

## High Performance Off-Line Controller ME8100

### General Description

ME8100 Series is a high performance green-energy offline power supply controller. It features a scalable driver for driving external NPN or MOSFET transistors for line voltage switching. This proprietary architecture enables many advanced features to be integrated into a small package(TO-92),resulting in lowest total cost solution.

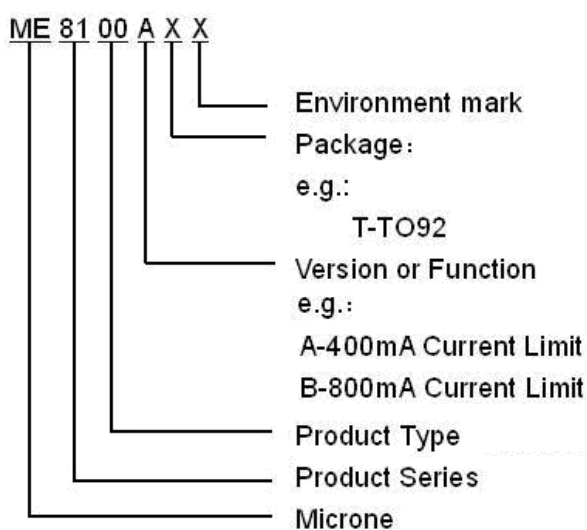
The ME8100 design has 6 internal terminals and is a pulse frequency and width modulation IC with many flexible packaging options. One combination of internal terminals is packaged in the space-saving TO-92 package (A/B versions) for 65kHz switching frequency and with 400mA or 800mA current limit. Consuming only 0.15W in standby, the IC features over-current, hiccup mode short circuit, and under-voltage protection mechanisms.

The ME8100 is ideal for use in high performance universal adaptors and chargers.

### Features

- Lowest Total Cost Solution
- 0.15W Standby Power
- Emitter Drive Allows Safe NPN Flyback Use
- Hiccup Mode Short Circuit
- Current Mode Operation
- Over-Current Protection
- Under-voltage Protection with Auto-restart
- Proprietary Scalable Output Driver
- Flexible Packaging Options(including TO-92)
- 65kHz Switching Frequency
- Selectable 0.4A to 0.8A Current Limit

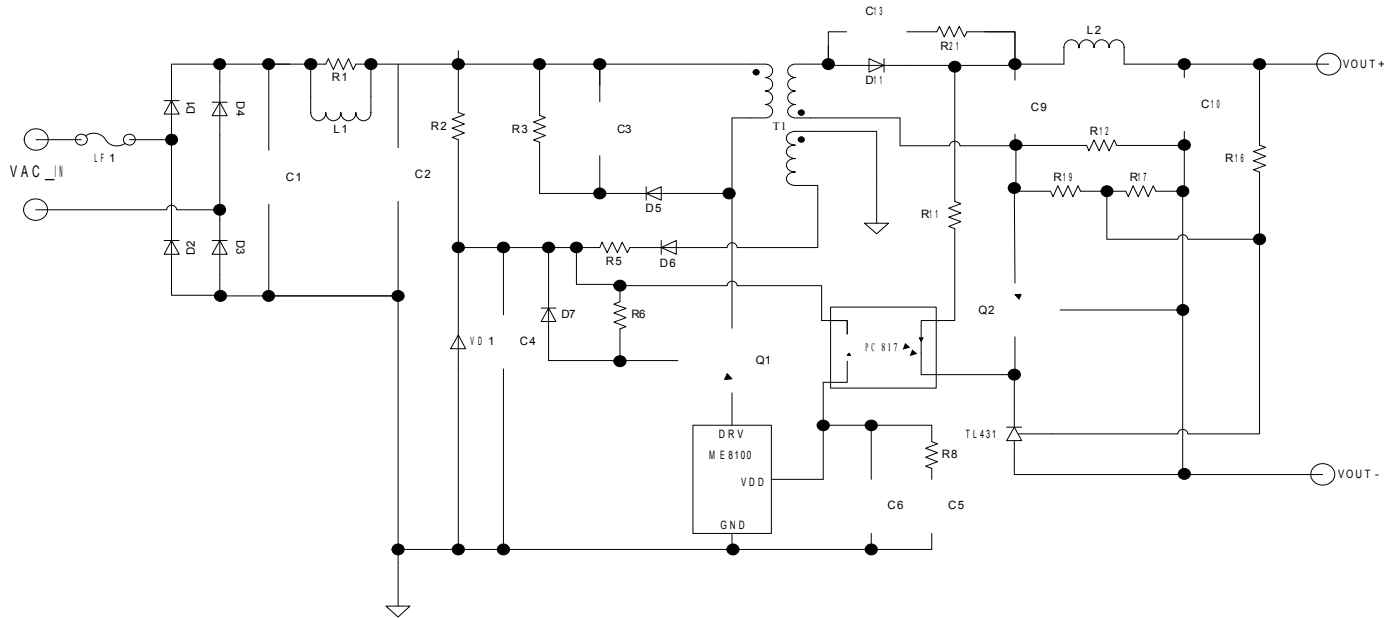
### Selection Guide



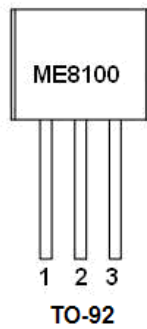
### Typical Application

- Battery Chargers
- Power Adaptors
- Standby Power Supplies
- Appliances
- Universal Off-line Power Supplies

## Typical Application Circuit



## Pin Configuration & Pin Assignment

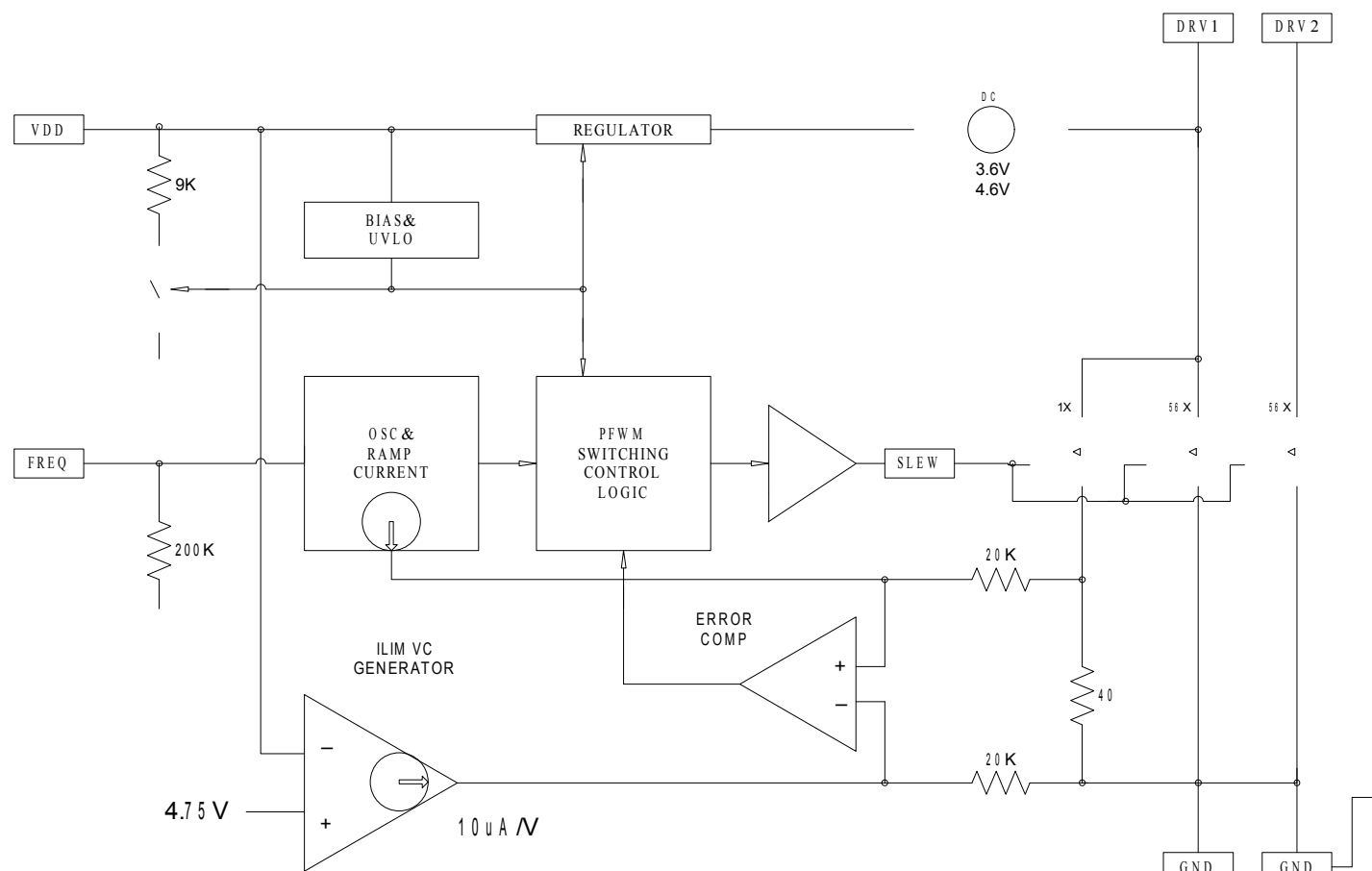


Pin Number	Pin Name	Function
TO-92		
1	VDD	Power Supply Pin. Connect to optocoupler's emitter. Internally limited to 5.5V max. Bypass to GND with a proper compensation network.
2	GND	Ground
3	DRV	Driver Output (TO-92 Only). Connect to emitter of the high voltage NPN or MOSFET.

## Absolute Maximum Ratings

Parameter	Symbol	Ratings	Units
VDD Pin Voltage	$V_{DD}$	-0.3 to 6	V
DRV Pin voltage	$V_{DRV}$	-0.3 to 18	V
VDD current	$I_{DD}$	20	mA
Continuous Total Power Dissipation	TO-92 $P_D$	500	mW
Operating Ambient Temperature	$T_{OPR}$	-25~+125	°C
Storage Temperature	$T_{STG}$	-40~+125	°C
Soldering temperature and time	$T_{SOLDER}$	260°C, 10s	

## Block Diagram



## Electrical Characteristics

ME8100AXX/BXX((Measuring conditions: Unless otherwise specified ,  $V_{IN}=4V$ ,  $T_{OPT}=25^{\circ}C$ )

Symbol	Parameter	Conditions	Min	Typ.	Max	Units	
$V_{START}$	VDD Star Voltage	Rising edge	4.75	5	5.25	V	
$V_{DRVST}$	DRV Start Voltage	DRV must be higher than this voltage to star up		9	11	V	
$V_{SCDRV}$	DRV Short-Circuit Detect Threshold			5.8		V	
$V_{UV}$	VDD Under-voltage Threshold	Falling edge	3.17	3.35	3.53	V	
	VDD Clamp Voltage	10mA	5.15	5.45	5.75	V	
$I_{DDST}$	Startup Supply Current	VDD=4V before $V_{UV}$		0.15	0.45	mA	
$I_{DD}$	Supply Current			0.4	1.0	mA	
$F_{SW}$	Switching Frequency	$F_{REQ}=0$	50	60	80	KHz	
$D_{MAX}$	Maximum Duty Cycle	VDD=4V	ME8100A	67	75	83	%
			ME8100B	60			
$D_{MIN}$	Minimum Duty Cycle	VDD=4.6V		5.5			
$I_{LIM}$	Effective Current Limit	VDD= $V_{UV}$ +0.1v	ME8100A		400		mA
			ME8100B		800		
$G_{GAIN}$	VDD to DRV Current Coefficient			-0.2		A/V	
$R_{VDD}$	VDD Dynamic Impedance			9		k $\Omega$	
	DRV Rise Time	1nF load,15 $\Omega$ pull-up		30		ns	
	DRV Fall Time	1nF load,15 $\Omega$ pull-up		20		ns	

## Function Description

As the Functional Block Diagram of the ME8100. The main components include switching control logic, two on-chip Medium-voltage power-MOSFETs with parallel current sensor, driver, oscillator and ramp generator, current limit VC generator, error comparator, hiccup control, bias and undervoltage-lockout, and regulator circuitry.

The design has 6 internal terminals. VDD is the power supply terminal. DRV1 and DRV2 are linear driver outputs that can drive the emitter of an external high voltage NPN transistor or N-channel MOSFET. This emitter-drive method takes advantage of the high VCBO of the transistor, allowing a low cost transistor such as 13003 (VCBO = 700V) or 13002 (VCBO = 600V) to be used for a wide AC input range. The slew-rate limited driver coupled with the turn-off characteristics of an external NPN result in lower EMI.

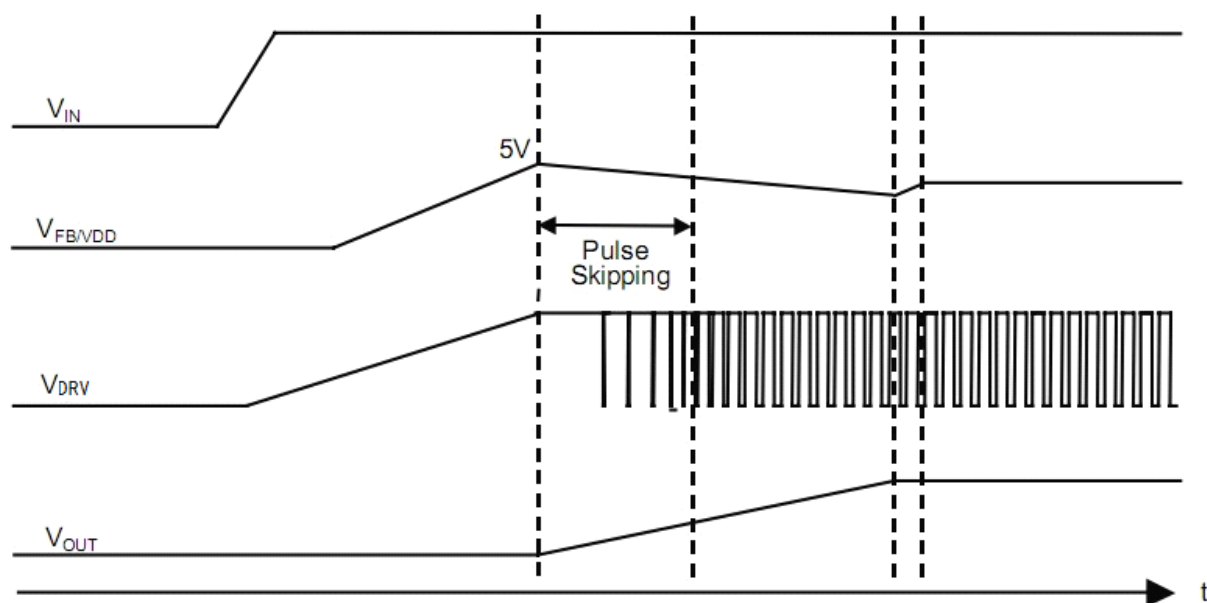
The driver peak current is designed to have a negative voltage coefficient with respect to supply voltage VDD, so that lower supply voltage automatically results in higher DRV1 peak current. This way, the optocoupler can control VDD directly to affect driver current.

## Startup Sequence

As the typical application Circuit for the ME8100. Initially, the small current through resistor R2 charges up the capacitor C4, and the BJT acts as a follower to bring up the DRV1 voltage. An internal regulator generates a VDD voltage equal to  $V_{DRV1} - 3.6V$  for ME8100A ( $V_{DRV1} - 4.6V$  for ME8100B) but limits it to 5.5VMAX. As VDD crosses 5V, the regulator sourcing function stops and VDD begins to drop due to its current consumption. As VDD voltage decreases below 4.75V, the IC starts to operate with increasing driver current. When the output voltage reaches regulation point, the optocoupler feedback circuit stops VDD from decreasing further. The switching action also allows the auxiliary windings to take over in supplying the C4 capacitor. The following sketch map shows a typical startup sequence for the ME8100.

To limit the auxiliary voltage, use a 12V zener diode for ME8100A or a 13V zener for ME8100B (VD1 diode in Typical Application).

Even though up to  $2M\Omega$  startup resistor (R2) can be used due to the very low startup current, the actual R2 value should be chosen as a compromise between standby power and startup time delay.



## Normal Operation

In normal operation, the feedback signal from the secondary side is transmitted through the optocoupler as a current signal into VDD pin, which has dynamic impedance of 9kΩ. The resulting VDD voltage affects the switching of the IC. As seen from the Functional Block Diagram, the Current Limit VC Generator uses the VDD voltage difference with 4.75V to generate a proportional offset at the negative input of the Error Comparator.

The drivers turn on at the beginning of each switching cycle. The current sense resistor current, which is a fraction of the transformer primary current, increases with time as the primary current increases. When the voltage across this current sense resistor plus the oscillator ramp signal equals Error Comparator's negative input voltage, the drivers turn off. Thus, the peak DRV1 current has a negative voltage coefficient of -0.29A/V and can be calculated from the following:

$$I_{DRV1PEAK} = 0.2A/V \times (4.75V - V_{DD})$$

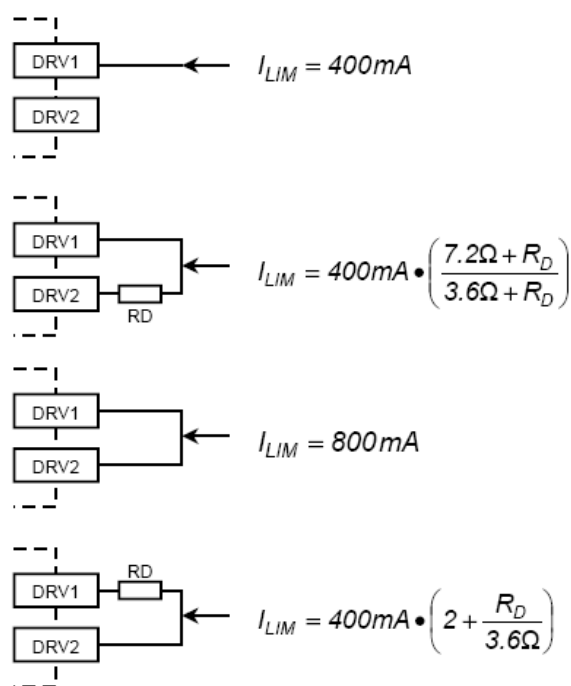
for  $V_{DD} < 4.75V$  and duty cycle  $< 50\%$ . When the output voltage is lower than regulation, the current into VDD pin is zero and VDD voltage decreases. At  $V_{DD} = V_{UV} = 3.35V$ , the peak DRV1 current has maximum value of 400mA.

## Pulse skipping

The PFWM Switching Control Logic block operates in different modes depending on the output load current level. At light load, the  $V_{DD}$  voltage is around 4.75V.

The energy delivered by each switching cycle (with minimum on time of 500ns) to the output causes  $V_{DD}$  to increase slightly above 4.75V. The FPWM Switching Control Logic block is able to detect this condition and prevents the IC from switching until  $V_{DD}$  is below 4.75V again. This results in a pulse-skipping action with fixed pulse width and varying frequency, and low power consumption because the switching frequency is reduced. Typical system standby power

## Current limit adjustment



### Driver output configurations

The IC's proprietary driver arrangement allows the current limit to be easily adjusted between 400mA and 1.2A. To understand this, the drivers have to be utilized as linear resistive devices with typically 3.6Ω (rather than as digital output switches). The current limit can then be calculated through linear combination as shown in the front. For TO-92 package, the ME8100A are preprogrammed to 400mA current limit and the ME8100 are preprogrammed to 800mA current limit.

## Short circuit hiccup

When the output is short circuited, the ME8100 enters hiccup mode operation. In this condition, the auxiliary supply voltage collapses. An on-chip detector compares DRV1 voltage during the off-time of each cycle to 6.8V. If DRV1 voltage is below 6.8V, the IC will not start the next cycle, causing both the auxiliary supply voltage and VDD to reduce further. The circuit enters startup mode when VDD drops below 3.35V. This hiccup behaviour continues until the short circuit is removed. In this behavior, the effective duty cycle is very low resulting in very low short circuit current.

To make sure that the IC enters hiccup mode easily, the transformer should be constructed so that there is close coupling between secondary and auxiliary, so that the auxiliary voltage is low when the output is short-circuited. This can be achieved with the primary/auxiliary/secondary sequencing from the bobbin.

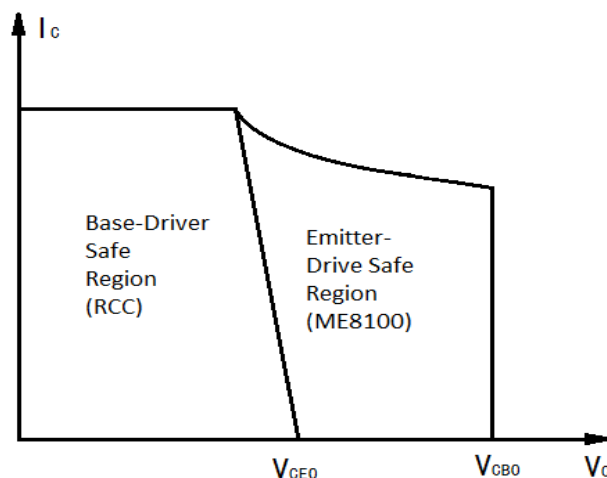
## Application information

### ➤ External power transistor

The ME8100 allows a low-cost high voltage power NPN transistor such as 13003 or 13002 to be used safely in flyback configuration. The required collector voltage rating for VAC=265V with full output load is at least 600V to 700V. As seen from follow map, NPN Reverse Bias Safe Operation Area, the breakdown voltage of an NPN is significantly improved when it is driven at its emitter. Thus, the ME8100+13002 or 13003 combination meet the necessary breakdown safety requirement even though RCC circuits using 13002 or 13003 do not. The follow table lists the breakdown voltage of some transistors appropriate for use with the ME8100.

Recommended Power Transistors List:

Device	V <sub>CBO</sub>	V <sub>CEO</sub>	I <sub>C</sub>	h <sub>FEMIN</sub>	Package
MJE13002	600V	300V	1.5A	8	TO-126
MJE13003	700V	400V	1.5A	8	TO-126
STX13003	700V	400V	1A	8	TO-92



### NPN Reverse Bias Safe Operation Area

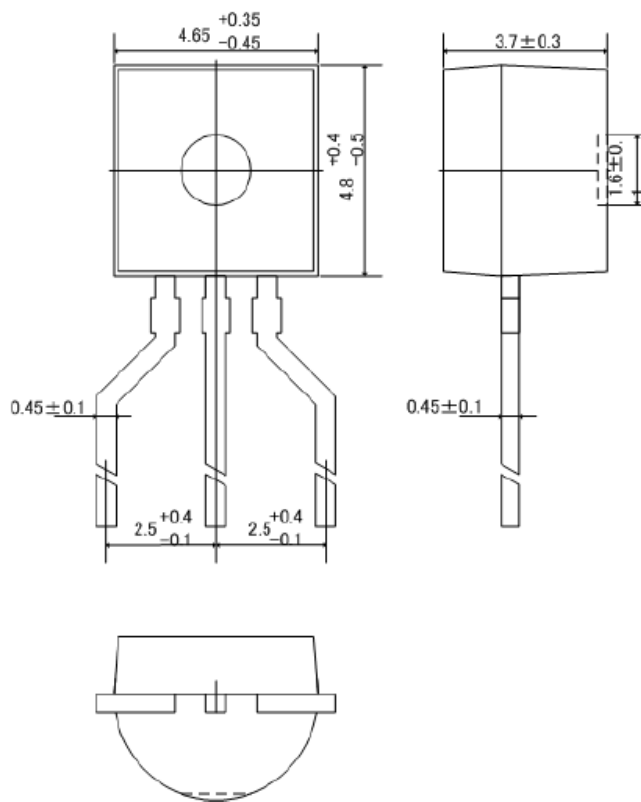
The power dissipated in the NPN transistor is equal to the collector current times the collector-emitter voltage. As a result, the transistor must always be in saturation when turned on to prevent excessive power dissipation. Select an NPN transistor with sufficiently high current gain ( $h_{FEMIN} > 8$ ) and a base drive resistor low enough to ensure that the transistor easily saturates.

### ➤ Layout considerations

The following should be observed when doing layout for the ME8100:

1. Use a "star point" connection at the GND pin of ME8100 for the VDD bypass components (C5 and C6 in typical application), the input filter capacitor (C2 in typical application) and other ground connections on the primary side.
2. Keep the loop across the input filter capacitor, the transformer primary windings, and the high voltage transistor, and the ME8100 as small as possible.
3. Keep ME8100 pins and the high voltage transistor pins as short as possible.
4. Keep the loop across the secondary windings, the output diode, and the output capacitors as small as possible.
5. Allow enough copper area under the high voltage transistor, output diode, and current shunt resistor for heat sink.

TO-92





- 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.