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PRODUCT DATASHEET

Electro-Static Discharge

**JEN1610-xxV ESD**

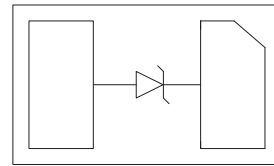
## Features

- Small package: 1.6x1.0x0.5mm(DFN1610)
- Protects one data or power line
- Operating Voltage: 3.3V, 5V, 7V, 9V, 12V, 15V, 18V, 24V, 36V
- High peak pulse current capability
- Ultra low clamping voltage
- 2-pin leadless package
- Complies with following standards:
  - IEC 61000-4-2 (ESD) immunity test
    - Air discharge:  $\pm 30\text{kV}$
    - Contact discharge:  $\pm 30\text{kV}$
- RoHS compliant

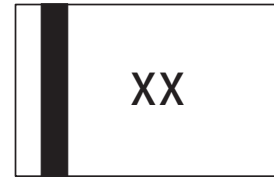
## Applications

- Mobile Phones and Accessories
- Battery Protection
- USB VBus
- Power Line Protection
- Hand Held Portable Applications

## Schematic Diagram



## Pin Description



## Limiting Values( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

| Symbol           | Parameter                       | Conditions                      | Value       | Unit             |
|------------------|---------------------------------|---------------------------------|-------------|------------------|
| V <sub>ESD</sub> | Electrostatic Discharge Voltage | IEC 61000-4-2;Contact Discharge | $\pm 30$    | kV               |
|                  |                                 | IEC 61000-4-2;Air Discharge     | $\pm 30$    | kV               |
| P <sub>PK</sub>  | Peak Pulse Power                | t <sub>p</sub> =8/20 $\mu$ s    | 1875        | W                |
| T <sub>J</sub>   | Operating Temperature Range     | -                               | -55 to +125 | $^\circ\text{C}$ |
| T <sub>stg</sub> | Storage Temperature Range       | -                               | -55 to +150 | $^\circ\text{C}$ |

## Electrical Characteristics( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

| Symbol           | Parameter               | Conditions                                | Min | Typ. | Max  | Unit          |
|------------------|-------------------------|---|-----|------|------|---------------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25 $^\circ\text{C}$       | -   | -    | 3.3  | V             |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                       | 3.5 | -    | -    | V             |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =3.3V                    | -   | -    | 1.0  | $\mu\text{A}$ |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,                     | -   | 1.0  | 1.2  | V             |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>p</sub> =8/20 $\mu$ s              | -   | -    | 150  | A             |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20 $\mu$ s pulse)  | -   | -    | 5.5  | V             |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =150A(8x20 $\mu$ s pulse) | -   | -    | 12.5 | V             |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHz                | -   | -    | 750  | pF            |

| Symbol           | Parameter               | Conditions                          | Min | Typ. | Max  | Unit |
|------------------|-------------------------|-------------------------------------|-----|------|------|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C                | -   | -    | 5    | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                 | 6.0 | -    | -    | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =5V                | -   | -    | 1.0  | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,               | -   | 1.0  | 1.2  | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs              | -   | -    | 125  | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse)  | -   | -    | 9.0  | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =125A(8x20μs pulse) | -   | -    | 15.0 | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHZ          | -   | -    | 550  | pF   |

| Symbol           | Parameter               | Conditions                          | Min | Typ. | Max  | Unit |
|------------------|-------------------------|-------------------------------------|-----|------|------|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C                | -   | -    | 7    | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                 | 7.5 | -    | -    | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =7V                | -   | -    | 0.5  | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,               | -   | 1.0  | 1.2  | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs              | -   | -    | 115  | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse)  | -   | -    | 12   | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =115A(8x20μs pulse) | -   | -    | 16.5 | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHZ          | -   | -    | 550  | pF   |

| Symbol           | Parameter               | Conditions                         | Min | Typ. | Max | Unit |
|------------------|-------------------------|------------------------------------|-----|------|-----|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C               | -   | -    | 9   | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                | 10  | -    | -   | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =9V               | -   | -    | 0.5 | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,              | -   | 1.0  | 1.2 | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs             | -   | -    | 90  | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse) | -   | -    | 15  | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =90A(8x20μs pulse) | -   | -    | 23  | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHZ         | -   | -    | 525 | pF   |

| Symbol           | Parameter               | Conditions                         | Min  | Typ. | Max | Unit |
|------------------|-------------------------|------------------------------------|------|------|-----|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C               | -    | -    | 12  | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                | 12.6 | -    | -   | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =12V              | -    | -    | 0.1 | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,              | -    | -    | 1.2 | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs             | -    | -    | 75  | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse) | -    | -    | 18  | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =75A(8x20μs pulse) | -    | -    | 25  | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHZ         | -    | -    | 500 | pF   |

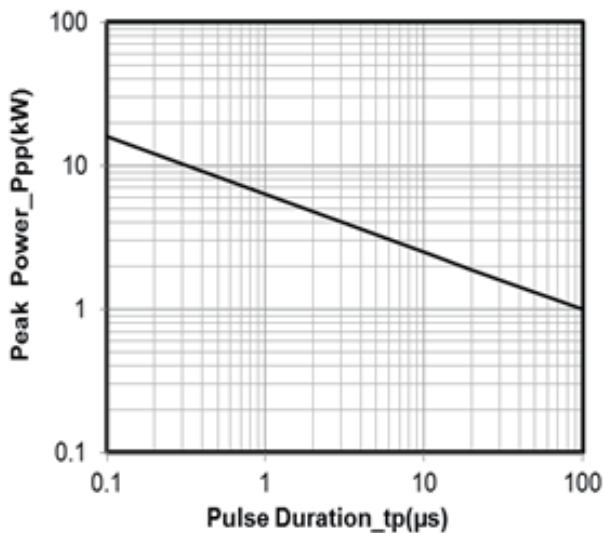
| Symbol           | Parameter               | Conditions                         | Min  | Typ. | Max   | Unit |
|------------------|-------------------------|------------------------------------|------|------|-------|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C               | -    | -    | 15    | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                | 16.5 | -    | -     | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =15V              | -    | -    | 0.1   | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,              | -    | -    | 1.2   | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs             | -    | -    | 60    | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse) | -    | -    | 22    | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =60A(8x20μs pulse) | -    | -    | 31.25 | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHz         | -    | -    | 450   | pF   |

| Symbol           | Parameter               | Conditions                         | Min  | Typ. | Max  | Unit |
|------------------|-------------------------|------------------------------------|------|------|------|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C               | -    | -    | 18   | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                | 19.6 | -    | -    | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =18V              | -    | -    | 0.1  | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,              | -    | 1.0  | 1.2  | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs             | -    | -    | 50   | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse) | -    | -    | 26   | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =50A(8x20μs pulse) | -    | -    | 37.5 | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHz         | -    | -    | 350  | pF   |

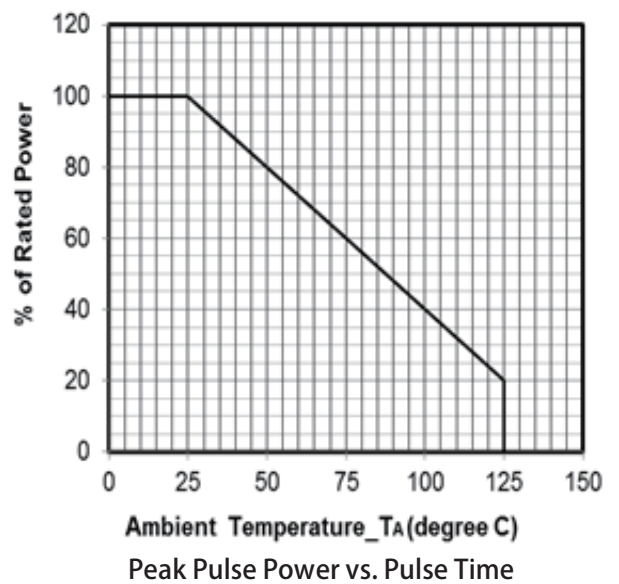
| Symbol           | Parameter               | Conditions                         | Min  | Typ. | Max  | Unit |
|------------------|-------------------------|------------------------------------|------|------|------|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C               | -    | -    | 24   | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                | 26.7 | -    | -    | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =24V              | -    | -    | 0.1  | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,              | -    | -    | 1.2  | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs             | -    | -    | 35   | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse) | -    | -    | 42   | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =35A(8x20μs pulse) | -    | -    | 53.5 | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V,f=1 MHz         | -    | -    | 200  | pF   |

| Symbol           | Parameter               | Conditions                         | Min | Typ. | Max | Unit |
|------------------|-------------------------|------------------------------------|-----|------|-----|------|
| V <sub>RWM</sub> | Reverse Working Voltage | T <sub>A</sub> =25°C               | -   | -    | 36  | V    |
| V <sub>BR</sub>  | Breakdown Voltage       | I <sub>T</sub> =1mA                | 37  | -    | -   | V    |
| I <sub>R</sub>   | Reverse Leakage Current | V <sub>RWM</sub> =36V              | -   | -    | 0.1 | μA   |
| V <sub>F</sub>   | Forward Voltage         | I <sub>F</sub> =10mA,              | -   | -    | 1.2 | V    |
| I <sub>PP</sub>  | Peak Pulse Current      | t <sub>P</sub> =8/20μs             | -   | -    | 25  | A    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =10A(8x20μs pulse) | -   | -    | 60  | V    |
| V <sub>C</sub>   | Clamping Voltage        | I <sub>PP</sub> =25A(8x20μs pulse) | -   | -    | 75  | V    |
| C <sub>J</sub>   | Junction Capacitance    | V <sub>R</sub> =0V, f=1 MHz        | -   | -    | 150 | pF   |

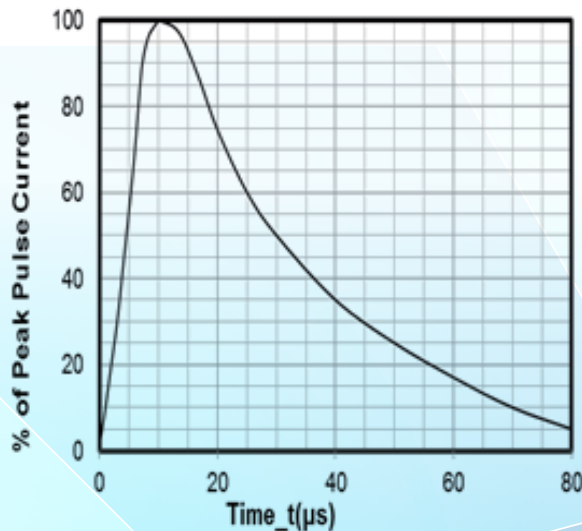
### Typical Characteristics



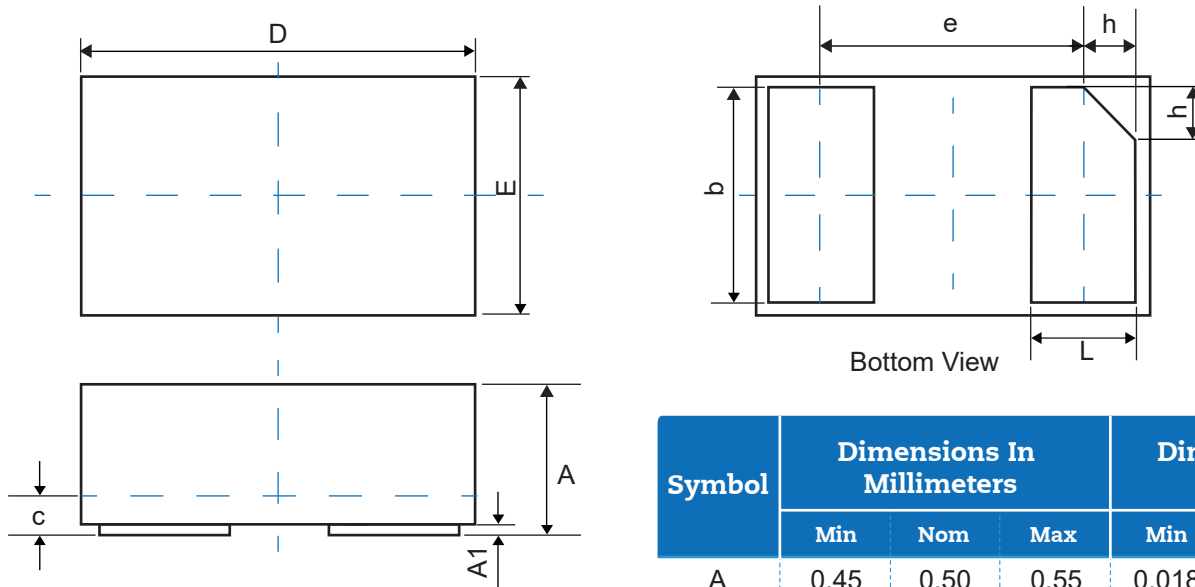
Junction Capacitance vs. Reverse Voltage



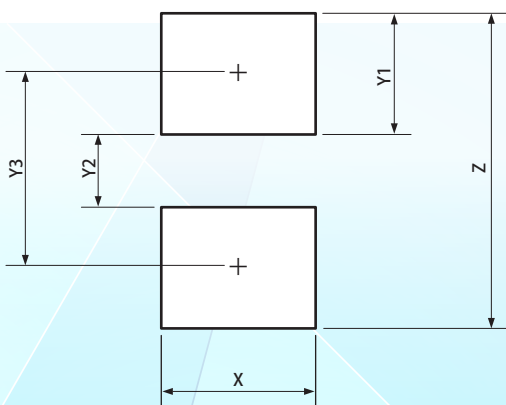
Peak Pulse Power vs. Pulse Time



Clamping Voltage vs. Peak Pulse Current (t<sub>p</sub> = 8/20 μs)

**Physical Dimensions(mm.)**


| Symbol | Dimensions In Millimeters |      |      | Dimensions In Inches |       |       |
|--------|---------------------------|------|------|----------------------|-------|-------|
|        | Min                       | Nom  | Max  | Min                  | Nom   | Max   |
| A      | 0.45                      | 0.50 | 0.55 | 0.018                | 0.020 | 0.022 |
| A1     | 0.00                      | 0.02 | 0.05 | 0.000                | 0.001 | 0.002 |
| b      | 0.75                      | 0.80 | 0.85 | 0.030                | 0.032 | 0.034 |
| c      | 0.10                      | 0.15 | 0.20 | 0.004                | 0.006 | 0.008 |
| D      | 1.55                      | 1.60 | 1.65 | 0.062                | 0.064 | 0.066 |
| e      | 1.10 BSC                  |      |      | 0.044 BSC            |       |       |
| E      | 0.95                      | 1.00 | 1.05 | 0.038                | 0.040 | 0.042 |
| L      | 0.35                      | 0.40 | 0.45 | 0.014                | 0.016 | 0.018 |
| h      | 0.15                      | 0.20 | 0.25 | 0.006                | 0.008 | 0.010 |

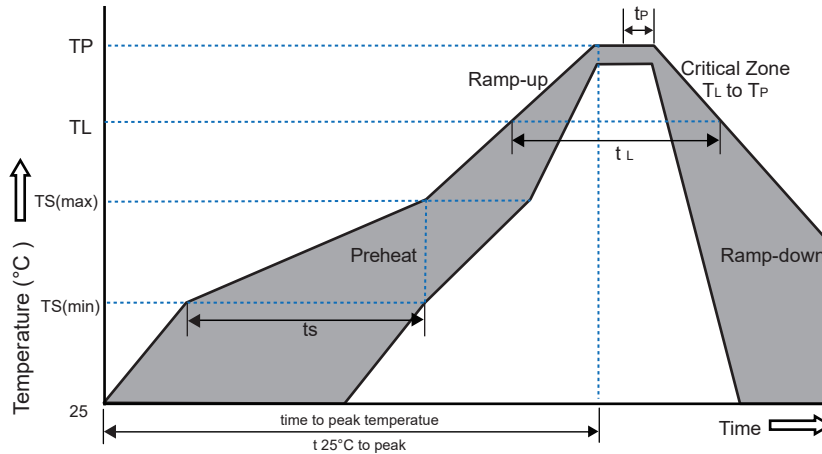
**Suggested Land Pattern**


| Symbol | Dimensions  |        |
|--------|-------------|--------|
|        | Millimeters | Inches |
| X      | 1.00        | 0.040  |
| Y1     | 0.62        | 0.025  |
| Y2     | 0.60        | 0.024  |
| Y3     | 1.22        | 0.049  |
| Z      | 1.85        | 0.074  |

### Packaging Quantity

| Part Number | Delivery Form | Delivery Quantity |
|-------------|---------------|-------------------|
| JEN1610-xxV | 7"T&R         | 3,000             |

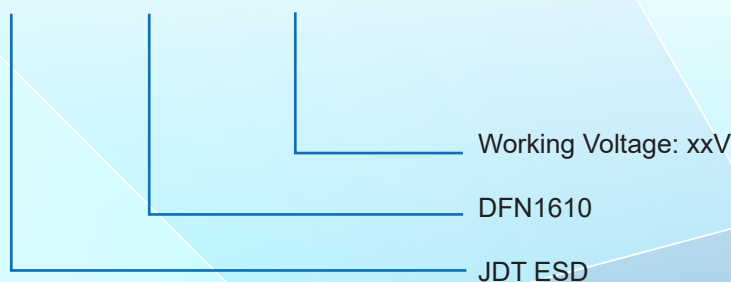
### Soldering Parameters



|  | Reflow Condition                 | Pb-Free Assembly |
|--|----------------------------------|------------------|
| Pre-heat   | -Temperature Min( $T_{s(min)}$ ) | +150°C           |
|  | -Temperature Max( $T_{s(max)}$ ) | +200°C           |
|  | -Time(Min to Max)( $t_s$ )       | 60~180 secs.     |
| Average ramp up rate (Liquid us Temp( $T_L$ ) to peak) |                                  | 3°C/sec. Max     |
| Ts(max) to $T_L$ - Ramp-up Rate                        |                                  | 3°C/sec. Max     |
| Reflow   | -Temperature( $T_L$ )(Liquid us) | +217°C           |
|  | -Temperature ( $t_L$ )           | 60~150 secs.     |
| Peak Temp ( $T_p$ )                                    |                                  | +260(+0/-5)°C    |
| Time within 5°C of actual Peak Temp ( $t_p$ )          |                                  | 30 secs. Max     |
| Ramp-down Rate   |                                  | 6°C/sec. Max     |
| xTime 25°C to Peak Temp (TP)                           |                                  | 8 min. Max       |
| Do not exceed  |                                  | +260°C           |

### Part Number System

## JE N1610 - xxV



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