

APM81911 Evaluation Board User Guide

DESCRIPTION

The APM81911 Evaluation Board is designed to help system designers evaluate the operation and performance of the APM81911 synchronous buck regulator ClearPower module. The APM81911 evaluation board output voltage can be configured with a jumper for 5 V or 3.3 V.

FEATURES

- APM81911 buck converter power module
- User-selectable output voltage, switching frequency, low-power mode, soft-start time, clock source, and output clock state
- Banana jacks for input and output power

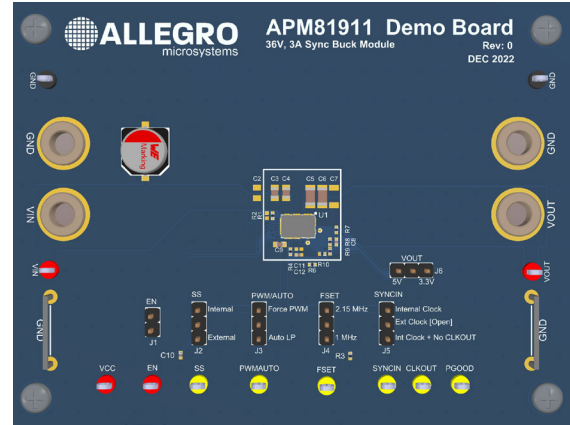


Figure 1: APM81911 Evaluation Board



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Table 1: APM81911 Evaluation Board Configurations

| Configuration Name | Part Number | Output Voltage |
|--------------------|-----------------|---------------------------|
| APM81911 | APEK81911KNB-01 | Selectable (3.3 V or 5 V) |

Table 2: General Specifications

| Specification | Min. | Nom. | Max. | Units |
|--|------|------|------|-------|
| Input Operating Voltage | 3.5 | – | 36 | V |
| Output Current* | 0 | – | 3 | A |
| Switching Frequency and SYNCIN Frequency | 1 | – | 2.15 | MHz |

*Maximum output current may be lower due to thermal limitations of the APM81911 and the APM81911 Evaluation Board at certain operating conditions.

USING THE EVALUATION BOARD

This section provides an overview of the connections and configuration options of the APM81911 Evaluation Board. Each group of connections highlighted in Figure 2 has a detail section below. The default jumper positions are highlighted in green. The APM81911 datasheet contains detailed information on the use and functionality of each pin and should be consulted for more detailed information than is contained in this user guide.

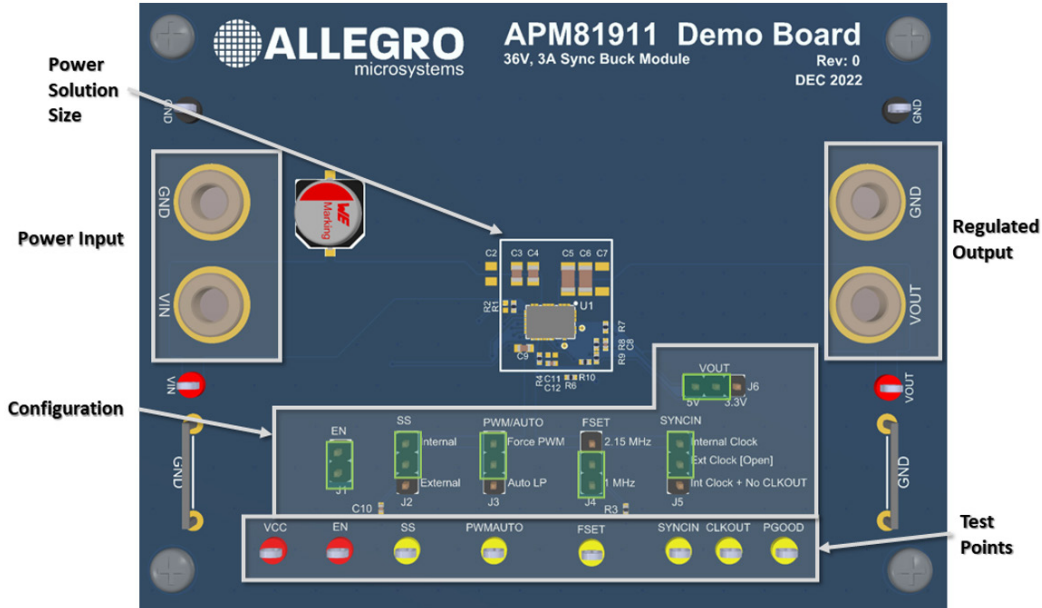


Figure 2: APM81911 Evaluation Board I/O Connections and Default Jumper Positions

Power Input

Connect a power supply using banana cables to the VIN and GND through hole banana jack or with test leads to the VIN and GND test points.

Device Configuration

There are six configuration jumpers on the evaluation board to exercise different operating modes of the APM81911. All configuration jumpers must be installed prior to power-on, unless using an external EN signal or SYNCIN signal where jumper J1 or J5 must be uninstalled, respectively.

Table 3: Jumper Descriptions

| Jumper | Name | Description |
|--------|----------|---|
| J1 | EN | Install to tie EN to VIN and enable the APM81911 when VIN is above UVLO. Uninstall to control EN through an external signal at the EN test point. |
| J2 | SS | Soft-start select. Install at "Internal" to use internal soft-start or "External" to use the external 47 nF soft-start capacitor. |
| J3 | PWM/AUTO | Low-power mode select. Install at "Auto LP" to allow the part to enter low-power mode under light loads. Install at "Force PWM" to always stay in PWM switching mode. |
| J4 | FSET | Frequency Set select. Install at "2.15 MHz" or "1 MHz". The "2.15 MHz" option ties FSET to VCC and the "1 MHz" option ties FSET to GND through a resistor. |
| J5 | SYNCIN | Clock synchronization input. Install from center pin to top "Internal Clock" pin to use the internal clock and enable the CLKOUT pin. Install from center pin to the bottom "Int Clock + No CLKOUT" to use the internal clock and disable the CLKOUT signal. Leave the jumper open to apply a synchronization clock at the SYNCIN test point. |
| J6 | VOUT | Output voltage select. Install at "5V" for 5 V output. Uninstall or install at "3.3V" for 3.3 V output. |

Table 4: Test Point Descriptions

| Test Point | Description |
|-------------------|---|
| VIN | Positive terminal for input voltage connection or sensing. |
| VOUT | Positive terminal for output voltage connection or sensing. |
| GND | Negative terminal for voltage input/output or sensing. |
| VCC | VCC pin voltage monitor test point. |
| EN | EN pin voltage monitor or external logic input. Uninstall J1 to use an external enable signal on the EN test point. |
| SS | Soft-start pin voltage monitor test point. |
| FSET | FSET voltage monitor test point. |
| PWMAUTO | PWM/AUTO voltage monitor test point. |
| SYNCIN | SYNCIN test point for connecting external PWM signal for clock synchronization. |
| CLKOUT | Clock monitor test point for CLKOUT signal if SYNCIN jumper is configured to enable CLKOUT. |
| PGOOD | PGOOD monitor test point. This pin is pulled up to VCC and asserts low to indicate the output is out of regulation. |

PERFORMANCE DATA

Startup and Shutdown

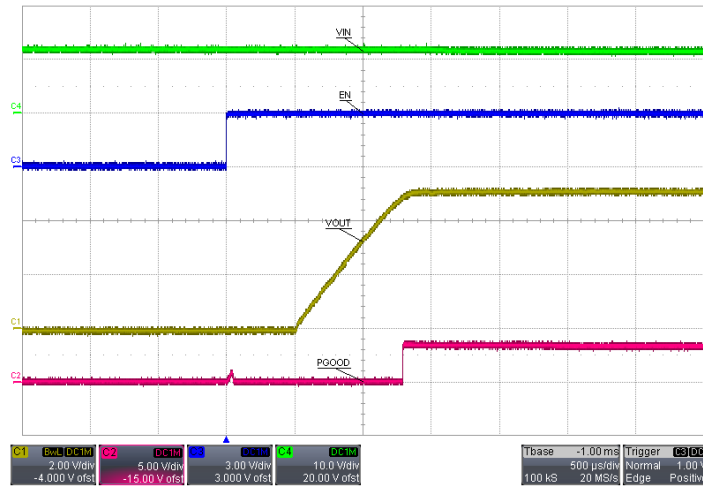


Figure 3: Startup with EN Signal and Internal Soft-Start

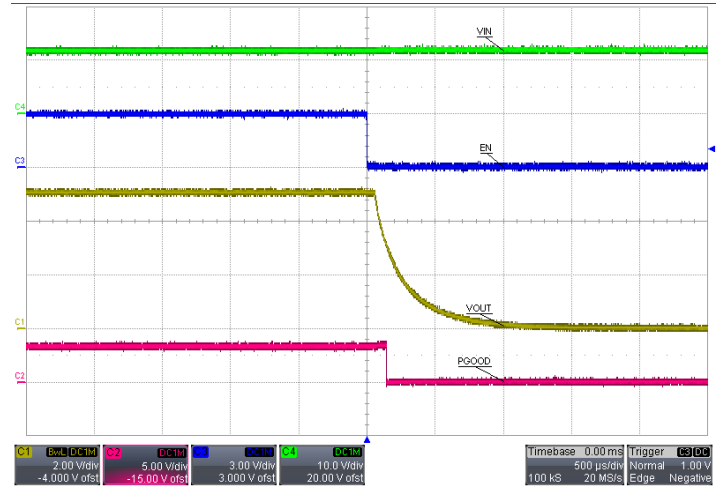


Figure 4: Shutdown with EN Signal;
5 Ω load applied to VOUT

Load Transient Response

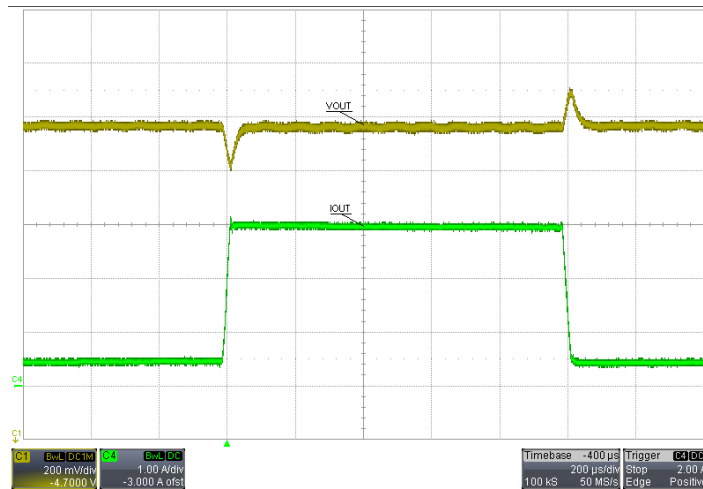


Figure 5: V_{OUT} Response to Load Transient; Load Step = 500 mA to 3 A, V_{OUT} = 5 V

Efficiency

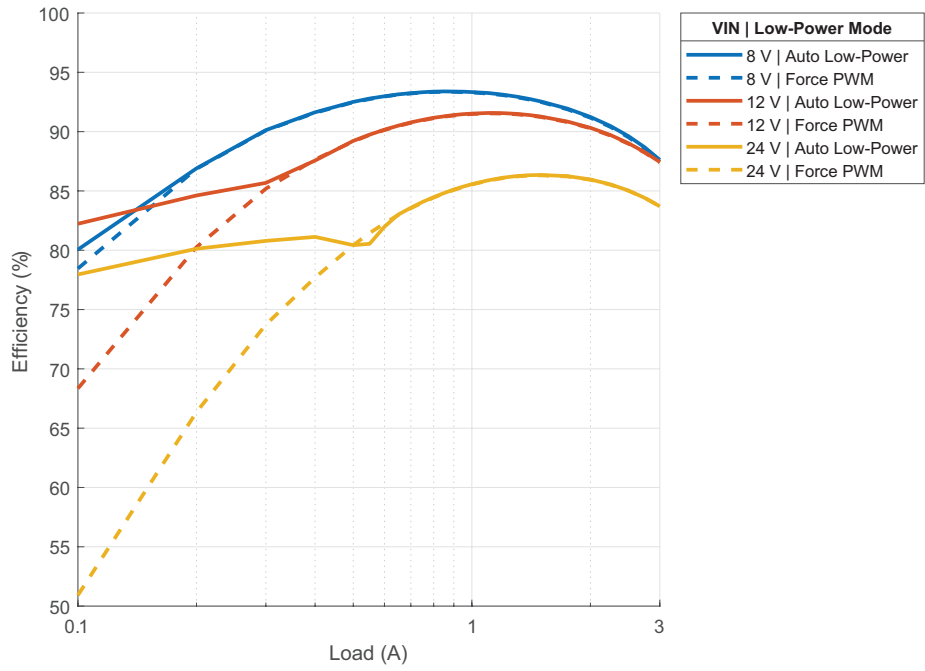


Figure 6: Efficiency at $V_{OUT} = 5\text{ V}$, $f_{SW} = 2.15\text{ MHz}$

Thermal Performance

The following figure shows the thermal performance of the APM81911 Evaluation Board after five minutes of continuous operation with ambient temperature near 25°C.

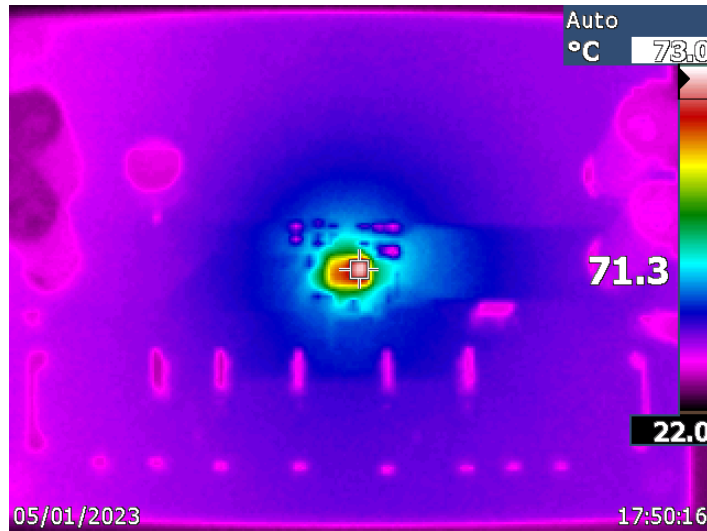


Figure 7: APM81911 Evaluation Board Thermal Image at $V_{IN} = 12\text{ V}$, $V_{OUT} = 5\text{ V}$, $I_{OUT} = 3\text{ A}$, $f_{SW} = 2.15\text{ MHz}$

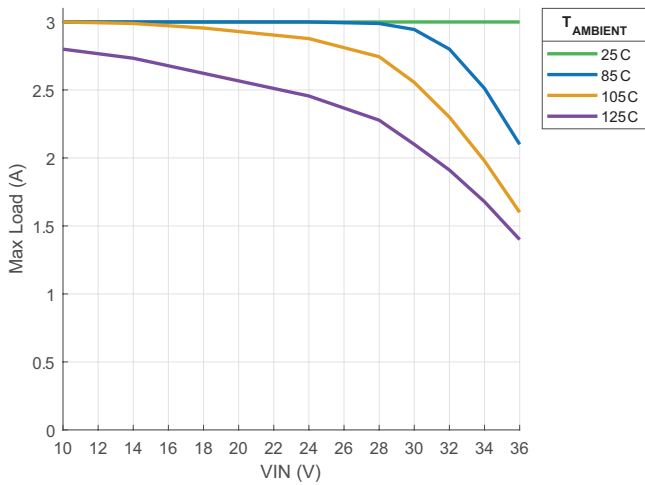


Figure 8: Maximum Load Current Derating for $V_{OUT} = 3.3\text{ V}$, $f_{SW} = 2.15\text{ MHz}$

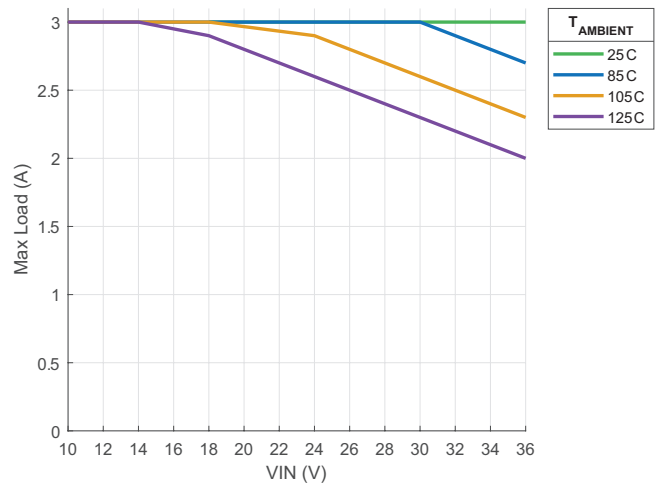
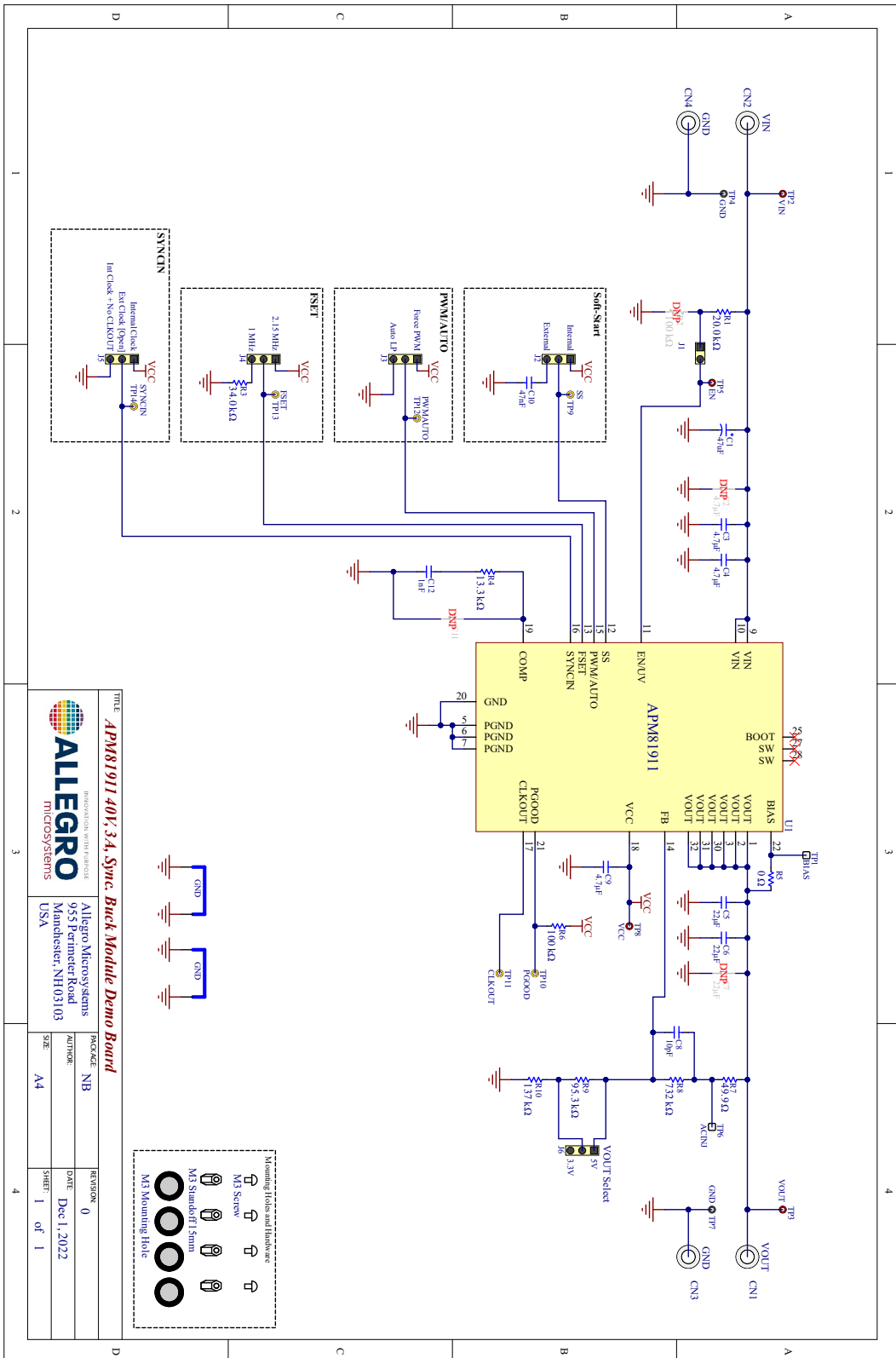


Figure 9: Maximum Load Current Derating for $V_{OUT} = 5\text{ V}$, $f_{SW} = 2.15\text{ MHz}$

SCHEMATIC



PCB LAYOUT

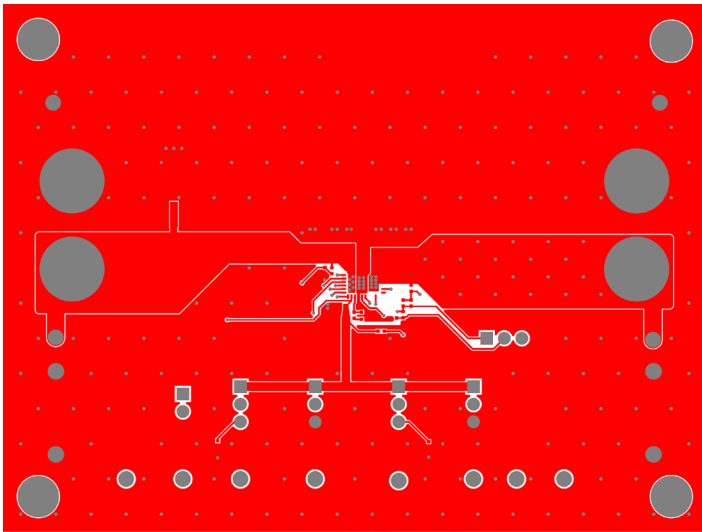


Figure 10: Top Layer

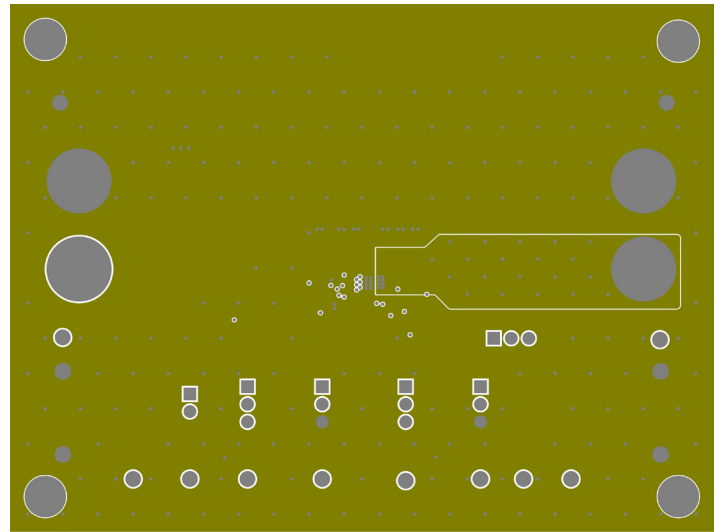


Figure 12: Inner Layer 2 (PGND Plane)

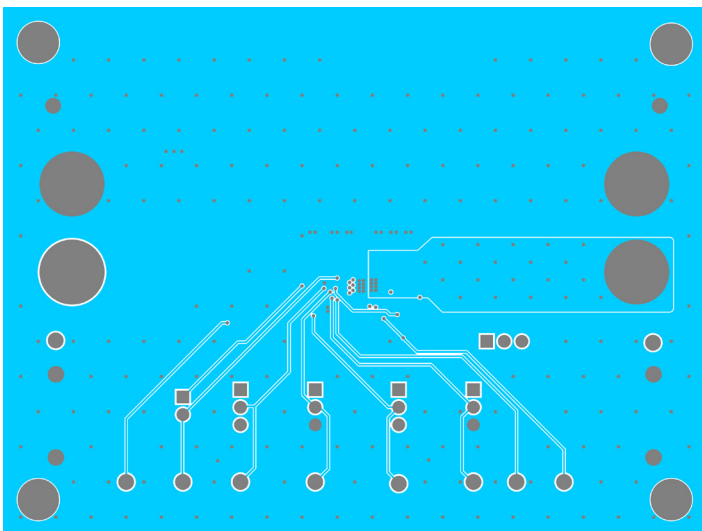


Figure 11: Inner Layer 1 (PGND Plane)

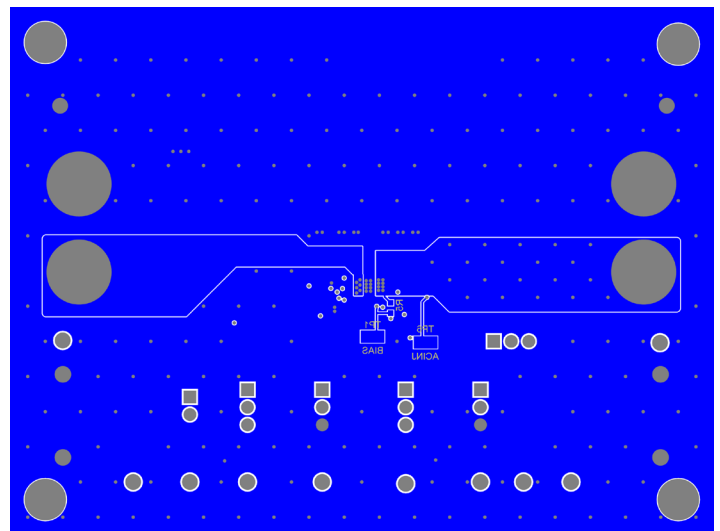


Figure 13: Bottom Layer

BILL OF MATERIALS

Table 5: APEK81911 Bill of Materials

| Designator | Description | Quantity | Manufacturer | Manufacturer Part Number |
|--|---|----------|----------------------|--------------------------|
| Electrical | | | | |
| C1 | Capacitor, Electrolytic, 47 μ F, 50 V, 8 mm | 1 | Nichicon | UUX1H470MNL6GS |
| C3, C4 | CAP CER 4.7 μ F, 50 V, X7S 0805 | 2 | Murata | GRM21BC71H475KE11L |
| C5, C6 | CAP CER 22 μ F, 25 V, X5R 1206 | 2 | TDK | C3216X5R1E226M160AB |
| C8 | CAP CER 10 pF, 50 V, NP0 0402 | 1 | TDK | C1005NP01H100D050BA |
| C9 | CAP CER 4.7 μ F, 10 V, X5R 0603 | 1 | KEMET | C0603C475M8PACTU |
| C10 | CAP CER 0.047 μ F, 16 V, X7R 0402 | 1 | Murata | GRM155R71C473KA01D |
| C12 | CAP CER 1000 pF, 50 V, NP0 0402 | 1 | Murata | GRM1555C1H102GA01D |
| R1 | Resistor, 20.0 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-0720KL |
| R3 | Resistor, 34.0 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-0734KL |
| R4 | Resistor, 13.3 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-0713K3L |
| R5 | Resistor, 0 Ω , 1/10 W, Jumper, 0603 | 1 | Yageo | RC0603JR-070RL |
| R6 | Resistor, 100 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-07100KL |
| R7 | Resistor, 49.9 Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RT0402FRE0749R9L |
| R8 | Resistor, 732 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-07732KL |
| R9 | Resistor, 95.3 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-0795K3L |
| R10 | Resistor, 137 k Ω , 1/16 W, 1%, 0402 | 1 | Yageo | RC0402FR-07137KL |
| U1 | APM81911 in QFN 4 mm \times 6 mm | 1 | Allegro MicroSystems | APM81911KNBATR |
| Mechanical | | | | |
| CN1, CN2, CN3, CN4 | Banana Jack- Non-Insulated 0.218" Length | 4 | Keystone Electronics | 575-4 |
| J1 | CONN HEADER VERT 2 POS 2.54 mm | 1 | Würth Electronics | 61300211121 |
| J2, J3, J4, J5, J6 | CONN HEADER VERT 3 POS 2.54 mm | 5 | Würth Electronics | 61300311121 |
| MS1, MS2, MS3, MS4 | PAN HEAD SCREW_M 3 \times 8 mm CROSS SL | 4 | Würth Electronics | 97790803111 |
| STND1, STND2, STND3, STND4 | Standoffs & Spacers 5.0 HEX 15.0 mm NYLON | 4 | Keystone Electronics | 25512 |
| BIAS, ACINJ | Test Point, SMT, 105 mil \times 40 mil | 2 | Keystone Electronics | 5015 |
| VIN, VOUT, EN, VCC | Test Point, Red, Through Hole Mount, 1.6 mm | 4 | Keystone Electronics | 5010 |
| GND | Test Point, Black, Through Hole Mount, 1.6 mm | 2 | Keystone Electronics | 5011 |
| SS, PGOOD, CLKOUT, PWMAUTO, FSET, SYNCIN | Test Point, Yellow, Through Hole Mount, 1.6 mm | 6 | Keystone Electronics | 5014 |
| Not Fitted | | | | |
| C2 | CAP CER 4.7 μ F, 50 V, X7S 0805 | 0 | Murata | GRM21BC71H475KE11L |
| C7 | CAP CER 22 μ F, 25 V, X5R 1206 | 0 | TDK | C3216X5R1E226M160AB |
| C11 | CAP CER 0.1 pF, 25 V, NP0 0402 | 0 | Murata | GRM1555C1ER10WA01D |
| R2 | Resistor, 100 k Ω , 1/16 W, 1%, 0402 | 0 | Yageo | RC0402FR-07100KL |

RELATED LINKS

- Product page: <https://www.allegromicro.com/en/products/regulate/clearpower-modules/regulator-modules/apm81911>
- Datasheet: <https://www.allegromicro.com/-/media/files/datasheets/apm81911-datasheet.pdf>

Revision History

| Number | Date | Description |
|--------|-------------------|-----------------------------|
| – | February 14, 2023 | Initial release |
| 1 | February 22, 2023 | Addition of Clearpower logo |

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