

Am29F016B 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 \pm 10%, single power supply operation**
 - Minimizes system level power requirements
- **Manufactured on 0.35 μ m process technology**
- **High performance**
 - 120 ns access time
- **Low power consumption**
 - 25 mA typical active read current
 - 30 mA typical program/erase current
 - <1 μ A 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 100,000 write/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**

GENERAL DESCRIPTION

The Am29F016B 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.

Am29F016B Features

The Am29F016B 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 Am29F016B is manufactured using AMD's 0.35 μm process technology. This device is designed to be programmed in-system with the standard system 5.0 volt VCC supply. A 12.0 volt VPP 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 pre-programs 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.

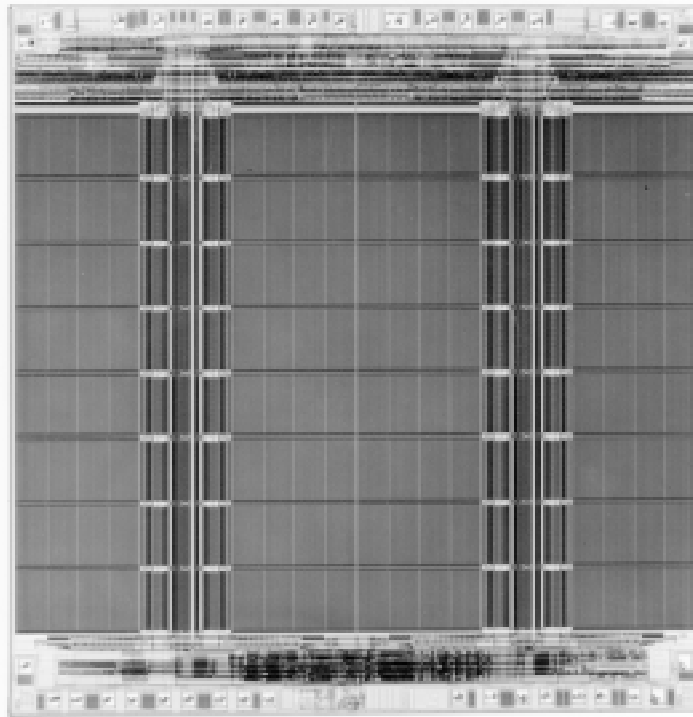
Electrical Specifications

Refer to the Am29F016B data sheet, PID 21444, for full electrical specifications on the Am29F016B in KGD form.

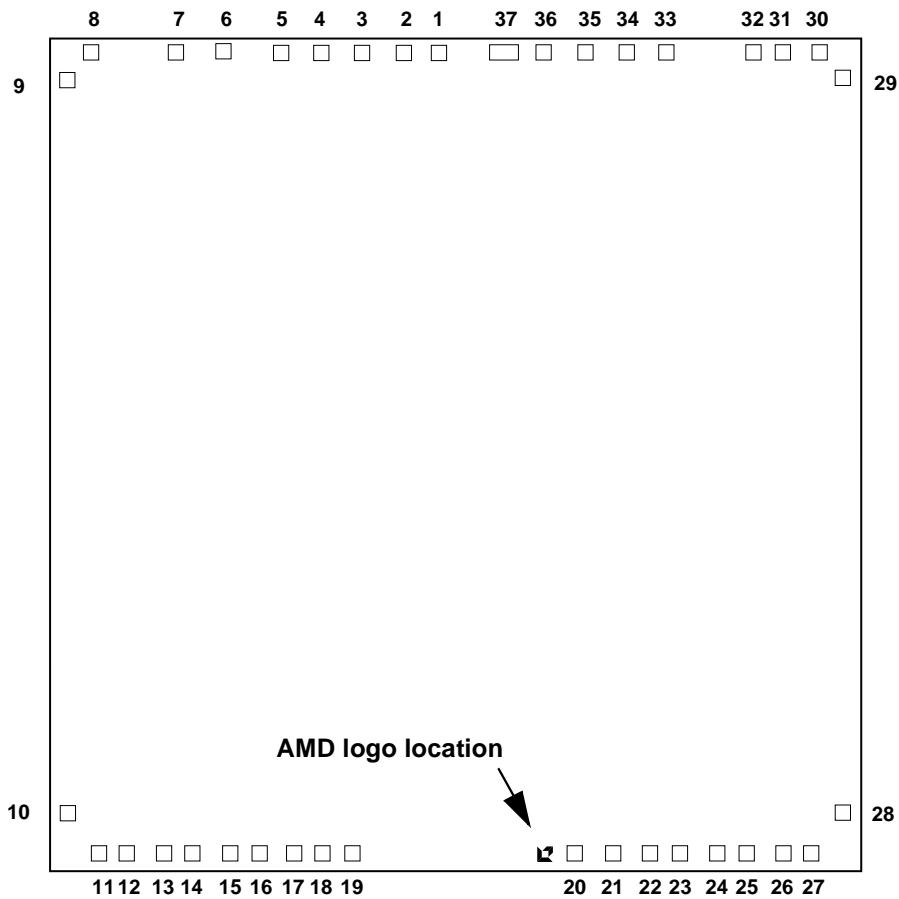
PRODUCT SELECTOR GUIDE

Family Part Number	Am29F016B KGD
Speed Option ($V_{CC} = 5.0 \text{ V} \pm 10\%$)	-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

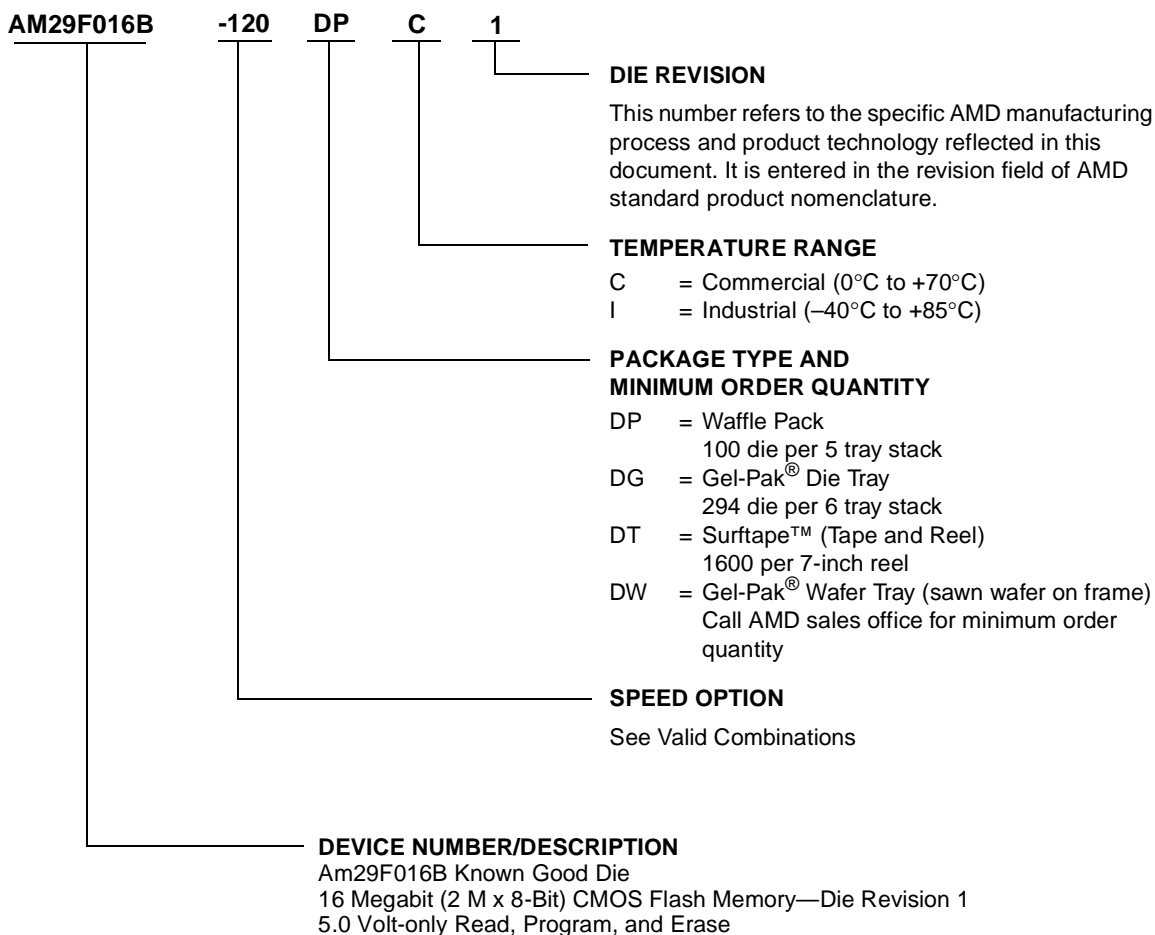
Pad	Signal	Pad Center (mils)		Pad Center (millimeters)	
		X	Y	X	Y
1	V _{CC}	0.00	0.00	0.00	0.00
2	DQ4	-10.60	0.00	-0.27	0.00
3	DQ5	-24.00	0.00	-0.61	0.00
4	DQ6	-37.20	0.00	-0.94	0.00
5	DQ7	-50.50	0.00	-1.28	0.00
6	RY/BY#	-68.90	0.00	-1.75	0.00
7	OE#	-84.20	0.00	-2.14	0.00
8	WE#	-111.80	0.00	-2.84	0.00
9	A20	-119.30	-8.50	-3.03	-0.22
10	A19	-119.30	-245.30	-3.03	-6.23
11	A18	-109.10	-258.20	-2.77	-6.56
12	A17	-100.20	-258.20	-2.55	-6.56
13	A16	-88.20	-258.20	-2.24	-6.56
14	A15	-79.00	-258.20	-2.01	-6.56
15	A14	-67.00	-258.20	-1.70	-6.56
16	A13	-57.80	-258.20	-1.47	-6.56
17	A12	-45.80	-258.20	-1.16	-6.56
18	CE#	-36.60	-258.20	-0.93	-6.56
19	V _{CC}	-27.20	-258.20	-0.69	-6.56
20	RESET#	45.00	-258.20	1.14	-6.56
21	A11	57.20	-258.20	1.45	-6.56
22	A10	69.20	-258.20	1.76	-6.56
23	A9	78.40	-258.20	1.99	-6.56
24	A8	90.60	-258.20	2.30	-6.56
25	A7	99.80	-258.20	2.53	-6.56
26	A6	112.00	-258.20	2.84	-6.56
27	A5	121.10	-258.20	3.08	-6.56
28	A4	131.20	-245.30	3.33	-6.23
29	A3	131.20	-8.50	3.33	-0.22
30	A2	123.80	0.00	3.14	0.00
31	A1	111.90	0.00	2.84	0.00
32	A0	102.40	0.00	2.60	0.00
33	DQ0	74.40	0.00	1.89	0.00
34	DQ1	61.20	0.00	1.55	0.00
35	DQ2	47.90	0.00	1.22	0.00
36	DQ3	34.70	0.00	0.88	0.00
37	V _{SS}	21.70	0.00	0.55	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:



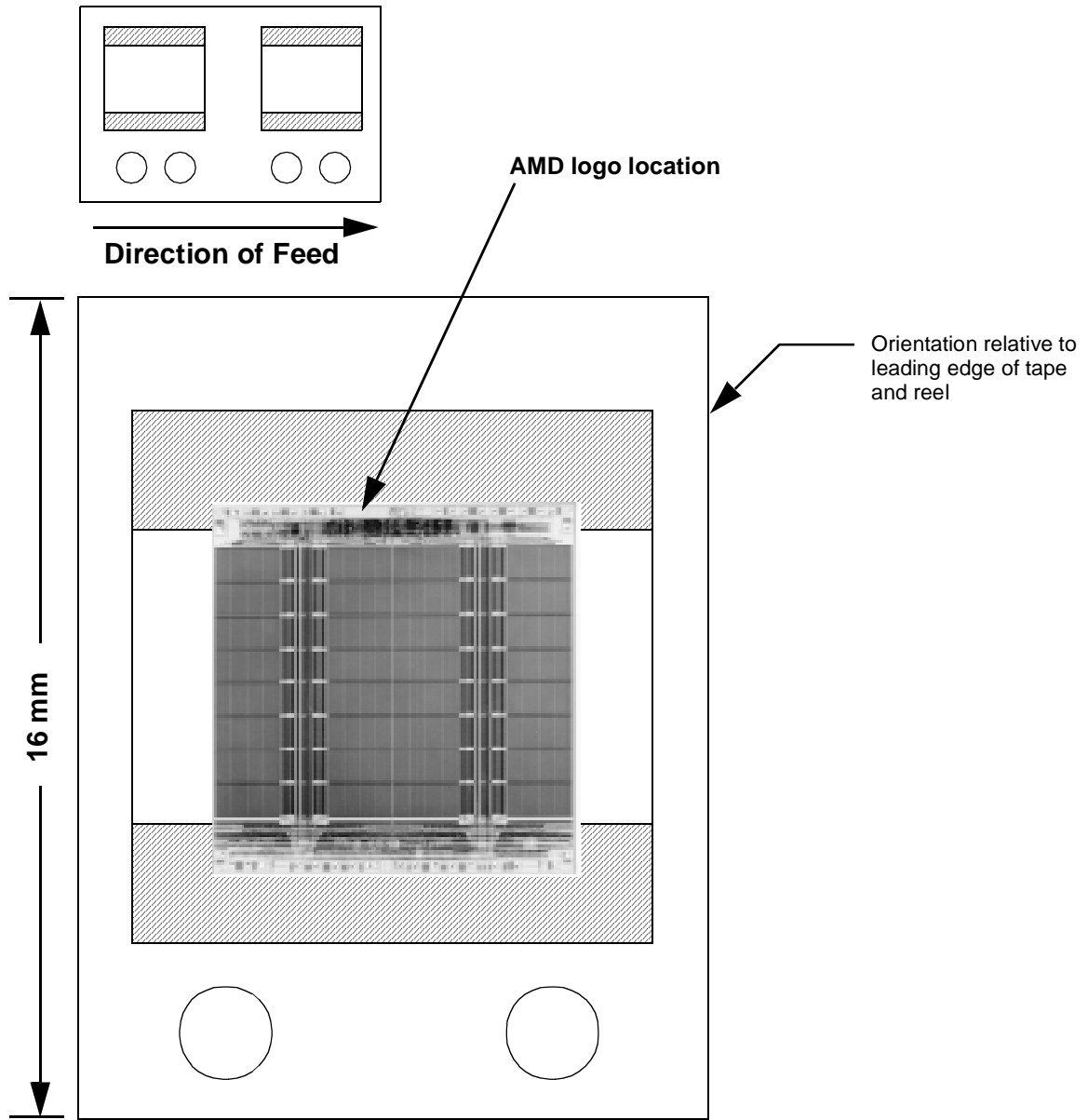
Valid Combinations	
AM29F016B-120	DPC 1, DPI 1, DGC 1, DGI 1, DTC 1, DTI 1, DWC 1, DWI 1

Valid Combinations

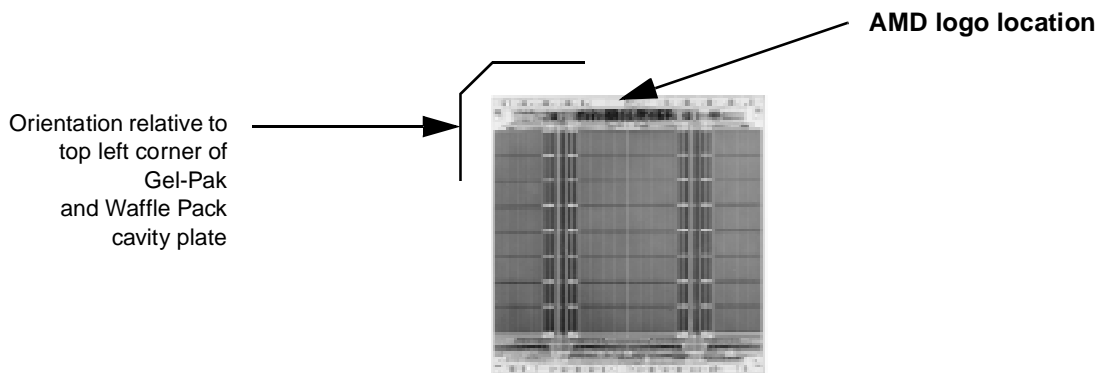
Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

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 Am29F016B 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.

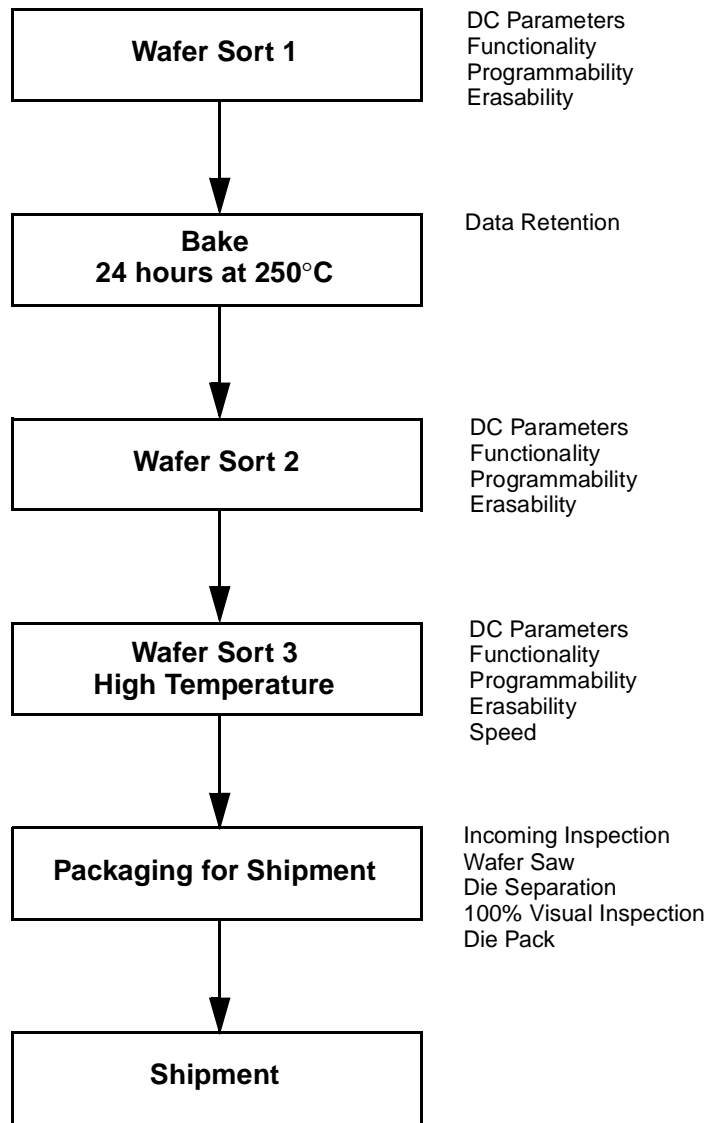


Figure 1. AMD KGD Product Test Flow

PHYSICAL SPECIFICATIONS

Die dimensions, X x Y	267 mils x 280 mils
	6.78 mm x 7.11 mm
Die Thickness	~20 mils
Bond Pad Size	X3.94 mils x 3.94 mils
	100 μm x 100 μm
Pad Area Free of Passivation	15.52 mils ²
	10,000 μm^2
Pads Per Die	37
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
Test	SDC
Manufacturing ID	98163DK
Preparation for Shipment	Penang, Malaysia
Fabrication Process	CS39
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+1****Valid Combinations**

Deleted designators in base part number to top and bottom boot.

Physical Specifications

Clarified X and Y die dimensions

Manufacturing Information

Deleted references to top and bottom boot

Revision B**Terms and Conditions**

Replaced warranty with new version.

Revision C**Packaging Information**

Added section. Moved orientation information from die photograph section into this section.

Trademarks

Copyright © 1998 Advanced Micro Devices, Inc. All rights reserved.

AMD, the AMD logo, and combinations thereof are registered trademarks of Advanced Micro Devices, Inc.

Product names used in this publication are for identification purposes only and may be trademarks of their respective companies.