- **Commercial Operating Free-Air Temperature Range −0°C to 70°C**
- **Military Operating Free-Air Temperature Range −55°C to 125°C, QML Processing**
- **Fast Instruction Cycle Time of 50 ns**
- **Two 1K × 32-Bit Single-Cycle Dual-Access On-Chip RAM Blocks**
- **32-Bit Instruction and Data Words, 24-Bit Addresses**
- **Integer, Floating-Point, and Logical Operations**
- **40- or 32-Bit Floating-Point/Integer Multiplier and Arithmetic Logic Unit (ALU)**
- **24 × 24-Bit Integer Multiplier, 32-Bit Product**
- **32 × 32-Bit Floating-Point Multiplier, 40-Bit Product**
- **Parallel ALU and Multiplier Execution in a Single Cycle**
- **32-Bit Barrel Shifter**
- **Eight Extended-Precision Registers (Accumulators)**
- **Circular and Bit-Reversed Addressing Capabilities**
- **One Independent Bidirectional Serial Port With Support for 8-, 16-, 24-, or 32-Bit Transfers**
- **Two 32-Bit Timers With Control and Counter Registers**
- **Validated Ada Compiler**
- **64-Word × 32-Bit Instruction Cache**
- **On-Chip Direct Memory Access (DMA) Controller for Concurrent I/O and CPU Operation**
- **Flexible Boot Program Loader for the ’320C31KGDB Instead of the ROM**
- **One 32-Bit External Port for the ’320C31KGDB (24-Bit Address)**
- **Two Address Generators With Eight Auxiliary Registers and Two Auxiliary Register Arithmetic Units (ARAUs)**
- **Zero-Overhead Loops With Single-Cycle Branches**
- **Interlocked Instructions for Multiprocessing Support**
- **Two- and Three-Operand Instructions**
- **Conditional Calls and Returns**
- **Block Repeat Capability**
- **Fabricated Using Enhanced Performance Implanted CMOS (EPIC™) Technology by Texas Instruments**

description

The TMP/SMJ320C31KGDB and SMJ320LC31KGDB digital signal processors (DSPs) known good dies (KGDs) are high-performance, 32-bit floating-point processors manufactured in 0.72-µm, double-level metal CMOS technology.

The TMP/SMJ320C31KGDB and SMJ320LC31KGDB internal busing and special digital signal processing instruction set have the speed and flexibility to execute up to 40 million floating-point operations per second (MFLOPS). The devices optimize speed by implementing functions in hardware that other processors implement through software or microcode. This hardware-intensive approach provides performance previously unavailable on a single chip.

The devices can perform parallel multiply and ALU operations on integer or floating-point data in a single cycle. Each processor also possesses a general-purpose register file, a program cache, dedicated ARAUs, internal dual-access memories, one DMA channel supporting concurrent I/O, and a short machine-cycle time. High performance and ease of use are results of these features.

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description (continued)

The large address space, multiprocessor interface, internally and externally generated wait states, one external interface port, two timers, one serial port, and multiple interrupt structure enhance general-purpose applications. The TMP320C31KGDB and the SMJ320C31KGDB support a wide variety of system applications from host processor to dedicated coprocessor.

High-level language support is implemented through a register-based architecture, large address space, and the device's ability to execute 40 million floating-point operations per second (MFLOPS) and perform parallel multiple and ALU operations.

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.

known good die (KGD) technology

KGD options are available for use in multichip modules and chip-on-board (COB) applications. The current verification technology that supports KGD requirements for the TMP320C31KGDB, SMJ320C31KGDB, and the SMJ320LC31KGDB is a removable tab (R-Tab).

The availability of selected DSP products in a tape-automated bond (TAB) configuration has made possible the use of an R-Tab technique. The TAB leadframe is attached to gold-bumped die using nonoptimal bonding parameters. This technique allows easy removal of the die after all the needed screens and parametric tests are complete. The tape is removed from the tested part and the die is shipped in a conventional die container. The gold bumps remain on the bond pads that provide for subsequent attachment of gold-ball bonds.

Future implementations may have only aluminum bond pads. Please contact factory for current information.

electrical specifications

For military electrical and timing specifications, please see the *SMJ320C31, SMJ320LC31, SMQ320LC31 Digital Signal Processors* data sheet, literature number SGUS026. For commercial specifications, see the *TMS320C31, TMS320LC31 Digital Signal Processors* data sheet, literature number SPRS035.

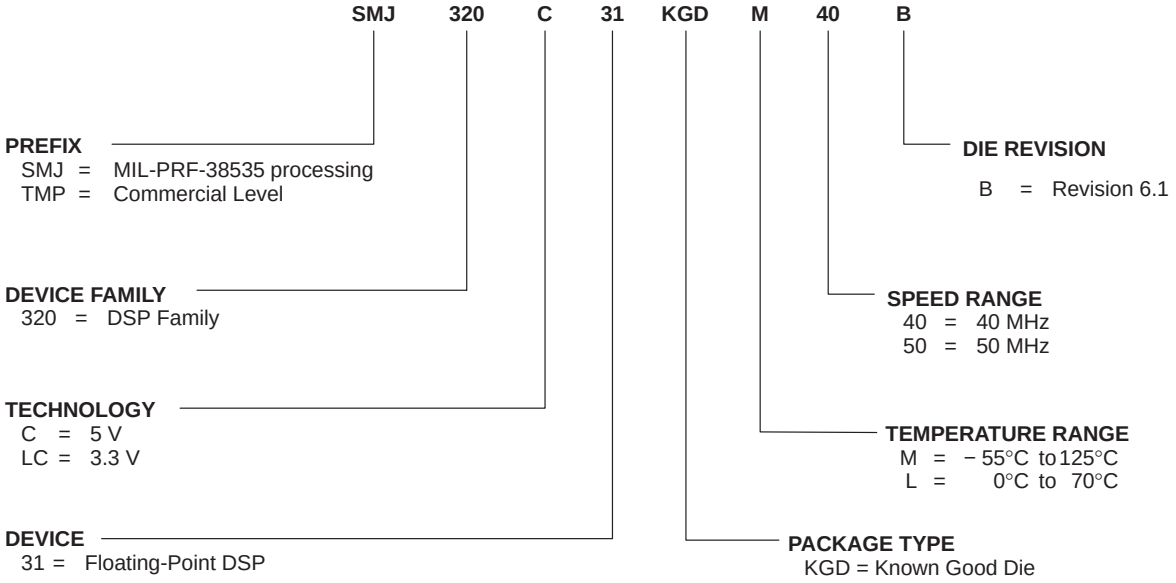

Figure 1. Device Nomenclature

JEDEC STANDARD

- Die thickness is approximately 15 mils ± 1 mil.
- Backside surface finish is silicon.
- Maximum allowable die junction operating temperature is 175°C.
- Glassivation material is compressive nitride.
- Bond pad metal is composed of copper-doped aluminum.
- Percentage of defect allowed for burned-in die is 5%.
- Life test data is available.
- Configuration control notification.
- Group A attribute summary is available (SMJ only).
- Suggested die-attach material is silver glass (QMI 2569F).
- Suggested bond wire size is 1.25 mils.
- Suggested bonding method is gold-ball bonding.
- ESD rating is Class II.
- Maximum allowable peak process temperature for die attach is 440°C ± 5°C (for QMI 2569F).
- Saw kerf is dependent on blade size used.
- Die backside potential is grounded.

TMP/SMJ320C31KGDB (rev 6.1) known good die pad information

Figure 2 shows the TMP/SMJ320C31KGDB die-numbering format. See Table 1 for TMP/SMJ320C31KGDB die pad information.

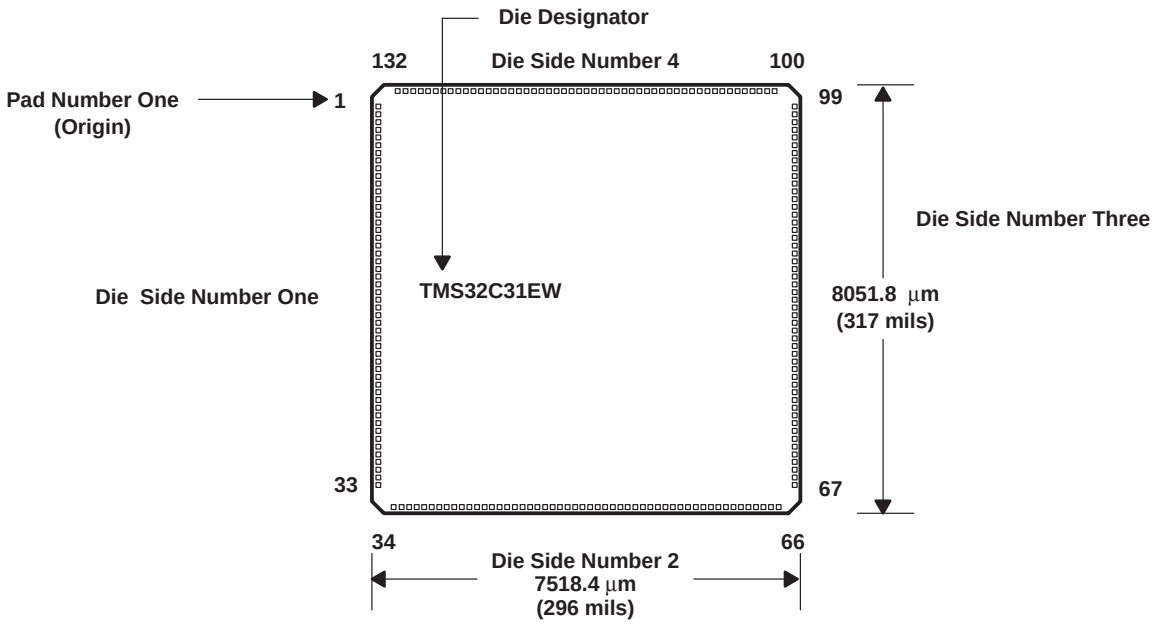

Figure 2. '320C31KGD Die Numbering Format (See Table 1)

Table 1 provides a reference for the following:

- The 'C31 signal identities in relation to the pad numbers.
- The 'C31 X,Y coordinates, where bond pad 1 serves as the origin (0,0).

In addition, significant specifications include:

- X,Y coordinate data is in microns (µm).
- Coordinate origin is at (0,0) (center of bond pad 1).
- Average pitch is 202 µm (7.95 mils).
- The active silicon dimensions are 7889.0 µm × 7353.25 µm (311 mils × 289 mils).
- The approximate diced silicon dimensions (active + cut scribe street) are 8051.8 µm × 7518.4 µm (317 mils × 296 mils).
- Bond pad dimensions are 103.50 µm × 103.50 µm (4.07 mils × 4.07 mils).
- Center of bond pad to edge of die ranges from 170 µm−213 µm (6.7 mils−8.4 mils). The range of 43 µm exists since the dicing process results in some tolerance. Due to the consistency and precision of the bond pad locations in reference to each other, the center of bond pad 1 was chosen as the origin.

Table 1. ’320C31KGD Die Pad/TAB Lead Information : rev 6.1 (0,72 μm)

DIE SIDE #1				
C31 DIE BOND PAD LOCATIONS	DIE/TAB BOND PAD IDENTITY	X-COORDINATE OF THE DIE BOND PAD (μm)	Y-COORDINATE OF THE DIE BOND PAD (μm)	PITCH OF LEAD (#,# REFERENCES WHICH DIE BONDS) (μm)
1	A9		0.00	224.46 (1, 2)
2	DV_{SS}		−224.46	201.78 (2, 3)
3	A8		−426.24	224.46 (3, 4)
4	A7		−650.70	224.46 (4, 5)
5	A6		−875.16	224.46 (5, 6)
6	A5		−1099.62	202.86 (6, 7)
7	AV_{DD}		−1302.48	201.78 (7, 8)
8	A4		−1504.26	224.46 (8, 9)
9	A3		−1728.72	224.46 (9, 10)
10	A2		−1953.18	224.46 (10, 11)
11	A1		−2177.64	224.46 (11, 12)
12	A0		−2402.10	202.86 (12, 13)
13	CV_{SS}		−2604.96	223.38 (13, 14)
14	D31		−2828.34	271.98 (14, 15)
15	V_{DDL}		−3100.32	162.36 (15, 16)
16	V_{DDL}		−3262.68	200.52 (16, 17)
17	D30	0.00	−3463.20	207.18 (17, 18)
18	V_{SSL}		−3670.38	162.36 (18, 19)
19	V_{SSL}		−3832.74	178.92 (19, 20)
20	DV_{SS}		−4011.66	244.98 (20, 21)
21	D29		−4256.64	224.46 (21, 22)
22	D28		−4481.10	188.46 (22, 23)
23	DV_{DD}		−4669.56	280.98 (23, 24)
24	D27		−4950.54	202.86 (24, 25)
25	IV_{SS}		−5153.40	180.18 (25, 26)
26	D26		−5333.58	202.86 (26, 27)
27	D25		−5536.44	202.86 (27, 28)
28	D24		−5739.30	202.86 (28, 29)
29	D23		−5942.16	202.86 (29, 30)
30	D22		−6145.02	202.86 (30, 31)
31	D21		−6347.88	174.60 (31, 32)
32	DV_{DD}		−6522.48	172.98 (32, 33)
33	D20		−6695.46	

Table 1.'320C31KGD Die Pad/TAB Lead Information : rev 6.1 (0,72 μm) (continued)

DIE SIDE #2				
C31 DIE BOND PAD LOCATIONS	DIE/TAB BOND PAD IDENTITY	X-COORDINATE OF THE DIE BOND PAD (μm)	Y-COORDINATE OF THE DIE BOND PAD (μm)	PITCH OF LEAD (#,# REFERENCES WHICH DIE BONDS) (μm)
34	DV_{SS}	396.72		180.72 (34, 35)
35	D19	577.44		202.86 (35, 36)
36	D18	780.30		210.06 (36, 37)
37	D17	990.36		210.06 (37, 38)
38	D16	1200.42		210.06 (38, 39)
39	D15	1410.48		188.46 (39, 40)
40	CV_{SS}	1598.94		187.38 (40, 41)
41	D14	1786.32		188.46 (41, 42)
42	DV_{DD}	1974.78		187.38 (42, 43)
43	D13	2162.16		188.46 (43, 44)
44	IV_{SS}	2350.62		187.38 (44, 45)
45	D12	2538.00		210.06 (45, 46)
46	D11	2748.06		210.06 (46, 47)
47	D10	2958.12		192.78 (47, 48)
48	V_{DDL}	3150.90		162.36 (48, 49)
49	V_{DDL}	3313.26		186.12 (49, 50)
50	D9	3499.38	−7219.80	210.06 (50, 51)
51	D8	3709.44		188.46 (51, 52)
52	DV_{SS}	3897.90		170.10 (52, 53)
53	V_{SSL}	4068.00		162.36 (53, 54)
54	V_{SSL}	4230.36		186.12 (54, 55)
55	D7	4416.48		210.06 (55, 56)
56	D6	4626.54		188.46 (56, 57)
57	DV_{DD}	4815.00		187.38 (57, 58)
58	D5	5002.38		210.06 (58, 59)
59	D4	5212.44		210.06 (59, 60)
60	D3	5422.50		210.06 (60, 61)
61	D2	5632.56		210.06 (61, 62)
62	D1	5842.62		210.06 (62, 63)
63	D0	6052.68		210.06 (63, 64)
64	H1	6262.74		210.06 (64, 65)
65	H3	6472.80		174.06 (65, 66)
66	DV_{DD}	6646.86		

Table 1.'320C31KGD Die Pad/TAB Lead Information : rev 6.1 (0,72 μm) (continued)

DIE SIDE #3				
C31 DIE BOND PAD LOCATIONS	DIE/TAB BOND PAD IDENTITY	X-COORDINATE OF THE DIE BOND PAD (μm)	Y-COORDINATE OF THE DIE BOND PAD (μm)	PITCH OF LEAD (#,# REFERENCES WHICH DIE BONDS) (μm)
67	DV_{SS}		−6714.54	158.58 (67, 68)
68	CV_{SS}		−6555.96	153.54 (68, 69)
69	IV_{SS}		−6402.42	160.56 (69, 70)
70	X2		−6241.86	169.56 (70, 71)
71	X1		−6072.30	292.14 (71, 72)
72	$\overline{HOLDA}$		−5780.16	205.56 (72, 73)
73	$\overline{HOLD}$		−5574.60	181.98 (73, 74)
74	CV_{DD}		−5392.62	276.48 (74, 75)
75	$\overline{RDY}$		−5116.14	217.98 (75, 76)
76	$\overline{STRB}$		−4898.16	224.46 (76, 77)
77	$R/\overline{W}$		−4673.70	219.96 (77, 78)
78	$\overline{RESET}$		−4453.74	217.98 (78, 79)
79	XF0		−4235.76	202.86 (79, 80)
80	CV_{DD}		−4032.90	223.38 (80, 81)
81	XF1		−3809.52	224.46 (81, 82)
82	$\overline{IACK}$		−3585.06	219.96 (82, 83)
83	$\overline{INT0}$	7136.64	−3365.10	196.38 (83, 84)
84	DV_{SS}		−3168.72	180.18 (84, 85)
85	V_{SSL}		−2988.54	197.28 (85, 86)
86	$\overline{INT1}$		−2791.26	200.70 (86, 87)
87	V_{DDL}		−2590.56	162.36 (87, 88)
88	V_{DDL}		−2428.20	196.02 (88, 89)
89	$\overline{INT2}$		−2232.18	213.48 (89, 90)
90	$\overline{INT3}$		−2018.70	268.38 (90, 91)
91	DR0		−1750.32	202.86 (91, 92)
92	CV_{SS}		−1547.46	201.78 (92, 93)
93	FSR0		−1345.68	224.46 (93, 94)
94	CLKR0		−1121.22	224.46 (94, 95)
95	CLKX0		−896.76	202.86 (95, 96)
96	IV_{SS}		−693.90	201.78 (96, 97)
97	FSX0		−492.12	202.86 (97, 98)
98	PV_{DD}		−289.26	273.78 (98, 99)
99	DX0		−15.48	

Table 1.'320C31KGD Die Pad/TAB Lead Information : rev 6.1 (0,72 μm) (continued)

DIE SIDE #4				
C31 DIE BOND PAD LOCATIONS	DIE/TAB BOND PAD IDENTITY	X-COORDINATE OF THE DIE BOND PAD (μm)	Y-COORDINATE OF THE DIE BOND PAD (μm)	PITCH OF LEAD (#,# REFERENCES WHICH DIE BONDS) (μm)
100	V_{SUBS}†	6705.00		224.10 (100, 101)
101	$\overline{SHZ}$	6480.90		181.98 (101, 102)
102	DV_{SS}	6298.92		172.98 (102, 103)
103	TCLK0	6125.94		174.06 (103, 104)
104	PV_{DD}	5951.88		230.58 (104, 105)
105	TCLK1	5721.30		282.06 (105, 106)
106	EMU3	5439.24		191.16 (106, 107)
107	EMU0	5248.08		184.68 (107, 108)
108	EMU1	5063.40		184.68 (108, 109)
109	EMU2	4878.72		184.68 (109, 110)
110	$\overline{MCMP}$	4694.04		167.58 (110, 111)
111	CV_{SS}	4526.46		201.78 (111, 112)
112	A23	4324.68		195.66 (112, 113)
113	A22	4129.02		266.40 (113, 114)
114	V_{DDL}	3862.62		162.36 (114, 115)
115	V_{DDL}	3700.26		278.28 (115, 116)
116	A21	3421.98		195.48 (116, 117)
117	A20	3226.50		174,06 (117, 118)
118	V_{SSL}	3052.44		151.38 (118, 119)
119	DV_{SS}	2901.06	452.52	172.98 (119, 120)
120	A19	2728.08		174.06 (120, 121)
121	AV_{DD}	2554.02		172.98 (121, 122)
122	A18	2381.04		195.66 (122, 123)
123	A17	2185.38		195.66 (123, 124)
124	A16	1989.72		195.66 (124, 125)
125	A15	1794.06		195.66 (125, 126)
126	A14	1598.40		282.06 (126, 127)
127	A13	1316.34		195.66 (127, 128)
128	A12	1120.68		195.66 (128, 129)
129	A11	925.02		174.06 (129, 130)
130	AV_{DD}	750.96		172.98 (130, 131)
131	A10	577.98		174.06 (131, 132)
132	CV_{SS}	403.92		

† V_{SUBS} connects to die metallization. Tie this pin to clean ground.

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