

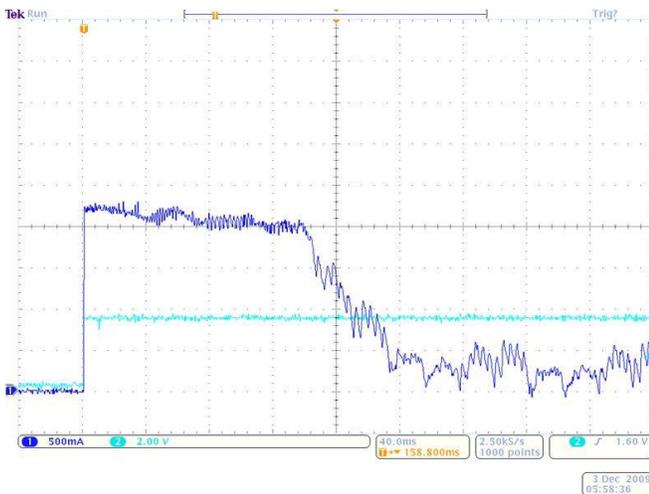
# Advantages of integrated current sensing

Ryan Kehr, Motor Drives



Monitoring and regulating current is a must for many brushed and stepper motor applications. For brushed motors, the current information can be used to determine changes in load conditions or for limiting startup and stall currents. For stepper motors, high levels of micro-stepping require current to be regulated for each step.

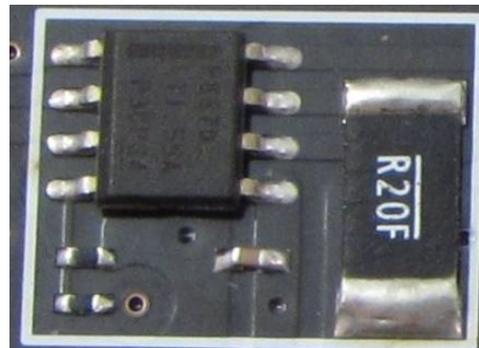
In [Figure 1](#), current is plotted versus time depicting the startup profile for a brushed DC motor. In this case, current is limited to approximately 2 amperes before the motor reaches a steady state condition of less than 1 ampere. Without current regulation, this same motor peaks to over 14 amperes. This not only requires an over-designed power supply to support this transient, but the motor driver also needs to be rated to reliably handle the peak currents.



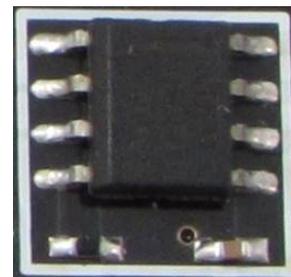
**Figure 1. DC Motor Current vs. Time**

Traditionally, this current limiting was achieved using external shunt resistors in the ground path. The voltage drop across these shunts was monitored and compared to a reference voltage either provided internally or externally depending on the device. Since the full load current passes through these shunts, the resistors must be power resistors and can be up to 1206 in case size which can be almost as large as the integrated circuit itself with a 3.2 mm by 1.6 mm dimension. [Figure 2](#) compares the size of a shunt to a DRV8870 DC motor driver. [Figure 3](#) depicts the DRV8871 with integrated current sensing where a single 0402 resistor is used to set the current limiting threshold. As is clearly shown in [Figure 3](#), integrated current sense leads to board and component savings.

A low wattage signal path resistor compared to a power resistor requires much smaller board space and lowers the bill of materials (BOM). In addition to these benefits, there is no power loss across the resistor and one more heat source is eliminated from a design that is most likely already under thermal budget pressure.



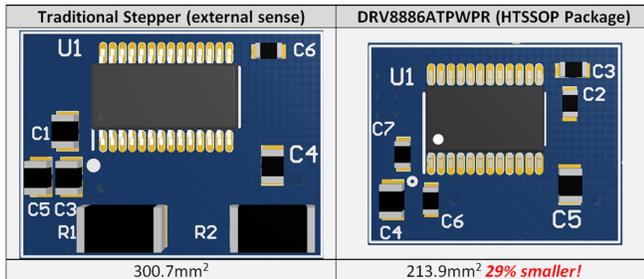
**Figure 2. DRV8870 with External Shunt**



**Figure 3. DRV8871 with Integrated Current Sensing**

Now that current limiting and integrated current sensing benefits are well understood, we can also add monitoring capability in our newest family of brushed DC motor drivers through the IPROPI pin. The DRV8873 is the newest product in the Brushed Motor Driver family that provides an analog current output proportional to the current flowing through the bridge. By passing this proportional current through a small resistor, a voltage proportional to current can be monitored with an external microcontroller to determine changes in load conditions and act accordingly. This internal current monitoring feature eliminates the need for an external power resistor and conditioning circuits like an operational amplifier.

Finally, we get to stepper motors that further benefit from the PCB size and BOM advantages of integrated current sensing since stepper motors have traditionally required two external sense resistors to feedback the current to the driver. Figure 4 compares the PCB footprint of a traditional driver to the DRV8886AT that benefits from internal current sensing.



**Figure 4. Board Layout Reduction**

One less tangible benefit that is only realized during PCB layout is the simplicity of the layout when choosing a device with the integrated sensing feature. It is no longer necessary to route around the large external shunt components and break up power, output, and GND routing that require larger traces for carrying device current.

In summary, integrated current sensing in TI's latest family of motor drivers removes costly power resistors from the BOM, reduces board size, component count, and simplifies PCB routing.

**Table 1. Alternate Device Table**

Device Name	Device Description
<a href="#">DRV8871</a>	3.6A Brushed DC Motor Driver with Integrated Current Sensing (PWM Ctrl)
<a href="#">DRV8871-Q1</a>	3.6A Automotive Brushed DC Motor Driver With Integrated Current Sensing (PWM Ctrl)
<a href="#">DRV8873</a>	10A H-Bridge Motor Driver with Integrated Current Sensing and Current Sense Output
<a href="#">DRV8873-Q1</a>	Automotive H-Bridge Motor Driver
<a href="#">DRV8876</a>	37-V, 3.5-A Brushed DC Motor Driver with Integrated Current Sensing and Current Sense Output
<a href="#">DRV8876-Q1</a>	Automotive H-bridge motor drivers with integrated current sense and regulation
<a href="#">DRV8884</a>	1.0A Stepper Motor Driver With 1/16 Microstepping and Integrated Current Sensing (STEP/DIR Ctrl)
<a href="#">DRV8885</a>	1.5A Stepper Motor Driver with 1/16 Microstepping and Integrated Current Sensing (STEP/DIR Ctrl)
<a href="#">DRV8886AT</a>	2A Stepper Motor Driver With Integrated Current Sense and Adaptive Decay Mode

## References

- [How to use integrated current sensing in brushed DC motors](#)
- [How to use integrated current sensing in stepper motors](#)

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale ([www.ti.com/legal/termsofsale.html](http://www.ti.com/legal/termsofsale.html)) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2019, Texas Instruments Incorporated