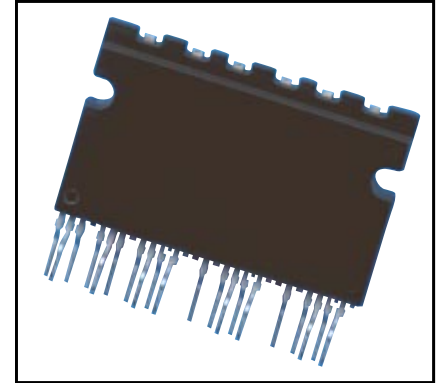
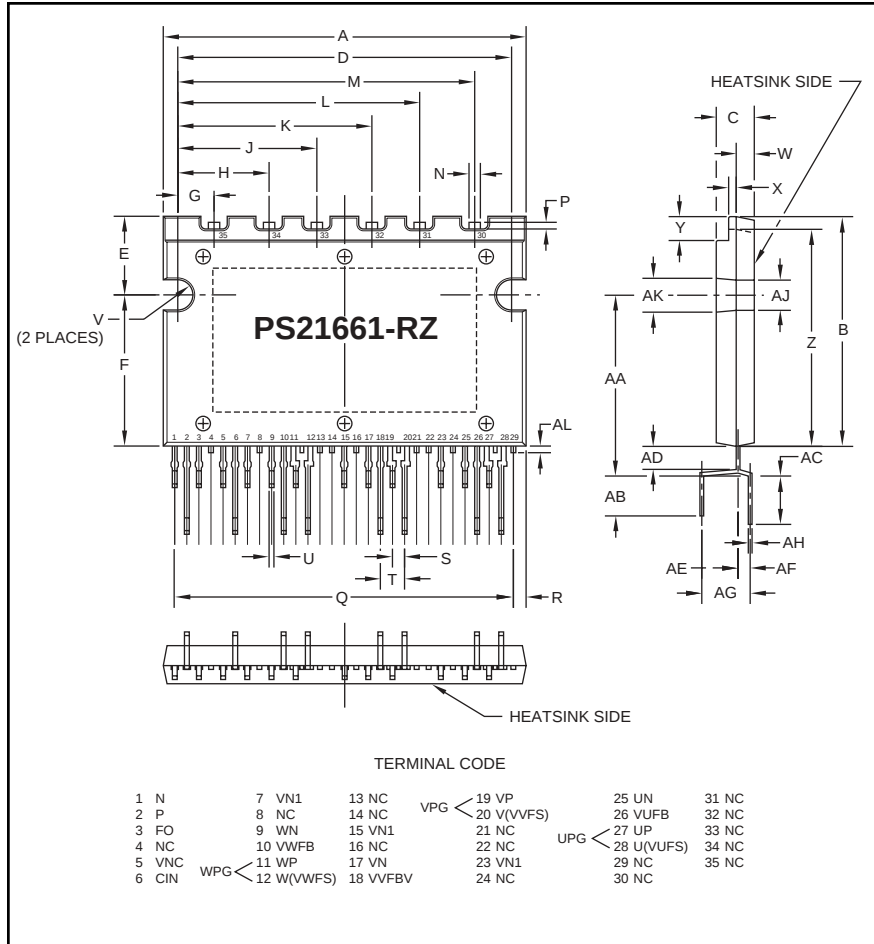


### Intellimod™ Module Single-In-Line Intelligent Power Module 3 Amperes/600 Volts



#### Description:

SIP-IPMs are intelligent power modules that integrate power devices, drivers, and protection circuitry in an ultra compact single-in-line transfer-mold package for use in driving small three phase motors. Use of 5th generation IGBTs, SIP packaging, and application specific HVICs allow the designer to reduce inverter size and overall design time.

#### Features:

- ☐ Compact Packages
- ☐ Single Power Supply
- ☐ Integrated HVICs
- ☐ Direct Connection to CPU

#### Applications:

- ☐ Washing Machines
- ☐ Refrigerators
- ☐ Air Conditioners
- ☐ Small Servo Motors
- ☐ Small Motor Control

#### Ordering Information:

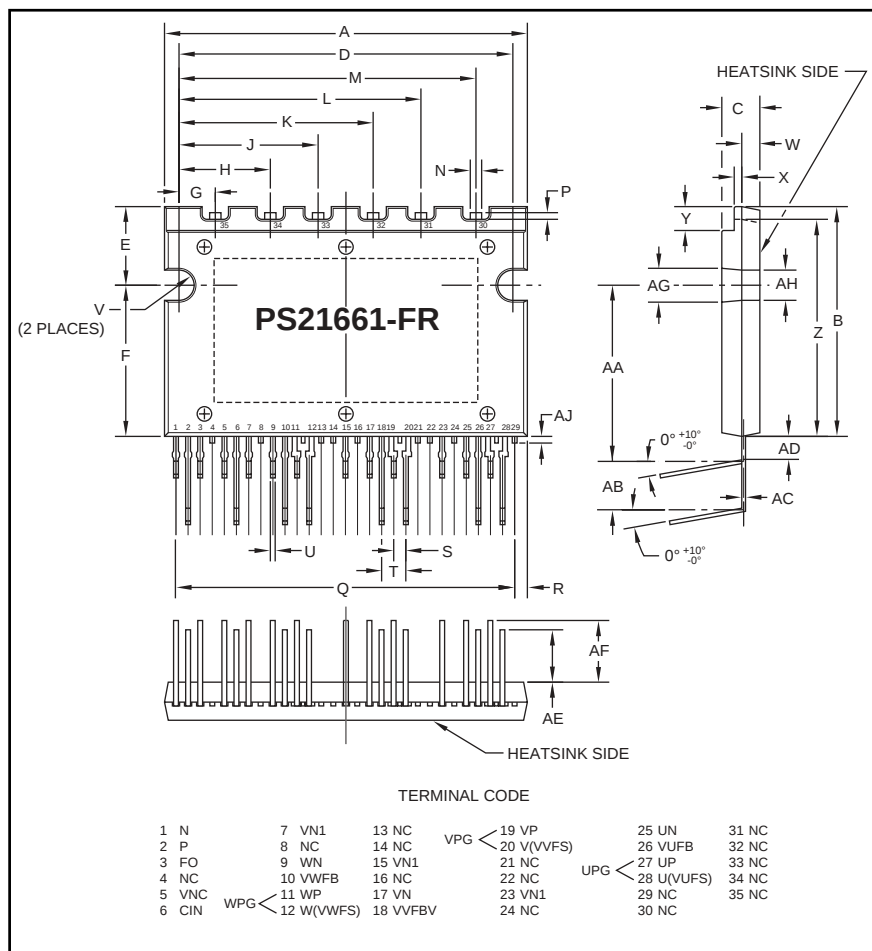
PS21661-RZ is a 600V, 3 Ampere SIP Intelligent Power Module.

Outline Drawing and Circuit Diagram

| Dimensions | Inches | Millimeters |
|------------|--------|-------------|
| A          | 1.50   | 38.0        |
| B          | 0.94   | 24.0        |
| C          | 0.16   | 4.0         |
| D          | 1.38   | 35.0        |
| E          | 0.33   | 8.5         |
| F          | 0.61   | 15.5        |
| G          | 0.15   | 3.8         |
| H          | 0.38   | 9.6         |
| J          | 0.57   | 14.6        |
| K          | 0.80   | 20.4        |
| L          | 1.00   | 25.4        |
| M          | 1.23   | 31.2        |
| N          | 0.047  | 1.2         |
| P          | 0.028  | 0.7         |
| Q          | 1.39   | 35.28       |
| R          | 0.048  | 1.22        |
| S          | 0.05   | 1.27        |
| T          | 0.10   | 2.54        |

| Dimensions | Inches | Millimeters |
|------------|--------|-------------|
| U          | 0.02   | 0.5         |
| V          | 0.06   | 1.6         |
| W          | 0.07   | 1.9         |
| X          | 0.03   | 0.8         |
| Y          | 0.11   | 2.7         |
| Z          | 0.90   | 22.8        |
| AA         | 0.75   | 19.0        |
| AB         | 0.17   | 4.2         |
| AC         | 0.20   | 5.2         |
| AD         | 0.09   | 2.4         |
| AE         | 0.15   | 3.81        |
| AF         | 0.05   | 1.27        |
| AG         | 0.20   | 5.08        |
| AH         | 0.016  | 0.4         |
| AJ         | 0.13   | 3.3         |
| AK         | 0.14   | 3.6         |
| AL         | 0.28   | 0.7         |

**PS21661-RZ/-FR**  
**Intellimod™ Module**  
**Single-In-Line Intelligent Power Module**  
 3 Amperes/600 Volts



**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|------------|--------|-------------|
| A          | 1.50   | 38.0        |
| B          | 0.94   | 24.0        |
| C          | 0.16   | 4.0         |
| D          | 1.38   | 35.0        |
| E          | 0.33   | 8.5         |
| F          | 0.61   | 15.5        |
| G          | 0.15   | 3.8         |
| H          | 0.38   | 9.6         |
| J          | 0.57   | 14.6        |
| K          | 0.80   | 20.4        |
| L          | 1.00   | 25.4        |
| M          | 1.23   | 31.2        |
| N          | 0.047  | 1.2         |
| P          | 0.028  | 0.7         |
| Q          | 1.39   | 35.28       |
| R          | 0.048  | 1.22        |
| S          | 0.05   | 1.27        |

| Dimensions | Inches | Millimeters |
|------------|--------|-------------|
| T          | 0.10   | 2.54        |
| U          | 0.02   | 0.5         |
| V          | 0.06   | 1.6         |
| W          | 0.07   | 1.9         |
| X          | 0.03   | 0.8         |
| Y          | 0.11   | 2.7         |
| Z          | 0.90   | 22.8        |
| AA         | 0.71   | 18.1        |
| AB         | 0.20   | 5.08        |
| AC         | 0.016  | 0.4         |
| AD         | 0.09   | 2.4         |
| AE         | 0.22   | 5.5         |
| AF         | 0.26   | 6.5         |
| AG         | 0.14   | 3.6         |
| AH         | 0.13   | 3.3         |
| AJ         | 0.028  | 0.7         |

**PS21661-RZ/-FR**  
**Intellimod™ Module**  
**Single-In-Line Intelligent Power Module**  
 3 Amperes/600 Volts

**Absolute Maximum Ratings,  $T_j = 25^\circ\text{C}$  unless otherwise specified**

| Characteristics                                                                    | Symbol          | PS21661-RZ/-FR | Units            |
|------------------------------------------------------------------------------------|-----------------|----------------|------------------|
| Power Device Junction Temperature*                                                 | $T_j$           | -20 to 125     | $^\circ\text{C}$ |
| Heatsink Operation Temperature (See $T_f$ Measurement Point Illustration)          | $T_f$           | -20 to 100     | $^\circ\text{C}$ |
| Storage Temperature                                                                | $T_{stg}$       | -40 to 125     | $^\circ\text{C}$ |
| Mounting Torque, M3 Mounting Screws                                                | —               | 7              | in-lb            |
| Module Weight (Typical)                                                            | —               | 10             | Grams            |
| Self-protection Supply Voltage Limit (Short Circuit Protection Capability)**       | $V_{CC(prot.)}$ | 400            | Volts            |
| Isolation Voltage, AC 1 minute, 60Hz Sinusoidal, Connection Pins to Heatsink Plate | $V_{ISO}$       | 2500           | Volts            |

\*The maximum junction temperature rating of the power chips integrated within the SIP-IPM is  $150^\circ\text{C}$  ( $@T_f \leq 100^\circ\text{C}$ ). However, to ensure safe operation of the SIP-IPM, the average junction temperature should be limited to  $T_{j(avg)} \leq 125^\circ\text{C}$  ( $@T_f \leq 100^\circ\text{C}$ ).

\*\* $V_D = 13.5 \sim 16.5\text{V}$ , Inverter Part,  $T_j = 125^\circ\text{C}$ , Non-repetitive, Less than  $2\mu\text{s}$

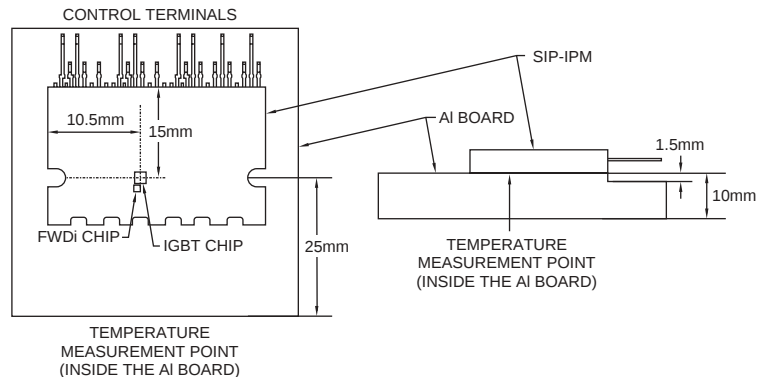
**IGBT Inverter Sector**

|                                                                             |                 |      |         |
|-----------------------------------------------------------------------------|-----------------|------|---------|
| Collector-Emitter Voltage                                                   | $V_{CES}$       | 600  | Volts   |
| Collector Current ( $T_f = 25^\circ\text{C}$ )                              | $\pm I_C$       | 3    | Amperes |
| Peak Collector Current ( $T_f = 25^\circ\text{C}$ , $t_w \leq 1\text{ms}$ ) | $\pm I_{CP}$    | 6    | Amperes |
| Supply Voltage (Applied between P - N)                                      | $V_{CC}$        | 450  | Volts   |
| Supply Voltage, Surge (Applied between P - N)                               | $V_{CC(surge)}$ | 500  | Volts   |
| Collector Dissipation ( $T_f = 25^\circ\text{C}$ , per 1 Chip)              | $P_C$           | 11.1 | Watts   |

**Control Sector**

|                                                                                                                  |          |                 |       |
|------------------------------------------------------------------------------------------------------------------|----------|-----------------|-------|
| Supply Voltage (Applied between $V_{N1}$ - $V_{NC}$ )                                                            | $V_D$    | 20              | Volts |
| Supply Voltage (Applied between $V_{UFB}$ - $U(V_{UFS})$ , $V_{VFB}$ - $V(V_{VFS})$ , $V_{WFB}$ - $W(V_{WFS})$ ) | $V_{DB}$ | 20              | Volts |
| Input Voltage (Applied between $U_P$ , $V_P$ , $W_P$ - $V_{NC}$ , $U_N$ , $V_N$ , $W_N$ - $V_{NC}$ )             | $V_{IN}$ | $-0.5 \sim V_D$ | Volts |
| Fault Output Supply Voltage (Applied between $F_O$ - $V_{NC}$ )                                                  | $V_{FO}$ | $-0.5 \sim V_D$ | Volts |
| Fault Output Current (Sink Current at $F_O$ Terminal)                                                            | $I_{FO}$ | 10              | mA    |
| Current Sensing Input Voltage (Applied between $C_{IN}$ - $V_{NC}$ )                                             | $V_{SC}$ | $-0.5 \sim V_D$ | Volts |

$T_f$  Measurement Point



## PS21661-RZ/-FR

### Intellimod™ Module

### Single-In-Line Intelligent Power Module

3 Amperes/600 Volts

## Electrical and Mechanical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

| Characteristics                      | Symbol        | Test Conditions                                                                                                                                                             | Min. | Typ. | Max. | Units         |
|--------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| <b>IGBT Inverter Sector</b>          |               |                                                                                                                                                                             |      |      |      |               |
| Collector Cutoff Current             | $I_{CES}$     | $V_{CE} = V_{CES}, T_j = 25^\circ\text{C}$                                                                                                                                  | —    | —    | 1.0  | mA            |
|                                      |               | $V_{CE} = V_{CES}, T_j = 125^\circ\text{C}$                                                                                                                                 | —    | —    | 10   | mA            |
| Diode Forward Voltage                | $V_{EC}$      | $T_j = 25^\circ\text{C}, -I_C = 3\text{A}, V_{IN} = 0\text{V}$                                                                                                              | —    | 1.55 | 2.00 | Volts         |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C = 3\text{A}, T_j = 25^\circ\text{C}, V_D = V_{DB} = 15\text{V}, V_{IN} = 5\text{V}$                                                                                    | —    | 1.60 | 2.15 | Volts         |
|                                      |               | $I_C = 3\text{A}, T_j = 125^\circ\text{C}, V_D = V_{DB} = 15\text{V}, V_{IN} = 5\text{V}$                                                                                   | —    | 1.70 | 2.30 | Volts         |
| Inductive Load Switching Times       | $t_{on}$      | $V_{CC} = 300\text{V}, V_D = V_{DB} = 15\text{V},$<br>$I_C = 3\text{A}, T_j = 125^\circ\text{C}, V_{IN} = 0 \leftrightarrow 5\text{V},$<br>Inductive Load (Upper-Lower Arm) | 0.50 | 0.85 | 1.25 | $\mu\text{S}$ |
|                                      | $t_{rr}$      |                                                                                                                                                                             | —    | 0.20 | —    | $\mu\text{S}$ |
|                                      | $t_{C(on)}$   |                                                                                                                                                                             | —    | 0.35 | 0.55 | $\mu\text{S}$ |
|                                      | $t_{off}$     |                                                                                                                                                                             | —    | 1.00 | 1.50 | $\mu\text{S}$ |
|                                      | $t_{C(off)}$  |                                                                                                                                                                             | —    | 0.55 | 1.10 | $\mu\text{S}$ |

## Thermal Characteristics

| Characteristic     | Symbol         | Condition                  | Min. | Typ. | Max. | Units                 |
|--------------------|----------------|----------------------------|------|------|------|-----------------------|
| Junction to Fin    | $R_{th(j-f)Q}$ | IGBT Part (Per 1/6 Module) | —    | —    | 9.0  | $^\circ\text{C/Watt}$ |
| Thermal Resistance | $R_{th(j-f)D}$ | FWDi Part (Per 1/6 Module) | —    | —    | 9.0  | $^\circ\text{C/Watt}$ |

## Recommended Conditions for Use

| Characteristic                  | Symbol                      | Condition                                                                                                                                         | Min. | Typ. | Value | Units            |
|---------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-------|------------------|
| Supply Voltage                  | $V_{CC}$                    | Applied between P-N Terminals                                                                                                                     | 0    | 300  | 400   | Volts            |
| Control Supply Voltage          | $V_D$                       | Applied between $V_{N1}$ - $V_{NC}$                                                                                                               | 13.5 | 15.0 | 16.5  | Volts            |
|                                 | $V_{DB}$                    | Applied between $V_{UFB}$ - $U(V_{UFS})$ , $V_{VFB}$ - $V(V_{VFS})$ , $V_{WFB}$ - $W(V_{WFS})$                                                    | 13.0 | 15.0 | 18.5  | Volts            |
| Control Supply Variation        | $\Delta V_D, \Delta V_{DB}$ |                                                                                                                                                   | -1   | —    | 1     | V/ $\mu\text{s}$ |
| PWM Input Frequency             | $f_{PWM}$                   | $T_f \leq 100^\circ\text{C}, T_j \leq 125^\circ\text{C}$                                                                                          | —    | 15   | —     | kHz              |
| Allowable RMS Current*          | $I_O$                       | $V_{CC} = 300\text{V}, V_D = 15\text{V}, f_c = 15\text{kHz},$<br>$P_F = 0.8$ Sinusoidal, $T_j \leq 125^\circ\text{C}, T_f \leq 100^\circ\text{C}$ | —    | —    | 17    | Arms             |
| $V_{NC}$ Terminal Voltage       | $V_{NC}$                    | Applied between $V_{NC}$ -N (Include Surge Voltage)                                                                                               | -5   | —    | 5     | Volts            |
| Minimum Input Pulse Width**     | $P_{WIN}$                   | ON/OFF                                                                                                                                            | 0.3  | —    | —     | $\mu\text{S}$    |
| Arm Shoot-through Blocking Time | $t_{DEAD}$                  | For Each Input Signal                                                                                                                             | 1.5  | —    | —     | $\mu\text{S}$    |

\* The allowable RMS current value depends on the actual application conditions.

\*\*There might be no output when the input signal width is less than  $P_{WIN}$ .

**PS21661-RZ/-FR**  
**Intellimod™ Module**  
**Single-In-Line Intelligent Power Module**  
**3 Amperes/600 Volts**

### Electrical and Mechanical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

| Characteristics              | Symbol               | Test Conditions                                                                                                                   | Min. | Typ. | Max. | Units         |
|------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| <b>Control Sector</b>        |                      |                                                                                                                                   |      |      |      |               |
| Supply Voltage               | $V_D$                | Applied between $V_{N1}$ - $V_{NC}$                                                                                               | 13.5 | 15.0 | 16.5 | Volts         |
|                              | $V_{DB}$             | Applied between $V_{UFB}$ - $V_{UFS}$ ,<br>$V_{VFB}$ - $V_{VFS}$ , $V_{WFB}$ - $V_{WFS}$                                          | 13.5 | 15.0 | 16.5 | Volts         |
| Circuit Current              | $I_D$                | $V_D = 15\text{V}$ , $V_{IN} = 0\text{V}$ ,<br>Total of $V_{N1}$ - $V_{NC}$ (U, V, W)                                             | —    | —    | 3.60 | mA            |
|                              |                      | $V_D = 15\text{V}$ , $V_{IN} = 5\text{V}$ ,<br>Total of $V_{N1}$ - $V_{NC}$ (U, V, W)                                             | —    | —    | 3.60 | mA            |
|                              | $I_{DB}$             | $V_{DB} = 15\text{V}$ , $V_{IN} = 0\text{V}$ ,<br>$V_{UFB}$ -U( $V_{UFS}$ ), $V_{VFB}$ -V( $V_{VFS}$ ), $V_{WFB}$ -W( $V_{WFS}$ ) | —    | —    | 0.50 | mA            |
|                              |                      | $V_{DB} = 15\text{V}$ , $V_{IN} = 5\text{V}$ ,<br>$V_{UFB}$ -U( $V_{UFS}$ ), $V_{VFB}$ -V( $V_{VFS}$ ), $V_{WFB}$ -W( $V_{WFS}$ ) | —    | —    | 0.50 | mA            |
|                              |                      |                                                                                                                                   |      |      |      |               |
|                              |                      |                                                                                                                                   |      |      |      |               |
| Fault Output Voltage         | $V_{FOH}$            | $V_{SC} = 0\text{V}$ , $F_O$ Circuit: 1k $\Omega$ to 5V Pull-up                                                                   | 4.9  | —    | —    | Volts         |
|                              | $V_{FOL}$            | $V_{SC} = 1\text{V}$ , $I_{FO} = -10\text{mA}$                                                                                    | —    | —    | 0.95 | Volts         |
| Input Current                | $I_{IN}$             | $V_{IN} = 5\text{V}$                                                                                                              | 0.70 | 1.06 | 1.50 | mA            |
| PWM Input Frequency          | $f_{PWM}$            | $T_f \leq 100^\circ\text{C}$ , $T_j \leq 125^\circ\text{C}$                                                                       | —    | 15   | —    | kHz           |
| Short Circuit Trip Level*    | $V_{SC(\text{ref})}$ | $T_j = 25^\circ\text{C}$ , $V_D = 15\text{V}$                                                                                     | 0.43 | 0.48 | 0.53 | Volts         |
| Supply Circuit Under-voltage | $UV_{DBt}$           | Trip Level, $T_j \leq 125^\circ\text{C}$                                                                                          | 10.0 | —    | 12.0 | Volts         |
|                              | $UV_{DBr}$           | Reset Level, $T_j \leq 125^\circ\text{C}$                                                                                         | 10.5 | —    | 12.5 | Volts         |
|                              | $UV_{Dt}$            | Trip Level, $T_j \leq 125^\circ\text{C}$                                                                                          | 10.3 | —    | 12.5 | Volts         |
|                              | $UV_{Dr}$            | Reset Level, $T_j \leq 125^\circ\text{C}$                                                                                         | 10.8 | —    | 13.0 | Volts         |
| Fault Output Pulse Width**   | $t_{FO}$             |                                                                                                                                   | 20   | 40   | —    | $\mu\text{S}$ |
| ON Threshold Voltage         | $V_{th(\text{on})}$  | Applied between $U_P$ , $V_P$ , $W_P$ - $V_{NC}$ ,                                                                                | 2.10 | 2.35 | 2.60 | Volts         |
| OFF Threshold Voltage        | $V_{th(\text{off})}$ | $U_N$ , $V_N$ , $W_N$ - $V_{NC}$                                                                                                  | 1.10 | 1.40 | 1.80 | Volts         |

\* Short Circuit protection is functioning only at the lower-arms. Please select the value of the external shunt resistor such that the SC trip level is less than 5.1A.

\*\*FO signal is only asserted when the SC or UV protection is activated on the low side.



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*Powerex, Inc., 200 E. Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272*

***PS21661-RZI-FR***

***Intellimod™ Module***

***Single-In-Line Intelligent Power Module***

***3 Amperes/600 Volts***