PFH05W Evaluation
Test Board
Application notes

Version 1.05
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BEFORE USING THE POWER SUPPLY UNIT

Be sure to read and understand this instruction manual thoroughly before using this product. Pay attention to all cautions and warnings before using this product. Incorrect usage could lead to an electrical shock, damage to the unit or a fire hazard.

⚠️ DANGER

Never use this product in locations where flammable gas or ignitable substances are present. There are risks of igniting these substances and exploding by arcing.

⚠️ WARNING

- Do not touch this product or its internal components while circuit is live, or shortly after shut down. There may be high voltage or high temperature present and you may receive an electric shock or burn.
- While this product is operating, keep your hands and face away from it as you may be injured by an unexpected situation.
- Do not make unauthorized changes to this product, otherwise you may receive an electric shock and void your warranty.
- Do not drop or insert anything into the product. It might lead to a failure, fire or electric shock.
- Do not use this product if abnormal conditions such as emission of smoke and/or abnormal smell or audible noise, etc... are present. It might lead to fire and/or electric shock. In such cases, please contact TDK Lambda. Do not attempt repair by yourself, as it is dangerous for the user.
- Do not operate these products in the presence of condensation. It might lead to fire or electric shock.

⚠️ CAUTION

- This power supply is designed and manufactured for use within an end product such that it is accessible only to trained SERVICE ENGINEERS.
- Confirm that the connections to input/output terminals, and signal terminals are correct as specified in this instruction manual before turning on the power.
- Input voltage, Output current, Output power, ambient temperature, case temperature, and ambient humidity should be kept within the specifications, otherwise the product may be damaged.
- Do not operate and store this product in an environment where condensation might occur. In such case, waterproof treatment is necessary.
- The equipment has been evaluated for use in a Pollution Degree 2 environment.
- Do not use this product in environment with a strong electromagnetic field, corrosive gas or conductive substances.
- For applications, which require very high reliability, such as nuclear related equipment, medical equipment, traffic control equipment, etc., it is necessary to provide a fail-safe mechanism in the end equipment.
- Do not inject abnormal voltages into the output terminal or signal terminal of this product. The injection of reverse voltage or over voltage exceeding nominal output voltage into the output terminal or signal terminal might cause damage to internal components.
- Never operate the product under the over-current or short circuit conditions. Failure or other damage may occur.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240W or more). It must not be made accessible to users. Protection must be provided for Service Engineers against indirect contact with the output terminals and/or to prevent tools being dropped across them. While working on this product, the AC input power must be switched off, and the input, output, +VBus, and -VBus terminal voltages should be at a safe level.
- The application circuits and their parameters are for reference only. Be sure to verify effectiveness of these circuits and their parameters before finalizing the circuit design.
- Use a Fast-Blow external fuse to each module to ensure safe operation and compliance with the safety standards to which it is approved. The recommended input fuse rating within the instructions is as follows: 10A, 250V fast acting fuse. The breaking capacity and voltage rating of this fuse may be subject to the end use application.
CAUTION

- This information in this document is subject to change without prior notice. Please refer to the latest version of the data sheet, etc., for the most up-to-date specifications of the product.
- No part of this document may be copied or reproduced in any form without prior written consent TDK-Lambda.

Reference Documents:

1.) PFH Instruction Manual
2.) PFH PMBus Specification Customer Release
3.) PFH500F-## Evaluation Report
4.) PFH GUI Interface

Note: ## - Denotes output voltage of PFH modules (e.g. “28” for 28Vdc)
1.0 Getting Started

NOTE: ## - Denotes output voltage of PFH modules (e.g. “28” for 28Vdc)

PFH05W##-100-EVK-S1 & PFH05W##-1D0-EVK-S1 Evaluation Boards

PFH05W-001-EVK-S0 Evaluation Board
1.1 Test Equipment

1.) **AC Voltage Source:** Capable of single-phase output, AC voltage range 85 V<sub>AC</sub> - 265 V<sub>AC</sub>, 47 Hz - 63 Hz, adjustable. AC Source should be adequately sized to support the PFH module’s operation.

2.) **DC Multimeter:** capable of 0V to 500V input range.

3.) **Output Load:** DC load capable of 60 V<sub>DC</sub> or greater, DC Load current up to 42A or greater (12V/42A, 28V/18A, or 48V/10.5A), and 500 W or greater, with display such as load current and load power.

4.) **Fan:** Airflow is required to be directed across the mounted heatsink of the PFH module.
1.2 Test Setup

1.) Electrical Input Connections:
   - **CONN1**: *LINE*, Input Line Connection
   - **CONN2**: *NEUT*, Input Neutral Connection
   - **CONN3**: *EGND*, Earth Ground Connection

*NOTE:* Refer to the PFH Datasheet for specific module’s AC Input Current requirement when sizing wire gauge and cable length.

2.) Electrical Output Connection:
   - **CONN5**: *+Vout*, Output Load Connections (Red Cable)
   - **CONN4**: *-Vout*, Output Load Return Connections (Black Cable)
⚠️ WARNING

Make sure ALL input and output cables are de-energized before making electrical connections to the Evaluation Test Board
1.3 Test Points

1.) Secondary Test Points:
   - TP201 $V_{out+}$, Monitor Output Voltage
   - TP204 $V_{out(-)}$, Monitor Output Voltage return
   - TP202 $RS(+)$, Output Remote Sense (+) connection
   - TP203 $TRIM$, Trim Test connection

   **WARNING HAZARDOUS VOLTAGE**

2.) Primary Test Points:
   - TP103 $+BUS$, Monitor 400Vdc
   - TP104 $-BUS$, Monitor 400Vdc return
   - TP101 $LINE$, Monitor AC Line Input
   - TP102 $NEUT$, Monitor AC Neutral Input
1.4 PMBus and Remote On/Off Functions

1.) PMBus Connections (J301)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Used</td>
</tr>
<tr>
<td>2</td>
<td>Not Used</td>
</tr>
<tr>
<td>3</td>
<td>Not Used</td>
</tr>
<tr>
<td>4</td>
<td>Not Used</td>
</tr>
<tr>
<td>5</td>
<td>USB 3.3Vdc</td>
</tr>
<tr>
<td>6</td>
<td>SGND</td>
</tr>
<tr>
<td>7</td>
<td>Not Used</td>
</tr>
<tr>
<td>8</td>
<td>PMBus Alert</td>
</tr>
<tr>
<td>9</td>
<td>PMBus Clock</td>
</tr>
<tr>
<td>10</td>
<td>PMBus Data</td>
</tr>
</tbody>
</table>

NOTE:
1. 3.3Vdc is supplied by the interface module.

To communicate with the PFH module via PMBus, use the Texas Instruments Interface Adapter EVM (P/N#: USB-TO-GPIO). This adapter is available from,

- TI
- Digi-Key
- Newark Element
- Mouser Electronics
- Arrow
**WARNING When AC voltage is applied to the Evaluation Test Board the 450V bulk capacitors ARE energized at ALL time**

2.) Remote On/Off (SW200)  **SW200**, Will either turn the module On or put it into Standby

3.) Auxiliary Voltage (DS301)  **DS301**, The LED will Turn-On when the 450Vdc bulk capacitors are energized above 70Vdc

4.) Power Good (DS300)  **DS300**, The LED will Turn-On once the module’s output has been Turned-On

5.) Test Points  TP301  Monitor Auxiliary Voltage  
TP302  Monitor Power Good Signal

### 1.5 Setting the PMBus Address

- The PMBus address setting on the Evaluation Test Board comes with the Factory default setting, Address: 0x33 (Hex) (R318 & R319 are populated with 41.2K)
- To change PMBus address to a different address R318 (AD1) and R319 (AD2) must be populated with appropriate resistor values located in “PFH PMBus Specification Customer Release” document.

**Example:** Suppose a PMBus address of 0x51 was desired instead of 0x33.

- R318 (PMBus AD1): Remove 41.2K (0805 Resistor) → Populate with 14K (0805 Resistor)
- R319 (PMBus AD2): Remove 41.2K (0805 Resistor) → Populate with 69.8K (0805 Resistor)
1.6 Turning PFH Module On/Off

1.) Before applying AC voltage to the module make sure,
   a. The surface under the test fixture is a non-conductive surface
   b. Securely connect Input and Output cables to the test board
   c. Securely connect all monitoring devices to test board

⚠️ WARNING When AC voltage is applied to the Evaluation Test Board the 450V bulk capacitors ARE energized at ALL time

2.) Apply AC input voltage to test fixture
   a. AC input voltage range 100Vac – 265Vac
   b. AC input voltage range < 100Vac, output load is de-rated 6.7W/V
   c. Once AC input voltage is applied, Auxiliary Voltage LED (DS301) will Turn-On

3.) Turning On PFH module can be accomplished 1 of 2 ways,
   i. Remote On/Off
   ii. PMBus
      a. The method chosen to turn On PFH has to be the SAME method to turn Off PFH
         i. Example: If Remote On/Off turns On PFH, then PMBus cannot turn it Off, only Remote On/Off can turn Off PFH.
      b. Method 1: Toggle Remote On/Off,
         I. Remote On/Off switch (SW200) On – Will turn PFH On
         II. Remote On/Off switch (SW200) Off – Will turn PFH Off.
      c. Method 2: PMBus,
         I. Write CMD 0x01, Byte 0x80 – Turns PFH On
         II. Write CMD 0x01, Byte 0x00 – Turn PFH Off
      d. Once PFH is turned On, Power Good LED (DS300) will turn On
      e. When PFH is turned Off, Power Good LED (DS300) will turn Off
2.0 Electrical Schematic Drawing
### 3.0 Bill of Material

**PFH05W-001-EVK-S0 Bill of Material**

<table>
<thead>
<tr>
<th>Part Reference</th>
<th>Mfr Part Number 1</th>
<th>Value</th>
<th>Description</th>
<th>Voltage</th>
<th>Mfr1</th>
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<tr>
<td>BMPR1 BMPR2 BMPR3 BMPR4 BMPR5 BMPR6</td>
<td>SJ-5027 (BLACK)</td>
<td>Rubber Bumper</td>
<td>Bumper, Rubber, 0.63&quot; Dia x 0.31&quot;</td>
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<td></td>
</tr>
<tr>
<td>C100 C103</td>
<td>B33292C310SM2040</td>
<td>1uF</td>
<td>Film Capacitor, 305V, Y2 Cap</td>
<td>250V</td>
<td>TDK</td>
</tr>
<tr>
<td>C101 C102</td>
<td>CS45-E2GA332M-NKA</td>
<td>3.3nF</td>
<td>Film Capacitor, 305V, Y2 Cap</td>
<td>250V</td>
<td>TDK</td>
</tr>
<tr>
<td>C104</td>
<td>B33292C322SM1040</td>
<td>2.2uF</td>
<td>Film Capacitor, 305V, X2 Cap</td>
<td>250V</td>
<td>TDK</td>
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<tr>
<td>C105 C106 C213 C214</td>
<td>CS45-B2GA471K-NKA</td>
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<td>Film Capacitor, 305V, Y2 Cap</td>
<td>250V</td>
<td>TDK</td>
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<tr>
<td>C107 C108</td>
<td>B43508B5477M007</td>
<td>470uF</td>
<td>Electrolytic Capacitor, 450V, 35X40</td>
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<td>TDK</td>
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<td>C200 C201</td>
<td>EEUCF2A471</td>
<td>470uF</td>
<td>Electrolytic Capacitor, 100V, 16X40</td>
<td>100V</td>
<td>Panasonic</td>
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<td>C202 C203 C204 C205 C206 C207 C208 C209</td>
<td>C3225X7S2A475K200AB</td>
<td>4.7uF</td>
<td>Ceramic Capacitor, 100V, 1210, 4.7uF</td>
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<td>TDK</td>
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<tr>
<td>C212 C221</td>
<td>C2012X7R2A104K125AA</td>
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<td>Ceramic Capacitor, 100V, 0805</td>
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<td>TDK</td>
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<td>C222 C223</td>
<td>C3216X7R2A105MT</td>
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<td>Ceramic Capacitor, 100V, 1206, 1.0uF</td>
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<td>TDK</td>
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<tr>
<td>C301</td>
<td>C52012X7R1E105KT</td>
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<td>Ceramic Capacitor, 25V, 0805</td>
<td>25V</td>
<td>TDK</td>
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<tr>
<td>CONN1 CONN2 CONN3 CONN4 CONN5</td>
<td>8196</td>
<td>PC Screw Terminal</td>
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<td>CR100</td>
<td>CRH01</td>
<td>KN Diode, Single Package, SMT</td>
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<td>DOC1</td>
<td>PFH500</td>
<td>PFH500 Evaluation Instruction Manual</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DS300 DS301</td>
<td>5381H5</td>
<td>5381H5</td>
<td>LED, Green, Thru Hole</td>
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<td></td>
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<tr>
<td>F100 F101</td>
<td>TA1907-03 TA1907-03</td>
<td>1.0A</td>
<td>Fusible fuse, 120V, PWB</td>
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<tr>
<td>F102</td>
<td>312010</td>
<td>3.0</td>
<td>Fuse, 10A, Fast-Blow</td>
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<tr>
<td>J301</td>
<td>N2510-60XX</td>
<td>1.00&quot; x 1.00&quot; Four-Wall Header</td>
<td>3m</td>
<td>3m</td>
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<tr>
<td>K100</td>
<td>JVN1A-12V-F</td>
<td>JVN1A-12V-F</td>
<td>RELAY SPST</td>
<td>Panasonic</td>
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<tr>
<td>L100 L102</td>
<td>ARA00499</td>
<td>6.3mH</td>
<td>Coil Ind, 0.325mH, Thru Hole</td>
<td>TDK-Lambda</td>
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<tr>
<td>PWB100</td>
<td>Z600511</td>
<td>Z600511</td>
<td>PWB, (n) oz. Cu, .062&quot;</td>
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<tr>
<td>R100</td>
<td>A5MC-22U0</td>
<td>22.0</td>
<td>Res. 22.0Ω, 250V</td>
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<td></td>
</tr>
<tr>
<td>R102 R103</td>
<td>SPR2C474J</td>
<td>470K</td>
<td>Res. 470Ω, 2.0W</td>
<td>250V</td>
<td>KOA SPEER</td>
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<tr>
<td>R200</td>
<td>RK73Z2ATTE</td>
<td>0</td>
<td>Res. 0Ω, 0.125W, 0.05Ω</td>
<td>N/A</td>
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<tr>
<td>R311 R312</td>
<td>RK73H2ATTE1001F</td>
<td>1.0k</td>
<td>Res. 1KΩ, 0.125W, 0.05Ω</td>
<td>150V</td>
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<tr>
<td>R313</td>
<td>RK73H2ATTE1501F</td>
<td>1.5k</td>
<td>Res. 1.5KΩ, 0.125W, 0.05Ω</td>
<td>150V</td>
<td>KOA SPEER</td>
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<tr>
<td>R315 R316 R317</td>
<td>RK73H2ATTE30R1F</td>
<td>30.1</td>
<td>Res. 30.1Ω, 0.125W, 0.05Ω</td>
<td>150V</td>
<td>KOA SPEER</td>
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<tr>
<td>R318 R319</td>
<td>RK73H2ATTE4122F</td>
<td>41.2K</td>
<td>Res. 41.2K, 0.125W, 0.05Ω</td>
<td>150V</td>
<td>KOA SPEER</td>
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<tr>
<td>SW200</td>
<td>1101FCQE</td>
<td>SPD1</td>
<td>SPD1 two position switch vertical (On None On)</td>
<td>C&amp;S</td>
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<tr>
<td>TP101 TP102</td>
<td>5011</td>
<td>5011</td>
<td>Test Point, Black, Thru Hole</td>
<td>Keystone Electronics</td>
<td></td>
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<tr>
<td>TP104 TP204</td>
<td>5010</td>
<td>5010</td>
<td>Test Point, Red, Thru Hole</td>
<td>Keystone Electronics</td>
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</tr>
<tr>
<td>TP201 TP202</td>
<td>5014</td>
<td>5014</td>
<td>Test Point, Yellow, Thru Hole</td>
<td>Keystone Electronics</td>
<td></td>
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</tbody>
</table>
4.0 Board Files

FIGURE 1 Top side Component Placement
FIGURE 6 Bottom side Component Placement
FIGURE 7 Circuit Outline