

# High Performance Single Phase DC/DC Controller with Digital Power Management

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LTC3883 is a single phase synchronous step-down DC/DC controller featuring a PMBus interface for digital control and monitoring, and integrated MOSFET gate drivers. It can function either standalone or in a digitally managed system with other Linear Technology PMBus enabled parts.

The LTC3883 features:

- 4.5V to 24V input voltage range and 0.5V to 5.5V output voltage range.
- $\pm 0.5\%$  output voltage accuracy over the operation temperature range of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .
- PMBus, which provides programmable voltage, current limits, sequencing, margining, OV/UV thresholds, frequency synchronization and fault logging.
- Telemetry read back including  $V_{\text{IN}}$ ,  $I_{\text{IN}}$ ,  $V_{\text{OUT}}$ ,  $I_{\text{OUT}}$ , temperature and faults.
- External voltage divider to set the chip address, switching frequency and the output voltage.
- Input current sensing and inductor DCR auto calibration.

## 1.8V/30A SINGLE PHASE DIGITAL POWER SUPPLY WITH $I_{\text{IN}}$ SENSE

Figure 1 shows a 7V to 14V input, 1.8V/30A output application that features inductor DCR current sensing. To improve the accuracy of DCR current sense, the LTC3883 senses inductor temperature and

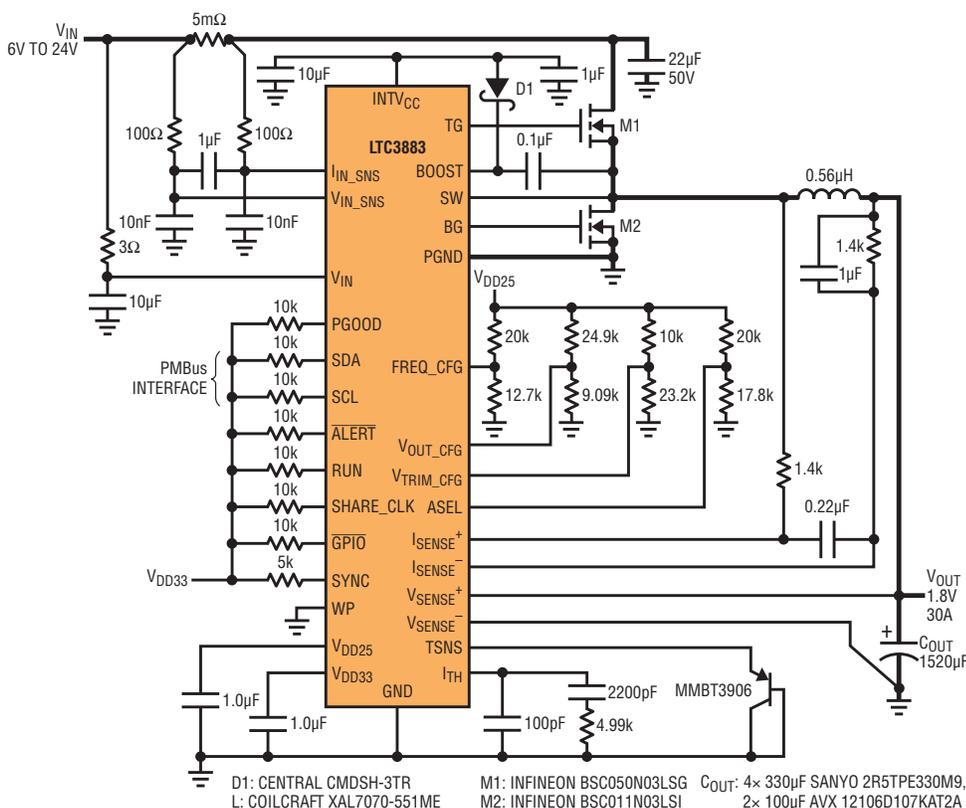
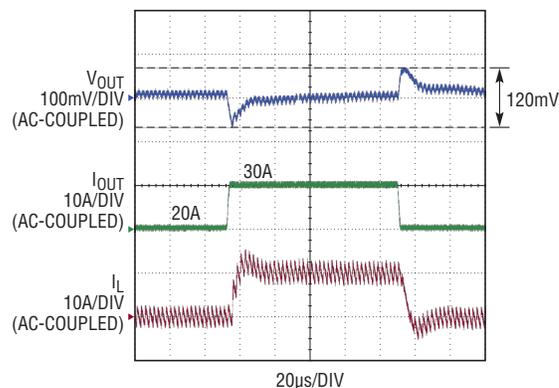


Figure 1. 1.8V/30A single phase digital power supply with  $I_{\text{IN}}$  sense

compensates for the  $\tau_C$  of the DCR. This method ensures the accuracy of the read-back current and overcurrent limit. The LTC3883's control loop uses peak current

mode control, which offers fast transient response. Figure 2 shows the typical waveforms of a 10A load step transient.

Figure 2. Transient performance of a 10A load step



The LTC3883 uses a proprietary inductor DCR auto-calibration function, which enables output current read back accuracy within 3%, regardless of inductor DCR tolerance.

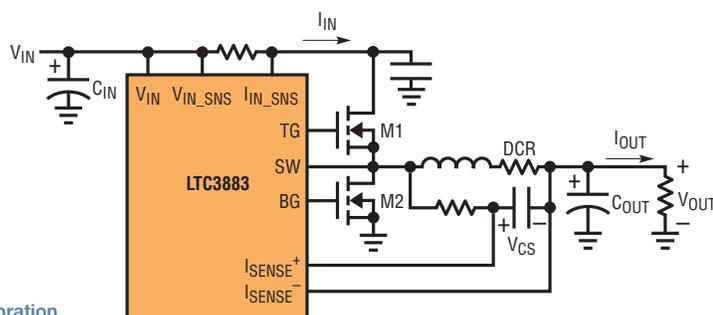


Figure 3. DCR auto calibration

The LTC3883 features input current sensing via a resistor in series with the input side of the buck converter—a 5mΩ sense resistor as shown in Figure 1. The sense voltage is translated into a power stage input current by the LTC3883’s 16-bit internal ADC. An internal sense resistor senses chip’s supply current at  $V_{IN}$ , so it can provide both the chip and the power stage’s input current measurements.

### INDUCTOR DCR AUTO CALIBRATION

The problem with the conventional inductor DCR current sensing is that the tolerance of the DCR can be as large as  $\pm 10\%$ , greatly limiting the current read back accuracy. To solve this problem, the LTC3883 uses a proprietary inductor DCR auto-calibration function. Figure 3 shows the simplified diagram of this circuit.

The LTC3883 accurately measures the input current,  $I_{IN}$ , the duty cycle,  $D$  and calibrates the real DCR value based on the relation:

$$DCR_{CALIBRATED} = V_{CS} \cdot \frac{D}{I_{IN}}$$

With this auto-calibration method, the output current read back accuracy can be within 3%, regardless of inductor DCR tolerance.

### 1.2V/60A 3-PHASE DIGITAL POWER SUPPLY

The LTC3883 has an analog current control loop, which makes it ideal for PolyPhase® operation. Figure 4 shows an example of a 3-phase single output circuit, with one LTC3883 and one LTC3880 for a 7V to 14V input, 1.2V/60A output application. The LTC3880 is a 2-phase synchronous buck controller with digital power system management. The interconnection between these two chips is straightforward and easy. Note how the input current sense resistor of the LTC3883 is used to sense the total input current for all three phases.

Figure 5 shows the dynamic current sharing for a load step transient. All the three phases can share the current evenly.

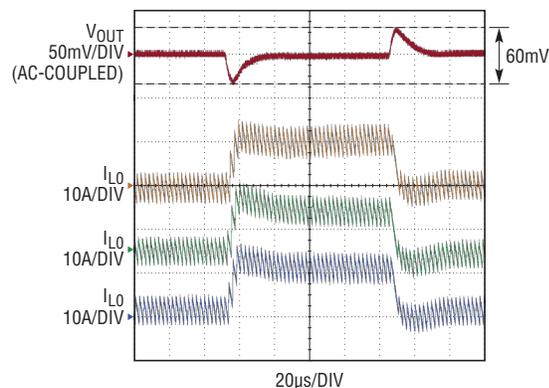
### LTPOWERPLAY DEVELOPMENT

All digital power management functions can be controlled by LTpowerPlay, PC-based software compatible with all of Linear Technology’s digital power products. With LTpowerPlay, designers can easily program and control the entire power system without writing a line of code. It is easy to configure any chip on the bus, verify the system’s status, read the telemetry, check fault status, control supply sequencing.

### CONCLUSION

The LTC3883 combines a best-in-class analog DC/DC controller with complete digital power management functions and precision data converters for unprecedented performance and control. Multiple LTC3883s can be used with other Linear Technology PMBus products to optimize multirail digital power systems. Powerful LTpowerPlay software simplifies the development of complex power systems. The LTC3883 can be used for telecom, computing, data storage, and other applications. ■

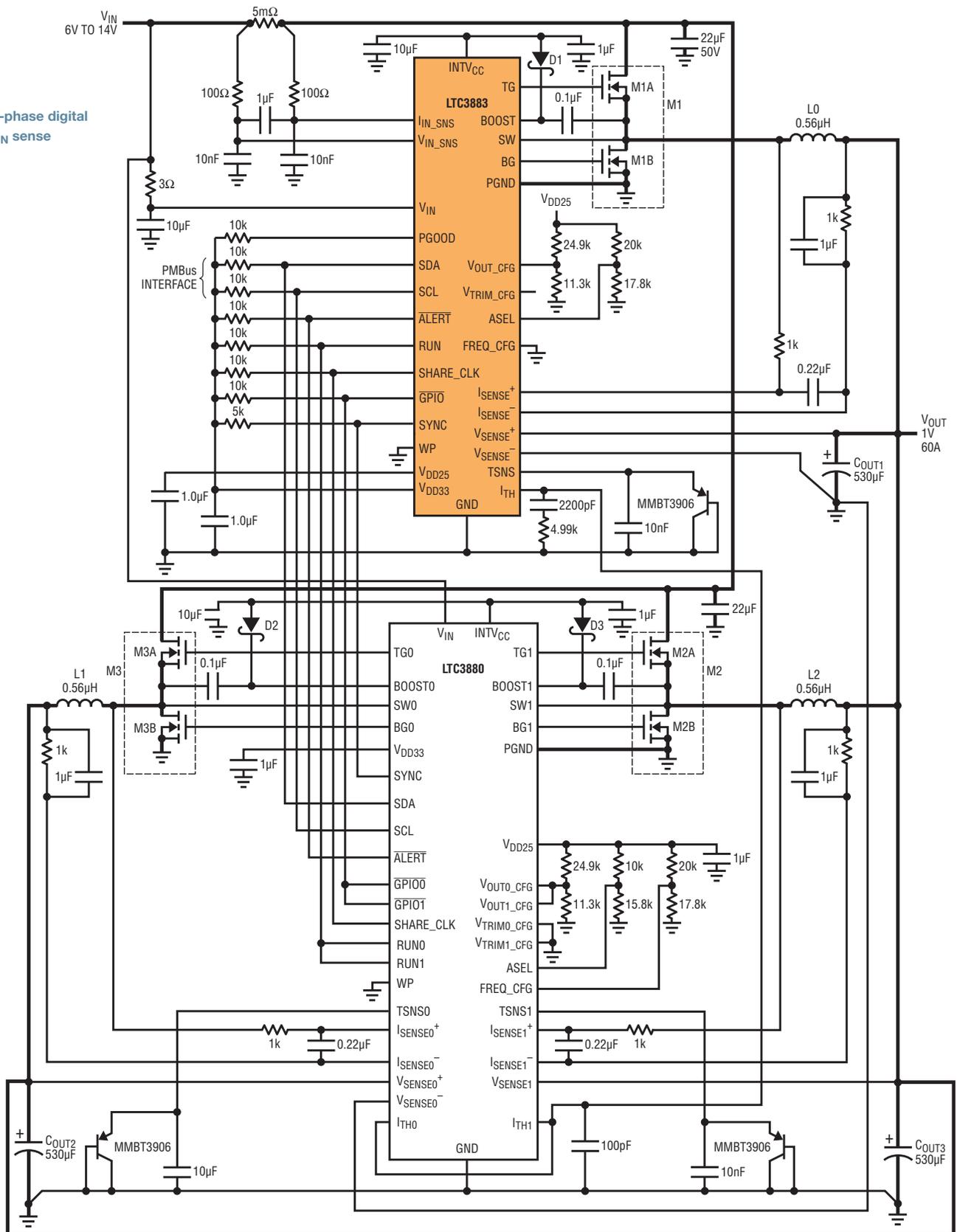
Figure 5. Transient performance of a 30A load step for 3-phase power supply



LTpowerPlay

LTpowerPlay™ software is available for free at [www.linear.com/ltpowerplay](http://www.linear.com/ltpowerplay)

Figure 4. 1.0V/60A 3-phase digital power supply with  $I_{IN}$  sense



D1-D3: CENTRAL CMDSH-3TR  
L0-L2: COILCRAFT XAL7070-301ME

M1, M2, M3: FAIRCHILD FDMS3620S  
C<sub>OUT1</sub>, C<sub>OUT2</sub>, C<sub>OUT3</sub>: 330μH SANYO 4TPF330ML, 2x 100μF AVX 12106D107KAT2A