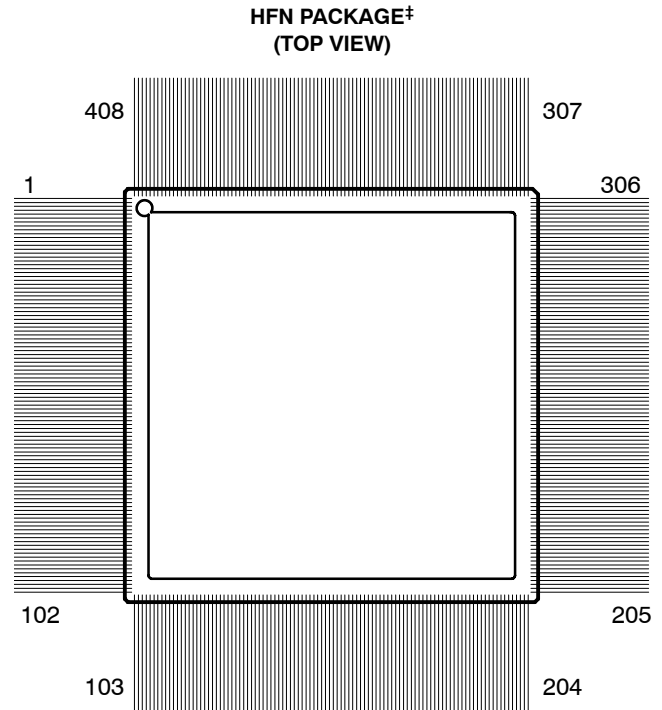


SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

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- **Performance:**
 - 80 Million Floating-Point Operations Per Second (MFLOPS) With 496-Mbps-Burst I/O Rate for 40-MHz Modules
 - Zero-Wait-State Local Memory for Each Processor
- **Organization:**
 - 128K-Word × 32-Bit Static Random-Access Memory (SRAM) (SMJ320MCM42D)
 - 256K-Word × 32-Bit SRAM (SMJ320MCM42C)
- Compliant With MIL-PRF-38535 QML
- Dual C40 Performance With Local Memory Requiring Only 8.7 Square Inches of Board Space
- Enhanced Performance Offered By Multichip-Module Solution
 - SMJ320MCM42C
 - 67% Reduction in Number of Interconnects
 - 54% Reduction (Minimum) in Board Area
 - Estimated 38% Reduction in Power Dissipation Due to Reduced Parasitic Capacitance and Interconnect Lengths
 - SMJ320MCM42D
 - 56% Reduction in Number of Interconnects
 - 30% Reduction (Minimum) in Board Area
 - Estimated 20% Reduction in Power Dissipation Due to Reduced Parasitic Capacitance and Interconnect Lengths
- Four Memory Ports for High Data Bandwidth
 - Two Full 2G-Word External Buses
- Two Internal Buses Mapped to Memory
 - 128K-Word × 32-Bit SRAM for Each C40 Local Bus (SMJ320MCM42D)
 - 256K-Word × 32-Bit SRAM for Each C40 Local Bus (SMJ320MCM42C)
- Ten External Communication Ports for Direct Processor-to-Processor Communication



[‡] Terminal assignment information is provided by the terminal assignments table. Package is shown for pinout reference only.

- IEEE-1149.1[†] (JTAG) Boundary-Scan Compatible
- 408-Lead Ceramic Quad Flatpack Package (HFN Suffix)
- Operating Free-Air Temperature Ranges:
 - 55°C to 125°C . . . (Military)
 - 0°C to 70°C . . . (Commercial)
- Communication-Port Connection Provided Between C40s for Interprocessor Communication



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.

[†] IEEE Standard 1149.1-1990 Standard Test-Access Port and Boundary-Scan Architecture

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
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On products compliant to MIL-STD-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

SMJ320MCM42C, SMJ320MCM42D

DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

description

The 42 dual C40 multichip module (MCM) contains two SMJ320C40 digital signal processors (DSPs) with 128K words $\times$ 32 bits (42D) or 256K words $\times$ 32 bits (42C) of zero-wait-state SRAMs mapped to each local bus. Global address and data buses with two sets of control signals are routed externally for each processor, allowing external memory to be accessed. The external global bus provides a continuous address reach of 2G words.

The dual C40 configuration allows standard microprocessor initialization using the bootstrap loader. Both reset-vector-control terminals are brought out to external terminals for each processor. A single CLKIN line and a RESET line feed both processors in parallel, minimizing clock skew and allowing easy synchronization for interlocked operations.

Communication port 0 of CPU #1 connects to communication port 3 of CPU #2 for direct processor-to-processor communication.

The IEEE-1149.1 (JTAG) test ports of the C40s are connected serially to allow scan operations and emulation of the module as a whole. Testability of the 42 adds value and reduces development and support costs. Texas Instruments offers a wide variety of ANSI/IEEE-1149.1 products and support.

The 42 dual C40 MCM is packaged in a 408-pin ceramic quad flat pack. The 42 dual C40 MCM is available in both a commercial temperature range (0°C to 70°C) and a military temperature range (-55°C to 125°C) option.

For additional information when designing for cold temperature operation, please see Texas Instruments application report *320C3x, 320C4x and 320MCM42x Power-up Sensitivity at Cold Temperature*, literature number SGUA001.



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SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

device symbol nomenclature

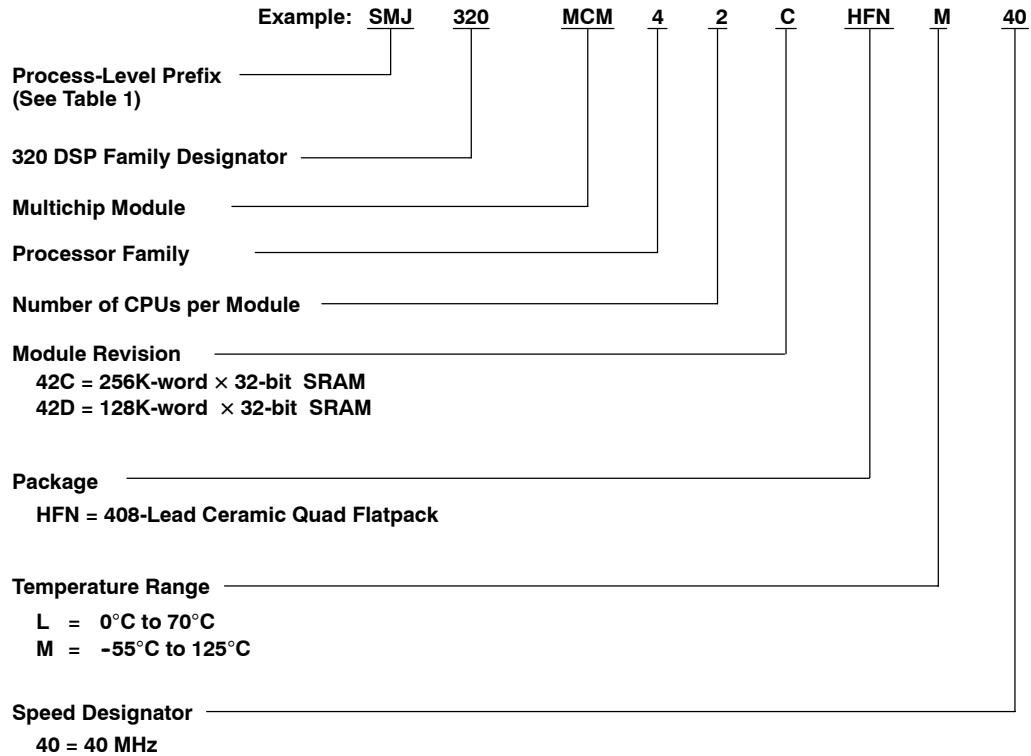


Table 1. MCM Processing Matrix

PROCESS LEVEL	TEMPERATURE RANGE		DIE	100% PROCESSED	SPEED TEST	TEST TEMPERATURE RANGE	QUALIFICATION TESTING
SM	L version	0°C to 70°C	Probed	No	No	25°C to 70°C	Package
	M version	-55°C to 125°C	Probed	No	Yes	-55°C to 125°C	Package
SMJ [†]	M version	-55°C to 125°C	KGD [‡]	Yes	Yes	-55°C to 125°C	MIL-H-38534

[†] SMJ-level product is full MIL-PRF-38535 QML compliant.

[‡] KGD stands for the known-good-die strategy as defined in the reference documentation section.



SMJ320MCM42C, SMJ320MCM42D

DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

Terminal Assignments

NO.	TERMINAL NAME	NO.	TERMINAL NAME	NO.	TERMINAL NAME	NO.	TERMINAL NAME
1	ROMEN_C40_#1	52	A10_C40_#1	103	RDY1_C40_#2	154	C4D5_C40_#2
2	IIOF0_C40_#1	53	A9_C40_#1	104	VSS_DR	155	C4D4_C40_#2
3	IIOF1_C40_#1	54	A8_C40_#1	105	VSS_CL	156	C4D3_C40_#2
4	IIOF2_C40_#1	55	A7_C40_#1	106	LOCK_C40_#2	157	C4D2_C40_#2
5	IIOF3_C40_#1	56	A6_C40_#1	107	VCC_CL	158	C4D1_C40_#2
6	NMI_C40_#1	57	A5_C40_#1	108	VSS_CL	159	C4D0_C40_#2
7	VCC_DR	58	A4_C40_#1	109	CE0_C40_#2	160	VCC_DR
8	VSS_CL	59	VCC_DR	110	RDY0_C40_#2	161	VCC_DR
9	TCLK0_C40_#1	60	A3_C40_#1	111	DE_C40_#2	162	VSS_CL
10	TCLK1_C40_#1	61	A2_C40_#1	112	TCK_COMM	163	C2D7_C40_#2
11	H3_C40_#1	62	A1_C40_#1	113	TDO_C40_#2	164	C2D6_C40_#2
12	H1_C40_#1	63	A0_C40_#1	114	TMS_COMM	165	C2D5_C40_#2
13	VSS_CL	64	D31_C40_#2	115	TRST_COMM	166	C2D4_C40_#2
14	TACK_C40_#1	65	D30_C40_#2	116	EMU0_COMM	167	C2D3_C40_#2
15	CLKIN_COMM	66	D29_C40_#2	117	EMU1_COMM	168	C2D2_C40_#2
16	VCC_DR	67	D28_C40_#2	118	PAGE1_C40_#2	169	C2D1_C40_#2
17	VCC_CL	68	D27_C40_#2	119	R/W1_C40_#2	170	C2D0_C40_#2
18	VCC_DR	69	D26_C40_#2	120	STRB1_C40_#2	171	CRDY2_C40_#2
19	VSS_CL	70	VCC_DR	121	STAT0_C40_#2	172	CSTRB2_C40_#2
20	VSS_DR	71	D25_C40_#2	122	STAT1_C40_#2	173	CACK2_C40_#2
21	VCC_DR	72	D24_C40_#2	123	VSS_CL	174	CREQ2_C40_#2
22	VCC_DR	73	D23_C40_#2	124	STAT2_C40_#2	175	VCC_DR
23	VCC_CL	74	D22_C40_#2	125	STAT3_C40_#2	176	CRDY1_C40_#2
24	VSS_CL	75	D21_C40_#2	126	PAGE0_C40_#2	177	CSTRB1_C40_#2
25	VSS_DR	76	D20_C40_#2	127	R/W0_C40_#2	178	CACK1_C40_#2
26	VSS_CL	77	D19_C40_#2	128	STRB0_C40_#2	179	CREQ1_C40_#2
27	VCC_DR	78	D18_C40_#2	129	AE_C40_#2	180	CRDY0_C40_#2
28	A30_C40_#1	79	D17_C40_#2	130	RESETLOC1_C40_#2	181	CSTRB0_C40_#2
29	A29_C40_#1	80	D16_C40_#2	131	VCC_DR	182	CACK0_C40_#2
30	A28_C40_#1	81	VSS_CL	132	RESETLOC0_C40_#2	183	CREQ0_C40_#2
31	VCC_DR	82	VSS_CL	133	RESET_COMM	184	VSS_DR
32	A27_C40_#1	83	VCC_DR	134	CRDY5_C40_#2	185	VSS_CL
33	A26_C40_#1	84	VSS_DR	135	CSTRB5_C40_#2	186	VSS_DR
34	A25_C40_#1	85	D15_C40_#2	136	CACK5_C40_#2	187	VCC_DR
35	A24_C40_#1	86	D14_C40_#2	137	CREQ5_C40_#2	188	C1D7_C40_#2
36	A23_C40_#1	87	D13_C40_#2	138	CRDY4_C40_#2	189	C1D6_C40_#2
37	A22_C40_#1	88	D12_C40_#2	139	CSTRB4_C40_#2	190	C1D5_C40_#2
38	A21_C40_#1	89	D11_C40_#2	140	CACK4_C40_#2	191	C1D4_C40_#2
39	A20_C40_#1	90	D10_C40_#2	141	CREQ4_C40_#2	192	C1D3_C40_#2
40	A19_C40_#1	91	D9_C40_#2	142	VCC_DR	193	C1D2_C40_#2
41	A18_C40_#1	92	D8_C40_#2	143	C5D7_C40_#2	194	C1D1_C40_#2
42	A17_C40_#1	93	D7_C40_#2	144	C5D6_C40_#2	195	C1D0_C40_#2
43	VCC_DR	94	D6_C40_#2	145	C5D5_C40_#2	196	VCC_DR
44	VSS_CL	95	D5_C40_#2	146	C5D4_C40_#2	197	C0D7_C40_#2
45	VSS_DR	96	VCC_DR	147	C5D3_C40_#2	198	C0D6_C40_#2
46	A16_C40_#1	97	D4_C40_#2	148	C5D2_C40_#2	199	C0D5_C40_#2
47	A15_C40_#1	98	D3_C40_#2	149	C5D1_C40_#2	200	C0D4_C40_#2
48	A14_C40_#1	99	D2_C40_#2	150	C5D0_C40_#2	201	C0D3_C40_#2
49	A13_C40_#1	100	D1_C40_#2	151	VCC_DR	202	C0D2_C40_#2
50	A12_C40_#1	101	D0_C40_#2	152	C4D7_C40_#2	203	C0D1_C40_#2
51	A11_C40_#1	102	CE1_C40_#2	153	C4D6_C40_#2	204	C0D0_C40_#2



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SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

Terminal Assignments (Continued)

TERMINAL NO. NAME	TERMINAL NO. NAME	TERMINAL NO. NAME	TERMINAL NO. NAME
205 ROMEN_C40_#2	256 A9_C40_#2	307 V _{SS} _DR	358 V _{SS} _DR
206 IIOF0_C40_#2	257 A8_C40_#2	308 V _{SS} _CL	359 V _{CC} _DR
207 IIOF1_C40_#2	258 A7_C40_#2	309 LOCK_C40_#1	360 C3D7_C40_#1
208 IIOF2_C40_#2	259 A6_C40_#2	310 V _{CC} _CL	361 C3D6_C40_#1
209 IIOF3_C40_#2	260 A5_C40_#2	311 V _{SS} _CL	362 C3D5_C40_#1
210 NMI_C40_#2	261 A4_C40_#2	312 CE0_C40_#1	363 C3D4_C40_#1
211 V _{CC} _DR	262 V _{CC} _DR	313 RDY0_C40_#1	364 C3D3_C40_#1
212 V _{SS} _CL	263 A3_C40_#2	314 DE_C40_#1	365 C3D2_C40_#1
213 TCLK0_C40_#2	264 A2_C40_#2	315 TDI_C40_#1	366 C3D1_C40_#1
214 TCLK1_C40_#2	265 A1_C40_#2	316 PAGE1_C40_#1	367 C3D0_C40_#1
215 H3_C40_#2	266 A0_C40_#2	317 R/W1_C40_#1	368 V _{CC} _DR
216 H1_C40_#2	267 D31_C40_#1	318 STRB1_C40_#1	369 V _{SS} _CL
217 V _{SS} _CL	268 D30_C40_#1	319 STAT0_C40_#1	370 C2D7_C40_#1
218 IACK_C40_#2	269 D29_C40_#1	320 STAT1_C40_#1	371 C2D6_C40_#1
219 V _{CC} _DR	270 D28_C40_#1	321 V _{SS} _CL	372 C2D5_C40_#1
220 V _{CC} _DR	271 D27_C40_#1	322 STAT2_C40_#1	373 C2D4_C40_#1
221 V _{CC} _DR	272 D26_C40_#1	323 STAT3_C40_#1	374 C2D3_C40_#1
222 V _{SS} _CL	273 V _{CC} _DR	324 PAGE0_C40_#1	375 C2D2_C40_#1
223 V _{SS} _DR	274 D25_C40_#1	325 R/W0_C40_#1	376 C2D1_C40_#1
224 V _{CC} _DR	275 D24_C40_#1	326 STRB0_C40_#1	377 C2D0_C40_#1
225 V _{CC} _DR	276 D23_C40_#1	327 AE_C40_#1	378 V _{SS} _DR
226 V _{CC} _CL	277 D22_C40_#1	328 RESETLOC1_C40_#1	379 V _{CC} _DR
227 V _{SS} _CL	278 D21_C40_#1	329 V _{CC} _DR	380 CRDY3_C40_#1
228 V _{SS} _DR	279 D20_C40_#1	330 RESETLOC0_C40_#1	381 CSTRB3_C40_#1
229 V _{SS} _CL	280 D19_C40_#1	331 CRDY5_C40_#1	382 CACK3_C40_#1
230 V _{CC} _DR	281 D18_C40_#1	332 CSTRB5_C40_#1	383 CREQ3_C40_#1
231 A30_C40_#2	282 D17_C40_#1	333 CACK5_C40_#1	384 V _{CC} _CL
232 A29_C40_#2	283 D16_C40_#1	334 CREQ5_C40_#1	385 V _{SS} _CL
233 A28_C40_#2	284 V _{SS} _CL	335 CRDY4_C40_#1	386 CRDY2_C40_#1
234 V _{CC} _DR	285 V _{SS} _CL	336 CSTRB4_C40_#1	387 CSTRB2_C40_#1
235 A27_C40_#2	286 V _{CC} _DR	337 CACK4_C40_#1	388 CACK2_C40_#1
236 A26_C40_#2	287 V _{SS} _DR	338 CREQ4_C40_#1	389 CREQ2_C40_#1
237 A25_C40_#2	288 D15_C40_#1	339 V _{SS} _DR	390 V _{CC} _DR
238 A24_C40_#2	289 D14_C40_#1	340 V _{CC} _DR	391 CRDY1_C40_#1
239 A23_C40_#2	290 D13_C40_#1	341 C5D7_C40_#1	392 CSTRB1_C40_#1
240 A22_C40_#2	291 D12_C40_#1	342 C5D6_C40_#1	393 CACK1_C40_#1
241 A21_C40_#2	292 D11_C40_#1	343 C5D5_C40_#1	394 CREQ1_C40_#1
242 A20_C40_#2	293 D10_C40_#1	344 C5D4_C40_#1	395 V _{SS} _DR
243 A19_C40_#2	294 D9_C40_#1	345 C5D3_C40_#1	396 V _{SS} _CL
244 A18_C40_#2	295 D8_C40_#1	346 C5D2_C40_#1	397 V _{SS} _DR
245 A17_C40_#2	296 D7_C40_#1	347 C5D1_C40_#1	398 V _{CC} _DR
246 V _{CC} _DR	297 D6_C40_#1	348 C5D0_C40_#1	399 C1D7_C40_#1
247 V _{SS} _CL	298 D5_C40_#1	349 V _{CC} _DR	400 C1D6_C40_#1
248 V _{SS} _DR	299 V _{CC} _DR	350 C4D7_C40_#1	401 C1D5_C40_#1
249 A16_C40_#2	300 D4_C40_#1	351 C4D6_C40_#1	402 C1D4_C40_#1
250 A15_C40_#2	301 D3_C40_#1	352 C4D5_C40_#1	403 C1D3_C40_#1
251 A14_C40_#2	302 D2_C40_#1	353 C4D4_C40_#1	404 C1D2_C40_#1
252 A13_C40_#2	303 D1_C40_#1	354 C4D3_C40_#1	405 C1D1_C40_#1
253 A12_C40_#2	304 D0_C40_#1	355 C4D2_C40_#1	406 C1D0_C40_#1
254 A11_C40_#2	305 CE1_C40_#1	356 C4D1_C40_#1	407 V _{CC} _DR
255 A10_C40_#2	306 RDY1_C40_#1	357 C4D0_C40_#1	408 V _{SS} _DR



SMJ320MCM42C, SMJ320MCM42D

DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

functional block diagram

The following terminals have 10-k Ω pullup resistors added within the module:

- $\overline{\text{CREQ}}_x_C40_ \#1$, $\overline{\text{CACK}}_x_C40_ \#1$, $\overline{\text{CSTRB}}_x_C40_ \#1$, $\overline{\text{CRDY}}_x_C40_ \#1$, where $x = 1, 2, 3, 4$, or 5
- $\overline{\text{CREQ}}_y_C40_ \#2$, $\overline{\text{CACK}}_y_C40_ \#2$, $\overline{\text{CSTRB}}_y_C40_ \#2$, $\overline{\text{CRDY}}_y_C40_ \#2$, where $y = 0, 1, 2, 4$, or 5
- $\overline{\text{LCE1}}_C40_ \#1$, $\overline{\text{LCE2}}_C40_ \#2$ (internal connections)

A total of 18 decoupling capacitors have been connected within the module.

Between clean power and ground, the following capacitors have been connected:

- Two 0.1- μF capacitors
- Two 0.01- μF capacitors

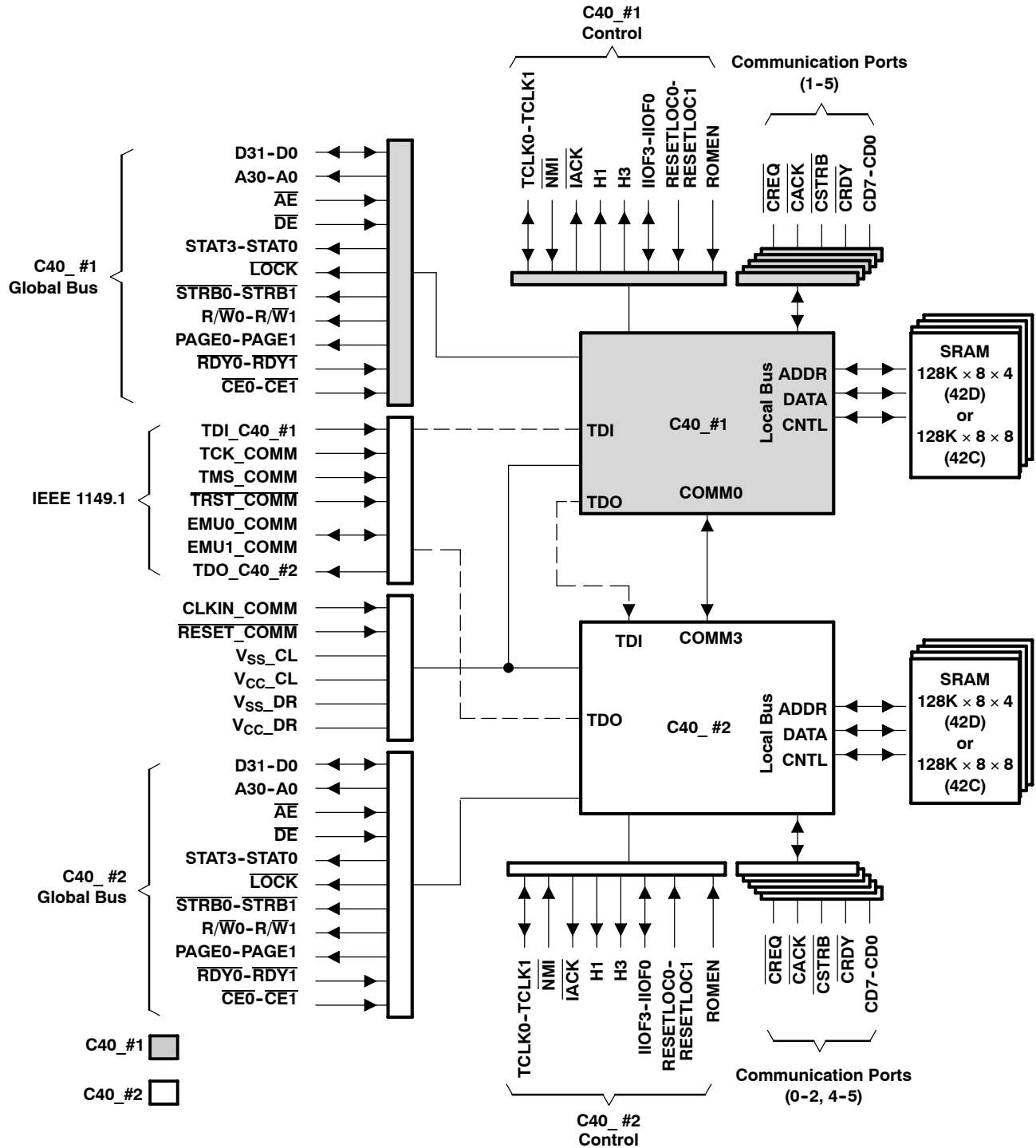
Between dirty power and ground, the following capacitors have been connected:

- Twelve 0.1- μF capacitors
- Two 0.01- μF capacitors

SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

functional block diagram (continued)



SMJ320MCM42C, SMJ320MCM42D
DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

operational overview

Treatment of the detailed operation of the C40 device is not included in the scope of this document. See the *TMS320C4x User's Guide* (literature number SPRU063) for a detailed description of this DSP. See Figure 1 and Figure 2 for the memory map.

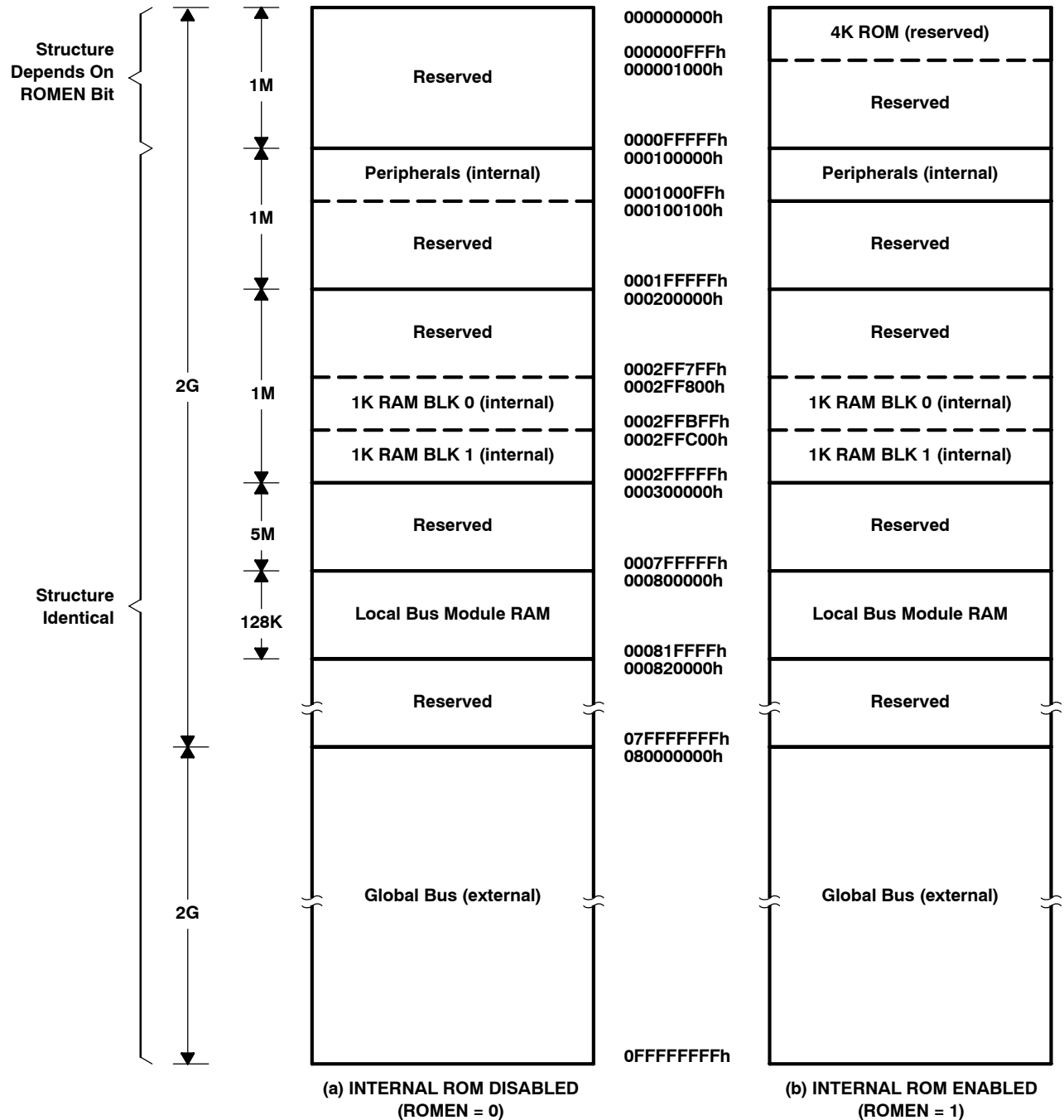


Figure 1. Memory Map for Each C40 Within the Multichip Module (42D)

operational overview (continued)

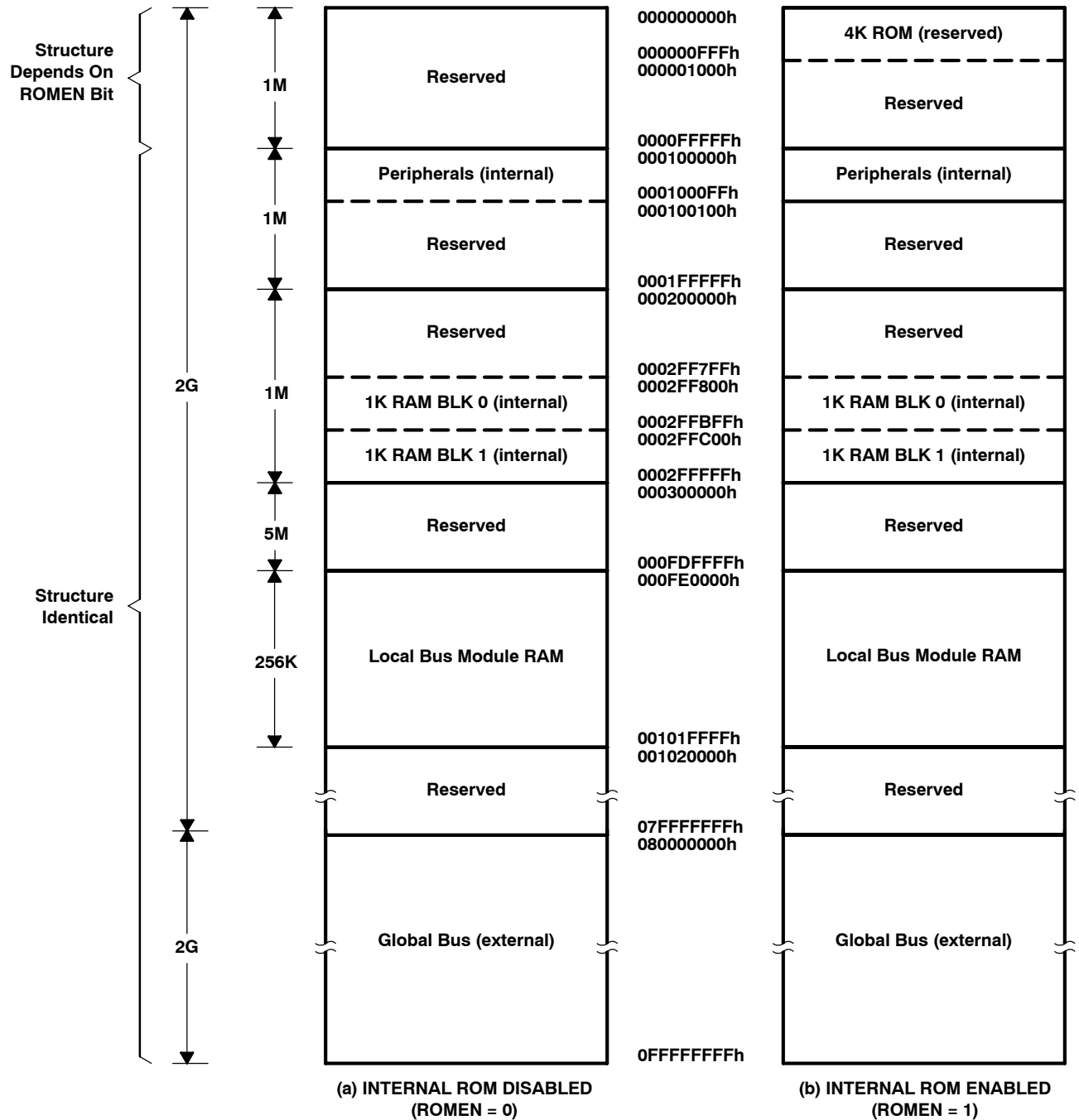


Figure 2. Memory Map for Each C40 Within the Multichip Module (42C)

SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

application note

For all MCM42x product manufactured prior to August 1, 2001 (i.e., date codes older than 0131), users should reference the application note on page 10 of SGKS001B (July 1997 - Revised February 2000) for proper memory function.

The following application note applies to MCM42x product manufactured after August 1, 2001 (i.e., date codes newer than 0131). Changes to this application note from the previous data sheet revision impact the MCM42C only. Note: The information for the MCM42D below remains unchanged regardless of the date code.

For all MCM42C, the location of the local memory is different from that of the MCM42D. In addition, for proper use of the memory, it is necessary to understand how the memory is controlled.

For product manufactured with date codes newer than 0131, the following applies to the MCM42C only: The entire memory array is controlled by $\overline{\text{LSTRB0}}$. The value to be loaded to the STRB ACTIVE area (bits 28–24) should be 11110 (binary). This will require a code change for customers who developed code intended for use with MCM42C devices manufactured with date codes older than 0131.

For the MCM42D, $\overline{\text{LSTRB0}}$ controls the entire 128K. The default value loaded into the STRB ACTIVE area of the LMICR after reset is sufficient to control the memory. The default value is 11110, and tells the C40 that the entire local memory is controlled by $\overline{\text{LSTRB0}}$.

This subject is discussed in depth in Chapter 9 of the *1996 TMS320C4x User's Guide* (literature number SPRU063). In particular, section 9.3 discusses the proper use of the memory interface control registers.

reference documentation and data sheet scope

The SMJ320MCM42 is qualified to MIL-PRF-38535. Electrical continuity of the module is ensured through the use of IEEE-1149.1-compatible boundary-scan testing and functional checkout of the local SRAM space.

KGD refers to TI known-good-die strategy. TI KGDs are fully tested over the military temperature range per MIL-PRF-38535 QML. Electrical tests ensure compliance of the C40 KGD components to the SMJ320C40 data sheet (literature number SGUS017) over the operating temperature range. Module timings are virtually unchanged from the SMJ320C40 data sheet timings. An SMJ320C40 data sheet is provided for customer reference only and does not imply MCM compliance to published timings.

For a description of the C40 operation and application information, see the *TMS320C4x User's Guide* (literature number SPRU063).



SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

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

Supply voltage range, V_{CC} (see Note 1)	- 0.3 V to 7 V
Voltage range on any terminal	- 0.3 V to 7 V
Output voltage range, V_O	- 0.3 V to 7 V
Operating free-air temperature range (commercial [L version]), T_A	0°C to 70°C
(military [M version]), T_A	- 55°C to 125°C
Junction temperature, T_J	150°C
Storage temperature range, T_{stg}	- 65°C to 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: All voltage values are with respect to V_{SS} .

recommended operating conditions

		MIN	MAX	UNIT
V_{CC} Supply voltage	42-33	4.5	5.5	V
	42-40	4.75	5.25	
V_{IH} High-level input voltage	CLKIN_COMM	2.6	$V_{CC} + 0.3$	V
	$\overline{CSTRBx}$, $\overline{CRDYx}$, $\overline{CREQx}$, $\overline{CACKx}$	2.2	$V_{CC} + 0.3$	
	All others	2	$V_{CC} + 0.3$	
V_{IL} Low-level input voltage		- 0.3	0.8	V
I_{OH} High-level output current			- 300	μA
I_{OL} Low-level output current			2	mA
T_A Operating free-air temperature range	L version	0	70	°C
	M version	- 55	125	

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (see Note 2)

PARAMETER	TEST CONDITIONS [†]	MIN	TYP	MAX	UNIT
V_{OH} High-level output voltage	$V_{CC} = \text{MIN}$, $I_{OH} = \text{MAX}$	2.4	3		V
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}$, $I_{OL} = \text{MAX}$		0.3	0.6	V
I_{CC} Supply current	42D	$V_{CC} = \text{MAX}$	0.7	1.1	A
	42C		0.8	1.5	
I_Z 3-state current	$V_I = V_{SS}$ to V_{CC}	- 20		20	μA
I_I Input current	$V_I = V_{SS}$ to V_{CC}	- 10		10	μA
I_{I2} Input current, COMM signal (see Note 3)	$V_I = V_{SS}$ to V_{CC}	- 20		20	μA
I_{IP} Input current, internal pullup (see Note 4)	$V_I = V_{SS}$ to V_{CC}	- 400		30	μA
I_{IP2} Input current, dual internal pullup (see Note 5)	$V_I = V_{SS}$ to V_{CC}	- 800		60	μA
I_{IC} Input current, CLKIN_COMM	$V_I = V_{SS}$ to V_{CC}	- 60		60	μA

[†] For conditions shown as MIN/MAX, use the appropriate value specified under recommended operating conditions.

NOTES: 2. Electrical characteristics are calculated algebraically from the SMJ320C40 data sheet limits.

3. Includes signals EMU0_COMM, EMU1_COMM, and RESET_COMM

4. Applies to TDI_C40_#1

5. Includes signals TCK_COMM, TMS_COMM, and TRST_COMM



SMJ320MCM42C, SMJ320MCM42D

DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

capacitance

Capacitance of a C40 die is specified by design to be 15 pF maximum for both inputs and outputs. Module networks add up to 5 pF. Characterization of die or substance capacitance is performed after any design change. Power measurements taken for a C40 die are made with an additional 80-pF load capacitance. Refer to the SMJ320C40 data sheet (literature number SGUS017) for the test load circuit.

operational timings and module testing

Texas Instruments processing assures that operation is verified to published data sheet specifications on the C40 in die form. All voltage, timing, speed, and temperature specifications are met before any die is placed into a multichip module. For this reason, all C40 voltage and timing parameters at the module level need not be verified.

Characterization of the 42 substrate shows that the module performs as an equivalent system of discretely packaged C40 devices. This performance is assured through a full-frequency functional checkout of the module that verifies selected worst-case timings. An additional propagation delay is introduced by the substrate. This value is assured by design to be less than 1 ns, but it is not tested. See the SMJ320C40 data sheet (literature number SGUS017) for a complete listing of timing diagrams and limits.

module test capability (future compatibility)

The C40 supports the IEEE-1149.1 testability standard, and the test access port (TAP) is brought out to the module footprint. TDI is connected to C40_#1, TDO of C40_#1 is connected to TDI of C40_#2, and TDO of C40_#2 is brought out to the TAP. TCK_COMM, TMS_COMM, and TRST_COMM are routed to both C40s in the module. This configuration allows users to test the module using third-party JTAG testability tools or other boundary-scan control software. Proper software configuration allows users to debug or launch code on the module by way of the C40 emulator and extended development system (XDS™) pod. Both of these tools are used as part of outgoing module testing.

The 42 supports third-party JTAG diagnostic families of products for verification and debug of boundary-scan circuits, boards, and systems. Further information on JTAG testability tools is available through any TI sales representative or authorized TI distributor.

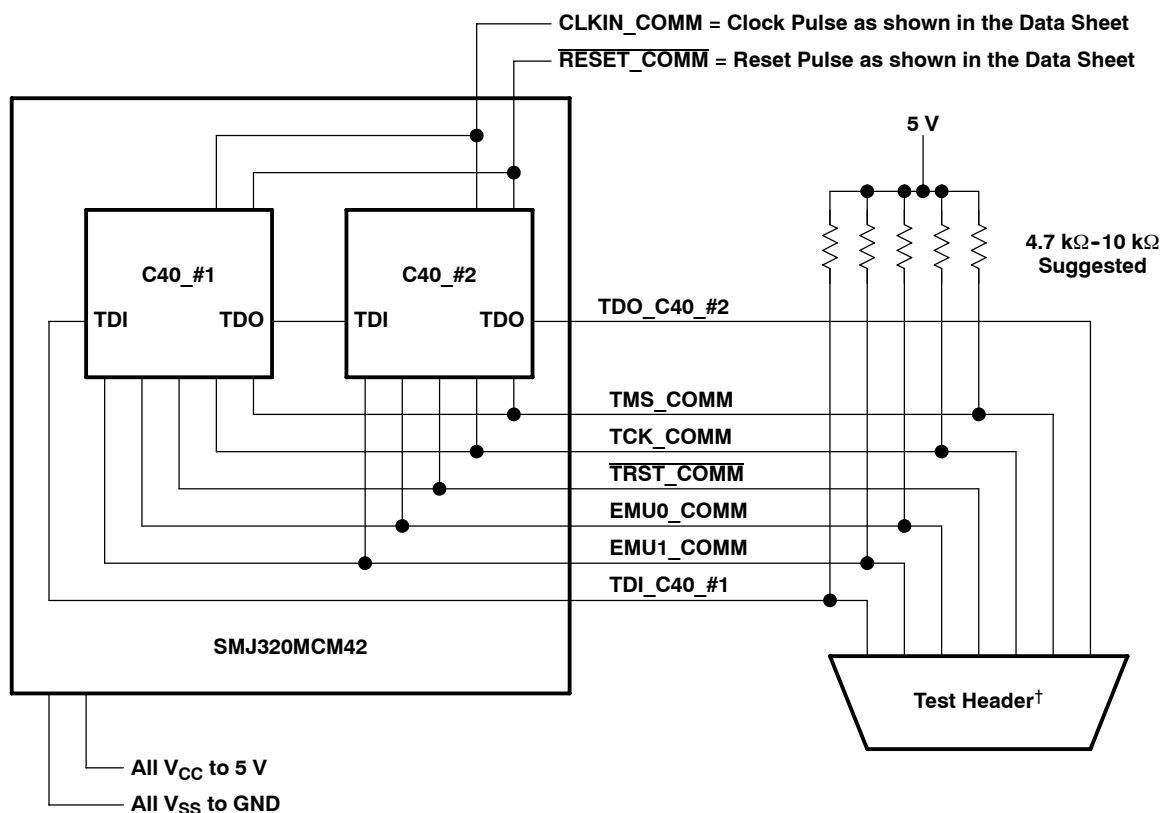
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module test circuit

Figure 3 illustrates the basic circuits for the 42. See the *TMS320C4x User's Guide* (literature number SPRU063) for more detailed information.



[†] The test header normally consists of the XDS510™ for the C40 emulation or ASSET hardware for interconnect testing.

Figure 3. Sample Test Circuit

SMJ320MCM42C, SMJ320MCM42D

DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

thermal analysis

Thermal conduction of components in the SMJ320MCM42 is dependent on thermal resistance of the material under each die as well as die area thermally connected to the heat-dissipating medium. Since these properties vary with layout and die size, C40 and SRAM components should be considered separately. Table 2 lists primary parameters required for thermal analysis of the module. T_J , the maximum junction temperature, is not to be exceeded for the C40s or the SRAM die.

Table 2. Thermal Characteristics

PARAMETER		MIN	TYP	MAX	UNIT
T_J	Maximum allowable junction temperature under operating condition			150	°C
P_{MCM}	Module power dissipation		3.5	5.8	W
$T_{JC_pkg}^\dagger$	Average thermal impedance (junction to case) for the package		2.1		°C/W
T_{JA}	Thermal impedance (junction to ambient air, 0 cfm) of package		20.5		°C/W
T_{SOL}	Maximum solder temperature (10 s duration)			260	°C

[†] T_{JC} package data was taken under the following conditions: two C40s dissipating 1.05 W each and eight SRAMs dissipating 0.175 W each.

power estimation

During the operation verification, the power requirements of the SMJ320MCM42 are characterized over the operating free-air temperature range. See the application report *Calculation of TMS320C40 Power Dissipation* (literature number SPRA032) as reference for power estimation of the C40 components.

Typical power dissipation is measured with both C40s executing a 64-point fast Fourier transform (FFT) algorithm. Input and output data arrays reside in module SRAM, and output data is written out to the global-address space. The global databus is loaded with 80-pF test loads, and both local and global writes are configured for zero-wait-state memory. Under typical conditions of 25°C, 5-V V_{CC} , and 40-MHz CLKIN frequency, the power dissipation is measured to be 3.5 W.

Maximum power dissipation is measured under worst-case conditions. The global databus is loaded with 80-pF test loads, and simultaneous zero-wait-state writes are performed to both local and global buses. Under worst-case environment conditions of -55°C, 5.25-V V_{CC} , and 40-MHz CLKIN frequency, the power dissipation is determined to be 5.9 W. The algorithm executed during these tests consists of parallel writes of alternating 0xAAs and 0x55s to both local SRAM and global-address spaces. This algorithm is not considered to be a practical use of the C40's resources; therefore, the associated power measurement must be considered absolute maximum only.



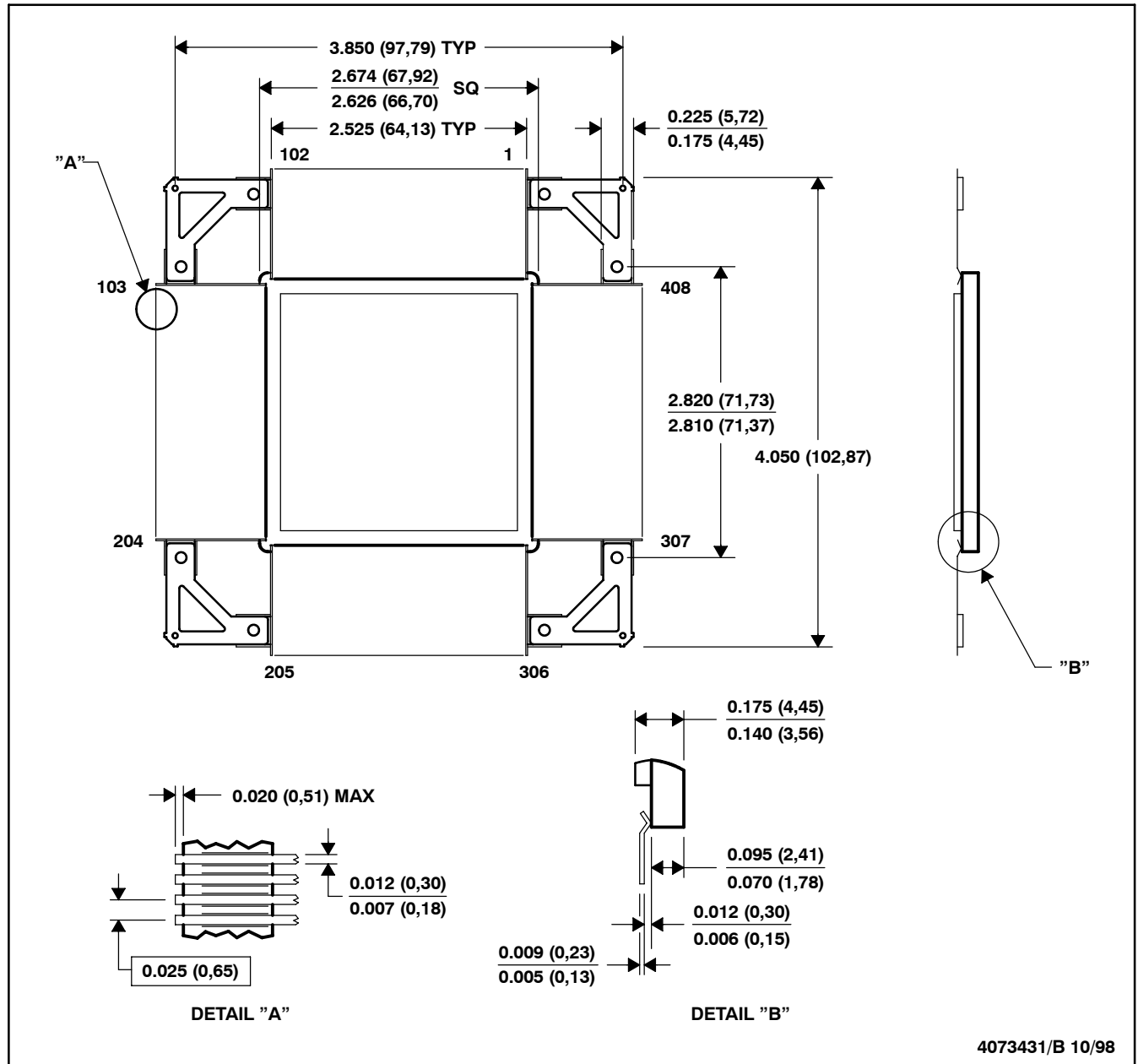
SMJ320MCM42C, SMJ320MCM42D DUAL SMJ320C40 MULTICHIP MODULE

SGKS001D - JULY 1997 - REVISED OCTOBER 2001

MECHANICAL DATA

HFN (S-CQFP-F408)

CERAMIC QUAD FLATPACK WITH TIE-BAR



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9678901QXC	OBSOLETE	CFP	HFN	408		TBD	Call TI	Call TI	-55 to 125	5962-9678901QX C SMJ320MCM42DHF NM40	

(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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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