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore reduces system design challenge.

Extended Burst Mode Operation

At zero load or light load condition, majority of the power dissipation in a switching mode power supply is from switching loss on the MOSFET transistor, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy.

The switching frequency is internally adjusted at no load or light load condition. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The Gate drive output switches only when VCC voltage drops below a preset level and FB input is active to output an on state. Otherwise the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extend. The nature of high frequency switching also reduces the audio noise at any loading conditions.

Oscillator Operation

The switching frequency of ME8111 is internally fixed at 65KHz. No external frequency setting components are required for PCB design simplification.

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in ME8111 current mode PWM control. The switch current is detected by a sense resistor into the sense pin. Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 220ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and cannot switch off the gate driver.

●Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp onto the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage.

Protection Controls

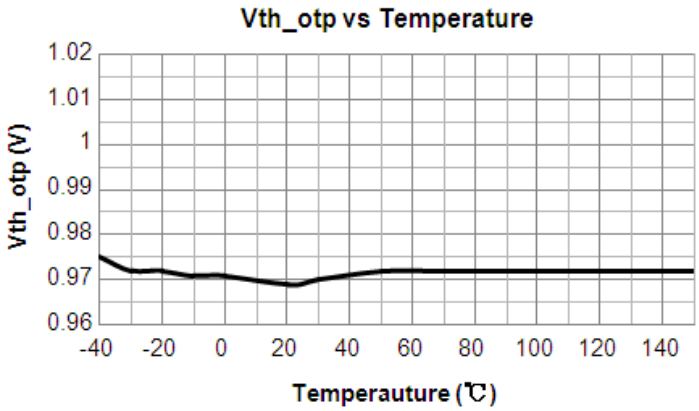
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), CS short protection, CS floating protection, and latch features including fixed or adjustable over voltage protection (OVP), and Under Voltage Lockout on VCC (UVLO).

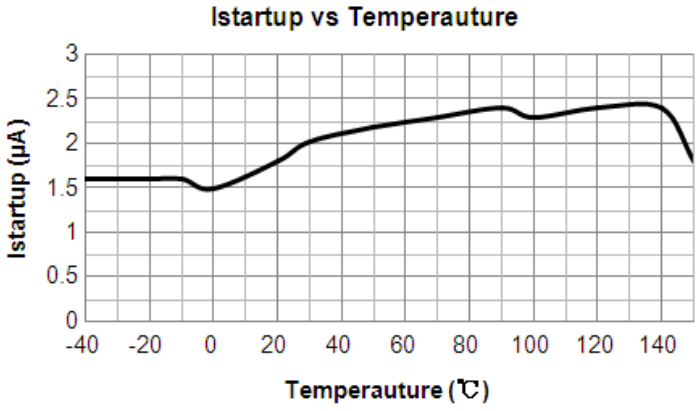
The OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

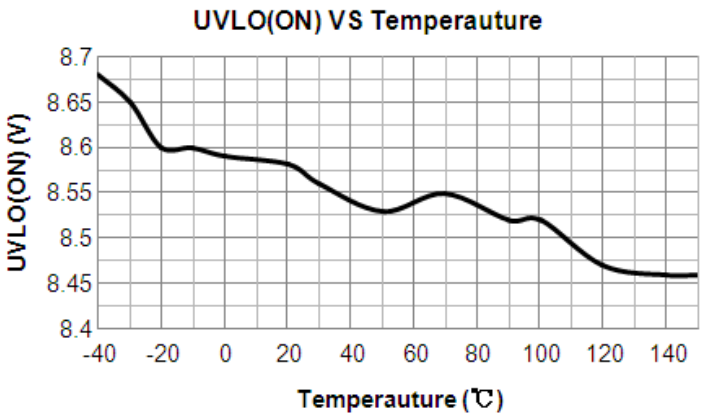
At overload condition, When FB input exceeds power limit threshold value for more than T_{D_PL}, control circuit reacts to shut down the Input power MOSFET. Similarly, control circuit reacts to shut down the switcher. Switcher restarts when VCC voltage drops below UVLO limit. For latch mode, control circuit shutdowns (latch) the power MOSFET when an Over Voltage condition is detected until VCC drops below 5V (Latch release voltage) , and device enters power on restart-up sequence thereafter.

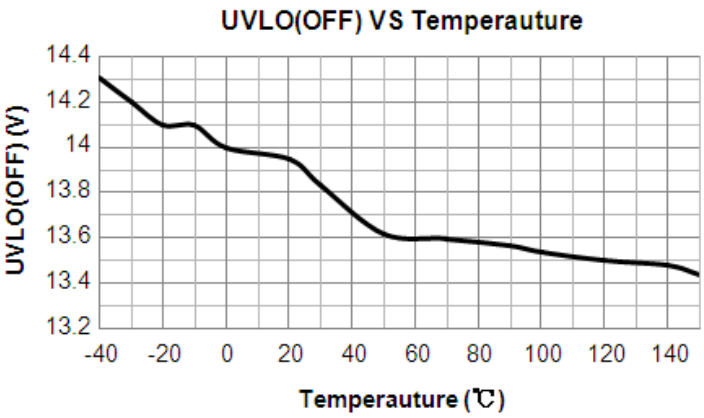
Typical performance characteristics

VCC = 16V, T_A = 25℃ condition applies if not otherwise noted

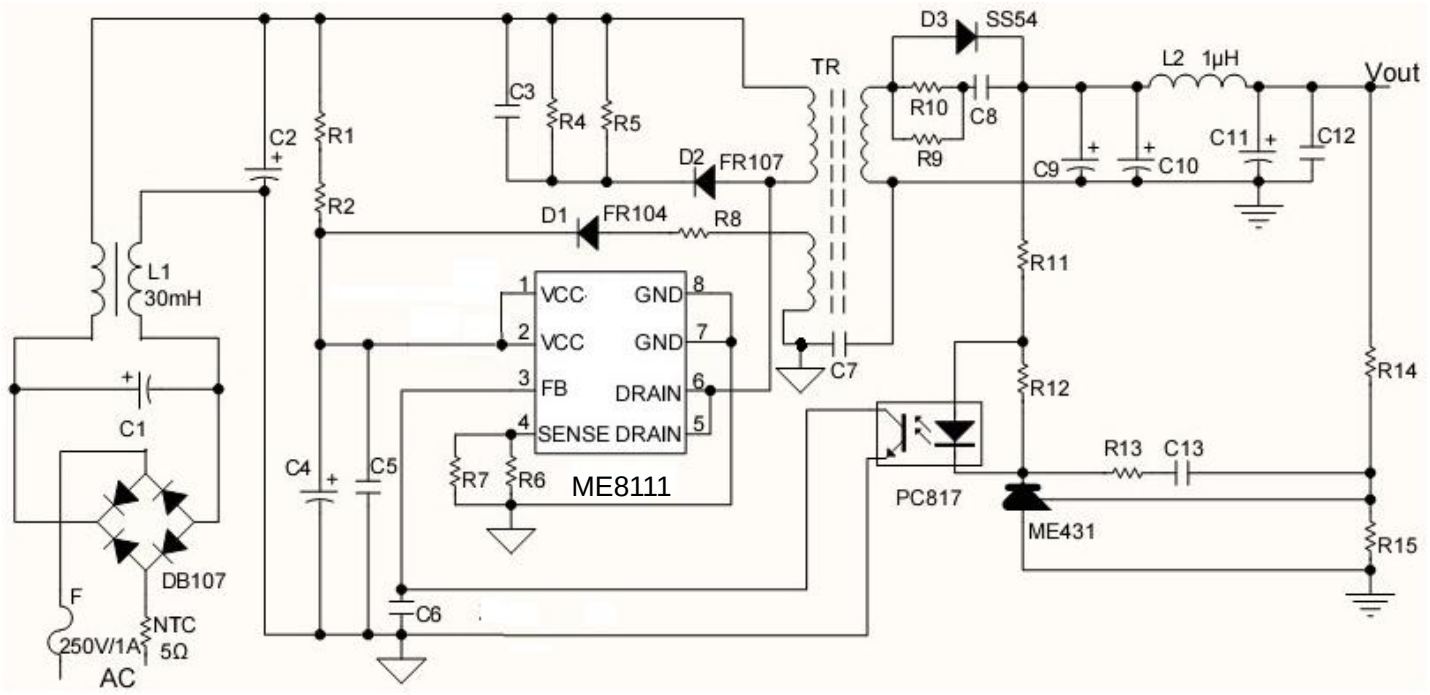






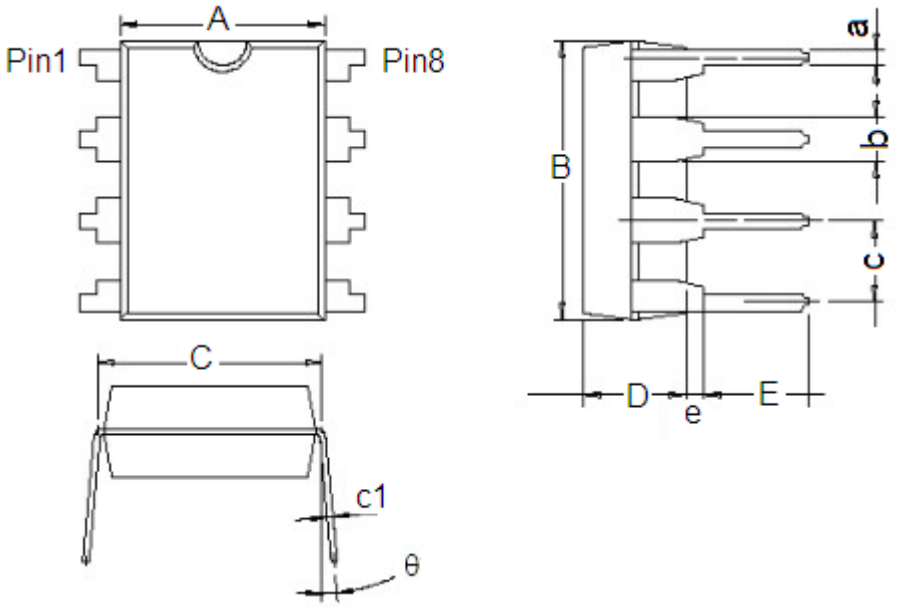


Typical Application



Packaging Information

Package type:DIP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	6.200	6.600	0.244	0.260
B	9.000	9.400	0.354	0.370
C	7.620(Typ.)		0.300(Typ.)	
D	3.200	3.600	0.126	0.142
E	3.000	3.600	0.118	0.142
a	0.360	0.560	0.014	0.022
b	1.524(Typ.)		0.060(Typ.)	
c	2.54(Typ.)		0.100(Typ.)	

c1	0.204	0.360	0.008	0.014
e	0.510(Min)		0.020(Min)	
θ	0^0	15^0	0^0	150