

## 45 SERIES

### GENERAL PURPOSE ▲ Si MOSFET RELAY

**SILICON Si MOSFET RELAY ▲** DIP and SMD type

Switches AC or DC load

One channel and two channel packages available

Input TTL / CMOS compatible

Moisture Sensitivity Level ▲ MSL 3

 **UL 1577 approved ▲** File no E344988

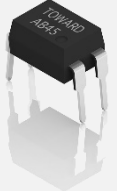
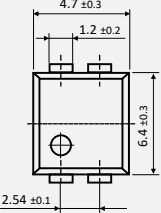
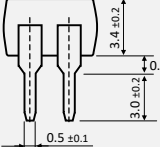
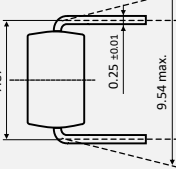
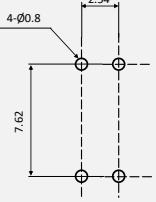
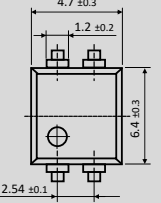
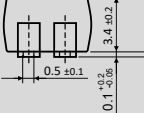
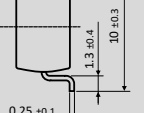
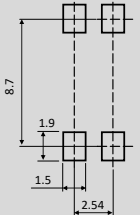
### SPECIFICATION

| Item                          |             | Characteristics                            |
|-------------------------------|-------------|--------------------------------------------|
| Contact Form                  |             | 1 Form A / 2 Form A ▲ Normally open switch |
| Load Voltage                  | $V_L$       | 60V                                        |
| Operation LED Current         | $I_{F\ ON}$ | 3mA                                        |
| Load Current                  | $I_L$       | 200mA                                      |
| On-Resistance                 | $R_{ON}$    | 3Ω                                         |
| Output Capacitance            | $C_{OUT}$   | 20pF                                       |
| Low Off-State Leakage Current | $I_{LEAK}$  | 1μA at 60V <sub>DC</sub>                   |

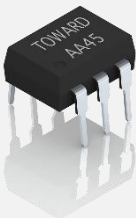
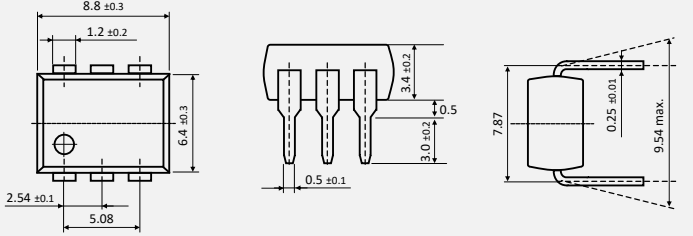
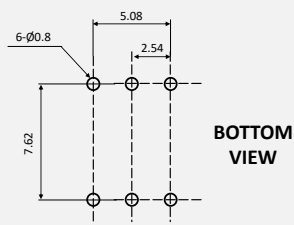
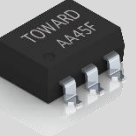
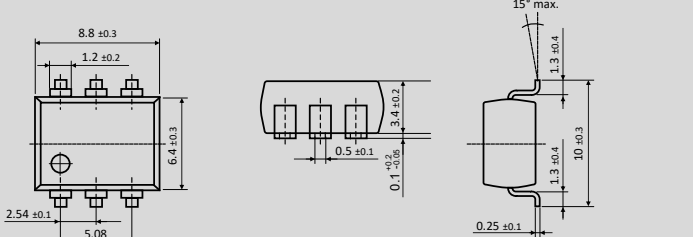
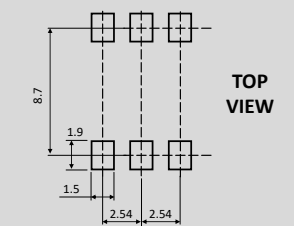
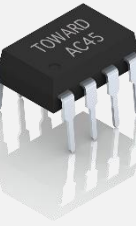
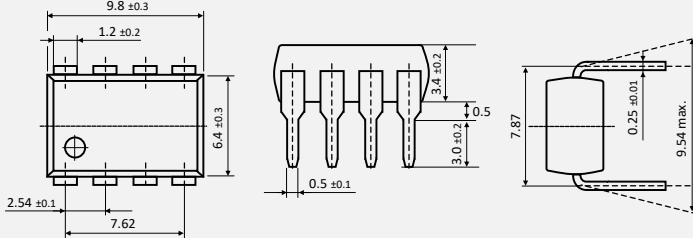
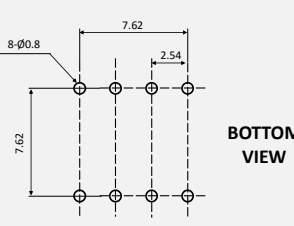
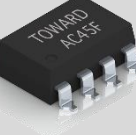
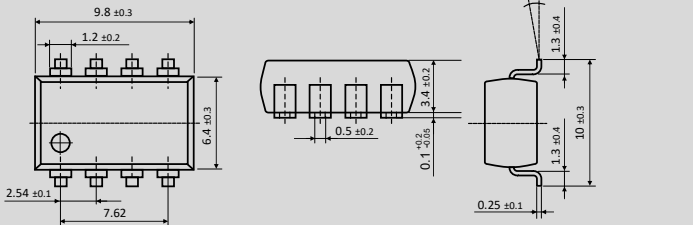
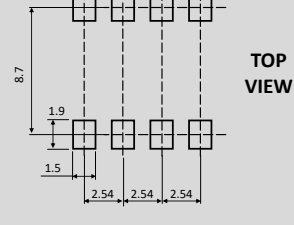
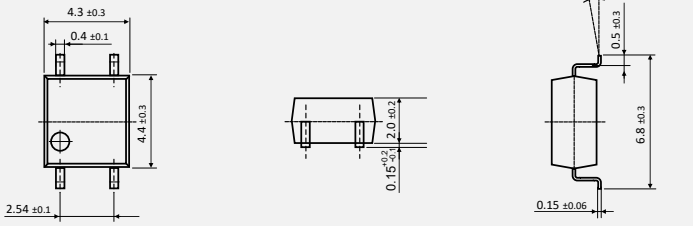
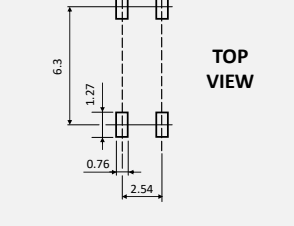
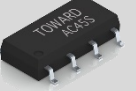
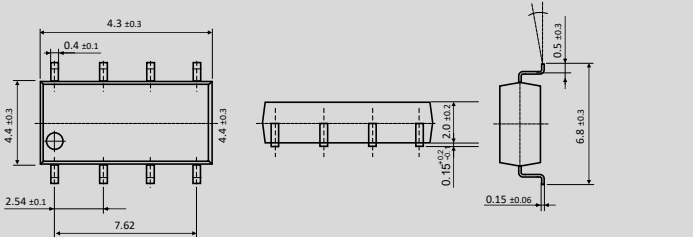
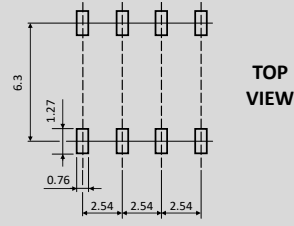
### APPLICATIONS

| Automatic Test Equipment                                                            | Electric Mobility                                                                   | I/O Modules                                                                         | Industrial Automation                                                               | Measurement Equipment                                                                | Security Equipment                                                                    | Sensing Equipment                                                                     |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |  |  |  |  |

### DIMENSIONS

| Package | Illustration                                                                        | Dimensions                                                                                                                                                                                                                                                   | PCB Board Pattern                                                                     |
|---------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| DIP-4   |  |    |  |
| SMD-4   |  |    |  |

## DIMENSIONS

| Package | Illustration                                                                        | Dimensions                                                                           | PCB Board Pattern                                                                     |
|---------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| DIP-6   |    |    |    |
| SMD-6   |    |    |    |
| DIP-8   |   |   |   |
| SMD-8   |  |  |  |
| SOP-4   |  |  |  |
| SOP-8   |  |  |  |

## ABSOLUTE MAXIMUM RATINGS ▲ AMBIENT TEMPERATURE $T_A = 25^\circ\text{C}$

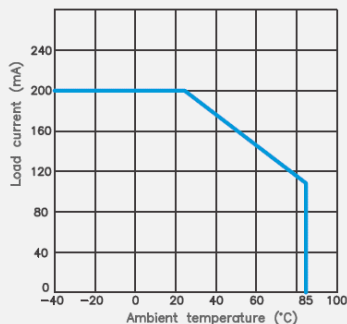
| Item   |                                  | Condition       | Symbol            | Value              |       |                |                |                | Unit             |
|--------|----------------------------------|-----------------|-------------------|--------------------|-------|----------------|----------------|----------------|------------------|
| Type   | Outline package                  |                 |                   | SOP-4              | SOP-8 | DIP-4<br>SMD-4 | DIP-8<br>SMD-8 | DIP-6<br>SMD-6 |                  |
|        | Part number                      |                 |                   | AB45S              | AC45S | AB45(F)        | AC45(F)        | AA45(F)        |                  |
|        | Output channels                  |                 |                   | 1                  | 2     | 1              | 2              | 1              | Channels         |
| Input  | Continuous LED Current           |                 | I <sub>F</sub>    | 50                 |       |                |                |                | mA               |
|        | Peak LED Current                 | 100 Hz, Duty 1% | I <sub>FP</sub>   | 500                |       |                |                |                | mA               |
|        | LED Reverse Voltage              |                 | V <sub>R</sub>    | 5                  |       |                |                |                | V                |
|        | Input Power Dissipation          |                 | P <sub>IN</sub>   | 75                 |       |                |                |                | mW               |
| Output | Load Voltage                     |                 | V <sub>L</sub>    | 60 (AC peak or DC) |       |                |                |                | V                |
|        | Load Current                     |                 | I <sub>L</sub>    | 200                | 200   | 200            | 200            | 200            | mA               |
|        | Peak Load Current                | 1 ms, 1 shot    | I <sub>PEAK</sub> | 600                | 600   | 600            | 600            | 600            | mA               |
|        | Output Power Dissipation         |                 | P <sub>OUT</sub>  | 300                | 450   | 450            | 600            | 450            | mW               |
| Relay  | Total Power Dissipation          |                 | P <sub>T</sub>    | 350                | 500   | 500            | 650            | 500            | mW               |
|        | I/O Breakdown Voltage            |                 | V <sub>I/O</sub>  | 1500               | 1500  | 3750           | 3750           | 3750           | V <sub>RMS</sub> |
|        | I/O Breakdown Voltage (Suffix-H) |                 | V <sub>I/O</sub>  | 3750               | 3750  | 5000           | 5000           | 5000           | V <sub>RMS</sub> |
|        | Operating Temperature Range      |                 | T <sub>OPR</sub>  | -40 to +85         |       |                |                |                | °C               |
|        | Storage Temperature Range        |                 | T <sub>STG</sub>  | -40 to +100        |       |                |                |                | °C               |

## ELECTRICAL CHARACTERISTICS ▲ AMBIENT TEMPERATURE $T_A = 25^\circ\text{C}$

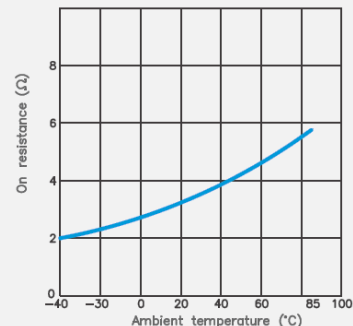
| Item              |                                       | Condition                                    | Symbol             | Min.            | Typ. | Max. | Unit |
|-------------------|---------------------------------------|----------------------------------------------|--------------------|-----------------|------|------|------|
| Input             | LED Forward Voltage                   | I <sub>F</sub> = 10mA                        | V <sub>F</sub>     | 1               | 1.17 | 1.5  | V    |
|                   | Operation LED Current                 |                                              | I <sub>F ON</sub>  |                 | 0.9  | 3    | mA   |
|                   | Recovery LED Voltage                  |                                              | V <sub>F OFF</sub> | 0.5             | 1    |      | V    |
| Output            | On-Resistance                         | I <sub>F</sub> =5mA, I <sub>L</sub> =Rating  | R <sub>ON</sub>    |                 | 3    | 14   | Ω    |
|                   | Drain to Drain (tested within 1 sec.) |                                              |                    |                 |      |      |      |
|                   | Off-State Leakage Current             | V <sub>L</sub> = 60V                         | I <sub>LEAK</sub>  |                 | 1    | μA   |      |
|                   | Output Capacitance                    | V <sub>L</sub> =0V, f=1MHz                   | C <sub>OUT</sub>   | 20              | pF   |      |      |
| Trans-<br>mission | Turn-On Time (for SOP type)           | I <sub>F</sub> =5mA, I <sub>L</sub> =Rating  | t <sub>ON</sub>    |                 | 0.1  | 1    | ms   |
|                   | Turn-Off Time (for SOP type)          | I <sub>F</sub> =5mA, I <sub>L</sub> =Rating  | t <sub>OFF</sub>   |                 | 0.03 | 0.5  | ms   |
|                   | Turn-On Time (for DIP/SMD type)       | I <sub>F</sub> =10mA, I <sub>L</sub> =Rating | t <sub>ON</sub>    |                 | 0.07 | 1    | ms   |
|                   | Turn-Off Time (for DIP/SMD type)      | I <sub>F</sub> =10mA, I <sub>L</sub> =Rating | t <sub>OFF</sub>   |                 | 0.03 | 0.5  | ms   |
| Coupled           | I/O Insulation Resistance             |                                              | R <sub>I/O</sub>   | 10 <sup>9</sup> |      |      | Ω    |
|                   | I/O Capacitance                       | f=1MHz                                       | C <sub>I/O</sub>   |                 | 1.3  |      | pF   |

## REFERENCE DATA

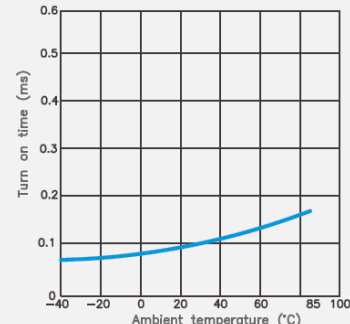
Load current vs. ambient temp.



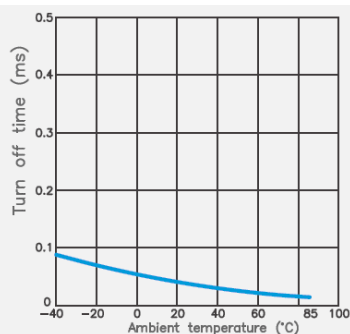
On resistance vs. ambient temp.



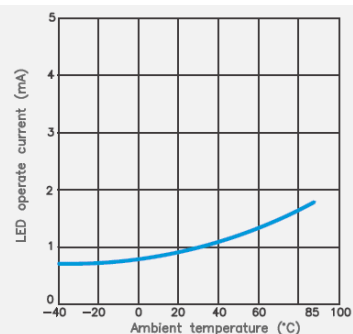
Turn on time vs. ambient temp.



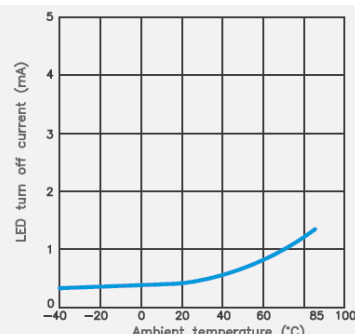
Turn off time vs. ambient temp.



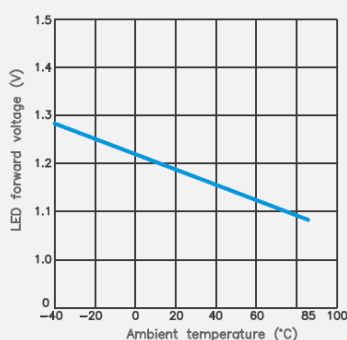
LED operate current vs. ambient temp



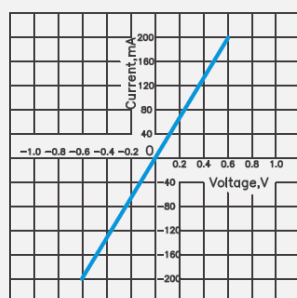
LED turn off current vs. ambient temp.



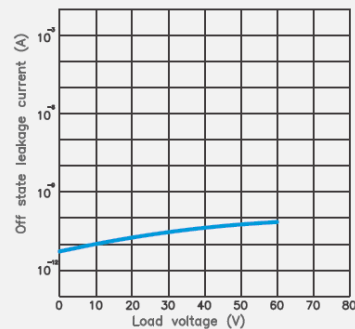
LED forward voltage vs. ambient temp.



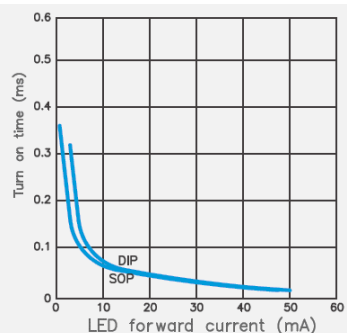
Current vs. voltage characteristics of output at MOS portion



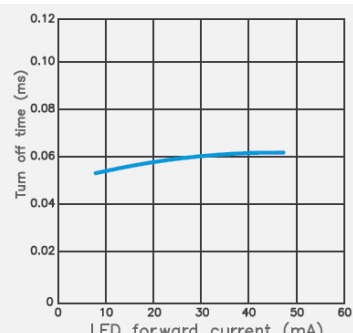
Off state leakage current vs. load voltage



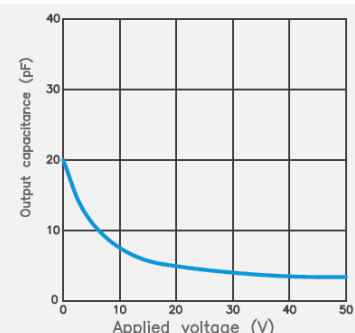
Turn on time vs. LED forward current



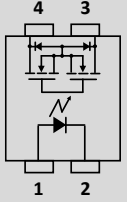
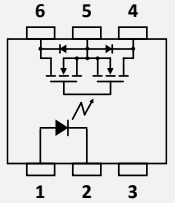
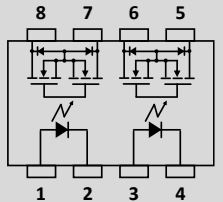
Turn off time vs. LED forward current



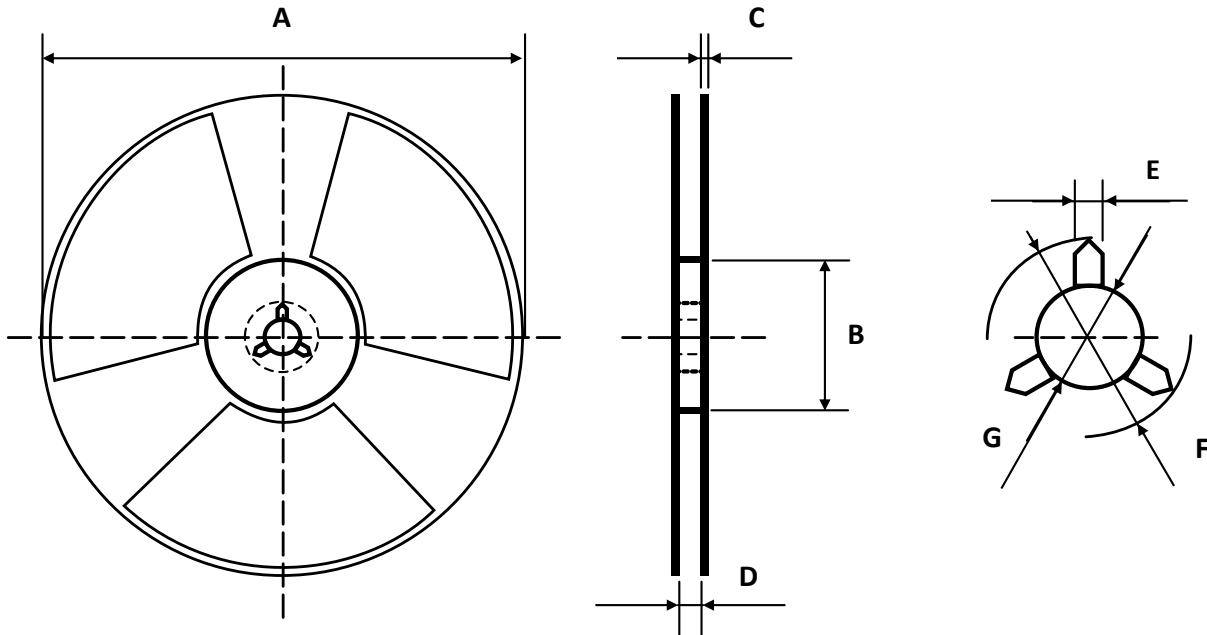
Output capacitance vs. applied voltage



## PIN DESCRIPTION AND PART NUMBER

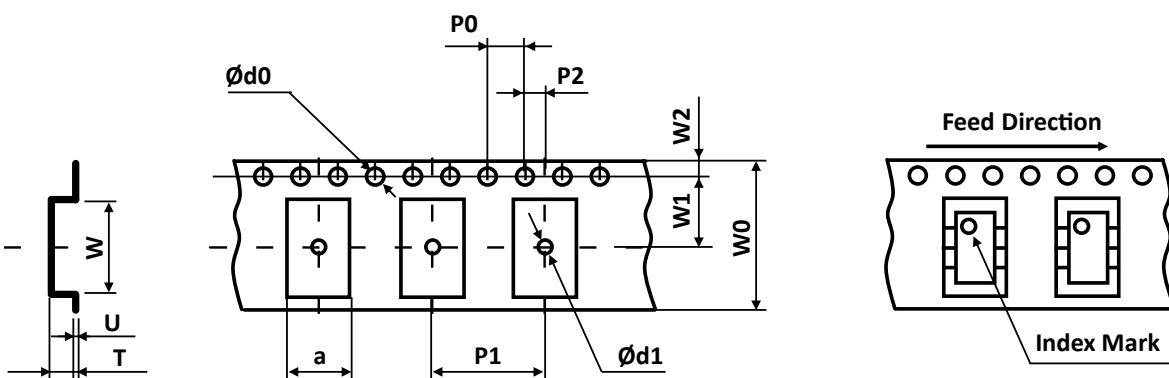
| Circuit Diagram                                                                    | Pin Description |                   | Part No. | Package | Packing        |
|------------------------------------------------------------------------------------|-----------------|-------------------|----------|---------|----------------|
|   | 1               | Anode (+) ■ LED   | AB45     | DIP-4   | Tube (90pcs)   |
|                                                                                    | 2               | Cathode (-) ■ LED | AB45F    | SMD-4   | Tube (90pcs)   |
|                                                                                    | 3,4             | Drain ■ MOSFET    | AB45S    | SOP-4   | Tube (100pcs)  |
|                                                                                    |                 |                   | AB45F-R1 | SMD-4   | Reel (1000pcs) |
|                                                                                    |                 |                   | AB45S-R1 | SOP-4   | Reel (1000pcs) |
|   | 1               | Anode (+) ■ LED   | AA45     | DIP-6   | Tube (50pcs)   |
|                                                                                    | 2               | Cathode (-) ■ LED | AA45F    | SMD-6   | Tube (50pcs)   |
|                                                                                    | 3               | NC                | AA45F-R1 | SMD-6   | Reel (1000pcs) |
|                                                                                    | 4,6             | Drain ■ MOSFET    |          |         |                |
|                                                                                    | 5               | Source ■ MOSFET   |          |         |                |
|  | 1,3             | Anode (+) ■ LED   | AC45     | DIP-8   | Tube (45pcs)   |
|                                                                                    | 2,4             | Cathode (-) ■ LED | AC45F    | SMD-8   | Tube (45pcs)   |
|                                                                                    | 5,6,7,8         | Drain ■ MOSFET    | AC45S    | SOP-8   | Tube (50pcs)   |
|                                                                                    |                 |                   | AC45F-R1 | SMD-8   | Reel (1000pcs) |
|                                                                                    |                 |                   | AC45S-R1 | SOP-8   | Reel (1000pcs) |

## REEL DIMENSIONS ▲ All dimensions in mm



| Size  | A   | B   | C   | D  | E | F  | G  |
|-------|-----|-----|-----|----|---|----|----|
| SOP-4 | 330 | 100 | 2   | 13 | 2 | 13 | 21 |
| SOP-8 | 330 | 100 | 2   | 17 | 2 | 13 | 21 |
| SMD-4 | 380 | 80  | 2.2 | 17 | 2 | 13 | 21 |
| SMD-6 | 380 | 80  | 2.2 | 17 | 2 | 13 | 21 |
| SMD-8 | 380 | 80  | 2.2 | 17 | 2 | 13 | 21 |

## TAPE DIMENSIONS ▲ All dimensions in mm



| Size  | W    | U   | T    | a    | Ød0 | Ød1 | P0 | P1 | P2 | W0 | W1   | W2   |
|-------|------|-----|------|------|-----|-----|----|----|----|----|------|------|
| SOP-4 | 4.6  | 0.3 | 2.3  | 7.2  | 1.5 | 1.5 | 4  | 12 | 2  | 12 | 7.5  | 1.75 |
| SOP-8 | 10.4 | 0.3 | 2.3  | 7.5  | 1.5 | 1.5 | 4  | 12 | 2  | 16 | 7.5  | 1.75 |
| SMD-4 | 5.3  | 0.3 | 4    | 10.6 | 1.5 | 1.5 | 4  | 16 | 2  | 16 | 7.5  | 1.75 |
| SMD-6 | 9.15 | 0.3 | 4.45 | 10.4 | 1.5 | 1.5 | 4  | 16 | 2  | 16 | 11.5 | 1.75 |
| SMD-8 | 9.9  | 0.3 | 4    | 10.6 | 1.5 | 1.5 | 4  | 16 | 2  | 16 | 7.5  | 1.75 |

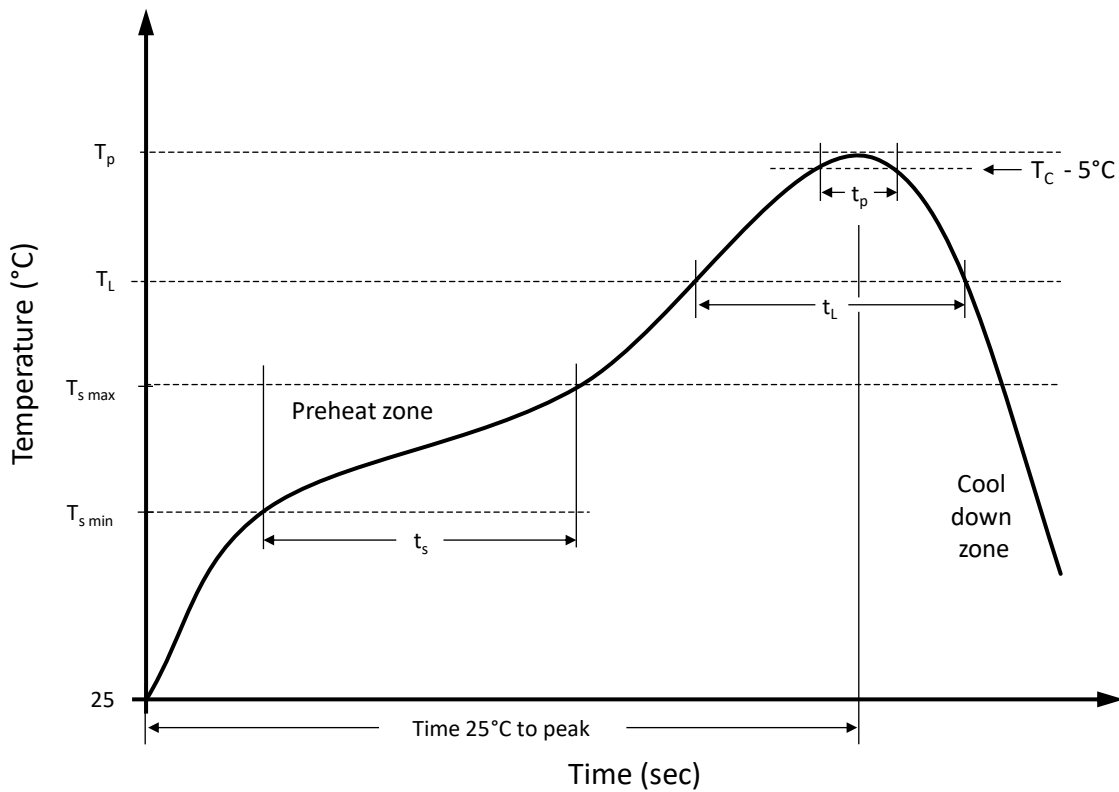
| Tape and Reel Packing | PCS/Reel |
|-----------------------|----------|
| SMD-4                 | 1000     |
| SMD-6                 | 1000     |
| SMD-8                 | 1000     |
| SOP-4                 | 1000     |
| SOP-8                 | 1000     |

| Tube Packing | PCS/Tube | Tubes/Box | Units/Box |
|--------------|----------|-----------|-----------|
| DIP-4        | 90       | 30        | 2700      |
| DIP-6        | 50       | 30        | 1500      |
| DIP-8        | 45       | 30        | 1350      |
| SMD-4        | 90       | 30        | 2700      |
| SMD-6        | 50       | 30        | 1500      |
| SMD-8        | 45       | 30        | 1350      |
| SOP-4        | 100      | 30        | 3000      |
| SOP-8        | 50       | 30        | 1500      |

## STORAGE AND HANDLING CONDITIONS

| ESD level   | Floor life | Conditions                            | MSL |
|-------------|------------|---------------------------------------|-----|
| HBM class 2 | Unlimited  | $T_A < 30^{\circ}\text{C}$ , RH < 85% | 1   |

## RECOMMENDED REFLOW SOLDERING PROFILE ▲ SMD PACKAGE

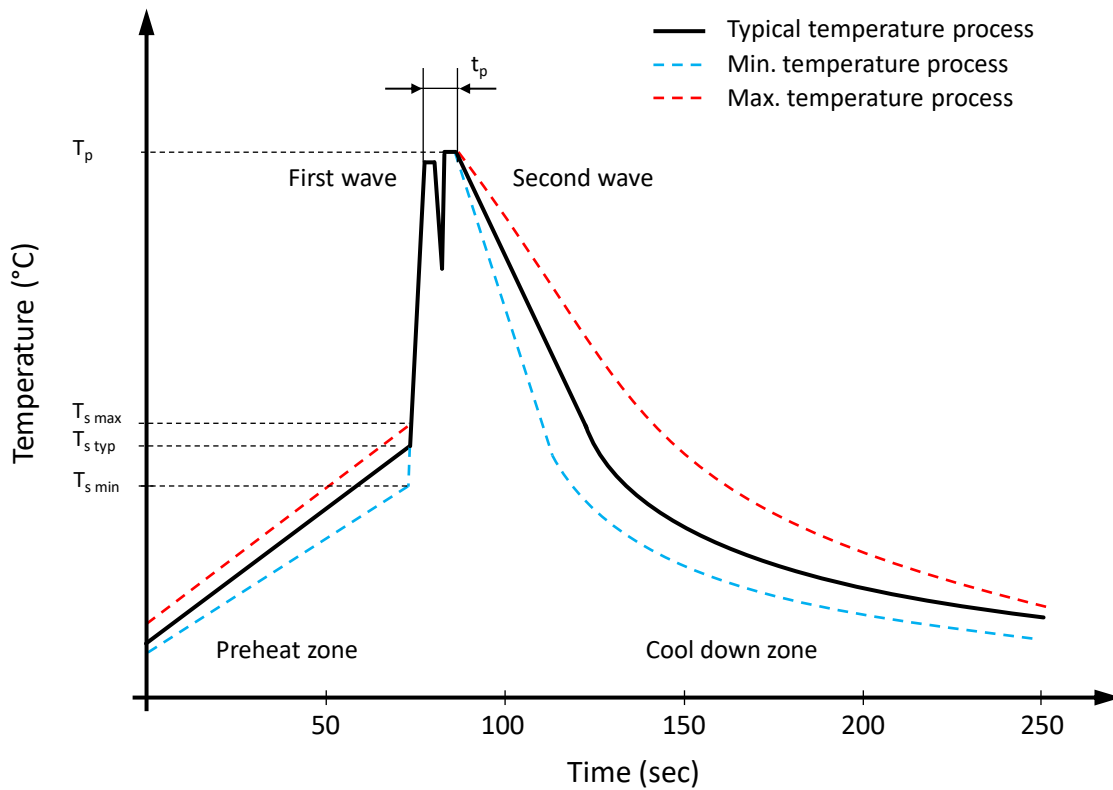


### Recommended reflow soldering conditions ▲ Refer to JEDEC J-STD-020E

| Profile Features                                                         |              | Sn-Pb Eutetic Assembly | Pb-Free Assembly |
|--------------------------------------------------------------------------|--------------|------------------------|------------------|
| Preheat temperature min.                                                 | $T_{s \min}$ | 100 °C                 | 150 °C           |
| Preheat temperature max.                                                 | $T_{s \max}$ | 150 °C                 | 200 °C           |
| Preheat time $t_s$ from $T_{s \min}$ to $T_{s \max}$                     | $t_s$        | 120 seconds            | 120 seconds      |
| Ramp-up rate ( $T_L$ to $T_p$ )                                          |              | max. 3 °C/second       | max. 3 °C/second |
| Liquidous temperature                                                    | $T_L$        | 183 °C                 | 217 °C           |
| Time $t_L$ maintained above $T_L$                                        | $t_L$        | 150 seconds max.       | 60 seconds max.  |
| Peak package body temperature                                            | $T_p$        | 235°C                  | 260°C            |
| Timeframe of within 5°C below and up to max actual peak body temperature | $t_p$        | 20 seconds max.        | 30 seconds max.  |
| Ramp-down rate ( $T_L$ to $T_p$ )                                        |              | max. 6 °C/second       | max. 6 °C/second |
| Time 25°C to peak temperature                                            |              | max. 6 minutes         | max. 8 minutes   |



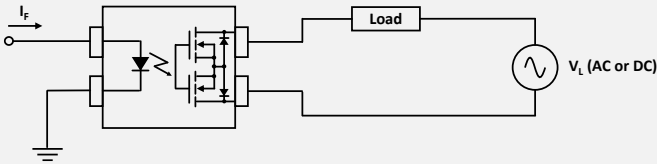
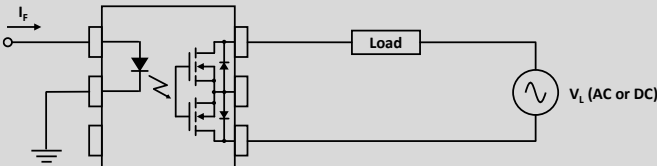
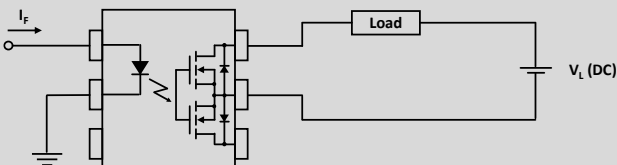
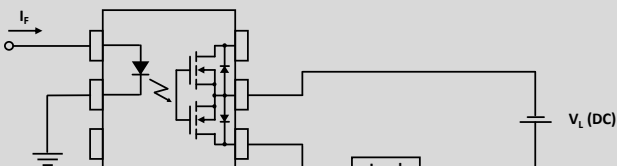
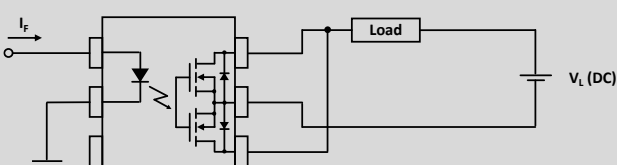
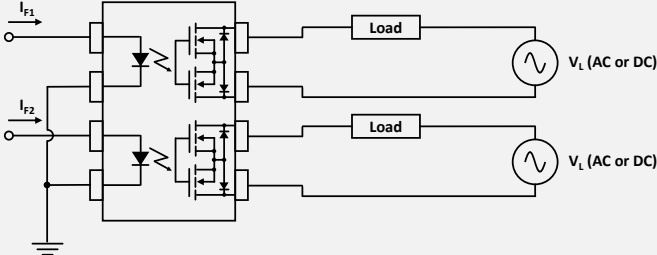
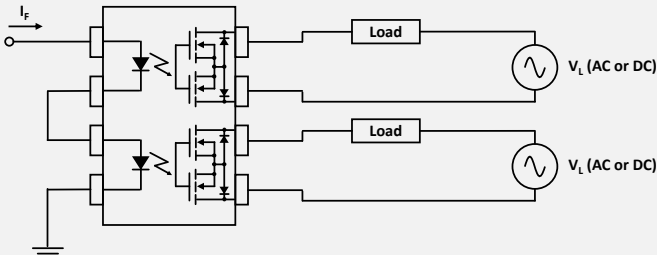
## RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE



### Classification wave soldering profile ▲ Refer to EN 61760-1: 2006

| Profile Features                                                          |                    | Value ▲ Sn-Pb Assembly                     | Value ▲ Pb-free Assembly                   |
|---------------------------------------------------------------------------|--------------------|--------------------------------------------|--------------------------------------------|
| Preheat temperature min.                                                  | T <sub>s min</sub> | 100 °C                                     | 100 °C                                     |
| Preheat temperature typical                                               | T <sub>s typ</sub> | 120 °C                                     | 120 °C                                     |
| Preheat temperature max.                                                  | T <sub>s max</sub> | 130 °C                                     | 130 °C                                     |
| Preheat time t <sub>s</sub> from T <sub>s min</sub> to T <sub>s max</sub> | t <sub>s</sub>     | 70 seconds                                 | 70 seconds                                 |
| Peak temperature                                                          | T <sub>p</sub>     | 235 °C to 260 °C                           | 245 °C to 260 °C                           |
| Time of actual peak temperature                                           | t <sub>p</sub>     | Max. 10 seconds<br>Max. 5 second each wave | Max. 10 seconds<br>Max. 5 second each wave |
| Ramp-down rate min.                                                       |                    | ~ 2 °C/second                              | ~ 2 °C/second                              |
| Ramp-down rate typical                                                    |                    | ~ 3.5 °C/second                            | ~ 3.5 °C/second                            |
| Ramp-down rate max.                                                       |                    | ~ 5 °C/second                              | ~ 5 °C/second                              |
| Time 25°C to 25°C                                                         |                    | 4 minutes                                  | 4 minutes                                  |

## LOAD CONNECTING METHOD

| Type   | Load     |          | Connection                                                                           | Feature                                                                 |
|--------|----------|----------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 4 pins | AC or DC |          |    | Control bi-directional signal                                           |
| 6 pins | A        | AC or DC |    | Control bi-directional signal                                           |
|        | B        | DC       |   | On-resistance is 1/2 of A-connection<br>2-Make-contacts (Source Common) |
|        |          |          |  |                                                                         |
|        | C        | DC       |  | On-Resistance is 1/2 of B-connection                                    |
| 8 pins | AC or DC |          |  | 2 input and 2 output                                                    |
|        |          |          |  | 1 input and 2 output                                                    |

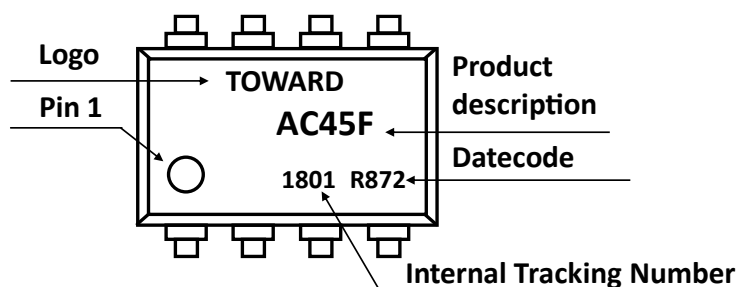
## PRODUCT CODE

Example: AC45F series ▲ 2 Form A ▲ 60V ▲ SMD-8 ▲ Tape & Reel

| AC      |                  | 45     |     | -              |                             | F               |                   | R1          |              |
|---------|------------------|--------|-----|----------------|-----------------------------|-----------------|-------------------|-------------|--------------|
| Package |                  | Series |     | Special Suffix |                             | Type            |                   | Packing     |              |
| AA      | 6 Pin ▲ 1 Form A | 45     | 60V | Blank<br>H     | Standard<br>High Insulation | Blank<br>F<br>S | DIP<br>SMD<br>SOP | Blank<br>R1 | Tube<br>Reel |
| AB      | 4 Pin ▲ 1 Form A |        |     |                |                             |                 |                   |             |              |
| AC      | 8 Pin ▲ 2 Form A |        |     |                |                             |                 |                   |             |              |

## PRODUCT MARKING

Example: AC45F series ▲ 2 Form A ▲ 60V ▲ SMD-8 ▲ Tape & Reel



## DATE CODE

Example: R872

| R                        |                | 8    |      | 7     |     | 2                 |                 |
|--------------------------|----------------|------|------|-------|-----|-------------------|-----------------|
| Material Characteristics |                | Year |      | Month |     | Week of the Month |                 |
| R                        | RoHS compliant | 8    | 2018 | 1     | Jan | 1                 | 1 <sup>st</sup> |
|                          |                | 9    | 2019 | 2     | Feb |                   | 2 <sup>nd</sup> |
|                          |                | A    | 2020 | 3     | Mar |                   | 3 <sup>rd</sup> |
|                          |                | B    | 2021 | 4     | Apr |                   | 4 <sup>th</sup> |
| H                        | Halogen free   | C    | 2022 | 5     | May | 2                 | 1 <sup>st</sup> |
|                          |                | ...  | ...  | ...   | ... |                   | 2 <sup>nd</sup> |
|                          |                | G    | 2026 | 12    | Dec |                   | 3 <sup>rd</sup> |
|                          |                |      |      |       |     |                   | 4 <sup>th</sup> |

## RELIABILITY TESTS ▲ STANDARD

Standard: JESD22-A

| No. | Test                                                    | Test Specification                                                                                                                                                                                       | Test Standard | Test Limits                                                  |
|-----|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------|
| 1   | Moisture Sensitivity Level Test                         | Bake condition: Temperature: 125°C; Duration 24 hours<br>Soak condition: Temperature: 30°C; Humidity: 60% RH<br>Duration 192 hours<br>Reflow condition:<br>Peak temperature: 260°C<br>Duration: 3 cycles | JESD22-A113H  | No abnormal phenomenon was found.<br>Functional test passed. |
| 2   | High Temperature Storage Test                           | Temperature: 150°C<br>Duration: 500 hours                                                                                                                                                                | JESD22-A103E  | No abnormal phenomenon was found.<br>Functional test passed. |
| 3   | Temperature Cycling Test                                | Temperature range: -55°C to +125°C<br>-55°C for 30 minutes<br>+125°C for 30 minutes<br>Duration: 100 cycles with 1 cycle = 70 minutes                                                                    | JESD22-A104E  | No abnormal phenomenon was found.<br>Functional test passed. |
| 4   | Low Temperature Storage Test                            | Temperature: -40°C<br>Duration: 500 hours                                                                                                                                                                | JESD22-A119E  | No abnormal phenomenon was found.<br>Functional test passed. |
| 5   | Temperature & Humidity Storage Test                     | Temperature: 85°C<br>Humidity: 85% RH<br>Duration: 500 hours                                                                                                                                             | JESD22-A101D  | No abnormal phenomenon was found.<br>Functional test passed. |
| 6   | Highly Accelerated Temperature and Humidity Stress Test | Temperature: 130°C<br>Humidity: 85% RH<br>Duration: 96 hours                                                                                                                                             | JESD22-A-118B | No abnormal phenomenon was found.<br>Functional test passed. |

## REVISION TABLE

| Revision | Date       | Status          | Notes               |
|----------|------------|-----------------|---------------------|
| 001      | 01/10/2021 | Initial release | Initial publication |
|          |            |                 |                     |
|          |            |                 |                     |
|          |            |                 |                     |
|          |            |                 |                     |
|          |            |                 |                     |

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