High Primary Side Control IC For Off-line Battery Chargers ME8300

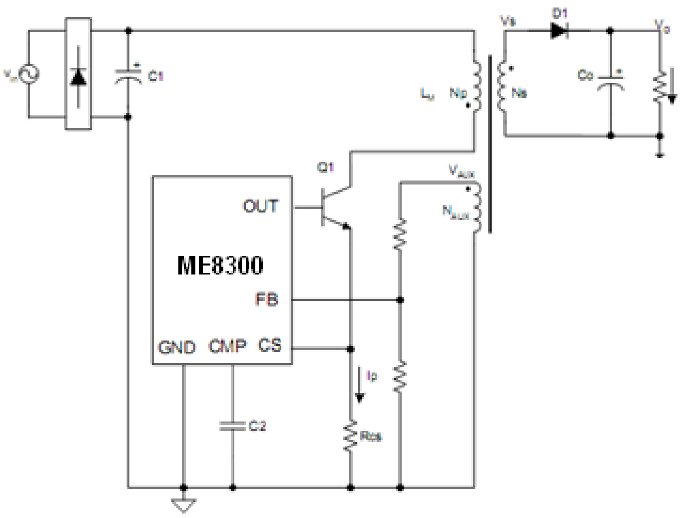
General Description

The ME8300 is a high performance AC/DC power supply controller for battery charger and adapter applications. The device uses Pulse Frequency Modulation (PFM) method to build discontinuous conduction mode (DCM) flyback power supplies. The ME8300 provides accurate constant voltage, constant current (CV/CC) regulation without requiring the opto-coupler and the secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining stability. The ME8300 achieves excellent regulation and high power efficiency, the no-load power consumption is less than 200mW at 265VAC input. The ME8300 is available in SOP-8 package.

Features

- Primary Side Control for Rectangular Constant Current and Constant Voltage Output
- Eliminates Opto-Coupler and Secondary CV/CC Control Circuitry
- Eliminates Control Loop Compensation Circuitry
- Output Cable Resistor Compensation
- Flyback Topology in DCM Operation
- Random Frequency Modulation to Reduce System EMI
- Valley Turn on of External Power NPN Transistor
- Built-in Soft Start
- Over Voltage Protection
- Short Circuit Protection

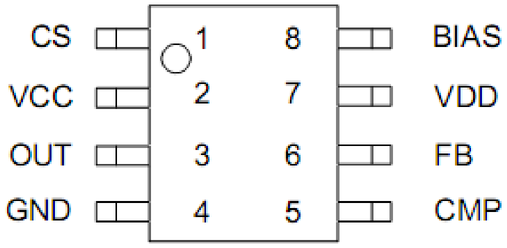
Typical Application Circuit



Typical Application

- Adapters/Chargers for Cell/Cordless Phones, PDAs, MP3 and Other Portable Apparatus
- Standby and Auxiliary Power Supplies

Pin Configuration



SOP8

Pin Assignment

Pin Number	Pin Name	Function
1	CS	The primary current sense
2	VCC	Supply voltage
3	OUT	This pin drives the base of external power NPN switch
4	GND	Ground
5	CMP	This pin connects a capacitor for output cable compensation
6	FB	The voltage feedback from the auxiliary winding
7	VDD	The 5V output of the internal voltage regulator
8	BIAS	This pin sets the bias current inside ME8300 with an external resistor to GND

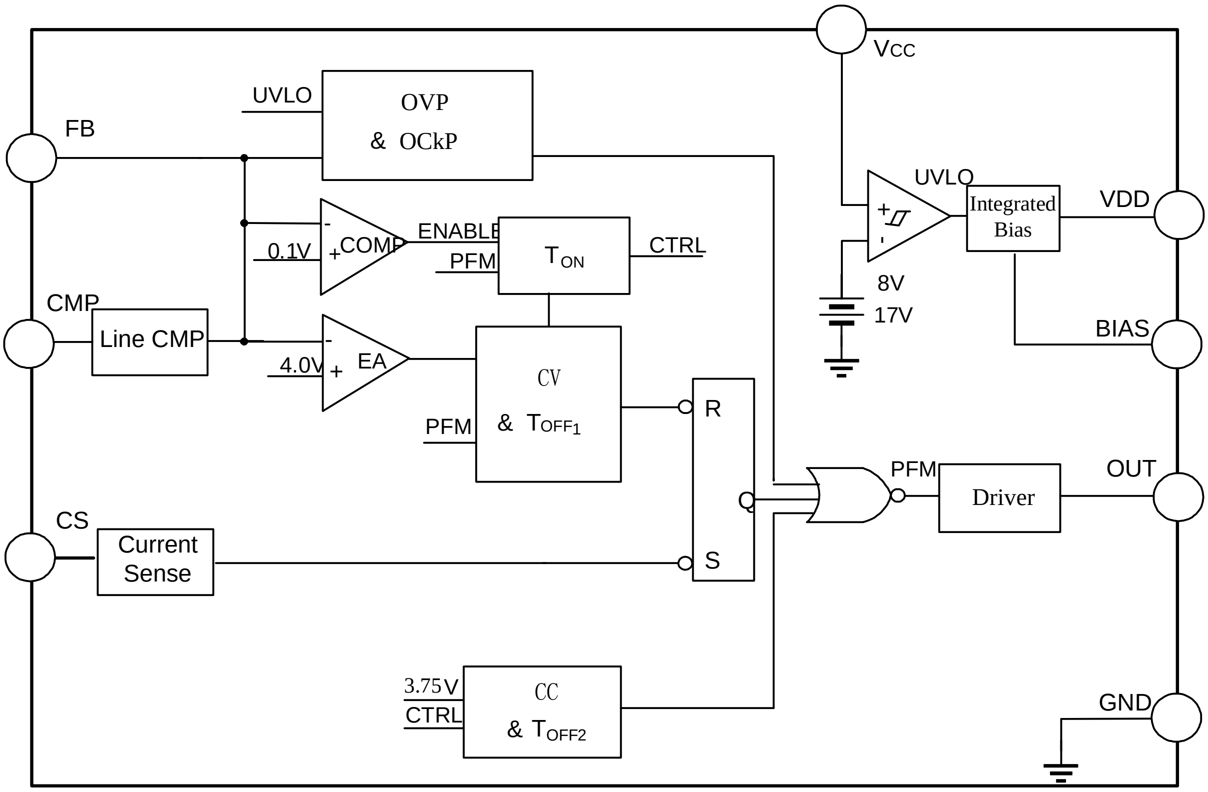
Absolute Maximum Ratings (Note 1)

Parameter	Value	Unit
Supply Voltage VCC	-0.3 to 30	V
Voltage at CS, BIAS, OUT, VDD, CMP to GND	-0.3 to 7	V
FB input (Pin 6)	-40 to 10	V
Output Current at OUT	Internally limited	A
Power Dissipation at TA=25℃	0.657	W
Operating Junction Temperature	150	℃
Storage Temperature	-65 to 150	℃
Lead Temperature (Soldering, 10s)	300	℃
Thermal Resistance Junction-to-Ambient	190	℃/W
ESD (Human Body Model)	2000	V

Note 1:

Stresses greater than those listed under "Absolute Maximum Ratings" 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Block Diagram

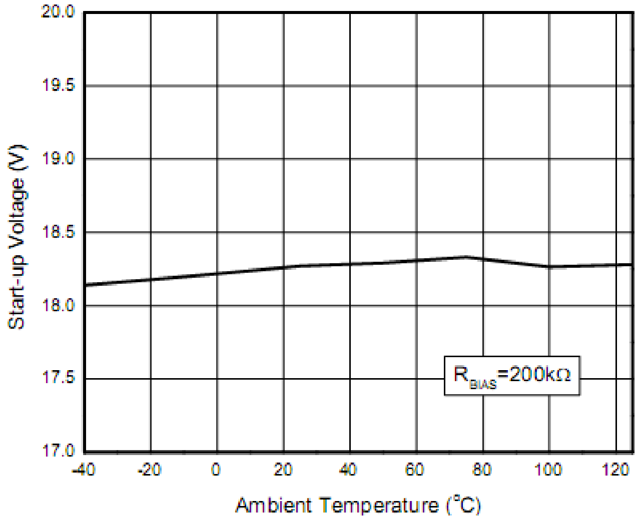


Electrical Characteristics

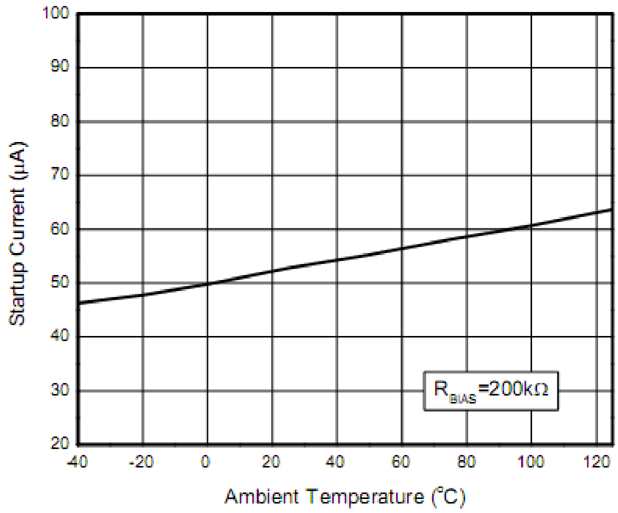
(V_{CC}=15V, TA=25℃, unless otherwise specified.)

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
UVLO SECTION							
Start-up Threshold		$V_{TH\ (ST)}$		17	18.5	20	V
Minimal Operating Voltage		$V_{OPR(min)}$	After turn on	7	7.7	8.4	V
REFERENCE VOLTAGE SECTION							
BIAS Pin Voltage		V_{BIAS}	R_{BIAS}=200kΩ, Before turn on	1.105	1.126	1.150	V
V_{DD} Pin Voltage		V_{DD}		4.90	5.026	5.10	V
STANDBY CURRENT SECTION							
Start-up Current		I_{ST}	V_{CC} = $V_{TH\ (ST)}$-0.5V, R_{BIAS}=200kΩ, Before turn on		50	65	μA
Operating Current		$I_{CC(OPR)}$	R_{BIAS}=200kΩ		550	700	μA
DRIVE OUTPUT SECTION							
OUT Maximum Current	Sink	I_{OUT}	R_{BIAS}=200kΩ	50			mA
	Source			25	30		
CURRENT SENSE SECTION							
Current Sense Threshold		V_{CS}		490	505	520	mV
Pre-Current Sense		$V_{CS(PRE)}$		444	458	472	mV
Leading Edge Blanking					430		ns
FEEDBACK INPUT SECTION							
Feedback Pin Input Leakage Curren		I_{FB}	V_{FB}=4V	1.72	2.15	2.58	μA
Feedback Threshold Voltage		V_{FB}		4	4.04	4.08	V
Enable Turn-on Voltage		$V_{FB(EN)}$		-1.1	-0.7	-0.5	V
Cable Compensation Voltage			f_{SW}=60kHz		0.40		V
PROTECTION SECTION							
Over Voltage Protection		$V_{FB(OVP)}$		7	8	9	V

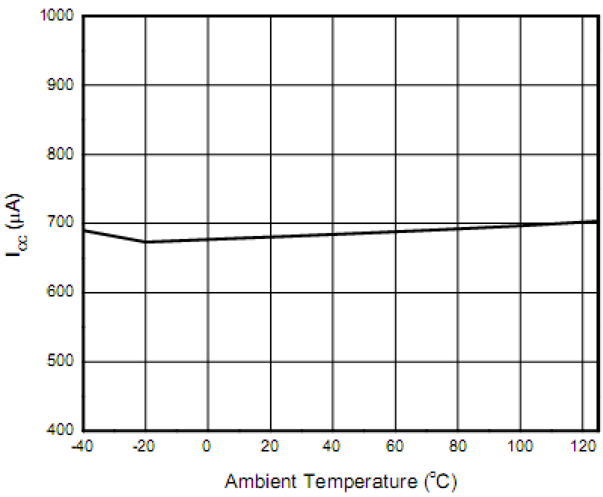
Type Characteristics



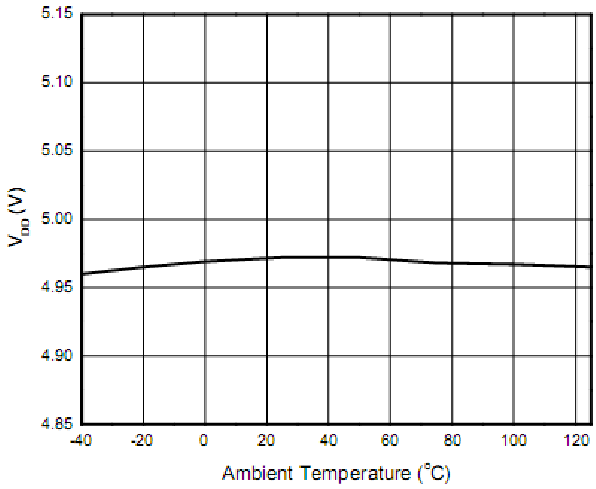
Start-up Voltage vs. Ambient Temperature



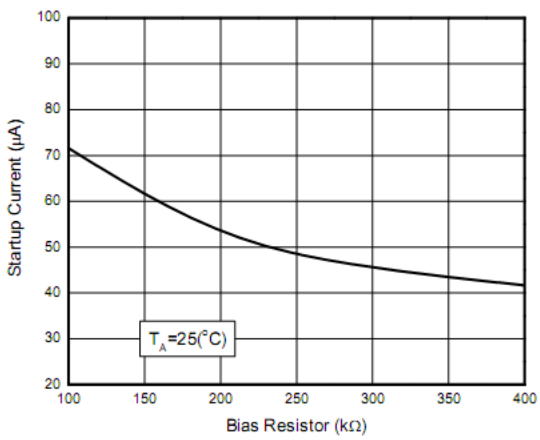
Start-up Current vs. Ambient Temperature



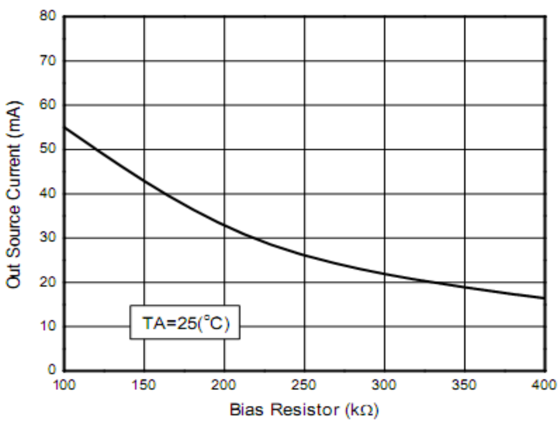
Operating Current vs. Ambient Temperature



VDD vs. Ambient Temperature

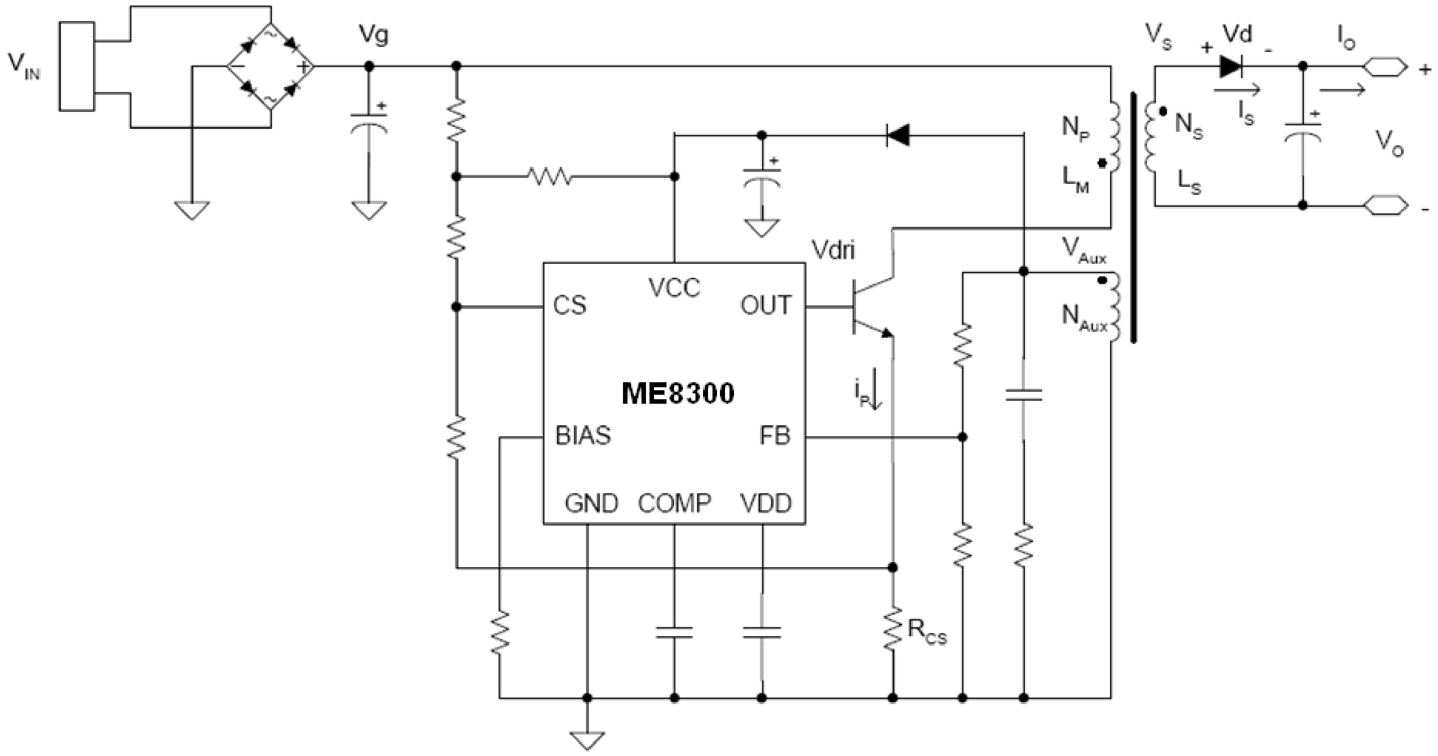


Start-up Current vs. Bias Resistor



OUT Source Current vs. Bias Resistor

Operation Description



➢ Constant Primary Peak Current

The primary current ip(t) is sensed by a current sense resistor RCS as shown in Figure 10.

The current rises up linearly at a rate of:

$$\frac{dip(t)}{dt} = \frac{vg(t)}{L_M} \qquad ......(1)$$

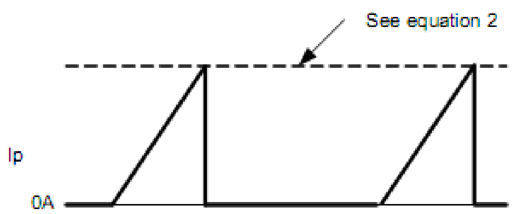


Figure 11. Primary Current Waveform

As illustrated in Figure 11, when the current ip(t) rises up to Ipk, the switch Q1 turns off. The constant peak current is given by:

$$Ipk = \frac{Vcs}{Rcs} \qquad ......(2)$$

The energy stored in the magnetizing inductance LM each cycle is therefore:

$$Eg = \frac{1}{2} \times L_M \times Ipk^2 \qquad ......(3)$$

So the power transferring from the input to the output is given by:

$$P = \frac{1}{2} \times L_M \times Ipk^2 \times f_{SW} \qquad ......(4)$$

where fSW is the switching frequency. When the peak current Ipk is constant, the output power depends on the switching frequency fSW.

➢ Constant Voltage Operation

The ME8300N/P captures the auxiliary winding feedback voltage at FB pin and operates in constant-voltage (CV) mode to regulate the output voltage. Assuming the secondary winding is master, the auxiliary winding is slave during the D1 on-time. The auxiliary voltage is given by:

$$V_{AUX} = \frac{N_{AUX}}{N_S} \times (Vo + Vd) \quad ....(5)$$

➢ Operation Description (Continued)

where Vd is the diode forward drop voltage.

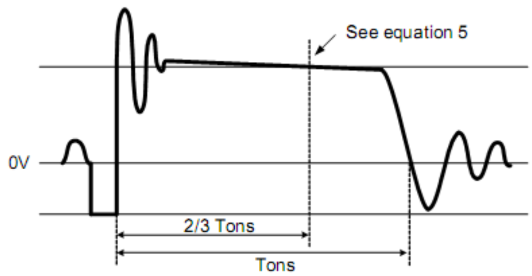


Figure 12. Auxiliary Voltage Waveform

The output voltage is different from the secondary voltage in a diode forward drop voltage that depends on the current. If the secondary voltage is always detected at a fixed secondary current, the difference between the output voltage and the secondary voltage will be a fixed Vd. The voltage detection point is at two-thirds of the D1 on-time. The CV loop control function of ME8300N/P then generates a D1 off-time to regulate the output voltage.

➢ Constant Current Operation

Figure 13 shows the secondary current waveforms.

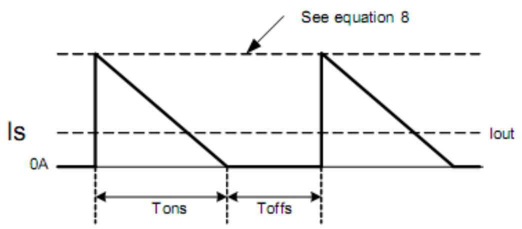


Figure 13. Secondary Current Waveform

In CC operation, the CC loop control function of ME8300N/P will keep a fixed proportion between D1 on-time Tons and D1 off-time Toffs by discharging or charging the capacitance connected in CMP pin. The fixed proportion is:

$$\frac{Tons}{Toffs} = \frac{4}{3} \quad ......(6)$$

The relationship between the output constant-current and secondary peak current Ipks is given by:

$$Iout = \frac{1}{2} \times Ipks \times \frac{Tons}{Tons + Toffs} \quad ......(7)$$

At the instant of D1 turn-on, the primary current transfers to the secondary at an amplitude of:

$$Ipks = \frac{N_P}{N_S} \times Ipk \quad ......(8)$$

Thus the output constant-current is given by:

$$Iout = \frac{1}{2} \times \frac{N_P}{N_S} \times Ipk \times \frac{Tons}{Tons + Toffs} = \frac{2}{7} \times \frac{N_P}{N_S} \times Ipk \quad ......(9)$$

Leading Edge Blanking

When the power switch is turned on, a turn-on spike will occur on the sense-resistor. To avoid false-termination of the switching pulse, a 430ns leading-edge blanking is built in. During this blanking period, the current sense comparator is disabled and the gate driver can not be switched off.

➢ CCM Protection

The ME8300N/P is designed to operate in discontinuous conduction mode (DCM) in both CV and CC modes. To avoid operating in continuous conduction mode (CCM), the ME8300N/P detects the falling edge of the FB input voltage on each cycle. If a 0.1V falling edge of FB is not detected, the ME8300N/P will stop switching.

➢ OVP & OCkP

The ME8300N/P includes output over-voltage protection (OVP) and open circuit protection (OCkP) circuitry as shown in Figure 14. If the voltage at FB pin exceeds 8V, 100% above the normal detection voltage, or the -0.7V falling edge of the FB input can not be monitored, the ME8300N/P will immediately shut off and enter hiccup mode. The ME8300N/P sends out a fault detection pulse every 32ms in hiccup mode until the fault has been removed.

➢ Operation Description (Continued)

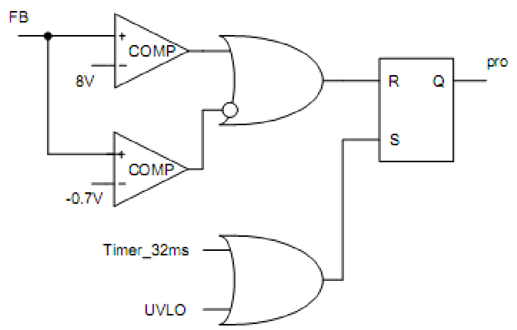


Figure 14. OVP and OCkP Function Block

➢ Output Cable Compensation

The ME8300N/P integrates the output cable compensation circuitry as shown in Figure 15. Tons shows the variation for FB flyback voltage.

Tons can be converted to a DC voltage by a low-pass filter. When system load current Iout changed from open load to full load Iload, The amplified voltage Vout1 through a rail-to-rail operation amplifier is obtained:

$$V_{OUT1} = (1+\frac{RB}{RA})\times 3.65V - \frac{RB}{RA}\times V_{CMP} \quad ......(10)$$

Through the internal RA and RB, the FB voltage can be compensated by the Vout1, the compensation voltage is 0.4V when full load switch frequency is 60kHz.

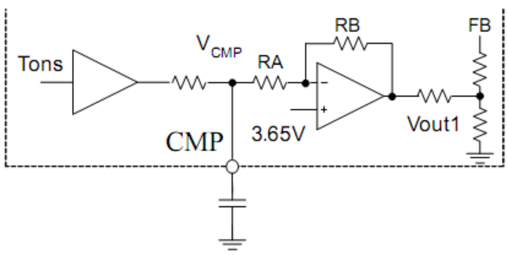
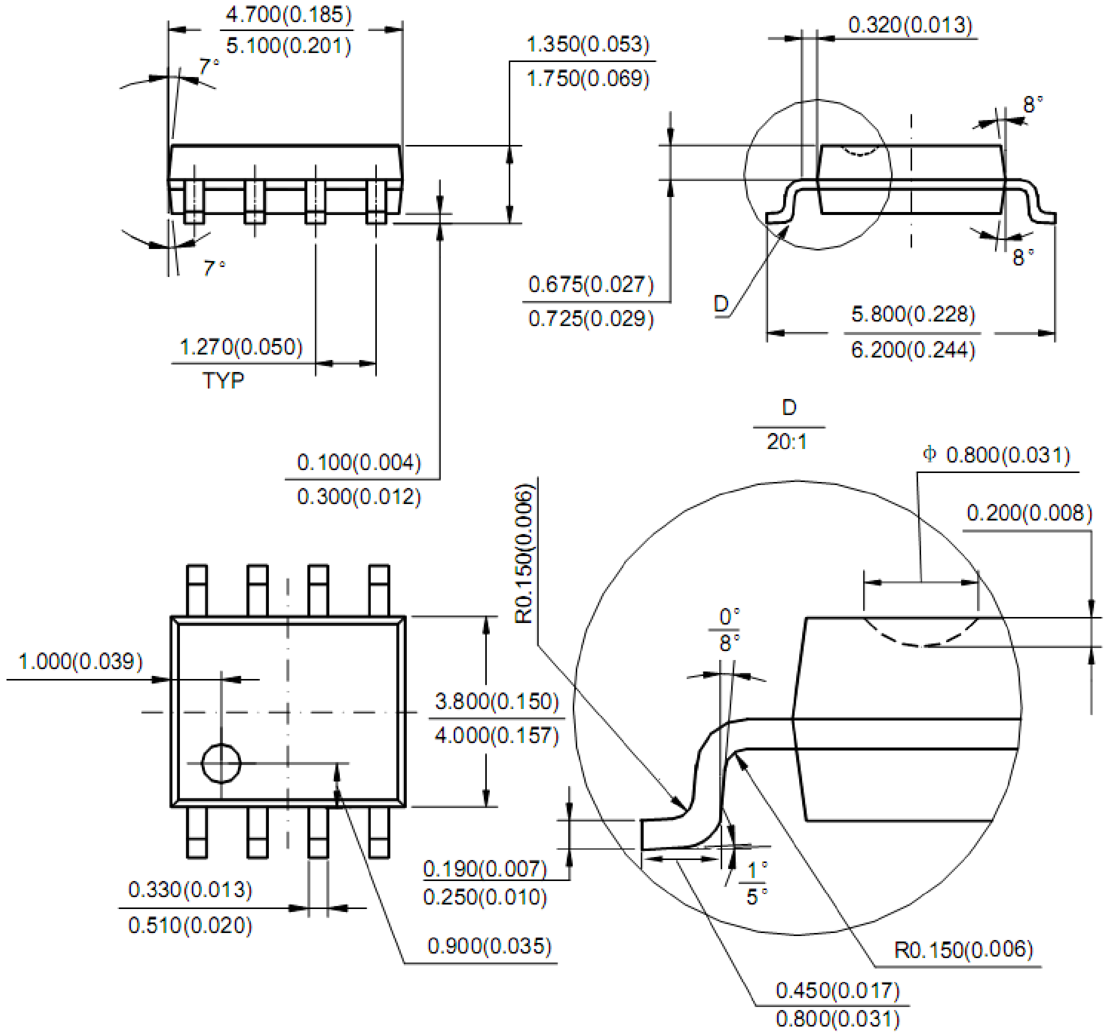


Figure 15. Output Cable Compensation Function Block

Packaging Information:

SOP-8



- The information described herein is subject to change without notice.
- Nanjing Micro One Electronics Inc is not responsible for any problems caused by circuits or diagrams described herein whose related industrial properties, patents, or other rights belong to third parties. The application circuit examples explain typical applications of the products, and do not guarantee the success of any specific mass-production design.
- Use of the information described herein for other purposes and/or reproduction or copying without the express permission of Nanjing Micro One Electronics Inc is strictly prohibited.
- The products described herein cannot be used as part of any device or equipment affecting the human body, such as exercise equipment, medical equipment, security systems, gas equipment, or any apparatus installed in airplanes and other vehicles, without prior written permission of Nanjing Micro One Electronics Inc.
- Although Nanjing Micro One Electronics Inc exerts the greatest possible effort to ensure high quality and reliability, the failure or malfunction of semiconductor products may occur. The user of these products should therefore give thorough consideration to safety design, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue.

Low-power off-line primary side regulation controller ME8302

General Description

The ME8302 is a high performance AC/DC power supply controller for battery charger and adapter applications. The device uses pulse frequency modulation (PFM) method to build discontinuous conduction mode(DCM) flyback power supplies.

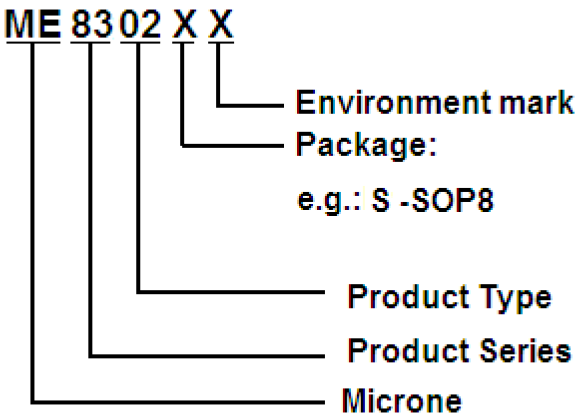
The ME8302 provides accurate constant voltage, constant current(CV/CC) regulation without requiring an Opto-coupler and secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining stability. The ME8302 achieves excellent regulation and high average efficiency, yet meets the requirement for no-load consumption less than 30mW.

The ME8302 has the built-in programmable cable voltage drop compensation function, which make it flexible to accommodate various cables with different gauges and lengths.

Features

- ●Primary side control for eliminating Opto-coupler and secondary CV/CC control circuitry
- ●30mW no-load input power
- ●Programmable output cable voltage drop compensation
- ●Compensation for external component temperature variations
- ●Flyback topology in DCM operation
- ●Random frequency adjustment to reduce system EMI
- ●Built-in soft start
- ●Open feedback protection
- ●Thermal shutdown protection
- ●over voltage protection
- ●Short circuit protection
- ●SOP8 package

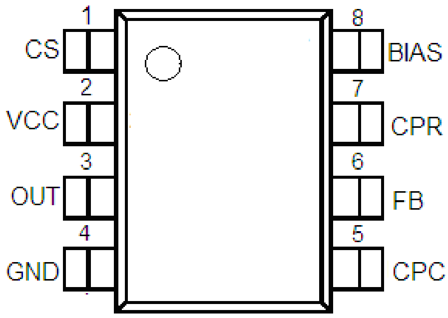
Selection Guide



Applications

- ●Adapter/chargers for cell/cordless phones, PDAs, MP3 and other portable apparatus
- ●LED driver
- ●Standby and auxiliary power supplies

Pin Configuration



Pin Assignment

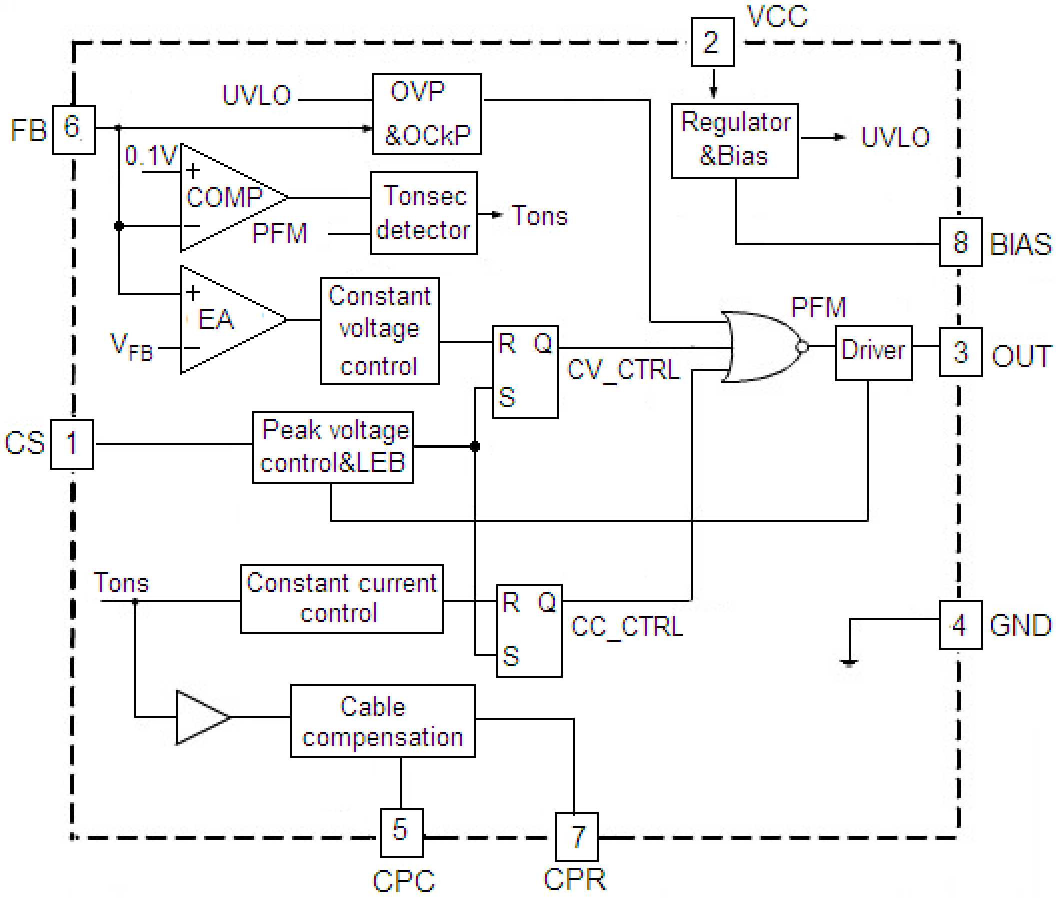
Pin Num.	Symbol	Function
1	CS	The primary current sense
2	VCC	Power Supply Pin
3	OUT	This pin drives the base of external power NPN switch
4	GND	Ground
5	CPC	This pin connects capacitor for output cable compensation
6	FB	The voltage feedback from the auxiliary winding
7	CPR	Connects a resistor to FB pin for adjustable output cable compensation
8	BIAS	This pin sets the bias current inside ME8302 with an external resistor to GND

Absolute Maximum Ratings

Parameter	Rating	Unit
Voltage at VCC pin to GND:VCC	-0.3～30	V
Voltage at CS,OUT to GND	-0.3～7	V
FB input	-40～10	V
Output current at OUT	Internally limited	A
Power Dissipation	800	mW
Thermal resistance junction-to-ambient	190	°C/W
ESD(Machine Model)	150	V
ESD(Human body Model)	3000	V
Operating junction temperature	150	°C
Storage Temperature	-65~+150	°C
Soldering temperature and time	+300（Recommended 10S）	°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.

Block Diagram

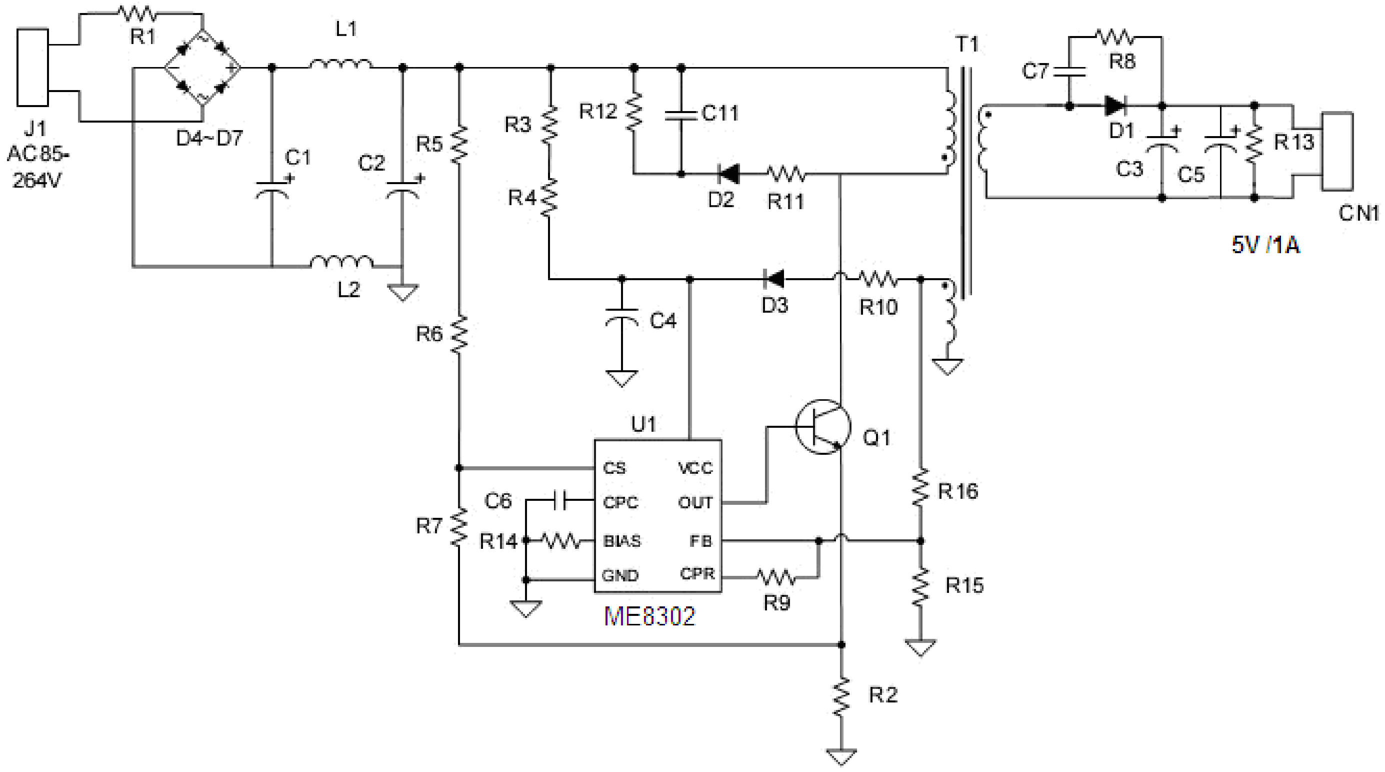


Electrical Characteristics

（T_A =25 °C, V_{CC} =15V, unless otherwise noted.）

Item		Symbol	Test condition	Min	Typ.	Max	Unit
UVLO section							
Start-up threshold		$V_{TH(ST)}$		15.5	17.5	20	V
Minimal operating voltage		$V_{OPR(min)}$		6.5	8	9.5	V
Reference voltage							
BIAS pin voltage		V_{BIAS}	R_{BIAS}=200KΩ after turn on	1.0	1.1	1.2	V
Standby current section							
Start-up current		I_{ST}	V_{CC} = $V_{TH(ST)}$ -0.5V, R_{BIAS}=200KΩ Before start-up	-	-	0.6	μA
Operating current		$I_{CC(OPR)}$	R_{BIAS}=200KΩ	-	390	480	μA
Drive output section							
OUT maximum current	source	I_{OUT}	R_{BIAS}=200KΩ	28	36	44	mA
Current sense section							
Current sense threshold		V_{CS}		535	550	565	mV
Pre-current sense		$V_{CS(PRE)}$		435	450	465	mV
Leading edge blanking				-	500	-	ns
Feedback input section							
Feedback pin input leakage current		I_{FB}	V_{FB}=4V	2.0	3.0	4.0	μA
Feedback threshold		V_{FB}		4.04	4.10	4.16	V
Enable turn-on voltage		$V_{FB(EN)}$		-1.8	-1.5	-1.2	V
Output voltage compensation section							
CPR voltage		V_{CPR}	Dons(Tons/T):from 55% to 0.02%	1.6	-	3.6	V
CPR sink current		I_{CPR}		-	-	200	μA
Protection section							
Over voltage protection		$V_{FB(OVP)}$		7	8	9	V
Thermal Shutdown Protection							
Thermal Shutdown Protection		Tsd		-	145	-	℃

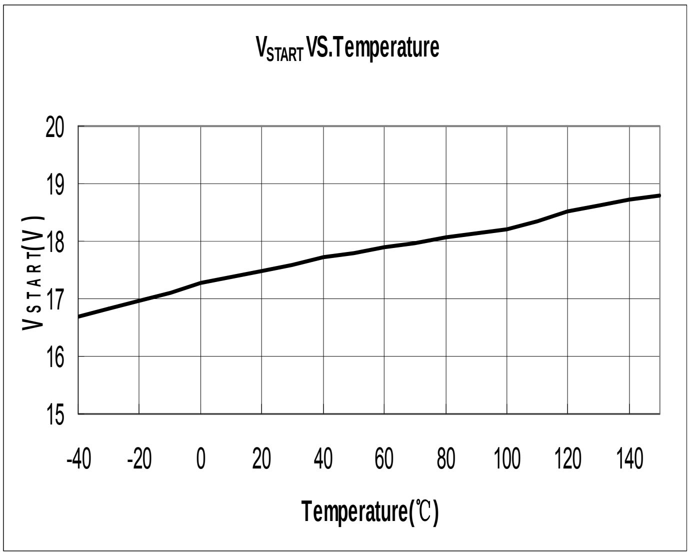
Typical Application



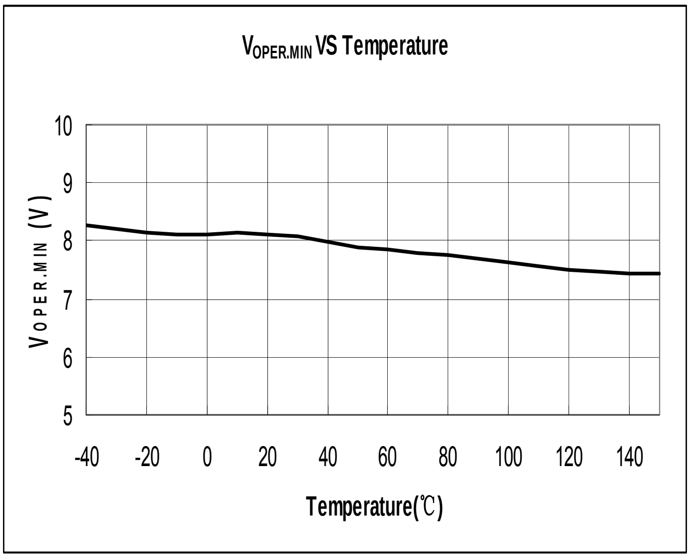
5V/1A Output for battery charger of mobile phone

Typical Performance Characteristics

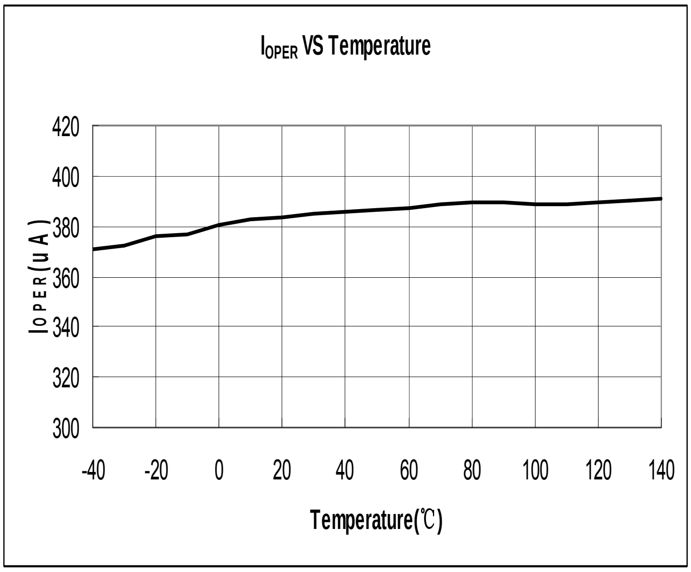
1. V_{START} VS Temperature



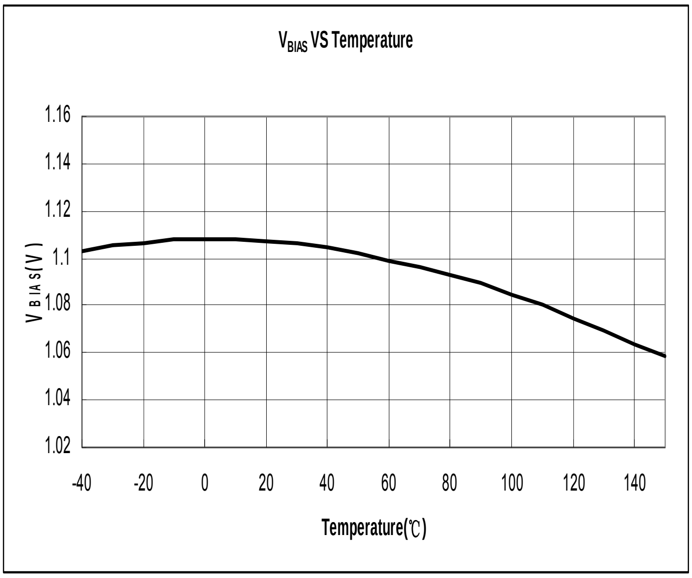
2. $V_{OPER.MIN}$ VS Temperature



3. I_{OPER} VS Temperature

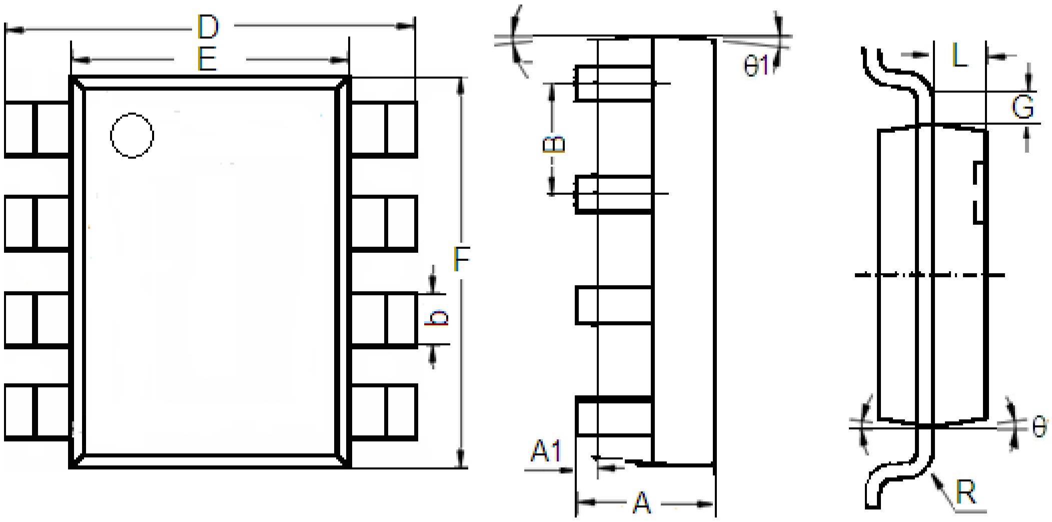


4. V_{BIAS} VS Temperature



Package Information

Package type:SOP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.1	0.3	0.004	0.012
B	1.27(Typ.)		0.05(Typ.)	
b	0.330	0.510	0.013	0.020
D	5.8	6.2	0.228	0.244
E	3.800	4.000	0.150	0.157
F	4.7	5.1	0.185	0.201
L	0.675	0.725	0.027	0.029
G	0.32(Typ.)		0.013(Typ.)	
R	0.15(Typ.)		0.006(Typ.)	
θ1	7°		7°	
θ	8°		8°	

- The information described herein is subject to change without notice.
- Nanjing Micro One Electronics Inc is not responsible for any problems caused by circuits or diagrams described herein whose related industrial properties, patents, or other rights belong to third parties. The application circuit examples explain typical applications of the products, and do not guarantee the success of any specific mass-production design.
- Use of the information described herein for other purposes and/or reproduction or copying without the express permission of Nanjing Micro One Electronics Inc is strictly prohibited.
- The products described herein cannot be used as part of any device or equipment affecting the human body, such as exercise equipment, medical equipment, security systems, gas equipment, or any apparatus installed in airplanes and other vehicles, without prior written permission of Nanjing Micro One Electronics Inc.
- Although Nanjing Micro One Electronics Inc exerts the greatest possible effort to ensure high quality and reliability, the failure or malfunction of semiconductor products may occur. The user of these products should therefore give thorough consideration to safety design, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue.

LOW-Power Off-line Primary Side Regulation Controller ME8304

General Description

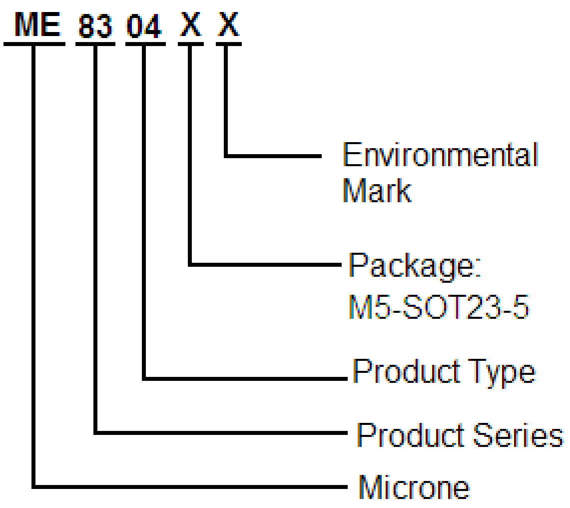
The ME8304 is a high performance AC/DC power supply controller for battery charger and adapter applications. The device uses Pulse Frequency Modulation(PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

The ME8304 provides accurate constant voltage, constant current (CV/CC) regulation while removing the opto-coupler and secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining stability. The ME8304 achieves excellent regulation and high average efficiency, yet meets the requirement for no-load consumption less than 30mW. The ME8304 is available in SOT23-5 package.

Features

- Primary Side Control for Rectangular Constant Current and Constant Voltage Output
- Sub-microampere Start-up Current
- 30mW No-load Input Power Feasible
- Tight CV Regulation Performance
- Eliminates Opto-coupler and Secondary CV/CC Control Circuitry
- Eliminates Control Loop Compensation Circuitry
- Flyback Topology in DCM Operation
- Random Frequency Modulation to Reduce System EMI
- Built-in Soft Start
- Open Feedback Protection
- Short Circuit Protection
- SOT23-5 Package

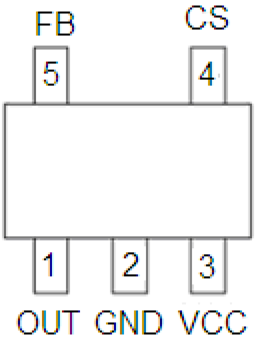
Selection Guide：



Typical Application

- Adapters/Chargers for Cell/Cordless Phones, PDAs, MP3 and Other Portable Apparatus
- LED Drivers
- Standby and Auxiliary Power Supplies

Pin Configuration



Pin Assignment

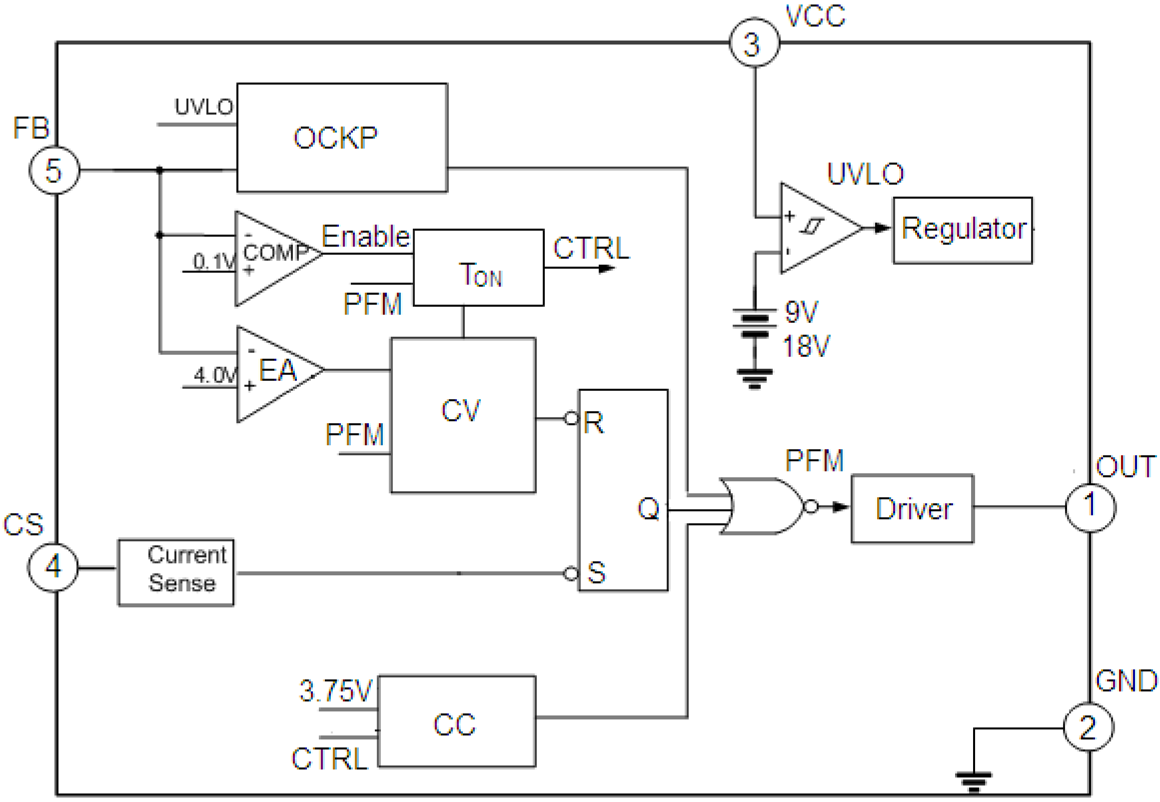
Pin Number	Pin Name	Function
1	OUT	This pin drives the base of external power NPN switch
2	GND	Ground
3	VCC	Supply voltage
4	CS	The primary current sense
5	FB	The voltage feedback from the auxiliary winding

Absolute Maximum Ratings (Note)

Parameter	Value	Unit
Supply Voltage V_{CC}	-0.3 to 30	V
Voltage at CS, OUT to GND	-0.3 to 7	V
FB input	-40 to 10	V
Output Current at OUT	Internally limited	A
Operating Junction Temperature	125	℃
Storage Temperature	-65 to 150	℃
Lead Temperature (Soldering, 10s)	300	℃
Thermal Resistance Junction-to-Ambient	250	℃/W
ESD (Machine Model)	200	V
ESD (Human Body Model)	2000	V

Note : 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.

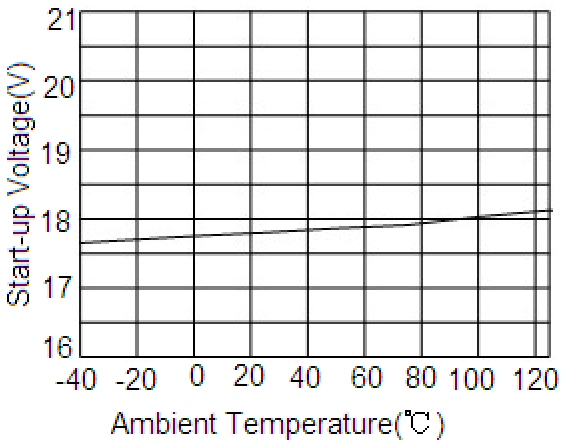
Block Diagram

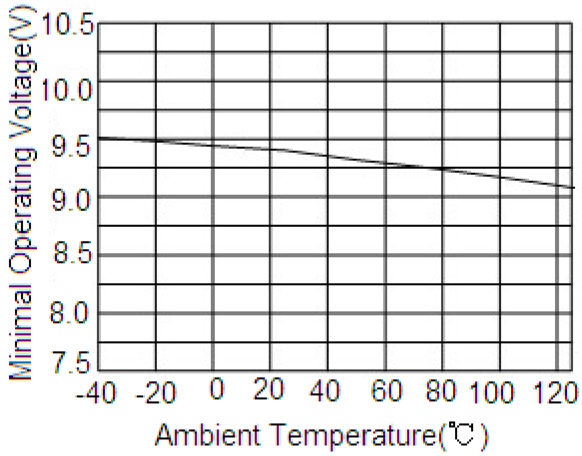


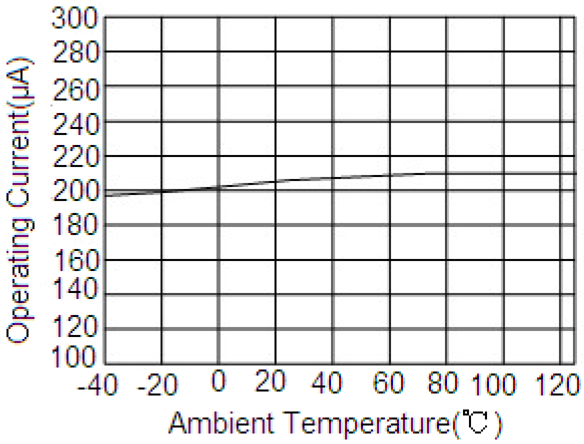
Electrical Characteristics (V_{CC}=15V, T_A=25℃, unless otherwise specified)

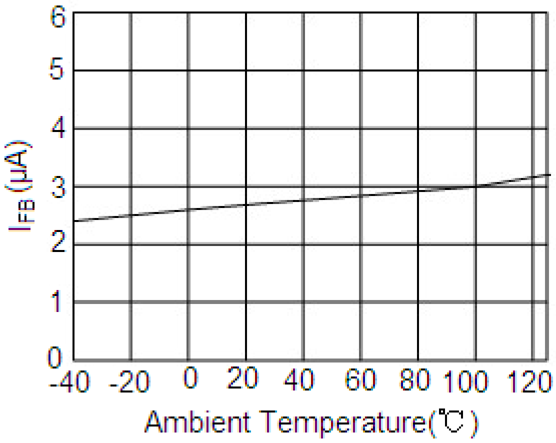
Parameter		Symbol	Conditions	Min	Typ.	Max	Unit
UVLO SECTION							
Start-up Threshold		$V_{TH\ (ST)}$		18	20	22	V
Minimal Operating Voltage		$V_{OPR(min)}$		7	8.5	10	V
STANDBY CURRENT SECTION							
Start-up Current		I_{ST}	V_{CC} = $V_{TH\ (ST)}$-0.5V, Before turn on	-	-	0.6	μA
Operating Current		$I_{CC(OPR)}$	Static	-	200	320	μA
DRIVE OUTPUT SECTION							
OUT Maximum Current	Sink	I_{OUT}		50	-	-	mA
	Source			24	30	36	
CURRENT SENSE SECTION							
Current Sense Threshold		V_{CS}		455	510	545	mV
Pre-Current Sense		$V_{CS(PRE)}$		356	410	455	mV
Leading Edge Blanking				-	750	-	ns
FEEDBACK INPUT SECTION							
Feedback Pin Input Leakage Current		I_{FB}	V_{FB}=4V	2.0	2.5	3.1	μA
Feedback Threshold Voltage		V_{FB}		3.89	3.95	4.01	V

Type Characteristics

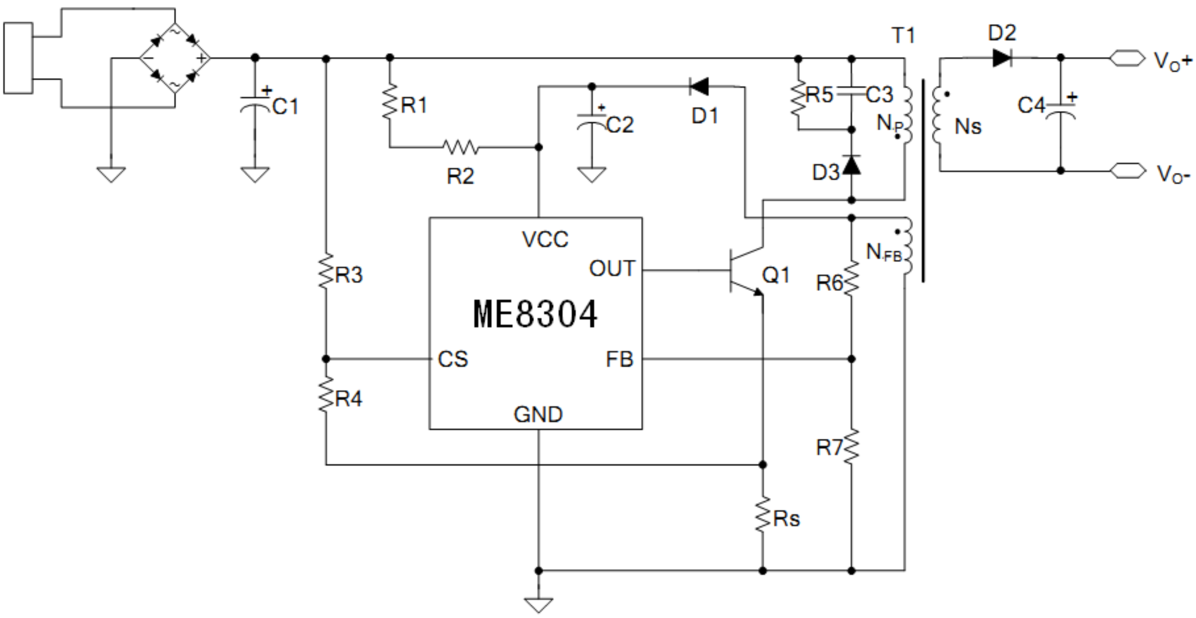






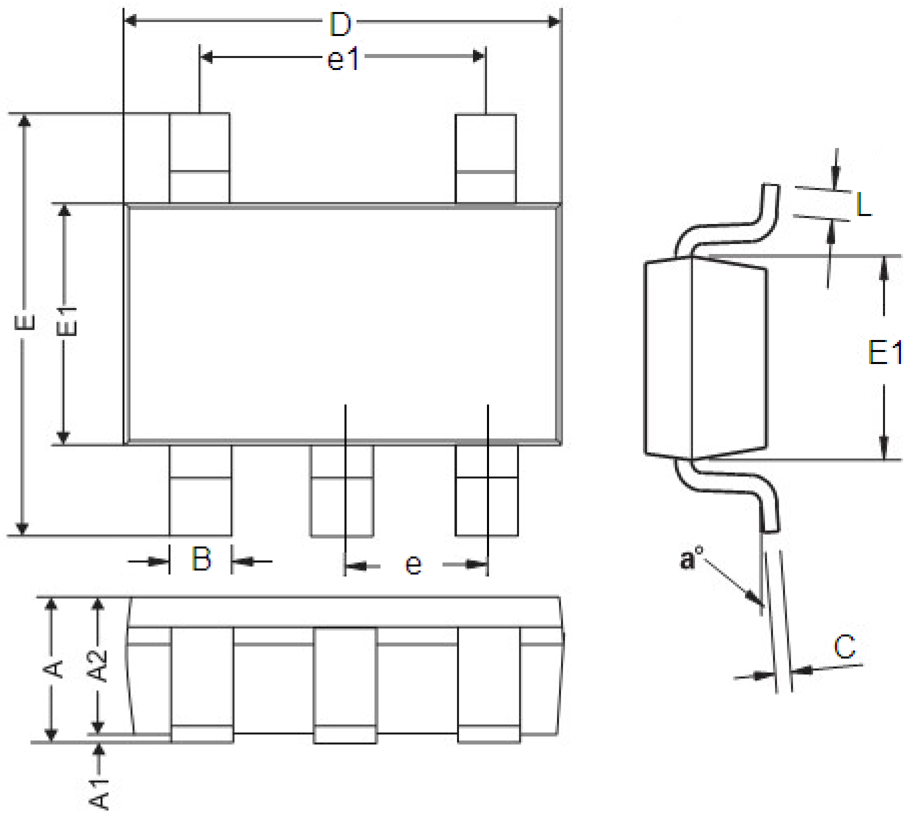


Typical Application



Packaging Information

Package Type: SOP23-5 Unit:mm(inch)



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	0.9	1.45	0.0354	0.0570
A1	0	0.15	0	0.0059
A2	0.9	1.3	0.0354	0.0511
B	0.2	0.5	0.0078	0.0196
C	0.09	0.26	0.0035	0.0102
D	2.7	3.10	0.1062	0.1220
E	2.2	3.2	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95REF		0.0374REF	
e1	1.90REF		0.0748REF	
L	0.10	0.60	0.0039	0.0236
a^0	0^0	30^0	0^0	30^0

- The information described herein is subject to change without notice.
- Nanjing Micro One Electronics Inc is not responsible for any problems caused by circuits or diagrams described herein whose related industrial properties, patents, or other rights belong to third parties. The application circuit examples explain typical applications of the products, and do not guarantee the success of any specific mass-production design.
- Use of the information described herein for other purposes and/or reproduction or copying without the express permission of Nanjing Micro One Electronics Inc is strictly prohibited.
- The products described herein cannot be used as part of any device or equipment affecting the human body, such as exercise equipment, medical equipment, security systems, gas equipment, or any apparatus installed in airplanes and other vehicles, without prior written permission of Nanjing Micro One Electronics Inc.
- Although Nanjing Micro One Electronics Inc exerts the greatest possible effort to ensure high quality and reliability, the failure or malfunction of semiconductor products may occur. The user of these products should therefore give thorough consideration to safety design, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue.

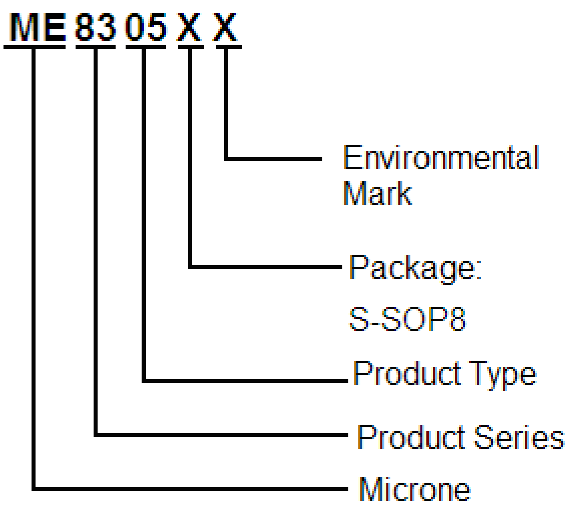
LOW-Power Off-line Primary Side Regulation Controller ME8305

General Description

The ME8305 is a high performance AC/DC power supply controller for battery charger and adapter applications. The device uses Pulse Frequency Modulation(PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

The ME8305 provides accurate constant voltage, constant current (CV/CC) regulation while removing the opto-coupler and secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining stability. The ME8305 achieves excellent regulation and high average efficiency, yet meets the requirement for no-load consumption less than 30mW.

Selection Guide



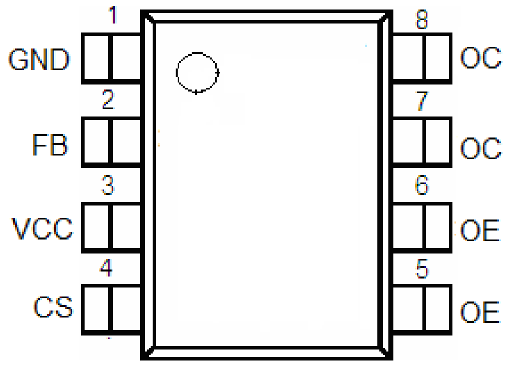
Features

- Set-in high-voltage power switch tube of 700V and few peripheral components.
- Primary Side Control for Rectangular Constant Current and Constant Voltage Output
- Sub-microampere Start-up Current
- 30mW No-load Input Power Feasible
- Tight CV Regulation Performance
- Eliminates Opto-coupler and Secondary CV/CC Control Circuitry
- Eliminates Control Loop Compensation Circuitry
- Flyback Topology in DCM Operation
- Random Frequency Modulation to Reduce System EMI
- Built-in Soft Start
- Thermal Shutdown Protection
- Short Circuit Protection
- SOP8 Package

Typical Application

- Adapters/Chargers for Cell/Cordless Phones, PDAs, MP3 and Other Portable Apparatus
- LED Drivers
- Standby and Auxiliary Power Supplies

Pin Configuration



Pin Assignment

Pin Number	Pin Name	Function
1	GND	Ground
2	FB	The voltage feedback from the auxiliary winding
3	VCC	Supply voltage
4	CS	The primary current sense
5,6	OE	Emitter electrode of power tube
7,8	OC	Output pins, meet switching transformer

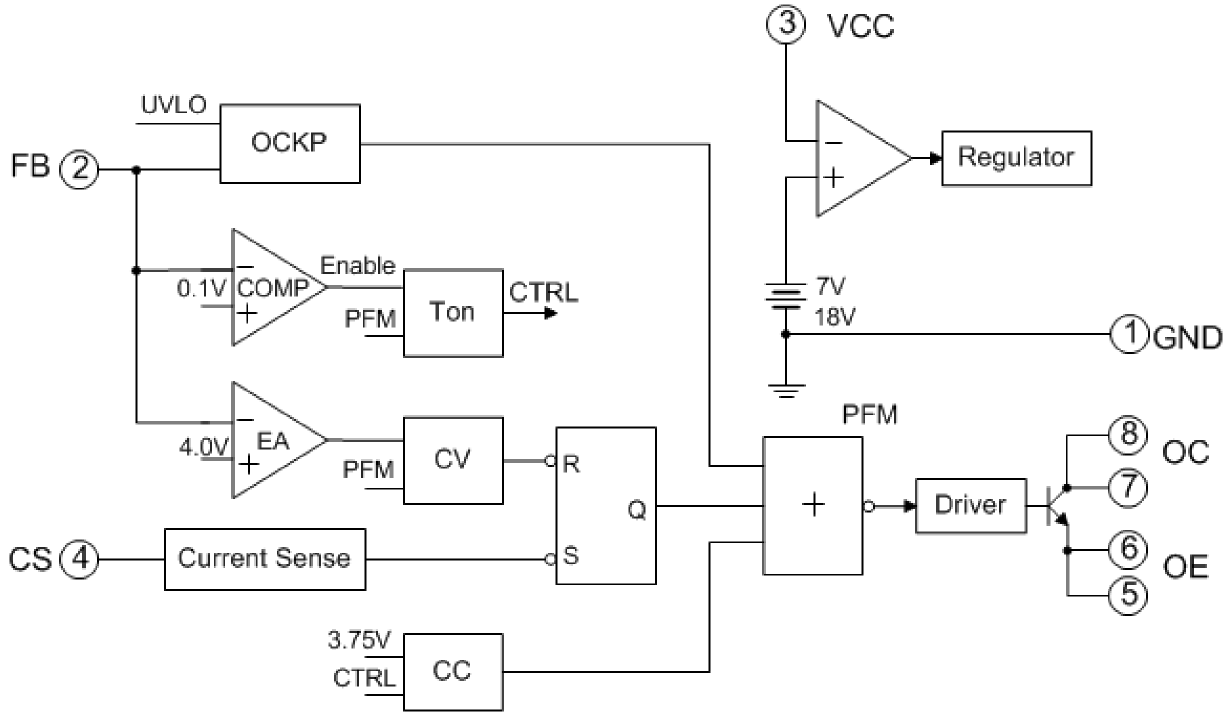
Absolute Maximum Ratings (Note)

Parameter	Value	Unit
Supply Voltage V_{CC}	-0.3 to 30	V
Voltage at CS to GND	-0.3 to 7	V
FB input	-40 to 10	V
Endurance voltage of OC collector	-0.3-700	V
Switching current of peak value	800	mA
Operating Junction Temperature	125	℃
Storage Temperature	-65 to 150	℃
Lead Temperature (Soldering, 10s)	300	℃
Thermal Resistance Junction-to-Ambient	250	℃/W
ESD (Machine Model)	200	V
ESD (Human Body Model)	2000	V

Note : 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.

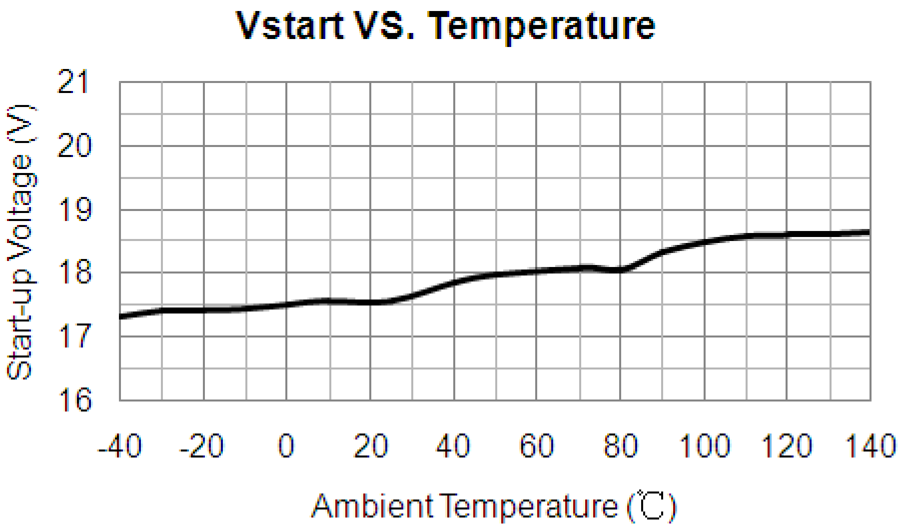
Block Diagram

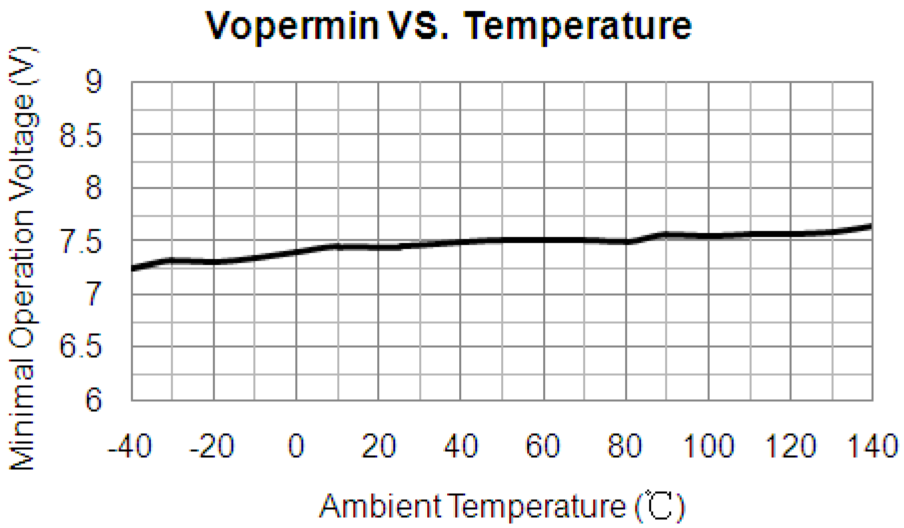


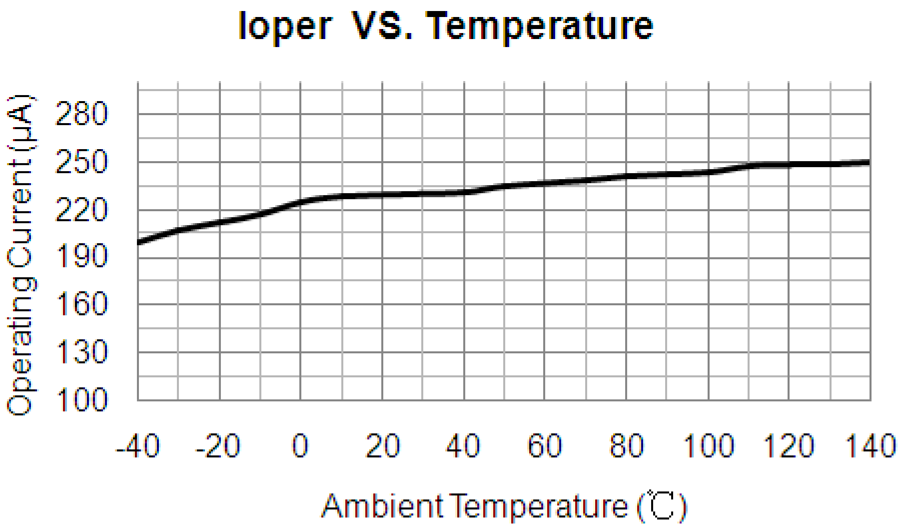
Electrical Characteristics (V_{CC}=20V, T_A=25℃, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
UVLO Section						
Start-up Threshold	$V_{TH\ (ST)}$		15	17	19	V
Minimal Operating Voltage	$V_{OPR(min)}$		6	7.5	9	V
Standby Current Section						
Start-up Current	I_{ST}	V_{CC} = $V_{TH\ (ST)}$-0.5V,	-	-	0.5	μA
Operating Current	$I_{CC(OPR)}$	Static	-	200	300	μA
Current Sense Section						
Current Sense Threshold	V_{CS}		470	500	530	mV
Pre-Current Sense	$V_{CS(PRE)}$		370	400	430	mV
Leading Edge Blanking			-	500	-	ns
Feedback Input Section						
Feedback Pin Input Leakage Current	I_{FB}	V_{FB}=4V	2.0	2.5	3.1	μA
Feedback Threshold Voltage	V_{FB}		3.89	3.95	4.01	V
Output						
Maximum pressure resistance of switching tube	V_{OC}(max)	Ioc=1mA, I_E=0	700	-	-	V
on-saturation pressure drop	V_{CE}(sat)	Ioc=600mA	-	-	1	V
Output limit current		Tj=0-100℃	465	500	535	mA
Thermal Shutdown Protection						
Thermal Shutdown Protection	T_{sd}			150		℃

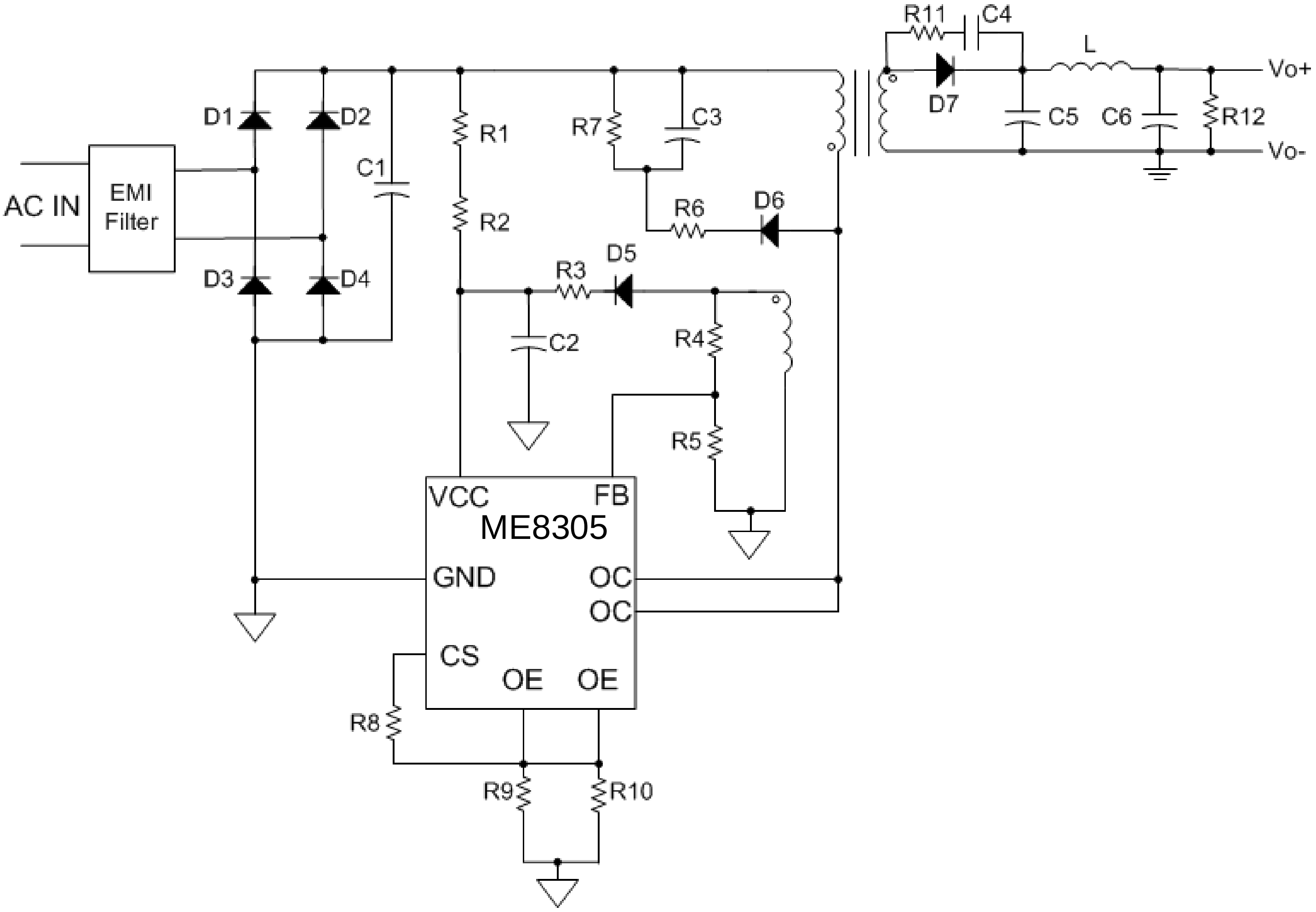
Type Characteristics





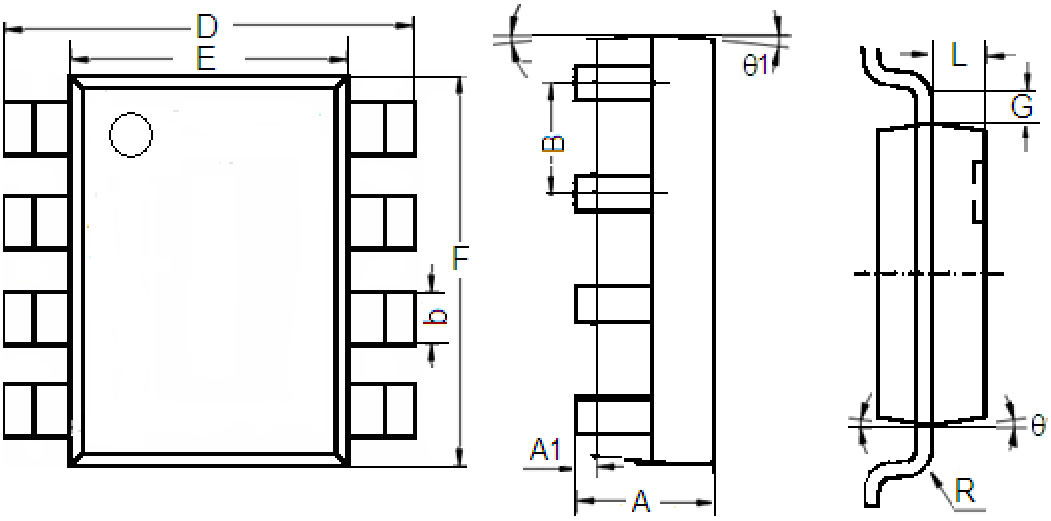


Typical Application



Packaging Information

Package type:SOP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.1	0.3	0.004	0.012
B	1.27(Typ.)		0.05(Typ.)	
b	0.330	0.510	0.013	0.020
D	5.8	6.2	0.228	0.244
E	3.800	4.000	0.150	0.157
F	4.7	5.1	0.185	0.201
L	0.675	0.725	0.027	0.029
G	0.32(Typ.)		0.013(Typ.)	
R	0.15(Typ.)		0.006(Typ.)	
θ1	7°		7°	
θ	8°		8°	

- The information described herein is subject to change without notice.
- Nanjing Micro One Electronics Inc is not responsible for any problems caused by circuits or diagrams described herein whose related industrial properties, patents, or other rights belong to third parties. The application circuit examples explain typical applications of the products, and do not guarantee the success of any specific mass-production design.
- Use of the information described herein for other purposes and/or reproduction or copying without the express permission of Nanjing Micro One Electronics Inc is strictly prohibited.
- The products described herein cannot be used as part of any device or equipment affecting the human body, such as exercise equipment, medical equipment, security systems, gas equipment, or any apparatus installed in airplanes and other vehicles, without prior written permission of Nanjing Micro One Electronics Inc.
- Although Nanjing Micro One Electronics Inc exerts the greatest possible effort to ensure high quality and reliability, the failure or malfunction of semiconductor products may occur. The user of these products should therefore give thorough consideration to safety design, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue.

High Precision CC/CV Primary-Side Controller ME8310

General Description

The ME8310 is a high performance offline PSR controller for low power AC/DC charger and adapter applications. It operates in primary-side sensing and regulation. Consequently, opto-coupler and ME431 could be eliminated. Proprietary Constant Voltage (CV) and Constant Current (CC) control is integrated as shown in the figure.1 below.

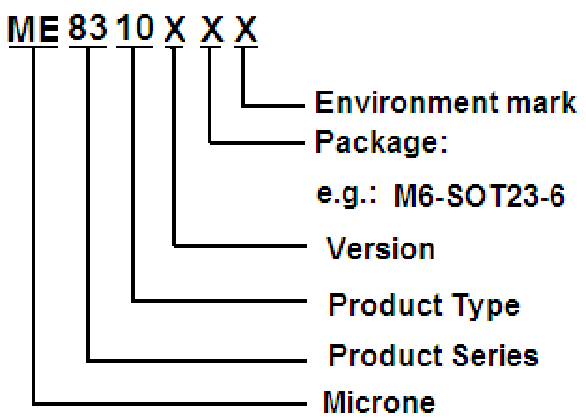
In CC control, the current and output power setting can be adjusted externally by the sense resistor R_S at CS pin. In CV control, PFM operations are utilized to achieve high performance and high efficiency. In addition, good load regulation is achieved by the built-in cable drop compensation. The chip consumes very low operation current (typical 420μA), it can achieve less than 30mW standby power to meet strict standby power standard.

ME8310 offers comprehensive protection coverage with auto-recovery features including Cycle-by-Cycle current limiting, VDD over voltage protection, feedback loop open protection, short circuit protection, built-in leading edge blanking, VDD under voltage lockout (UVLO), etc.

Features

- ±5% Constant Voltage Regulation at universal AC input
- High precision constant current regulation at universal AC input
- Primary-side sensing and regulation without ME431 and opo-coupler
- Built-in primary winding inductance compensation
- Programmable cable drop compensation
- Driver NMOS switch
- Ultra low start-up current (Typ. 1μA)
- VDD over voltage protection
- Built-in feedback loop open protection
- Built-in leading edge blanking (LEB)
- Built-in short circuit protection
- Cycle-by-Cycle current limiting
- VDD under voltage lockout with hysteresis (UVLO)
- SOT23-6 package

Selection Guide

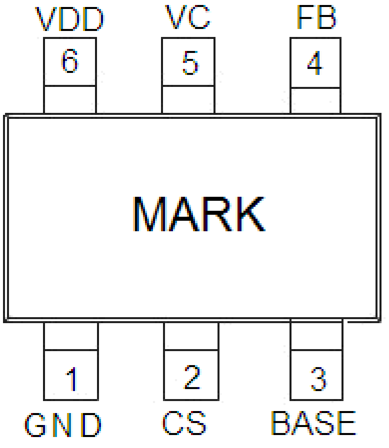


Applications

Low power AC/DC offline SMPS for:

- Cell phone charge
- Digital cameras charger
- Small power adapter
- Auxiliary power for PC, TV, etc.

Pin Configuration



Pin Assignment

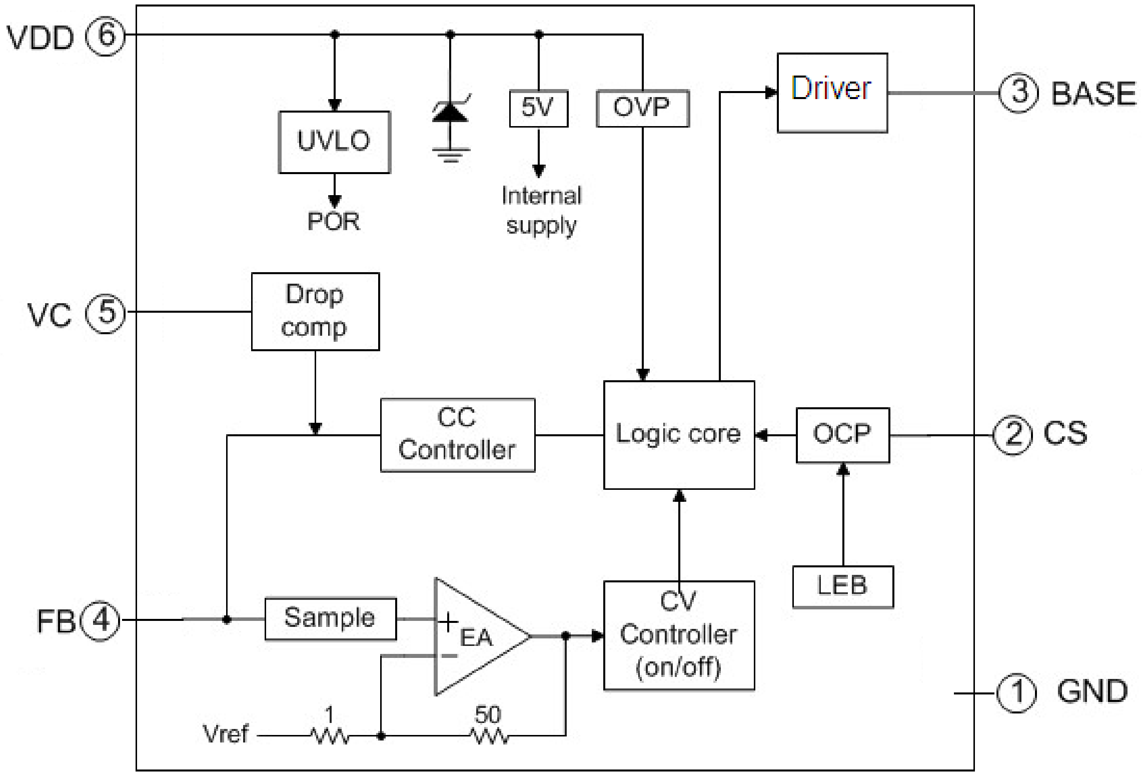
Pin Num.	Symbol	Function
1	GND	Ground
2	CS	Current sense input
3	BASE	Drive for MOSFET
4	FB	The voltage feedback from the auxiliary winding. Connected to resistor divider from auxiliary winding reflecting output voltage
5	VC	Low pass filter capacitor for cable compensation
6	VDD	Power supply

Absolute Maximum Ratings

Parameter	Rating	Unit
Voltage at VDD pin to GND:VDD	-0.3～30	V
Voltage at CS,VC,BASE,FB PIN to GND	-0.3～7	V
Min/Max operating Junction Temperature T_J	-40～150	°C
Lead Temperature (Soldering, 10secs)	260	°C
Min/Max Soldering temperature T_{stg}	-55～150	°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.

Block Diagram



Electrical Characteristics

（T_A =25 °C, V_{DD} =15V, unless otherwise noted.）

Item	Symbol	Test condition	Min	Typ.	Max	Unit
Supply Voltage(VDD) section						
Start-up current	$I_{start\text{-}up}$	VDD=11V	-	1	3	μA
Static current	I_{static}	VDD=15V	-	420	500	μA
VDD under voltage lockout exit	UVLO(off)		12.5	13.5	14.5	V
VDD under voltage lockout enter	UVLO(on)		7.4	8.0	8.6	V
VDD over voltage protection	V_{DD_OVP}		30	31	32	V
Max. operating voltage	V_{DD_max}		-	-	30	V
Current sense input section						
LEB time	T_{LEB}		-	0.5	-	μS
Over current threshold	V_{th_ocp}		485	500	515	mV
OCP propagation delay	Td_oc	From OCP comparator to base driver	-	100	-	nS
FB input section						
Reference voltage for feedback threshold	V_{REF_FB}	VDD=15V，V_{CS}=4V	1.94	2.00	2.10	V
Minimum pause	T_{pause_min}		-	2.0	-	μS
Maximum pause	T_{pause_max}		8	10	12	mS
Maximum cable compensation current	I_{comp_cable}	VDD=15V，V_{CS}=4V	42	45	49	μA
Base drive section						
Base sourcing Clamping voltage	V_{base_camp}		14	14.7	15.5	V

Operation Description

ME8310 is a cost effective PSR controller optimized for off-line low power AC/DC applications including battery chargers. It operates in primary side sensing and regulation, thus opto-coupler and ME431 are not required. Proprietary built-in CV and CC control can achieve high precision CC/CV control meeting most charger application requirements.

●Startup Current and Start up Control

Startup current of ME8310 is designed to be very low so that VDD could be charged up above UVLO threshold and starts up quickly. A large value startup resistor can therefore be used to minimize the power loss in application.

●Operating Current

The Operating current of ME8310 is as low as 420μA. Good efficiency and very low standby power(less than 30mW) is achieved with the low operating current.

●CC/CV Operation

ME8310 is designed to produce good CC/CV control characteristic as shown in the Fig.1. In charger applications, a discharged battery charging starts in the CC portion of the curve until it is nearly full charged and smoothly switches to operate in CV portion of the curve. The CC portion provides output current limiting. In CV operation, the output voltage is regulated through the primary side control. In CC operation mode, ME8310 will regulate the output current constant regardless of the output voltage drop.

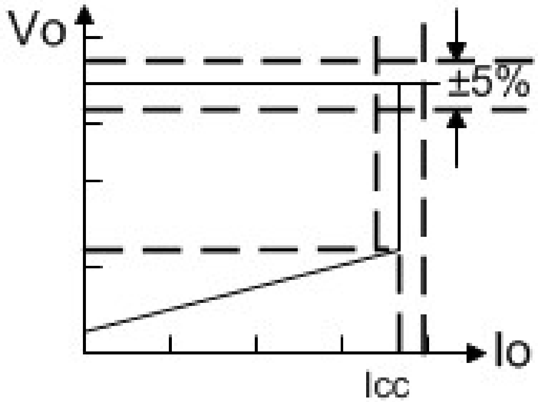


Fig.1: Typical CC/CV Curve

●Principle of Operation

To support ME8310 proprietary CC/CV control, power dissipation in a switching mode power supply is from switching loss on the MOSFET transistor, the core system needs to be designed in DCM mode for flyback system (Refer to Typical Application Diagram).

In the DCM flyback converter, the output voltage can be sensed via the auxiliary winding. During MOSFET turn-on time, the load current is supplied from the output filter capacitor, Co. The current in the primary winding ramps up. When MOSFET turns off, the energy stored in the primary winding is transferred to the secondary side such that the current in the secondary winding is : $Is = \frac{Np}{Ns} * Ip$.

The auxiliary voltage reflects the output voltage as shown in Fig.2 and it is given by $V_{AUX} = \frac{N_{AUX}}{Ns} * (Vo + \Delta V)$

Where the ΔV indicates the drop voltage of the output Diode.

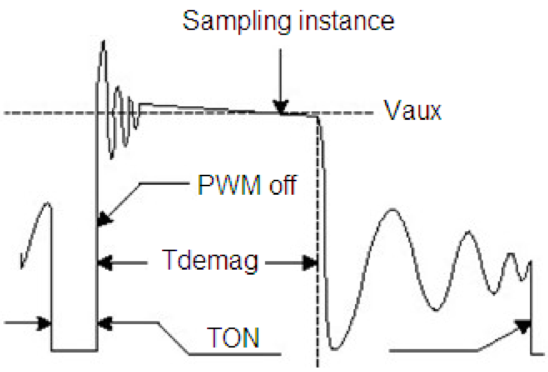


Fig.2: Auxiliary voltage waveform

Via a resistor divider connected between the auxiliary winding and FB (pin 4), the auxiliary voltage is sampled at the middle of the demagnetization and it is hold until the next sampling. The sampled voltage is compared with V_{REF} (2.0V) and the error is amplified. The error amplifier output reflects the load condition and controls the switching off time to regulate the output voltage, thus constant output voltage can be achieved. When the sampled voltage is below V_{REF} and the error amplifier output reaches its minimum, the switching frequency is controlled by the sampled voltage to regulate the output current, thus the constant output current can be achieved.

●Adjustable CC point and Output Power

In ME8310, the CC point and maximum output power can be externally adjusted by external current sense resistor Rs at CS pin as illustrated in typical application diagram. The larger Rs, the smaller CC point is, and the smaller output power becomes, and vice versa as shown in Fig.3.

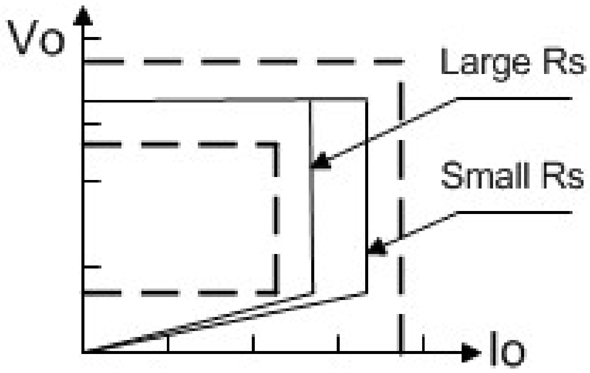


Fig.3: Adjustable output power by changing

●Operation switching frequency

The switching frequency of ME8310 is adaptively controlled according to the load conditions and the operation modes. For flyback operating in DCM, The maximum output power is given by $Po_{MAX} = \frac{1}{2} * Lp * Fsw * I^2p$

Where L_P indicates the inductance of primary winding and L_P is the peak current of primary winding. Refer to the equation below, the change of the primary winding inductance results in the change of the maximum output power and the constant output current in CC mode. To compensate the change from variations of primary winding inductance, the switching frequency is locked by an internal loop such that the switching frequency is

$$Fsw = \frac{1}{2 * Tdemag}$$

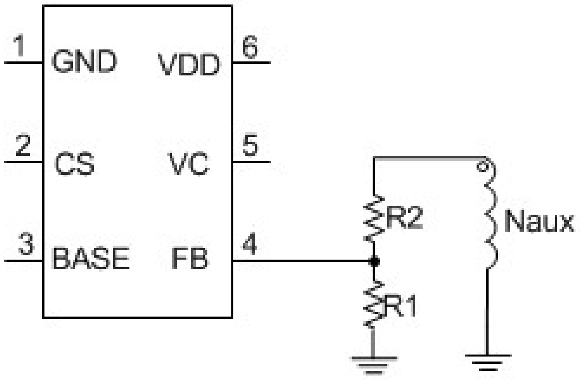
Since Tdemag is inversely proportional to the inductance, as a result, the product L_P and F_{SW} is constant, thus the maximum output power and constant current in CC mode will not change as primary winding inductance changes. Up to ±10% variation of the primary winding inductance can be compensated.

●Programmable Cable drop Compensation

In ME8310, cable drop compensation is implemented to achieve good load regulation. An offset voltage is generated at FB pin by an internal current flowing into the resister divider. The current is proportional to the switching off time, as a result, it is inversely proportional to the output load current, and the drop due to the cable loss can be compensated. As the load current decreases from full-load to no-load, the offset voltage at FB will increase. It can also be programmed by adjusting the resistance of the divider to compensate the drop for various cable lines used.

The percentage of maximum compensation is $\frac{\Delta V}{Vout} = \frac{Icomp\_cable * (R1//R2) * 10^{-6}}{2} * 100\%$

ΔV is load compensation voltage and Vout is output voltage; For example: R1∥R2=3KΩ, the percentage of maximum compensation is $\frac{\Delta V}{Vout} = \frac{45 * 3000 * 10^{-6}}{2} * 100\% = 6.75\%$



●Current Sensing and Leading Edge Blanking

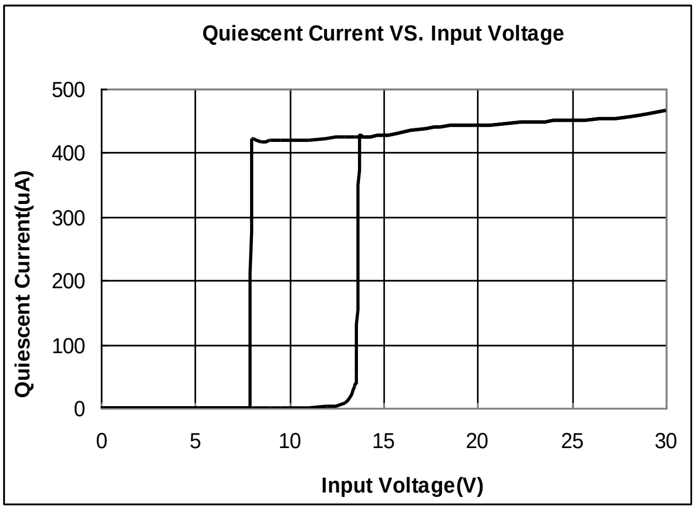
Cycle-by-Cycle current limiting is offered in ME8310. The switch current is detected by a sense resistor into the CS pin. An internal leading edge blanking circuit chops off the sensed voltage spike at initial power MOSFET on state so that the spike at initial power MOSFET on state so that the external RC filtering on sense input is no longer needed.

●Protection Control

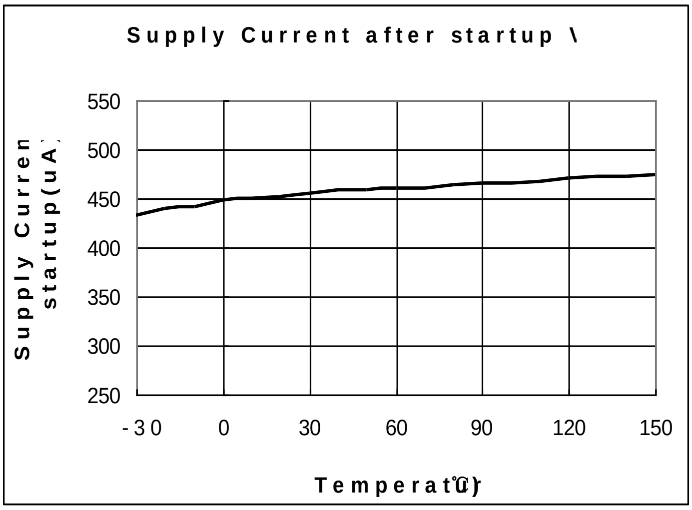
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), VDD over voltage protection, feedback loop open protection, short circuit protection and Under Voltage Lockout on VDD (UVLO). VDD is supplied by transformer auxiliary winding output. The output of ME8310 is shut down when VDD drops below UVLO (ON) and the power converter enters power on start-up sequence thereafter.

Typical performance characteristics

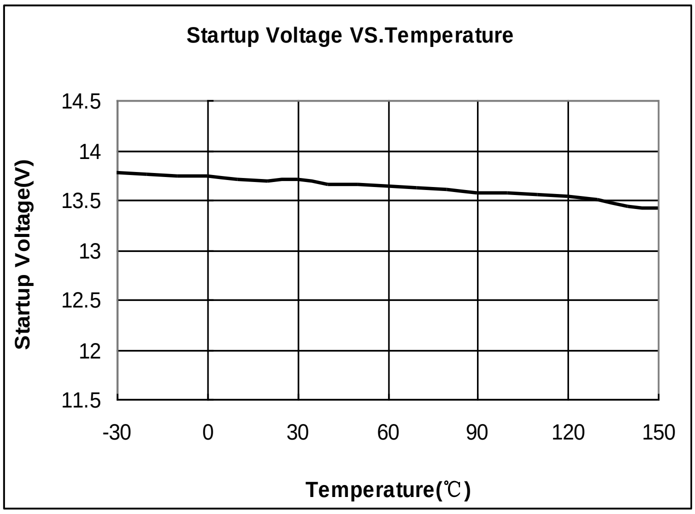
(1) IC Supply Current vs. Input Voltage



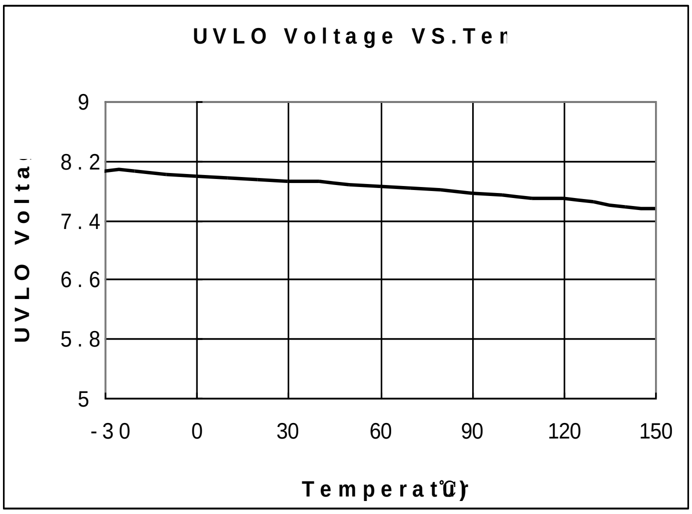
(2) Supply Current after startup vs. Temperature



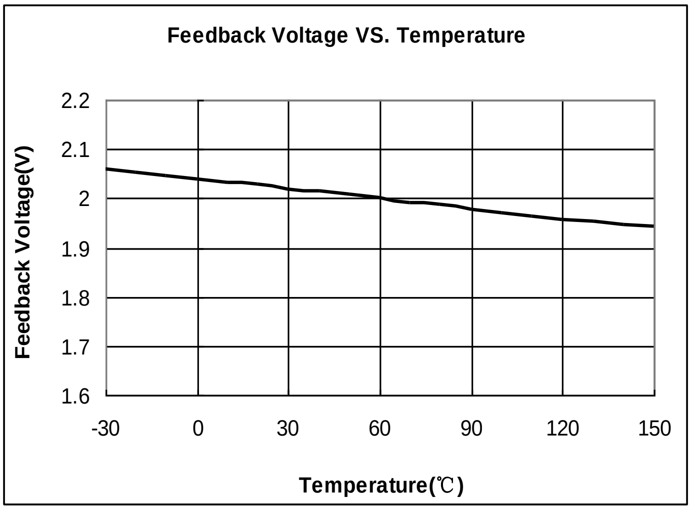
(3) Startup Voltage VS. Temperature



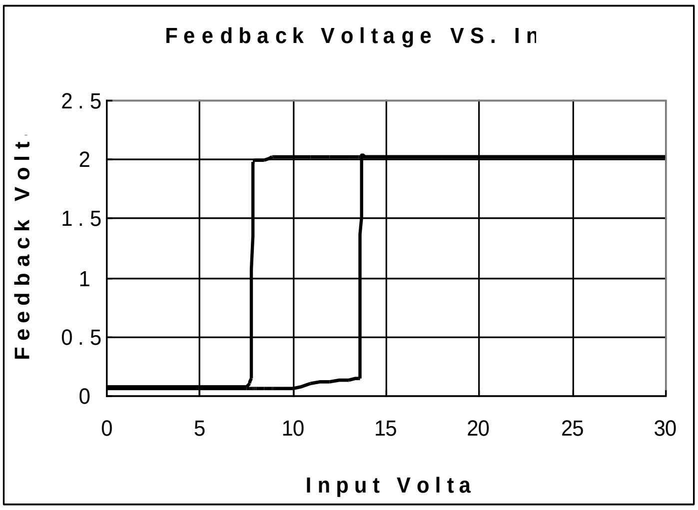
(4) VDD UVLO enter voltage vs. Temperature



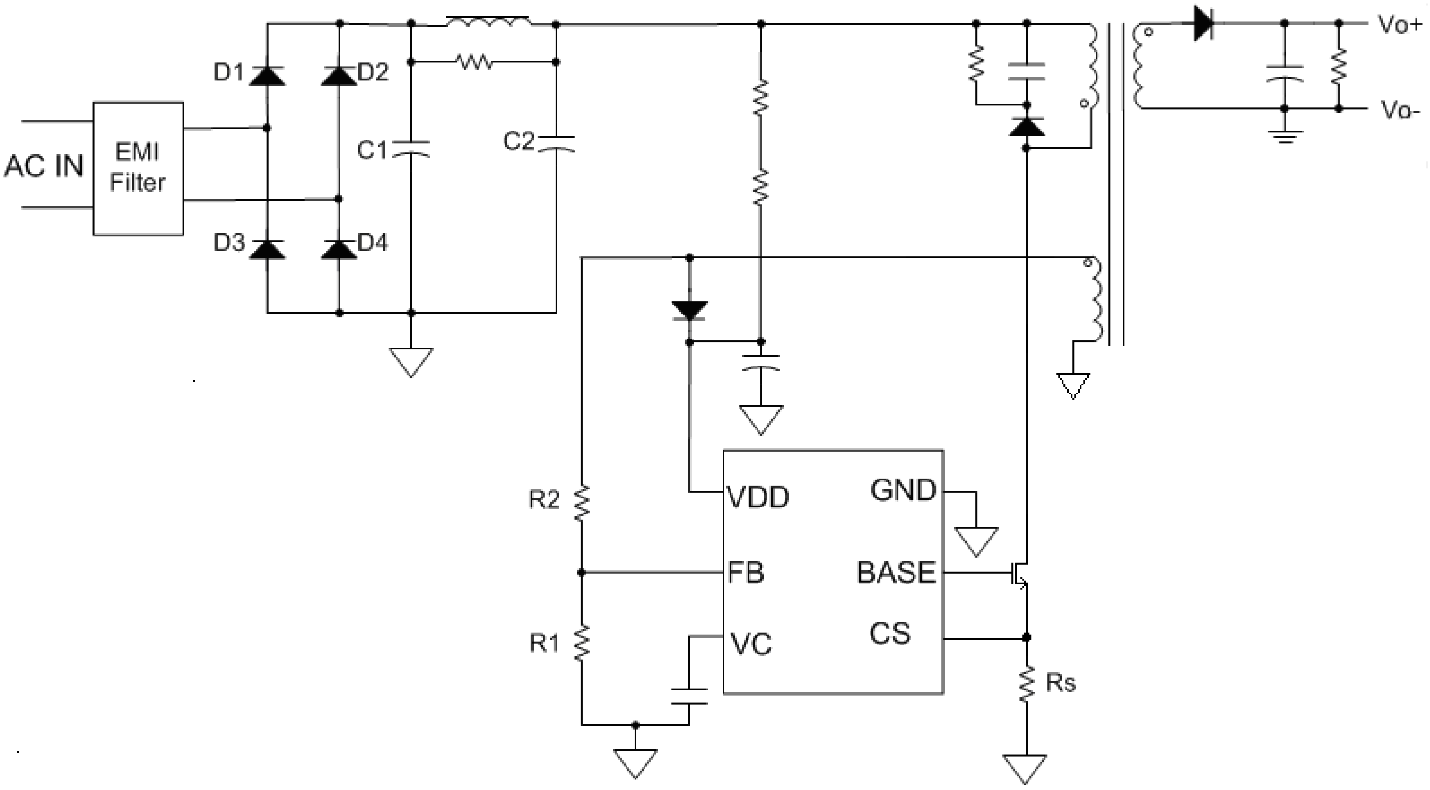
(5) Feedback voltage vs. Temperature



(6) Feedback Voltage VS. Input Voltage

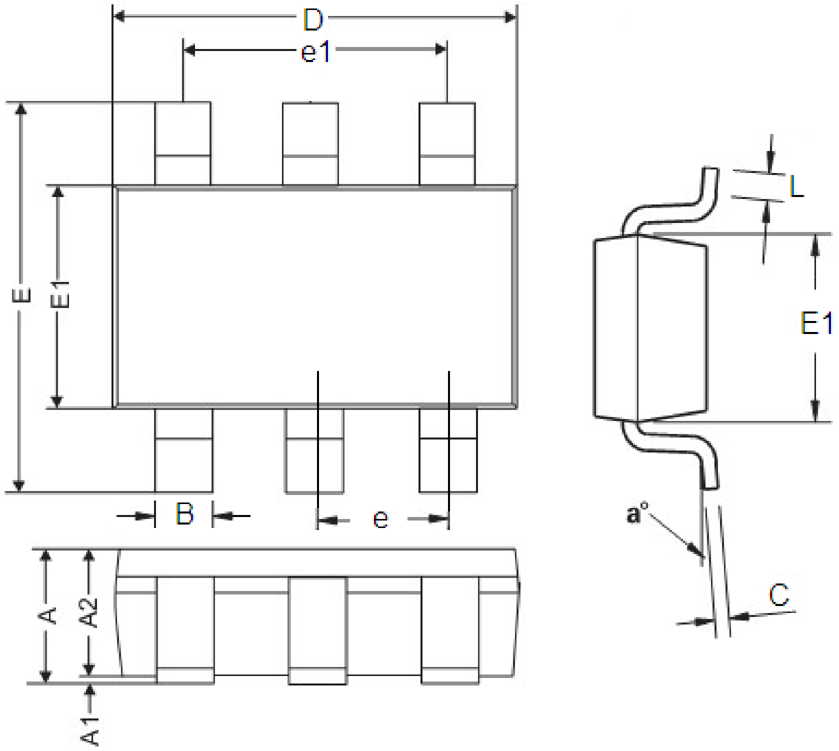


Typical Application



Package Information

Package type:SOT23-6 Unit:mm(inch)



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	0.9	1.45	0.0354	0.0570
A1	0	0.15	0	0.0059
A2	0.9	1.3	0.0354	0.0511
B	0.2	0.5	0.0078	0.0196
C	0.09	0.26	0.0035	0.0102
D	2.7	3.10	0.1062	0.1220
E	2.2	3.2	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95REF		0.0374REF	
e1	1.90REF		0.0748REF	
L	0.10	0.60	0.0039	0.0236
a^0	0^0	30^0	0^0	30^0

- The information described herein is subject to change without notice.
- Nanjing Micro One Electronics Inc is not responsible for any problems caused by circuits or diagrams described herein whose related industrial properties, patents, or other rights belong to third parties. The application circuit examples explain typical applications of the products, and do not guarantee the success of any specific mass-production design.
- Use of the information described herein for other purposes and/or reproduction or copying without the express permission of Nanjing Micro One Electronics Inc is strictly prohibited.
- The products described herein cannot be used as part of any device or equipment affecting the human body, such as exercise equipment, medical equipment, security systems, gas equipment, or any apparatus installed in airplanes and other vehicles, without prior written permission of Nanjing Micro One Electronics Inc.
- Although Nanjing Micro One Electronics Inc exerts the greatest possible effort to ensure high quality and reliability, the failure or malfunction of semiconductor products may occur. The user of these products should therefore give thorough consideration to safety design, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue.