

### DESCRIPTION

The AP66200 is an adjustable switching frequency, internally compensated, synchronous DC-DC Buck converter with a default internal frequency of 500kHz. The device fully integrates a 185mΩ high-side power MOSFET and an 80mΩ low-side power MOSFET to provide highly efficient step-down DC-DC conversion.

The AP66200 enables a continuous load current of up to 2A with as high as 95% efficiency in enhanced bias. It features current mode control operation, which enables easy loop

stabilization while supporting a wide range of output capacitive loads.

With its high level of integration and minimal need for external components, the AP66200 simplifies board layout and reduces space requirements. This makes it ideal for distributed power architectures.

The AP66200 is available in the standard Green U-QFN4040-16/SWP (Type UXB) package.

### FEATURES

- $V_{IN}$  3.8 to 60V
- 2A Continuous Output Current
- $V_{OUT}$  Adjustable from 0.8V to 50V
- Enhanced Efficiency Mode with Bias
- Adjustable Switching Frequency. 500kHz Default Frequency
- Start-up with Pre-biased Output
- External Soft-Start with Tracking – Sequential, Ratiometric, or Absolute. Default Internal Soft-Start of 2ms
- Enable Pin with 5% tolerance
- Soft Discharge
- $\pm 5\%$  Power Good Detection with Internal Pull-up Resistor
- Overcurrent Protection (OCP) with Hiccup
- **Totally Lead-Free & Fully RoHS Compliant**
- **Halogen and Antimony Free. “Green” Device**
- **An automotive-compliant part is available under separate datasheet ([AP66200Q](#))**

### APPLICATIONS

- General purpose point-of-load DC/DC power conversion
- Automotive infotainment
- Telecommunication
- Distributed power systems
- Home audio
- Consumer electronics
- Network systems
- FPGA, DSP, and ASIC supplies
- Green electronics such as PCs, monitors, televisions, washing machines, refrigerators, microwaves

### ABSOLUTE MAXIMUM RATINGS

| Symbol                    | Parameter                | Rating                                       | Unit |
|---------------------------|--------------------------|--|------|
| V <sub>IN</sub>           | Supply Voltage           | -0.3 to +72                                  | V    |
| V <sub>SW</sub>           | Switch Node Voltage      | -1.0 to V <sub>IN</sub> +0.3 (DC)            | V    |
| V <sub>SW</sub>           | Switch Node Voltage      | -2.5 to V <sub>IN</sub> +2 (ns)              | V    |
| V <sub>EN</sub>           | Enable/UVLO Voltage      | -0.3V to +72                                 | V    |
| V <sub>BST</sub>          | Bootstrap Voltage        | V <sub>SW</sub> -0.3 to V <sub>SW</sub> +6.0 | V    |
| V <sub>BIAS</sub>         | Bias Voltage             | -0.3 to +18                                  | V    |
| V <sub>CC</sub>           | VCC Voltage              | -0.3V to +6.0                                | V    |
| V <sub>FB</sub>           | Feedback Voltage         | -0.3V to +6.0                                | V    |
| V <sub>FS</sub>           | Frequency Adjust         | -0.3V to +6.0                                | V    |
| V <sub>PG</sub>           | Power Good Voltage       | -0.3V to +6.0                                | V    |
| V <sub>SS/TR</sub>        | Soft-start / Tracking    | -0.3V to +6.0                                | V    |
| V <sub>MSYNC</sub>        | Synchronization and MODE | -0.3V to +6.0                                | V    |
| T <sub>ST</sub>           | Storage Temperature      | -65 to +150                                  | °C   |
| T <sub>J</sub>            | Junction Temperature     | +150   | °C   |
| T <sub>L</sub>            | Lead Temperature         | +300   | °C   |
| <b>ESD Susceptibility</b> |                          |  |      |
| HBM                       | Human Body Model         | ±2500  | V    |
| CDM                       | Charged Device Model     | ±1500  | V    |

### RECOMMENDED OPERATING CONDITIONS

| Symbol            | Parameter                            | Min | Max  | Unit |
|-------------------|--------------------------------------|-----|------|------|
| V <sub>IN</sub>   | Supply Voltage                       | 3.8 | 60   | V    |
| V <sub>BIAS</sub> | Supply Voltage                       | 3.8 | 15   | V    |
| T <sub>A</sub>    | Operating Ambient Temperature Range  | -40 | +85  | °C   |
| T <sub>J</sub>    | Operating Junction Temperature Range | -40 | +125 | °C   |

### ORDERING INFORMATION

| Orderable Part Number | Package Code | Package                        | Identification Code | Packing  |               |                    |
|-----------------------|--------------|--------------------------------|---------------------|----------|---------------|--------------------|
|                       |              |                                |                     | Quantity | Carrier       | Part Number Suffix |
| AP66200FVBW-13        | FVBW         | U-QFN4040-16/SWP<br>(Type UXB) | F2                  | 3000     | Tape and Reel | -13                |

### EVALUATION BOARD

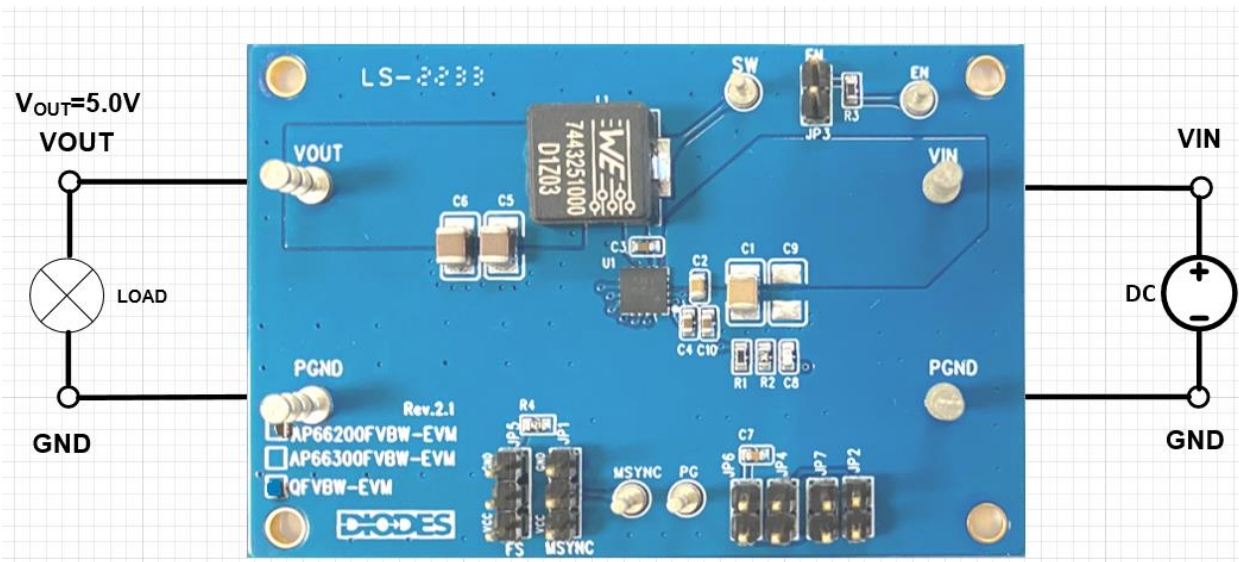


Figure 1. AP66200FVBW-EVM

### QUICK START GUIDE

The AP66200 EVM board has a simple layout and allows access to the appropriate signals through test points. To evaluate the performance of the AP66200, follow the procedure below:

1. Insert jumpers to configure the EVM board setting as described in the Application Information sections of the device datasheet.
2. Use jumper JP3 (100KΩ to VIN) set device enabled.
3. Remove jumpers JP3 and connect external voltage source on EN pin directly.
4. Use jumper JP5 to set FS to default 500KHz (VCC) or 2.5MHz (GND).
5. Use jumper JP1 to set MSYNC to forced PWM (VCC) or PFM (GND) operation.
6. Remove jumper JP1 and force an external clock source on MSYNC pin for synchronization with positive edge trigger and PWM.
7. Use jumper JP6 for default external soft start (C7) of 2ms.
8. Remove jumper JP6 and use jumper JP7 (VCC) for internal soft start of 1.7ms.
9. Use jumper JP4 to connect BIAS pin to PGND.
10. Use jumper JP2 to connect BIAS pin to VOUT.
11. Remove JP2 and JP4 and connect an external voltage source on BIAS pin (<15V).
12. Connect a 12V power supply between the VIN and PGND terminals. Make sure the power supply is turned off.
13. Connect an adjustable current or resistive load to the VOUT and PGND terminals.
14. Turn on the power supply. Do not turn on the power supply until all connections are completed and fully checked.
15. The EVM board should now power up with a 5V output voltage.
16. Increase the load current and observe the output voltage change.
17. Check for the stable operation of the SW and VOUT signal on the oscilloscope.
18. Measure the switching frequency on SW probe jack in the EVM board.
19. Measure the output ripple on the VOUT probe jack in the EVM board.

### MEASUREMENT/PERFORMANCE GUIDELINES

When measuring the output voltage ripple, maintain the shortest possible ground lengths on the oscilloscope probe. Long ground leads can erroneously inject high frequency noise into the measured ripple.

**EVALUATION BOARD SCHEMATIC**

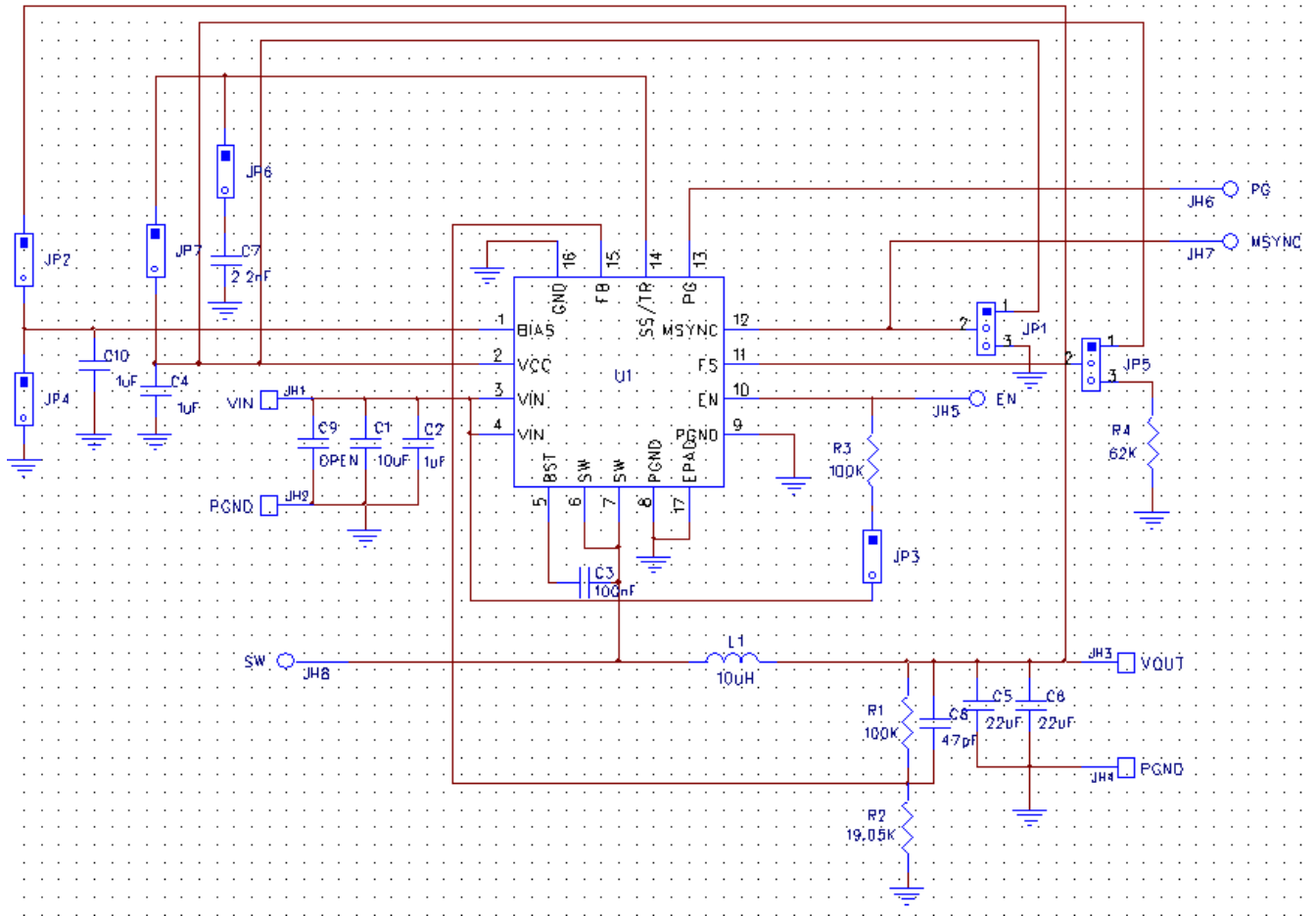


Figure 2. AP66200FVBW-EVM Schematic

**PCB LAYOUT**

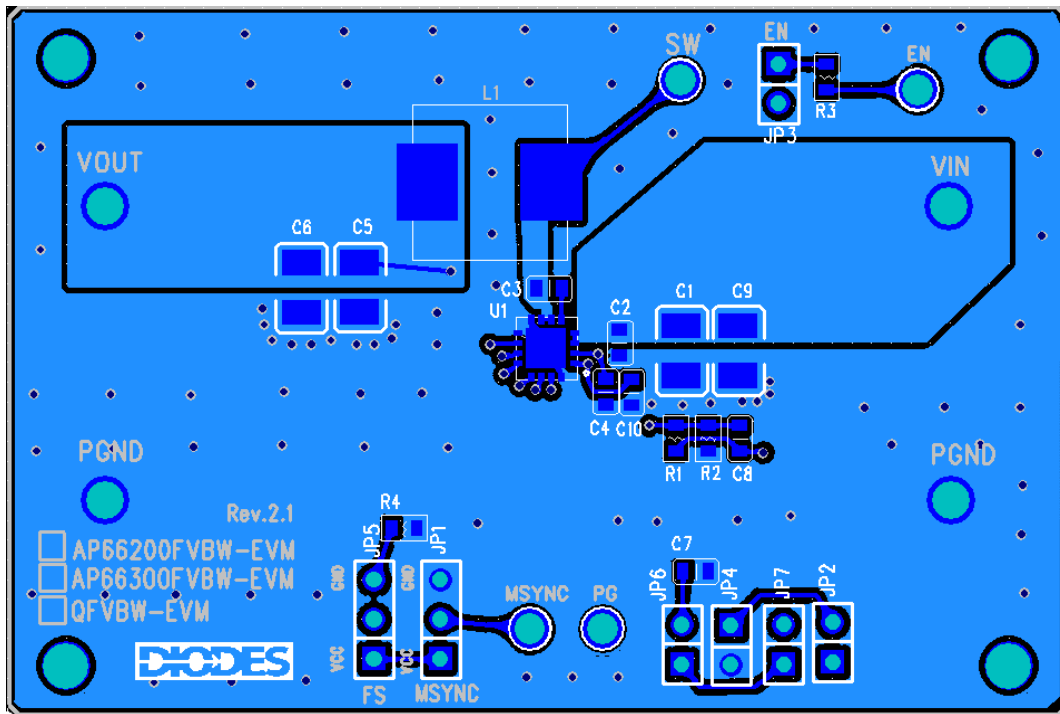


Figure 3. AP66200FVBW-EVM – Top Layer

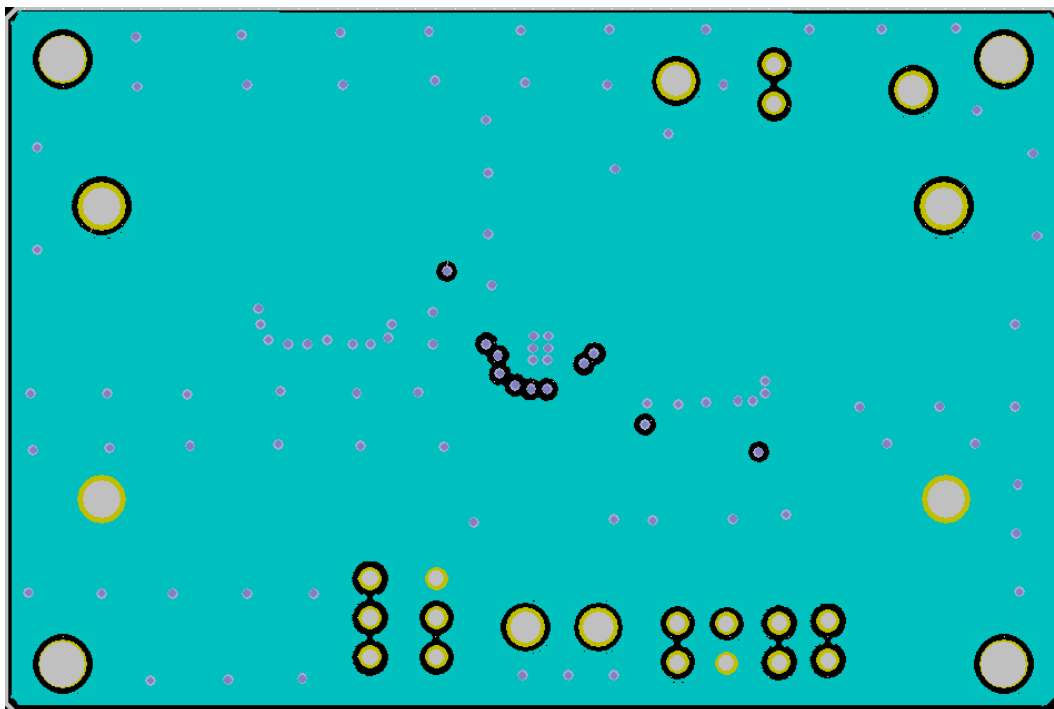


Figure 4. AP66200FVBW-EVM – Layer 2

PCB LAYOUT (continued)

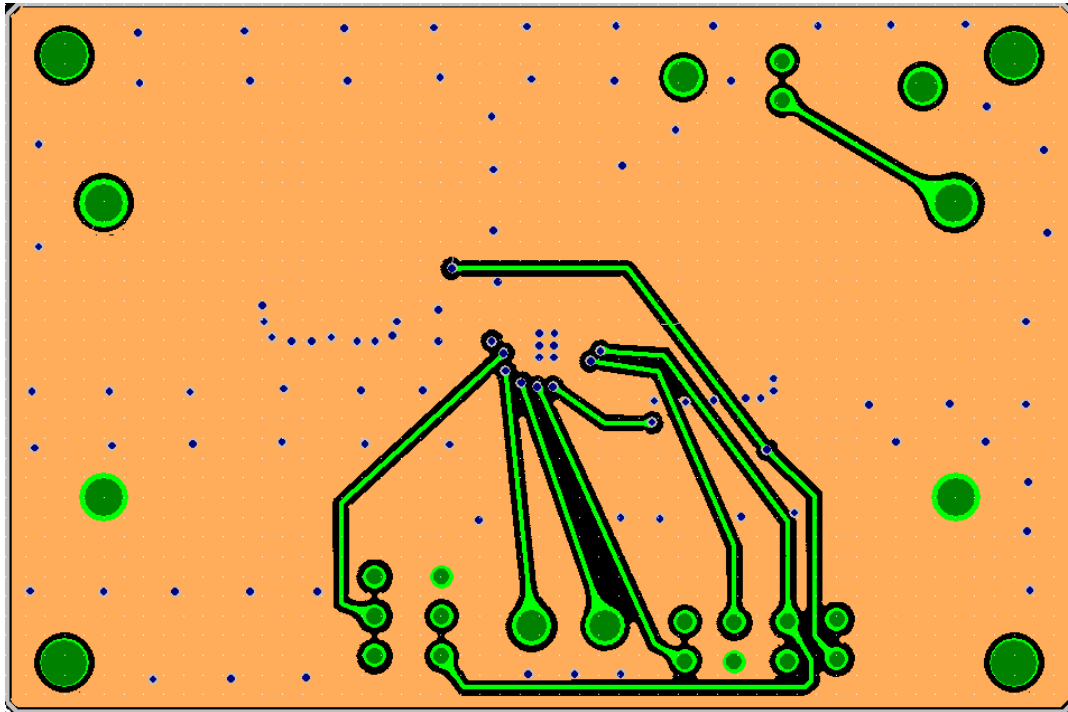


Figure 5. AP66200FVBW-EVM – Layer 3

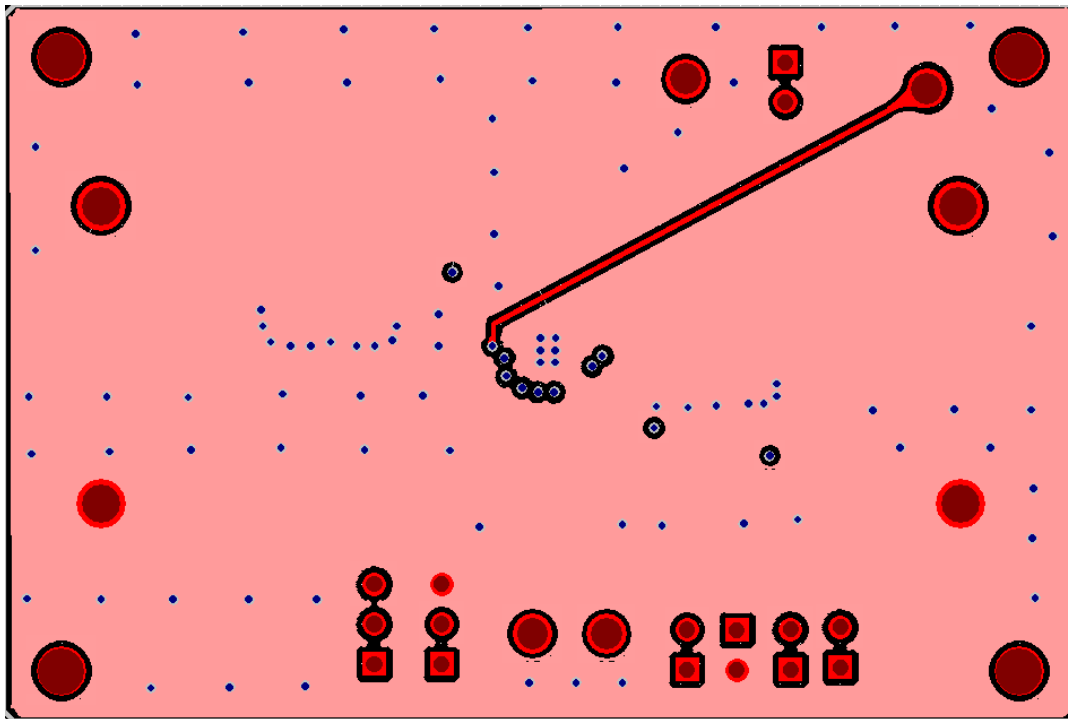


Figure 6. AP66200FVBW-EVM – Bottom Layer

### BILL OF MATERIALS for AP66200 EVM

| Qty | Ref               | Value  | Description                       | Package         | Manufacturer         | Manufacturer P/N     |
|-----|-------------------|--------|-----------------------------------|-----------------|----------------------|----------------------|
| 1   | C1                | 10uF   | Ceramic Capacitor, 100V           | 1210            | Murata               | GRM32EC72A106KE05L   |
| 1   | C2                | 1uF    | Ceramic Capacitor, 100V, X5R, 20% | 0805            | Murata               | GRJ21BC72A105KE11L   |
| 1   | C3                | 100nF  | Ceramic Capacitor, 50V, X7R, 10%  | 0603            | TDK                  | CGA3E2X7R1H104KTOYON |
| 2   | C4, C10           | 1uF    | Ceramic Capacitor, 25V, X7R, 10%  | 0603            | Taiyo Yuden          | 963-TMK107B7105KA-T  |
| 2   | C5, C6            | 22uF   | Ceramic Capacitor, 25V, X5R       | 1210            | Taiyo Yuden          | TMK325BJ226MM-T      |
| 1   | C7                | 2.2nF  | Ceramic Capacitor, 25V, X7R, 10%  | 0603            | AVX                  | 06033C222KAT2A       |
| 1   | C8                | 47pF   | Ceramic Capacitor, 100V, X7R, 20% | 0603            | Kemet                | C0603C470K1RACTU     |
| 2   | R1, R3            | 100KΩ  | Film Resistor                     | 0603            | Panasonic            | ERJ-3EKF1003V        |
| 1   | R2                | 19.1KΩ | Film Resistor                     | 0603            | Yageo                | AC0603FR-0719K1L     |
| 1   | R4                | 62KΩ   | Film Resistor                     | 0603            | Yageo                | AC0603FR-1362KL      |
| 1   | L1                | 10uH   | DCR=16.3mΩ, Isat=7.2A             | 10.5x10.5x4.7mm | Würth Electronics    | 7443251000           |
| 5   | JP2, 3, 4, 6, 7   |        | PCB Header, 40 POS                | 1X2             | 3M                   | 2340-6111TG          |
| 2   | JP1, 5            |        | PCB Header, 40 POS                | 1X3             | 3M                   | 2340-6111TG          |
| 4   | PG, MSYNC, SW, EN |        | PCB Turret Term, 0.082"           | 0.082"          | Keystone Electronics | 1573-2               |
| 4   | VIN, VOUT, PGNDx2 |        | PCB Turret Term, 0.094"X1/16      | 0.082"          | Keystone Electronics | 1598-2               |
| 1   | AP66200           |        | IC                                | U-QFN4040-16    | Diodes Inc           | AP66200FVBW          |

### TYPICAL PERFORMANCE CHARACTERISTICS

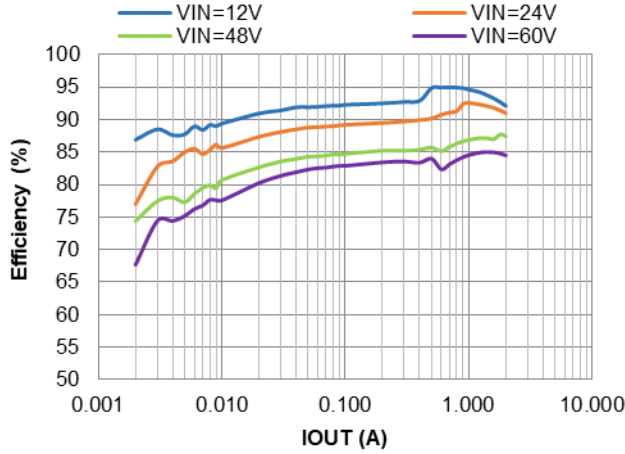


Figure 7. PFM Efficiency vs. IOU,  $V_{out}=5V$ ,  $L=10\mu H$

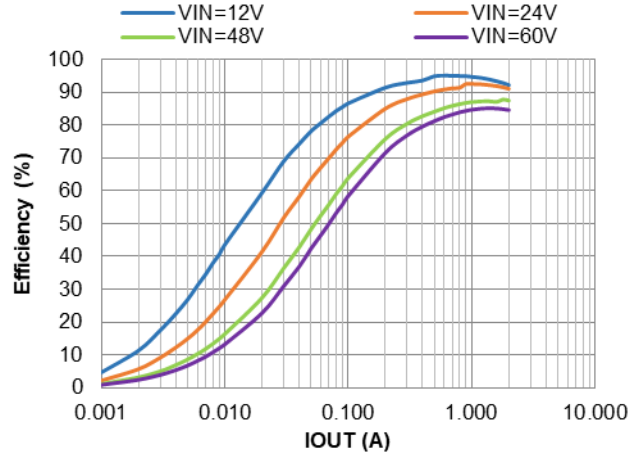


Figure 8. PWM Efficiency vs. IOU,  $V_{out}=5V$ ,  $L=10\mu H$

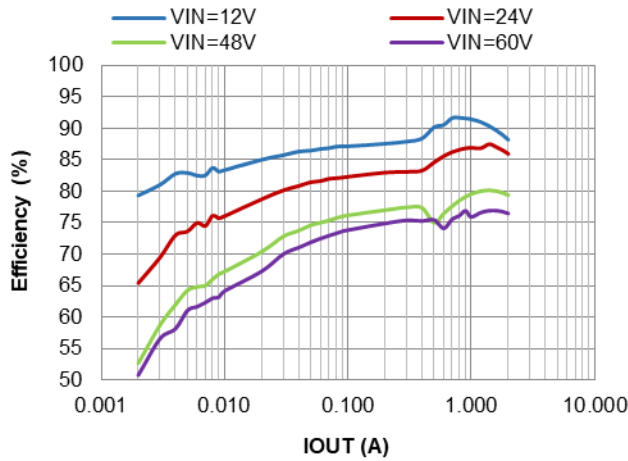


Figure 9. PFM Efficiency vs. IOU,  $V_{out}=3.3V$ ,  $L=8.2\mu H$

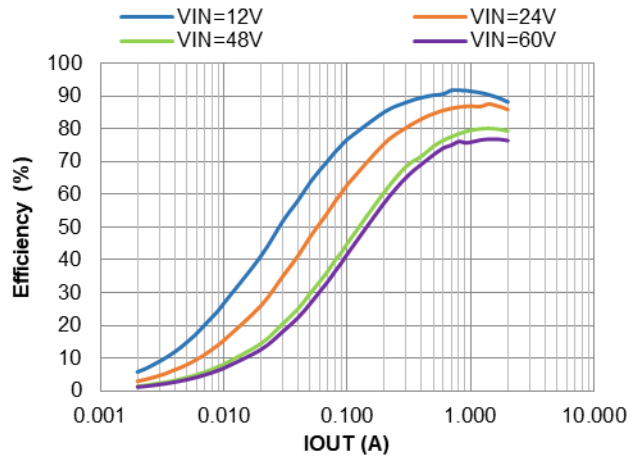


Figure 10. PWM Efficiency vs. IOU,  $V_{out}=3.3V$ ,  $L=8.2\mu H$



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