



# Alternator Voltage Regulator FET Driver

## Description

The CS3361 integral alternator regulator integrated circuit provides the voltage regulation for automotive, 3-phase alternators.

It drives an external logic level N channel enhancement power FET for control of the alternator field current. In the event of a charge

fault, a lamp output pin is provided to drive an external darlington transistor capable of switching on a fault indicator lamp. An overvoltage or no Stator signal condition activates the lamp output.

The CS3361 is available in a 14 lead SO package.

### Features

- Drives Logic Level Power NFET
- 80V Load Dump
- Temperature Compensated Regulation Voltage
- Shorted Field Protection Duty Cycle, Self Clearing

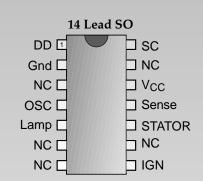
### Absolute Maximum Ratings

Storage Temperature Range	55°C to +165°C
Junction Temperature Range	
Continuous Supply	
I <sub>CC</sub> Load Dump	
Lead Temperature Soldering	
Reflow (SMD styles only)60 sec. max	above 183°C, 230°C peak

#### **Block Diagram** Vcc Load Dump ENABLE Detection and Series IGN Protection Regulator VSUP OSC osc VSUP Lamp Indicato RS Flop Set Sense Dominate Device 15 Driver Q **†**R VREG ÷ DELAY VHV Ŷ SC ENABLE STATOR Power Up LAMP STATOR Timer STATOR VSUP ⊥\_ Gnd



### **Package Options**



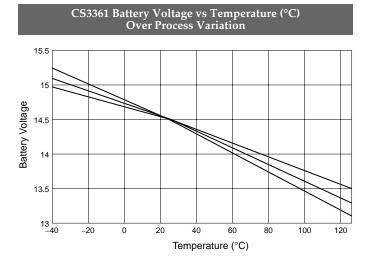
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Supply         -         10           Supply Current Enabled         -         10           Supply Current Disabled         -         50           Driver Stage         -         50           Output High Voltage         5.5         12           Output High Current         Vpp = 1.2V         -10         -6         -4           Output High Current         Vpp = 1.2V         -10         -6         -4           Output High Current         Vpp = 0.022 μF         200         -         -           Minimum ON Time         Cosc = 0.022 μF         200         -         -           Short Circuit Duty Cycle         1         5         5         -           Field Switch Tum On         Rise Time         15         75         -           Fall Time         15         75         -         -           Input High Voltage         10         -         -         6           Stator         10         -         -         50           Output High Voltage         Ir_c > 10A         -         0.35           Imput Low Voltage         Ir_c > 10A         -         0.35           Input High Voltage         Ir_c > 10A         -	
Supply Current Disabled         -         50           Driver Stage	
Driver Stage	m
Output High Voltage         5.5         12           Output High Current $V_{DD} = 1.2V$ -10         -6         -4           Output Low Voltage $I_{OL} = 25\muA$ -         0.35           Minimum ON Time $C_{OSC} = 0.022\muF$ 200         -           Short Circuit Duty Cycle         -         6         10           Short Circuit Duty Cycle         1         5         75           Field Switch Turn On         Rise Time         15         75           Fall Time         15         75         75           Stator         -         6         100         600           Input High Voltage         -         6         600         600           Lamp         -         6         100         600           Lamp         -         0.35         0         0.35           Ignition         -         -         50         0           Output High Voltage $I_{CC} > ImA$ 1.8         -         -           Input High Voltage $I_{CC} < 100\mu A$ -         0.5         50           Output High Voltage $I_{CC} < 100\mu A$ -         0.5         50 <td>μ.</td>	μ.
Output High Current $V_{DD} = 1.2V$ -10         -6         -4           Output Low Voltage $I_{OL} = 25\mu$ A         -         0.35           Minimum ON Time $C_{OSC} = 0.022\mu$ F         200         -           Minimum Duty Cycle         -         6         10           Short Circuit Duty Cycle         1         5         5           Field Switch Turn On         Rise Time         15         75           Fall Time         10         -         6         00           Input High Voltage         10         -         6         5           Input Low Voltage         -         6         100         600           Lamp         0         -         6         100         600           Lamp         0         -         50         0         0.35           Ignition         -         0.35         0         0.35         0           Input High Voltage         I <sub>LAMP</sub> @ 3V         -         0.35         0           Input High Voltage         I <sub>LCC</sub> > 1mA         1.8         -         -           Input High Voltage         I <sub>CC</sub> < 0.022µF	
Output Low Voltage $I_{OL} = 25\mu A$ -         0.35           Minimum ON Time $C_{OSC} = 0.022\mu F$ 200         -         6         10           Short Circuit Duty Cycle         -         6         10         5         5           Field Switch Turn On         Rise Time         15         75         75           Fall Time         15         75         75           Stator         -         6         10           Input High Voltage         -         6         6           Input High Voltage         -         6         6           Input Low Voltage         -         6         100         600           Lamp         -         0.35         0         0         0.35           Ignition         -         0.35         0         0.35         0           Input High Voltage         I <sub>CC</sub> > 1mA         1.8         -         -           Input Kigh Voltage         I <sub>CC</sub> > 1mA         1.8         -         -           Input Low Voltage         I <sub>CC</sub> < 0.022µF	- <u> </u>
Minimum ON Time $C_{OSC} = 0.022 \mu F$ 200           Minimum Duty Cycle         -         6         10           Short Circuit Duty Cycle         1         5           Field Switch Turn On         15         75           Rise Time         15         75           Fall Time         10         1           Input High Voltage         10         6           Stator         -         6           Input Low Voltage         -         6           Stator Time Out         High to Low         6         100           Output Low Voltage         -         50         6           Output High Current         V <sub>LAMP</sub> @ 3V         -         50           Output High Voltage         I <sub>LAMP</sub> @ 30mA         -         0.35           Ignition         -         0.35         5           Input High Voltage         I <sub>CC</sub> > 1mA         1.8         -           Input High Voltage         I <sub>CC</sub> > 0.022 μF         90         210           Site Time / Fall Time         C <sub>OSC</sub> = 0.022 μF         90         210           Rise Time / Fall Time         C <sub>OSC</sub> = 0.022 μF         -         4.5      Battery Sense         -         -10 <td>m</td>	m
Minimum Duty Cycle       -       6       10         Short Circuit Duty Cycle       1       5         Field Switch Turn On       15       75         Rise Time       15       75         Fall Time       10       75         Stator       10       10         Input High Voltage       -       6         Stator Time Out       High to Low       6       100       600         Lamp       -       6       50       00       600         Lamp       -       50       00       600       600       600         Lamp       -       0.35       50       00       600 <td>V</td>	V
Short Circuit Duty Cycle       1       5         Field Switch Turn On       15       75         Fall Time       15       75         Stator       15       75         Input High Voltage       10       6         Input Low Voltage        6         Stator Time Out       High to Low       6       100       600         Lamp       -       50       00       600         Lamp       -       50       0.35       1         Output High Current       VLAMP @ 3V       -       0.35       0.35         Ignition       -       0.35       0.35       0.35       0.35         Input High Voltage       I_CC > 1mA       1.8       -       -         Input High Voltage       I_CC < 100 $\mu$ A       -       0.5       0.5         Oscillator       -       0.5       0.5       0.5         Oscillator Frequency       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       -       4.5       3.5         Battery Sense       -	μ
Short Circuit Duty Cycle       1       5         Field Switch Turn On       15       75         Fall Time       15       75         Stator       15       75         Input High Voltage       10       6         Input Low Voltage        6         Stator Time Out       High to Low       6       100       600         Lamp       -       50       00       600         Lamp       -       50       0.35       1         Output High Current       VLAMP @ 3V       -       0.35       0.35         Ignition       -       0.35       0.35       0.35       0.35         Input High Voltage       I_CC > 1mA       1.8       -       -         Input High Voltage       I_CC < 100 $\mu$ A       -       0.5       0.5         Oscillator       -       0.5       0.5       0.5         Oscillator Frequency       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       -       4.5       3.5         Battery Sense       -	%
Field Switch Turn On Rise Time       15       75         Fall Time       15       75         Stator       15       75         Input High Voltage       10       10         Input Low Voltage       -       6         Stator Time Out       High to Low       6       100       600         Lamp       -       50       6       00       600         Lamp       -       -       50       0.35         Output High Current       VLAMP @ 3V       -       0.35         Ignition       -       0.35       1         Input Low Voltage       I_CC > 1mA       1.8       -         Input Low Voltage       I <sub>CC</sub> < 100 $\mu$ A       -       0.5         Oscillator       -       0.5       5         Oscillator Frequency       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       90       210         Rise Time/Fall Time       C <sub>OSC</sub> = 0.022 $\mu$ F       -       4.5         Battery Sense       -       -       4.5         Input Current       -10       +10	%
Fall Time       15       75         Stator       10       10         Input High Voltage       10       6         Input Low Voltage       -       6         Stator Time Out       High to Low       6       100       600         Lamp       -       50       50         Output High Current $V_{LAMP} @ 3V$ -       50         Output Low Voltage       ILAMP @ 30mA       -       0.35         Ignition       -       0.35         Input High Voltage       I <sub>CC</sub> > 1mA       1.8       -         Input Low Voltage       I <sub>CC</sub> < 100μA	
Stator         10           Input High Voltage         10           Input Low Voltage         -           Stator Time Out         High to Low           6         100           Lamp         -           Output High Current $V_{LAMP} @ 3V$ $V_{LAMP} @ 30mA$ -           Output Low Voltage $I_{LAMP} @ 30mA$ Input High Voltage $I_{CC} > 1mA$ Input Low Voltage $I_{CC} < 100 \mu A$ Oscillator         -           Oscillator         -           Oscillator Frequency $C_{OSC} = 0.022 \mu F$ 90           Rise Time / Fall Time $C_{OSC} = 0.022 \mu F$ -           Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -           Battery Sense         -         4.5           Input Current         -         -           Regulation Voltage $@ 25^{\circ}C, R_1 = 100 k\Omega, R_2 = 50 k\Omega$ 13.8           Proportional Control         0.10         0.25           High Voltage         V <sub>High Voltage</sub> @ Lamp On         1.083	μ
Input High Voltage         10           Input Low Voltage         -         6           Stator Time Out         High to Low         6         100         600           Lamp         6         100         600           Output High Current $V_{LAMP} @ 3V$ -         50           Output Low Voltage $I_{LAMP} @ 30mA$ -         0.35           Ignition         -         -         0.35           Input High Voltage $I_{CC} > 1mA$ 1.8         -           Input Low Voltage $I_{CC} < 100 \mu A$ -         0.5           Oscillator         Icc < 100 μA	μ
Input Low Voltage       -       6         Stator Time Out       High to Low       6       100       600         Lamp       -       50       6       100       600         Lamp       -       50       50       50         Output High Current $V_{LAMP} @ 3W$ -       50         Output Low Voltage $I_{LAMP} @ 30mA$ -       0.35         Ignition       -       -       0.35         Input High Voltage $I_{CC} > 1mA$ 1.8       -         Input Low Voltage $I_{CC} < 100 \mu A$ -       0.5         Oscillator       -       0.5       -         Oscillator       -       17       -         Oscillator Frequency $C_{OSC} = 0.022 \mu F$ 90       210         Rise Time/Fall Time $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -       -       4.5         Input Current       -10       +10       -         Regulation Voltage $@25^{\circ C}$ , $R_1 = 100 k\Omega$ , $R_2 = 50 k\Omega$ 13.8       15.8         Proportional Control       0.10       0.25       -         High Voltage       V <sub>High Voltage</sub> @ Lamp On <td></td>	
Input Low Voltage       -       6         Stator Time Out       High to Low       6       100       600         Lamp       -       50       6       100       600         Lamp       -       50       50       50         Output High Current $V_{LAMP} @ 3W$ -       50         Output Low Voltage $I_{LAMP} @ 30mA$ -       0.35         Ignition       -       -       0.35         Input High Voltage $I_{CC} > 1mA$ 1.8       -         Input Low Voltage $I_{CC} < 100 \mu A$ -       0.5         Oscillator       -       0.5       -         Oscillator       -       17       -         Oscillator Frequency $C_{OSC} = 0.022 \mu F$ 90       210         Rise Time/Fall Time $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -       -       4.5         Input Current       -10       +10       -         Regulation Voltage $@25^{\circ C}$ , $R_1 = 100 k\Omega$ , $R_2 = 50 k\Omega$ 13.8       15.8         Proportional Control       0.10       0.25       -         High Voltage       V <sub>High Voltage</sub> @ Lamp On <td></td>	
Stator Time Out       High to Low       6       100       600         Lamp $\sim$	V
Lamp         -         50           Output High Current $V_{LAMP} @ 3V$ -         50           Output Low Voltage $I_{LAMP} @ 30mA$ -         0.35           Ignition         -         0.35           Input High Voltage $I_{CC} > ImA$ 1.8         -           Input Low Voltage $I_{CC} > ImA$ 1.8         -           Input Low Voltage $I_{CC} < 100 \mu A$ -         0.5           Oscillator         -         0.5         -           Oscillator Frequency $C_{OSC} = 0.022 \mu F$ 90         210           Rise Time/Fall Time $C_{OSC} = 0.022 \mu F$ 90         210           Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -         4.5           Battery Sense         -         -         4.5           Input Current         -10         +10           Regulation Voltage $@25^{\circ}C, R_1 = 100 k\Omega, R_2 = 50 k\Omega$ 13.8         15.8           Proportional Control         0.10         0.25         149 Voltage         0.10         0.25	m
Output High Current $V_{LAMP} @ 3V$ -         50           Output Low Voltage         I <sub>LAMP</sub> @ 30mA         -         0.35           Ignition         -         0.35           Input High Voltage         I <sub>CC</sub> > 1mA         1.8         -           Input Low Voltage         I <sub>CC</sub> < 100 $\mu$ A         -         0.5           Oscillator         -         0.5           Oscillator Frequency         C <sub>OSC</sub> = 0.022 $\mu$ F         90         210           Rise Time / Fall Time         C <sub>OSC</sub> = 0.022 $\mu$ F         90         210           Oscillator High Threshold         C <sub>OSC</sub> = 0.022 $\mu$ F         -         4.5           Battery Sense         -         -         4.5           Input Current         -10         +10           Regulation Voltage         @25°C, R <sub>1</sub> = 100kΩ, R <sub>2</sub> = 50kΩ         13.8         15.8           Proportional Control         0.10         0.25         1190           High Voltage         V <sub>High Voltage</sub> @ Lamp On         1.083         1.190	
Output Low Voltage $I_{LAMP} @ 30mA$ -         0.35           Ignition	μ
Image:	μ. V
Input High Voltage         I <sub>CC</sub> > ImA         1.8         -           Input Low Voltage         I <sub>CC</sub> < 100 $\mu$ A         -         0.5           Oscillator         -         0.5           Oscillator Frequency         C <sub>OSC</sub> = 0.022 $\mu$ F         90         210           Rise Time/Fall Time         C <sub>OSC</sub> = 0.022 $\mu$ F         -         4.5           Oscillator High Threshold         C <sub>OSC</sub> = 0.022 $\mu$ F         -         4.5           Battery Sense         -         -         4.5           Input Current         -10         +10           Regulation Voltage         @25°C, R <sub>1</sub> = 100kΩ, R <sub>2</sub> = 50kΩ         13.8         15.8           Proportional Control         0.10         0.25         1190	v
Input Low Voltage         I <sub>CC</sub> < 100μA         -         0.5           Oscillator $-$ 0.5           Oscillator Frequency         C <sub>OSC</sub> = 0.022μF         90         210           Rise Time/Fall Time         C <sub>OSC</sub> = 0.022μF         90         210           Oscillator High Threshold         C <sub>OSC</sub> = 0.022μF         -         4.5           Battery Sense         -         4.5           Input Current         -10         +10           Regulation Voltage         @25°C, R <sub>1</sub> = 100kΩ, R <sub>2</sub> = 50kΩ         13.8         15.8           Proportional Control         V <sub>High Voltage</sub> @ Lamp On         1.083         1.190	
Oscillator       90       210         Oscillator Frequency $C_{OSC} = 0.022 \mu F$ 90       210         Rise Time/Fall Time $C_{OSC} = 0.022 \mu F$ 17       -         Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -       4.5         Input Current       -10       +10         Regulation Voltage       @25°C, R <sub>1</sub> = 100k $\Omega$ , R <sub>2</sub> = 50k $\Omega$ 13.8       15.8         Proportional Control       0.10       0.25         High Voltage       V <sub>High Voltage</sub> @ Lamp On       1.083       1.190	V
Oscillator Frequency $C_{OSC} = 0.022 \mu F$ 90       210         Rise Time/Fall Time $C_{OSC} = 0.022 \mu F$ 17       -         Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -       4.5         Input Current       -10       +10         Regulation Voltage       @25°C, R <sub>1</sub> = 100k $\Omega$ , R <sub>2</sub> = 50k $\Omega$ 13.8       15.8         Proportional Control       0.10       0.25         High Voltage       V <sub>High Voltage</sub> @ Lamp On       1.083       1.190	V
Rise Time / Fall Time $C_{OSC} = 0.022 \mu F$ 17       -         Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -       4.5         Input Current       -10       +10         Regulation Voltage       @25°C, R <sub>1</sub> = 100k $\Omega$ , R <sub>2</sub> = 50k $\Omega$ 13.8       15.8         Proportional Control       0.10       0.25         High Voltage       V <sub>High Voltage</sub> @ Lamp On       1.083       1.190	
Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -         Input Current       -10       +10         Regulation Voltage       @25°C, $R_1 = 100 k\Omega$ , $R_2 = 50 k\Omega$ 13.8       15.8         Proportional Control       V <sub>High Voltage</sub> @ Lamp On       1.083       1.190	H
Oscillator High Threshold $C_{OSC} = 0.022 \mu F$ -       4.5         Battery Sense       -         Input Current       -10       +10         Regulation Voltage       @25°C, $R_1 = 100 k\Omega$ , $R_2 = 50 k\Omega$ 13.8       15.8         Proportional Control       V <sub>High Voltage</sub> @ Lamp On       1.083       1.190	-
Input Current         -10         +10           Regulation Voltage $@25^{\circ}$ C, $R_1 = 100$ k $\Omega$ , $R_2 = 50$ k $\Omega$ 13.8         15.8           Proportional Control         0.10         0.25           High Voltage         V <sub>High Voltage</sub> @ Lamp On         1.083         1.190	V
Input Current         -10         +10           Regulation Voltage $@25^{\circ}$ C, $R_1 = 100$ k $\Omega$ , $R_2 = 50$ k $\Omega$ 13.8         15.8           Proportional Control         0.10         0.25           High Voltage         V <sub>High Voltage</sub> @ Lamp On         1.083         1.190	
Regulation Voltage $@25^{\circ}C, R_1 = 100k\Omega, R_2 = 50k\Omega$ 13.8         15.8           Proportional Control         0.10         0.25           High Voltage         V <sub>High Voltage</sub> @ Lamp On         1.083         1.190	
Proportional Control         0.10         0.25           High Voltage         V <sub>High Voltage</sub> @ Lamp On         1.083         1.190	μ.
High VoltageV High Voltage @ Lamp On1.0831.190	V
	V
Threshold Ratio     V <sub>Regulation</sub> @ 50% Duty Cycle       High Voltage Hysteresis     0.020	

	Package Pin Description		
PACKAGE PIN #	PIN SYMBOL	rge Pin Description C33 FUNCTION 61	
14 Lead SO			
1	Driver	Output driver for external power switch.	
2	Gnd	Ground.	
3, 6, 7, 9, 13	NC	No connection.	
4	OSC	Timing capacitor for oscillator.	
5	Lamp	Base driver for lamp driver indicates no stator signal or over- voltage condition.	
8	IGN	Switched ignition power up.	
10	Stator	Stator signal input for stator timer.	
11	Sense	Battery sense voltage regulator comparator input and protection.	
12	V <sub>CC</sub>	Supply for IC.	
14	SC	Short circuit sensing.	

### **Typical Performance Characteristics**



The CS3361 is designed for use in an alternator charging system.

In a standard alternator design (Figure 1), the rotor carries the field winding. An alternator rotor usually has several N and S poles. The magnetic field for the rotor is produced by forcing current through a field or rotor winding. The Stator windings are formed into a number of coils spaced around a cylindrical core. The number of coils equals the number of pairs of N and S poles on the rotor. The alternating current in the Stator windings is rectified by the diodes and applied to the regulator. By controlling the amount of field current, the magnetic field strength is controlled and hence the output voltage of the alternator.

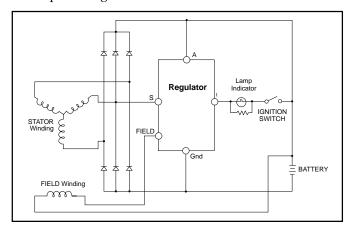


Figure 1. IAR System Block Diagram

Referring to Figure 2, a typical application diagram, the oscillator frequency is set by an external capacitor connected between OSC and ground. The sawtooth waveform ramps between 1V and 3V and provides the timing for the system. For the circuit shown the oscillator frequency is approximately 140Hz. The alternator voltage is sensed at Terminal A via the resistor divider network R1/R2 on the Sense pin of the IC. The voltage at the sense pin determines the duty cycle for the regulator. The voltage is adjusted by potentiometer R2. A relatively low voltage on the sense pin causes a long duty cycle that increases the Field current. A high voltage results in a short duty cycle.

The ignition Terminal (I) switches power to the IC through the  $V_{CC}$  pin. The Stator pin monitors the voltage from the stator and senses a stopped engine condition. It drives the Lamp pin high after the stator timeout expires. The Lamp pin also goes high when an overvoltage condition is detected on the sense pin. This causes the darlington lamp drive transistor to switch on and pull current through the lamp. If the system voltage continues to increase, the field and lamp output turn off as in an overvoltage or load dump condition.

The SC or Short Circuit pin monitors the field voltage. If the drive output and the SC voltage are simultaneously high for a predetermined period, a short circuit condition is assumed and the output is disabled. The regulator is forced to a minimum short circuit duty cycle.

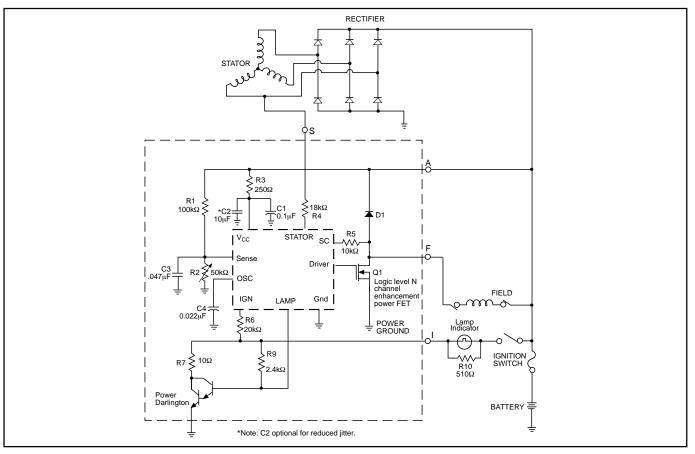


Figure 2. Typical Application Diagram

#### **Package Specification**

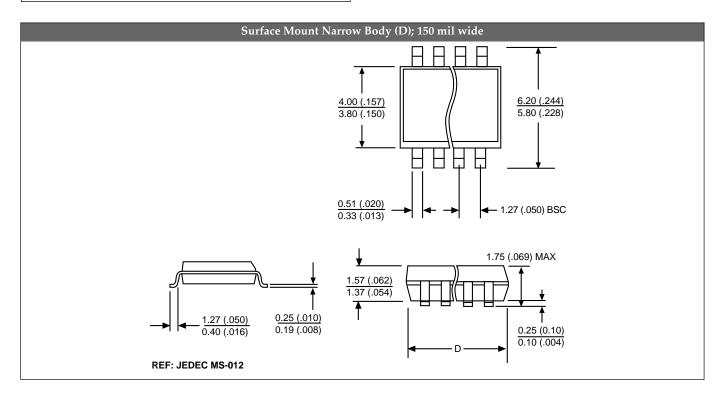
#### PACKAGE DIMENSIONS IN mm (INCHES)

		D		
Lead Count	Me	tric	Eng	lish
	Max	Min	Max	Min
14L SO	8.75	8.55	.344	.337

#### PACKAGE THERMAL DATA

CS3361

Therma	l Data	14L SO	
R <sub>ØJC</sub>	typ	30	°C/W
$R_{\Theta JA}$	typ	125	°C/W



Ordering Information		
Part Number	Description	
CS3361YD14	14L SO	
CS3361YDR14	14L SO (tape & reel)	

Cherry Semiconductor Corporation reserves the right to make changes to the specifications without notice. Please contact Cherry Semiconductor Corporation for the latest available information.

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