CS-8135

5V, 5V Low Dropout Dual Regulator with RESET/ENABLE

Description

The CS-8135 is a low dropout, high current 5V regulator. Also included is a standby 5V/10mA output for powering systems with standby memory. Quiescent current drain is less than 3mA when supplying 10mA loads from the standby regulator.

In automotive applications, the CS-8135 and all regulated circuits are protected from reverse battery installations, as well as two-battery jumps. During line transients, such as a 60V load dump, the 500mA regulator will automatically shut down the primary output to protect both internal circuits and the load. The standby regulator will continue to power any standby load.

The CS-8135 is packaged in a 5-lead TO-220, with copper tab for connection to a heat sink, if necessary.

NOTE: The CS-8135 is pin-compatible with the LM2935.

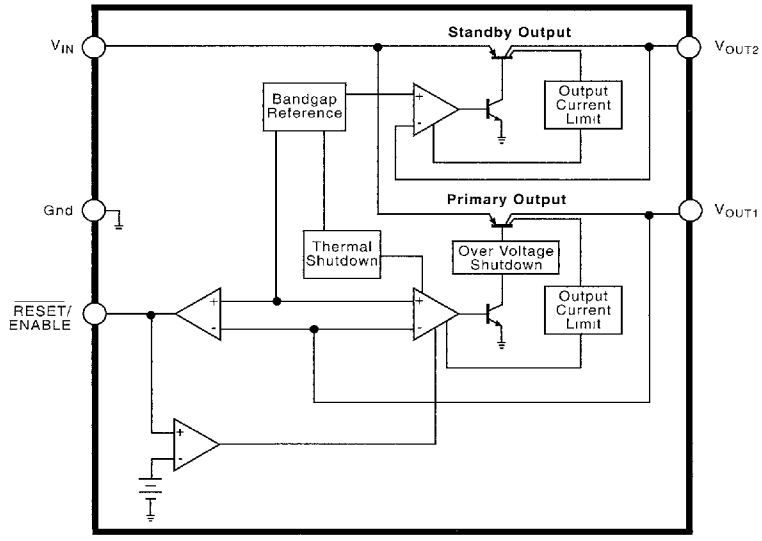
Features

- Two Regulated Outputs
- Primary Output 5V ± 5%; 500mA
- Low Dropout Voltage (0.6V at 0.5A)
- ON/OFF Control Option
- Standby 5V Output
- Low Quiescent Drain (<3mA)
- RESET Option
- Protection Features
  - Reverse Battery
  - 60V Load Dump
  - -50V Reverse Transient
  - Short Circuit
  - Thermal Shutdown

Absolute Maximum Ratings

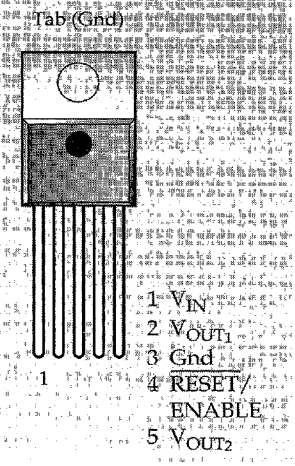
Input Voltage	
Operating Range	-0.5V to 26V
Overvoltage Protection	60V
Internal Power Dissipation	Internally Limited
Operating Temperature Range	-40°C to +125°C
Junction Temperature Range (T_J)	-40°C to +150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering 10sec) TO-220	260°C
Electrostatic Discharge (Human Body Model)	2kV

Block Diagram



Package Options

TO-220 5 Lead



CSC™ CHERRY SEMICONDUCTOR

Cherry Semiconductor Corporation
2000 South County Trail
East Greenwich, Rhode Island 02818-1530
Tel: (401)885-3600 Fax (401)885-5786
Telex WUI 6817157

Electrical Characteristics : V_{IN} = 14V, I_{OUT} = 500mA, -40°C ≤ T_A = 125°C, –40°C≤T_J≤150°C unless otherwise specified

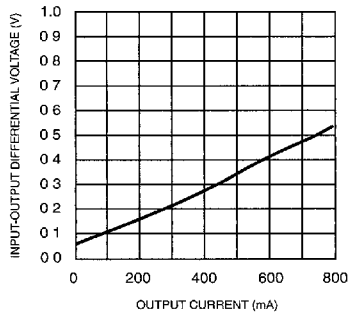
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ Output Stage (V_{OUT_1})					
Output Voltage, V_{OUT_1}	6V≤V_{IN}≤26V, I_{OUT_1}≤500mA,	4.75	5.00	5.25	V
Dropout Voltage(V_{IN} -V_{OUT_1})	I_{OUT}=500mA		0.35	0.60	V
	I_{OUT}=750mA		0.50		V
Line Regulation	6V≤V_{IN}≤26V, I_{OUT_1}=5mA		10	50	mV
Load Regulation	5mA≤I_{OUT}≤500mA		10	50	mV
Quiescent Current	I_{OUT_1}≤10mA, No Load on Standby		3		mA
	I_{OUT_1}=500mA, No Load on Standby		35	100	mA
	I_{OUT_1}=750mA, No Load on Standby		100		mA
Ripple Rejection	f=120Hz		66		dB
Current Limit		0.75	1.40		A
Maximum Line Transient	V_{OUT_1}≤5.5V	60	90		V
Reverse Polarity Input Voltage, DC	V_{OUT_1}≥-0.6V, 10Ω Load	-15	-50		V
Reverse Polarity Input Voltage, Transient	1% Duty Cycle, t=100ms, V_{OUT_1}≥-6V, 10Ω Load	-50	-80		V
Output Noise Voltage	10Hz-100kHz		100		µVrms
Long Term Stability			20		mV/khr
Output Impedance	500mA_{DC} and 10mA_{rms}, 100Hz-10kHz		200		mΩ
■ Standby Output (V_{OUT_2})					
Output Voltage (V_{OUT_2})	6V≤V_{IN}≤26V,I_{OUT_1}≤10mA	4.75	5.00	5.25	V
Dropout Voltage	I_{OUT_2}≤10mA		0.3	0.7	V
Tracking	V_{OUT_1}-V_{OUT_2}		50	200	mV
Line Regulation	6V≤V_{IN}≤26V		4	50	mV
Load Regulation	1mA≤I_{OUT_1}≤10mA		10	50	mV
Quiescent Current	I_{OUT}≤10mA, V_{OUT} OFF		2	3	mA
Ripple Rejection	f=120Hz		66		dB
Current Limit		25	70		mA
Output Noise Voltage	10Hz-100kHz		300		µV
Long Term Stability			20		mV/khr
Output Impedance	10mA_{DC} and 1mA_{rms}, 100Hz-10kHz		1		Ω
■ $\overline{\text{RESET}}$ Function					
$\overline{\text{RESET}}$ Output Voltage					
Low R_1=20kΩ, V_{IN}=4.5V			0.8	1.0	V
High R_1=20kΩ, V_{IN}=14V		4.5	5.0	5.5	V
$\overline{\text{RESET}}$ Output Current	V_{IN}=4.5V, $\overline{\text{RESET}}$ in Low State		5		mA
ON/OFF Resistor	R_1 (±10% Tolerance)		20	30	kΩ

Package Pin Description

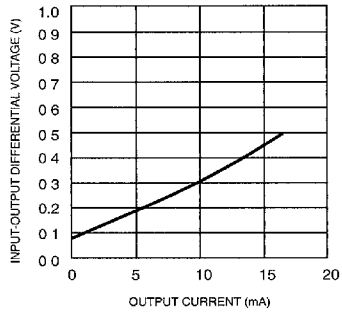
PACKAGE PIN #	PIN SYMBOL	FUNCTION
TO-220		
1	V_{IN}	Supply voltage to IC, usually direct from battery.
2	V_{OUT_1}	Regulated output voltage 5V, 500mA (typ) switched.
3	Gnd	Ground connection.
4	RESET/ ENABLE	CMOS compatible output pin, RESET goes low whenever V_{OUT_1} becomes unregulated. To use ENABLE option, connect pin via a resistor to V_{IN} (see app. notes).
5	V_{OUT_2}	STANDBY output 5V, 10mA typ, always on.

Typical Performance Characteristics

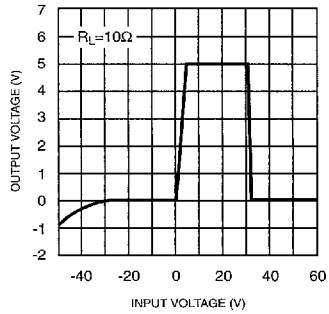
Dropout Voltage vs. Output Current



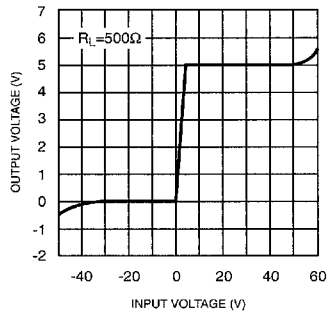
Standby Dropout Voltage vs. Output Current



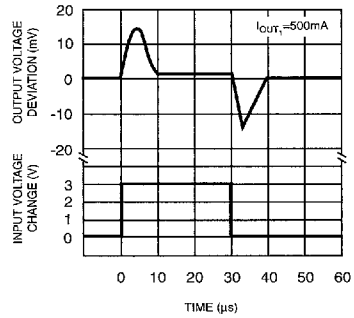
Output Voltage vs. Input Voltage



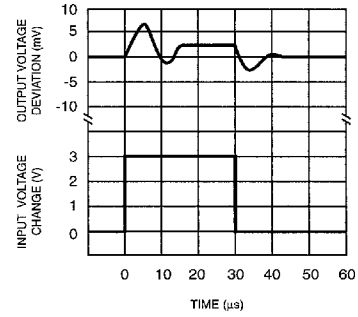
Standby Output Voltage vs. Input Voltage



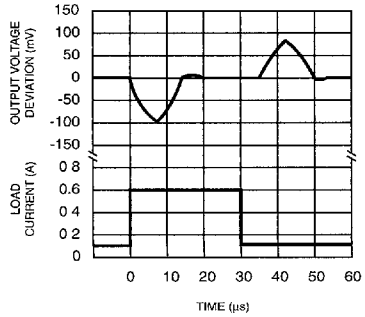
Line Transient Response (V_{OUT1})



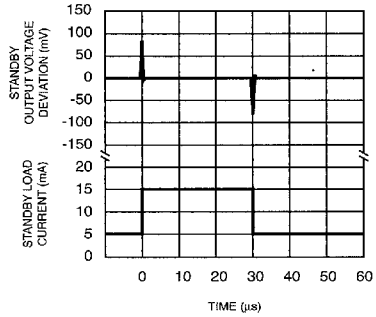
Line Transient Response (V_{OUT2})



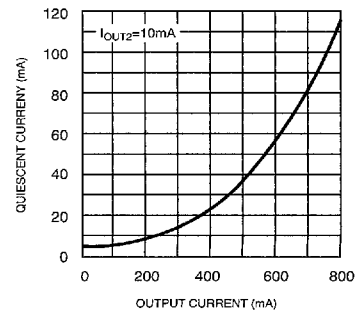
Load Transient Response (V_{OUT1})



Load Transient Response (V_{OUT2})

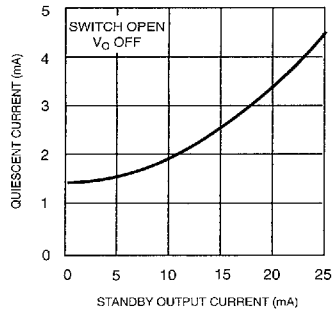


Quiescent Current vs. Output Current

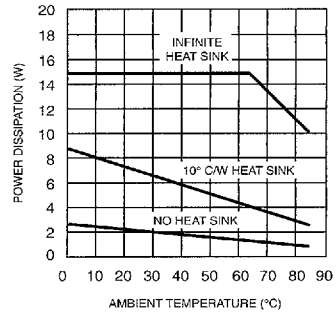


Typical Performance Characteristics: continued

Quiescent Current vs. Standby Output Current



Maximum Power Dissipation (TO-220)



Definition of Terms

Dropout Voltage: The input-output voltage differential at which the circuit ceases to regulate against further reduction in input voltage. Measured when the output voltage has dropped 100mV from the nominal value obtained at 14V input, dropout voltage is dependent upon load current and junction temperature.

Input Voltage: The DC voltage applied to the input terminals with respect to ground.

Input Output Differential: The voltage difference between the unregulated input voltage and the regulated output voltage for which the regulator will operate.

Line Regulation: The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

Load Regulation: The change in output voltage for a change in load current at constant chip temperature.

Long Term Stability: Output voltage stability under accelerated life-test conditions after 1000 hours with maximum rated voltage and junction temperature.

Output Noise Voltage: The rms AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

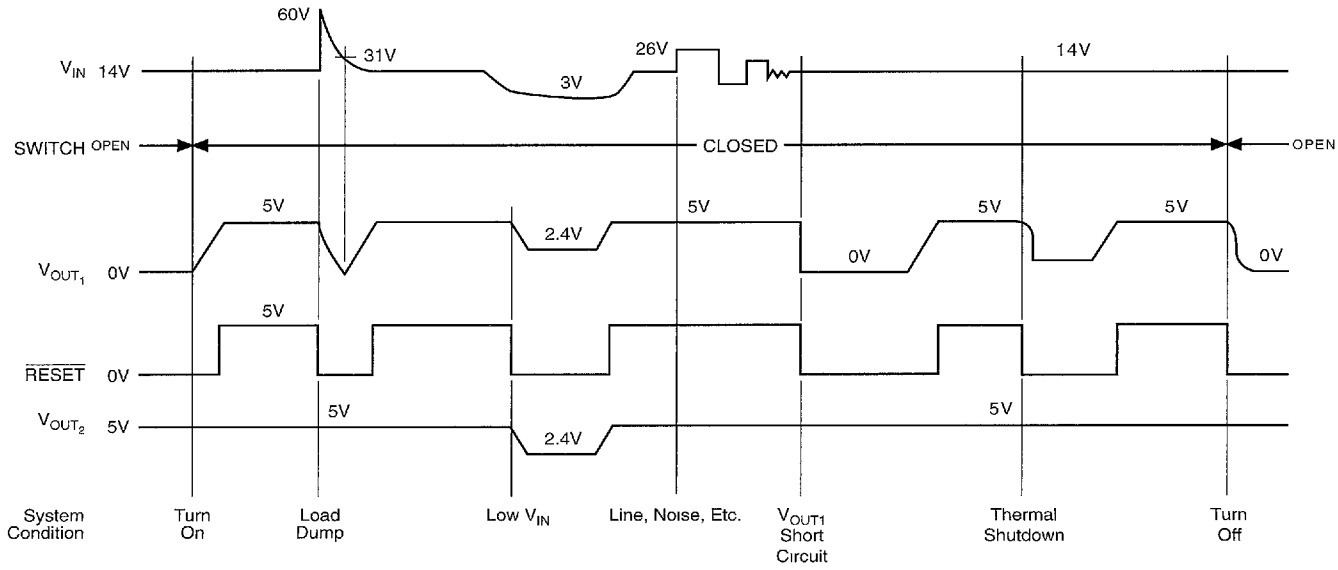
Quiescent Current: The part of the positive input current that does not contribute to the positive load current. i.e., the regulator ground lead current.

Ripple Rejection: The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

Temperature Stability of V_{OUT}: The percentage change in output voltage for a thermal variation from room temperature to either temperature extreme.

Current Limit: Peak current that can be delivered to the output.

Typical Circuit Waveform



Circuit Description and Application Notes

External Capacitors

The CS-8135 output capacitors are required for stability. Without them, the regulator outputs will oscillate. The capacitor values shown are the minimum recommended values. Actual size and type may vary depending upon the application load and temperature range. Capacitor effective series resistance (ESR) is also a factor in the IC stability. Worst-case is determined at the minimum ambient temperature and maximum load expected.

Output capacitors can be increased in size to any desired value above the minimum. One possible purpose of this would be to maintain the output voltages during brief conditions of negative input transients that might be characteristic of a particular system.

Capacitors must also be rated at all ambient temperatures expected in the system. To maintain regulator stability down to -40°C, capacitors rated at that temperature (such as tantalums) must be used.

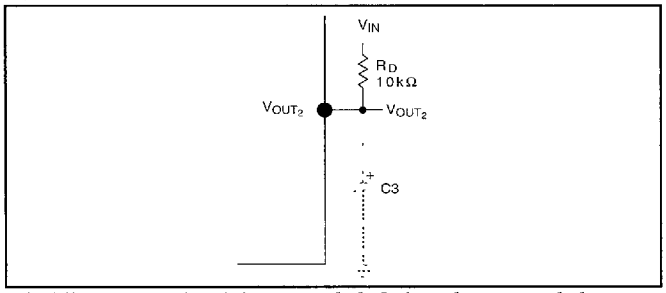
No capacitor should be attached to the $\overline{\text{RESET}}$ pin. Due to the internal circuits of the IC, oscillation on this pin could result.

Standby Output

The CS-8135 differs from most fixed voltage-regulators in that it is equipped with two regulator outputs instead on one. The additional output is intended for use in systems requiring standby memory circuits. While the high current regulator output can be controlled with the $\overline{\text{RESET}}$ pin described below, the standby output remains on under all conditions as long as sufficient input voltage is applied to the IC. Thus, memory and other circuits powered by this output remain unaffected by positive line transients, thermal shutdown, etc.

The standby regulator circuit is designed so that the quiescent current to the IC is very low (<3mA) when the other regulator output is off.

In applications where the standby output is not needed, it may be disabled by connecting a resistor from the standby output to the supply voltage. This eliminates the need for a capacitor on the output to prevent unwanted oscillations. The value of the resistor depends upon the minimum input voltage expected for a given system. Since the standby output is shunted with an internal diode zener, the current through the external resistor should be sufficient to bias V_{OUT_2} up to this point. Approximately 60µA will suffice, resulting in a 10kΩ external resistor for most applications.



Disabling V_{OUT_2} when it is not needed. C3 is no longer needed.

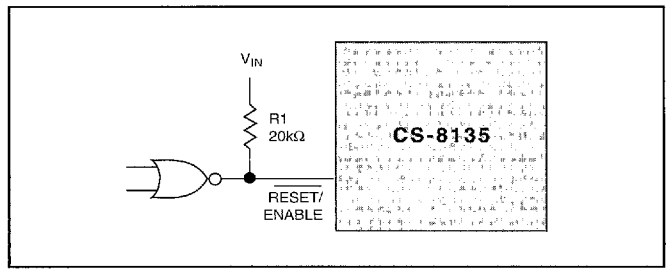
High Current Output

Unlike the standby regulated output, which must remain on whenever possible, the high current regulated output is fault protected against overvoltage and also incorporates thermal shutdown. If the input voltage rises above approximately 30V (e.g., load dump), this output will automatically shutdown. This protects the internal circuitry and enables the IC to survive higher voltage transients than would otherwise be expected. Thermal shutdown is effective against die overheating since the high current output is the dominant source of power dissipation in the IC.

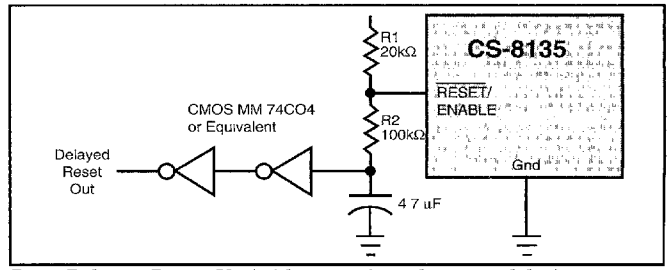
$\overline{\text{RESET}}$ Function

The $\overline{\text{RESET}}$ function has the ability to serve a dual purpose if desired. When controlled in the manner shown in the test circuit (common in automotive systems where $\overline{\text{RESET}}$/ENABLE is connected to the ignition switch), the pin also serves as an output flag that is active low whenever a fault condition is detected with the high current regulated output. In other words, under normal operating conditions, the output voltage of this pin is high (5V). This is set by an internal clamp. If the high current output becomes unregulated for any reason (line transients, short circuit, thermal shutdown, low input voltage, etc.) the pin switches to the active low state, and is capable of sinking several milliamps. This output signal can be used to initiate any reset or start-up procedure that may be required of the system.

The $\overline{\text{RESET}}$ pin can also be driven directly from logic circuits. The only requirement is that the 20kΩ pull-up resistor remain in place. This will not affect the logic gate since the voltage on this pin is limited by the internal clamp to 5V. The $\overline{\text{RESET}}$ signal is sacrificed in this arrangement since the maximum sink capability of the pin the active low state (approximately 5mA) is usually not sufficient to pull down the active high logic gate. Of course, the flag can be retained if the driving gate is open collector logic.



Controlling ON/OFF Terminal with a Typical CMOS or TTL Logic Gate



Reset Pulse on Power-Up (with approximately 300ms delay)

Circuit Description and Application Notes: continued

Thermal Management

The CS-8135 operates up to a junction temperature (T_J) of 150°C. However, the IC's worst-case operating conditions determine the maximum ambient temperature for a given application. The maximum ambient temperature may be calculated by the following equation:

$$T_A = T_J - [(V_{IN} - V_{O1})I_{O1} + (V_{IN} - V_{O2})I_{O2} + V_{IN}I_Q] R_{JA}$$

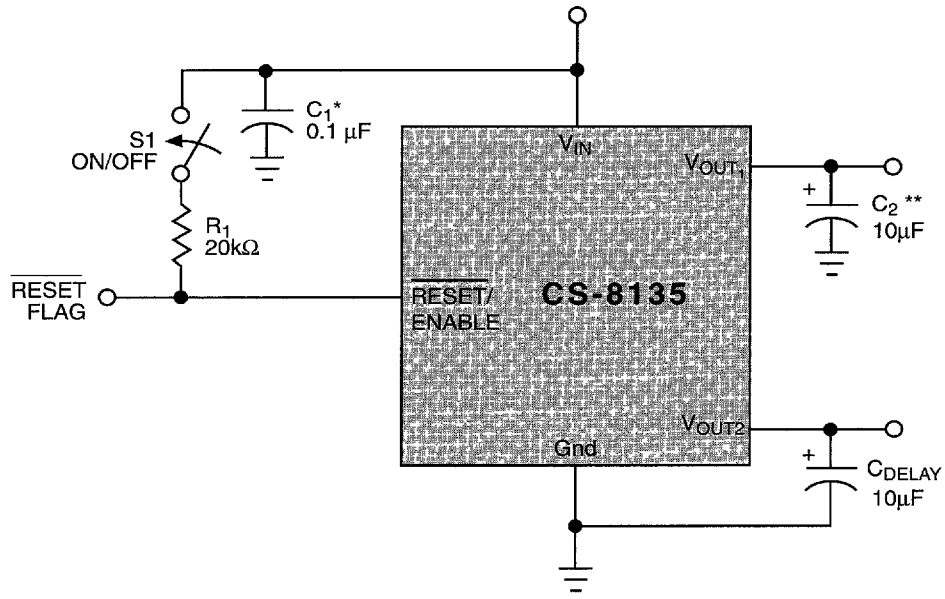
where T_J = 150°C
V_{IN} = Maximum Input Voltage
V_{O1} = 5V
I_{O1} = 5V Maximum Output Current
V_{O2} = 5V
I_{O2} = 5V Maximum Output Current
I_Q = IC's Quiescent current at Maximum Output Currents

The TO-220 thermal resistances are listed under the package thermal data heading. When using a heat sink:

$$R_{JA} = R_{JC} + R_{CA} = 3.5°C/W + R_{CA}$$

where R_{CA} = Heat Sink Thermal Resistance

Test & Application Circuit



NOTES:
* C1 required if regulator is located far from power supply filter.
** C2 required for stability value may be increased. Capacitor must operate at minimum temperature expected.

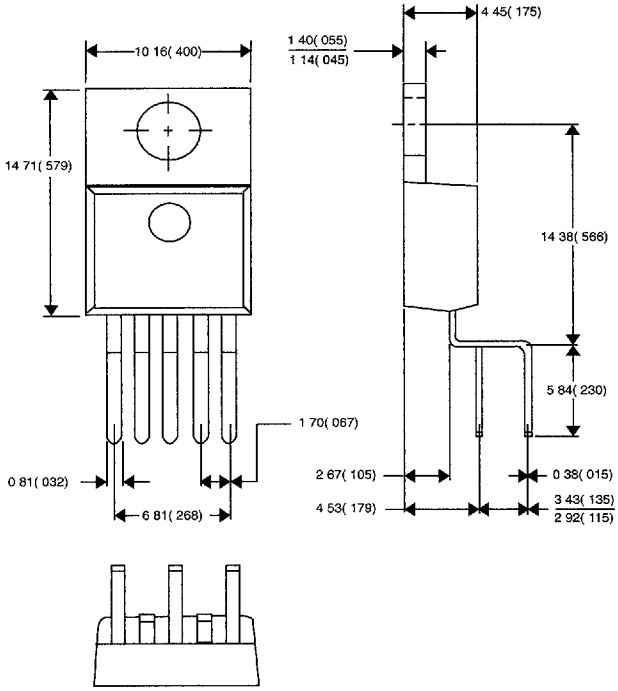
Package Specification

Package Dimensions in MM (Inches)

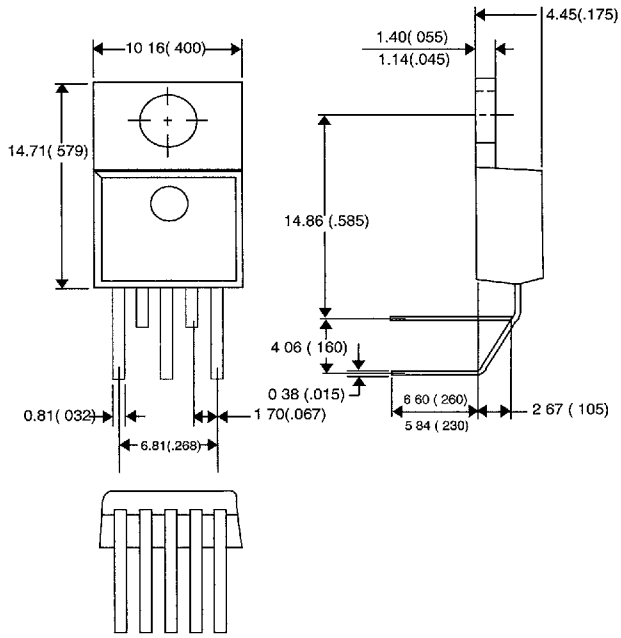
PACKAGE THERMAL DATA

Thermal Data		TO-220	
$R_{\Theta JC}$	typ	3.5	°C/W
$R_{\Theta JA}$	typ	50	°C/W

TO-220 Vertical



TO-220 Horizontal



Ordering Information

Part Number	Description
CS-8135T	TO-220 Straight
CS-8135TV	TO-220 Vertical
CS-8135TH	TO-220 Horizontal

Preliminary

This product is in the preproduction stages of the design process. The data sheet contains preliminary data. CSC reserves the right to make changes to the specifications without notice. Please contact CSC for the latest available information.