

# MAX17536 5V Output Evaluation Kit

## Evaluates: MAX17536 in 5V Output-Voltage Application

### General Description

The MAX17536 5V output evaluation kit (EV kit) provides a proven design to evaluate this high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for a 5V output at load currents up to 4A and features a 450kHz switching frequency for optimum efficiency and component size. The EV kit features adjustable input, undervoltage lockout, adjustable soft-start, open-drain  $\overline{\text{RESET}}$  signal, and external frequency synchronization.

### Features

- Operates from a 6.5V to 60V Input Supply
- 5V Output Voltage
- Up to 4A Output Current
- 450kHz Switching Frequency
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Adjustable Soft-Start Time
- MODE Pin to Select Among PWM, PFM, or DCM Modes
- Open-Drain  $\overline{\text{RESET}}$  Output
- External Frequency Synchronization
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested

[Ordering Information](#) appears at end of data sheet.

### Quick Start

#### Recommended Equipment

- MAX17536 5V output EV kit
- 6.5V to 60V, 10A DC input power supply
- Load capable of sinking 4A
- Digital voltmeter (DVM)

#### Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on power supply until all connections are completed.**

- 1) Set the power supply at a voltage between 6V and 60V. Disable the power supply.
- 2) Connect the positive terminal of the power supply to the VIN PCB pad and the negative terminal to the nearest PGND PCB pad. Connect the positive terminal of the 4A load to the VOUT PCB pad and the negative terminal to the nearest PGND PCB pad.
- 3) Connect the DVM across the VOUT PCB pad and the nearest PGND PCB pad.
- 4) Verify that shunts are installed across pins 1-2 on jumper JU1 and pins 2-3 on JU3 (see [Table 1](#) for details).
- 5) Select the shunt position on JU2 according to the intended mode of operation (see [Table 2](#) for details).
- 6) Turn on the DC power supply.
- 7) Enable the load.
- 8) Verify that the DVM displays 5V.

## Detailed Description

The MAX17536 EV kit provides a proven design to evaluate the high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for a 5V output from a 6.5V to 60V input at load currents up to 4A and features a 450kHz switching frequency for optimum efficiency and component size.

The EV kit includes an EN/UVLO PCB pad and JU1 to enable the output at a desired input voltage. The SYNC PCB pad and JU3 allow an external clock to synchronize the device. JU2 allows the selection of a particular mode of operation based on light-load performance requirements. An additional  $\overline{\text{RESET}}$  PCB pad is available for monitoring when the converter output is in regulation.

### Soft-Start Input (SS)

The device utilizes an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by the value of the external capacitor from SS to GND (C3). The selected output capacitance ( $C_{\text{SEL}}$ ) and the output voltage ( $V_{\text{OUT}}$ ) determine the minimum value of C3, as shown by the following equation:

$$C3 \geq 28 \times 10^{-6} \times C_{\text{SEL}} \times V_{\text{OUT}}$$

The soft-start time ( $t_{\text{SS}}$ ) is related to C3 by the following equation:

$$t_{\text{SS}} = C3 / (5.55 \times 10^{-6})$$

For example, to program a 2.2ms soft-start time, C3 should be 12nF.

### Regulator Enable/Undervoltage-Lockout Level (EN/UVLO)

The device offers an adjustable-input, undervoltage-lockout level. For normal operation, a shunt should be installed across pins 1-2 on JU1. To disable the output, install a shunt across pins 2-3 on JU1 and the EN/UVLO pin is pulled to GND. See [Table 1](#) for JU1 settings.

Set the voltage at which the device turns on with the resistive voltage-divider R1/R2 connected from  $V_{\text{IN}}$  to SGND. Connect the center node of the divider to EN/UVLO. Choose R1 to be 3.32M $\Omega$  and then calculate R2 as follows:

$$R2 = \frac{R1 \times 1.215}{V_{\text{INU}} - 1.215}$$

where  $V_{\text{INU}}$  is the voltage at which the device is required to turn on.

### Mode/SYNC Selection (MODE)

The device's MODE pin can be used to select among the PWM, PFM, or DCM modes of operation. The logic state of the MODE pin is latched when the  $V_{\text{CC}}$  and EN/UVLO voltages exceed the respective UVLO rising thresholds and all internal voltages are ready to allow LX switching. State changes on the MODE pin are ignored during normal operation. Refer to the MAX17536IC data sheet for more information on the PWM, PFM, and DCM modes of operation.

[Table 2](#) lists JU2 jumper settings that can be used to configure the desired mode of operation. The internal oscillator of the device can be synchronized to an external clock signal on the SYNC pin. The external synchronization clock frequency must be between  $1.1f_{\text{SW}}$  and  $1.4f_{\text{SW}}$ , where  $f_{\text{SW}}$  is the frequency of operation set by R5. The minimum external clock high pulse width should be greater than 50ns, while the minimum external clock low pulse width should be greater than 160ns.

**Table 1. Regulator Enable (EN/UVLO) Description (JU1)**

| SHUNT POSITION | EN/UVLO PIN                                                | MAX17536_OUTPUT                                         |
|----------------|------------------------------------------------------------|---------------------------------------------------------|
| 1-2*           | Connected to VIN                                           | Enabled                                                 |
| Not installed  | Connected to the center node of resistor-divider R1 and R2 | Enabled, UVLO level set through the R1 and R2 resistors |
| 2-3            | Connected to SGND                                          | Disabled                                                |

\*Default position.

**Table 2. MODE Description (JU2)**

| SHUNT POSITION | MODE PIN          | MAX17536_MODE         |
|----------------|-------------------|-----------------------|
| Not installed* | Unconnected       | PFM mode of operation |
| 1-2            | Connected to SGND | PWM mode of operation |
| 2-3            | Connected to VCC  | DCM mode of operation |

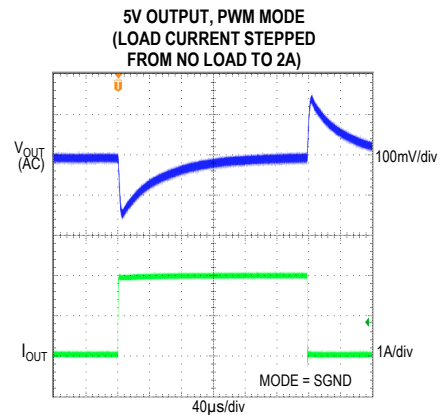
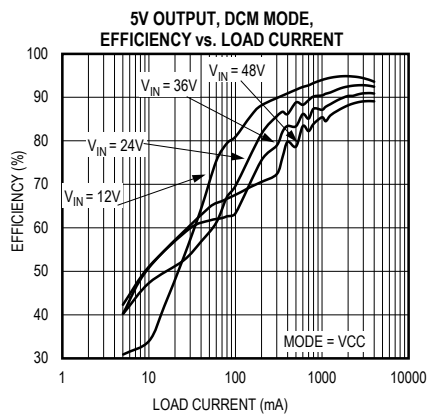
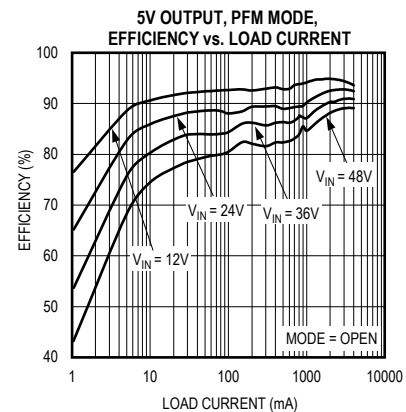
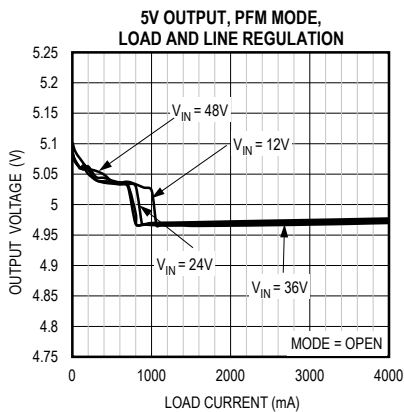
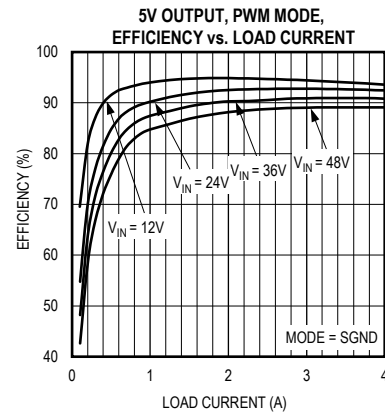
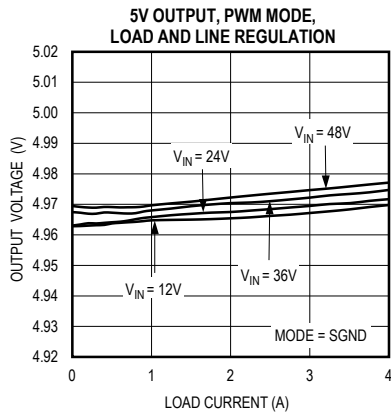
\*Default position.

# MAX17536 5V Output Evaluation Kit

## Evaluates: MAX17536 in 5V Output-Voltage Application

### EV Kit Performance Report

(Input voltage = 24V, unless otherwise noted.)

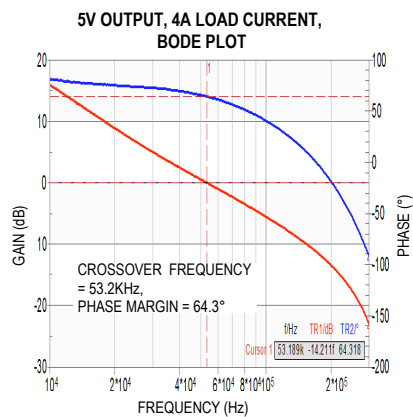
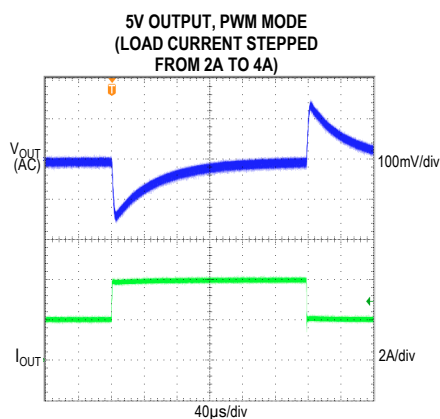
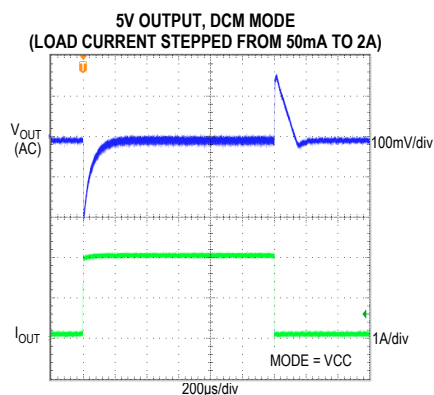
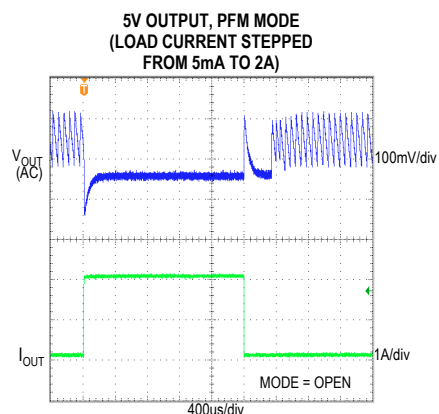


## MAX17536 5V Output Evaluation Kit

Evaluates: MAX17536 in  
5V Output-Voltage Application

### EV Kit Performance Report (continued)

(Input voltage = 24V, unless otherwise noted.)



## Component Suppliers

| SUPPLIER            | WEBSITE           |
|---------------------|-------------------|
| Coilcraft, Inc.     | www.coilcraft.com |
| TDK Corp.           | www.tdk.com       |
| Murata Americas     | www.murata.com    |
| Panasonic Corp.     | www.panasonic.com |
| Renesas Electronics | www.renesas.com   |
| Vishay              | www.vishay.com    |

**Note:** Indicate that you are using the MAX17536 when contacting these component suppliers.

## Component List, PCB Files and Schematic

See the following links for component information, PCB files, and schematics:

- [MAX17536 5V EV BOM](#)
- [MAX17536 5V EV PCB Files](#)
- [MAX17536 5V EV Schematics](#)

## Ordering Information

| PART            | TYPE   |
|-----------------|--------|
| MAX17536EVKITB# | EV Kit |

#Denotes RoHS compliant.

## MAX17536 5V Output Evaluation Kit

Evaluates: MAX17536 in  
5V Output-Voltage Application

### Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION     | PAGES<br>CHANGED |
|--------------------|------------------|-----------------|------------------|
| 0                  | 6/15             | Initial release | —                |

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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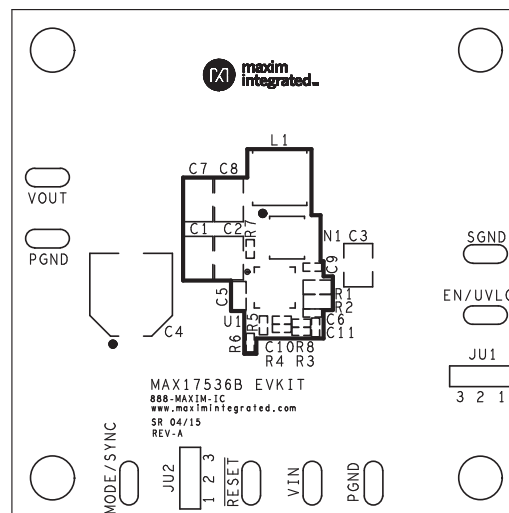
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HARDWARE NAME:MAX17536B\_EVKIT\_A

HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: SILK\_TOP





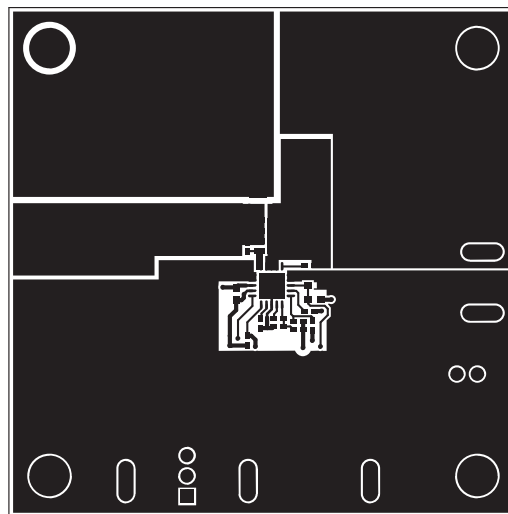
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ODB++/GERBER: TOP







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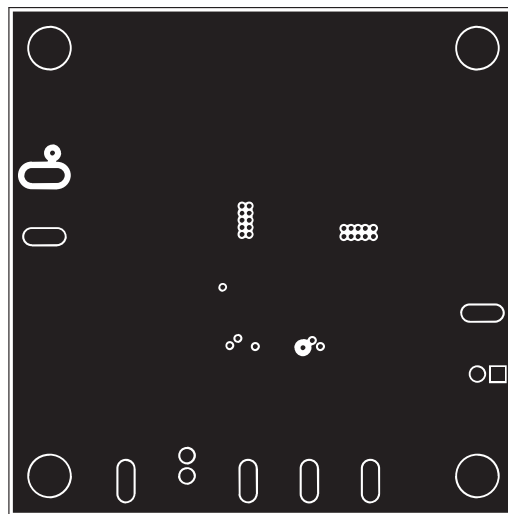
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ODB++/GERBER: L2 - SGND





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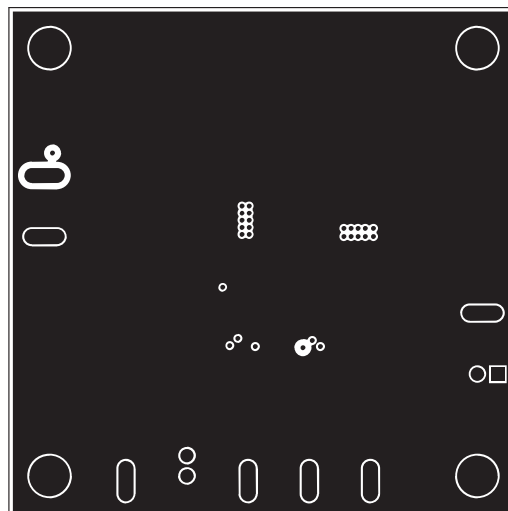
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ODB++/GERBER: L3-SGND





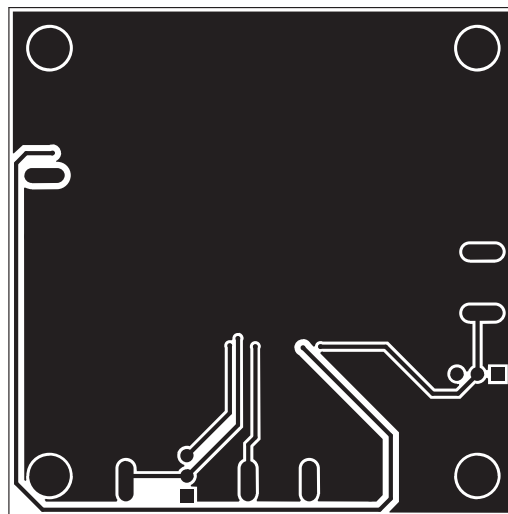
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HARDWARE NUMBER:

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ODB++/GERBER: BOTTOM





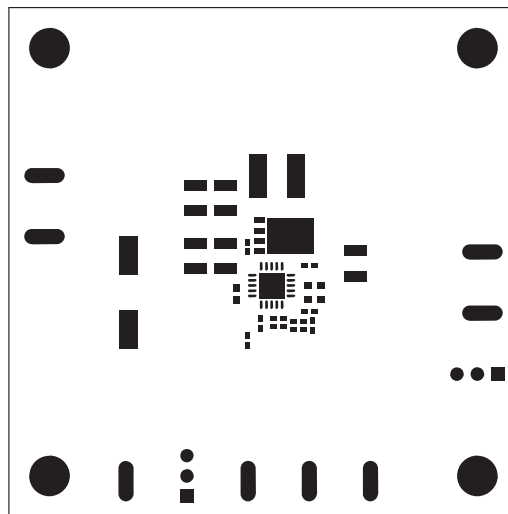
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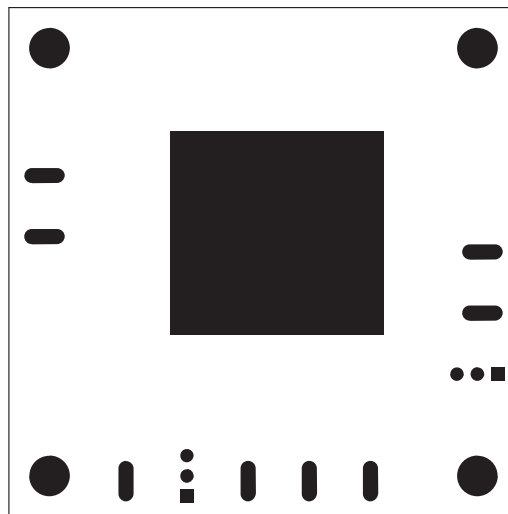
HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: MASK\_TOP

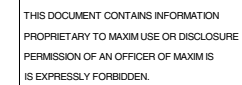


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| HARDWARE NUMBER:                                                                                               |                        |                                                                                                                                                                                               |
|                                                                                                                |                        |                                                                                                                                                                                               |
| DATE: 04/10/2015                                                                                               | ODB++/GERBER: MASK_BOT |                                                                                                                                                                                               |



The schematic diagram illustrates a DC-DC converter circuit using the MAX17536 IC. The circuit includes the following components and connections:

- MAX17536 IC:** The central component, with pins labeled VIN, PGND, VCC, MODE/SYNC, RESET, RT, SGND, CF, FB, EP, SS, EN/UVLO, and EXT VCC.
- Input Stage:** VIN is connected to the input of the MOSFET (N1) and the MAX17536. A 47uF 80V capacitor (C4) is connected between VIN and PGND. A 2.2uF 100V capacitor (C1) is connected between the input of the MOSFET and PGND. A 2.2uF 100V capacitor (C2) is connected between the input of the MOSFET and VCC. A 47uF 10V capacitor (C7) is connected between the output of the MOSFET and PGND. A 22uF 10V capacitor (C8) is connected between the output of the MOSFET and PGND.
- Output Stage:** The output of the MOSFET is connected to the output of the MAX17536 (VOUT). A 4.7uH inductor (L1) is connected between the output of the MOSFET and VOUT. A 47uF 10V capacitor (C7) is connected between VOUT and PGND. A 22uF 10V capacitor (C8) is connected between VOUT and PGND.
- Feedback Network:** A feedback network consisting of resistors R1 (3.32M) and R2 (604K) is connected between VOUT and the EN/UVLO pin of the MAX17536. A 0.022uF capacitor (C6) is connected between the EN/UVLO pin and SGND.
- Current Sense:** A current sense resistor (R3, 196K) is connected between the output of the MOSFET and VOUT. A 4.7 ohm resistor (R8) is connected between the output of the MOSFET and VOUT.
- Other Components:** A 4.7uF 10V capacitor (C9) is connected between the output of the MOSFET and PGND. A 0.1uF capacitor (C10) is connected between the output of the MOSFET and PGND. A 0.1uF capacitor (C11) is connected between the output of the MOSFET and PGND. A 43.2K resistor (R4) is connected between the output of the MOSFET and PGND. A 10K resistor (R6) is connected between the output of the MOSFET and PGND. A 196K resistor (R5) is connected between the output of the MOSFET and PGND.



|                |                  |                   |  |
|----------------|------------------|-------------------|--|
| PROJECT TITLE: |                  | MAX17536B_EVKIT_A |  |
| DRAWING TITLE: |                  |                   |  |
| SIZE:          | HARDWARE NUMBER: |                   |  |
| B              |                  |                   |  |
| ENGINEER:      | DRAWN BY:        | DATE: 08/04/15    |  |
|                | TEMPLATE REV: B  | REV: A            |  |

**BILL OF MATERIALS (BOM) Revision 6/15**

| Serial No. | Description                                    | Quantity | Designator       | Part Number              |
|------------|------------------------------------------------|----------|------------------|--------------------------|
| 1          | 2.2µF ±10%, 100V X7R ceramic capacitor (1210)  | 2        | C1, C2           | MURATA GRM32ER72A225KA35 |
| 2          | Not installed, OPEN (1210)                     | 0        | C3               |                          |
| 3          | 47uF 80V aluminum electrolytic (D=10mm)        | 1        | C4               | PANASONIC EEEFK1K470P    |
| 4          | 2.2µF ±10%, 10V X7R ceramic capacitor (0603)   | 1        | C5               | MURATA GRM188R71A225K    |
| 5          | 22000pF ±10%, 50V X7R ceramic capacitor (0402) | 1        | C6               | MURATA GRM155R71H223K    |
| 6          | 47uF ±10%, 10V X7R ceramic capacitor (1210)    | 1        | C7               | MURATA GRM32ER71A476K    |
| 7          | 22uF ±10%, 10V X7R ceramic capacitor (1210)    | 1        | C8               | MURATA GRM32ER71A226K    |
| 8          | 0.1µF ±10%, 50V X7R ceramic capacitor (0402)   | 1        | C9               | MURATA GRM155R71H104KE14 |
| 9          | Not installed, OPEN (0402)                     | 0        | C10              |                          |
| 10         | 0.1µF ±10%, 50V X7R ceramic capacitor (0402)   | 1        | C11              | MURATA GRM155R71H104KE14 |
| 11         | 3-pin header (36-pin header 0.1" centers )     | 2        | JU1, JU2         | Sullins: PTC36SAAN       |
| 12         | 4.7uH Inductor (6.36mm x 6.56mm x 6.1mm)       | 1        | L1               | Coilcraft XAL6060-472    |
| 13         | MOSFET (60V, 25A)                              | 1        | N1               | Renesas RJK0651-DPB      |
| 14         | 3.32M ohm ±1%, resistor (0603)                 | 1        | R1               |                          |
| 15         | 604k ohm ±1%, resistor (0603)                  | 1        | R2               |                          |
| 16         | 196k ohm ±1%, resistor (0402)                  | 1        | R3               |                          |
| 17         | 43.2k ohm ±1%, resistor (0402)                 | 1        | R4               |                          |
| 18         | Not installed, OPEN (0402)                     | 0        | R5               |                          |
| 19         | 10k ohm ±1%, resistor (0402)                   | 1        | R6               |                          |
| 20         | Not installed, OPEN (0402)                     | 0        | R7               |                          |
| 21         | 4.7 ohm ±1%, resistor (0402)                   | 1        | R8               |                          |
| 22         | Buck Converter<br>MAX17536ATP+                 | 1        | U1               | MAX17536ATP+             |
| 23         | Shunt                                          | 2        | See Jumper Table | SULLINS STC02SYAN        |

**Jumper Table**

| JUMPER | SHUNT POSITION |
|--------|----------------|
| JU1    | 1-2            |
| JU2    | 1              |

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