电子元器件系列(中国.厦门)

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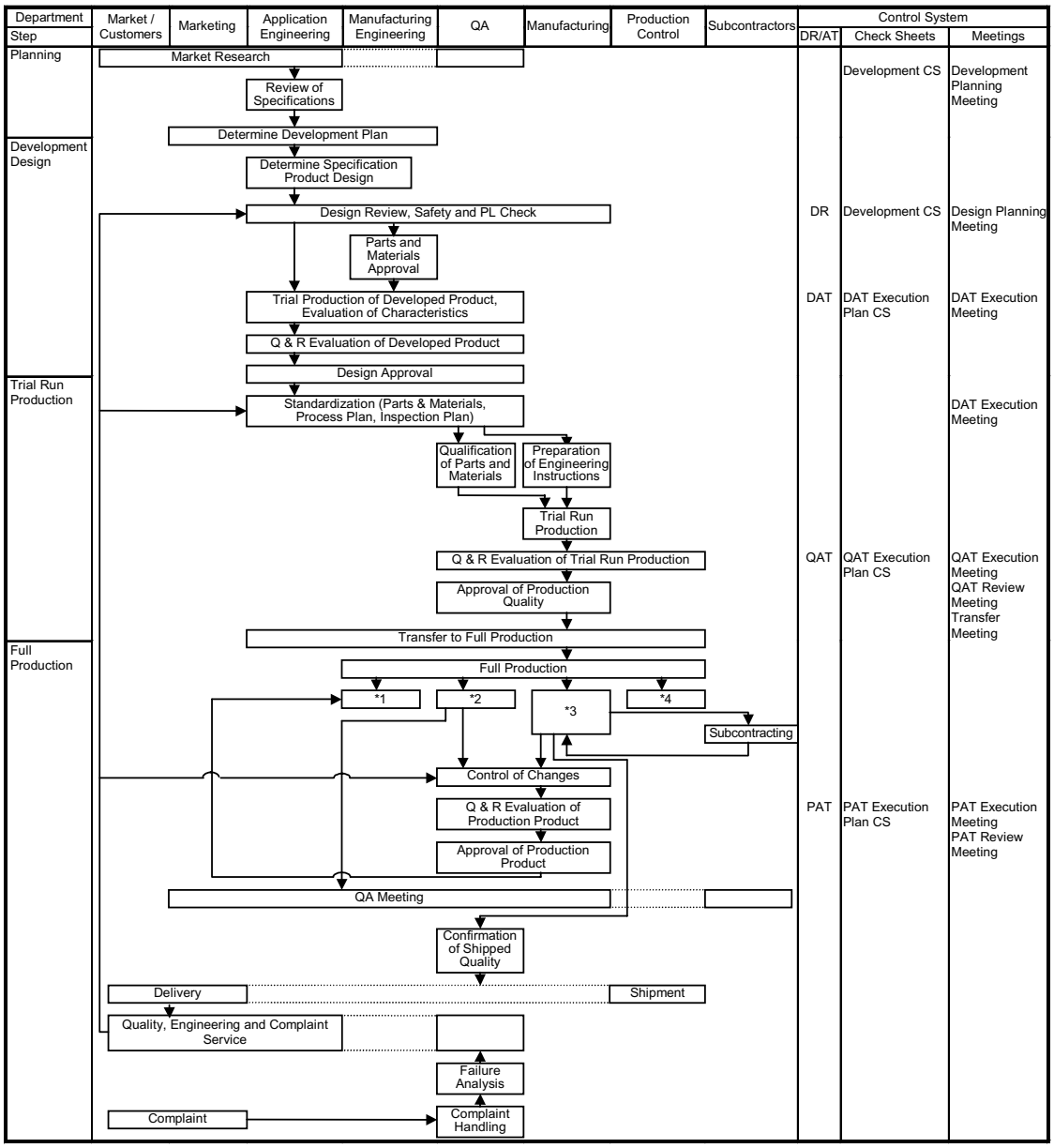


DR: Design Review
DAT: Design Approval Test
QAT: Quality Approval Test
CS: Check Sheet

***1 Improvement of Manufacturing Technology**
Promotion of Automatization
***2 Inspection of Incoming Parts**
Line Audit
Reliability Test
Measurement Control
Quality Training & Education
***3 Manufacturing Control**
Environmental Control
Facility Control
Assurance of Quality, Cost & Delivery
***4 Control of Delivery and Quantity**

Figure 1 Quality Assurance (QA) System of Procedural Flow

1.3 Reliability of Microcontrollers

For microcontroller products, reliability can be estimated within the following temperature range.

Tj = 0°C to 85°C

Tj (junction temperature) can be calculated using the following formula:

$Tj = Ta + Q \times \theta ja$

Ta: Operating environment temperature for the product [°C]
The operating environment temperature is the temperature of the surrounding environment. The thermal effects of the operation of the product are not taken into account.

Q: Average power consumption of the product [W]

θja: Thermal resistance of the package [°C / W]

Note 1:	When operating the device outside the range Tj = 0°C to 85°C for extended periods, please contact your nearest Toshiba office or authorized Toshiba dealer.
Note 2:	For details of the value of θja, please contact your nearest Toshiba office or authorized Toshiba dealer.

2 Handling Precautions for Microcontrollers

2.1 Mounting Precautions

Plastics have basically porous feature. When a chip (especially an SMD which has a thin plastic surface) is heated in a state of moisturized and is soldered by the reflow soldering method, moisture is vaporized as the temperature rises to cause a package expanded. Or a borderd surface between a lead frame and a plastic material is peeled off to cause a crack. These bring serious troubles on reliability.
In order to prevent hygroscopity or enable high heat treatment after absorbing moisture, Toshiba uses a dampproof packing and/or a heat proof tray.

(1) Recommended Methods of Soldering for Flat Packages

- Table 2.1 lists the recommended method of soldering flat packages. If you have any question or request, please refer to "IC PACKAGE MANUAL" or contact your local offices.
- For overall heating method, recommended mounting methods and conditions after opening the pack differ depending on products to be used. See Table 2.2 and 2.3 for the details.
- For locally heating a lead part, soldering iron method is recommended. For other localized heating methods, refer to "IC PACKAGE MANUAL" or contact your Toshiba local offices.

Table 2.1 Recommended soldering methods and precautions when mounting

Soldering method	Mounting method	Mounting precaution
Localized heating method	Soldering iron method	The recommended soldering conditions are as follows: (1) Standard: EIAJ ED-4701A-133 Environment test, soldering heat-resistance test (SMD) (2) Soldering method: Soldering (lead only) (3) Soldering condition: (a) at 350°C for up to 3 seconds. (b) at 260°C for up to 10 seconds.
Overall heating method	Wave soldering method (Solder flow)	(1) Apply preheating for 60 to 120 seconds at a temperature of 150°C. (2) For lead insertion-type packages, complete solder flow within 10 seconds with the temperature at the stopper (or, if there is no stopper, at a location more than 1.5 mm from the body) which does not exceed 260°C. (3) For surface-mount packages, complete soldering within 5 seconds at a temperature of 250°C or less in order to prevent thermal stress in the device. For details, contact your local Toshiba dealer.
	Short infrared reflow method	Because thermal stress is severe, as with solder dipping, the infrared reflow method is not recommended for some products. For details, contact your local Toshiba dealer.
	Far or middle infrared Hot air reflow	The recommended conditions for SMD reflow are as follows: (1) Standard: EIAJ ED-4701 A-133 Environment test (2) Soldering method: (a) Hot air reflow (with optional far or middle infrared reflow process) (b) Far or middle infrared reflow (3) Pre-heating: 140 to 160°C, for 60 to 120 seconds. (4) Reflow: (a) 240°C max (b) At more than 210°C, for 30 to 50 seconds. (5) Number of reflows: Maximum of two times within the allowable period of use The specified soldering temperatures are based on the temperature of the package surface. For a sample recommended temperature profile, refer to Figure 2.1.

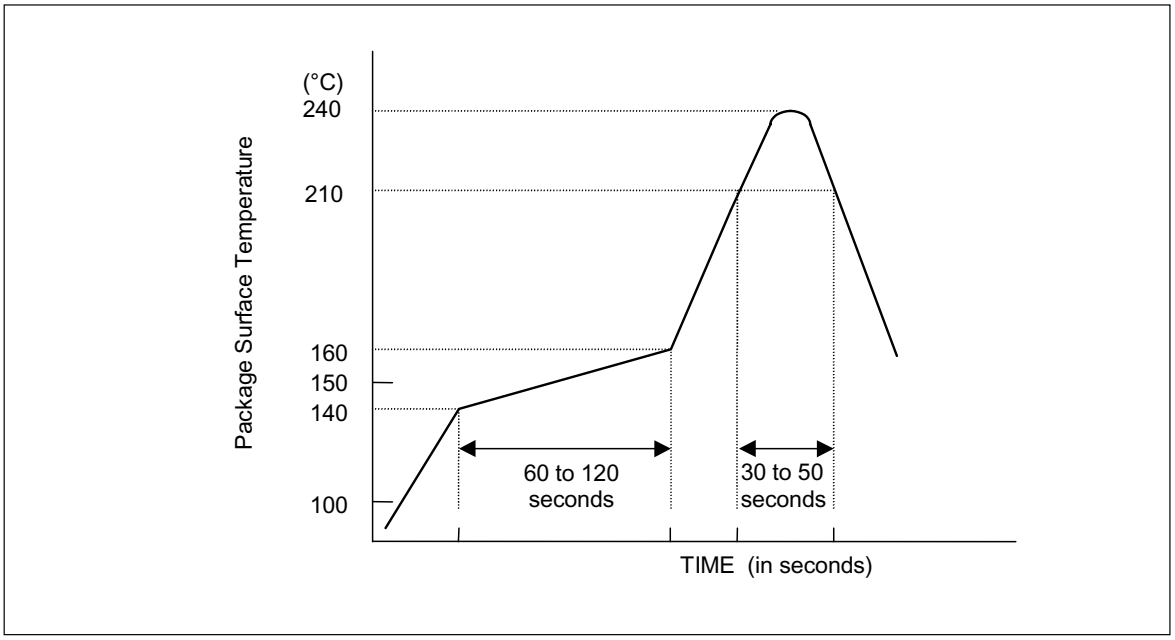


Figure 2.1 Sample recommended temperature profile for infrared or hot air reflow method

2.1.1 Precaution for Dry Pack

Figure 2.2 shows the tray type of the dry pack form. Precaution for handling dry pack products are as follows.

① Do not toss or drop to avoid damaging the devices and/or the moisture proof bag.

② Desiccant in the form of granulated silica gel includes blue indicator beads which become transparent when moisture is present, such as if the bag is torn or opened. In this case, the devices must be high temperature baked to remove the moisture prior to solder mounting.

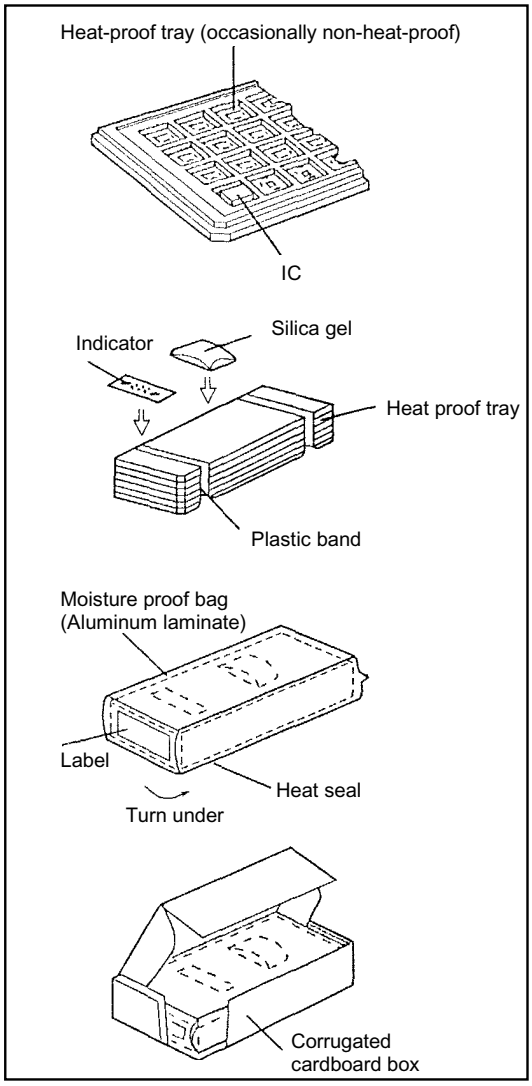
③ Store the pack at 30°C / 90%RH. After opening the pack mount it the device within 12 months of the date on the seal. If the 30% humidity indicator is entirely pink when the device unpacked, or when the 12-month duration has expired treat the device before use at high temperature (bake it at more than 125°C for 20h) to remove moisture.

④ How quickly a product should be used after the pack is opened depends of the product. See Tables 2-2 and 2-3 for details. If the time limit for use has expired when devices are unpacked, they should be baked.

⑤ Devices in heat-proof trays should be baked at 125°C for at least 20h.
Heat-proof trays bear the mold marking "HEAT PROOF" .
Be careful not to bend the leads when baking devices.

⑥ Binding trays using a plastic tapes
If trays are rebound with plastic tapes after having been untied, two tapes should be used as shown in Figure 2.2 (a). If a tape is tied lengthwise along the trays the tray edges may break.

(a) Method



(b) Shipping carton

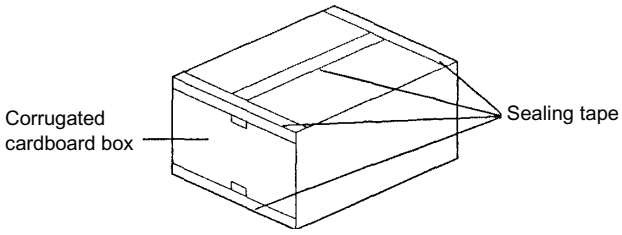


Figure 2.2 SMDs Dry pack Form

Table 2.2 Usable period after opening moisture proof bags

SYMBOL	Usable period after opening moisture proof bags
A = 168h	Products sealed in moisture proof packing should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 168 hours (1 week), after opened. If the products are kept beyond 168 hours (1 week) after opened, the products should be baked for at least 20 hours at 125°C before mounted. After baked, the products should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 192 hours.
B = 72h	Products sealed in moisture proof packing should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 72 hours (3 days), after opened. If the products are kept beyond 72 hours (3days) after opened, the products should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 96 hours (4 days).
C = 48h	Products sealed in moisture proof packing should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 48 hours (2 days), after opened. If the products are kept beyond 48 hours (2 days) after opened, the products should be baked for at least 20 hours at 125°C before mounted. After baked, the products should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 72 hours (3 days).
D = 24h	Products sealed in moisture proof packing should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 24 hours (1 day), after opened. If the products are kept beyond 24 hours (1 day) after opened, the products should be baked for at least 20 hours at 125°C before mounted. After baked, the products should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 48 hours (2 days).
E = 12h	Products sealed in moisture proof packing should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 12 hours, after opened. If the products are kept beyond 12 hours after opened, the products should be baked for at least 20 hours at 125°C before mounted. After baked, the products should be stored in temperature below 30°C and relative humidity below 60%, and should be used within 36 hours.
●	For the details, contact your Toshiba local offices.
—	Overall heating method is not recommended for mounting ; use soldering iron method of localized heating method.

(1) 900, 900/H, 900/L, 900/H2, 900/L1 Series

Table 2.3 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (1/2)

Products Name	Package no.	Air reflow	Infrared reflow
TMP96C141BF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP96C041BF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP96CM40F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP96PM40F	P-QFP80-1420-0.80B	—	—
TMP96C031ZF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP93CM40F	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP93CS40F	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP93CS41F	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP93PS40F	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP93CS40DF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93CS41DF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93PS40DF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93CW40DF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93CW41DF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93PW40DF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93CS42AF	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP93PS42AF	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP93CW46AF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP93PW46AF	P-LQFP100-1414-0.50D	C(48h)	C(48h)
TMP93CS44F	P-LQFP80-1212-0.50A	A(168h)	A(168h)
TMP93CS45F	P-LQFP80-1212-0.50A	A(168h)	A(168h)
TMP93PS44F	P-LQFP80-1212-0.50A	A(168h)	A(168h)
TMP93CU44DF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP93CW44DF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP93PW44ADF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP93CS32F	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP93PW32F	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP93CS20F	P-LQFP144-1616-0.40	A(168h)	A(168h)
TMP93PW20AF	P-LQFP144-1616-0.40	A(168h)	A(168h)
TMP93CT76F	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP93CU76F	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP93CW76F	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP93CF76F	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP93CF77F	P-QFP-100-1420-0.65A	A(168h)	A(168h)
TMP93PW76F	P-QFP100-1420-0.65A	B(72h)	B(72h)
TMP93PF76F	P-QFP100-1420-0.65A	●	●
TMP93C071F	P-QFP120-2828-0.80B	A(168h)	A(168h)
TMP95C061BF	P-QFP100-1414-0.50	A(168h)	A(168h)
TMP95C063F	P-QFP144-2020-0.50	A(168h)	A(168h)
TMP95C001F	P-QFP64-1414-0.80A	B(72h)	B(72h)
TMP95CS64F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95C265F	P-LQFP100-1414-0.50C	A(168h)	A(168h)

Note 1: As of September, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

Table 2.3 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (2/2)

Products Name	Package no.	Air reflow	Infrared reflow
TMP95CW64F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95CW65F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95PW64F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95FY64F	P-QFP100-1414-0.50E	A(168h)	A(168h)
TMP95CS66F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95CS54F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95PS54F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95CU54AF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95CW54AF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP95FW54AF	P-LQFP100-1414-0.50E	A(168h)	A(168h)
TMP94C241CF	P-QFP160-2828-0.65A	A(168h)	A(168h)
TMP94C251AF	P-QFP144-2020-0.50	A(168h)	A(168h)
TMP94FU81F	P-LQFP100-1414-0.50C	A(168h)	A(168h)
TMP91CW18AF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP91PW18AF	P-QFP80-1420-0.80B	●	●
TMP91CW12F	P-LQFP100-1414-0.50C	A(168h)	A(168h)
TMP91PW12F	P-LQFP100-1414-0.50C	B(72h)	B(72h)
TMP91CW12AF	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91FY12AF	P-LQFP100-1414-0.50E	A(168h)	A(168h)
TMP91CY22F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91FY22F	P-LQFP100-1414-0.50E	A(168h)	A(168h)
TMP91CU10F	P-LQFP100-1414-0.50C	A(168h)	A(168h)
TMP91PW10F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91CW11F	P-LQFP100-1414-0.50C	A(168h)	A(168h)
TMP91PW11F	P-LQFP100-1414-0.50C	●	●
TMP91C219F	P-LQFP100-1414-0.50B	A(168h)	A(168h)
TMP91C219F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91C829F	P-LQFP100-1414-0.50B	A(168h)	A(168h)
TMP91C829F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91C815F	P-TQFP128-1414-0.40	A(168h)	A(168h)
TMP91C016F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91C025F	P-LQFP100-1414-0.50D	A(168h)	A(168h)
TMP91C824F	P-LQFP100-1414-0.50D	A(168h)	A(168h)

Note 1: As of February, 2002

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E (12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(2) 90 Series

Table 2.4 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (1/2)

Products Name	Package no.	Air reflow	Infrared reflow
TMP90C840AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C841AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP91C640F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP91C641F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90CM40AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C041AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C141F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C441F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C802AM	P-SSOP40-450-0.80	A(168h)	A(168h)
TMP90C803AM	P-SSOP40-450-0.80	A(168h)	A(168h)
TMP90CH02M	P-SSOP40-450-0.80	A(168h)	A(168h)
TMP90CH03M	P-SSOP40-450-0.80	A(168h)	A(168h)
TMP90C400F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C401F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C800F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C801F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C844AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90CH44F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90C845AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90CH45F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90CM36F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90CM37F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90CM38F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90CM39F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90C051F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP90CS36F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90CS37F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90CS38F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90CS39F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90C848F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP91P640F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90PM40F	P-QFP64-1420-1.00A	—	—
TMP90P802AM	P-SSOP40-450-0.80	A(168h)	A(168h)
TMP90PH02M	P-SSOP40-450-0.80	A(168h)	A(168h)
TMP90P800F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90PH44F	P-QFP64-1420-1.00A	—	—
TMP90PM36F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90PM38F	P-QFP80-1414-0.65A	A(168h)	A(168h)
TMP90PS36F	P-QFP44-1414-0.65A	A(168h)	A(168h)
TMP90PS38F	P-QFP44-1414-0.65A	A(168h)	A(168h)

Note 1: As of September, 2001

Note 2: Ensure that the conditions for top/bottom heating using the long/medium infrared reflow method are strictly adhered to, even when this method is used in combination with the air reflow method.

Note 3: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

Table 2.4 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (2/2)

Products Name	Package no.	Air reflow	Infrared reflow
TMP90PH48F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP91P642F	P-QFP64-1420-1.00A	B(72h)	B(72h)
TMP91C642AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP90PM42F	P-QFP64-1420-1.00A	—	—
TMP90PM42DF	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP90CH42F	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP90CH42DF	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP90CK42F	P-QFP100-1420-0.65A	—	—
TMP90CK42DF	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP90PS74DF	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP90CM36T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CM37T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90PM36T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CM38T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CM39T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90PM38T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CS36T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CS37T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90PS36T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CS38T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90CS39T	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMP90PS38T	P-QFJ84-S115-1.27	A(168h)	A(168h)

Note 1: As of September, 2001

Note 2: Ensure that the conditions for top/bottom heating using the long/medium infrared reflow method are strictly adhered to, even when this method is used in combination with the air reflow method.

Note 3: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(3) 870 Series

Table 2.5 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (1/3)

Products Name	Air reflow	Infrared reflow
TMP87C800F	A(168h)	A(168h)
TMP87CH00F	A(168h)	A(168h)
TMP87PH00F	B(72h)	B(72h)
TMP87C800DF	A(168h)	A(168h)
TMP87CH00DF	A(168h)	A(168h)
TMP87CH00LF	A(168h)	A(168h)
TMP87PH00DF	B(72h)	B(72h)
TMP87PH00LF	A(168h)	A(168h)
TMP87C807U	A(168h)	A(168h)
TMP87C408M	A(168h)	A(168h)
TMP87C408LM	A(168h)	A(168h)
TMP87C808M	A(168h)	A(168h)
TMP87C808LM	A(168h)	A(168h)
TMP87C408DM	A(168h)	A(168h)
TMP87P808M	A(168h)	A(168h)
TMP87P808LM	A(168h)	A(168h)
TMP87C814F	A(168h)	A(168h)
TMP87CH14F	A(168h)	A(168h)
TMP87CK14F	A(168h)	A(168h)
TMP87CM14F	A(168h)	A(168h)
TMP87PM14F	B(72h)	B(72h)
TMP87CC20F	A(168h)	A(168h)
TMP87CH20F	A(168h)	A(168h)
TMP87PH20F	B(72h)	B(72h)
TMP87CK20AF	A(168h)	A(168h)
TMP87CM20AF	A(168h)	A(168h)
TMP87PM20F	B(72h)	B(72h)
TMP87CH21F	A(168h)	A(168h)
TMP87CH21BF	A(168h)	A(168h)
TMP87CH21DF	A(168h)	A(168h)
TMP87CH21BDF	A(168h)	A(168h)
TMP87CM21F	A(168h)	A(168h)
TMP87CM21DF	A(168h)	A(168h)
TMP87PP21F	B(72h)	B(72h)
TMP87PP21DF	A(168h)	A(168h)
TMP87CM23F	A(168h)	A(168h)
TMP87CP23F	A(168h)	A(168h)
TMP87PP23F	B(72h)	B(72h)
TMP87CM24AF	A(168h)	A(168h)
TMP87CP24AF	A(168h)	A(168h)
TMP87PP24AF	A(168h)	A(168h)
TMP87CH29U	A(168h)	A(168h)
TMP87CK29U	A(168h)	A(168h)
TMP87CM29U	A(168h)	A(168h)
TMP87PM29U	A(168h)	A(168h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

Table 2.5 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (2/3)

Products Name	Air reflow	Infrared reflow
TMP87CH38F	A(168h)	A(168h)
TMP87CK38F	A(168h)	A(168h)
TMP87CM38F	D(24h)	D(24h)
TMP87CP38F	D(24h)	D(24h)
TMP87CS38F	A(168h)	A(168h)
TMP87PS38F	—	—
TMP87CM39F	A(168h)	A(168h)
TMP87CP39F	A(168h)	A(168h)
TMP87CS39F	A(168h)	A(168h)
TMP87PS39F	—	—
TMPA8700CHF	A(168h)	A(168h)
TMPA8700CKF	A(168h)	A(168h)
TMPA8700CMF	A(168h)	A(168h)
TMPA8700CPF	A(168h)	A(168h)
TMPA8700CSF	A(168h)	A(168h)
TMPA8700PSF	—	—
TMPA8701CHF	A(168h)	A(168h)
TMPA8701CKF	A(168h)	A(168h)
TMPA8701CMF	A(168h)	A(168h)
TMP87C840F	A(168h)	A(168h)
TMP87CC40F	A(168h)	A(168h)
TMP87CH40F	A(168h)	A(168h)
TMP87PH40AF	B(72h)	B(72h)
TMP87CK40AF	A(168h)	A(168h)
TMP87CK40F	A(168h)	A(168h)
TMP87CM40AF	A(168h)	A(168h)
TMP87PM40AF	B(72h)	B(72h)
TMP87C841F	A(168h)	A(168h)
TMP87CC41F	A(168h)	A(168h)
TMP87CH41F	A(168h)	A(168h)
TMP87CK41F	A(168h)	A(168h)
TMP87CM41F	A(168h)	A(168h)
TMP87PM41F	A(168h)	A(168h)
TMP87C841U	A(168h)	A(168h)
TMP87CC41U	A(168h)	A(168h)
TMP87CH41U	A(168h)	A(168h)
TMP87CK41U	A(168h)	A(168h)
TMP87CM41U	A(168h)	A(168h)
TMP87PM41U	A(168h)	A(168h)
TMP87C447U	A(168h)	A(168h)
TMP87C847U	A(168h)	A(168h)
TMP87C847LU	A(168h)	A(168h)
TMP87CH47U	A(168h)	A(168h)
TMP87CH47LU	A(168h)	A(168h)
TMP87PH47U	A(168h)	A(168h)
TMP87PH47LU	A(168h)	A(168h)
TMP87CH48U	A(168h)	A(168h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

Table 2.5 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (3/3)

Products Name	Air reflow	Infrared reflow
TMP87CH48DF	A(168h)	A(168h)
TMP87PH48U	A(168h)	A(168h)
TMP87PH48DF	A(168h)	A(168h)
TMP87CM53F	A(168h)	A(168h)
TMP87PM53F	A(168h)	A(168h)
TMP87CM64F	A(168h)	A(168h)
TMP87CP64F	A(168h)	A(168h)
TMP87CS64F	A(168h)	A(168h)
TMP87PS64F	A(168h)	A(168h)
TMP87CS68DF	●	●
TMP87PS68DF	A(168h)	A(168h)
TMP87CC70F	A(168h)	A(168h)
TMP87CH70F	A(168h)	A(168h)
TMP87CK70AF	A(168h)	A(168h)
TMP87CM70AF	A(168h)	A(168h)
TMP87CH70BF	A(168h)	A(168h)
TMP87CM70BF	A(168h)	A(168h)
TMP87PM70F	B(72h)	B(72h)
TMP87CM71F	A(168h)	A(168h)
TMP87CN71F	A(168h)	A(168h)
TMP87CP71F	A(168h)	A(168h)
TMP87CS71F	A(168h)	A(168h)
TMP87PS71F	B(72h)	B(72h)
TMP87CH74AF	A(168h)	A(168h)
TMP87CM74AF	A(168h)	A(168h)
TMP87PM74F	B(72h)	B(72h)
TMP87CH75F	A(168h)	A(168h)
TMP87CM75F	A(168h)	A(168h)
TMP87PM75F	A(168h)	A(168h)
TMP87CC78F	A(168h)	A(168h)
TMP87CH78F	A(168h)	A(168h)
TMP87CK78F	A(168h)	A(168h)
TMP87CM78F	A(168h)	A(168h)
TMP87PM78F	A(168h)	A(168h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(4) 870/C Series

Table 2.6 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method

Products Name	Package no.	Air reflow	Infrared reflow
TMP86CH06U	P-QFP44-1010-0.80	A(168h)	A(168h)
TMP86PH06U	P-QFP44-1010-0.80	A(168h)	A(168h)
TMP86C420F	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86C420U	P-LQFP64-1010-0.50	A(168h)	A(168h)
TMP86C820F	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86C820U	P-LQFP64-1010-0.50	A(168h)	A(168h)
TMP86C829AF	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86C829AU	P-LQFP64-1010-0.50	A(168h)	A(168h)
TMP86CH29AF	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86CH29AU	P-LQFP64-1010-0.50	A(168h)	A(168h)
TMP86CM29AF	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86CM29AU	P-LQFP64-1010-0.50	A(168h)	A(168h)
TMP86PM29AF	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86PM29AU	P-LQFP64-1010-0.50	A(168h)	A(168h)
TMP86CM41F	P-QFP64-1414-0.80A	A(168h)	A(168h)
TMP86FS41F	P-QFP64-1414-0.80B	A(168h)	A(168h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(5) 870/X Series

Table 2.7 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method

Products Name	Package no.	Air reflow	Infrared reflow
TMP88CK48F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP88CM48F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP88CS48AF	P-QFP64-1420-1.00A	B(72h)	B(72h)
TMP88CK49F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP88CM49F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP88PS49F	P-QFP64-1420-1.00A	B(72h)	B(72h)
TMP88C060F	P-LQFP80-1212-0.50A	A(168h)	A(168h)
TMP88CU74F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP88PU74F	P-QFP80-1420-0.80B	B(72h)	B(72h)
TMP88CP76F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP88CS76F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP88PS76F	P-QFP80-1420-0.80B	B(72h)	B(72h)
TMP88CP77F	P-QFP100-1420-0.65A	B(72h)	B(72h)
TMP88CS77F	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP88PU77F	P-QFP100-1420-0.65A	B(72h)	B(72h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(6) 47 Series

Table 2.8 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (1/3)

Products Name	Package no.	Air reflow	Infrared reflow
TMP47C101M	P-SOP16-300-1.27	A(168h)	A(168h)
TMP47C201M	P-SOP16-300-1.27	A(168h)	A(168h)
TMP47C102M	P-SOP20-300-1.27	A(168h)	A(168h)
TMP47C202M	P-SOP20-300-1.27	A(168h)	A(168h)
TMP47P202VM	P-SOP20-300-1.27	A(168h)	A(168h)
TMP47C103M	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47C203M	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47C206M	P-SOP20-300-1.27	A(168h)	A(168h)
TMP47P206VM	P-SOP20-300-1.27	A(168h)	A(168h)
TMP47C241VM	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47P241VM	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47P403VM	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47C222F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C422F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P422VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C243M	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47C243DM	P-SSOP30-56-0.65	A(168h)	A(168h)
TMP47C443M	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47C443DM	P-SSOP30-56-0.65	A(168h)	A(168h)
TMP47P443VM	P-SOP28-450-1.27	A(168h)	A(168h)
TMP47P443VDM	P-SSOP30-56-0.65	A(168h)	A(168h)
TMP47E186M	P-SOP16-300-1.27	C(48h)	C(48h)
TMP47E187M	P-SOP16-300-1.27	C(48h)	C(48h)
TMP47P186M	P-SOP16-300-1.27	C(48h)	C(48h)
TMP47P187M	P-SOP16-300-1.27	C(48h)	C(48h)
TMP47E885AIF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47E885AWF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P885F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C200BF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C400BF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P400VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C407AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P407VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C210AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C410AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P410AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C216F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C416F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P416VF	P-QFP44-1414-0.80D	D(24h)	D(24h)
TMP47C221ADF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C421ADF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47P421ADF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C423ADF	P-QFP64-1420-1.00A	A(168h)	A(168h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

Table 2.8 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (2/3)

Products Name	Package no.	Air reflow	Infrared reflow
TMP47C440BF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P440VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C441AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P441AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C446ADF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47P446VDF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C452BF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P452VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C453AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P453VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C456ADF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C434AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C634AF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C800F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P800F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C620DF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C820DF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47P820VDF	P-QFP80-1420-0.80B	—	—
TMP47C623F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C823F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47P823VF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C834F	P-QFP44-1414-0.80D	—	—
TMP47P834F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C640F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C840F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P840VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C647F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C847F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47P847VF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C850F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47P850VF	P-QFP64-1420-1.00A	B(72h)	B(72h)
TMP47C853F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P853VF	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C857F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C457F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47P857F	P-QFP44-1414-0.80D	A(168h)	A(168h)
TMP47C655F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C855F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47P855VF	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C858F	P-QFP100-1420-0.65A	A(168h)	A(168h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

Table 2.8 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method (3/3)

Products Name	Package no.	Air reflow	Infrared reflow
TMP47C660AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C860AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47P860VF	P-QFP64-1420-1.00A	●	●
TMP47C1220F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47C1620F	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP47P1620VF	P-QFP80-1420-0.80B	B(72h)	B(72h)
TMP47C1260F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47C1660F	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMP47P1660VF	P-QFP64-1420-1.00A	B(72h)	B(72h)

Note 1: As of March, 2001

Note 2: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(7) 68000 Series

Table 2.9 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method

Products Name	Package no.	Air reflow	Infrared reflow
TMP68301AF-xx	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP68301AKF-xx	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP68303DF-xx	P-QFP100-2222-0.80A	●	A(168h)
TMP68305F-xx	P-QFP100-2222-0.80A	A(168h)	A(168h)
TMP68301AFR-xx	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP68301AKFR-xx	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMP68HC003F-xx	P-QFP80-1420-0.80B	A(168h)	A(168h)
TMP68204F-xx	P-QFP160-2828-0.65A	●	A(168h)

Note 1: As of February, 1998

Note 2: Ensure that the conditions for top/bottom heating using the long/medium infrared reflow method are strictly adhered to, even when this method is used in combination with the air reflow method.

Note 3: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

(8) Z80 Series

Table 2.10 Storage conditions, permissible usage Period after unpacking and baking requirements for each soldering method

Products Name	Package no.	Air reflow	Infrared reflow
TMPZ84C011BF	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMPZ84C015BF	P-QFP100-1420-0.65A	A(168h)	A(168h)
TMPZ84C013AT	P-QFJ84-S115-1.27	A(168h)	A(168h)
TMPZ84C112AF	P-QFP64-1420-1.00A	A(168h)	A(168h)
TMPZ84C711AF	P-QFP144-2626-0.65B	A(168h)	A(168h)
TMPZ84C810AF	P-QFP100-1420-0.65A	A(168h)	A(168h)

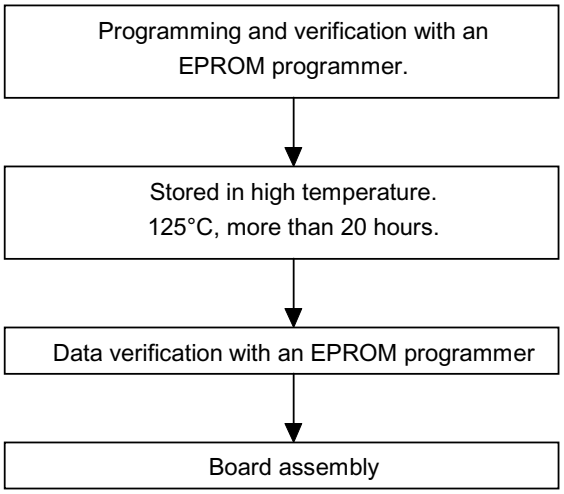
Note 1: As of September, 1994

Note 2: Ensure that the conditions for top/bottom heating using the long/medium infrared reflow method are strictly adhered to, even when this method is used in combination with the air reflow method.

Note 3: Symbols A (168h), B (72h), C (48h), D (24h), E(12h), ● and — indicate the maximum permissible period between unpacking and mounting of the device, and the required storage conditions for the device. For details of these conditions, please refer to Table 2.2.

2.1.2 Writing an OTP type Microcontrollers-Recommended Flow

In the case of blank OTP (One Time PROM) type MCU, it is not completely possible to screen defect parts that occur during assembly process, because it is not possible to perform programming test after a chip is assembled in a plastic package.
As a result, it is recommended to do the following screening process to maintain quality and reliability of OTP type MCU after data are programmed.



For details of the initial failure rate of OTP-type microcontrollers when screening is not performed at 125°C for 20 hours or more after programming, please contact your Toshiba local offices.

Figure 2.3 Recommended Screening flow chart of type MCU

2.2 Transport Precautions

The device and its packaging material should be handled with care. To avoid damage to the device, do not toss or drop it. During transport, ensure that the device is not subjected to mechanical vibration or shock.

Avoid getting devices wet. Moisture can also adversely affect the packaging by nullifying the effect of the anti-static agent.

2.3 Using Toshiba Semiconductor Safely

TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.

In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..

The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.

2.4 Product-Specific Precautions and Usage Considerations

2.4.1 Using Resonators not Listed Under "Recommended Types"

Resonators recommended for use with Toshiba products in microcontroller oscillator applications are listed in Toshiba databooks along with information about oscillation conditions. If you use a resonator not included in this list, please consult Toshiba or the resonator manufacturer concerning the suitability of the device for your application.

2.4.2 Undefined Functions

In some microcontrollers certain instruction code values do not constitute valid processor instructions. Also, it is possible that the values of bits in registers will become undefined. Take care in your applications not to use invalid instructions or to let register bit values become undefined.

2.4.3 Injuries from Probe Tips

Some probes and adapters have sharp pointed leads. Be careful not to injure yourself on the leads of devices.

3 Safety Precautions

This section lists important precautions which users of semiconductor devices (and anyone else) should observe in order to avoid injury and damage to property, and to ensure safe and correct use of devices.
Please be sure that you understand the meanings of the labels and the graphic symbol described below before you move on to the detailed descriptions of the precautions.

[Explanation of labels]

Graphic symbol	Meaning
⚠DANGER	Indicates an imminently hazardous situation which will result in death or serious injury if you do not follow instructions.
⚠WARNING	Indicates a potentially hazardous situation which could result in death or serious injury if you do not follow instructions.
⚠CAUTION	Indicates a potentially hazardous situation which if not avoided, may result in minor injury or moderate injury.

[Explanation of graphic symbol]

Graphic symbol	Meaning
	Indicates that caution is required (laser beam is dangerous to eyes).

3.1 General Precautions Regarding Semiconductor Devices

⚠CAUTION
Do not use devices under conditions exceeding their absolute maximum ratings (e.g. current, voltage, power dissipation or temperature). This may cause the device to break down, degrade its performance, or cause it to catch fire or explode, resulting in injury. Do not insert devices in the wrong orientation. Make sure that the positive and negative terminals of power supplies are connected correctly. Otherwise the rated maximum current or power dissipation may be exceeded and the device may break down or undergo performance degradation, causing it to catch fire or explode and resulting in injury. When power to a device is on, do not touch the device's heat sink. Heat sinks become hot, so you may burn your hand. Do not touch the tips of device leads. Because some types of device have leads with pointed tips, you may prick your finger. When conducting any kind of evaluation, inspection or testing, be sure to connect the testing equipment's electrodes or probes to the pins of the device under test before powering it on. Otherwise, you may receive an electric shock causing injury. Before grounding an item of measuring equipment or a soldering iron, check that there is no electrical leakage from it. Electrical leakage may cause the device which you are testing or soldering to break down, or could give you an electric shock. Always wear protective glasses when cutting the leads of a device with clippers or a similar tool. If you do not, small bits of metal flying off the cut ends may damage your eyes.

4 General Safety Precautions and Usage Considerations

This section is designed to help you gain a better understanding of semiconductor devices, so as to ensure the safety, quality and reliability of the devices which you incorporate into your designs.

4.1 From Incoming to Shipping

4.1.1 Electrostatic Discharge (ESD)

When handling individual devices (which are not yet mounted on a printed circuit board), be sure that the environment is protected against electrostatic electricity. Operators should wear anti-static clothing, and containers and other objects which come into direct contact with devices should be made of anti-static materials and should be grounded to earth via an 0.5- to 1.0-MΩ protective resistor.

Please follow the precautions described below; this is particularly important for devices which are marked “Be careful of static.”.

4.1.1.1 Work Environment

(1) When humidity in the working environment decreases, the human body and other insulators can easily become charged with static electricity due to friction. Maintain the recommended humidity of 40% to 60% in the work environment, while also taking into account the fact that moisture-proof-packed products may absorb moisture after unpacking.

(2) Be sure that all equipment, jigs and tools in the working area are grounded to earth.

(3) Place a conductive mat over the floor of the work area, or take other appropriate measures, so that the floor surface is protected against static electricity and is grounded to earth. The surface resistivity should be 10^4 to 10^8 Ω/sq and the resistance between surface and ground, 7.5×10^5 to 10^8 Ω.

(4) Cover the workbench surface also with a conductive mat (with a surface resistivity of 10^4 to 10^8 Ω/sq, for a resistance between surface and ground of 7.5×10^5 to 10^8 Ω). The purpose of this is to disperse static electricity on the surface (through resistive components) and ground it to earth. Workbench surfaces must not be constructed of low-resistance metallic materials that allow rapid static discharge when a charged device touches them directly.

(5) Pay attention to the following points when using automatic equipment in your workplace:
   (a) When picking up ICs with a vacuum unit, use a conductive rubber fitting on the end of the pick-up wand to protect against electrostatic charge.
   (b) Minimize friction on IC package surfaces. If some rubbing is unavoidable due to the device's mechanical structure, minimize the friction plane or use material with a small friction coefficient and low electrical resistance. Also consider the use of an ionizer.
   (c) In sections that come into contact with device lead terminals, use a material which dissipates static electricity.
   (d) Ensure that no statically charged bodies (such as work clothes or the human body) touch the devices.
   (e) Make sure that sections of the tape carrier which come into contact with installation devices or other electrical machinery are made of a low-resistance material.
   (f) Make sure that jigs and tools used in the assembly process do not touch devices.
   (g) In processes in which packages may retain an electrostatic charge, use an ionizer to neutralize the ions.

(6) Make sure that CRT displays in the working area are protected against static charge, for example by a VDT filter. As much as possible, avoid turning displays on and off. Doing so can cause electrostatic induction in devices.

(7) Keep track of charged potential in the working area by taking periodic measurements.

(8) Ensure that work chairs are protected by an anti-static textile cover and are grounded to the floor surface by a grounding chain. (Suggested resistance between the seat surface and grounding chain is 7.5×10^5 to 10^{12} Ω.)

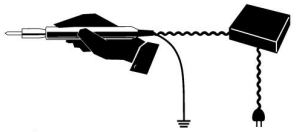
(9) Install anti-static mats on storage shelf surfaces. (Suggested surface resistivity is 10^4 to 10^8 Ω/sq; suggested resistance between surface and ground is 7.5×10^5 to 10^8 Ω.)

(10) For transport and temporary storage of devices, use containers (boxes, jigs or bags) that are made of anti-static materials or materials which dissipate electrostatic charge.

(11) Make sure that cart surfaces which come into contact with device packaging are made of materials which will conduct static electricity, and verify that they are grounded to the floor surface via a grounding chain.

(12) In any location where the level of static electricity is to be closely controlled, the ground resistance level should be Class 3 or above. Use different ground wires for all items of equipment which may come into physical contact with devices.

4.1.1.2 Operating Environment



(1) Operators must wear anti-static clothing and conductive shoes (or a leg or heel strap).

(2) Operators must wear a wrist strap grounded to earth via a resistor of about 1 MΩ.

(3) Soldering irons must be grounded from iron tip to earth, and must be used only at low voltages (6 V to 24 V).

(4) If the tweezers you use are likely to touch the device terminals, use anti-static tweezers and in particular avoid metallic tweezers. If a charged device touches a low-resistance tool, rapid discharge can occur. When using vacuum tweezers, attach a conductive chucking pat to the tip, and connect it to a dedicated ground used especially for anti-static purposes (suggested resistance value: 10^4 to 10^8 Ω).

(5) Do not place devices or their containers near sources of strong electrical fields (such as above a CRT).

(6) When storing printed circuit boards which have devices mounted on them, use a board container or bag that is protected against static charge. To avoid the occurrence of static charge or discharge due to friction, keep the boards separate from one other and do not stack them directly on top of one another.

(7) Ensure, if possible, that any articles (such as clipboards) which are brought to any location where the level of static electricity must be closely controlled are constructed of anti-static materials.

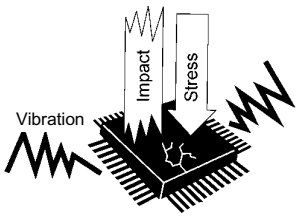
(8) In cases where the human body comes into direct contact with a device, be sure to wear anti-static finger covers or gloves (suggested resistance value: 10^8 Ω or less).

(9) Equipment safety covers installed near devices should have resistance ratings of 10^9 Ω or less.

(10) If a wrist strap cannot be used for some reason, and there is a possibility of imparting friction to devices, use an ionizer.

(11) The transport film used in TCP products is manufactured from materials in which static charges tend to build up. When using these products, install an ionizer to prevent the film from being charged with static electricity. Also, ensure that no static electricity will be applied to the product's copper foils by taking measures to prevent static occurring in the peripheral equipment.

4.1.2 Vibration, Impact and Stress



Handle devices and packaging materials with care. To avoid damage to devices, do not toss or drop packages. Ensure that devices are not subjected to mechanical vibration or shock during transportation. Ceramic package devices and devices in canister-type packages which have empty space inside them are subject to damage from vibration and shock because the bonding wires are secured only at their ends.

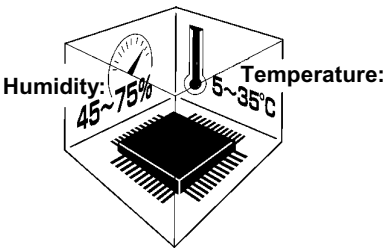
Plastic molded devices, on the other hand, have a relatively high level of resistance to vibration and mechanical shock because their bonding wires are enveloped and fixed in resin. However, when any device or package type is installed in target equipment, it is to some extent susceptible to wiring disconnections and other damage from vibration, shock and stressed solder junctions. Therefore when devices are incorporated into the design of equipment which will be subject to vibration, the structural design of the equipment must be thought out carefully.
If a device is subjected to especially strong vibration, mechanical shock or stress, the package or the chip itself may crack. In products such as CCDs which incorporate window glass, this could cause surface flaws in the glass or cause the connection between the glass and the ceramic to separate. Furthermore, it is known that stress applied to a semiconductor device through the package changes the resistance characteristics of the chip because of piezoelectric effects. In analog circuit design attention must be paid to the problem of package stress as well as to the dangers of vibration and shock as described above.

4.2 Storage

4.2.1 General Storage

(1) Avoid storage locations where devices will be exposed to moisture or direct sunlight.

(2) Follow the instructions printed on the device cartons regarding transportation and storage.



(3) The storage area temperature should be kept within a temperature range of 5°C to 35°C, and relative humidity should be maintained at between 45% and 75%.

(4) Do not store devices in the presence of harmful (especially corrosive) gases, or in dusty conditions.

(5) Use storage areas where there is minimal temperature fluctuation. Rapid temperature changes can cause moisture to form on stored devices, resulting in lead oxidation or corrosion. As a result, the solderability of the leads will be degraded.

(6) When repacking devices, use anti-static containers.

(7) Do not allow external forces or loads to be applied to devices while they are in storage.

(8) If devices have been stored for more than two years, their electrical characteristics should be tested and their leads should be tested for ease of soldering before they are used.

4.2.2 Moisture-Proof Packing

(1) Moisture-proof packing should be handled with care. The handling procedure specified for each packing type should be followed scrupulously. If the proper procedures are not followed, the quality and reliability of devices may be degraded. This section describes general precautions for handling moisture-proof packing. Since the details may differ from device to device, refer also to the relevant individual datasheets or databook.

(2) General precautions
Follow the instructions printed on the device cartons regarding transportation and storage.

(3) Do not drop or toss device packing. The laminated aluminum material in it can be rendered ineffective by rough handling.

(4) The storage area temperature should be kept within a temperature range of 5°C to 30°C, and relative humidity should be maintained at 90% (max). Use devices within 12 months of the date marked on the package seal.

(5) If the 12-month storage period has expired, or if the 30% humidity indicator shown in Figure 4.1 is pink when the packing is opened, it may be advisable, depending on the device and packing type, to back the devices at high temperature to remove any moisture. Please refer to the table below. After the pack has been opened, use the devices in a 5°C to 30°C. 60% RH environment and within the effective usage period listed on the moisture-proof package. If the effective usage period has expired, or if the packing has been stored in a high-humidity environment, bake the devices at high temperature.

Packing	Moisture removal
Tray	If the packing bears the “Heatproof” marking or indicates the maximum temperature which it can withstand, bake at 125°C for 20 hours. (Some devices require a different procedure.)
Tube	Transfer devices to trays bearing the “Heatproof” marking or indicating the temperature which they can withstand, or to aluminum tubes before baking at 125°C for 20 hours.
Tape	Deviced packed on tape cannot be baked and must be used within the effective usage period after unpacking, as specified on the packing.

When baking devices, protect the devices from static electricity.

Moisture indicators can detect the approximate humidity level at a standard temperature of 25°C. 6-point indicators and 3-point indicators are currently in use, but eventually all indicators will be 3-point indicators.

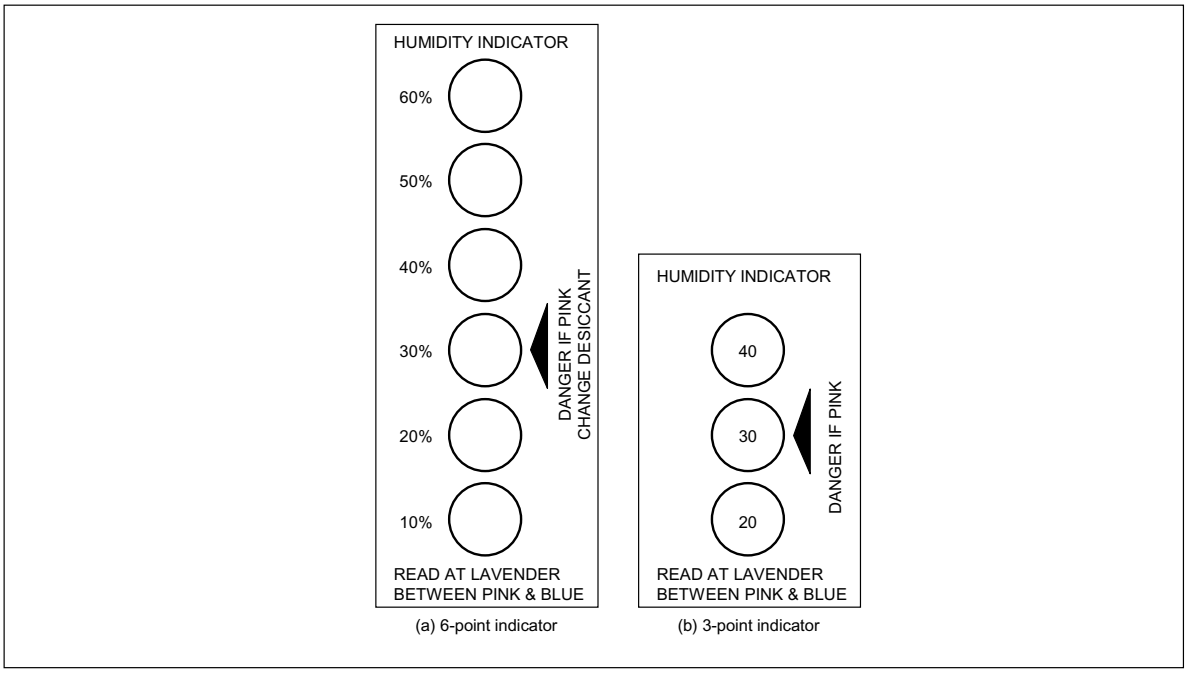


Figure 4.1 Humidity Indicator

4.3 Design

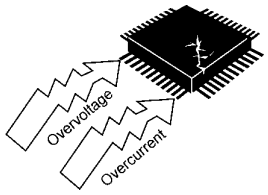
Care must be exercised in the design of electronic equipment to achieve the desired reliability. It is important not only to adhere to specifications concerning absolute maximum ratings and recommended operating conditions, it is also important to consider the overall environment in which equipment will be used, including factors such as the ambient temperature, transient noise and voltage and current surges, as well as mounting conditions which affect device reliability. This section describes some general precautions which you should observe when designing circuits and when mounting devices on printed circuit boards.

For more detailed information about each product family, refer to the relevant individual technical datasheets available from Toshiba.

4.3.1 Absolute Maximum Ratings

⚠CAUTION	Do not use devices under conditions in which their absolute maximum ratings (e.g. current, voltage, power dissipation or temperature) will be exceeded. A device may break down or its performance may be degraded, causing it to catch fire or explode resulting in injury to the user.

The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Although absolute maximum ratings differ from product to product, they essentially concern the voltage and current at each pin, the allowable power dissipation, and the junction and storage temperatures.



If the voltage or current on any pin exceeds the absolute maximum rating, the device's internal circuitry can become degraded. In the worst case, heat generated in internal circuitry can fuse wiring or cause the semiconductor chip to break down.

If storage or operating temperatures exceed rated values, the package seal can deteriorate or the wires can become disconnected due to the differences between the thermal expansion coefficients of the materials from which the device is constructed.

4.3.2 Recommended Operating Conditions

The recommended operating conditions for each device are those necessary to guarantee that the device will operate as specified in the datasheet.
If greater reliability is required, derate the device's absolute maximum ratings for voltage, current, power and temperature before using it.

4.3.3 Derating

When incorporating a device into your design, reduce its rated absolute maximum voltage, current, power dissipation and operating temperature in order to ensure high reliability.
Since derating differs from application to application, refer to the technical datasheets available for the various devices used in your design.