Test Report
January 2015

TIDA-00334 Test Report

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Abstract

TI design TIDA-00334 wireless power supply transmitter is an application of the bq500212A IC in a small form factor design targeted at low power wearable devices. Input voltage to the unit is 5V from a Micro USB connector. The low power design will support output power at the receiver up to 2.5W.

All key transmitter circuits are laid out in a 30mm area which matches the diameter the Wurth coil P/N 760308101103. This area is slightly larger than a US Quarter or 2 Euro coin. PCB is 38mm X 76mm (1.5" X 3.0") but area for the circuit is inside the 30mm coil diameter is about 700mm^2.

The design is based on Qi standard components and will operate with Qi compliant receivers but due to the reduced power level is not certifiable to the standard.

The TIDA-00334 is derived from the application design PR2186, both numbers may appear in documentation but refer to a single design.

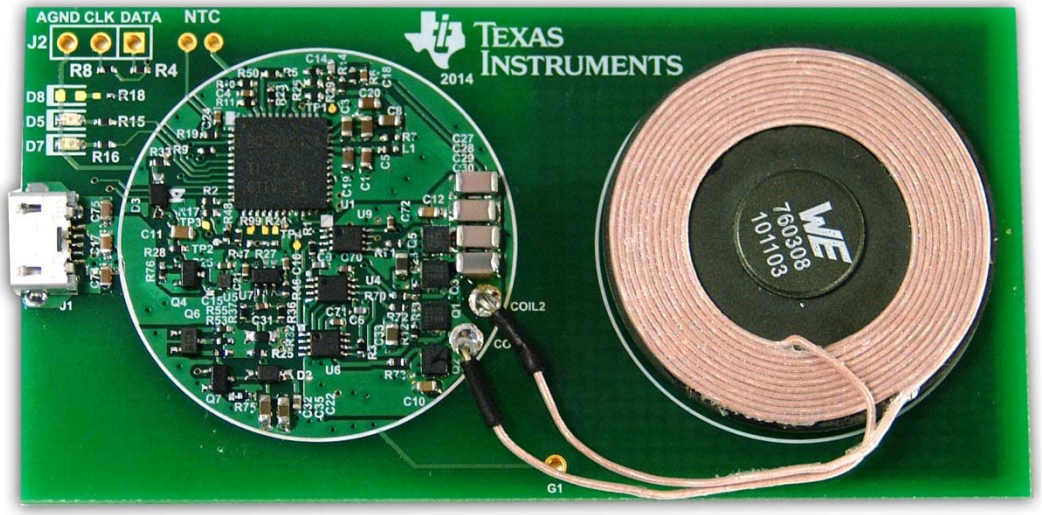

Figure 1. TIDA-00334 Photo

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bq51003 EVM / Receive Coil

- The bq51003 wireless power receiver is optimized for low power application. The TDK WR222230 is smaller coil that is half the size of the standard EVM coil. The combination of the bq51003 and WR222230 are an example of a small low power receiver solution. Test data is shown with this receiver configuration. Also see TIDA-00318 and TIDA-00329 compact receiver designs. They will work well with this transmitter and are good companion designs.

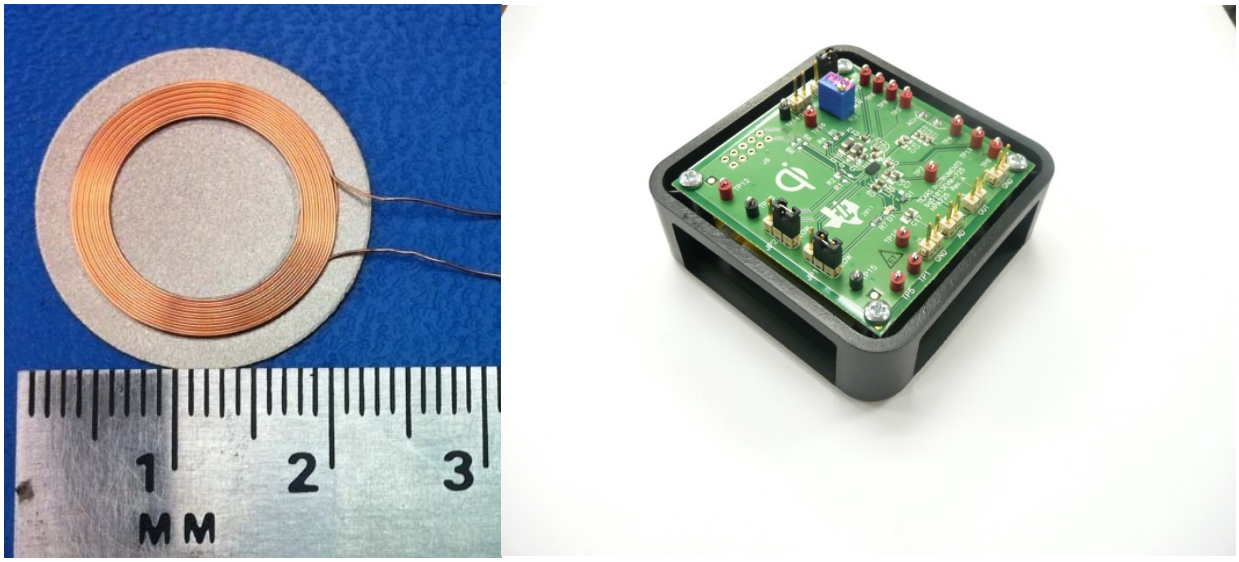

Figure 2 Test Receiver Coil and bq51003 EVM

Block Diagram

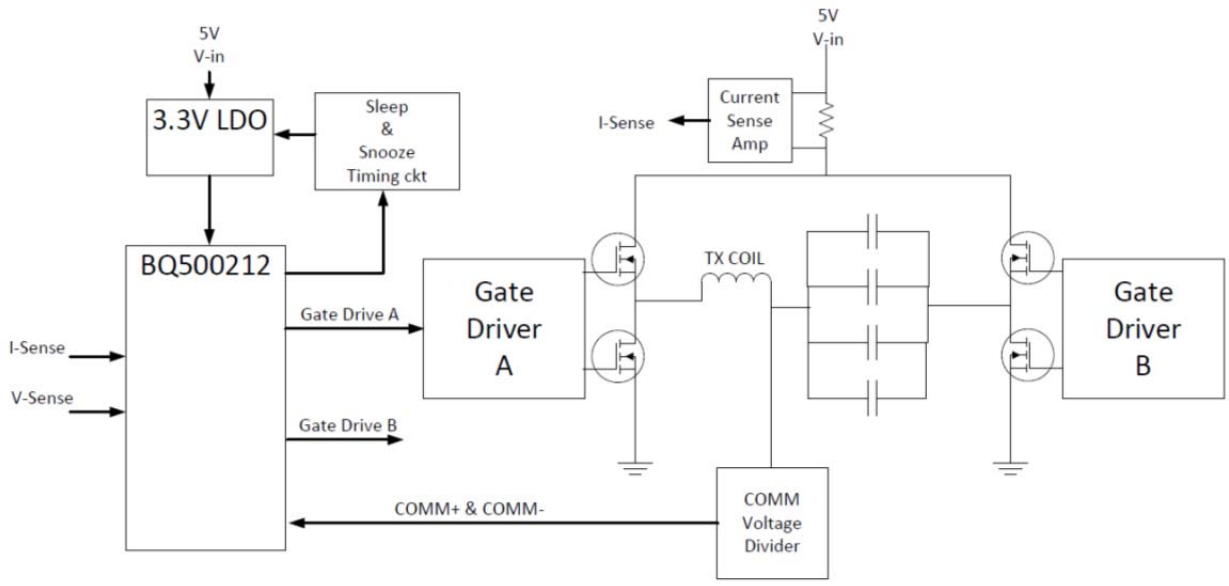

Figure 3 Block Diagram

Schematic

- The TIDA-00334 power schematic shown in figure 4 and bq500212A section schematic is shown in figure 5.

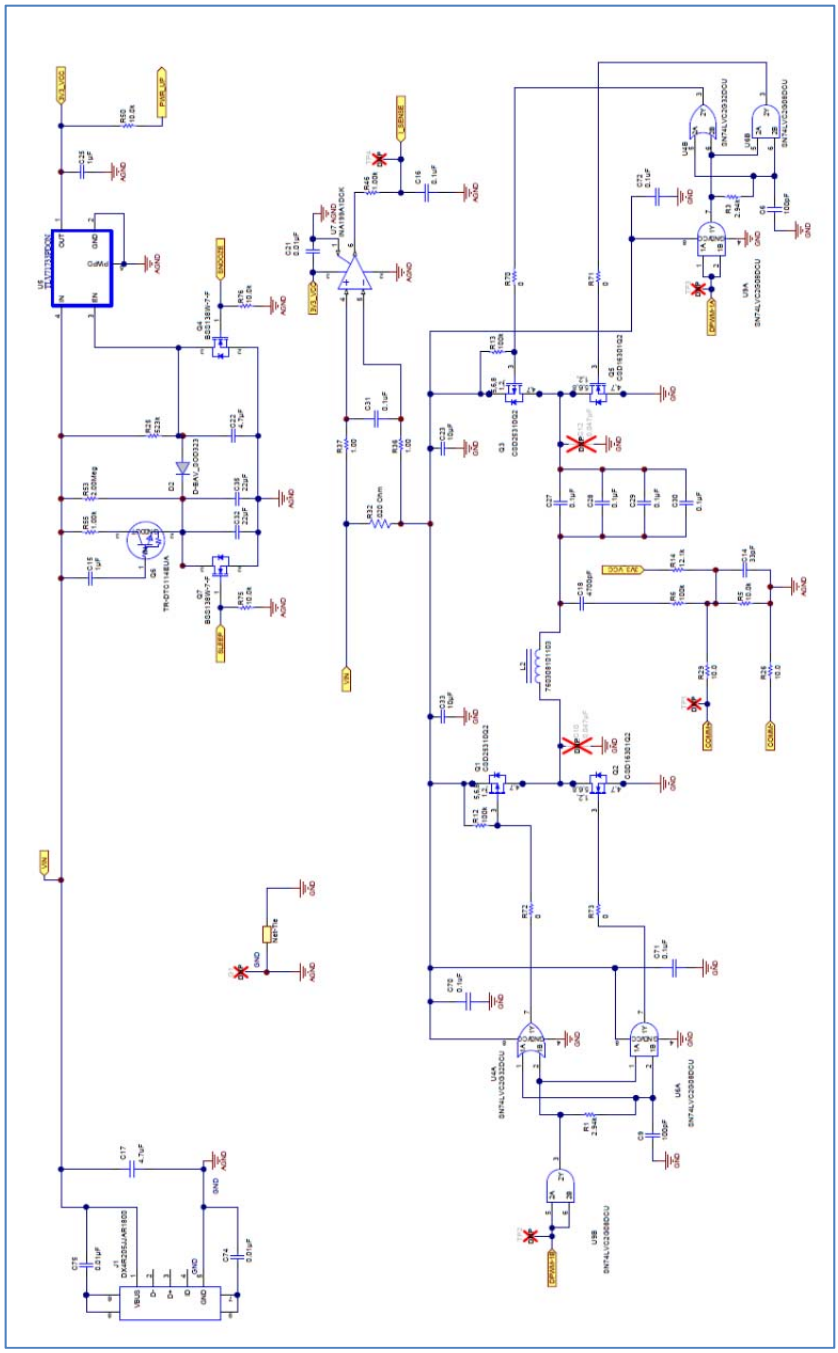

Figure 4 Schematic Power Section

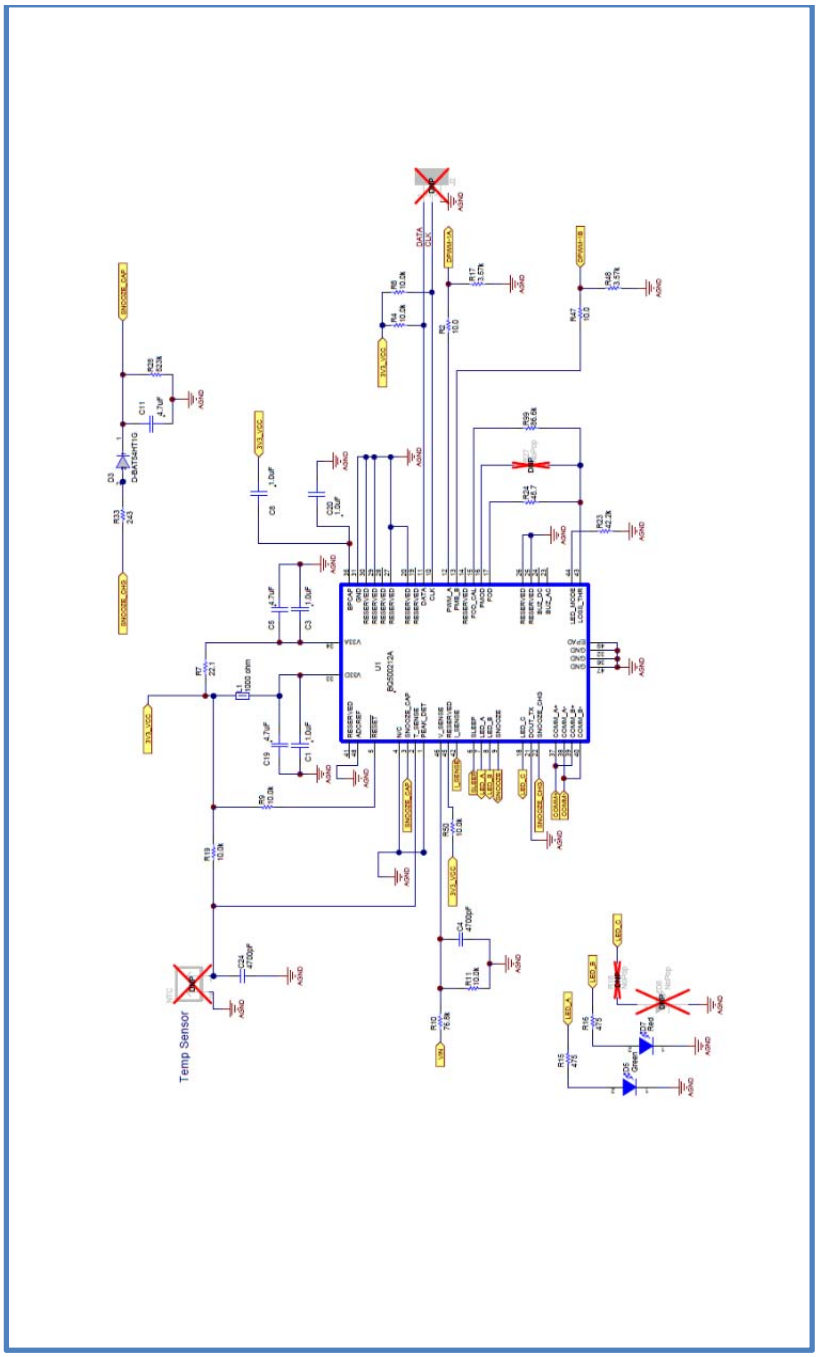

Figure 5 Schematic bq500212A Section

Configuration Options

LED Mode – Resistor R23 controls the behavior of status LED D5, D7 and D8. The standard value is 42.2k Ω for control option 1, see data sheet for additional settings.

NTC- Connector provides the option for connecting a negative temperature coefficient (NTC) sensor for thermal protection, see data sheet for additional settings.

DATA / CLK / AGND – I^2C interface to the bq500212A can be used with software tools to monitor device operation. Consult datasheet for more info.

FOD / PMOD – Protection feature that is enabled and disabled using resistor R24 & R99 for FOD and R27 for PMOD. Recommend disabling the feature for initial evaluation, remove R24, R99 and R27. If feature is used a calibration procedure needs to be run on final production unit to determine values, see datasheet for additional settings.

Power Section Configuration

The coil is driven by a full H-Bridge under logic control of the bq500212A. The H-Bridge configuration used for TIDA-00334 is one of several that can be used.

1.) Low cost logic drive used on the TIDA-00334. The MOSFET driver is replaced by a logic circuit that drives a P & N-type MOSFET switch configuration.
2.) Small integrated solution using power stage device, CSD97376CQ4M. This device will integrate the MOSFETs and Driver into one small package. Design used on the bq500212A EVM and can be used here also.
3.) MOSFET Drive solution using TPS28225. This driver or similar devices can driver any number of external N-type MOSFETs can be used. Design used on the bq500211 EVM and can also be used here.

Key requirements to keep in mind while designing the power section. Current in the TX Coil and Resonant Capacitor (C27, 28, 29 and 30) is high even with no load, about 1A. MOSFETs with low RDSon should be used, typically 10m to 30m Ω. Propagation time though the driver will impact communication and should be kept low.

Test Results

- Figure 6 shows a typical start up behavior for the TX and RX as the RX is placed on a TX in standby. The TX can be seen transitioning from standby with digital ping every 500ms to power transfer.

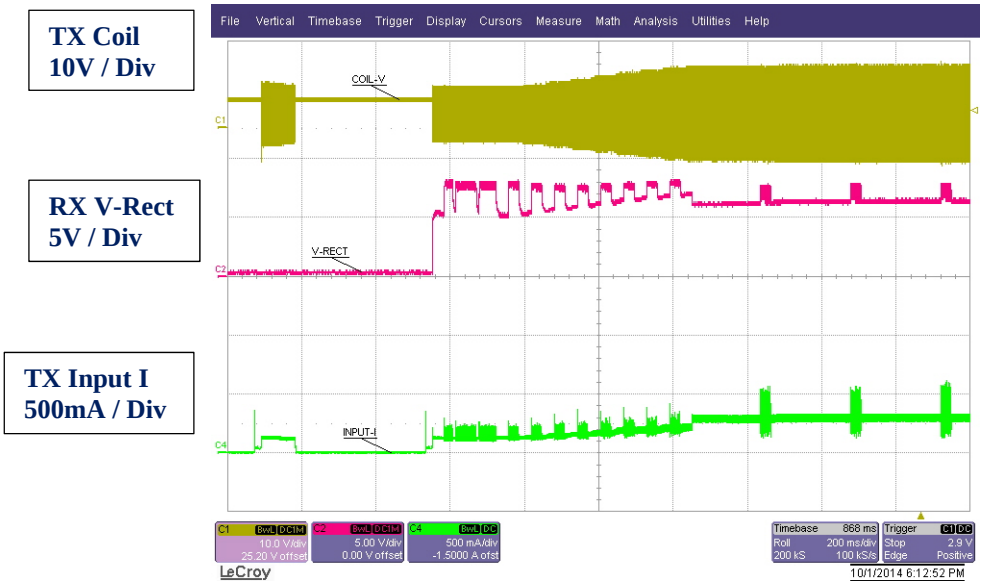

Figure 6 Start Up into 100mA load

- Figure 7 shows the TX and RX behavior during Charge Complete, EPT 01. The bq51003 is configured to send EPT 01. In response TX will end power transfer and not ping for about 2.5 seconds.

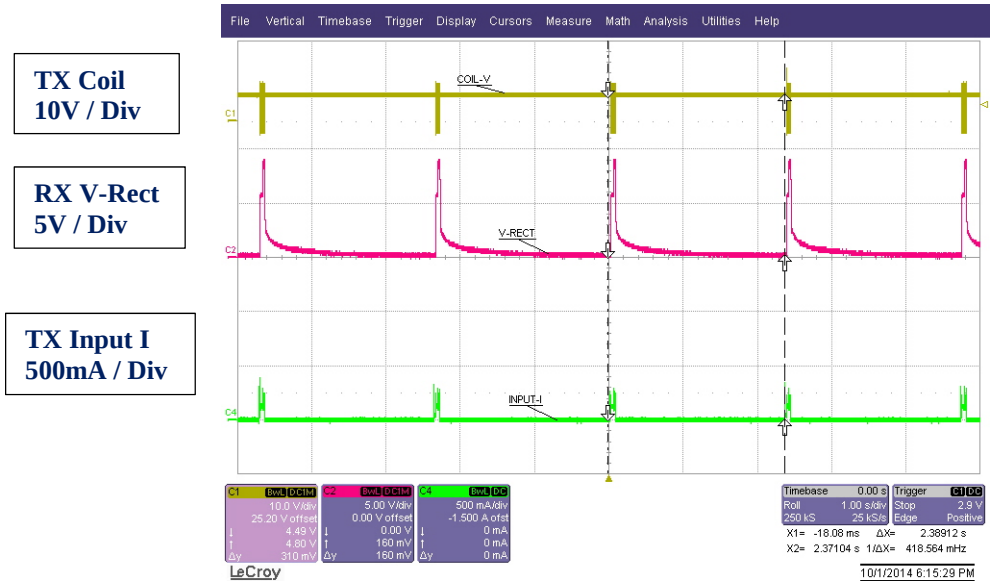

Figure 7 Charge Complete, End Power Transfer 01

- Figure 8 shows the efficiency across the power range with the bq51003EVM-764. This is the total system efficiency including the transmitter, coils and receiver.

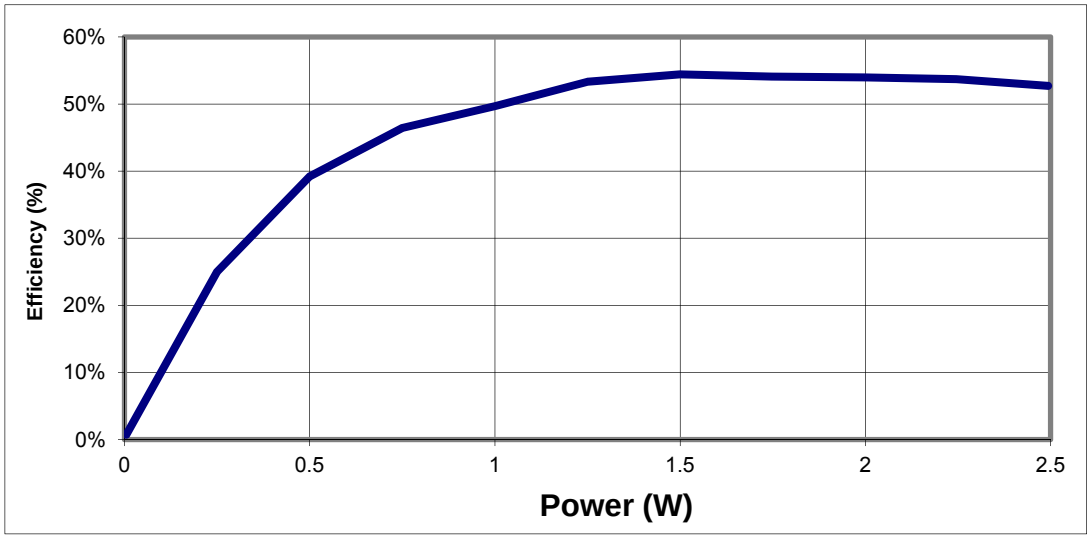

Figure 8 TIDA-00334 Efficiency with bq51003

Thermal Measurements

- The following figure shows a thermal image of the TIDA-00334 operating with the bq51003EVM-764 RX at 500mA output load.

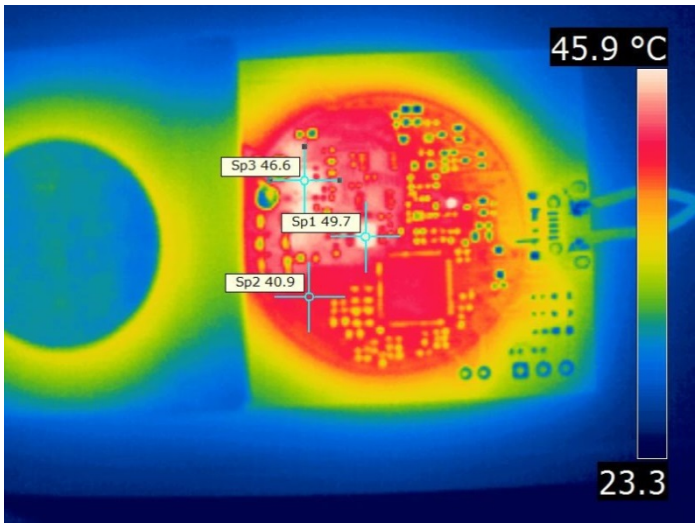

Figure 9 TIDA-00334, RX output current 500mA

References

1. Data Sheet bq500212A Wireless Power Controller for WPC (SLUSBD6C)

Document History

Version	Date	Author	Notes
2.0	January 2015	Bill Johns	Correct BOM Value, R24, R33, R70, R71, R72, R73 and R99 Changed R23 to 42.2k LED mode 1. Change R24 and R99 to open, FOD optional Change bq500212A pins 21, 25, 26, 27, 29 and 30 to open. Avoid conflict with datasheet.

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