- **Independent Asynchronous Inputs and Outputs**
- **Low-Power Advanced CMOS Technology**
- **Bidirectional**
- **Dual 1024 by 9 Bits**
- **Programmable Almost-Full/Almost-Empty Flag**
- **Empty, Full, and Half-Full Flags**
- **Access Times of 25 ns With a 50-pF Load**
- **Data Rates up to 50 MHz**
- **Fall-Through Times of 22 ns Maximum**
- **High Output Drive for Direct Bus Interface**
- **Package Options Include 44-Pin Plastic Leaded Chip Carriers (FN) and 64-Pin Thin Quad Flat (PAG, PM) Packages**

description

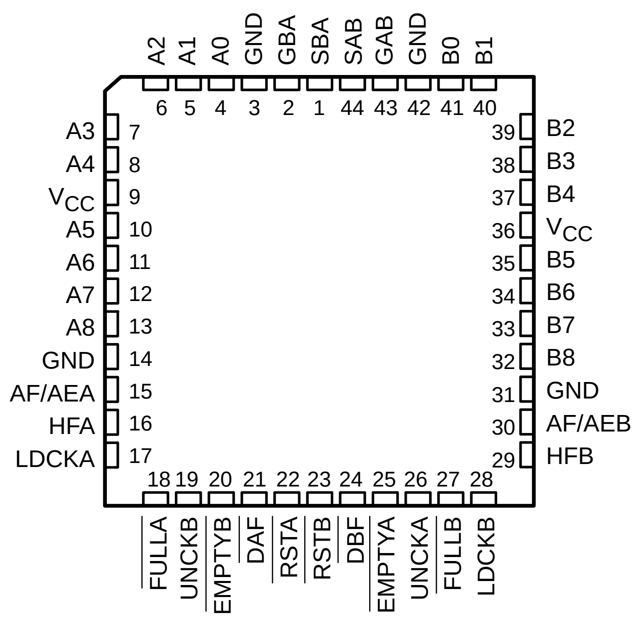
A FIFO memory is a storage device that allows data to be written into and read from its array at independent data rates. The SN74ACT2235 is arranged as two 1024 × 9-bit FIFOs for high speed and fast access times. It processes data at rates up to 50 MHz, with access times of 25 ns in a bit-parallel format.

The SN74ACT2235 consists of bus-transceiver circuits, two 1024 × 9-bit FIFOs, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal FIFO memories. Enable (GAB and GBA) inputs are provided to control the transceiver functions. The select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. Figure 2 shows the eight fundamental bus-management functions that can be performed with the SN74ACT2235.

For more information on this device family, see the application report, *1K × 9 × 2 Asynchronous FIFO SN74ACT2235*, literature number SCAA010.

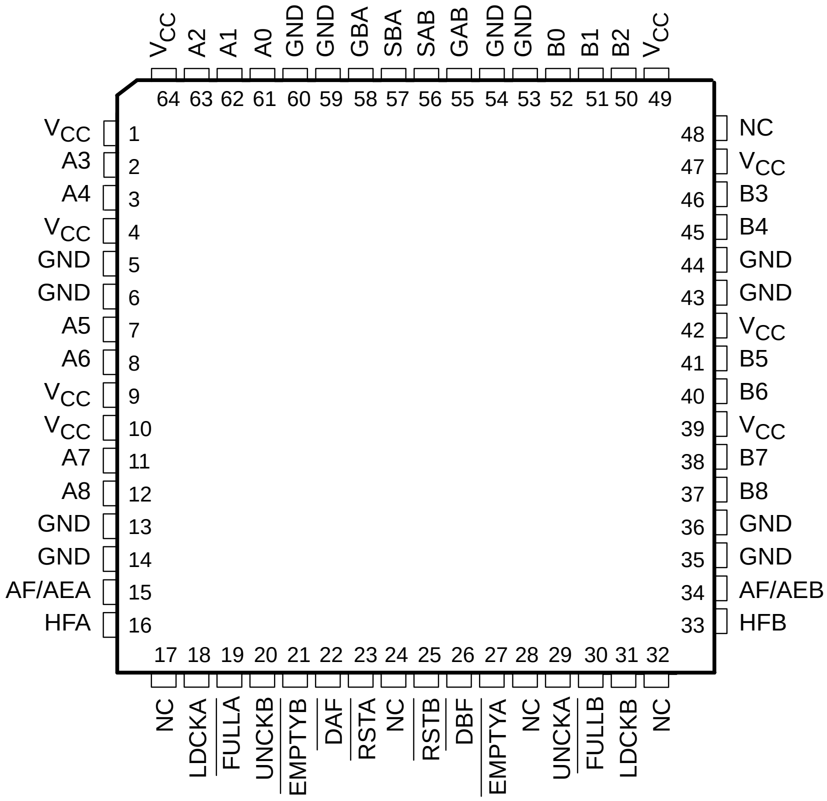
The SN74ACT2235 is characterized for operation from 0°C to 70°C.

FN PACKAGE
(TOP VIEW)



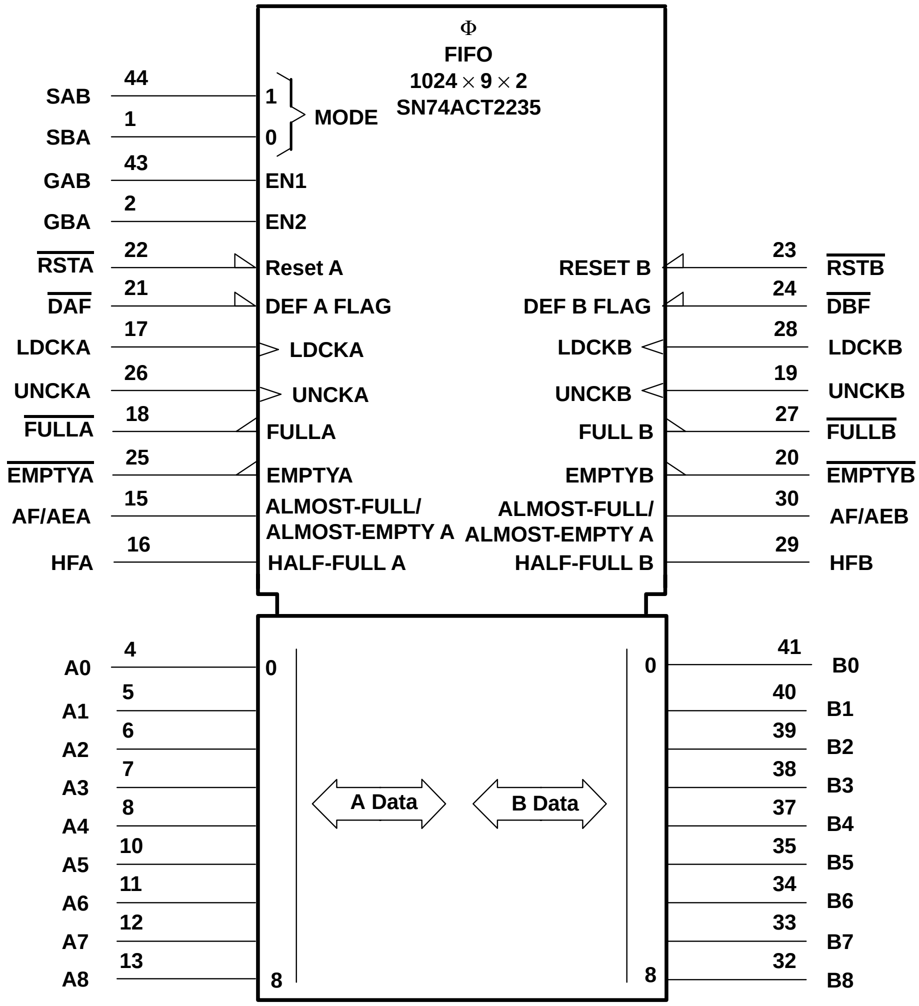
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PAG OR PM PACKAGE
(TOP VIEW)



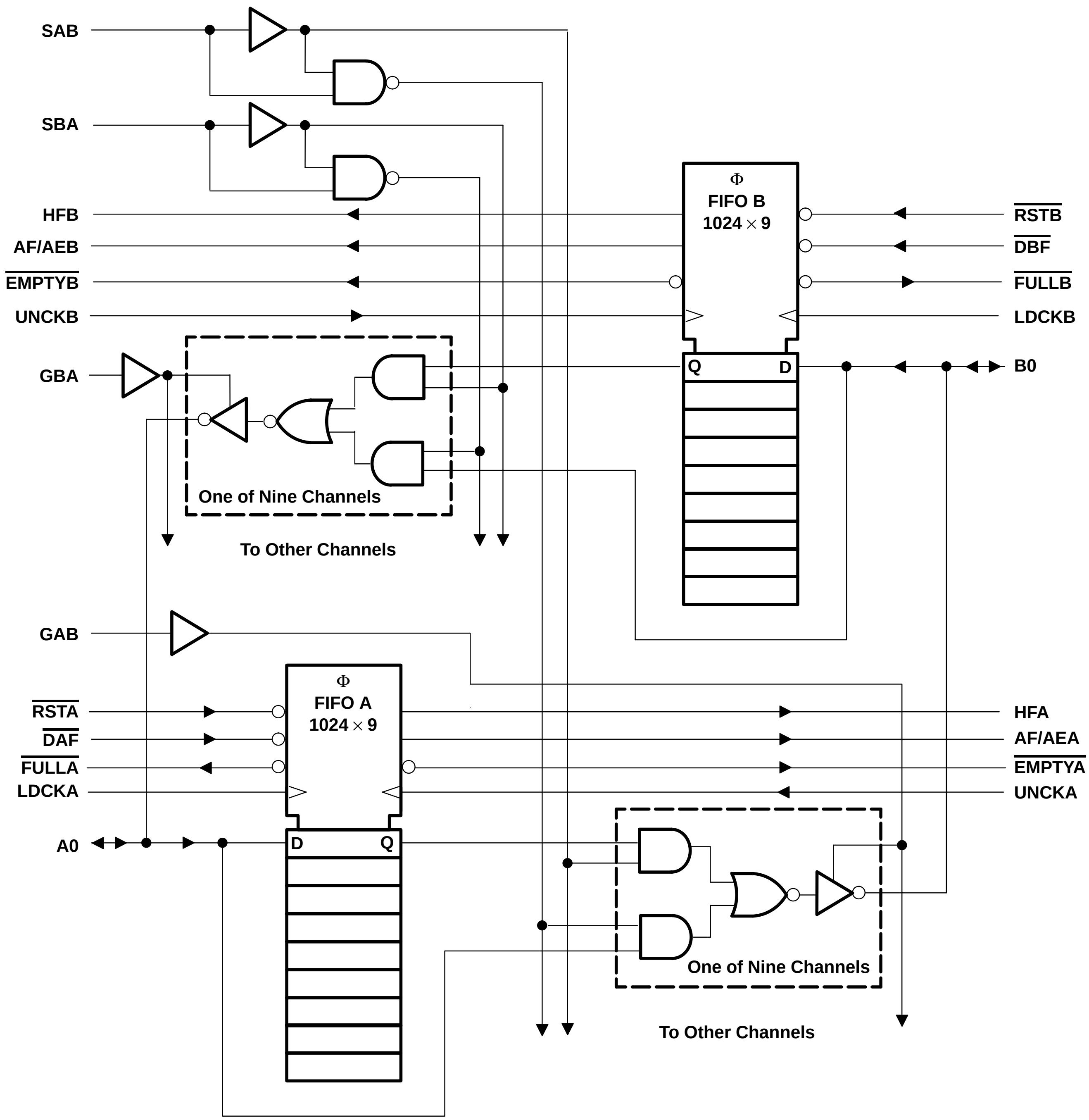
NC – No internal connection

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the FN package.

logic diagram (positive logic)



Terminal Functions

TERMINAL† NAME	TERMINAL† NO.	I/O	DESCRIPTION
AF/AEA AF/AEB	15 30	O	Almost full/almost empty flags. The almost-full/almost-empty A flag (AF/AEA) is defined by the almost-full/almost-empty offset value for FIFO A (X). AF/AEA is high when FIFO A contains X or fewer words or 1024 – X words. AF/AEA is low when FIFO A contains between (X + 1) or (1023 – X) words. The operation of the almost-full/almost-empty B flag (AF/AEB) is the same as AF/AEA for FIFO B.
A0–A8	4–8, 10–13	I/O	A-data inputs and outputs
B0–B8	32–35, 37–41	I/O	B-data inputs and outputs
$\overline{\mathrm{DAF}}$ $\overline{\mathrm{DBF}}$	21 24	I	Define-flag inputs. The high-to-low transition of $\overline{\mathrm{DAF}}$ stores the binary value on A0–A8 as the almost-full/almost-empty offset value for FIFO A (X). The high-to-low transition of $\overline{\mathrm{DBF}}$ stores the binary value of B0–B8 as the almost-full/almost-empty offset value for FIFO B (Y).
$\overline{\mathrm{EMPTYA}}$ $\overline{\mathrm{EMPTYB}}$	25 20	O	Empty flags. $\overline{\mathrm{EMPTYA}}$ and $\overline{\mathrm{EMPTYB}}$ are low when their corresponding memories are empty and high when they are not empty.
$\overline{\mathrm{FULLA}}$ $\overline{\mathrm{FULLB}}$	18 27	O	Full flags. $\overline{\mathrm{FULLA}}$ and $\overline{\mathrm{FULLB}}$ are low when their corresponding memories are full and high when they are not full.
HFA HFB	16 29	O	Half-full flags. HFA and HFB are high when their corresponding memories contain 512 or more words and low when they contain 511 or fewer words.
LDCKA LDCKB	17 28	I	Load clocks. Data on A0–A8 is written into FIFO A on a low-to-high transition of LDCKA. Data on B0–B8 is written into FIFO B on a low-to-high transition of LDCKB. When the FIFOs are full, LDCKA and LDCKB have no effect on the data residing in memory.
GAB GBA	43 2	I	Output enables. GAB, GBA control the transceiver functions. When GBA is low, A0–A8 are in the high-impedance state. When GAB is low, B0–B8 are in the high-impedance state.
$\overline{\mathrm{RSTA}}$ $\overline{\mathrm{RSTB}}$	22 23	I	Reset. A reset is accomplished in each direction by taking $\overline{\mathrm{RSTA}}$ and $\overline{\mathrm{RSTB}}$ low. This sets $\overline{\mathrm{EMPTYA}}$, $\overline{\mathrm{EMPTYB}}$, $\overline{\mathrm{FULLA}}$, $\overline{\mathrm{FULLB}}$, and AF/AEB high. Both FIFOs must be reset upon power up.
SAB SBA	44 1	I	Select-control inputs. SAB and SBA select whether real-time or stored data is transferred. A low level selects real-time data and a high level selects stored data. Eight fundamental bus-management functions can be performed as shown in Figure 2.
UNCKA UNCKB	26 19	I	Unload clocks. Data in FIFO A is read to B0–B8 on a low-to-high transition of UNCKA. Data in FIFO B is read to A0–A8 on a low-to-high transition of UNCKB. When the FIFOs are empty, UNCKA and UNCKB have no effect on data residing in memory.

† Terminals listed are for the FN package.

programming procedure for AF/AEA

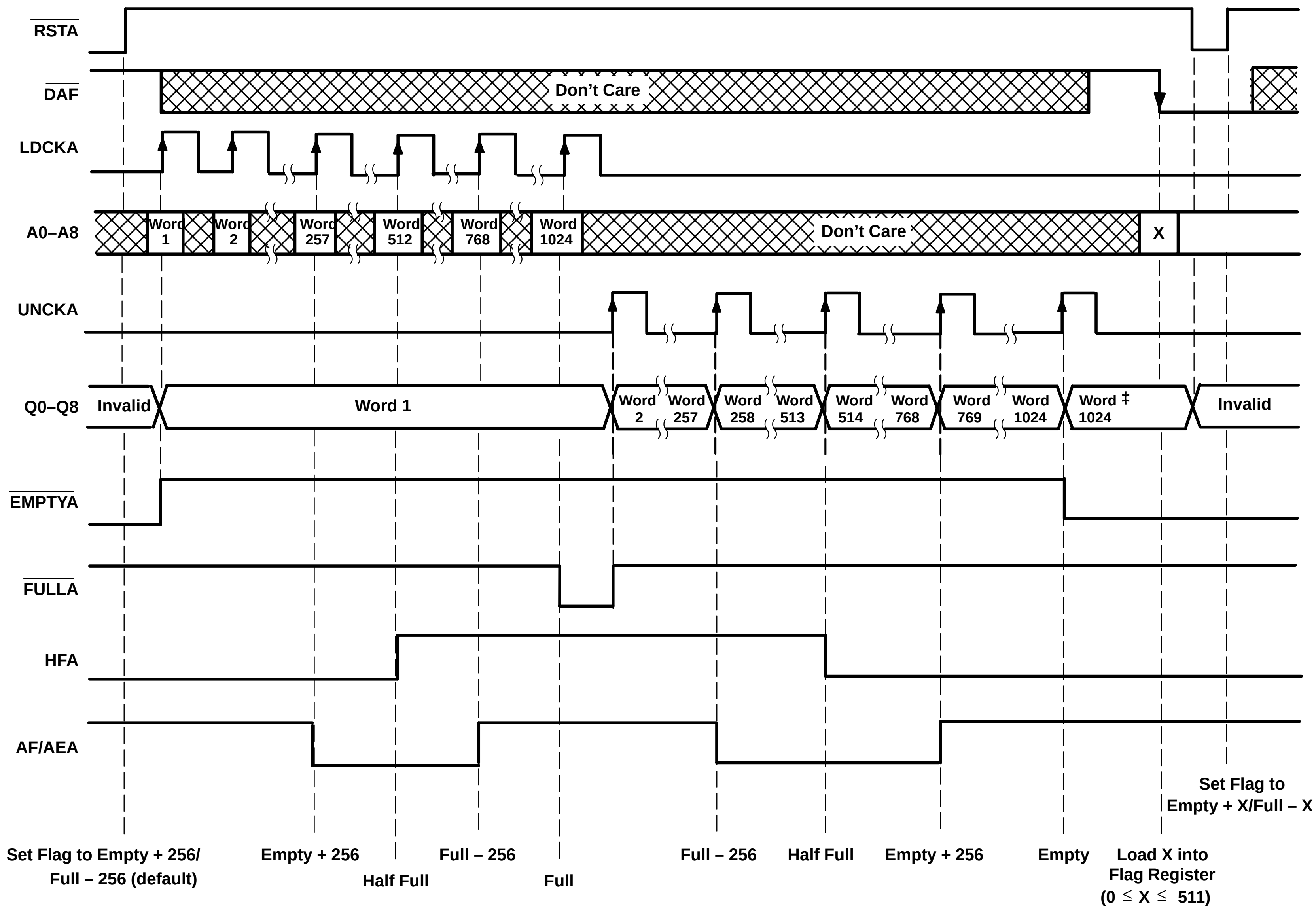
The almost-full/almost-empty flags (AF/AEA, AF/AEB) are programmed during each reset cycle. The almost-full/almost-empty offset value for FIFO A (X) and for FIFO B (Y) is either a user-defined value or the default values of X = 256 and Y = 256. Below are instructions to program AF/AEA using both methods. AF/AEB is programmed in the same manner for FIFO B.

user-defined X

Take $\overline{\mathrm{DAF}}$ from high to low. This stores A0–A8 as X.
If $\overline{\mathrm{RSTA}}$ is not already low, take $\overline{\mathrm{RSTA}}$ low.
With $\overline{\mathrm{DAF}}$ held low, take $\overline{\mathrm{RSTA}}$ high. This defines AF/AEA using X.
To retain the current offset for the next reset, keep $\overline{\mathrm{DAF}}$ low.

default X

To redefine AF/AE using the default value of X = 256, hold $\overline{\mathrm{DAF}}$ high during the reset cycle.



† Operation of FIFO B is identical to that of FIFO A.
‡ Last valid data stays on outputs when FIFO goes empty due to a read.

Figure 1. Timing Diagram for FIFO A†

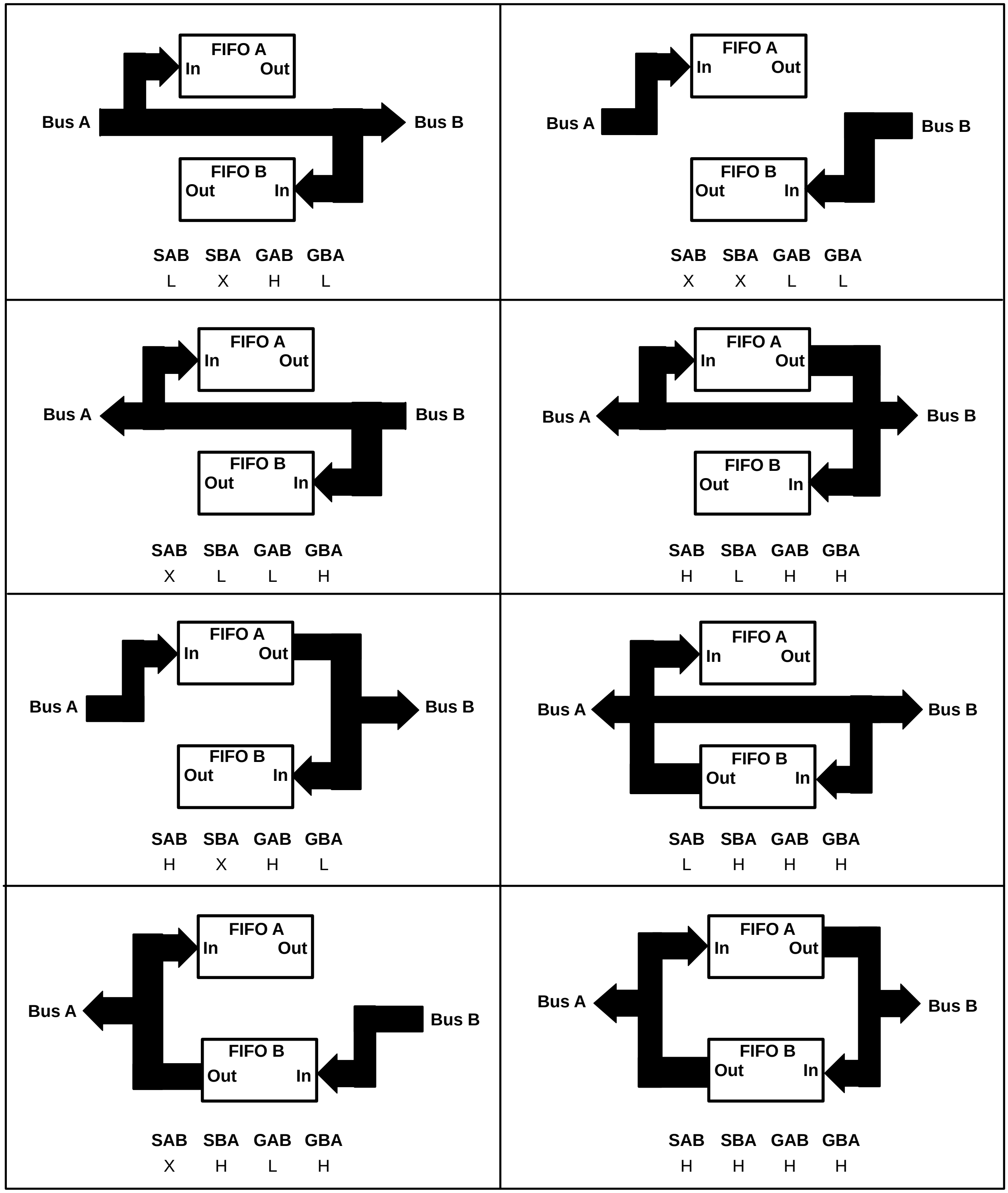


Figure 2. Bus-Management Functions

SELECT-MODE CONTROL

CONTROL		OPERATION	
SAB	SBA	A BUS	B BUS
L	L	Real-time B to A bus	Real-time A to B bus
L	H	FIFO B to A bus	Real-time A to B bus
H	L	Real-time B to A bus	FIFO A to B bus
H	H	FIFO B to A bus	FIFO A to B bus

OUTPUT-ENABLE CONTROL

CONTROL		OPERATION	
GAB	GBA	A BUS	B BUS
H	H	A bus enabled	B bus enabled
L	H	A bus enabled	Isolation/input to B bus
H	L	Isolation/input to A bus	B bus enabled
L	L	Isolation/input to A bus	Isolation/input to B bus

Figure 2. Bus-Management Functions (Continued)

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} . . . . –0.5 V to 7 V
Input voltage range, V_I: Control inputs . . . . –0.5 V to 7 V
I/O ports . . . . –0.5 V to 5.5 V
Voltage range applied to a disabled 3-state output . . . . 5.5 V
Package thermal impedance, θ_{JA} (see Note 1): FN package . . . . 46°C/W
PAG package . . . . 58°C/W
PM package . . . . 67°C/W
Storage temperature range, T_{stg} . . . . –65°C to 150°C
Maximum junction temperature, T_J . . . . 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions

			ACT2235-20		ACT2235-30		ACT2235-40		ACT2235-60		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		4.5	5.5	4.5	5.5	4.5	5.5	4.5	5.5	V
V_{IH}	High-level input voltage		2		2		2		2		V
V_{IL}	Low-level input voltage			0.8		0.8		0.8		0.8	V
I_{OH}	High-level output current	A or B ports		–8		–8		–8		–8	mA
		Status flags		–8		–8		–8		–8	
I_{OL}	Low-level output current	A or B ports		16		16		16		16	mA
		Status flags		8		8		8		8	
T_A	Operating free-air temperature		0	70	0	70	0	70	0	70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP†	MAX	UNIT
V_{OH}		V_{CC} = 4.5 V,	I_{OH} = –8 mA		2.4			V
V_{OL}	Flags	V_{CC} = 4.5 V,	I_{OL} = 8 mA				0.5	V
	I/O ports	V_{CC} = 4.5 V,	I_{OL} = 16 mA				0.5	
I_I		V_{CC} = 5.5 V,	$V_I = V_{CC}$ or 0				±5	µA
I_{OZ}		V_{CC} = 5.5 V,	$V_O = V_{CC}$ or 0				±5	µA
I_{CC}‡		$V_I = V_{CC}$ – 0.2 V or 0				10	400	µA
ΔI_{CC}§		V_{CC} = 5.5 V,	One input at 3.4 V,	Other inputs at V_{CC} or GND			1	mA
C_i		V_I = 0,	f = 1 MHz			4		pF
C_o		V_O = 0,	f = 1 MHz			8		pF

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ I_{CC} is tested with outputs open.
§ This is the supply current when each input is at one of the specified TTL voltage levels, rather than 0 V or V_{CC}.

timing requirements over recommended operating conditions (unless otherwise noted) (see Figure 3)

			'ACT2235-20		'ACT2235-30		'ACT2235-40		'ACT2235-60		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	LDCKA or LDCKB		50		33		25		16.7	MHz
		UNCKA or UNCKB		50		33		25		16.7	
t_w	Pulse duration	$\overline{\text{RSTA}}$ or $\overline{\text{RSTB}}$ low	20		20		25		25		ns
		LDCKA or LDCKB low	8		10		14		20		
		LDCKA or LDCKB high	8		10		14		20		
		UNCKA or UNCKB low	8		10		14		20		
		UNCKA or UNCKB high	8		10		14		20		
		$\overline{\text{DAF}}$ or $\overline{\text{DBF}}$ high	10		10		10		10		
t_{su}	Setup time	Data before LDCKA or LDCKB↑	4		4		5		5		ns
		Define AF/AE: D0–D8 before $\overline{\text{DAF}}$ or $\overline{\text{DBF}}$↓	5		5		5		5		
		Define $\overline{\text{AF/AE}}$: $\overline{\text{DAF}}$ or $\overline{\text{DBF}}$↓ before $\overline{\text{RSTA}}$ or $\overline{\text{RSTB}}$↑	7		7		7		7		
		Define AF/AE (default): $\overline{\text{DAF}}$ or $\overline{\text{DBF}}$ high before $\overline{\text{RSTA}}$ or $\overline{\text{RSTB}}$↑	5		5		5		5		
		$\overline{\text{RSTA}}$ or $\overline{\text{RSTB}}$ inactive (high) before LDCKA or LDCKB↑	5		5		5		5		
t_h	Hold time	Data after LDCKA or LDCKB↑	1		1		2		2		ns
		Define AF/AE: D0–D8 after $\overline{\text{DAF}}$ or $\overline{\text{DBF}}$↓	0		0		0		0		
		Define AF/AE: $\overline{\text{DAF}}$ or $\overline{\text{DBF}}$ low after $\overline{\text{RSTA}}$ or $\overline{\text{RSTB}}$↑	0		0		0		0		
		Define AF/AE (default): $\overline{\text{DAF}}$ or $\overline{\text{DBF}}$ high after $\overline{\text{RSTA}}$ or $\overline{\text{RSTB}}$↑	0		0		0		0		

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 3)

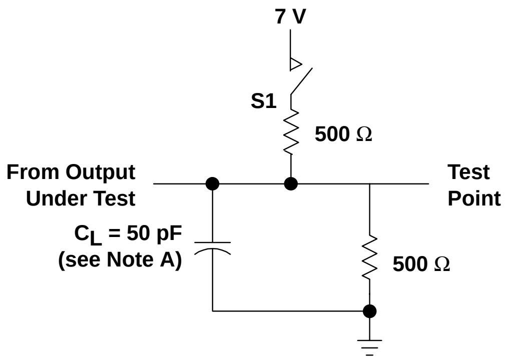
PARAMETER	FROM (INPUT)	TO (OUTPUT)	’ACT2235-20			’ACT2235-30		’ACT2235-40		’ACT2235-60		UNIT
			MIN	TYP†	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}	LDCK		50			33		25		16.7		MHz
	UNCK		50			33		25		16.7		
t_{pd}	LDCK↑, LDCKB↑	B or A	8		22	8	22	8	24	8	26	ns
	UNCKA↑, UNCKB↑		12	17	25	12	25	12	35	12	45	
t_{PLH}	LDCK↑, LDCKB↑	$\overline{\text{EMPTYA}}$, $\overline{\text{EMPTYB}}$	4		15	4	15	4	17	4	19	ns
t_{PHL}	UNCKA↑, UNCKB↑	$\overline{\text{EMPTYA}}$, $\overline{\text{EMPTYB}}$	2		17	2	17	2	19	2	21	ns
	$\overline{\text{RSTA}}$↓, $\overline{\text{RSTB}}$↓		2		18	2	18	2	20	2	22	
	LDCK↑, LDCKB↑	$\overline{\text{FULLA}}$, $\overline{\text{FULLB}}$	4		15	4	15	4	17	4	19	
t_{PLH}	UNCKA↑, UNCKB↑	$\overline{\text{FULLA}}$, $\overline{\text{FULLB}}$	4		15	4	15	4	17	4	19	ns
	$\overline{\text{RSTA}}$↓, $\overline{\text{RSTB}}$↓	$\overline{\text{FULLA}}$, $\overline{\text{FULLB}}$	2		15	2	15	2	17	2	19	
		AF/AEA, AF/AEB	2		15	2	15	2	17	2	19	
	LDCK↑, LDCKB↑	HFA, HFB	2		15	2	15	2	17	2	19	
t_{PHL}	UNCKA↑, UNCKB↑	HFA, HFB	4		18	4	18	4	20	4	22	ns
	$\overline{\text{RSTA}}$↓, $\overline{\text{RSTB}}$↓		1		15	1	15	1	17	1	19	
t_{pd}	SAB or SBA‡	B or A	1		11	1	11	1	12	1	14	ns
	A or B		1		11	1	11	1	12	1	14	
	LDCK↑, LDCKB↑	AF/AEA, AF/AEB	2		18	2	18	2	20	2	22	
	UNCKA↑, UNCKB↑		2		18	2	18	2	20	2	22	
t_{en}	GBA or GAB	A or B	2		11	2	11	2	13	2	15	ns
t_{dis}	GBA or GAB	A or B	1		9	1	9	1	11	1	13	ns

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

operating characteristics, V_{CC} = 5 V, T_A = 25°C

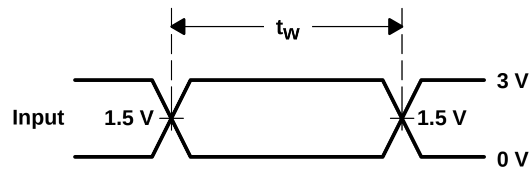
PARAMETER			TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance per 1K bits	Outputs enabled	C_L = 50 pF, f = 5 MHz	71	pF
		Outputs disabled		57	

PARAMETER MEASUREMENT INFORMATION

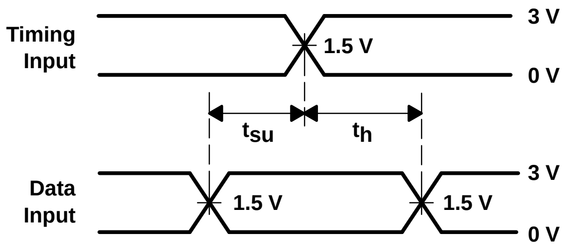


LOAD CIRCUIT

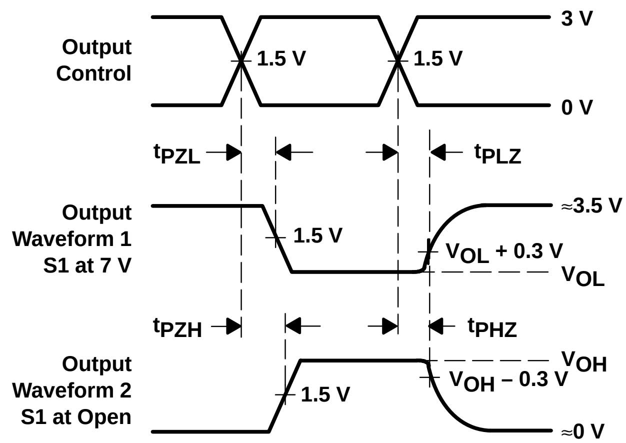
PARAMETER		S1
t_{en}	t_{PZH}	Open
	t_{PZL}	Closed
t_{dis}	t_{PHZ}	Open
	t_{PLZ}	Closed
t_{pd}	t_{PLH}	Open
	t_{PHL}	Open



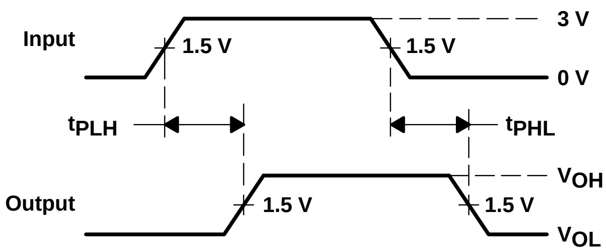
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

NOTE A: C_L includes probe and jig capacitance.

Figure 3. Load Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

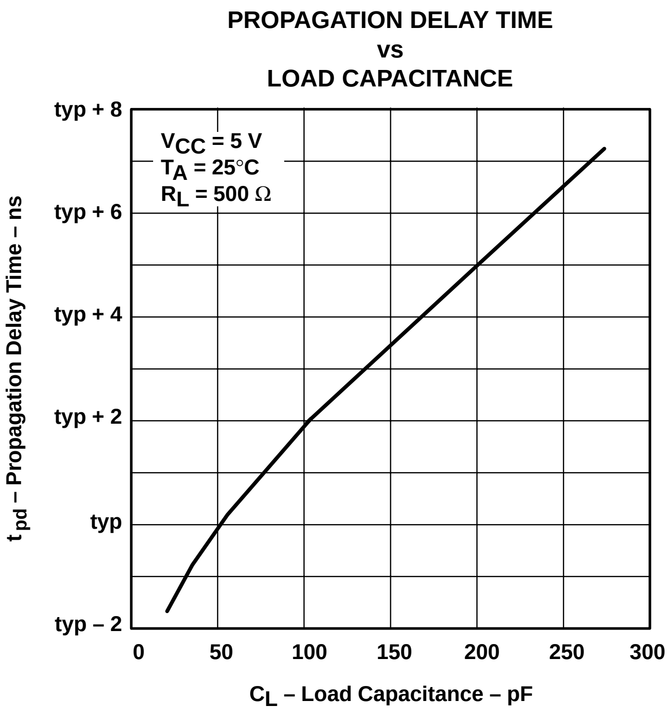


Figure 4

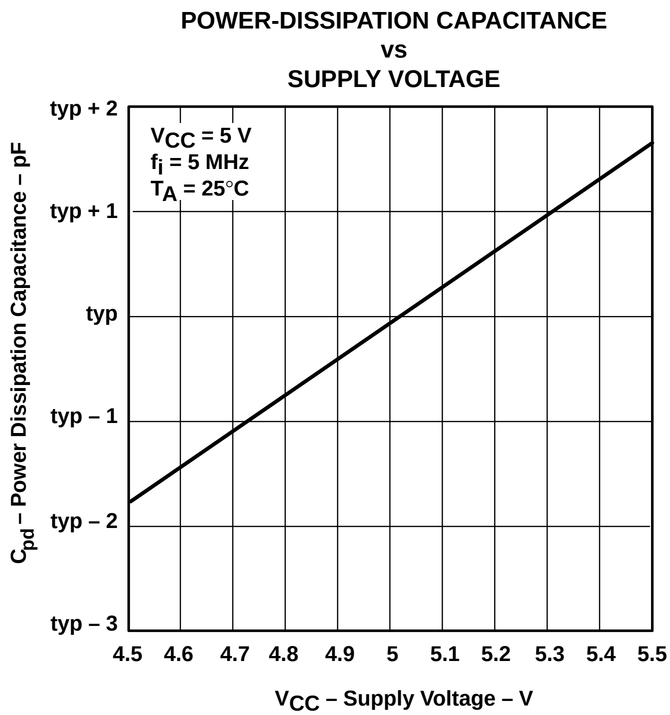


Figure 5

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74ACT2235-20FN	ACTIVE	PLCC	FN	44	26	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-20PAG	ACTIVE	TQFP	PAG	64	160	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-20PM	OBSOLETE	LQFP	PM	64		TBD	Call TI	Call TI
SN74ACT2235-30FN	OBSOLETE	PLCC	FN	44		TBD	Call TI	Call TI
SN74ACT2235-30PAG	ACTIVE	TQFP	PAG	64	160	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-30PM	OBSOLETE	LQFP	PM	64		TBD	Call TI	Call TI
SN74ACT2235-40FN	ACTIVE	PLCC	FN	44	26	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-40PAG	ACTIVE	TQFP	PAG	64	160	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-40PM	OBSOLETE	LQFP	PM	64		TBD	Call TI	Call TI
SN74ACT2235-60FN	ACTIVE	PLCC	FN	44	26	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-60PAG	ACTIVE	TQFP	PAG	64	160	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ACT2235-60PM	OBSOLETE	LQFP	PM	64		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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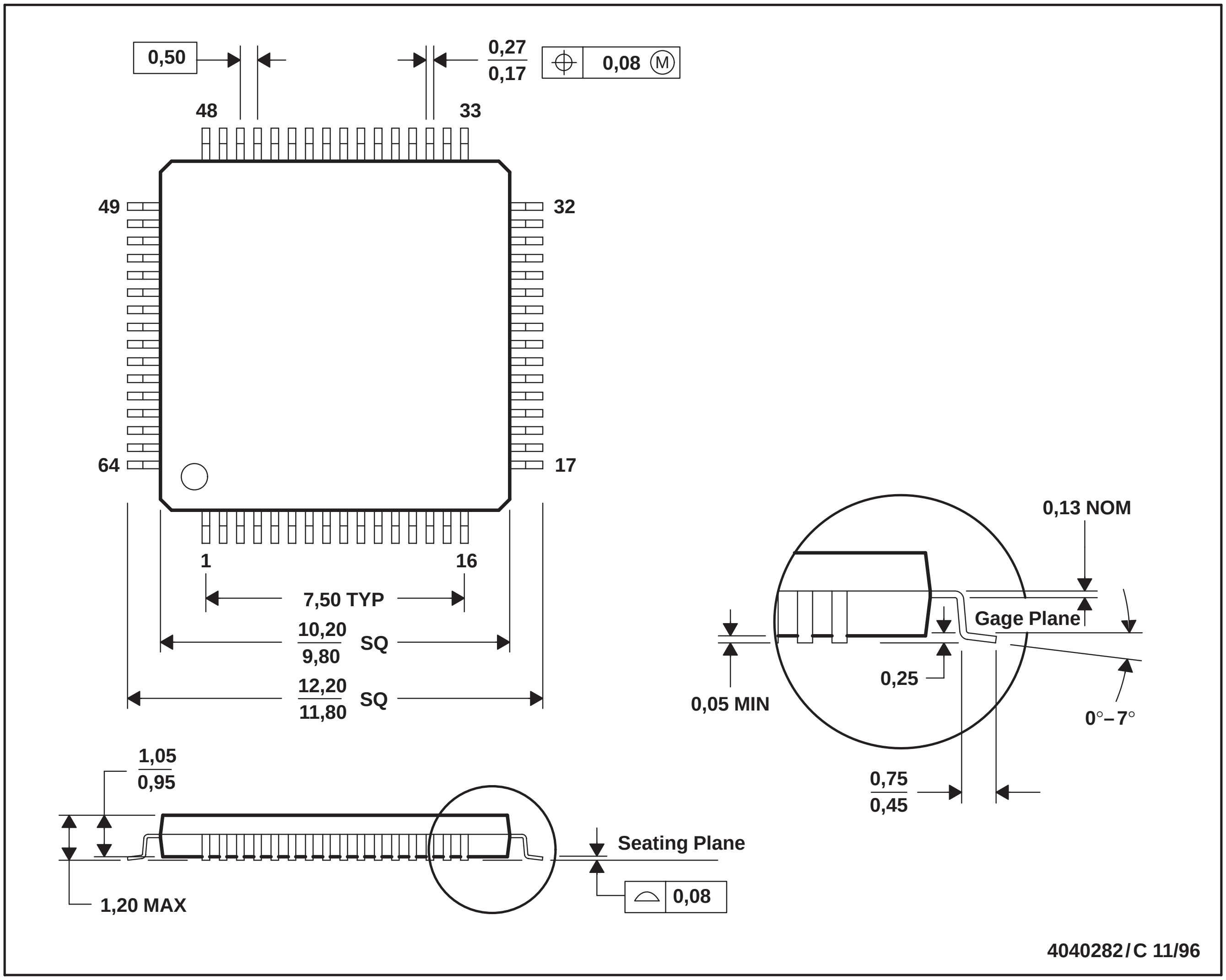
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

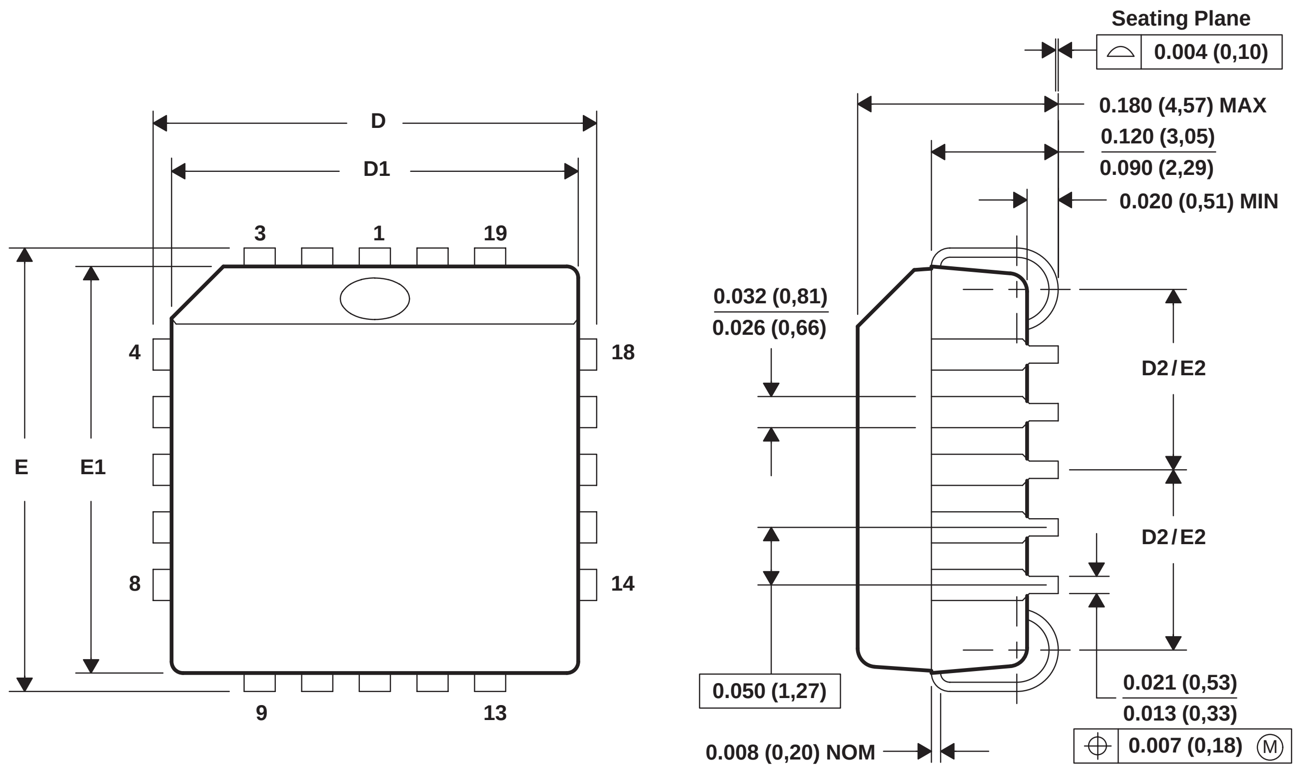
PAG (S-PQFP-G64) **PLASTIC QUAD FLATPACK**



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-026

FN (S-PQCC-J)** **PLASTIC J-LEADED CHIP CARRIER**

20 PIN SHOWN

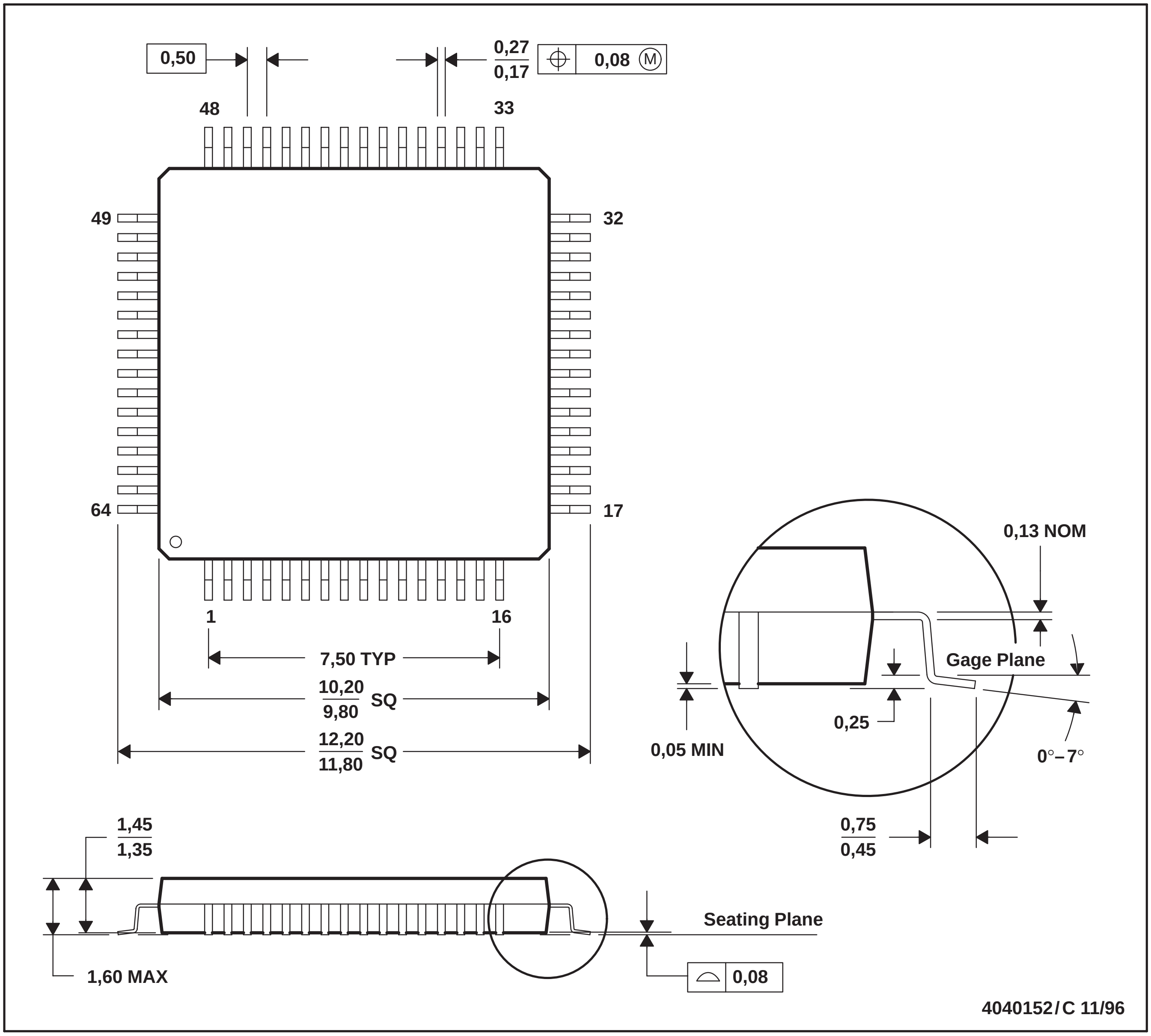


NO. OF PINS **	D / E		D1 / E1		D2 / E2	
	MIN	MAX	MIN	MAX	MIN	MAX
20	0.385 (9,78)	0.395 (10,03)	0.350 (8,89)	0.356 (9,04)	0.141 (3,58)	0.169 (4,29)
28	0.485 (12,32)	0.495 (12,57)	0.450 (11,43)	0.456 (11,58)	0.191 (4,85)	0.219 (5,56)
44	0.685 (17,40)	0.695 (17,65)	0.650 (16,51)	0.656 (16,66)	0.291 (7,39)	0.319 (8,10)
52	0.785 (19,94)	0.795 (20,19)	0.750 (19,05)	0.756 (19,20)	0.341 (8,66)	0.369 (9,37)
68	0.985 (25,02)	0.995 (25,27)	0.950 (24,13)	0.958 (24,33)	0.441 (11,20)	0.469 (11,91)
84	1.185 (30,10)	1.195 (30,35)	1.150 (29,21)	1.158 (29,41)	0.541 (13,74)	0.569 (14,45)

4040005 / B 03/95

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-018

PM (S-PQFP-G64) **PLASTIC QUAD FLATPACK**



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-026
D. May also be thermally enhanced plastic with leads connected to the die pads.