SIMPLE CIRCUITS

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Greetings fellow IMSA members and readers of this journal. My name is Jeff Alder and I am a technical sales representative for ENCOM Wireless Data Solutions, a wireless manufacturer for interconnect and ITS traffic applications. I am also a Certified Engineering Technologist, and have had many interesting opportunities over the years to be involved with the implementation of some unique and interesting components and devices. These have been designed into circuits ranging from satellite instruments to simple keyboard encoders.

This is a very exciting opportunity for me. I would like to thank Marilyn, Sharon and the folks at the IMSA Journal for supporting me writing this column.

This column is dedicated to the review of some of the interesting parts and sensors I have been privileged to use over my 25 years in the electronics industry. Many of these parts are quite simple to implement and will provide excellent applications opportunities in traffic and non-traffic applications alike.

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The idea for this column came from my travels with ENCOM. I quickly realized from my meetings with signal shop staff (24 States from coast to coast), that there are some outstanding technical people out there who apply their skills to our industry every day. Many of the folks I meet are also avid hobbyists and we have had some excellent discussions, sharing knowledge of electronics, helping each other design circuits and solve problems.

This column is not meant as any kind of advertisement or endorsement for any particular product or manufacturer, but I will have to mention part numbers and manufacturers from time to time as many of the parts I will review will be single source and if you want to get a couple to try out, you will need to have that information.

That said, I would like to begin my first column with a really cool part I have used in battery charge and discharge applications. This component is a single chip, high side current monitor which can monitor current flowing into and out of a battery or bank of batteries, and can monitor an amazing range of DC currents over a wide input voltage range.

The MAX471 and MAX472 are two stand alone devices which as I mentioned before, offer high side current monitoring. While there are advantages to both types of monitoring, high side techniques will not interfere with ground paths which, on some circuits must not have even small extraneous impedances introduced. Another added benefit is, that should a fault to ground occur, outside of the regular load or ground path, the extra current draw will be observed as these monitoring circuits are typically connected directly to the power source. These devices typically cost between $5 and $10 dollars in single lot and are available in hardened, extended temperature ranges as well. The MAX471 is usually off the shelf at vendors such as Digi-Key. The MAX472 might have to be purchased directly from MAXIM.

Both monitoring devices operate on voltages between 3 and 36 volts DC and draw less that 100uA during normal operation.

The MAX471 is a current monitor with a precision, internal 35 milliohm current sense resistor, Rsense. It has a fixed current measuring range of + and – 3 amps.

The MAX471 produces an output current which can be turned into a ground referenced voltage via a precision load resistor. It also has a "Sign Output" pin which is open collector and would require something in the order of a 100K pull up resistor. This output pin could easily be connected directly to a TTL level input pin

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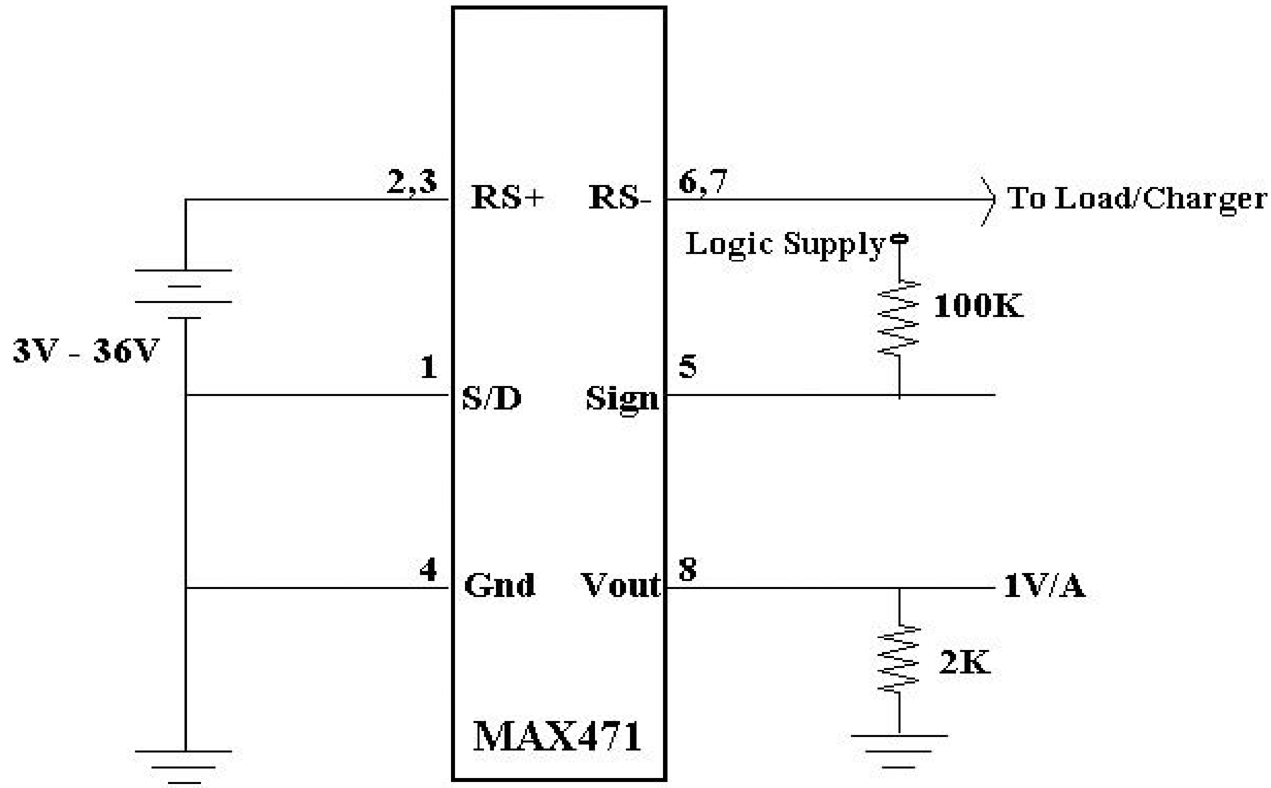

Figure A

on a single chip CPU for more sophisticated circuits. See Figure A for a typical application of this chip.

The output voltage for this device, using a 2000 Ohm load resistor is 1 Volt per Amp of current flow through Rsense.

The MAX472 is a more interesting device, in that by selecting a precision external current sense resistor, an incredibly wide range of currents can be measured, from milliamps right up to 10 Amps and more! Two external gain resistors are also required when applying the MAX472. See Figure B for a typical application of this chip.

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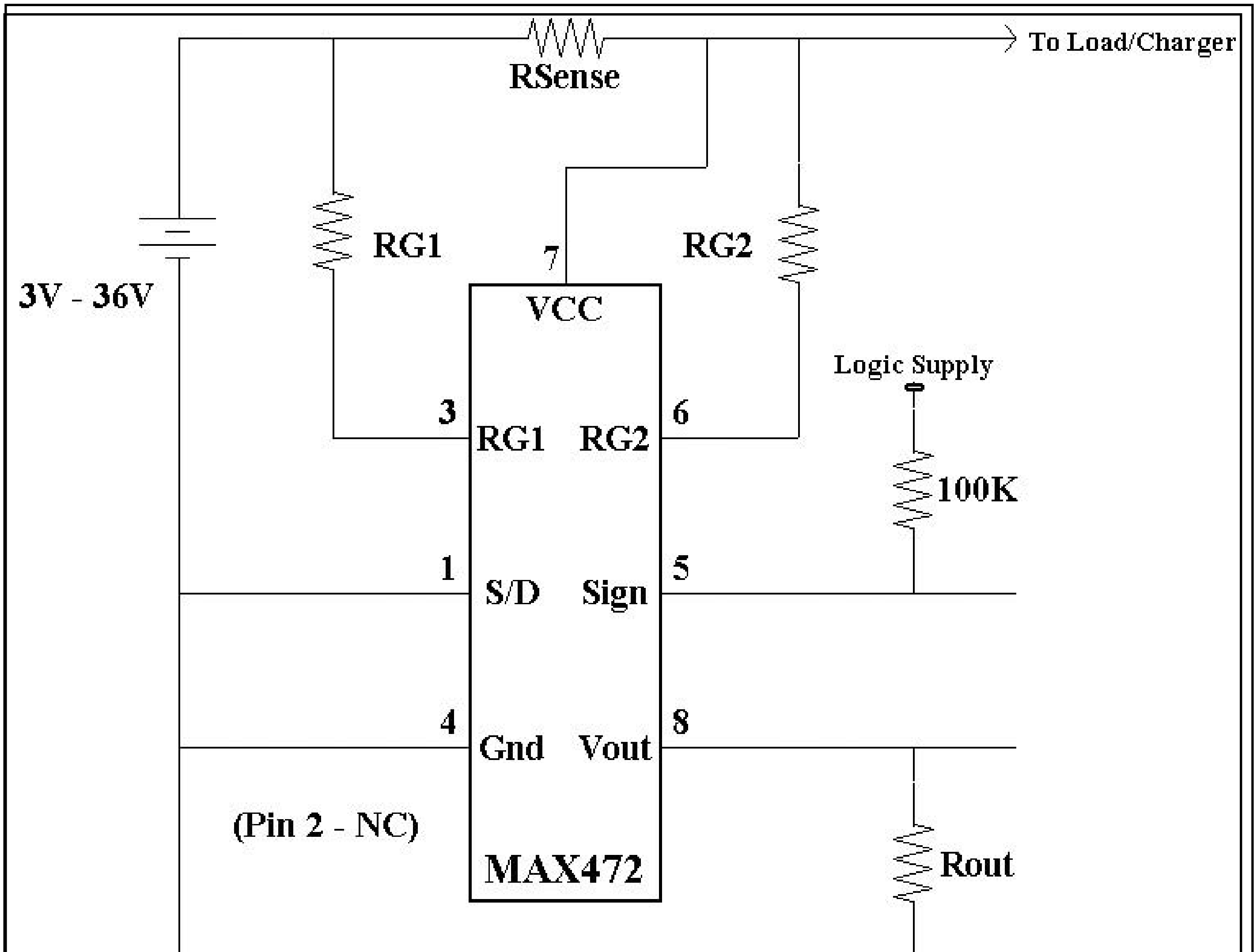

Figure B

To help determine the value of the current sense and gain resistors, as well as the output voltage, a couple of formulas have been made available. They are as follows:

Vout = (Rsense x Rout x Iload) / RG

Vout is the desired full scale output voltage
Rsense is the current sensing resistor
Rout is the output voltage setting resistor
Iload is the full scale current being sensed
RG is the gain setting resistor
(RG=RG1=RG2)

Modified, this formula can be used to determine Rout for a particular full scale range:

Rout = (Vout x RG) / (Iload x Rsense)

For those of you looking for guidelines as to some suggested component values used in these circuits, Maxim has provided a table in their data sheet which I have partially reproduced as follows:

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Full Scale Load Current Isense (A)	Current Sense Resistor Rsense (mohms)	Gain Setting Resistors RG1 = RG2 (Ohms)	Output Resistor Rout (Kohms)	Full Scale Output Voltage Vout (V)	Scale Factor Vout / Isense (V/A)
0.1	500	200	10	2.5	25
1	50	200	10	2.5	2.5
5	10	100	5	2.5	0.5
10	5	50	2	2	0.2

Table 1

Let's plug some of these values into the equations and see how they make out for a 1 Amp full scale load current.

Vout = (Rsense x Rout x Iload) / RG

Vout = (50 x 10 x 1) / 200

Vout = 2.5 V full scale (Remember, Rsense is in milliohms, Rout is in Kohms, RG is in ohms and Iload is in amps)

For Rout, the numbers work as follows:

Rout = (Vout x RG) / (Iload x Rsense)

Rout = (2.5 x 200) / (1 x 50)

Rout = 10 (Kohms)

There is no way to cover all aspects of these devices in one column. MAX471 devices can be paralleled to sense larger currents and other MAX472 applications involve using printed circuit board traces as sense resistors.

I recommend that you avoid wire wound and inductive sense resistors, that you keep your sense traces as short and as heavy as possible and that you always solder the devices in place, especially the MAX471. Also, keep your eye on the power dissipation requirements of Rsense, especially at higher current levels.

All the information I have provided I believe to be correct, although I must confess it has been a while since I have had the chance to work with these chips. I hope you have some fun with this but I would still urge you to read the MAXIM data sheets thoroughly before designing these devices into your circuits. There may be information which I have not reviewed that might be pertinent to your particular application.

Until next time, take care out there!

Jeff