CS8363

3.3V Dual Micropower Low Dropout Regulator with $\overline{\text{ENABLE}}$ and $\overline{\text{RESET}}$

Description

The CS8363 is a precision micropower dual voltage regulator with $\overline{\text{ENABLE}}$ and $\overline{\text{RESET}}$.

The 3.3V standby output is accurate within ±2% while supplying loads of 100mA. Quiescent current is low, typically 140μA with a 300μA load. The active $\overline{\text{RESET}}$ output monitors the 3.3V standby output and holds the $\overline{\text{RESET}}$ line low during power-up and regulator dropout conditions. The $\overline{\text{RESET}}$ circuit includes hysteresis and is guaranteed to operate correctly with 1V on the standby output.

The second output tracks the 3.3V standby output through an external adjust lead, and can supply loads of 250mA with a typical dropout voltage of 400mV. The logic level $\overline{\text{ENABLE}}$ lead is used to control this tracking regulator output.

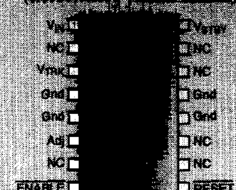
Both outputs are protected against overvoltage, short circuit, reverse battery and overtemperature conditions. The robustness and low quiescent current of the CS8363 makes it not only well suited for automotive microprocessor applications, but for any battery powered microprocessor applications.

Features

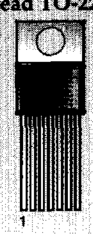
Short Circuit
60V Peak Transient
Reverse Battery

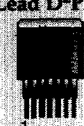
Package Options

16 Lead PDIP & SOIC Wide
(internally fused leads)



7 Lead TO-220 **7 Lead D²PAK**

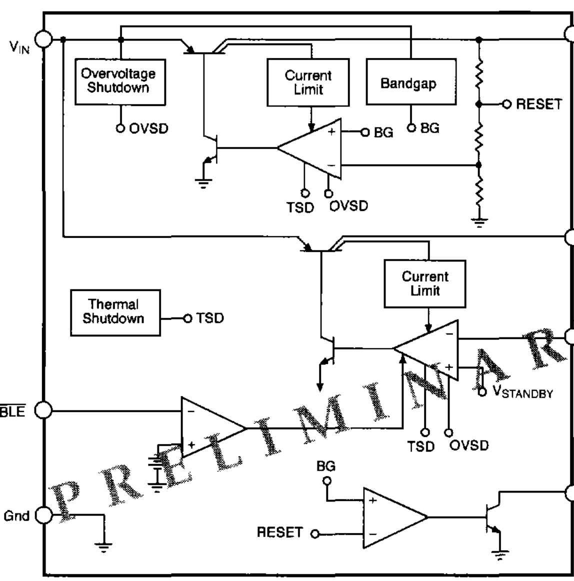




1. V_{STBY}
2. V_{IN}
3. V_{TRK}
4. Gnd
5. Adj
6. $\overline{\text{ENABLE}}$
7. $\overline{\text{RESET}}$

Consult factory for 20 Lead PSOP and SOIC Wide

Block Diagram



* Consult factory for positive ENABLE option.

Cherry Semiconductor

Cherry Semiconductor Corporation
2000 South County Trail, East Greenwich, RI 02818
Tel: (401)885-3600 Fax: (401)885-5786
Email: info@cherry-semi.com
Web Site: www.cherry-semi.com

Absolute Maximum Ratings

Supply Voltage, V_{IN} ..... -16V to 26V
Positive Transient Input Voltage, tr > 1ms 60V
Negative Transient Input Voltage, T < 100ms, 1% Duty Cycle ..... -50V
Input Voltage Range ($\overline{ENABLE}$, $\overline{RESET}$) ..... -0.3V to 10V
Junction Temperature ..... -40°C to +150°C
Storage Temperature Range ..... -55°C to +150°C
ESD Susceptibility (Human Body Model) 2kV
Lead Temperature Soldering
Wave Solder (through hole styles only) ..... 10 sec. max, 260°C peak
Reflow (SMD styles only) ..... 60 sec. max above 183°C, 230°C peak

Electrical Characteristics: 6V ≤ V_{IN} ≤ 26V, I_{OUT1} = I_{OUT2} = 100µA, -40°C ≤ T_A ≤ +125°C, -40°C ≤ T_J ≤ +150°C unless otherwise specified.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ Tracking Output (V_{TRK})					
V_{STBY} – V_{TRK}, V_{TRK} Tracking Error	6V ≤ V_{IN} ≤ 26V 100µA ≤ I_{TRK} ≤ 250mA (note 1)	-25		+25	mV
Adjust Pin Current, I_{Adj}	Loop in Regulation		1.5	5	µA
Line Regulation	6V ≤ V_{IN} ≤ 26V (note 1)		5	50	mV
Load Regulation	100µA ≤ I_{TRK} ≤ 250mA (note 1)		5	50	mV
Dropout Voltage (V_{IN} – V_{TRK})	I_{TRK} = 100µA I_{TRK} = 250mA		100 400	150 700	mV mV
Current Limit	V_{IN} = 12V, V_{TRK} = 3.0V	275	500		mA
Quiescent Current	V_{IN} = 12V, I_{TRK} = 250mA No Load on V_{STBY} V_{IN} = 12V, I_{TRK} =500µA, I_{STBY} = 100µA		25 145	50 220	mA µA
Reverse Current	V_{TRK} = 3.3V, V_{IN} = 0V		200	1500	µA
Ripple Rejection	f = 120Hz, I_{TRK} = 250mA 7V ≤ V_{IN} ≤ 17V	60	70		dB
■ Standby Output (V_{STBY})					
Output Voltage, V_{STBY}	4.5V ≤ V_{IN} ≤ 26V 100µA ≤ I_{STBY} ≤ 100mA	3.234	3.300	3.366	V
Line Regulation	6V ≤ V_{IN} ≤ 26V		5	50	mV
Load Regulation	100µA ≤ I_{STBY} ≤ 100mA		5	50	mV
Dropout Voltage (V_{IN} – V_{STBY})	I_{STBY} = 100µA, V_{IN} = 4.2V I_{STBY} = 100mA, V_{IN} = 4.2V			1.0 1.0	V V
Current Limit	V_{IN} = 12V, V_{STBY} = 3.0V	125	200		mA
Short Circuit Current	V_{IN} = 12V, V_{STBY} = 0V	10	100		mA
Quiescent Current	V_{IN} = 12V, I_{STBY} = 100mA I_{TRK} = 0mA V_{IN} = 12V, I_{STBY} = 300µA I_{TRK} = 0mA		10 140	20 200	mA µA
Reverse Current	V_{STBY} = 3.3V, V_{IN} = 0V		100	200	µA
Ripple Rejection	f = 120Hz, I_{STBY} = 100mA 7V ≤ V_{IN} ≤ 17V	60	70		dB

Note 1: V_{TRK} connected to Adj lead. V_{TRK} can be set to higher values by using an external resistor divider.

Electrical Characteristics: V_{IN} = V_{STBY} = 26V, I_{OUT1} = I_{OUT2} = 100mA, -40°C < T_J < +125°C, -40°C < T_J < +150°C unless otherwise specified.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ RESET ENABLE Functions					
ENABLE Input Threshold		0.8	1.2	2.0	V
ENABLE Input Bias Current	V_{ENABLE} = 0V to 10V	-10	0	10	µA
RESET Hysteresis		20	60	100	mV
RESET Threshold Low (V_{RL})	V_{STBY} Decreasing, V_{IN} > 4.5V	92.5%	95%	97.5%	V_{STBY}
RESET O/P Leakage				25	µA
Output Voltage					
Low (V_{RLO}); R_{RST} = 10kΩ	1V ≤ VS_{TBY} ≤ V_{RL}		0.1	0.4	V
Low (V_{RPEAK})	V_{STBY}, Power Up, Power Down		0.6	1.0	V
V_{IN} (V_{RST} Low)	V_{STBY} = 3.3V		4.0	4.5	V
■ Protection Circuitry (Both Outputs)					
Independent Thermal Shutdown	V_{STBY}	150	180		°C
	V_{TRK}	150	165		°C
Overvoltage Shutdown		30	34	38	V

Package Lead Description

PACKAGE LEAD #				LEAD SYMBOL	FUNCTION
7L TO-220	7L D^2PAK	16L PDIP & SO Wide *(Internally Fused Leads)*	20L SO Wide *(Internally Fused Leads)*		
1	1	16	20	V_{STBY}	Standby output voltage delivering 100mA.
2	2	1	1	V_{IN}	Input voltage.
3	3	3	2	V_{TRK}	Tracking output voltage controlled by ENABLE delivering 250mA.
4	4	4,5,12,13	4,5,6,7 14,15,16,17	Gnd	Reference ground connection.
5	5	6	8	Adj	Resistor divider from V_{TRK} to Adj. Sets the output voltage on V_{TRK}. If tied to V_{TRK}, V_{TRK} will track V_{STBY}.
6	6	8	10	ENABLE	Provides on/off control of the tracking output, active LOW.
7	7	9	11	RESET	CMOS compatible output lead that goes low whenever V_{STBY} falls out of regulation.
		2,7,10, 11,14,15	3,9,12,13, 18,19	NC	No Connection.

Circuit Description

ENABLE Function

The $\overline{\text{ENABLE}}$ function switches the output transistor for V_{TRK} on and off. When the $\overline{\text{ENABLE}}$ lead voltage exceeds 1.4V(typ), V_{TRK} turns off. This input has several hundred millivolts of hysteresis to prevent spurious output activity during power-up or power-down.

RESET Function

The $\overline{\text{RESET}}$ is an open collector NPN transistor, controlled by a low voltage detection circuit sensing the V_{STBY} (3.3V) output voltage. This circuit guarantees the $\overline{\text{RESET}}$ output stays below 1V (0.1V typ) when V_{STBY} is as low as 1V to ensure reliable operation of microprocessor-based systems.

V_{TRK} Output Voltage

This output uses the same type of output device as V_{STBY}, but is rated for 250mA. The output is configured as a tracking regulator of the standby output. By using the standby output as a voltage reference, giving the user an external programming lead (Adj lead), output voltages from 3.3V to 20V are easily realized. The programming is done with a simple resistor divider, and following the formula:

$$V_{TRK} = V_{STBY} \times (1 + R1/R2) + I_{Adj} \times R1$$

If another 3.3V output is needed, simply connect the Adj lead to the V_{TRK} output lead.

Application Notes

External Capacitors

Output capacitors for the CS8363 are required for stability. Without them, the regulator outputs will oscillate. 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 must be used.

More information on capacitor selection for Smart Regulators™ is available in the Smart Regulator application note, "Compensation for Linear Regulators."

Calculating Power Dissipation in a Dual Output Linear Regulator

The maximum power dissipation for a dual output regulator (Figure 1) is:

$$PD(max) = \{V_{IN}(max) - V_{OUT1}(min)\}I_{OUT1}(max) + \{V_{IN}(max) - V_{OUT2}(min)\}I_{OUT2}(max) + V_{IN}(max)I_Q \quad (1)$$

Where

$V_{IN}(max)$ is the maximum input voltage,

$V_{OUT1}(min)$ is the minimum output voltage from V_{OUT1},

$V_{OUT2}(min)$ is the minimum output voltage from V_{OUT2},

$I_{OUT1}(max)$ is the maximum output current, for the application

$I_{OUT2}(max)$ is the maximum output current, for the application

I_Q is the quiescent current the regulator consumes at $I_{OUT}(max)$.

Once the value of PD(max) is known, the maximum permissible value of $R_{\Theta JA}$ can be calculated:

$$R_{\Theta JA} = \frac{150°C - T_A}{P_D} \quad (2)$$

The value of $R_{\Theta JA}$ can then be compared with those in the package section of the data sheet. Those packages with $R_{\Theta JA}$'s less than the calculated value in equation 2 will keep the die temperature below 150°C.

In some cases, none of the packages will be sufficient to dissipate the heat generated by the IC, and an external heat sink will be required.

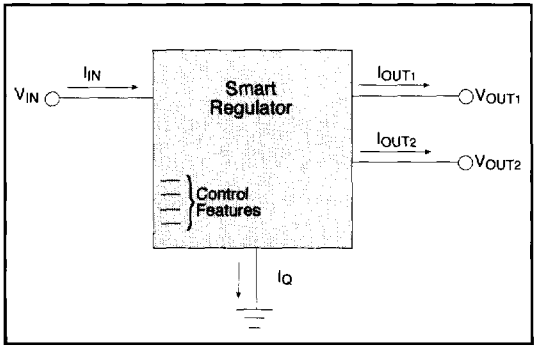


Figure 1: Dual output regulator with key performance parameters labeled.

Heat Sinks

A heat sink effectively increases the surface area of the package to improve the flow of heat away from the IC and into the surrounding air.

Each material in the heat flow path between the IC and the outside environment will have a thermal resistance. Like series electrical resistances, these resistances are summed to determine the value of $R_{\Theta JA}$:

$$R_{\Theta JA} = R_{\Theta JC} + R_{\Theta CS} + R_{\Theta SA} \quad (3)$$

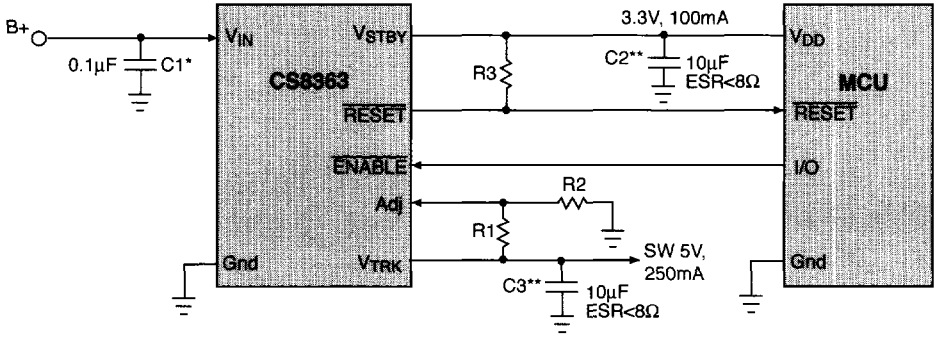
where:

$R_{\Theta JC}$ = the junction–to–case thermal resistance,
$R_{\Theta CS}$ = the case–to–heat sink thermal resistance, and
$R_{\Theta SA}$ = the heat sink–to–ambient thermal resistance.

$R_{\Theta JC}$ appears in the package section of the data sheet. Like $R_{\Theta JA}$, it too is a function of package type. $R_{\Theta CS}$ and $R_{\Theta SA}$ are functions of the package type, heat sink and the interface between them. These values appear in heat sink data sheets of heat sink manufacturers.

Test & Application Circuits

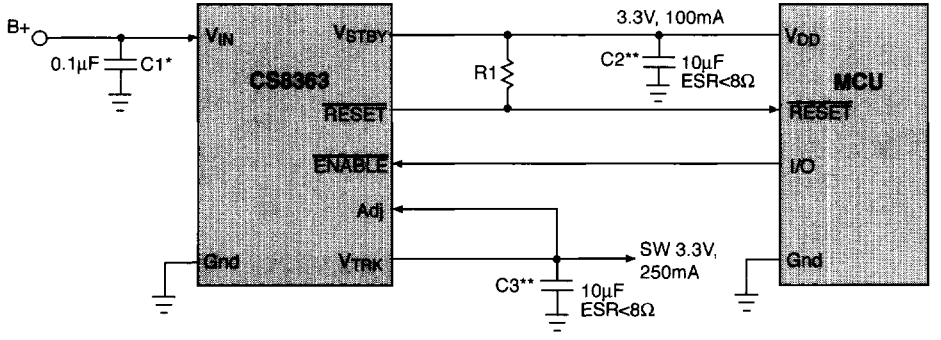
3.3V, 5V Regulator



$V_{TRK} \sim V_{STBY}\ (1 + R1/R2)$
For $V_{TRK} \sim 5V$, $R1/R2 \sim 0.5$

* C1 is required if regulator is located far from power supply filter.
** C2 and C3 are required for stability.

Dual 3.3V Regulator



* C1 is required if regulator is located far from power supply filter.
** C2 and C3 are required for stability.

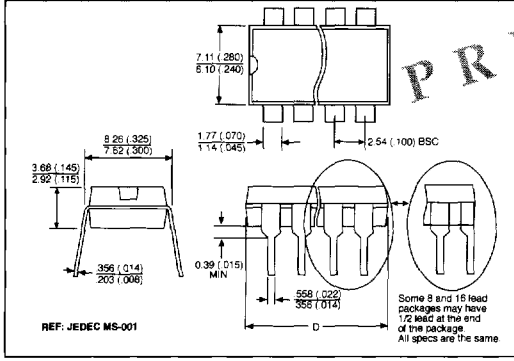
Package Specification

PACKAGE DIMENSIONS IN mm(INCHES)

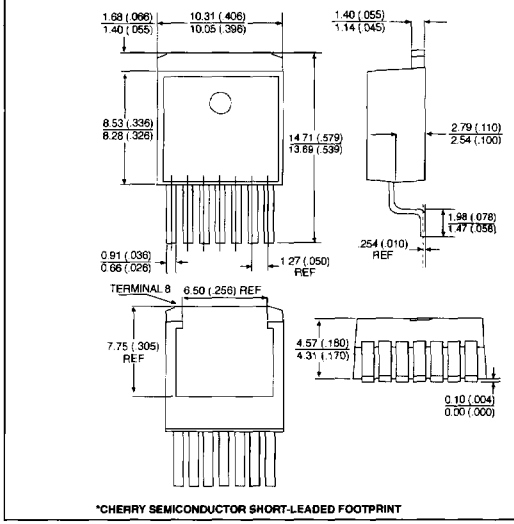
Lead Count	D			
	Metric		English	
	Max	Min	Max	Min
16L PDIP	19.69	18.67	.775	.735
16L SO Wide*	10.50	10.10	.413	.398
20L SO Wide*	13.00	12.60	.512	.496

** Internally Fused Leads*

Plastic DIP (N); 300 mil wide



7 Lead D²PAK (DPS)* Short-Leaded



*CHERRY SEMICONDUCTOR SHORT-LEADED FOOTPRINT

Ordering Information

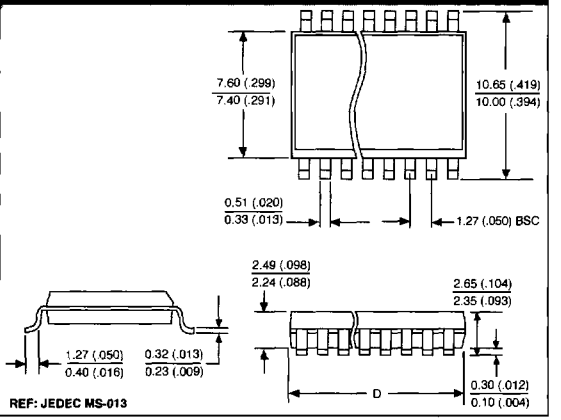
Part Number	Description
CS8363YDPS7	7L D²PAK short-leaded
CS8363YDPSR7	7L D²PAK short-leaded, *(tape & reel)*
CS8363YT7	7L TO-220 (Straight)
CS8363YDWF16	16L SO Wide*
CS8363YDWFR16	16L SO Wide*, *(tape & reel)*
CS8363YN16	16L PDIP
CS8363YDWF20	20L SO Wide*
CS8363YDWFR20	20L SO Wide*, *(tape & reel)*

PACKAGE THERMAL DATA

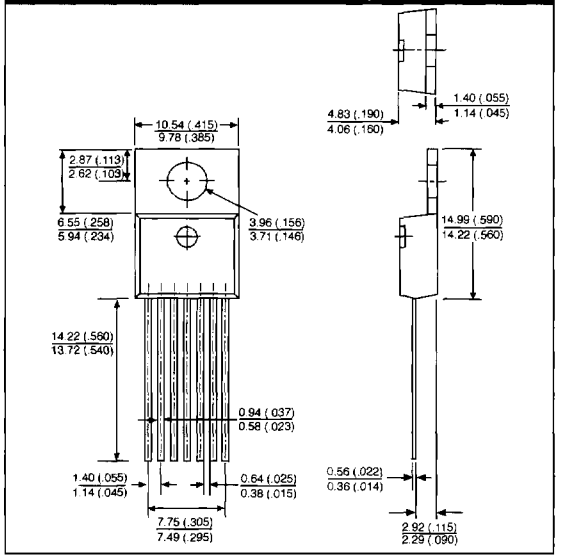
Thermal Data	typ	$R_{\theta JA}$	$R_{\theta JC}$	°C/W
7L D²PAK		10-50**	3.5	
7L TO-220		50	3.5	
16L PDIP		80	42	
16L SO Wide*		75	18	
20L SO Wide*		55	9	

*** Depending on thermal properties of substrate. $R_{\theta JA} = R_{\theta JC} + R_{\theta CA}$*

Surface Mount Wide Body (DW); 300 mil wide



7 Lead TO-220 (T) Straight



Preliminary

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