INDEX

B

ball grid array
- organic ball grid array (see organic ball grid array)
- plastic ball grid array (see plastic ball grid array)

ball pitch (see package attributes)
board assembly
- changes in process ... 3-2
- profiling method ... 3-4
- reflow profile recommendation ... 3-3
- reflow soldering ... 3-3
  - convection reflow ... 3-3
  - infrared reflow ... 3-3
- wave soldering ... 3-3

bond wire series
- inductance and resistance ... 5-15

boxes
- intermediate (see Q-PACK boxes)
- outer (see outer container boxes)

C

CµPGA (see ceramic micro pin grid array)
carrier tape ... 8-2
CCGA (see ceramic column grid array)
ceramic column grid array
- device count
  - per tray and box ... 7-3
- package attributes ... 2-9
- package codes ... 1-5
- package design ... 2-8
- product carrier dimensions
  - trays (see also trays) ... 7-8 – 7-11
- tray suppliers ... 7-5

ceramic micro pin grid array
- device count
  - per tray and box ... 7-3
- flip-chip interconnection ... 2-26
- package attributes ... 2-26
- package codes ... 1-5
- package design ... 2-26
- product carrier dimensions
  - trays (see also trays) ... 7-12 – 7-13
- tray suppliers ... 7-5

ceramic pin grid array
- device count
  - per tray and box ... 7-3
- flip-chip interconnection ... 2-24
- package attributes ... 2-25
- package codes ... 1-5
- package design ... 2-24
- product carrier dimensions
  - trays (see also trays) ... 7-14 – 7-17
- tray suppliers ... 7-5

certificate of conformance ... 13-9
chemicals
- in packages (see also package materials) ... 4-2
- in packing (see also packing materials) ... 14-2

column grid array (see ceramic column grid array)
combined picklist shipper ... 13-9
controlled materials, packages
- EIA definition of ... 4-2
- listing of ... 4-3

convection reflow (see board assembly)
coplanarity (see package attributes)
cover tape ... 8-3

D

date codes
- definition ... 1-9
- quantity per
  - jewel box ... 13-7
  - outer container ... 13-3
  - Q-PACK box ... 13-3
  - reel ... 13-6
  - tray ... 13-5
  - tube ... 13-5
- structure ... 1-9

dessicant ... 12-4
die sale label ... 11-3
die shipments
- known good die
  - definition ... 11-2
  - versus die ... 11-2
- package codes ... 1-8
- packing container ... 11-2
- product carriers
  - GEL-PAK die tray ... 11-7
  - surftape and reel ... 11-3
  - waffle pack ... 11-3

dry pack bag (see moisture barrier bag)
dry pack labels ... 12-4
dry packing (see also moisture sensitive products)
- materials
  - desiccant ... 12-4
  - dry pack labels ... 12-4
  - humidity indicator card ... 12-4
  - moisture barrier bag ... 12-3
- process ... 12-3

E

EIA Material Declaration Guide ... 4-2
EIA Standard 481
- cover tape, compliance with ... 8-3
- reel, compliance with ... 8-3
- tape and reel design, compliance with ... 8-2

electrical characterization
- importance of ... 5-11
- methodology ... 5-13
  - mutual capacitance (Cxy) ... 5-14
  - mutual inductance (Mxy) ... 5-15
  - self capacitance (Cxx) ... 5-14
  - self inductance (Lxx) ... 5-14
  - series resistance (Rxx) ... 5-14

electrical modeling 5-17
electrical values
- low profile quad flat package 5-16
- plastic leaded chip carrier 5-16
- plastic quad flat package 5-16
- thin profile quad flat package 5-16

electro-static discharge
- bubble pack 13-3
- carrier tape, protection from 8-2
- cover tape, protection from 8-3
- moisture barrier bag 12-3
- Q-PACK boxes 13-2
- reel, protection from 8-3
- trays, protection from 7-2
- tubes, protection from 9-2

environmental, health, and safety programs 14-2

F

flammability rating and oxygen index (see package attributes)
flip-chip interconnection
- advantages 2-24
- ceramic micro pin grid array 2-26
- ceramic pin grid array 2-24
- organic micro pin grid array 2-28
- organic pin grid array 2-27

G

GEL-PAK die tray 11-7
GEL-PAK wafer tray 11-9
gull-wing lead design
- definition 2-10
- low profile quad flat package 2-10
- plastic quad flat package 2-10
- shrink small outline package 2-10
- small outline package 2-10
- thin profile quad flat package 2-10

H

heat sink design (see thermally enhanced plastic packages)
heat spreader design (see thermally enhanced plastic packages)
heat slug 2-11
humidity indicator card 12-4

I

infrared reflow (see board assembly)
internal package codes (see package codes)
inventory label 11-7, 13-3, 13-8
IPC/JEDEC Standard J-STD-020B 12-2

J

j-bend lead design
- definition 2-10
- plastic leaded chip carrier 2-10

JEDEC drawing number (see package attributes)
JEDEC moisture sensitivity rating (see package attributes)
jewel boxes
- date codes, quantity per 13-7
- design and material 10-2
- device count per box 10-2
- packing (see also Q-PACK program) 13-7
- pin one orientation 10-2

K

KGD label 11-7
known good die (see die shipments)
known good wafer (see wafer shipments)

L

labels
- box labels
  - die sale label 11-3
  - inventory label 11-7, 13-3, 13-8
  - shipping label 13-3, 13-9
  - ship-to-stock label 13-9
  - waffle pack label 11-3
- carrier labels
  - die sale label 11-3
  - KGD label 11-7
  - surftape and reel labels 11-7
  - surftape end sticker 11-4
  - tape and reel labels 8-3
    - bar code specifications 8-3
- customized by customer
  - intermediate boxes 13-9
  - outer container 13-9

land patterns 3-4
lead formation (see package attributes)
low profile quad flat package
- applications used in 2-21
- compared to PQFP 2-21
- device count
  - per reel 8-4
  - per tray and box 7-3
- electrical values 5-16
- lead design 2-10
- package attributes ....2-22 – 2-23
- package codes 1-5
- package design 2-21
- product carrier dimensions
  - reel 8-7
  - tape (see also tape and reel) ....8-9 – 8-10
  - trays (see also trays) ....7-18 – 7-27
- tray suppliers 7-5

LQFP (see low profile quad flat package)

M

materials of interest, packages

EIA definition of 4-2
listing of 4-10
moisture barrier bag 12-3
moisture sensitive products
controlling moisture 13-2
generic listing of 12-6
handling of 12-4
packing for
jewel boxes 13-7
tape and reel 13-6
trays 13-5
tubes 13-5
recommended out-of-bag times 12-6
storing of 12-5
moisture sensitivity
IPC/JEDEC standard J-STD-020B 12-2
levels 12-3
testing for 12-2
moisture sensitivity rating (see package attributes)

O

OμPGA (see organic micro pin grid array)
OBGA (see organic ball grid array)
OPGA (see organic pin grid array)
OPN (see ordering part number)
OPN package codes (see package codes)
ordering part number
package codes
die and wafer 1-8
IC device 1-5
quantity per
outer container box 13-3
Q-PACK box 13-3
organic ball grid array
device count
per reel 8-4
per tray and box 7-3
package attributes 2-3
package codes 1-5
package design 2-2
product carrier dimensions
reel 8-7
tape (see also tape and reel) . . . . 8-10 – 8-11
trays (see also trays) . . . . 7-28 – 7-33
tray suppliers 7-5
organic micro pin grid array
device count
per tray and box 7-3
flip-chip interconnection 2-28
package attributes 2-28
package codes 1-5
package design 2-28
product carrier dimensions
trays (see also trays) . . . . 7-34 – 7-39
tray suppliers 7-5
organic pin grid array
device count
per tray and box 7-3
flip-chip interconnection 2-27
package attributes 2-27
package codes 1-6
package design 2-27
product carrier dimensions
trays (see also trays) . . . . 7-40 – 7-43
tray suppliers 7-5
outer container boxes
box quantity per 13-3
dimensions of 13-4
OPNs per 13-3
packing of
gel pak wafer tray 11-9
wafer jars 11-9

P

package attributes
ceramic column grid array 2-9
ceramic micro pin grid array 2-26
ceramic pin grid array 2-25
low profile quad flat package . . . . 2-22 – 2-23
organic ball grid array 2-3
organic micro pin grid array 2-28
organic pin grid array 2-27
plastic ball grid array . . . . 2-5 – 2-7
plastic dual-in-line . . . . 2-29 – 2-31
plastic leaded chip carrier . . . . 2-12 – 2-13
plastic quad flat package . . . . 2-14 – 2-17
shrink small outline package 2-18
small outline package . . . . 2-19 – 2-20
thin profile quad flat package 2-21
package body size (see package attributes)
package body thickness (see package attributes)
package codes
die 1-8
wafer 1-8
package height (see package attributes)
package materials
controlled materials not found in packages 4-3
EIA Material Declaration Guide 4-2
materials of interest 4-10
restricted materials not found in packages 4-8
package weight (see package attributes)
packing materials
chemical content 14-2
chemicals not present in 14-5
recyclability 14-3
packing systems (see product carriers)
PBGA (see plastic ball grid array)
PCB (see printed circuit boards)
pin one orientation
jewel boxes 10-2
tape and reel 8-3
trays 7-2
tubes 9-2
pitch (see package attributes)

plastic ball grid array
device count
per reel 8-4
per tray and box 7-3
material declaration sheet . . . . 4-18 – 4-24
package attributes . . . . 2-5 – 2-7
package codes 1-6
package design 2-4
product carrier dimensions
reel 8-7
tape (see also tape and reel) . . . . 8-12 – 8-14
trays (see also trays) . . . . 7-44 – 7-55
tray suppliers 7-6
plastic dual-in-line
applications used in 2-29
compared to PLCC 2-11
compared to SOIC 2-19
device count
per tube and box 9-2
package attributes . . . . 2-29 – 2-31
package codes 1-6
package design 2-29
product carrier dimensions
tube (see also tubes) 9-4
plastic leaded chip carrier
benefits 2-11
compared to PDIP 2-11
device count
per reel 8-4
per tube and box 9-3
electrical values 5-16
lead design 2-10, 2-11
material declaration sheet . . . . 4-26 – 4-31
package attributes . . . . 2-12 – 2-13
package codes 1-6
package design 2-11
product carrier dimensions
reel 8-7
tape (see also tape and reel) . . . . 8-15 – 8-16
tube (see also tubes) 9-5
thermally enhanced designs 2-10
plastic quad flat package
benefits 2-14
compared to LQFP 2-21
compared to TQFP 2-21
device count
per jewel box 10-2
per reel 8-5
per tray and box 7-4
electrical values 5-16
lead design 2-10, 2-14
material declaration sheet . . . . 4-32 – 4-41
package attributes . . . . 2-14 – 2-17
package codes 1-7
package design 2-14
product carrier dimensions
reel 8-7
tape (see also tape and reel) 8-16
trays (see also trays) . . . . 7-62 – 7-71
thermally enhanced designs 2-10, 2-14
tray suppliers 7-6
plastic thru-hole packages (see plastic dual-in-line)
PLCC (see plastic leaded chip carrier)
PQFP (see plastic quad flat package)
printed circuit boards
designs 3-2
materials 3-2
product carrier (see package attributes)
product carriers
carrier choices for die and wafers 11-2
carrier choices per package type 1-3
GEL-PAK die tray 11-7
GEL-PAK wafer tray 11-9
jewel boxes 10-2
options per OPN 11-2
packing containers for 13-2
recyclability of 14-3
surftape and reel 11-3
tape and reel 8-2
trays 7-2
tubes 9-2
wafer jar 11-9
waffle pack 11-3
product date codes (see date codes)
profile method (see board assembly)

Q

Q-PACK boxes
date code quantities per 13-3
design of 13-2
device quantities per 13-2
dimensions of 13-4
OPN quantities per 13-3
packing of
GEL-PAK die tray 11-7
jewel box 13-7
surftape and reel 11-7
tape and reel 13-6
trays 13-5
tubes 13-5
waffle pack (for die) 11-3
quantities per outer container 13-3
quality pack program (Q-PACK) 13-2

R

recycling
packing materials 14-2
product carriers 14-3
recycling companies 14-6
tray recycling program 14-2
references
thermal characterization 5-18
reflow soldering (see board assembly)
restricted materials, packages
EIA definition of 4-2

listing of 4-8
revision status 1-2

S

shipping forms
- certificate of conformance 13-9
- combined picklist shipper (CPS) 13-9

shipping invoice (see combined picklist shipper)
shipping label 13-3, 13-9
ship-to-stock labels 13-9
shrink small outline package 2-18
- benefits 2-18
- compared to SOIC 2-18
- device count
  - per reel 8-5
  - per tray and box 7-4
  - per tube and box 9-3
- lead design 2-10, 2-18
- material declaration sheet 4-47
- package attributes 2-18
- package codes 1-7
- package design 2-18
- product carrier dimensions
  - reel 8-8
  - tape (see also tape and reel) . . . . 8-17 – 8-18
  - trays (see also trays) . . . . 72 – 73
  - tubes 9-6
- tray suppliers 7-6

small outline package
- benefits 2-19
- compared to PDIP 2-19
- compared to SSOP 2-18
- device count
  - per reel 8-5
  - per tube and box 9-3
- lead design 2-10, 2-19
- material declaration sheet . . . . 4-42 – 4-46
- package attributes . . . . 2-19 – 2-20
- package codes 1-7
- package design 2-19
- product carrier dimensions
  - reel 8-8
  - tape (see also tape and reel) . . . . 8-18 – 8-20
  - tubes (see also tubes) 9-7

SOIC (see small outline package)
solder lands (see land patterns)
SSOP (see shrink small outline package)
surface-mount array
- AMD package families 2-2
- benefits 2-2
- trade-offs 2-2

surface-mount leaded packages
- development of 2-10
- lead designs
  - gull-wing 2-10
  - j-bend 2-10
- thermally enhanced designs 2-10

surftape and reel 11-3
- packing and labeling of 11-7
- quantity per reel 11-6
- reel design 11-4
- reel dimensions 11-6
- surftape design 11-4
- surftape dimensions 11-5

T

tape and reel
- benefits 8-2
- carrier tape, design and materials of 8-2
- cover tape, design and materials of 8-3
- device count per reel
  - low profile quad flat package 8-4
  - organic ball grid array 8-4
  - plastic ball grid array 8-4
  - plastic leaded chip carrier 8-4
  - plastic quad flat package 8-5
  - shrink small outline package 8-5
  - small outline package 8-5
  - thin profile quad flat package 8-5
- EIA Standard 481
  - cover tape, compliance with 8-3
  - reel, compliance with 8-3
  - tape and reel design, compliance with 8-2
- labels, bar code specifications 8-3
- packing 13-6
- pin one orientation 8-3
- reel dimensions
  - low profile quad flat package 8-7
  - organic ball grid array 8-7
  - plastic ball grid array 8-7
  - plastic leaded chip carrier 8-7
  - plastic qual flat package 8-7
  - shrink small outline package 8-8
  - small outline package 8-8
  - thin profile quad flat package 8-8
- tape dimensions
  - low profile quad flat package
    - PDL 100 8-9
    - PDL 144 8-10
    - PQL 048 8-9
    - PQL 100 8-9
    - PQL 144 8-10
  - organic ball grid array
    - OBF 349 8-10
    - OLF 564 8-11
    - OLF 829 8-11
  - plastic ball grid array
    - BGA 272 8-13
    - BGA 292 8-13
    - BGA 328 8-13
    - BGA 388 8-14
    - BGA 492 8-14
    - BGA 569 8-14
    - BGD 420 8-13

BGT 256 8-12
plastic leaded chip carrier
PL, PLH 020—068 8-15
PL, PLH 084 8-16
plastic quad flat package
PQR 080 8-16
shrink small outline package
SSO 020 8-17
SSO 024 8-17
SSO 056 8-18
small outline package
SO 016 8-18
SO 020 8-19
SO 024 8-19
SO 044 8-20
SOR 044 8-20
SOW 028 8-20
thin profile quad flat package
PQT 044 8-21
PQT 048 8-21
PQT 080 8-22
thermal characterization
importance of 5-2
measurement conditions 5-10
measurement methods 5-4
psijt parameter 5-7
terminology 5-3
thermal measurement
environments
case environment 5-6
forced convection (moving air) 5-6
natural convection (still air) 5-6
methods
live device method 5-4
thermal test die method 5-4
thermal resistance
sample calculations 5-5
thermal test boards
high-effective thermal conductivity 5-8
low-effective thermal conductivity 5-7
thermally enhanced plastic packages
heat sink design 2-11
heat spreader design 2-10
thermally sensitive device (TSD)
calibration of 5-4
thin profile quad flat package
applications used in 2-21
compared to PQFP 2-21
device count
per reel 8-5
per tray and box 7-4
electrical values 5-16
lead design 2-10
material declaration sheet . . . . . 4-48 – 4-50
package attributes 2-21
package codes 1-7
package design 2-21
product carrier dimensions
reel 8-8
tape (see also tape and reel) . . . . . 8-21 – 8-22
trays (see also trays) . . . . . 74 – 79
tray suppliers 7-6
thru-hole packages 2-24
TQFP (see thin profile quad flat package)
trays
design and materials 7-2
device count per tray and box
ceramic column grid array 7-3
ceramic micro pin grid array 7-3
ceramic pin grid array 7-3
low profile quad flat package 7-3
organic ball grid array 7-3
organic micro pin grid array 7-3
organic pin grid array 7-3
plastic ball grid array 7-3
plastic quad flat package 7-4
shrink small outline package 7-4
thin profile quad flat package 7-4
dimensions
ceramic column grid array
C2F 949 7-10
CCF 575 7-8
ceramic micro pin grid array
UCG 940 7-12
ceramic pin grid array
CGF 321 7-14
CGF 453 7-14
low profile quad flat package
PDL 064 7-20
PDL 100 7-20
PDL 144 7-22
PQL 048 7-18
PQL 100 7-20
PQL 144 7-22
PQL 160 7-24
PQL 176 7-24
PQL 208 7-26
organic ball grid array
OBF 349 7-28
OLF 564 7-30
OLF 829 7-32
organic micro pin grid array
UOG 563 7-34
UOG 638 7-36
UOG 754 7-38
organic pin grid array
OGF 453 7-40
plastic ball grid array
BGA 272 7-46
BGA 292 7-46
BGA 328 7-46
BGA 388 7-50
BGA 492 7-50
BGA 569 7-52
BGD 420 7-48
BGT 256 7-44

LBA 176 . . . 7-54
LBA 399 . . . 7-58
LBA 424 . . . 7-60
LBB 324 . . . 7-56
plastic quad flat package
PQB 100 . . . 7-66
PQB 132 . . . 7-70
PQR 044 . . . 7-62
PQR 080 . . . 7-64
PQR 100 . . . 7-64
PRH 080 . . . 7-64
PRH 100 . . . 7-64
shrink small outline package
SSO 056 . . . 72
thin profile quad flat package
PQT 044 . . . 74
PQT 048 . . . 76
PQT 064 . . . 74
PQT 080 . . . 78
ESD protection . . . 7-2
packing . . . 13-5
pin one orientation . . . 7-2
recycling . . . 14-6
suppliers
ceramic column grid array . . . 7-5
ceramic micro pin grid array . . . 7-5
ceramic pin grid array . . . 7-5
contact information . . . 7-7
low profile quad flat package . . . 7-5
organic ball grid array . . . 7-5
organic micro pin grid array . . . 7-5
organic pin grid array . . . 7-5
plastic ball grid array . . . 7-6
plastic quad flat package (English) . . . 7-6
plastic quad flat package (metric) . . . 7-6
shrink small outline package . . . 7-6
thin profile quad flat package . . . 7-6
wafer trays (see GEL-PAK wafer tray)
tubes
design and materials . . . 9-2
device count per tube and box
plastic dual-in-line . . . 9-2
plastic leaded chip carrier . . . 9-3
shrink small outline plastic . . . 9-3
small outline plastic . . . 9-3
dimensions
plastic dual-in-line . . . 9-4
plastic leaded chip carrier . . . 9-5
shrink small outline plastic . . . 9-6
small outline plastic . . . 9-7
end plugs . . . 9-2
packing . . . 13-5
pin one orientation . . . 9-2

U

UL flammability rating and oxygen index (see package attributes)

W

wafer jar . . . 11-9
wafer shipments
known good wafer
definition . . . 11-2
versus wafer . . . 11-2
package codes . . . 1-8
packing container . . . 11-2
product carriers
GEL-PAK wafer tray . . . 11-9
wafer jar . . . 11-9
wafer tray (see GEL-PAK wafer tray)
wafers (see wafer shipments)
waffle pack . . . 11-3
waffle pack labels . . . 11-3
wave soldering (see board assembly)
wire bond interconnection
plastic dual-in-line . . . 2-29
plastic leaded chip carrier . . . 2-11
plastic quad flat package . . . 2-14
small outline package . . . 2-19