Am29F016D
Known Good Die
Data Sheet

July 2003

The following document specifies Spansion memory products that are now offered by both Advanced Micro Devices and Fujitsu. Although the document is marked with the name of the company that originally developed the specification, these products will be offered to customers of both AMD and Fujitsu.

Continuity of Specifications

There is no change to this datasheet as a result of offering the device as a Spansion product. Any changes that have been made are the result of normal datasheet improvement and are noted in the document revision summary, where supported. Future routine revisions will occur when appropriate, and changes will be noted in a revision summary.

Continuity of Ordering Part Numbers

AMD and Fujitsu continue to support existing part numbers beginning with "Am" and "MBM". To order these products, please use only the Ordering Part Numbers listed in this document.

For More Information

Please contact your local AMD or Fujitsu sales office for additional information about Spansion memory solutions.

Publication Number **26244** Revision **A** Amendment **+1** Issue Date **June 11, 2002**

SUPPLEMENT

Am29F016D Known Good Die

16 Megabit (2 M x 8-Bit)

CMOS 5.0 Volt-only, Sector Erase Flash Memory—Die Revision 1

DISTINCTIVE CHARACTERISTICS

- **5.0 V ± 10%, single power supply operation**
  - — Minimizes system level power requirements
- **Manufactured on 0.23 µm process technology**
- **High performance**
  - — 120 ns access time
- **Low power consumption**
  - — 25 mA typical active read current
  - — 30 mA typical program/erase current
  - — <1 µA typical standby current (standard access time to active mode)
- **Flexible sector architecture**
  - — 32 uniform sectors of 64 Kbytes each
  - — Any combination of sectors can be erased.
  - — Supports full chip erase
  - — Group sector protection:

    A hardware method of locking sector groups to prevent any program or erase operations within that sector group

    Temporary Sector Group Unprotect allows code changes in previously locked sectors
- **Embedded Algorithms**
  - — Embedded Erase algorithm automatically preprograms and erases the entire chip or any combination of designated sectors
  - — Embedded Program algorithm automatically writes and verifies bytes at specified addresses
- **Minimum 1 million erase cycles guaranteed**
- **Compatible with JEDEC standards**
  - — Pinout and software compatible with single-power-supply Flash standard
  - — Superior inadvertent write protection
- **Data# Polling and toggle bits**
  - — Provides a software method of detecting program or erase cycle completion
- **Ready/Busy output (RY/BY#)**
  - — Provides a hardware method for detecting program or erase cycle completion
- **Erase Suspend/Resume**
  - — Suspends a sector erase operation to read data from, or program data to, a non-erasing sector, then resumes the erase operation
- **Hardware reset pin (RESET#)**
  - — Resets internal state machine to the read mode
- **Tested to datasheet specifications at temperature**
- **Quality and reliability levels equivalent to standard packaged components**
- **20-year data retention at 125°C**

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Issue Date: **June 11, 2002**

GENERAL DESCRIPTION

The Am29F016D in Known Good Die (KGD) form is a 16 Mbit, 5.0 volt-only Flash memory. AMD defines KGD as standard product in die form, tested for functionality and speed. AMD KGD products have the same reliability and quality as AMD products in packaged form.

Am29F016D Features

The Am29F016D is a 16 Mbit, 5.0 volt-only Flash memory organized as 2,097,152 bytes of 8 bits each. The 2 Mbytes of data are divided into 32 sectors of 64 Kbytes each for flexible erase capability. The 8 bits of data appear on DQ0–DQ7. The Am29F016D is manufactured using AMD's 0.32 µm process technology. This device is designed to be programmed in-system with the standard system 5.0 volt V_{CC} supply. A 12.0 volt V_{PP} is not required for program or erase operations. The device can also be programmed in standard EPROM programmers.

The standard device offers an access time of 120 ns, allowing high-speed microprocessors to operate without wait states. To eliminate bus contention, the device has separate chip enable (CE#), write enable (WE#), and output enable (OE#) controls.

The device is entirely command set compatible with the JEDEC single-power-supply Flash standard. Commands are written to the command register using standard microprocessor write timings. Register contents serve as input to an internal state machine that controls the erase and programming circuitry. Write cycles also internally latch addresses and data needed for the programming and erase operations. Reading data out of the device is similar to reading from 12.0 volt Flash or EPROM devices.

The device is programmed by executing the program command sequence. This invokes the Embedded Program algorithm—an internal algorithm that automatically times the program pulse widths and verifies proper cell margin. The device is erased by executing the erase command sequence. This invokes the Embedded Erase algorithm—an internal algorithm that automatically preprograms the array (if it is not already programmed) before executing the erase operation. During erase, the device automatically times the erase pulse widths and verifies proper cell margin.

The sector erase architecture allows memory sectors to be erased and reprogrammed without affecting the data contents of other sectors. A sector is typically erased and verified within one second. The device is erased when shipped from the factory.

The hardware sector group protection feature disables both program and erase operations in any combination of the eight sector groups of memory. A sector group consists of four adjacent sectors.

The Erase Suspend feature enables the system to put erase on hold for any period of time to read data from, or program data to, a sector that is not being erased. True background erase can thus be achieved.

The device requires only a single 5.0 volt power supply for both read and write functions. Internally generated and regulated voltages are provided for the program and erase operations. A low V_{CC} detector automatically inhibits write operations during power transitions. The host system can detect whether a program or erase cycle is complete by using the RY/BY# pin, the DQ7 (Data# Polling) or DQ6 (toggle) status bits. After a program or erase cycle has been completed, the device automatically returns to the read mode.

A hardware RESET# pin terminates any operation in progress. The internal state machine is reset to the read mode. The RESET# pin may be tied to the system reset circuitry. Therefore, if a system reset occurs during either an Embedded Program or Embedded Erase algorithm, the device is automatically reset to the read mode. This enables the system's microprocessor to read the boot-up firmware from the Flash memory.

AMD's Flash technology combines years of Flash memory manufacturing experience to produce the highest levels of quality, reliability, and cost effectiveness. The device electrically erases all bits within a sector simultaneously via Fowler-Nordheim tunneling. The bytes are programmed one byte at a time using the EPROM programming mechanism of hot electron injection.

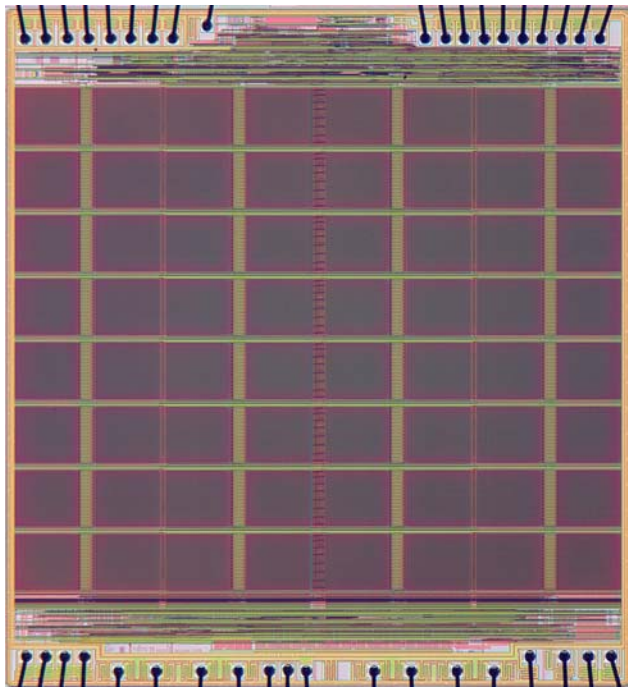
Electrical Specifications

Refer to the Am29F016D data sheet, publication number 21444, for full electrical specifications on the Am29F016D in KGD form.

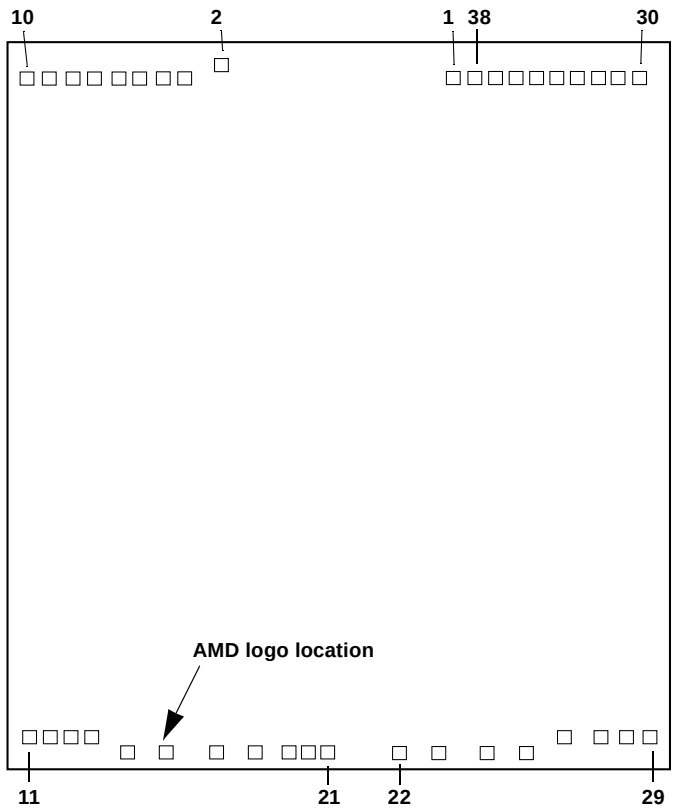
PRODUCT SELECTOR GUIDE

Family Part Number	Am29F016D KGD
Speed Option (V_{CC} = 5.0 V ± 10%)	**-120**
Max Access Time, t_{ACC} (ns)	120
Max CE# Access, t_{CE} (ns)	120
Max OE# Access, t_{OE} (ns)	50

DIE PHOTOGRAPH



DIE PAD LOCATIONS



PAD DESCRIPTION (RELATIVE TO DIE CENTER)

Pad	Signal	Pad Center (mils)		Pad Center (millimeters)	
		X	Y	X	Y
1	V_{CC}	31.30	90.86	0.80	2.31
2	RESET#	–32.75	94.54	–0.83	2.40
3	A11	–42.74	90.77	–1.09	2.31
4	A10	–48.89	90.77	–1.24	2.31
5	A9	–55.27	90.77	–1.40	2.31
6	A8	–61.10	90.77	–1.55	2.31
7	A7	–67.48	90.77	–1.71	2.31
8	A6	–73.63	90.77	–1.87	2.31
9	A5	–80.01	90.77	–2.03	2.31
10	A4	–86.16	90.77	–2.19	2.31
11	A3	–85.72	–90.77	–2.18	–2.31
12	A2	–79.88	–90.77	–2.03	–2.31
13	A1	–74.42	–90.77	–1.89	–2.31
14	A0	–68.59	–90.77	–1.74	–2.31
15	DQ0	–58.60	–95.09	–1.49	–2.42
16	DQ1	–47.60	–95.09	–1.21	–2.42
17	DQ2	–34.33	–95.09	–0.87	–2.42
18	DQ3	–23.34	–95.09	–0.59	–2.42
19	V_{SS}	–14.38	–94.83	–0.37	–2.41
20	V_{SS}	–8.96	–94.83	–0.23	–2.41
21	V_{CC}	–3.54	–95.03	–0.09	–2.41
22	DQ4	16.33	–95.09	0.41	–2.42
23	DQ5	27.32	–95.09	0.69	–2.42
24	DQ6	40.59	–95.09	1.03	–2.42
25	DQ7	51.59	–95.09	1.31	–2.42
26	RY/BY#	62.06	–90.77	1.58	–2.31
27	OE#	72.14	–90.77	1.83	–2.31
28	WE#	79.49	–90.77	2.02	–2.31
29	A20	85.87	–90.77	2.18	–2.31
30	A19	82.54	90.77	2.10	2.31
31	A18	76.71	90.77	1.95	2.31
32	A17	71.25	90.77	1.81	2.31
33	A16	65.41	90.77	1.66	2.31
34	A15	59.95	90.77	1.52	2.31
35	A14	54.12	90.77	1.37	2.31
36	A13	48.66	90.77	1.24	2.31
37	A12	42.82	90.77	1.09	2.31
38	CE#	37.36	90.77	0.95	2.31

Note: *The coordinates above are relative to the die center and can be used to operate wire bonding equipment.*

PAD DESCRIPTION (RELATIVE TO V_{CC})

Pad	Signal	Pad Center (mils)		Pad Center (millimeters)	
		X	Y	X	Y
1	V_{CC}	0.00	0.00	0.00	0.00
2	RESET#	–64.05	3.68	–1.63	0.09
3	A11	–74.04	–0.09	–1.88	0.00
4	A10	–80.19	–0.09	–2.04	0.00
5	A9	–86.57	–0.09	–2.20	0.00
6	A8	–92.41	–0.09	–2.35	0.00
7	A7	–98.79	–0.09	–2.51	0.00
8	A6	–104.94	–0.09	–2.67	0.00
9	A5	–111.32	–0.09	–2.83	0.00
10	A4	–117.47	–0.09	–2.98	0.00
11	A3	–117.02	–181.63	–2.97	–4.61
12	A2	–111.19	–181.63	–2.82	–4.61
13	A1	–105.73	–181.63	–2.69	–4.61
14	A0	–99.89	–181.63	–2.54	–4.61
15	DQ0	–89.90	–185.96	–2.28	–4.72
16	DQ1	–78.91	–185.96	–2.00	–4.72
17	DQ2	–65.64	–185.96	–1.67	–4.72
18	DQ3	–54.64	–185.96	–1.39	–4.72
19	V_{SS}	–45.69	–185.69	–1.16	–4.72
20	V_{SS}	–40.26	–185.69	–1.02	–4.72
21	V_{CC}	–34.84	–185.89	–0.88	–4.72
22	DQ4	–14.98	–185.96	–0.38	–4.72
23	DQ5	–3.98	–185.96	–0.10	–4.72
24	DQ6	9.29	–185.96	0.24	–4.72
25	DQ7	20.28	–185.96	0.52	–4.72
26	RY/BY#	30.75	–181.63	0.78	–4.61
27	OE#	40.84	–181.63	1.04	–4.61
28	WE#	48.19	–181.63	1.22	–4.61
29	A20	54.57	–181.63	1.39	–4.61
30	A19	51.24	–0.09	1.30	0.00
31	A18	45.41	–0.09	1.15	0.00
32	A17	39.94	–0.09	1.01	0.00
33	A16	34.11	–0.09	0.87	0.00
34	A15	28.65	–0.09	0.73	0.00
35	A14	22.81	–0.09	0.58	0.00
36	A13	17.35	–0.09	0.44	0.00
37	A12	11.52	–0.09	0.29	0.00
38	CE#	6.06	–0.09	0.15	0.00

Note: *The coordinates above are relative to the center of pad 1 and can be used to operate wire bonding equipment.*

ORDERING INFORMATION

Standard Products

AMD standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of the following:

Am29F016D -120 DP C 1

DIE REVISION
This number refers to the specific AMD manufacturing process and product technology reflected in this document. It is entered in the revision field of AMD standard product nomenclature.

TEMPERATURE RANGE
C = Commercial (0°C to +70°C)
I = Industrial (–40°C to +85°C)

PACKAGE TYPE AND MINIMUM ORDER QUANTITY
DP = Waffle Pack
180 die per 5 tray stack
DG = Gel-Pak® Die Tray
432 die per 6 tray stack
DT = Surftape™ (Tape and Reel)
2500 per 7-inch reel

SPEED OPTION
See Product Selector Guide and Valid Combinations

DEVICE NUMBER/DESCRIPTION
Am29F016D Known Good Die
16 Megabit (2 M x 8-Bit) CMOS Flash Memory—Die Revision 1
5.0 Volt-only Program and Erase

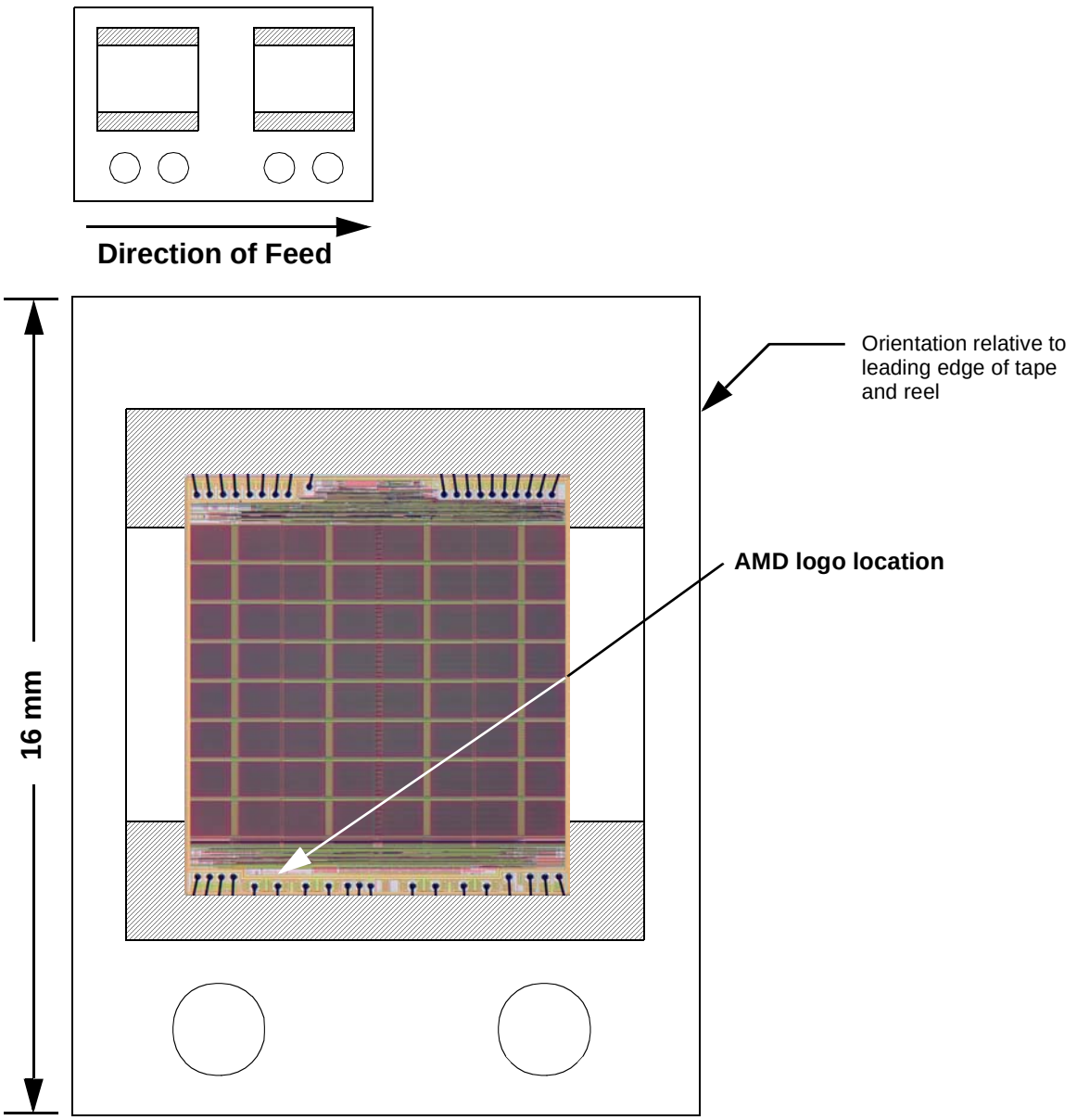
Valid Combinations	
AM29F016D-120	DPC 1, DPI 1, DGC 1, DGI 1, DTC 1, DTI 1, DWC 1, DWI 1

Valid Combinations

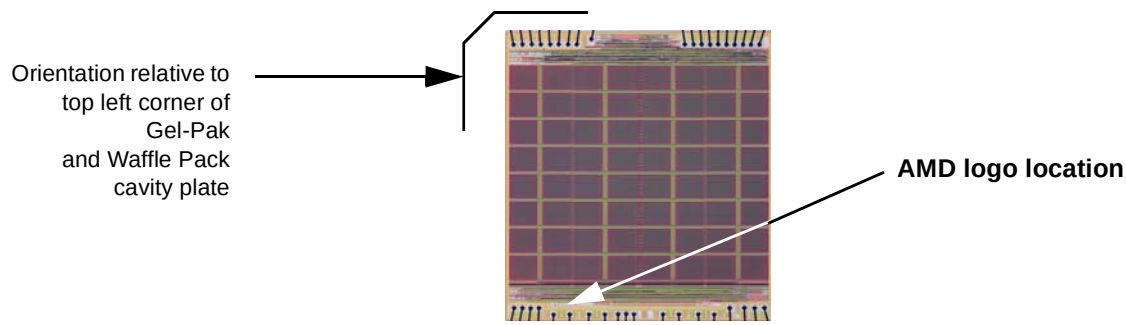
Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

PACKAGING INFORMATION

Surftape Packaging



Gel-Pak and Waffle Pack Packaging



PRODUCT TEST FLOW

Figure 1 provides an overview of AMD's Known Good Die test flow. For more detailed information, refer to the Am29F016D product qualification database supplement for KGD. AMD implements quality assurance procedures throughout the product test flow. In addition, an off-line quality monitoring program (QMP) further guarantees AMD quality standards are met on Known Good Die products. These QA procedures also allow AMD to produce KGD products without requiring or implementing burn-in.

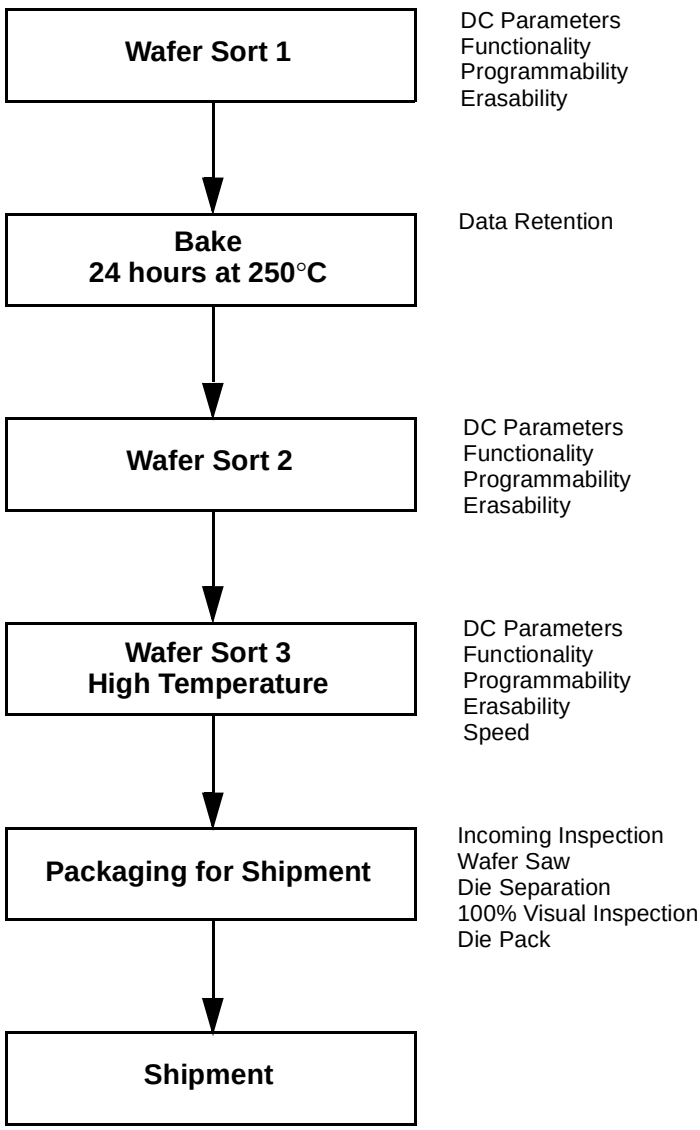


Figure 1. AMD KGD Product Test Flow

PHYSICAL SPECIFICATIONS

Die Dimensions, X x Y . . . . 186.61 mils x 208.66 mils
. . . . . .4.74 mm x 5.30 mm

Die Thickness . . . . . .~20 mils
. . . . . .500 µm

Bond Pad Size . . . . . 3.52 mils x 3.52 mils
. . . . . .89.3 µm x 89.3 µm

Pad Area Free of Passivation . . . . . .15.52 mils^2
. . . . . 10,000 µm^2

Pads Per Die 38

Bond Pad Metalization . . . . . Al/Cu/Si

Die Backside . . . . . .No metal,
may be grounded (optional)

Passivation. . . . . Nitride/SOG/Nitride

DC OPERATING CONDITIONS

V_{CC} (Supply Voltage) . . . . . .4.5 V to 5.5 V

Junction Temperature Under Bias . . T_J (max) = 130°C

Operating Temperature

Commercial . . . . . 0°C to +70°C

Industrial . . . . . –40°C to +85°C

MANUFACTURING INFORMATION

Manufacturing . . . . . .FASL

Wafer Sort Test . . . . . Sunnyvale, CA
. . . . . and Penang, Malaysia

Manufacturing ID 98J32AK

Preparation for Shipment . . . . . .Penang, Malaysia

Fabrication Process CS49HS

Die Revision 1

SPECIAL HANDLING INSTRUCTIONS

Processing

Do not expose KGD products to ultraviolet light or process them at temperatures greater than 250°C. Failure to adhere to these handling instructions will result in irreparable damage to the devices. For best yield, AMD recommends assembly in a Class 10K clean room with 30% to 60% relative humidity.

Storage

Store at a maximum temperature of 30°C in a nitrogen-purged cabinet or vacuum-sealed bag. Observe all standard ESD handling procedures.

TERMS AND CONDITIONS OF SALE FOR AMD NON-VOLATILE MEMORY DIE

All transactions relating to unpackaged die under this agreement shall be subject to AMD's standard terms and conditions of sale, or any revisions thereof, which revisions AMD reserves the right to make at any time and from time to time. In the event of conflict between the provisions of AMD's standard terms and conditions of sale and this agreement, the terms of this agreement shall be controlling.

AMD warrants unpackaged die of its manufacture ("Known Good Die" or "Die") against defective materials or workmanship for a period of one (1) year from date of shipment. This warranty does not extend beyond the first purchaser of said Die. Buyer assumes full responsibility to ensure compliance with the appropriate handling, assembly and processing of Known Good Die (including but not limited to proper Die preparation, Die attach, wire bonding and related assembly and test activities), and compliance with all guidelines set forth in AMD's specifications for Known Good Die, and AMD assumes no responsibility for environmental effects on Known Good Die or for any activity of Buyer or a third party that damages the Die due to improper use, abuse, negligence, improper installation, accident, loss, damage in transit, or unauthorized repair or alteration by a person or entity other than AMD ("Warranty Exclusions").

The liability of AMD under this warranty is limited, at AMD's option, solely to repair the Die, to send replacement Die, or to make an appropriate credit adjustment or refund in an amount not to exceed the original purchase price actually paid for the Die returned to AMD, provided that: (a) AMD is promptly notified by Buyer in writing during the applicable warranty period of any defect or nonconformity in the Known Good Die; (b) Buyer obtains authorization from AMD to return the defective Die; (c) the defective Die is returned to AMD by Buyer in accordance with AMD's shipping instructions set forth below; and (d) Buyer shows to AMD's satisfaction that such alleged defect or nonconformity actually exists and was not caused by any of the above-referenced Warranty Exclusions. Buyer shall ship such defective Die to AMD via AMD's carrier, collect. Risk of loss will transfer to AMD when the defective Die is provided to AMD's carrier. If Buyer fails to adhere to these warranty returns guidelines, Buyer shall assume all risk of loss and shall pay for all freight to AMD's specified location. The aforementioned provisions do not extend the original warranty period of any Known Good Die that has either been repaired or replaced by AMD.

WITHOUT LIMITING THE FOREGOING, EXCEPT TO THE EXTENT THAT AMD EXPRESSLY WARRANTS TO BUYER IN A SEPARATE AGREEMENT SIGNED BY AMD, AMD MAKES NO WARRANTY WITH RESPECT TO THE DIE'S PROCESSING OF DATE DATA, AND SHALL HAVE NO LIABILITY FOR DAMAGES OF ANY KIND, UNDER EQUITY, LAW, OR ANY OTHER THEORY, DUE TO THE FAILURE OF SUCH KNOWN GOOD DIE TO PROCESS ANY PARTICULAR DATA CONTAINING DATES, INCLUDING DATES IN AND AFTER THE YEAR 2000, WHETHER OR NOT AMD RECEIVED NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

THIS WARRANTY IS EXPRESSED IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THE IMPLIED WARRANTY OF MERCHANTABILITY AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON AMD's PART, AND IT NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR AMD ANY OTHER LIABILITIES. THE FOREGOING CONSTITUTES THE BUYER'S SOLE AND EXCLUSIVE REMEDY FOR THE FURNISHING OF DEFECTIVE OR NON CONFORMING KNOWN GOOD DIE AND AMD SHALL NOT IN ANY EVENT BE LIABLE FOR INCREASED MANUFACTURING COSTS, DOWNTIME COSTS, DAMAGES RELATING TO BUYER'S PROCUREMENT OF SUBSTITUTE DIE (i.e., "COST OF COVER"), LOSS OF PROFITS, REVENUES OR GOODWILL, LOSS OF USE OF OR DAMAGE TO ANY ASSOCIATED EQUIPMENT, OR ANY OTHER INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES BY REASON OF THE FACT THAT SUCH KNOWN GOOD DIE SHALL HAVE BEEN DETERMINED TO BE DEFECTIVE OR NON CONFORMING.

Buyer agrees that it will make no warranty representations to its customers which exceed those given by AMD to Buyer unless and until Buyer shall agree to indemnify AMD in writing for any claims which exceed AMD's warranty.

Known Good Die are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of the Die can reasonably be expected to result in a personal injury. Buyer's use of Known Good Die for use in life support applications is at Buyer's own risk and Buyer agrees to fully indemnify AMD for any damages resulting in such use or sale.

REVISION SUMMARY

Revision A (April 12, 2002)

Initial release.

Revision A+1 (June 11, 2002)

Ordering Information

Deleted Gel Pak wafer tray from packaging type options.

Manufacturing Information

Corrected manufacturing ID. Added Sunnyvale, CA to wafer sort test locations.