LM138, LM338

LM138/LM338 5-Amp Adjustable Regulators

Literature Number: SNVS771A
General Description

The LM138 series of adjustable 3-terminal positive voltage regulators is capable of supplying in excess of 5A over a 1.2V to 32V output range. They are exceptionally easy to use and require only 2 resistors to set the output voltage. Careful circuit design has resulted in outstanding load and line regulation—comparable to many commercial power supplies. The LM138 family is supplied in a standard 3-lead transistor package.

A unique feature of the LM138 family is time-dependent current limiting. The current limit circuitry allows peak currents of up to 12A to be drawn from the regulator for short periods of time. This allows the LM138 to be used with heavy transient loads and speeds start-up under full-load conditions. Under sustained loading conditions, the current limit decreases to a safe value protecting the regulator. Also included on the chip are thermal overload protection and safe area protection for the power transistor. Overload protection remains functional even if the adjustment pin is accidentally disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An output capacitor can be added to improve transient response, while bypassing the adjustment pin will increase the regulator’s ripple rejection.

Features

- Guaranteed 7A peak output current
- Guaranteed 5A output current
- Adjustable output down to 1.2V
- Guaranteed thermal regulation
- Current limit constant with temperature
- P+ Product Enhancement tested
- Output is short-circuit protected

Applications

- Adjustable power supplies
- Constant current regulators
- Battery chargers

Connection Diagrams

(See Physical Dimension section for further information)

Connection Diagrams

(TO-3 STEEL)

Metal Can Package

(TO-220)

Plastic Package

Bottom View
Order Number LM138K STEEL or LM338K STEEL
See NS Package Number K02A

Front View
Order Number LM338T
See NS Package Number T03B
Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

(Note 2)

Power Dissipation Internally limited
Input/Output Voltage Differential +40V, −0.3V

Operating Temperature Range

<table>
<thead>
<tr>
<th>Device</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM138</td>
<td>−55˚C ≤ T J ≤ +150˚C</td>
</tr>
<tr>
<td>LM338</td>
<td>0˚C ≤ T J ≤ +125˚C</td>
</tr>
</tbody>
</table>

Electrical Characteristics

Specifications with standard type face are for T J = 25˚C, and those with boldface type apply over full Operating Temperature Range. Unless otherwise specified, V IN − V OUT = 5V; and I OUT = 10 mA. (Note 2)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>LM138</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>V REF</td>
<td>Reference Voltage</td>
<td>3V ≤ (V IN − V OUT) ≤ 35V, 10 mA ≤ I OUT ≤ 5A, P ≤ 50W</td>
<td>1.19 1.24 1.29</td>
<td>V</td>
</tr>
<tr>
<td>V RLINE</td>
<td>Line Regulation</td>
<td>3V ≤ (V IN − V OUT) ≤ 35V (Note 3)</td>
<td>0.005 0.01</td>
<td>%/V</td>
</tr>
<tr>
<td>V RLOAD</td>
<td>Load Regulation</td>
<td>10 mA ≤ I OUT ≤ 5A (Note 3)</td>
<td>0.1 0.3</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>Thermal Regulation</td>
<td>20 ms Pulse</td>
<td>0.002 0.01</td>
<td>%/W</td>
</tr>
<tr>
<td>I ADJ</td>
<td>Adjustment Pin Current</td>
<td>45 100</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>∆ I ADJ</td>
<td>Adjustment Pin Current Change</td>
<td>10 mA ≤ I ADJ ≤ 5A, 3V ≤ (V IN − V OUT) ≤ 35V</td>
<td>0.2 5</td>
<td>µA</td>
</tr>
<tr>
<td>∆ V R/T</td>
<td>Temperature Stability</td>
<td>T MIN ≤ T J ≤ T MAX</td>
<td>1</td>
<td>%</td>
</tr>
<tr>
<td>I LOAD(Min)</td>
<td>Minimum Load Current</td>
<td>V IN − V OUT = 35V</td>
<td>3.5 5</td>
<td>mA</td>
</tr>
<tr>
<td>I CL</td>
<td>Current Limit</td>
<td>V IN − V OUT ≤ 10V DC 0.5 ms Peak</td>
<td>5 8 12</td>
<td>A</td>
</tr>
<tr>
<td>V N</td>
<td>RMS Output Noise, % of V OUT</td>
<td>10 Hz ≤ f ≤ 10 kHz</td>
<td>0.003</td>
<td>%</td>
</tr>
<tr>
<td>∆ V R</td>
<td>Ripple Rejection Ratio</td>
<td>V OUT = 10V, f = 120 Hz, C ADJ = 0 µF</td>
<td>60</td>
<td>dB</td>
</tr>
<tr>
<td>∆ V IN</td>
<td>V OUT = 10V, f = 120 Hz, C ADJ = 10 µF</td>
<td>75</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>θ JC</td>
<td>Thermal Resistance, Junction to Case</td>
<td>K Package</td>
<td>0.3 1</td>
<td>%</td>
</tr>
<tr>
<td>θ JA</td>
<td>Thermal Resistance, Junction to Ambient (No Heat Sink)</td>
<td>K Package</td>
<td>35</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Electrical Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>LM338</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>V REF</td>
<td>Reference Voltage</td>
<td>3V ≤ (V IN − V OUT) ≤ 35V, 10 mA ≤ I OUT ≤ 5A, P ≤ 50W</td>
<td>1.19 1.24 1.29</td>
<td>V</td>
</tr>
<tr>
<td>V RLINE</td>
<td>Line Regulation</td>
<td>3V ≤ (V IN − V OUT) ≤ 35V (Note 3)</td>
<td>0.005 0.03</td>
<td>%/V</td>
</tr>
<tr>
<td>V RLOAD</td>
<td>Load Regulation</td>
<td>10 mA ≤ I OUT ≤ 5A (Note 3)</td>
<td>0.1 0.5</td>
<td>%</td>
</tr>
</tbody>
</table>
### Electrical Characteristics (Continued)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>LM338</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{ADJ} )</td>
<td>Adjustment Pin Current</td>
<td></td>
<td></td>
<td>0.002</td>
</tr>
<tr>
<td>( \Delta I_{ADJ} )</td>
<td>Adjustment Pin Current Change</td>
<td>10 mA ( \leq ) ( I_{OUT} \leq 5) A, 3V ( \leq ) ( V_{IN} - V_{OUT} ) \leq 35V</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>( \Delta V_{RT} )</td>
<td>Temperature Stability</td>
<td>( T_{MIN} \leq T_{J} \leq T_{MAX} )</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>( I_{LOAD}(\text{Min}) )</td>
<td>Minimum Load Current</td>
<td>( V_{IN} - V_{OUT} = 35V )</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>( I_{CL} )</td>
<td>Current Limit</td>
<td>( V_{IN} - V_{OUT} \leq 10V )</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC</td>
<td></td>
<td>0.5 ms Peak</td>
</tr>
<tr>
<td>( V_{N} )</td>
<td>RMS Output Noise, % of ( V_{OUT} )</td>
<td>10 Hz ( \leq f \leq 10 ) kHz</td>
<td></td>
<td>0.003</td>
</tr>
<tr>
<td>( \Delta V_{R} )</td>
<td>Ripple Rejection Ratio</td>
<td>( V_{OUT} = 10V, f = 120 ) Hz, ( C_{ADJ} = 0 ) µF</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>( \Delta V_{IN} )</td>
<td>Ripple Rejection Ratio</td>
<td>( V_{OUT} = 10V, f = 120 ) Hz, ( C_{ADJ} = 10 ) µF</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>( \theta_{JC} )</td>
<td>Thermal Resistance</td>
<td>K Package</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T Package</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>( \theta_{JA} )</td>
<td>Thermal Resistance, Junction to Ambient (No Heat Sink)</td>
<td>K Package</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T Package</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

**Note 2:** These specifications are applicable for power dissipations up to 50W for the TO-3 (K) package and 25W for the TO-220 (T) package. Power dissipation is guaranteed at these values up to 15V input-output differential. Above 15V differential, power dissipation will be limited by internal protection circuitry. All limits (i.e., the numbers in the Min. and Max. columns) are guaranteed to National’s AOQL (Average Outgoing Quality Level).

**Note 3:** Regulation is measured at a constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specifications for thermal regulation.

**Note 4:** Refer to RETS138K drawing for military specifications of LM138K.

### Typical Performance Characteristics

![Typical Performance Characteristics](image1)

![Current Limit](image2)
Typical Performance Characteristics (Continued)

Current Limit

![Current Limit Graph]

Dropout Voltage

![Dropout Voltage Graph]

Temperature Stability

![Temperature Stability Graph]

Load Regulation

![Load Regulation Graph]

Adjustment Current

![Adjustment Current Graph]

Output Impedance

![Output Impedance Graph]
Application Hints

In operation, the LM138 develops a nominal 1.25V reference voltage, $V_{REF}$, between the output and adjustment terminal. The reference voltage is impressed across program resistor $R_1$ and, since the voltage is constant, a constant current $I_1$ then flows through the output set resistor $R_2$, giving an output voltage of

$$V_{OUT} = V_{REF} \left(1 + \frac{R_2}{R_1}\right) + I_{ADJ} R_2.$$
Application Hints (Continued)

Since the 50 μA current from the adjustment terminal represents an error term, the LM138 was designed to minimize I<sub>ADJ</sub> and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

EXTERNAL CAPACITORS

An input bypass capacitor is recommended. A 0.1 μF disc or 1 μF solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the LM138 to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. With a 10 μF bypass capacitor 75 dB ripple rejection is obtainable at any output level. Increases over 20 μF do not appreciably improve the ripple rejection at frequencies above 120 Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device.

In general, the best type of capacitors to use are solid tantalum. Solid tantalum capacitors have low impedance even at high frequencies. Depending upon capacitor construction, it takes about 25 μF in aluminum electrolytic to equal 1 μF solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies; but some types have a large decrease in capacitance at frequencies around 0.5 MHz. For this reason, 0.01 μF disc may seem to work better than a 0.1 μF disc as a bypass.

Although the LM138 is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500 pF and 5000 pF. A 1 μF solid tantalum (or 25 μF aluminum electrolytic) on the output swamps this effect and insures stability.

LOAD REGULATION

The LM138 is capable of providing extremely good load regulation but a few precautions are needed to obtain maximum performance. The current set resistor connected between the adjustment terminal and the output terminal (usually 240Ω) should be tied directly to the output of the regulator (case) rather than near the load. This eliminates line drops from appearing effectively in series with the reference and degrading regulation. For example, a 15V regulator with 0.05Ω resistance between the regulator and load will have a load regulation due to line resistance of 0.05Ω x I<sub>L</sub>. If the set resistor is connected near the load the effective line resistance will be 0.05Ω (1 + R2/R1) or in this case, 11.5 times worse.

Figure 2 shows the effect of resistance between the regulator and 240Ω set resistor.

With the TO-3 package, it is easy to minimize the resistance from the case to the set resistor, by using 2 separate leads to the case. The ground of R2 can be returned near the ground of the load to provide remote ground sensing and improve load regulation.

PROTECTION DIODES

When external capacitors are used with any IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator. Most 20 μF capacitors have low enough internal series resistance to deliver 20A spikes when shorted. Although the surge is short, there is enough energy to damage parts of the IC.

When an output capacitor is connected to a regulator and the input is shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage of the regulator, and the rate of decrease of VIN. In the LM138 this discharge path is through a large junction that is able to sustain 25A surge with no problem. This is not true of other types of positive regulators. For output capacitors of 100 μF or less at output of 15V or less, there is no need to use diodes.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when either the input or output is shorted. Internal to the LM138 is a 50Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25V or less and 10 μF capacitance. Figure 3 shows an LM138 with protection diodes included for use with outputs greater than 25V and high values of output capacitance.
Application Hints (Continued)

D1 protects against C1
D2 protects against C2

\[ V_{OUT} = 1.25V \left( \frac{R2}{R1} + I_{ADJ}R2 \right) \]

FIGURE 3. Regulator with Protection Diodes
Typical Applications

Regulator and Voltage Reference

Full output current not available at high input-output voltages.

†Optional—improves transient response. Output capacitors in the range of 1 µF to 1000 µF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients.

*Needed if device is more than 6 inches from filter capacitors.

\[ V_{\text{OUT}} = 2.5V \left( 1 + \frac{R_2}{R_1} \right) + I_{\text{ADJ}}(R_2) \]

**R1 = 240Ω for LM138. R1, R2 as an assembly can be ordered from Bourns:
MIL part no. 7105A-AT2-502
COMM part no. 7105A-AT7-502
Schematic Diagram

Typical Applications

Precision Power Regulator with Low Temperature Coefficient

![Precision Power Regulator Schematic Diagram]

* Adjust for 3.75 across R1
Typical Applications (Continued)

Slow Turn-On 15V Regulator

Adjustable Regulator with Improved Ripple Rejection

High Stability 10V Regulator

Digitally Selected Outputs

†Solid tantalum
*Discharges C1 if output is shorted to ground
**R1 = 240Ω for LM138

*Sets maximum VOUT
**R1 = 240Ω for LM138

LM138/LM338

www.national.com
Typical Applications (Continued)

15A Regulator

* Minimum load — 100 mA

5V Logic Regulator with Electronic Shutdown**

** Minimum output = 1.2V
Typical Applications (Continued)

0 to 22V Regulator

\[ \text{LM338} \]

\[ \text{VIN} \rightarrow \text{VOUT} \]

\[ \text{ADJ} \]

\[ \text{R1} = 2 \Omega, \text{R2} = 5k \text{ for LM138} \]

Full output current not available at high input-output voltages

12V Battery Charger

\[ \text{VIN} \geq 18V \]

\[ \text{LM338} \]

\[ \text{LED} \]

\[ \text{R2} = 15 \]

\[ \text{R3} = 230 \]

\[ \text{R4} = 15k \]

\[ \text{R6} = 0.2 \]

\[ \text{Q1} = 2N2905 \]

\[ \text{IN457} \]

\[ \text{LM301A} \]

\[ \text{START} \]

\[ \text{TO 12V BATTERY} \]

\[ \text{START} \]

\[ \text{VIN} \geq 18V \]

\[ \text{LM338} \]

\[ \text{LED} \]

\[ \text{R2} = 15 \]

\[ \text{R3} = 230 \]

\[ \text{R4} = 15k \]

\[ \text{R6} = 0.2 \]

\[ \text{Q1} = 2N2905 \]

\[ \text{IN457} \]

\[ \text{LM301A} \]

\[ \text{START} \]

\[ \text{TO 12V BATTERY} \]
Typical Applications (Continued)

Adjustable Current Regulator

**Precision Current Limiter**

5A Current Regulator

Tracking Preregulator

Adjusting Multiple On-Card Regulators with Single Control*

† Minimum load — 10 mA

* All outputs within ±100 mV
Typical Applications (Continued)

Power Amplifier

AV = 1, RF = 10k, CF = 100 pF
AV = 10, RF = 100k, CF = 10 pF
Bandwidth \( \geq \) 100 kHz
Distortion \( \leq \) 0.1%

Simple 12V Battery Charger

Use of \( R_S \) allows low charging rates with fully charged battery.
**The 1000 \( \mu \)F is recommended to filter out input transients

\[ Z_{OUT} = R_S \left( 1 + \frac{R_2}{R_1} \right) \]
Typical Applications  (Continued)

Adjustable 15A Regulator

```
Vin                  0.1
LM338
LM338
LM338
Vin     Vout
ADJ
5k
5k
150
1.5k
100

2N2905
6
2
200 µF
GND

4.5V TO 25V
```

Current Limited 6V Charger

```
Vin                  240
LM338
Vin     Vout
ADJ
1.1k
100
1000µF**
```

* Set max charge current to 3A
** THE 1000 µF is recommended to filter out input transients.
Typical Applications (Continued)

10A Regulator

* Minimum load — 100 mA
Physical Dimensions  inches (millimeters)
unless otherwise noted

2 Lead TO-3 Metal Can Package (K)
Order Number LM138K or LM338K STEEL
NS Package Number K02A

3 Lead Molded TO-220 (T)
Order Number LM338T
NS Package Number T03B
Notes

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL’S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no “Banned Substances” as defined in CSP-9-111S2.
**IMPORTANT NOTICE**

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use. Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any damages arising out of the use of TI products in such automotive applications.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

<table>
<thead>
<tr>
<th>Products</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio</td>
<td>Communications and Telecom</td>
</tr>
<tr>
<td>Amplifiers</td>
<td>Computers and Peripherals</td>
</tr>
<tr>
<td>Data Converters</td>
<td>Consumer Electronics</td>
</tr>
<tr>
<td>DLP® Products</td>
<td>Energy and Lighting</td>
</tr>
<tr>
<td>DSP</td>
<td>Industrial</td>
</tr>
<tr>
<td>Clocks and Timers</td>
<td>Medical</td>
</tr>
<tr>
<td>Interface</td>
<td>Security</td>
</tr>
<tr>
<td>Logic</td>
<td>Space, Avionics and Defense</td>
</tr>
<tr>
<td>Power Mgmt</td>
<td>Transportation and Automotive</td>
</tr>
<tr>
<td>Microcontrollers</td>
<td>Video and Imaging</td>
</tr>
<tr>
<td>RFID</td>
<td></td>
</tr>
<tr>
<td>OMAP Mobile Processors</td>
<td></td>
</tr>
<tr>
<td>Wireless Connectivity</td>
<td></td>
</tr>
</tbody>
</table>

TI E2E Community Home Page [e2e.ti.com](http://e2e.ti.com)