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User Guide for  
FEBFDMQ8203\_13 W  
GreenBridge™ Evaluation Kit  
for Power Over Ethernet  
13 W Flyback DC-DC

MLP 4.5x5 GreenBridge™  
SSOT-6 150 V MOSFET  
SSOT-3 30 V MOSFET

Featured Fairchild Products:  
FDMQ8203, FDC86244, FDN537N

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## Table of Contents

|                                          |    |
|------------------------------------------|----|
| 1. Introduction.....                     | 3  |
| 1.1. Description .....                   | 3  |
| 1.2. Features .....                      | 3  |
| 2. Evaluation Board Specifications.....  | 3  |
| 3. Photographs.....                      | 4  |
| 4. Printed Circuit Board .....           | 5  |
| 5. Schematic.....                        | 6  |
| 6. Bill of Materials .....               | 8  |
| 7. Electrical Characteristics .....      | 10 |
| 8. Setup and Test Procedure.....         | 11 |
| 8.1. Hardware Connector Description..... | 11 |
| 9. Performance of Evaluation Board.....  | 12 |
| 10. Revision History .....               | 13 |

The following user guide supports the evaluation kit for high-efficiency, IEEE802.3af, Class3 Power over Ethernet Power Device (PoE PD) Flyback DCDC with PoE interface controller. It should be used in conjunction with the FDMQ8203 datasheet as well as Fairchild's application notes and technical support team. Please visit Fairchild's website at [www.fairchildsemi.com](http://www.fairchildsemi.com).

## 1. Introduction

This board is designed to rectify the positive and negative power source from Power Source Equipment (PSE) and regulate 48 V (36 V ~ 57 V) to provide 5 V<sub>OUT</sub> at maximum 2.6 A with 250 kHz switching frequency and over 90% of the total efficiency in the compact power density. It meets the required specification under IEEE802.3af.

### 1.1. Description

This kit contains the MLP 4.5x5 GreenBridge™ MOSFET evaluation board.

### 1.2. Features

- GreenBridge™ FDMQ8203 quad P&N-Channel MOSFET
- Flyback Primary Switch FDC86244 Single N-Channel MOSFET
- Flyback Secondary Switch FDN537N Single N-Channel MOSFET
- Controller IEEE802.3at PD with Flyback Controller
- Output-Voltage Range 5 V, Adjustable by R39 and R37
- Switching Frequency 250 kHz, Adjustable by C55
- Maximum Output Current 2.6 A, Limited by Power Component

## 2. Evaluation Board Specifications

**Table 1. MOSFET Parameters**

| Part Number | Location | Package  | BV <sub>DSS</sub> (V) | R <sub>DS(ON)</sub> [mΩ]<br>at 10 V <sub>GS</sub> | Qg [nC]<br>at 10 V <sub>GS</sub> | C <sub>oss</sub> [pF] |
|-------------|----------|----------|-----------------------|---------------------------------------------------|----------------------------------|-----------------------|
|             |          |          |                       | Max.                                              | Typ.                             | Typ.                  |
| FDMQ8203    | Q1, Q4   | MLP4.5x5 | 100                   | 110                                               | 2.9                              | 41.0                  |
|             | Q2, Q3   |          | -80                   | 190                                               | 13                               | 46                    |
| FDC86244    | Single   | SSOT-6   | 150                   | 144.0                                             | 4.2                              | 32.0                  |
| FDN537N     | Single   | SSOT-3   | 30                    | 28                                                | 5.3                              | 135                   |

### 3. Photographs

Size = 70 X 60 mm.

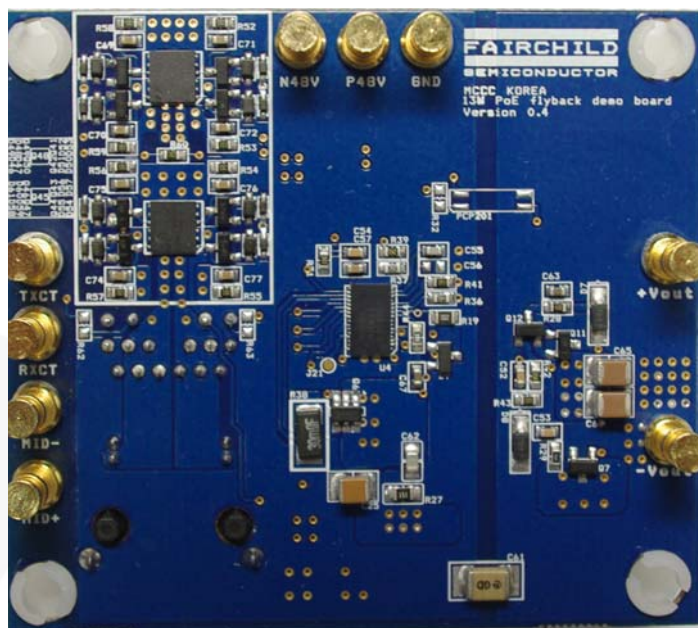


Figure 1. Top Side View of Evaluation Kit

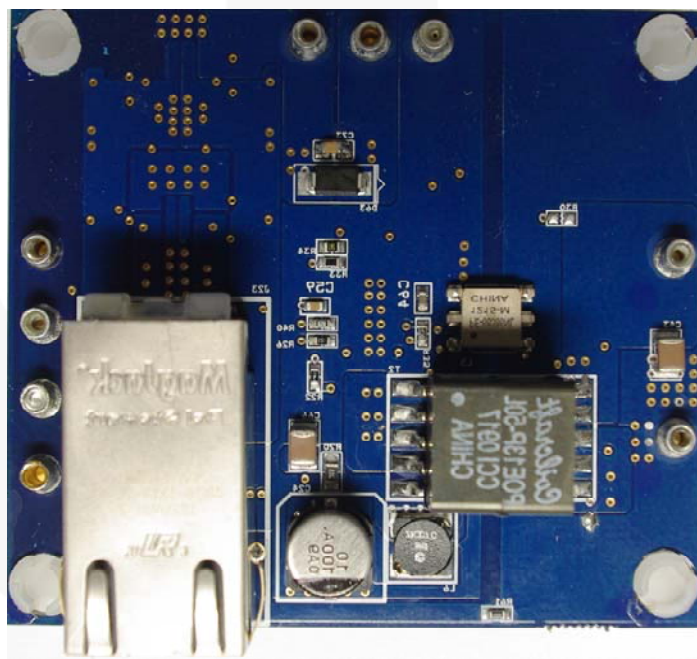


Figure 2. Bottom Side View of Evaluation Kit



## 4. Printed Circuit Board

PCB Layout (70 mm x 60 mm, 4-Layer).

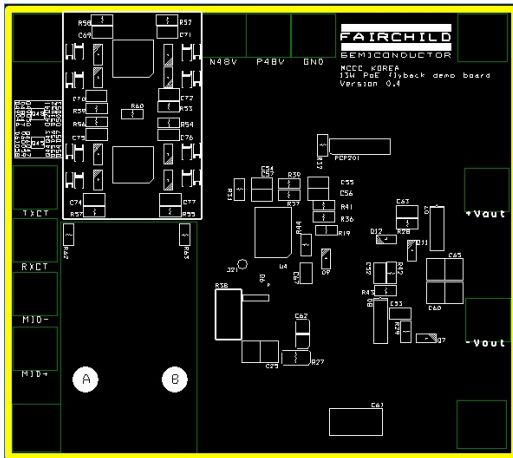


Figure 3. SST (Component Side) Layer

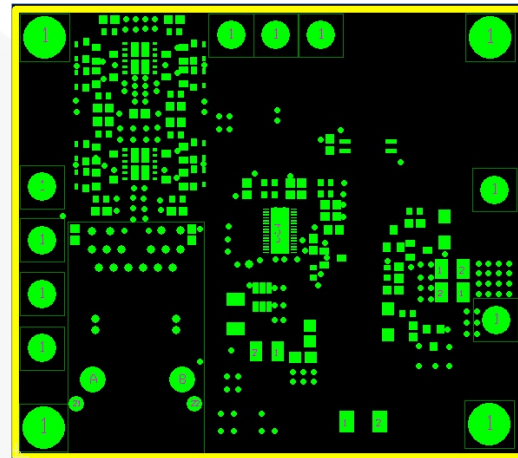


Figure 4. SSB (Component) Layer

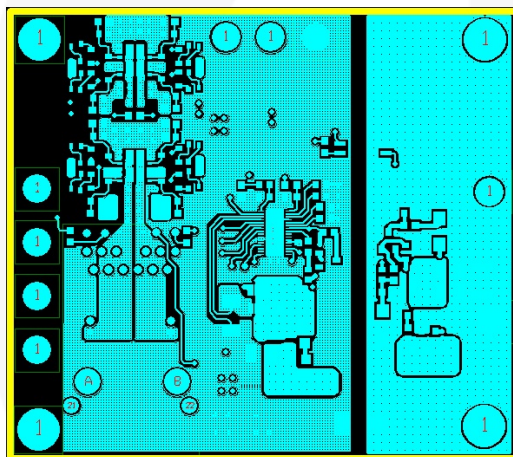


Figure 5. TOP & SMT Layer

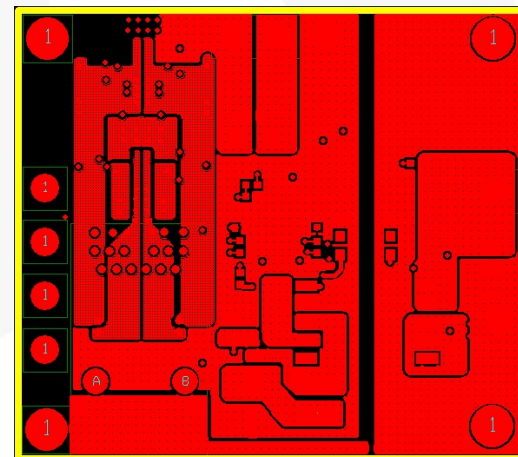


Figure 6. BOT & SMB Layer

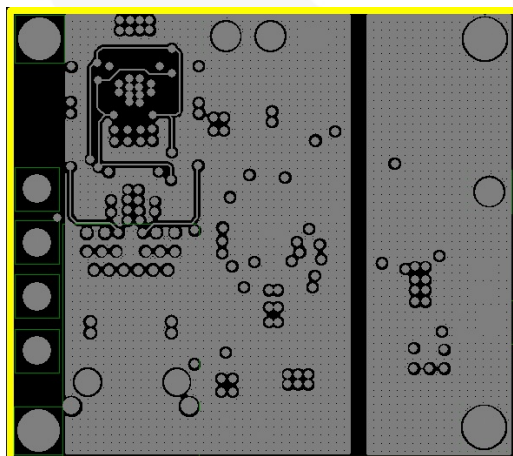


Figure 7. INNER1 (GND) Layer

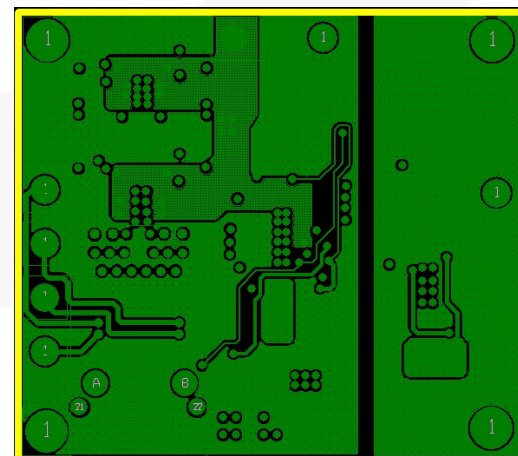


Figure 8. INNER2 (POWER) Layer

## 5. Schematic

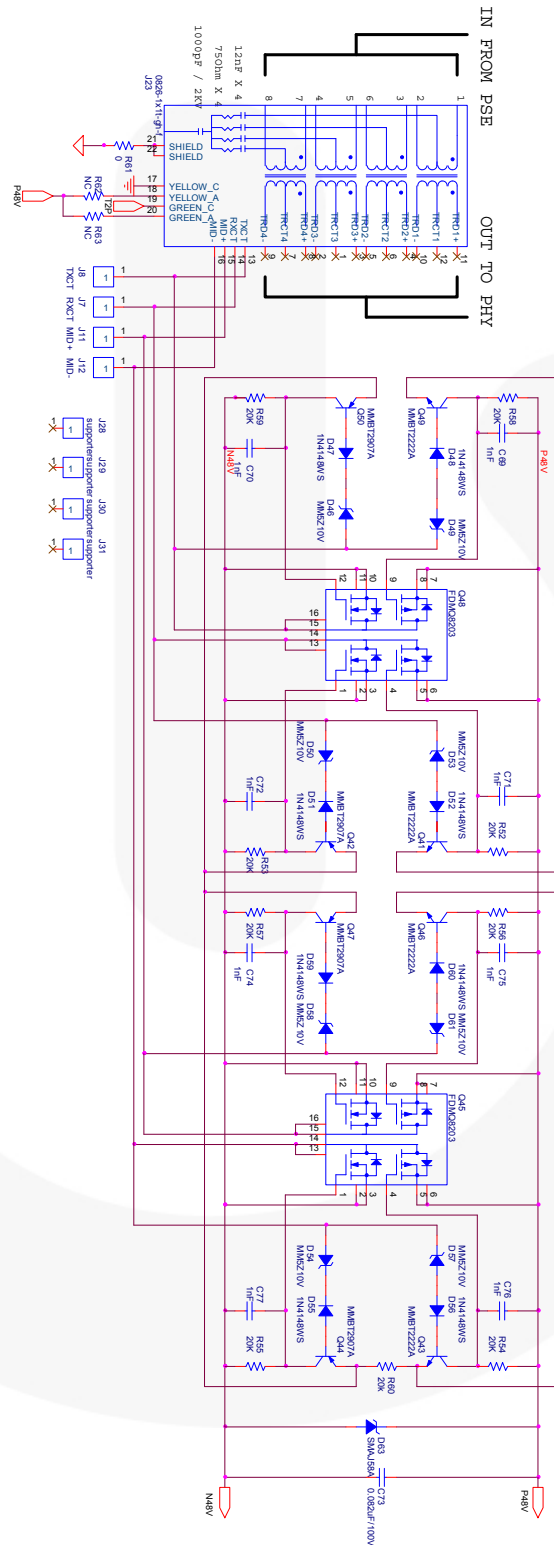


Figure 9. GreenBridge™ Block Schematic





## 6. Bill of Materials

**Table 2. Bill of Materials**

| Item | Qty. | Reference                                      | Part Name            | Vender                  | Comment                     |
|------|------|------------------------------------------------|----------------------|-------------------------|-----------------------------|
| 1    | 1    | C24                                            | EEE2AA100UP          | Panasonic               | 10 $\mu$ F / 100 V          |
| 2    | 1    | C25                                            | GRM32ER72A225KA35    | Murata                  | 2.2 $\mu$ F / 100 V         |
| 3    | 4    | C43, C60, C65, C66                             | C3225X7RIC226M       | TDK                     | 22 $\mu$ F / 16 V / 3216    |
| 4    | 1    | C52                                            | 2.2 nF / 1608        | Any                     |                             |
| 5    | 1    | C53                                            | 1.5 nF / 1608        | Any                     |                             |
| 6    | 1    | C54                                            | 3.3 nF / 1608        | Any                     |                             |
| 7    | 1    | C55                                            | 33 pF / 1608         | Any                     |                             |
| 8    | 6    | R30, R32, C56, R62,<br>R63, PCP201             | NC                   |                         |                             |
| 9    | 9    | C57, C69, C70, C71,<br>C72, C74, C75, C76, C77 | 1 nF / 1608          | Any                     |                             |
| 10   | 1    | C59                                            | 0.1 $\mu$ F / 1608   | Any                     |                             |
| 11   | 1    | C61                                            | GA343D               | Murata                  | 4700 pF / 250 V             |
| 12   | 1    | C62                                            | 100 pF / 2012        | Any                     |                             |
| 13   | 3    | C63, C64, C67                                  | 1 $\mu$ F / 1608     | Any                     |                             |
| 14   | 1    | C73                                            | C0805C823K1RACTU     | Kemet                   | 0.082 $\mu$ F / 100 V       |
| 15   | 1    | D6                                             | BAS21                | Fairchild Semiconductor |                             |
| 16   | 2    | D7, D8                                         | MBR0540              | Fairchild Semiconductor |                             |
| 17   | 8    | D46, D49, D50, D53,<br>D54, D57, D58, D61      | MM5Z10V              | Fairchild Semiconductor | 10 V Zener Diode            |
| 19   | 8    | D47, D48, D51, D52,<br>D55, D56, D59, D60      | 1N4148WS             | Fairchild Semiconductor |                             |
| 20   | 1    | D63                                            | SMAJ58A              | Diodes                  | TVS Diode                   |
| 21   | 1    | J23                                            | 0826-1G1T-GH-F       | Belfuse                 | RJ45 with Transformer       |
| 22   | 1    | L5                                             | PE-68386NL           | Pulse trans             |                             |
| 23   | 1    | L6                                             | SD6020-8R9           | Coiltronics             | 8.2 $\mu$ H                 |
| 24   | 1    | Q6                                             | FDC86244             | Fairchild Semiconductor | 150 V 144 m $\Omega$ MOSFET |
| 25   | 1    | Q7                                             | FDN537N              | Fairchild Semiconductor | 30 V 28 m $\Omega$ MOSFET   |
| 26   | 5    | Q11, Q42, Q44, Q47, Q50                        | MMBT2907A            | Fairchild Semiconductor |                             |
| 27   | 5    | Q12, Q41, Q43, Q46, Q49                        | MMBT2222A            | Fairchild Semiconductor |                             |
| 28   | 2    | Q45, Q48                                       | FDMQ8203             | Fairchild Semiconductor | GreenBridge™ Quad MOSFET    |
| 29   | 1    | R19                                            | 20 $\Omega$ / 2012   | Any                     |                             |
| 30   | 1    | R20                                            | 20 k $\Omega$ / 2012 | Any                     |                             |
| 31   | 1    | R22                                            | 4.7 $\Omega$ / 1608  | Any                     |                             |
| 32   | 1    | R26                                            | 12 k $\Omega$ / 1608 | Any                     |                             |
| 33   | 1    | R27                                            | 150 $\Omega$ / 2012  | Any                     |                             |
| 34   | 1    | R28                                            | 47 $\Omega$ / 1608   | Any                     |                             |
| 35   | 1    | R29                                            | 5.1 $\Omega$ / 1608  | Any                     |                             |
| 36   | 2    | R31, R43                                       | 10 k $\Omega$ / 1608 | Any                     |                             |



## Bill of Materials (Continued)

| Item | Qty. | Reference                                      | Part Name                 | Vender    | Comment              |
|------|------|------------------------------------------------|---------------------------|-----------|----------------------|
| 37   | 1    | R33                                            | 14 k $\Omega$ 1% / 1608   | Any       |                      |
| 38   | 1    | R34                                            | 39 k $\Omega$ / 1% / 1608 | Any       |                      |
| 39   | 1    | R35                                            | 45.3 $\Omega$ / 1608      | Any       |                      |
| 40   | 1    | R36                                            | 100 k $\Omega$ / 1608     | Any       |                      |
| 41   | 1    | R37                                            | 3 k $\Omega$ / 1% / 1608  | Any       |                      |
| 42   | 1    | R38                                            | 0.03 m $\Omega$ / 0.5 W   | HMR       | Shunt Resistor       |
| 43   | 1    | R39                                            | 24 k $\Omega$ / 1% / 1608 | Any       |                      |
| 44   | 1    | R40                                            | 750 $\Omega$ / 1608       | Any       |                      |
| 45   | 1    | R41                                            | 39 k $\Omega$ / 1608      | Any       |                      |
| 46   | 1    | R42                                            | 15 $\Omega$ / 1608        | Any       |                      |
| 47   | 1    | R44                                            | 100 $\Omega$ / 1608       | Any       |                      |
| 48   | 9    | R52, R53, R54, R55,<br>R56, R57, R58, R59, R60 | 20 k $\Omega$ / 1608      | Any       |                      |
| 49   | 1    | R61                                            | 0 $\Omega$ / 1608         | Any       |                      |
| 50   | 1    | T2                                             | POE13P-50L                | Coilcraft | 13 W PoE Transformer |
| 51   | 1    | U4                                             | LTC4269-1                 | LTC       | PoE Flyback IC       |

## 7. Electrical Characteristics

**Table 3. Electrical Specification**

| Parameter                | Value                                  | Remark                                           |
|--------------------------|----------------------------------------|--------------------------------------------------|
| GreenBridge™             | FDMQ8203                               | Quad P&N-Channel MOSFET, Fairchild Semiconductor |
| Flyback Primary Switch   | FDC86244                               | Single N-Channel MOSFET, Fairchild Semiconductor |
| Flyback Secondary Switch | FDN537N                                | Single N-Channel MOSFET, Fairchild Semiconductor |
| Controller               | IEEE802.3at PD with Flyback Controller |                                                  |
| V <sub>OUT</sub> Range   | 5 V                                    | Adjustable by R39 and R37                        |
| Switching Frequency      | 250 kHz                                | Adjustable by C55                                |
| Maximum I <sub>OUT</sub> | 2.6 A                                  | Limited by Power Component                       |

## 8. Setup and Test Procedure

**Table 4. Test Point Descriptions**

| Test Point | Label | Descriptions                                                |
|------------|-------|-------------------------------------------------------------|
| J17        | P48 V | Measurement test point for rectified positive input voltage |
| J18        | N48 V | Measurement test point for rectified negative input voltage |
| J16        | GND   | Measurement test point for input voltage return             |
| J19        | +VOUT | Measurement test point for output voltage                   |
| J22        | -VOUT | Measurement test point for output voltage return            |

### 8.1. Hardware Connector Description

The evaluation kit is fully assembled and tested. Follow the steps below to verify board operation.

1. Use one of the following methods to power the evaluation kit:
  - If network connectivity is required: Connect a CAT5 Ethernet network cable from the evaluation kit input port RJ45 connector to the corresponding PSE Ethernet LAN connection, which provides power to the evaluation kit. J21 connector provides an interface with the Ethernet data signals only.
  - If network connectivity is not required: Connect a -48 V DC power supply between the TXCT and RXCT. OR connect a -48 V DC power supply between the MID+ and MID-.

**Caution: Do not turn on the power supply until all connections are completed.**

2. Activate the PSE power supply or turn on the external DC power supply.
3. Using a voltmeter, verify that the evaluation kit provides +5 V across the +VOUT and -VOUT pins. -VOUT is isolated from the evaluation kit's input N48 V and GND pins.

## 9. Performance of Evaluation Board

Figure 11 and Figure 12 show measured data.

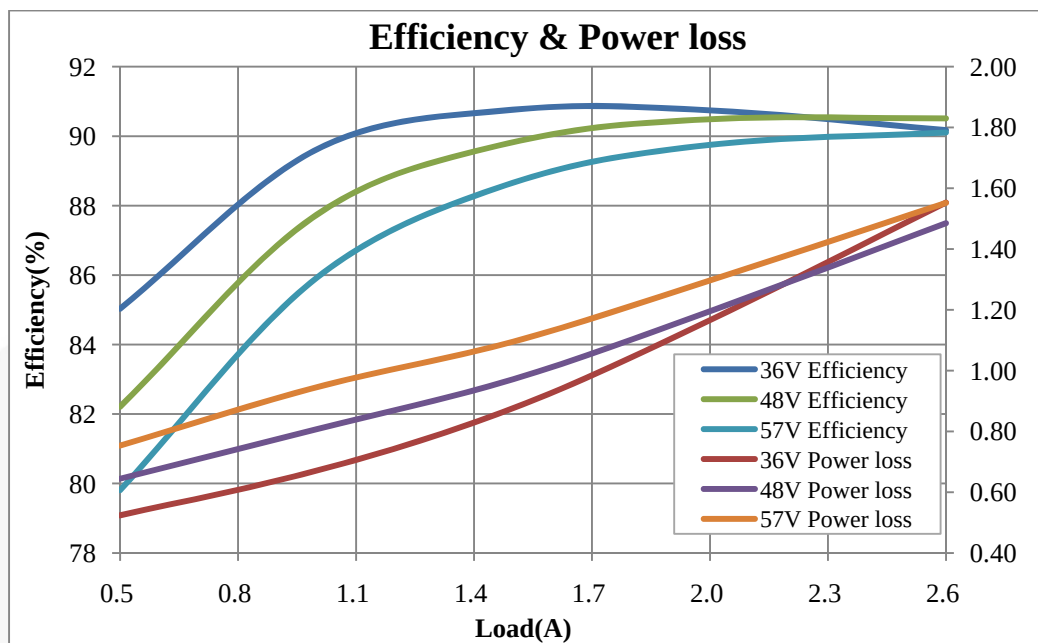


Figure 11. Efficiency & Power Loss at  $V_{OUT}=5$  V, Soaking=5 Minutes,  $f_{SW}=250$  kHz

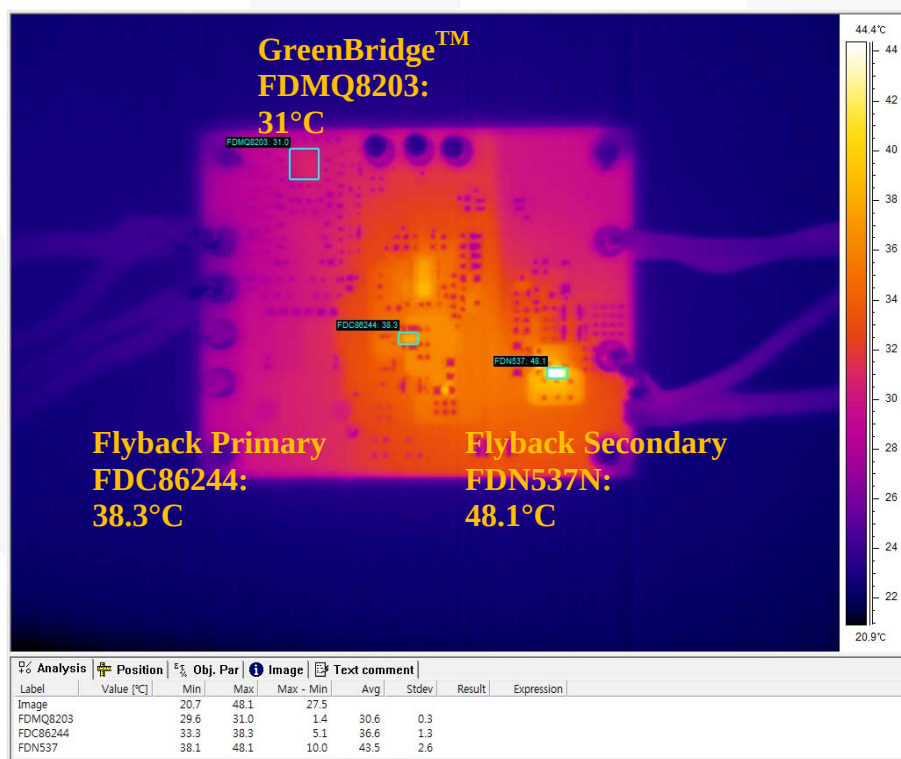


Figure 12. Thermal Performance at  $V_{IN}=48$  V,  $V_{OUT}=5$  V,  $I_{OUT}=2.6$  A, Soaking=5 Minutes,  $f_{SW}=250$  kHz

## 10. Revision History

| Rev.  | Date              | Description                                           |
|-------|-------------------|-------------------------------------------------------|
| 0.1.0 | February 13, 2012 | Initial Release                                       |
| 1.0.0 | November 28, 2012 | Reformat to template<br>Proofread and correct content |
|       |                   |                                                       |
|       |                   |                                                       |

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