

# 1 Form A Solid-State Relay



## DESCRIPTION

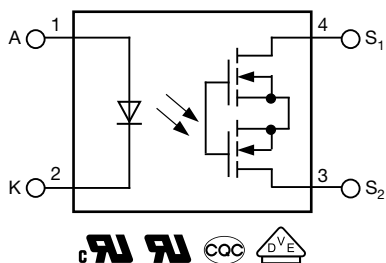
The VO1401AEF is an optically isolated 1 form A solid-state relay in a surface mount 4 pin SOP package.

## FEATURES

- Maximum  $R_{ON}$  2.5  $\Omega$
- Load voltage 60 V
- Continuous load current 550 mA
- Isolation test voltage 3750 V<sub>RMS</sub>
- Small 4 pin SOP package
- Clean bounce free switching
- TTL / CMOS compatible input
- Available on tape and reel
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)



## APPLICATIONS

- Security systems
- Instrumentation
- Industrial controls

## AGENCY APPROVALS

- UL 1577
- cUL
- DIN EN 60747-5-5 (VDE 0884-5)
- CQC
- FIMKO

## LINKS TO ADDITIONAL RESOURCES



## ORDERING INFORMATION

|             |   |   |   |   |   |                         |                    |                     |   |   |
|-------------|---|---|---|---|---|-------------------------|--------------------|---------------------|---|---|
| V           | O | 1 | 4 | 0 | 1 | A                       | E                  | F                   | T | R |
| PART NUMBER |   |   |   |   |   | ELECTRICAL<br>VARIATION | PACKAGE<br>CONFIG. | TAPE<br>AND<br>REEL |   |   |



| PACKAGE              | UL, cUL, CQC, VDE, FIMKO |
|----------------------|--------------------------|
| SOP-4, tape and reel | VO1401AEFTR              |

| <b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                           |            |             |                    |
|--|---------------------------|------------|-------------|--------------------|
| PARAMETER  | CONDITIONS                | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>   |                           |            |             |                    |
| LED continuous forward current   |                           | $I_F$      | 50          | mA                 |
| LED reverse voltage  |                           | $V_R$      | 5           | V                  |
| <b>OUTPUT</b>  |                           |            |             |                    |
| DC or peak AC load voltage   |                           | $V_L$      | 60          | V                  |
| Continuous load current AC/DC peak   |                           | $I_L$      | 550         | mA                 |
| Peak load current  | $t = 10\text{ ms}$        | $I_{LPK}$  | 1.2         | A                  |
| <b>SSR</b>   |                           |            |             |                    |
| Total power dissipation  |                           | $P_{diss}$ | 800         | mW                 |
| Ambient temperature range  |                           | $T_{amb}$  | -40 to +85  | $^{\circ}\text{C}$ |
| Storage temperature range  |                           | $T_{stg}$  | -40 to +125 | $^{\circ}\text{C}$ |
| Soldering temperature  | $t \leq 10\text{ s max.}$ | $T_{sld}$  | 260         | $^{\circ}\text{C}$ |

**Notes**

- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

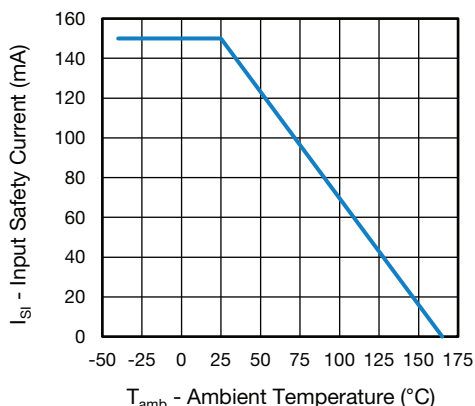
**ABSOLUTE MAXIMUM RATING CURVE**


Fig. 1 - Input Safety Current vs. Ambient Temperature

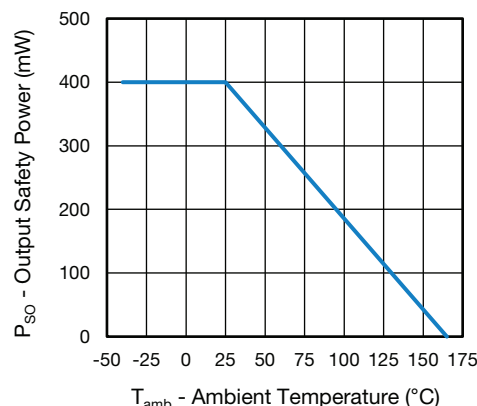


Fig. 2 - Output Safety Power vs. Ambient Temperature

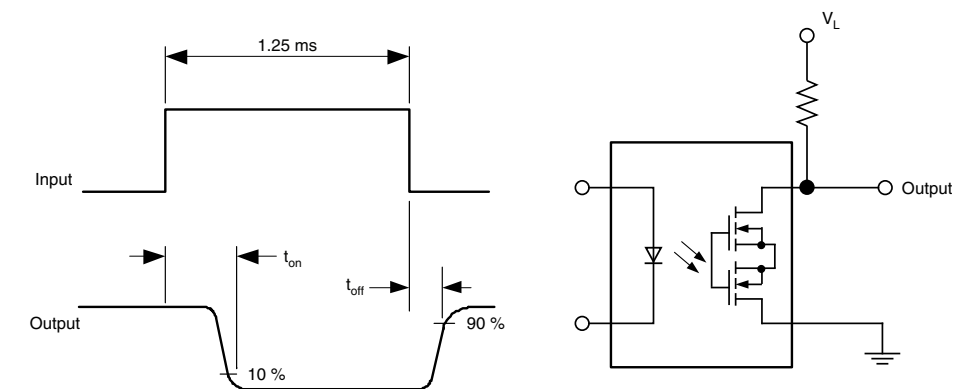
| <b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |            |      |      |      |               |
|--|--|------------|------|------|------|---------------|
| PARAMETER  | TEST CONDITION   | SYMBOL     | MIN. | TYP. | MAX. | UNIT          |
| <b>INPUT</b>   |  |            |      |      |      |               |
| LED forward current, switch turn-on  | $I_L = 100\text{ mA}$ , $V_L \leq 0.5\text{ V}$ , $t = 10\text{ ms}$ | $I_{Fon}$  | -    | 2.5  | 5    | mA            |
| LED forward current, switch turn-off   | $I_L = 1\text{ }\mu\text{A}$   | $I_{Foff}$ | 0.4  | 2    | -    | mA            |
| LED reverse current  | $V_R = 5\text{ V}$   | $I_R$      | -    | -    | 1    | $\mu\text{A}$ |
| LED forward voltage  | $I_F = 5\text{ mA}$  | $V_F$      | 0.8  | 1.2  | 1.5  | V             |
| <b>OUTPUT</b>  |  |            |      |      |      |               |
| On-resistance  | $I_F = 10\text{ mA}$ , $I_L = 500\text{ mA}$                         | $R_{ON}$   | -    | 0.6  | 2.5  | $\Omega$      |
| Off-state leakage current  | $I_F = 0\text{ mA}$ , $V_L = 60\text{ V}$                            | $I_{LEAK}$ | -    | -    | 1    | $\mu\text{A}$ |

**Note**

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information only and are not part of the testing requirements.

**SWITCHING CHARACTERISTICS**

| PARAMETER     | TEST CONDITION  | SYMBOL    | MIN. | TYP. | MAX. | UNIT |
|---------------|---|-----------|------|------|------|------|
| Turn-on time  | $I_F = 10 \text{ mA}$ , $V_L = 20 \text{ V}$ , $I_L = 550 \text{ mA}$ | $t_{on}$  | -    | 1.3  | 3    | ms   |
| Turn-off time | $I_F = 10 \text{ mA}$ , $V_L = 20 \text{ V}$ , $I_L = 550 \text{ mA}$ | $t_{off}$ | -    | 1.45 | 0.5  | ms   |



20991-2

Fig. 3 - Timing Test Circuit and Waveforms

**SAFETY AND INSULATION RATINGS**

| PARAMETER                                    | TEST CONDITION   | SYMBOL     | VALUE          | UNIT               |
|--|--|------------|----------------|--------------------|
| Climatic classification                      | According to IEC 68 part 1   |            | 40 / 85 / 21   |                    |
| Pollution degree                             | According to DIN VDE 0109  |            | 2              |                    |
| Comparative tracking index                   | Insulation group IIIa  | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | According to UL1577, $t = 1 \text{ min}$   | $V_{ISO}$  | 3750           | $V_{RMS}$          |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5  | $V_{IOTM}$ | 4800           | $V_{peak}$         |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5  | $V_{IORM}$ | 707            | $V_{peak}$         |
| Insulation resistance                        | $T_{amb} = 25 \text{ }^{\circ}\text{C}$ , $V_{IO} = 500 \text{ V}$   | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$           |
|  | $T_{amb} = 100 \text{ }^{\circ}\text{C}$ , $V_{IO} = 500 \text{ V}$  | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$           |
|  | $T_{amb} = T_S$ , $V_{IO} = 500 \text{ V}$   | $R_{IO}$   | $\geq 10^9$    | $\Omega$           |
| Output safety power                          |  | $P_{SO}$   | 400            | mW                 |
| Input safety current                         |  | $I_{SI}$   | 200            | mA                 |
| Input safety temperature                     |  | $T_S$      | 150            | $^{\circ}\text{C}$ |
| Clearance distance                           | Measured from input terminals to output terminals, shortest distance through air                                       |            | $\geq 5.2$     | mm                 |
| Creepage distance                            | Measured from input terminals to output terminals, shortest distance path along body                                   |            | $\geq 5.2$     | mm                 |
| Input to output test voltage, method B       | $V_{IORM} \times 1.875 = V_{PR}$ , 100 % production test with $t_M = 1 \text{ s}$ , partial discharge $< 5 \text{ pC}$ | $V_{PR}$   | 1326           | $V_{peak}$         |
| Input to output test voltage, method A       | $V_{IORM} \times 1.6 = V_{PR}$ , 100 % sample test with $t_M = 10 \text{ s}$ , partial discharge $< 5 \text{ pC}$      | $V_{PR}$   | 1131           | $V_{peak}$         |

**Note**

- This SSR is suitable for "safe electrical insulation" only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

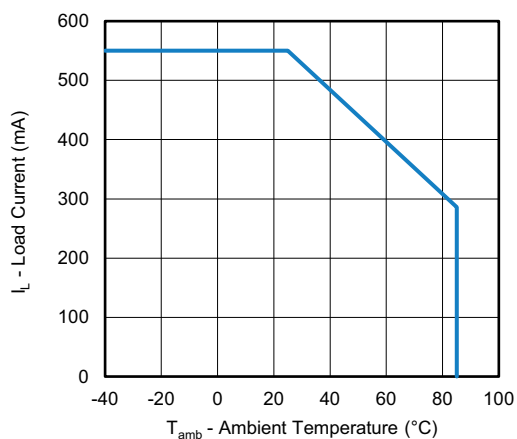
**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


Fig. 4 - Load Current vs. Ambient Temperature

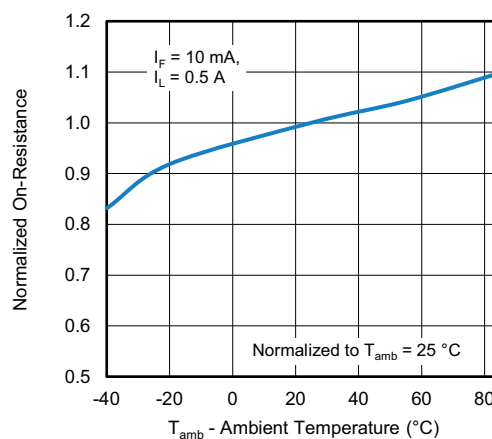


Fig. 7 - Normalized On-Resistance vs. Ambient Temperature

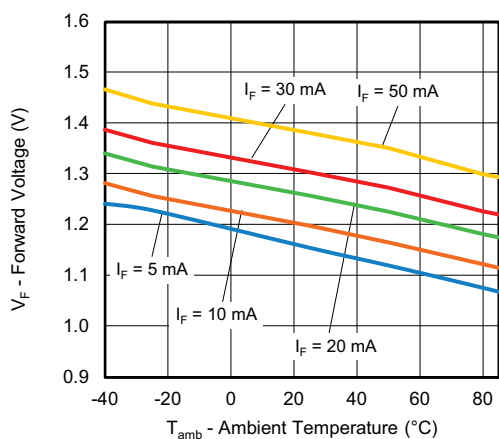


Fig. 5 - Forward Voltage vs. Ambient Temperature

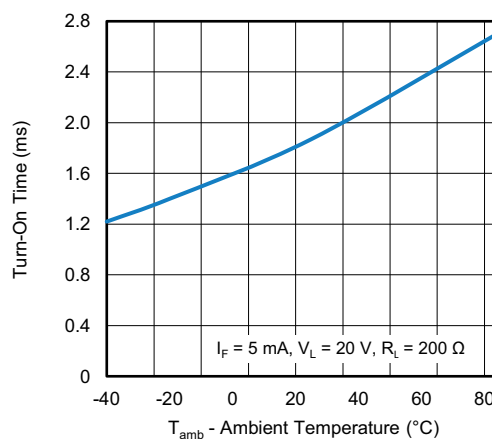


Fig. 8 - Turn-On Time vs. Ambient Temperature

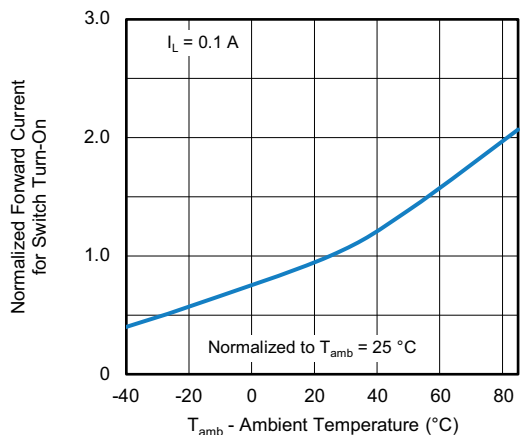


Fig. 6 - Normalized Forward Current for Switch Turn-On vs. Ambient Temperature

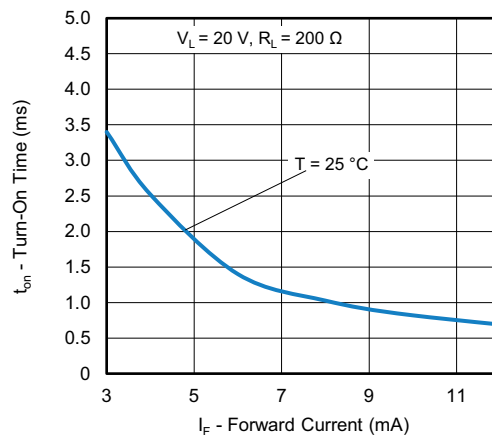


Fig. 9 - Turn-On Time vs. Forward Current

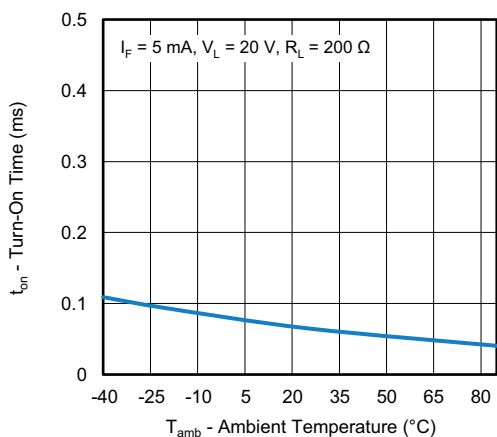


Fig. 10 - Turn-On Time vs. Ambient Temperature

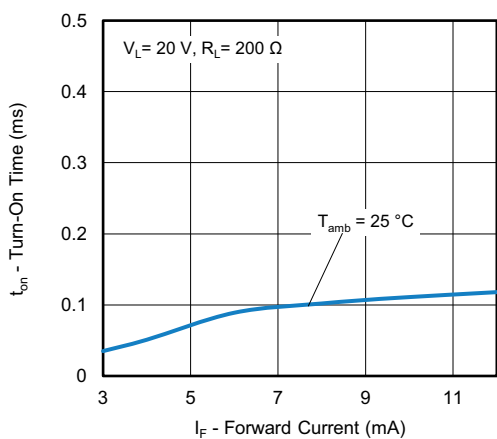


Fig. 11 - Turn-On Time vs. Forward Current

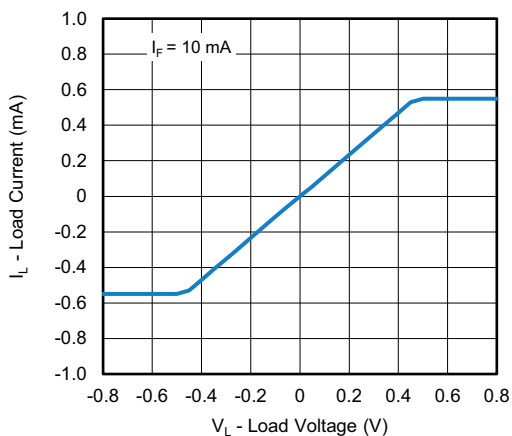


Fig. 12 - Load Current vs. Load Voltage

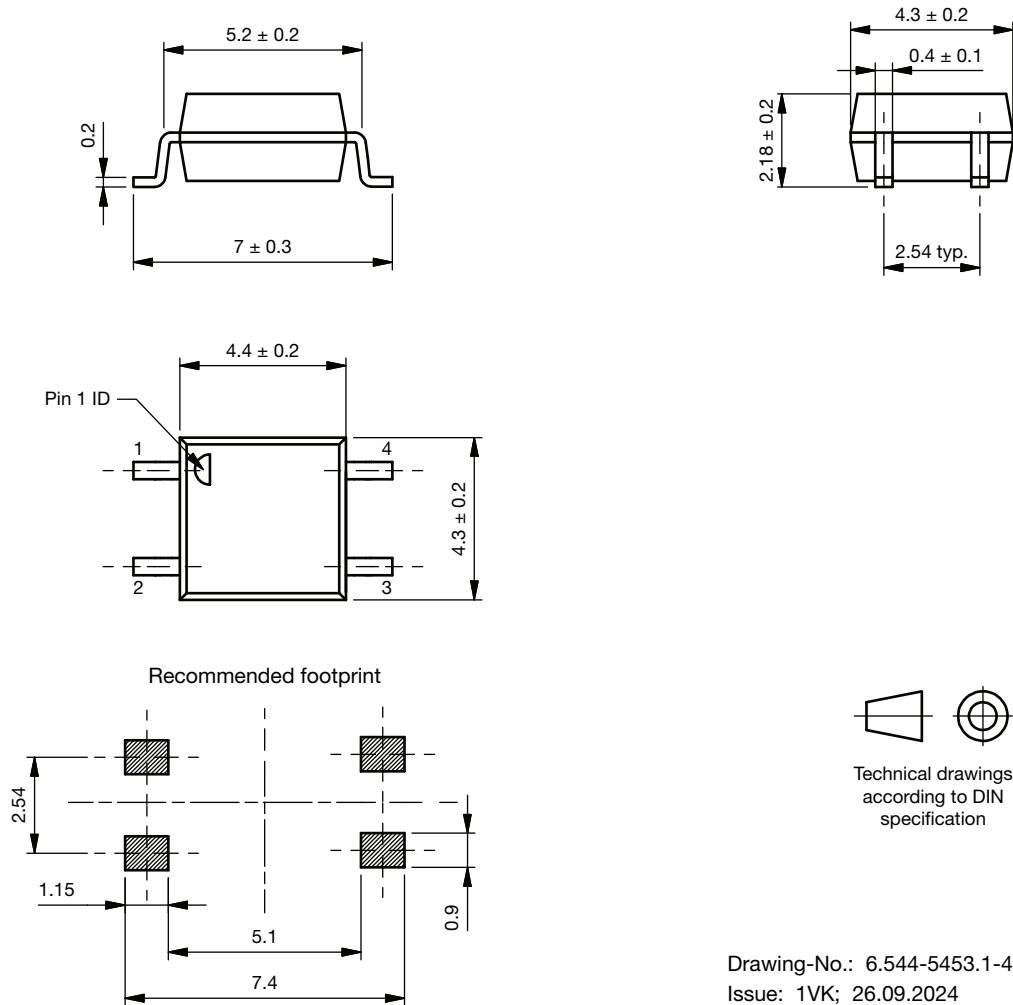
**PACKAGE DIMENSIONS** (in millimeters)


Fig. 13 - Package Drawings

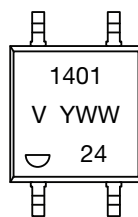
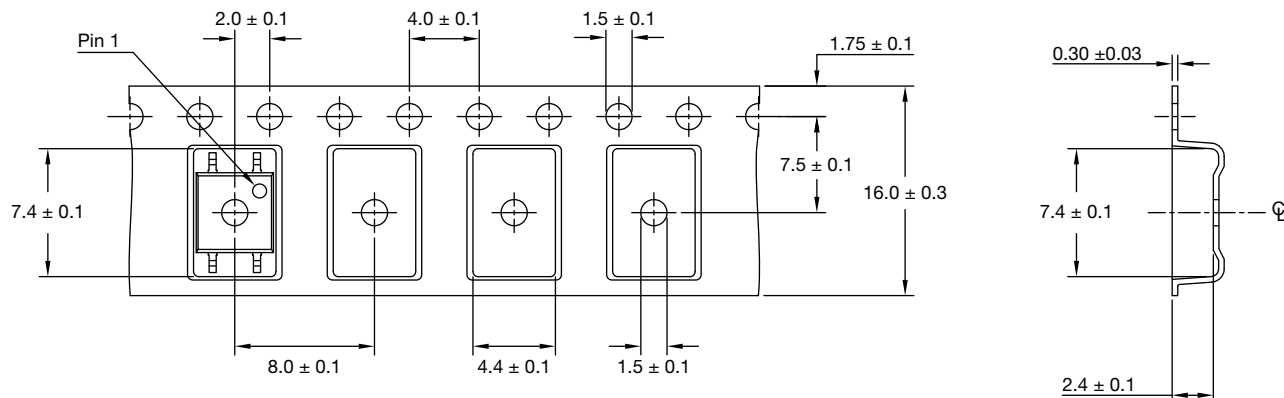
**PACKAGE MARKING**


Fig. 14 - VO1401AEF

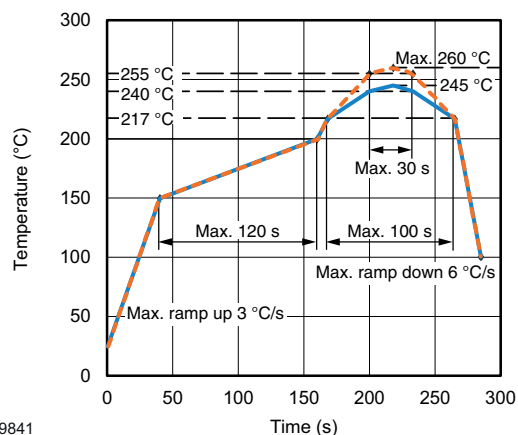
**Notes**

- YWW = date code
- Tape and reel suffix (TR) is not part of the package marking

**TAPE AND REEL INFORMATION** (in millimeters)

**Note:**

- Cumulative tolerance of 10 spocket holes is 0.20

Fig. 15 - VO1401AEFTR (3000 pieces on reel)

**SOLDER PROFILES**


19841

Fig. 16 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

**HANDLING AND STORAGE CONDITIONS**

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ °C}$ ,  $RH < 85\%$ 

Moisture sensitivity level 1, according to J-STD-020



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