CS3361

Alternator Voltage Regulator FET Driver

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.

This IC has customized current sense circuitry enabling it to drive FET transistors. The CS3361 is available in an SOIC−14 package.

Features

- Drives Logic Level Power NFET
- 80 V Load Dump
- Temperature Compensated Regulation Voltage
- Shorted Field Protection Duty Cycle, Self Clearing
- This is a Pb−Free Device

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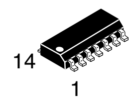
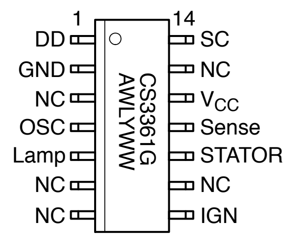


SOIC−14
D SUFFIX
CASE 751A

PIN CONNECTIONS AND MARKING DIAGRAM



A	= Assembly Location
WL	= Wafer Lot
YY	= Year
WW	= Work Week
G	= Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping†
CS3361YDR14G	SOIC−14 (Pb−Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

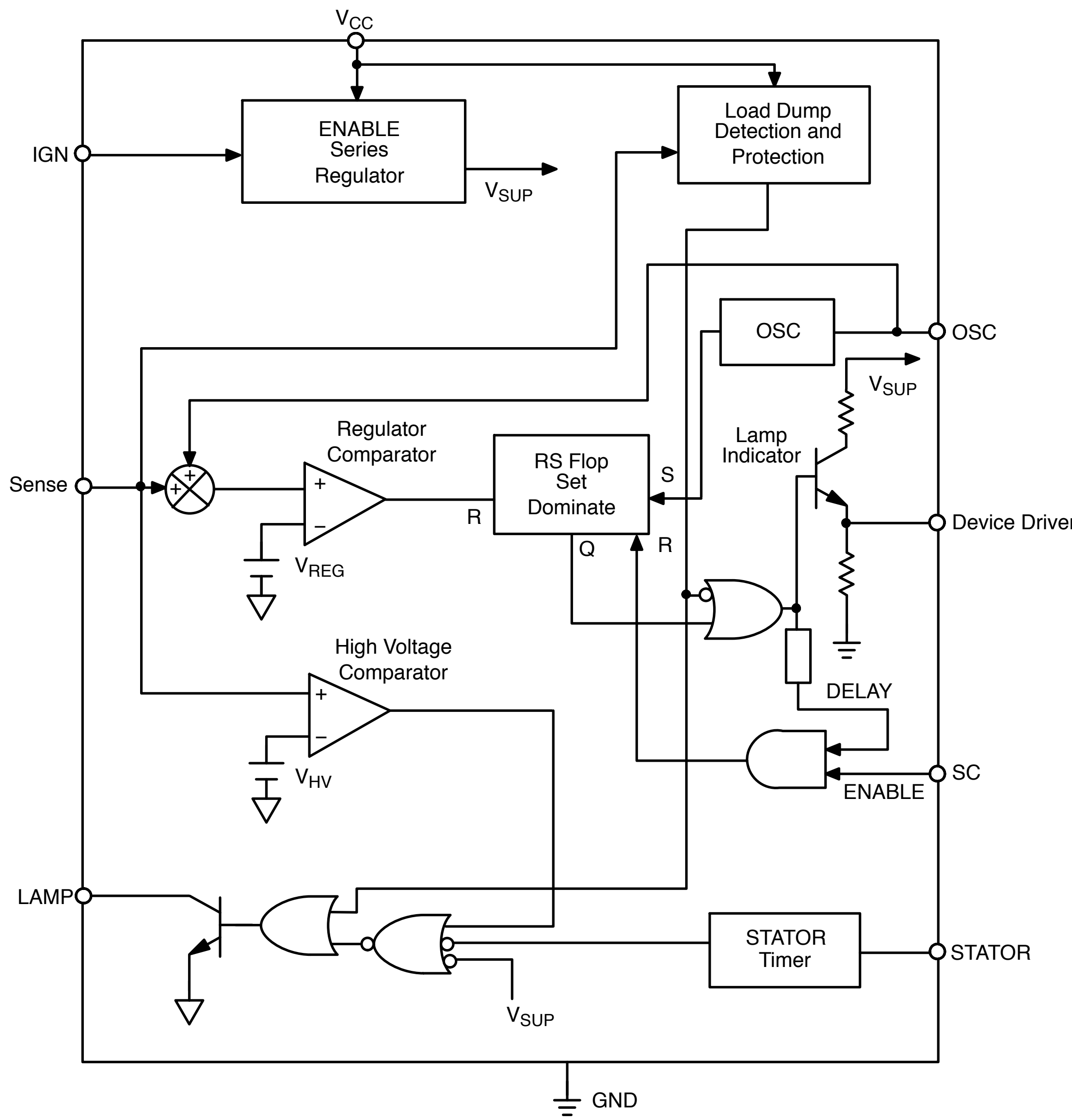


Figure 1. Block Diagram

PACKAGE PIN DESCRIPTION

PIN NO.	PIN SYMBOL	FUNCTION
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 overvoltage 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_{CC}	Supply for IC.
14	SC	Short circuit sensing.

MAXIMUM RATINGS

Rating		Value	Unit
Storage Temperature Range, T_S		–55 to +165	C
Junction Temperature Range		–40 to 150	C
Continuous Supply		27	V
I_{CC} Load Dump (@ V_{CC} = 80 V_{peak})		400	mA
Lead Temperature Soldering:	Reflow: (SMD styles only) (Note 1)	260 peak	C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. 60 second maximum above 183 C.

PACKAGE THERMAL DATA

Parameter		SO–14	Unit
$R_{\Theta JC}$	Typical	30	C/W
$R_{\Theta JA}$	Typical	125	C/W

ELECTRICAL CHARACTERISTICS (–40 C < T_A < 125 C, –40 C < T_J < 150 C, 9.0 V ≤ V_{CC} ≤ 17 V; unless otherwise specified.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
Supply					
Supply Current Enabled	–	–	–	10	mA
Supply Current Disabled	–	–	–	50	A
Driver Stage					
Output High Voltage	–	5.5	–	12	V
Output Low Voltage	I_{OL} = 25 A	–	–	0.35	V
Output High Current	V_{DD} = 1.2 V	–10	–6.0	–4.0	mA
Minimum ON Time	C_{OSC} = 0.022 F	200	–	–	s
Minimum Duty Cycle	–	–	6.0	10	%
Short Circuit Duty Cycle	–	1.0	–	5.0	%
Field Switch Turn On Rise Time	–	15	–	75	s
Field Switch Turn On Fall Time	–	15	–	75	s
Stator					
Input High Voltage	–	10	–	–	V
Input Low Voltage	–	–	–	6.0	V
Stator Time Out	High to Low	6.0	100	600	ms
Lamp					
Output High Current	V_{LAMP} @ 3.0 V	–	–	50	A
Output Low Voltage	I_{LAMP} @ 30 mA	–	–	0.35	V
Ignition					
Input High Voltage	I_{CC} > 1.0 mA	1.8	–	–	V
Input Low Voltage	I_{CC} < 100 A	–	–	0.5	V
Oscillator					
Oscillator Frequency	C_{OSC} = 0.022 F	90	–	210	Hz
Rise Time/Fall Time	C_{OSC} = 0.022 F	–	17	–	–
Oscillator High Threshold	C_{OSC} = 0.022 F	–	–	4.5	V
Battery Sense					
Input Current	–	–10	–	+10	A
Regulation Voltage	@25 C, R_1 = 100 kΩ, R_2 = 50 kΩ	13.8	–	15.8	V
Proportional Control	–	0.10	–	0.25	V
High Voltage Threshold Ratio	$\frac{V_{High\ Voltage@LampOn}}{V_{Regulation@50\%Duty\ Cycle}}$	1.083	–	1.190	V/V
High Voltage Hysteresis	–	0.020	–	0.600	V

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL PERFORMANCE CHARACTERISTICS

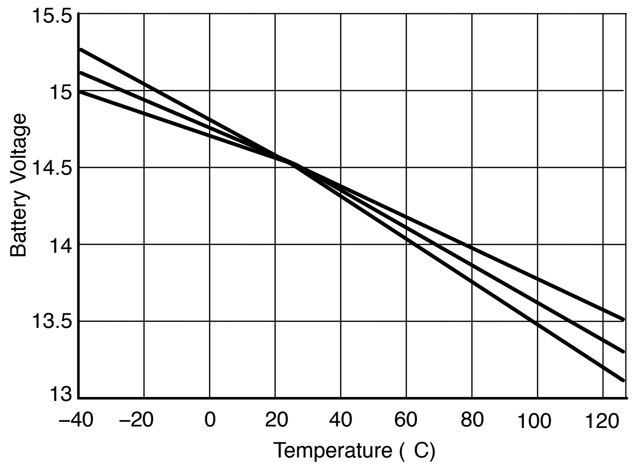


Figure 2. CS3361 Battery Voltage vs. Temperature (C) Over Process Variation

APPLICATIONS INFORMATION

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

In a standard alternator design (Figure 3), 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.

Referring to Figure 7, a typical application diagram, the oscillator frequency is set by an external capacitor connected between OSC and ground. The sawtooth waveform ramps between 1.0 V and 3.0 V and provides the timing for the system. For the circuit shown the oscillator frequency is approximately 140 Hz. 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.

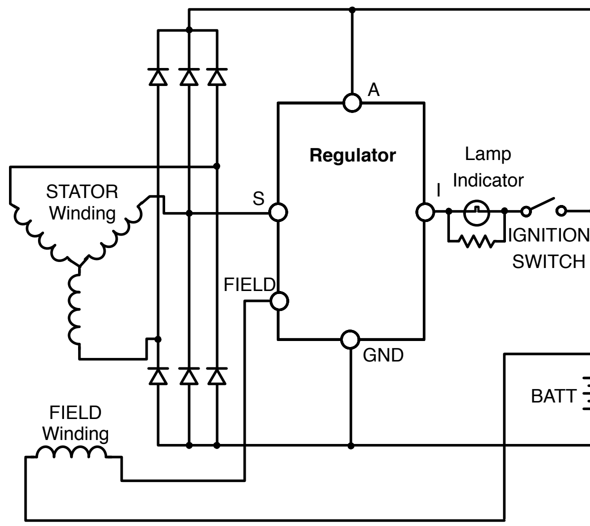


Figure 3. IAR System Block Diagram

REGULATION WAVEFORMS

The CS3361 utilizes proportion control to maintain regulation. Waveforms depicting operation are shown in Figures 4, 5 and 6, where $V_{BAT/N}$ is the divided down voltage present on the Sense pin using R1 and R2 (Figure 7). A sawtooth waveform is generated internally. The amplitude of this waveform is listed in the electric parameter section as proportion control. The oscillator voltage is summed with $V_{BAT/N}$, and compared with the internal voltage regulator (V_{REG}) in the regulation comparator which controls the field through the output “Device Driver.”

Figure 4 shows typical steady−state operation. A 50% duty cycle is maintained.

Figure 5 shows the effect of a drop in voltage on ($V_{BAT/N}$ + V_{OSC}). Notice the duty cycle increase to the field drive.

Figure 6 shows the effect of an increase in voltage (above the regulation voltage) on ($V_{BAT/N}$ + V_{OSC}). Notice the decrease in field drive.

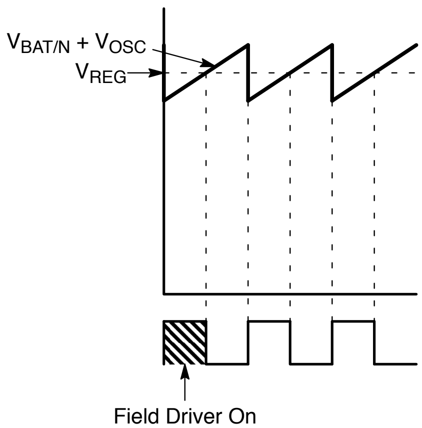


Figure 4. 50% Duty Cycle, Steady State

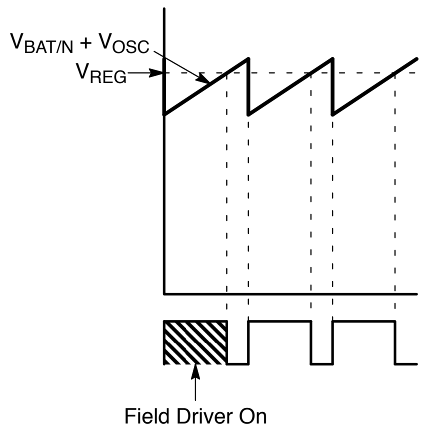


Figure 5. > 50% Duty Cycle, Increased Load

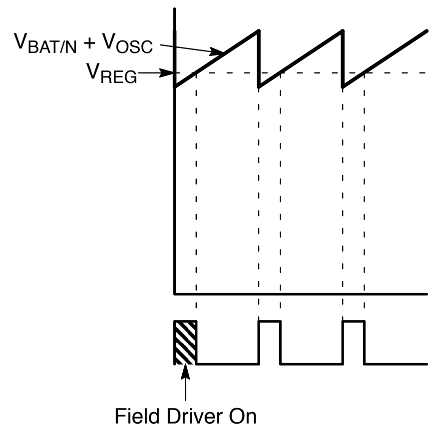


Figure 6. < 50% Duty Cycle, Decreased Load

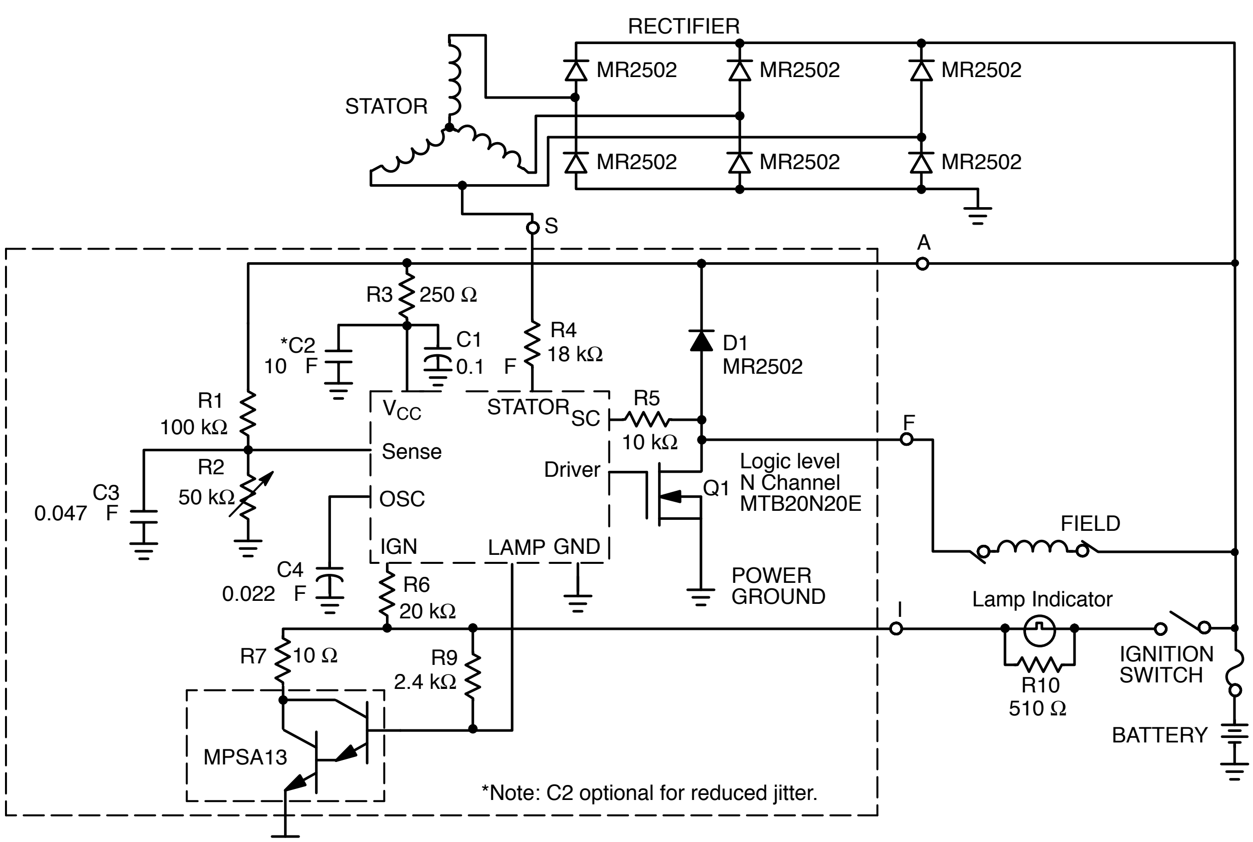
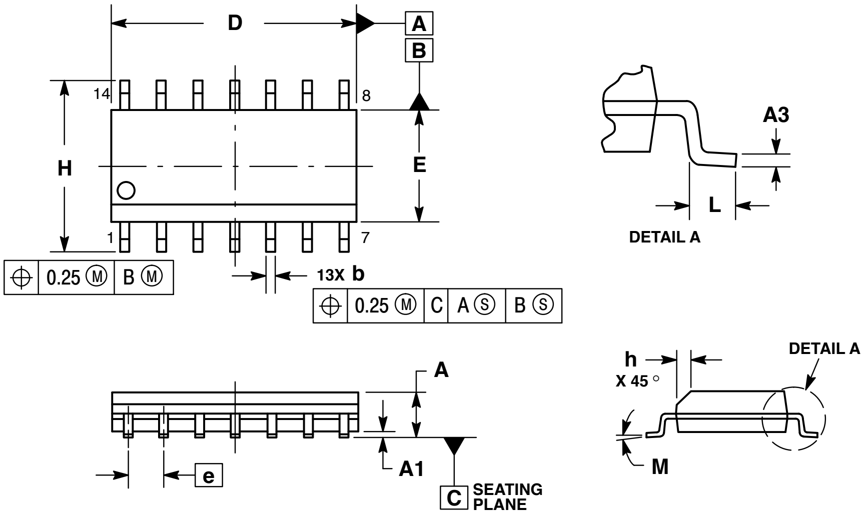


Figure 7. Typical Application Diagram

PACKAGE DIMENSIONS

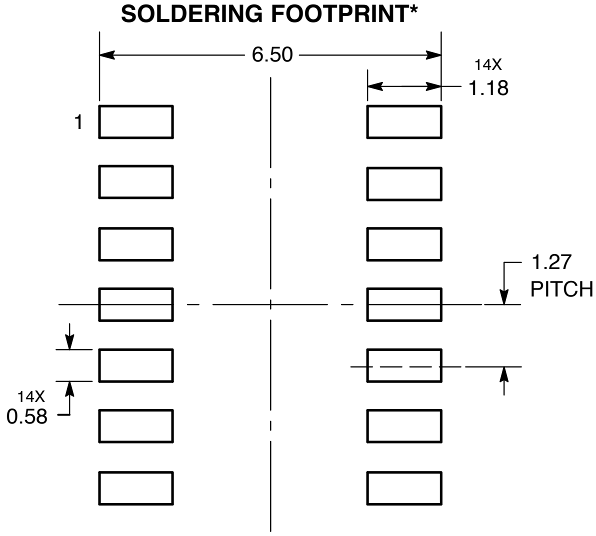
SOIC−14 NB
CASE 751A−03
ISSUE K



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

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