Preventing cracks of IC packages and LEDs with McDry ultra-low humidity control

Even when the doors are opened and closed, McDry provides functionality equivalent to moisture barrier bags. (Conforms to the new IPC/JEDEC J-STD-033C standard.)
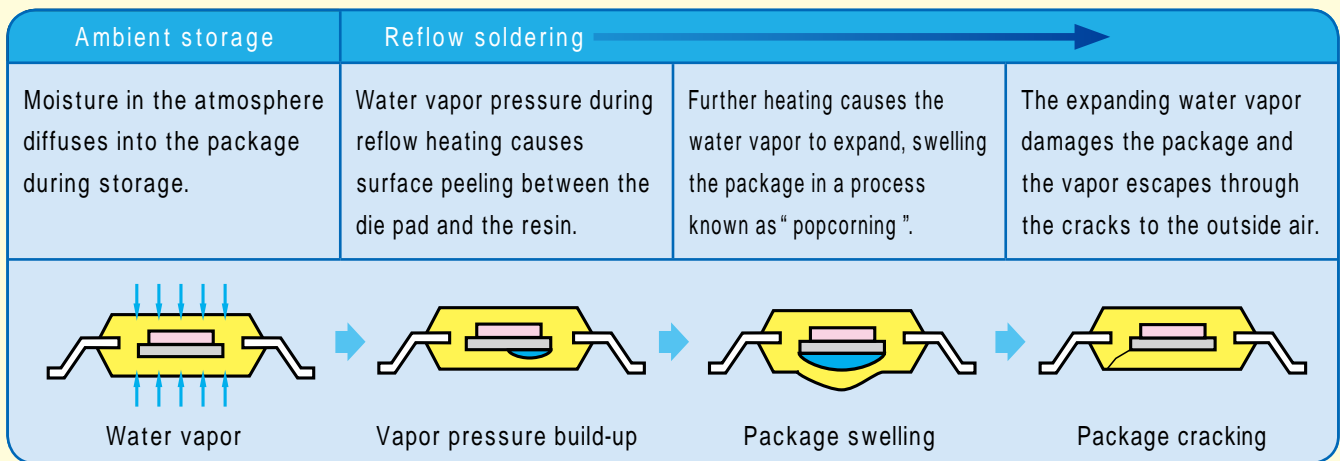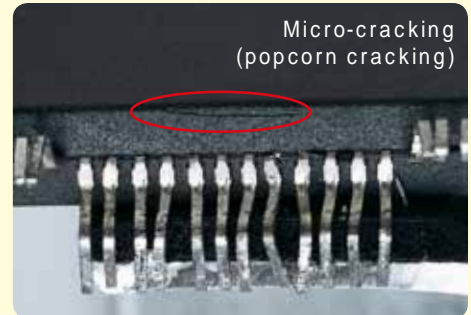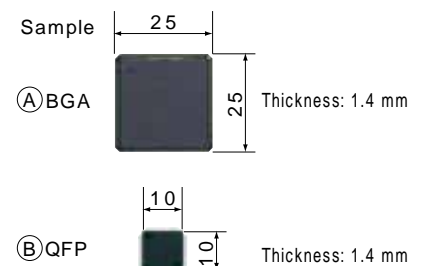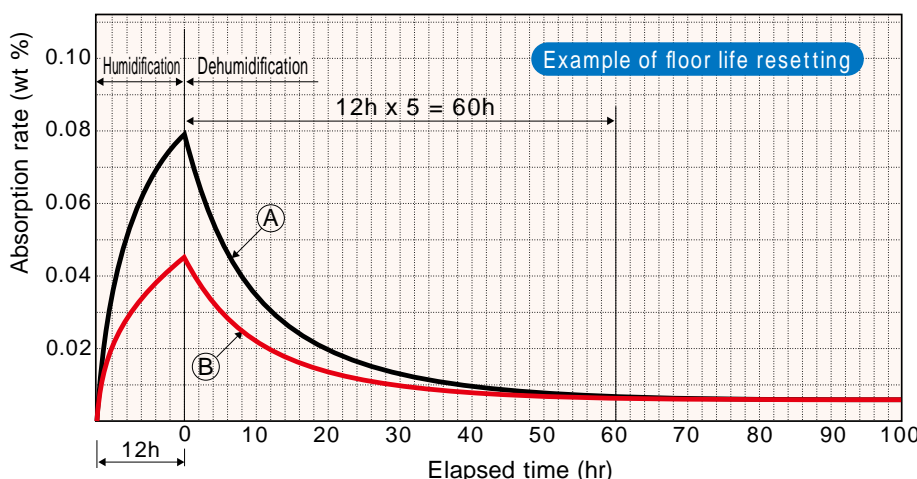
Preventing popcorn cracks of MSDs (moisture-sensitive devices)

If an IC package or LED has been taken out of its moisture barrier bag and is not surface mounted during its floor life (the permitted time for exposure to the air), it will absorb moisture from the air and exceed its permitted moisture content level. When IC packages or LEDs that have absorbed enough moisture to exceed their permitted levels are surface mounted, the heating during reflow causes the moisture accumulated in the die pad to instantly expand, resulting in popcorn cracking in almost 100% of cases. To avoid this scenario, simply reset the floor life of the IC packages or LEDs by storing them in a McDry ultra-low humidity cabinet as soon as they are removed from the moisture barrier bags.

Micro-cracking (popcorn cracking)

Ambient storage	Reflow soldering		
Moisture in the atmosphere diffuses into the package during storage.	Water vapor pressure during reflow heating causes surface peeling between the die pad and the resin.	Further heating causes the water vapor to expand, swelling the package in a process known as "popcorning".	The expanding water vapor damages the package and the vapor escapes through the cracks to the outside air.
Water vapor	Vapor pressure build-up	Package swelling	Package cracking

Room temperature dehumidification of IC packages under the new IPC/JEDEC control standards (resetting)

According to new IPC/JEDEC J-STD-033C Standard, level 2 to level 4 IC packages removed from moisture barrier bags are to be kept in storage cabinets at a humidity of 10%RH or less. The standard also specifies that the floor life of an IC package removed from its moisture barrier bag and left exposed at 30° C with a humidity of 60% RH or less will be reset if the package is stored in a cabinet with a humidity of 10% RH or less for 5 times as long as it was left exposed. (Note that the exposure period must not exceed 12 hours.)

Example of floor life resetting

Absorption rate (wt %)

Humidification | Dehumidification

12h x 5 = 60h

Elapsed time (hr)

12h

Sample
(A) BGA 25 × 25 Thickness: 1.4 mm
(B) QFP 10 × 10 Thickness: 1.4 mm

Pretreatment: Baked at 125 for 24 hours
Measurement conditions
(1) Humidification: Exposed for 12 hours at 30 and 60% RH (using a constant temperature and humidity room)
(2) Dehumidification: Stored in a low-humidity cabinet at 3% RH
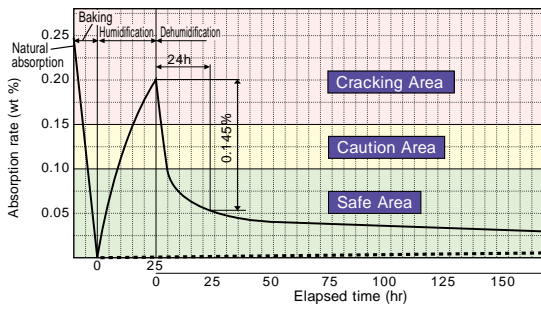
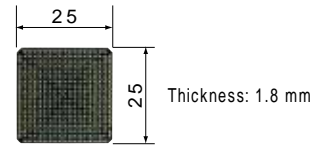# IC package moisture absorption and dehumidification data

Pretreatment: Baked at 125 for 24 hours
Measurement conditions
(1) Humidification: Exposed for 25 hours at 30 and 85% RH (using a constant temperature and humidity room)
(2) Dehumidification: Stored in a low-humidity cabinet at 5% RH
(3) Stored in a low-humidity cabinet at 5% RH after baking
(Example of storage in a low-humidity cabinet at 5% RH in accordance with the new IPC/JEDEC J-STD-033C standard)

Sample: PBGA

25
25
Thickness: 1.8 mm

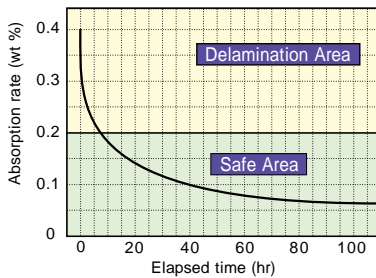# Low-humidity storage of multi-layer PCBs

The thinner multi-layered PCBs are, the faster they absorb moisture. If the moisture content of a PCB is 0.2 wt% or more, the heat of reflow soldering during surface mounting causes problems such as delamination and measling. Accordingly, IPC-1601 stipulates that PCBs be stored in a low-humidity cabinet at 10% RH or less.

PBGA carrier board
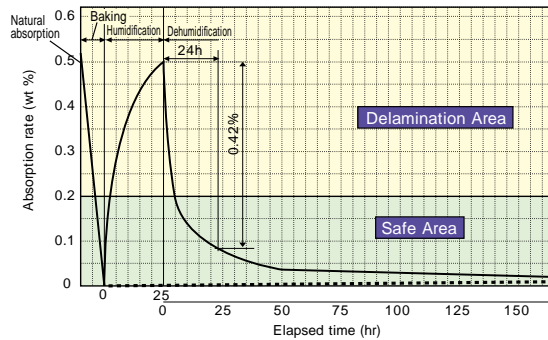
Measurement conditions
Pretreatment: Baked at 125 for 24 hours
(1) Exposed for 25 hours at 30 and 85% RH (using a constant temperature and humidity room)
(2) After the treatment in (1) above, stored in a low-humidity cabinet at 5% RH
(3) Stored in a low-humidity cabinet at 5% RH after baking

PCB (glass-epoxy PCB)
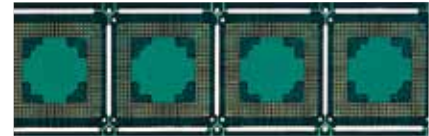

Sample: Thin multi-layer PCB (6 layers)
Size: 50 x 100 x 1 (t) (mm)
Measurement conditions
Pretreatment: Baked at 125 for 24 hours
Humidification: Steamed for 2 hours
Dehumidification: Stored in a low-humidity cabinet at 5% RH

IC Package Storage Standard   New IPC/JEDEC J-STD-033C (Joint Electron Devices Engineering Council)

▬ 5% or 10% RH storage using low-humidity cabinets ▬

The new IPC/JEDEC J-STD-033C standard stipulates that once the moisture barrier bag for an IC package has been opened, the package is to be stored in a low-humidity cabinet at no more than 5% or 10% RH to prevent the absorption of ambient moisture. However, at sites where IC packages are surface mounted, the cabinet doors are opened frequently to put in and take out devices, allowing ambient humidity into the cabinet and raising its internal humidity. To prevent this and maintain a humidity level of 5% or 10% RH in the cabinet at all times, the cabinet must have an even lower level of humidity.

For this reason, the McDry cabinets are classified into different grades depending on the frequency with which the cabinet is opened at the work site.
IC packages are also classified by JEDEC into 7 levels according to how readily they absorb moisture, namely 5a, 5, 4, 3, 2a, 2 and 1. It is recommended that a G1 or G2 cabinet be used for level 5a, 5, 4, and 3 packages, since they most readily absorb moisture.

Item/ Grade	Minimum humidity	Frequency of opening-closing of doors	Model	Usage example	Recommended IC package storage level (JEDEC standard)
G1	1%RH	Once in approx every 10-20 min.	HM	• Moisture-proof storage for IC packages at surface-mounting sites where cabinets are frequently opened • Moisture-proof storage for processes where low humidity is a particular requirement	5a, 5, 4, 3
G2	1%RH	Once in approx every 30-45 min.	DXU	• Moisture-proof storage for IC packages at normal surface-mounting sites	5, 4, 3
G3	2%RH or 1%RH	Once in approx every 1-2 hours	MCU or MC	• Moisture-proof storage for IC packages at surface-mounting sites where cabinets are infrequently opened • Moisture-proof long-term storage for IC packages and electronic components • Moisture-proof storage for PCBs, etc.	3, 2a, 2, 1

G2 Standard model

McDry Functions

Storage standards for IC packages and PCBs

(1) Controlled humidity for IC packages conforms to IPC/JEDEC J-STD-033C.

(2) Controlled humidity for PCBs conforms to IPC-1601.

(3) Electrostatic protection conforms to IEC-61340-5-1 (surface resistance: $1 \times 10^4 \leq R \leq 1 \times 10^{10}$).

Simply turn the handle 90° to lock the door (locking)

Even in an earthquake, the doors will not fly open and allow products to spill out.

Digital humidity meter (capacitance type) ERC-301B

Calibration certificate available on request.

Measurement range: 1-90% RH
Precision: ± 3% RH

Displayed even during power outages.

Shelves

Drying unit

To ensure that the JEDEC controlled humidity of 5% RH or less is quickly achieved after the cabinet is opened, the amount of dessicant is greater than usual and the surface area is increased.

Casters (urethane wheels with stoppers)

High-resistance grounding (at rear)

McDry applications

Low-humidity storage of LEDs and IC packages after removal from moisture barrier bags
Low-humidity storage of MSDs removed from the mounter
Low-humidity storage of PCBs
Low-humidity storage of other electronic components

McDry quality control

McDry humidity control completely eliminates micro-cracks in IC packages during mounting.
Calibrating the humidity meter once a year allows humidity management using accurate humidity values.
Electrostatic protection ensures a resistance of $7.5 \times 10^5 \leq R \leq 1 \times 10^9$ from the metal handles to the ground.

McDry performance

HM-1001B (1% RH) (unloaded)

Humidity (% RH)

HM-1001B

Elapsed time (hr)

HM-1001B (1% RH) (unloaded)

Humidity (% RH)

Internal humidity after power switches of f (during a power outage)

Elapsed time (hr)
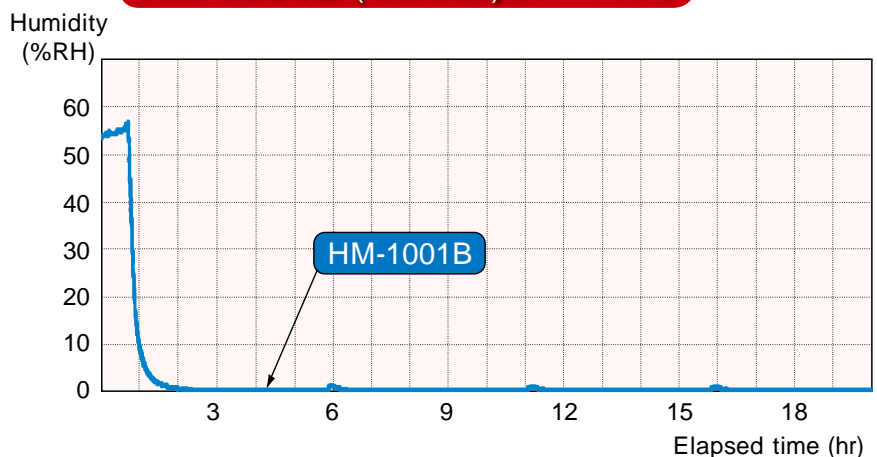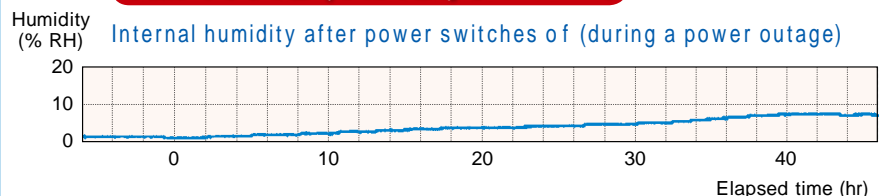
McDry

G1 HM MODEL — 1% internal humidity (ultra-fast dehumidifying model)

McDry high-performance model

Mounting sites with a cabinet opening frequency of once every 10-20 minutes

Recommended IC package storage levels: 5a, 5, 4 and 3 (JEDEC standard)

With automatic energy-saving function

When the cabinet is only opened infrequently, it switches to energy-saving mode and uses only **60%** of normal operation mode power.

Low-energy design:
Normal operation mode: Power consumption approx. **36%** lower (Compaired with exiting product)
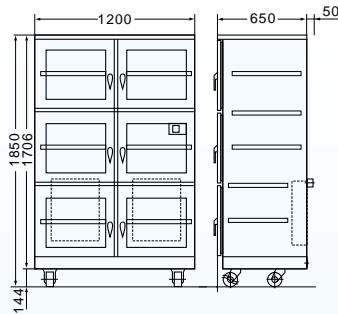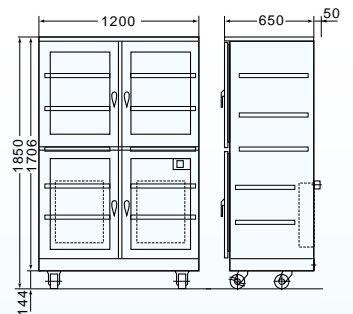Low-energy operation mode: Power consumption approx. **60%** lower (Compaired with exiting product)
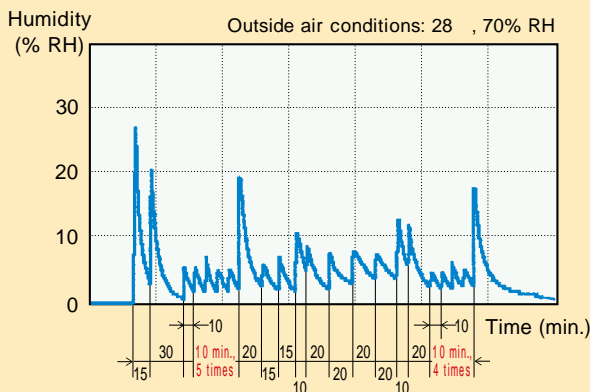

HM–1001B — 1200 (6-door)

1200 · 650 · 50 · 1850 · 1706 · 144

HM–1002B — 1200 (4-door)

1200 · 650 · 50 · 1850 · 1706 · 144

HM-1001B opening-closing data (unloaded)

Humidity (% RH) — Outside air conditions: 28 , 70% RH

30 — 20 — 10 — 0

Time (min.) — 10 — 10 — 15 — 30 — 10 min., 5 times — 20 — 15 — 20 — 10 — 20 — 20 — 10 — 20 — 10 min., 4 times

C D
B A
E F

<Location and time of door opening/closing>
(1) 2 doors C and D .... 2 min., both doors
(2) 2 doors A and B .... 1 min., both doors
(3) 1 of A, B, C, D, E and F .... 15 sec.
(4) 2 doors A and B .... 1 min., both doors
(5) 1 of E and F .... 15 sec.
(6) 2 doors E and F .... 30 sec., both doors
(7) 1 of E and F .... 20 sec.
(8) 2 doors E and F .... 30 sec., both doors
(9) 1 of A, B, E and F .... 15 sec.
(10) 2 doors A and B .... 1 min., both doors

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Model	HM-1001B	HM-1002B
Humidity regulator	Automatic dial regulator (RH)	
External dimensions	1200W× 700D× 1850H (mm)	
Internal dimensions	1150W× 600D× 1700H (mm)	
Capacity	Approx. 1200	
Drying unit	USF-7000× 2	
Material	Steel with conductive coating (color: silver)	
Doors (magnetic)	6-door with glass panels	4-door with glass panels
Weight	200 kg	190 kg
Power supply	AC 100 V (50/60 Hz)	
Power consumption	48 W/h (normal operation), 28 W/h (low-energy mode), max. 470 W	
Accessories	5 shelves, locks, humidity meter, casters (with stopper), ground terminal	

Features

Ultra-powerful rapid dehumidification drying unit
Digital humidity meter with large display panel
1 M ground terminal
Shelf load capacity: 100 kg
No central pillar allows full shelf width to be used

Custom orders

N_2 gas socket can also be installed.

G2 **DXU** MODEL
1% internal humidity
(rapid dehumidifying model)

For normal surface mounting sites

Mounting sites with a cabinet opening frequency of once every 30-45 minutes
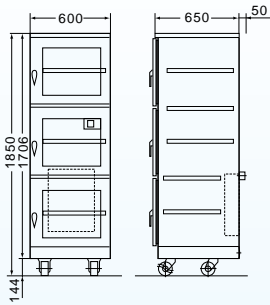
Recommended IC package storage levels: 5, 4 and 3 (JEDEC standard)

Low-energy design: Power consumption approx. 40% lower (Compaired with exiting product)
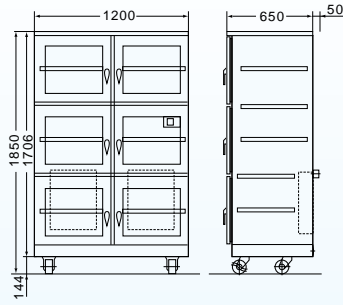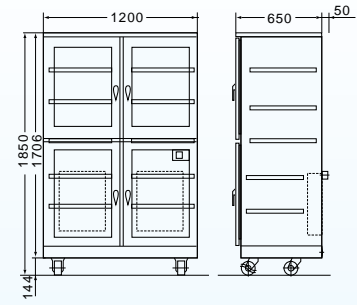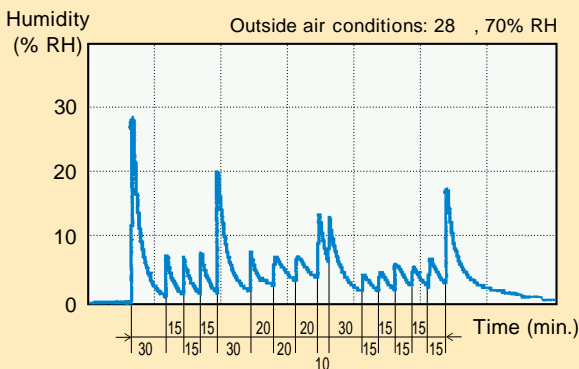
With 1 drying unit

DXU–501A
600 (3-door)

With 2 drying units

DXU–1001A
1200 (6-door)

DXU–1002A
1200 (4-door)

DXU-1001A opening-closing data (unloaded)

C	D
B	A
E	F

<Location and time of door opening/closing>
(1) 2 doors C and D .... 2 min., both doors
(2) 1 of A, B, C, D, E and F .... 15 sec.
(3) 2 doors A and B .... 1 min., both doors
(4) 1 of E and F .... 15 sec.
(5) 2 doors E and F .... 1 min., both doors
(6) 2 doors E and F .... 30 sec., both doors
(7) 1 of A, B, E and F .... 15 sec.
(8) 2 doors C and D .... 30 sec., both doors

Humidity (% RH) — Outside air conditions: 28 , 70% RH — Time (min.)

Model	DXU-501A	DXU-1001A	DXU-1002A
Humidity regulator	Automatic dial regulator		
External dimensions	600W× 700D× 1850H (mm)	1200W× 700D× 1850H (mm)	
Internal dimensions	550W× 600D× 1700H (mm)	1150W× 600D× 1700H (mm)	
Capacity	Approx. 600	Approx. 1200	
Drying unit	US-5000F	US-5000F× 2	
Material	Steel with conductive coating (color: silver)		
Doors (magnetic)	3-door with glass panels	6-door with glass panels	4-door with glass panels
Weight	110 kg	200 kg	180 kg
Power supply	AC 100 V (50/60 Hz)		
Power consumption	28 W/h (MAX 350 W)	56 W/h (MAX 700 W)	
Accessories	5 shelves, locks, humidity meter, casters (with stopper), gound terminal		

Features

Ultra-powerful rapid dehumidification drying unit
Digital humidity meter with large display panel
1 M ground terminal
Shelf load capacity: 100 kg
No central pillar allows full shelf width to be used.

Custom orders

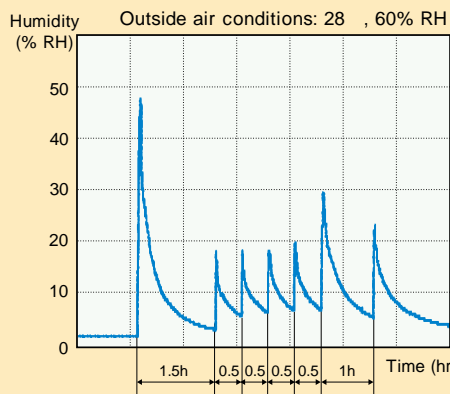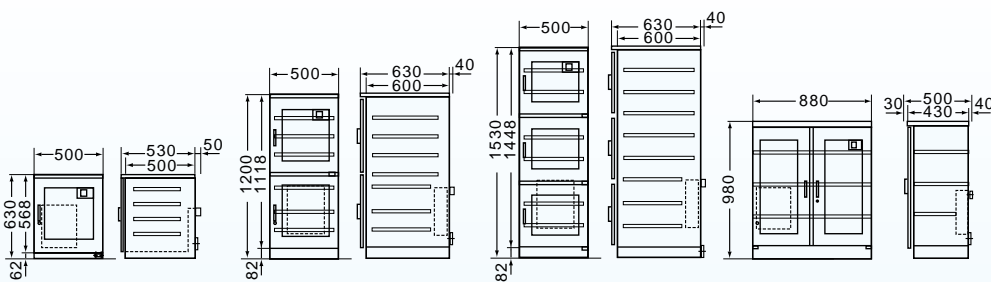N_2 gas socket can also be installed.

For surface mounting sites where cabinets are opened infrequently
For long-term low-humidity storage

Mounting sites with a cabinet opening frequency of once every 1-2 hours

Recommended IC package storage levels: 3, 2a, 2 and 1 (JEDEC standard)

MCU-201	MCU-301	MCU-401	MCU-340
135	300	420	300

MCU-580   520

Internal humidity: 1%

MCU-401 opening-closing data (unloaded)

Outside air conditions: 28, 60% RH

<Location and time of door opening/closing>

(1) 2 doors A and B.....2 min., both doors
(2)(3)(4)(5) 1 door A ....20 sec.
(6) 1 door A...1 min.
(7) 1 door A.....................................30 sec.

Features

Rapid dehumidification drying unit
Digital humidity meter with large display panel
1 M ground terminal
Shelf load capacity: 50 kg

Options

Dedicated casters also available.

Model	MCU-201	MCU-301	MCU-401	MCU-340	MCU-580
Humidity regulator	Automatic dial regulator				
External dimensions	500W× 570D× 630H (mm)	500W× 630D× 1200H (mm)	500W× 630D× 1530H (mm)	880W× 500D× 980H (mm)	880W× 800D× 980H (mm)
Internal dimensions	480W× 500D× 540H (mm)	480W× 600D× 1080H (mm)	480W× 600D× 1410H (mm)	830W× 430D× 790H (mm)	830W× 730D× 790H (mm)
Capacity	Approx. 135	Approx. 310	Approx. 400	Approx. 300	Approx.520
Drying unit	1	1	1	1	1
Material	Steel with conductive coating (color: ivory)				Steel with conductive coating (color: silver)
Doors (magnetic)	1-door with glass panels	2-door with glass panels	3-door with glass panels	2-door with glass panels	2-door with glass panels
Weight	30 kg	60 kg	70 kg	58 kg	80 kg
Power supply	AC 100 V (50/60 Hz)				
Power consumption	21 W/h (MAX 140 W)	33 W/h (MAX 250 W)	33 W/h (MAX 250 W)	33 W/h (MAX 250 W)	28 W/h (MAX 350 W)
Accessories	4 shelves, locks, humidity meter, ground terminal	8 shelves, locks, humidity meter, ground terminal		3 shelves, locks, humidity meter, ground terminal	

McDry

MC MODEL — 1% internal humidity

**For surface mounting sites where cabinets are opened infrequently
For long-term low-humidity storage
Low-humidity PCB storage**

Mounting sites with a cabinet opening frequency of once every 1-2 hours

Recommended IC package storage levels: 3, 2a, 2 and 1 (JEDEC standard)
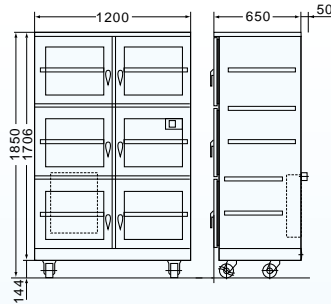
Low-energy design: Power consumption approx. 40% lower (Compaired with exiting product)
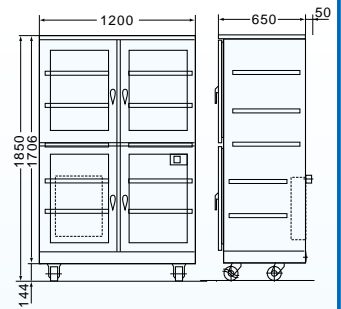
With 1 drying unit

Ideal for long-term storage of IC packages and moisture-free storage of PCBs Controls humidity levels for PCBs, preventing delamination and measling and also preventing board oxidation.
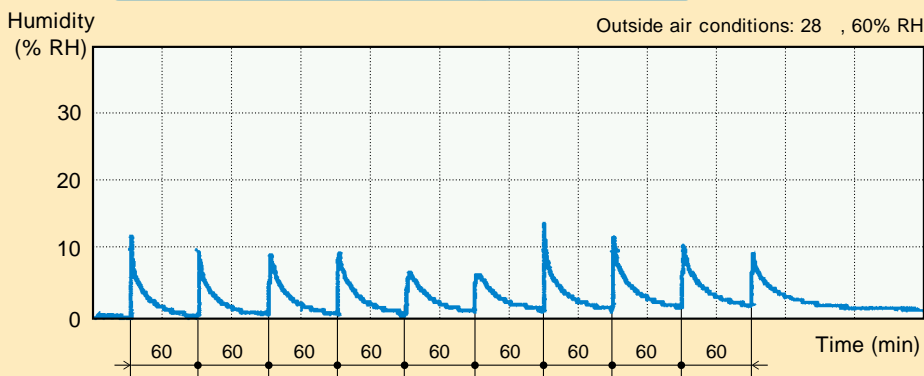
**MC-1001A
1200 (6-door)**

1200   650   50
1850
1706
144

**MC-1002A
1200 (4-door)**

1200   650   50
1850
1706
144

MC-1001A opening-closing data (unloaded)

Humidity
(% RH)

Outside air conditions: 28 , 60% RH

30

20

10

0

60 60 60 60 60 60 60 60 60

Time (min)

< Location and time of door opening/closing >

One of A, B, C, D, E and F opened for 20 seconds once per hour.

C   D
B   A
E   F

Model	MC-1001A	MC-1002A
Humidity regulator	Automatic dial regulator	
External dimensions	1200W× 700D× 1850H (mm)	
Internal dimensions	1150W× 600D× 1700H (mm)	
Capacity	Approx. 1200	
Drying unit	US-5000F	
Material	Steel with conductive coating (color: silver)	
Doors (magnetic)	6-door with glass panels	4-door with glass panels
Weight	190 kg	180 kg
Power supply	AC 100 V (50/60 Hz)	
Power consumption	28 W/h (MAX 350 W)	
Accessories	5 shelves, locks, humidity meter, casters (with stopper), ground terminal	

Features

Ultra-powerful rapid dehumidification drying unit
Digital humidity meter with large display panel
1 M ground terminal
Shelf load capacity: 100 kg
No central pillar allows full shelf width to be used.

Custom orders

N$_2$ gas socket can also be installed.

MB MODEL

Low-temperature, low-humidity baking oven
(IPC/JEDEC-standard)

Dehumidification and storage of IC packages and PCBs

Internal temperature: Room temperature (20) to 50   Internal humidity: 1-2%

This low-temperature, low-humidity baking oven can be used for low-humidity PCB storage and for dehumidifying IC packages with tape reels that cannot be hot-baked.
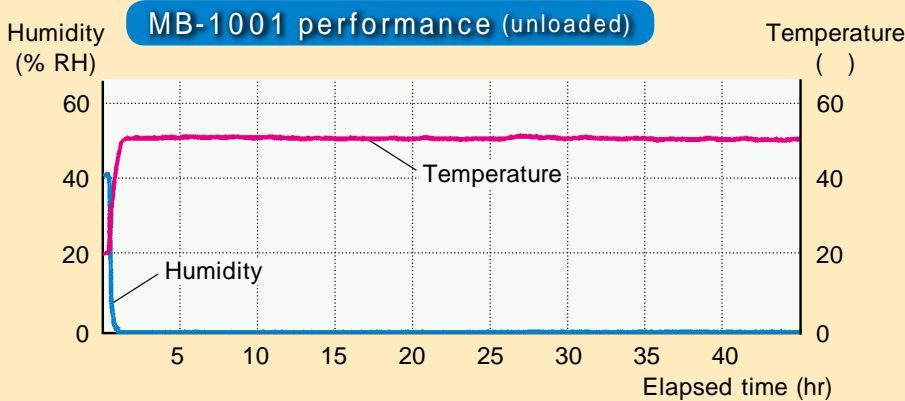
Low-temperature, low-humidity baking can reset IC packages with tape reels that have exceeded their floor life. (JEDEC standard) Can also be used to dehumidify PCBs that cannot be hot-baked and to pre-bake PCBs during repairs.

The baking heater can also be switched off, allowing the cabinet to be used as a room-temperature low-humidity cabinet.

MB-1001
1200 (6-door)

MB-301
300 (2-door)

MB-1001 performance (unloaded)

Humidity (% RH)

Temperature ( )

Temperature

Humidity

Elapsed time (hr)

Fan-equipped baking unit for MB-1001

Model	MB-1001	MB-301
External dimensions	1245W× 770D× 1985H (mm)	525W× 650D× 1395H (mm)
Internal dimensions	1150W× 600D× 1700H (mm)	460W× 600D× 1070H (mm)
Capacity	Approx. 1200	Approx. 300
Drying unit	US-5000F× 2	US-4000
Material	Steel with conductive coating (color: silver)	Steel with conductive coating (color: ivory)
Doors (magnetic)	6-door with glass panels	2-door with glass panels
Weight	220 kg	70 kg
Power supply	AC 100 V (50/60 Hz)	
Power consumption	Max. 1400 W/h (heater unit: 600 W/h)	700 W/h (MAX)
Accessories	5 shelves, locks, humidity meter, casters (with stopper), ground terminal	5 shelves, locks, humidity meter, ground terminal

Features

Ultra-powerful rapid drying unit
Digital humidity meter with large display panel
1 M ground terminal
Shelf load capacity: 100 kg (MB-301: 50 kg)
Complies with the IPC/JEDEC J-STD-033C standard
Electrostatic discharge (ESD) complies with IEC 61340-5-1

Feeder Storage Cabinet 1% internal humidity   Patented product

Stores feeders with tape reels with no need to remove the reel from the feeder.

Applications
(1) Feeder storage for IC packages with tape reels
(2) Feeder storage for LEDs with tape reels
(3) Feeder storage for chips with tape reels

The feeder rack runs on sliding rails, making it easy to load and remove feeders.
Capable of accommodating feeders with integrated tapes as well as those with separate tapes.
Complies with the IPC/JEDEC J-STD-033C control standard for IC packages
Compatible with all mounter manufacturers, even those that use different feeder loading methods.

Allows tape reels to be stowed in the cabinet for each tape feeder.

Tape feeder
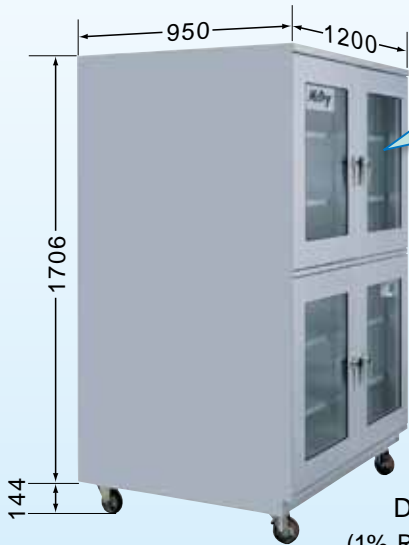
DXU–1002-L
(1% RH) (900 mm deep)

Slide rail system optional.

Model	DXU-1002-L
Humidity regulator	Automatic dial regulator
External dimensions	1200W× 1000D× 1850H (mm)
Internal dimensions	1150W× 900D× 1700H (mm)
Capacity	Approx. 1600
Drying unit	US-5000F× 2
Material	Steel with conductive coating (color: silver)
Doors (magnetic)	4-door with glass panels
Weight	250 kg
Power supply	AC 100 V (50/60 Hz)
Power consumption	56 W/h (MAX 700 W)
Accessories	5 shelves, locks, humidity meter, casters (with stopper), ground terminal

DXU-580SF 1%RH
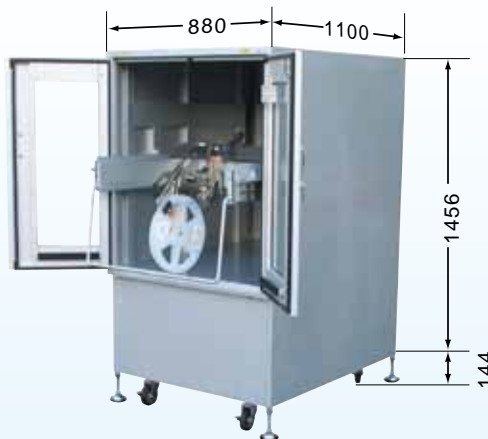
DXU-580AF 1%RH

DXU–400HF 1%RH

Model	DXU-580SF	DXU-580AF	DXU-400HF
External dimensions	800W× 1200D× 1324H (mm)	880W× 1200D× 1600H (mm)	650W× 600D× 1380H (mm)
Internal dimensions	830W× 1100D× 790H (mm)	830W× 1100D× 955H (mm)	620W× 550D× 1200H (mm)
Capacity	Approx. 900	Approx. 932	Approx. 400
Drying unit	US-5000F× 2		US-5000F
Material	Steel with conductive coating (color: silver)		
Doors (magnetic)	2-door with glass panels		1-door with glass panels
Weight	200 kg	240 kg	110 kg
Power supply	AC 100 V (50/60 Hz)		AC 100 V
Power consumption	56 W/h (MAX 700 W)		28 W/h (MAX 350 W)
Accessories	Locks, humidity meter, casters (with stopper), ground terminal		Locks, humidity meter, casters (with stopper), ground terminal

Feeder Cabinet with RFID 1% internal humidity

DXU–2400SIF

Picking lamp

Capable of storing tape reel-equipped chip feeders.
Uses RFID to simplify traceability (floor life) management for IC packages.
Feeders are removed from the storage unit rack where the picking lamp is lit, ensuring that feeder removal is reliable and error-free.

| Model	DXU-2400SIF
External dimensions	1650W× 1170D× 1660H (mm)
Internal dimensions	1570W× 1090D× 1358H (mm)
Capacity	Approx. 2400
Drying unit	USK-6000× 2
Material	Steel with conductive coating (color: silver)
Doors (magnetic)	2-door with glass panels
Weight	Approx. 500 kg
Power supply	AC 100 V
Power consumption	47 W/h (MAX 890 W)
RFID receiver	Reader-writer modules (50)
Accessories	1 Shelf, Locks, humidity meter, casters (with stopper), ground terminal

Feeder Wagon Storage Cabinet 1% internal humidity

We also manufacture storage cabinets with a height of 1250 mm or less. Contact us for details.

DXU–2900

Feeder wagon
(batch exchange wagon)
(storage unit)
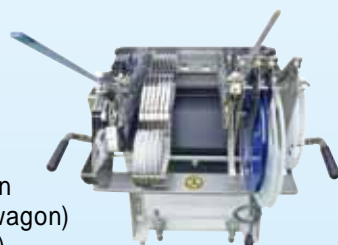
Feeder wagons can be stored individually.
Individual wagon storage prevents feeder connection errors and eliminates cycle time.
Also features shelving, allowing trays and tape reels to be stored along with feeder wagons.

Safe stowing and removal

A feeder wagon weighs approximately 100 kg with the feeder and tape reel mounted. This plus the small casters means it's very difficult to get over even small bumps. With the McDry, loading and removal is simple because there are virtually no bumps to negotiate getting in and out of the cabinet.
The height of the McDry also ensures that the operator's head will not strike the cabinet during feeder loading and removal, allowing the operator to concentrate solely on the feeder wagon.

Model	DXU-2900
External dimensions	1300W× 1255D× 1971H (mm)
Internal dimensions	1140W× 1000D× 1800H (mm)
Capacity	Approx. 2900
Drying unit	USK-6000B× 3
Material	Steel with conductive coating (color: silver)
Doors (magnetic)	2-door with glass panels
Weight	530 kg
Power supply	AC 100 V (50/60 Hz)
Power consumption	135 W/h (MAX 1410 W)
Accessories	1 Shelf, lock, humidity meter

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Humidity Meter with Alarm (Optional)

ERC-3O1AD

Calibration certificate available on request.

The ERC-3O1AD alarm-equipped humidity meter is fitted in place of the standard ERC-3O1B humidity meter.

The alarm lamp flashes if the humidity continuously exceeds the specified humidity value for a set time.

After the alarm lamp flashes, ten hourly humidity data values are stored.

When the humidity continuously exceeds the specified humidity value for a set time, signal lights flash (optional) and a buzzer sounds.

E.g. Humidity data after the alarm lamp flashes (hourly data)	
Time (h)	Humidity (% RH)
0	30
1	30
2	30
3	40
4	40
5	40
6	40
7	40
8	40
9	40

Alarm lamp

Alarm setting switch

Alarm data switch

Power switch

Display
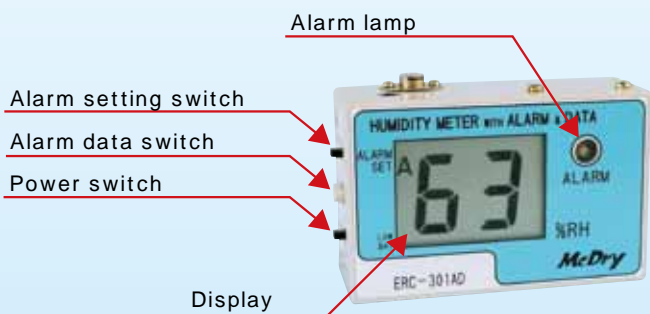
Specifications

Set humidity: 5%, 10% or 20% RH

Set time: 60, 120 or 180 minutes

At abnormal humidity: Alarm lamp flashes

Humidity data after an alarm: 10 data values (1 per hour)

Power supply: 4 AA alkaline batteries (approx. 1 year battery life)

McDry Optional Products

Catering to a wide-range of specifications

Alarm-equipped humidity meter	Reel rack	Stainless steel shelving	N₂ socket
An alarm lamp flashes if the specified humidity is exceeded for a set time.	Capable of holding different types of tape reel.	Stainless steel shelves are also available.	Allows the use of nitrogen gas also.
Sliding shelf	**Casters**	**Adjusters**	**Signal lights**
The sliding shelf makes it even easier to remove products.	MCU casters also available. (DXU casters supplied as standard.)	Can be used to adjust the level of the cabinet. Adjusters with holes for anchor bolts are also available for use in preventing the cabinet from falling over.	The signal lights flash if the humidity set on the alarm-equipped humidity meter is exceeded.

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