MC9S12C-Family

16-Bit Microcontroller

Based on Freescale's market-leading flash technology, members of the MC9S12C-Family deliver the power and flexibility of our 16 Bit core (CPU12) family to a whole new range of cost and space sensitive, general purpose Industrial and Automotive network applications. MC9S12C-Family members are comprised of standard on-chip peripherals including a 16-bit central processing unit (CPU12), up to 128K bytes of Flash EEPROM or ROM, up to 4K bytes of RAM, an asynchronous serial communications interface (SCI), a serial peripheral interface (SPI), an 8-channel 16-bit timer module (TIM), a 6-channel 8-bit pulse width modulator (PWM), an 8-channel, 10-bit analog-to-digital converter (ADC) and up to one CAN 2.0 A, B software compatible module (MSCAN12). The MC9S12C-Family has full 16-bit data paths throughout. The inclusion of a PLL circuit allows power consumption and performance to be adjusted to suit operational requirements. In addition to the I/O ports available in each module, up to 10 dedicated I/O port bits are available with Wakeup capability from STOP or WAIT mode. The MC9S12C-Family is available in 48-pin and 52-pin LQFP, and in 80-pin QFP packages (all RoHS Compliant J-STD-020C); the 80-pin version is pin-compatible with the HCS12B- and D-Family derivatives.

The C-Family includes ROM versions MC3S12C128/96/64/32/16 of all devices which provide a further cost reduction path for applications with high volume and stable code.

1 Features

- **16-Bit HCS12 CORE**
  - HCS12 CPU
  - MMC (memory map and interface)
  - INT (interrupt control)
  - BDM (background debug mode)
  - DBG12 (enhanced debug12 module including breakpoints and change-of-flow trace buffer)
  - Multiplexed Expansion Bus (available only in 80-pin package version)

- **16-Bit HCS12 CPU**
  - Upward compatible with M68HC11 instruction set
  - Interrupt stacking and programmer's model identical to M68HC11
  - Instruction queue
  - Enhanced indexed addressing
- **Wake-up Interrupt Inputs**
  - Up to 10-port bits available for wake up interrupt function
- **Memory Options**
  - 16K, 32K, 64K, 96K and 128K Byte Flash EEPROM (erasable in 512-byte sectors) or
  - 16K, 32K, 64K, 96K and 128K Byte ROM
  - 1K, 2K, and 4K Byte RAM
- **Analog-to-Digital Converters**
  - One 8-channel module with 10-bit resolution.
  - External conversion trigger capability
- **Up to One 1M Bit Per Second, CAN 2.0 A, B Software Compatible Modules**
  - Five receive and three transmit buffers
  - Flexible identifier filter programmable as 2 x 32 bit, 4 x 16 bit or 8 x 8 bit
  - Four separate interrupt channels for receive, transmit, error and wake-up
  - Low-pass filter wake-up function
  - Loop-back for self test operation
- **Timer Module (TIM)**
  - 16-bit Counter with 7-bit Prescaler
  - 8 programmable input capture or output compare channels
  - Simple PWM Mode
  - Modulo Reset of Timer Counter
  - 16-Bit Pulse Accumulator
  - External Event Counting
  - Gated Time Accumulation
- **6 PWM Channels**
  - Programmable period and duty cycle
  - 8-bit 6-channel or 16-bit 3-channel
  - Separate control for each pulse width and duty cycle
  - Center-aligned or left-aligned outputs
  - Programmable clock select logic with a wide range of frequencies
  - Fast emergency shutdown input

- **Serial Interfaces**
  - One asynchronous serial communications interface (SCI)
  - One synchronous serial peripheral interface (SPI)
- **CRG (Clock Reset Generator Module)**
  - Windowed COP watchdog,
  - Real time interrupt,
  - Clock monitor,
  - Clock generation
  - Reset Generation
  - Phase-locked loop clock frequency multiplier
  - Limp home mode in absence of external clock
  - Low power 0.5 to 16 MHz crystal oscillator reference clock
- **Operation Frequency**
  - 32MHz equivalent to 16MHz Bus Speed for single chip
  - 32MHz equivalent to 16MHz Bus Speed in expanded bus modes
  - Option: 50MHz equivalent to 25MHz Bus Speed
  - Internal 2.5V Regulator
  - Supports an input voltage range from 3.3V-10% to 5.5V
  - Low power mode capability
  - Includes low voltage reset (LVR) circuitry
  - Includes low voltage interrupt (LVI) circuitry
- **48-pin LQFP, 52-pin LQFP, or 80-pin QFP Package (all RoHS Compliant J-STD-020C)**
  - Up to 58 I/O lines with 5V input and drive capability
  - Up to 2 dedicated 5V input only lines (IRQ, XIRQ)
  - 5V A/D converter inputs and 5V I/O
- **Development Support**
  - Single-wire background debug™ mode (BDM)
  - On-chip hardware breakpoints
  - Enhanced DBG12 debug features

2 MC9S12C-Family Members

Table 1. List of MC9S12C-Family Members

Flash	ROM	RAM	Package	Device	CAN	SCI	SPI	A/D	PWM	Timer	I/O
128K	0	4K	48LQFP	MC9S12C128	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC9S12C128	1	1	1	8ch	6ch	8ch	35
			80QFP	MC9S12C128	1	1	1	8ch	6ch	8ch	60
96K	0	4K	48LQFP	MC9S12C96	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC9S12C96	1	1	1	8ch	6ch	8ch	35
			80QFP	MC9S12C96	1	1	1	8ch	6ch	8ch	60
64K	0	4K	48LQFP	MC9S12C64	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC9S12C64	1	1	1	8ch	6ch	8ch	35
			80QFP	MC9S12C64	1	1	1	8ch	6ch	8ch	60
32K	0	2K	48LQFP	MC9S12C32	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC9S12C32	1	1	1	8ch	6ch	8ch	35
			80QFP	MC9S12C32	1	1	1	8ch	6ch	8ch	60
32K	0	2K	48LQFP	MC9S12GC32	0	1	1	8ch	6ch	8ch	31
			52LQFP	MC9S12GC32	0	1	1	8ch	6ch	8ch	35
			80QFP	MC9S12GC32	0	1	1	8ch	6ch	8ch	60
16K	0	1K	48LQFP	MC9S12GC16	0	1	1	8ch	6ch	8ch	31
			52LQFP	MC9S12GC16	0	1	1	8ch	6ch	8ch	35
			80QFP	MC9S12GC16	0	1	1	8ch	6ch	8ch	60
0	128K	4K	48LQFP	MC3S12C128	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC3S12C128	1	1	1	8ch	6ch	8ch	35
			80QFP	MC3S12C128	1	1	1	8ch	6ch	8ch	60
0	96K	4K	48LQFP	MC3S12C96	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC3S12C96	1	1	1	8ch	6ch	8ch	35
			80QFP	MC3S12C96	1	1	1	8ch	6ch	8ch	60
0	64K	4K	48LQFP	MC3S12C64	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC3S12C64	1	1	1	8ch	6ch	8ch	35
			80QFP	MC3S12C64	1	1	1	8ch	6ch	8ch	60
0	32K	2K	48LQFP	MC3S12C32	1	1	1	8ch	6ch	8ch	31
			52LQFP	MC3S12C32	1	1	1	8ch	6ch	8ch	35
			80QFP	MC3S12C32	1	1	1	8ch	6ch	8ch	60
0	32K	2K	48LQFP	MC3S12GC32	0	1	1	8ch	6ch	8ch	31
			52LQFP	MC3S12GC32	0	1	1	8ch	6ch	8ch	35
			80QFP	MC3S12GC32	0	1	1	8ch	6ch	8ch	60
0	16K	1K	48LQFP	MC3S12GC16	0	1	1	8ch	6ch	8ch	31
			52LQFP	MC3S12GC16	0	1	1	8ch	6ch	8ch	35
			80QFP	MC3S12GC16	0	1	1	8ch	6ch	8ch	60

3 Pin Out Explanations

I/O is the sum of ports capable to act as digital input or output.

- For 80 Pin Versions:
  - Port A = 8, B = 8, E = 6 + 2 input only, J = 2, M = 6, P = 8, S = 4, T = 8, PAD = 8.
  - 12 inputs provide Interrupt capability (P = 8, J = 2, IRQ, XIRQ)
- For 52 Pin Versions:
  - Port A = 3, B = 1, E = 2 + 2 input only, M = 6, P = 3, S = 2, T = 8, PAD = 8.
  - 5 inputs provide Interrupt capability (P = 3, IRQ, XIRQ)
- For 48 Pin Versions:
  - Port A = 1, B = 1, E = 2 + 2 input only, M = 6, P = 1, S = 2, T = 8, PAD = 8.
  - 3 inputs provide Interrupt capability (P = 1, IRQ, XIRQ)

4 Block Diagram

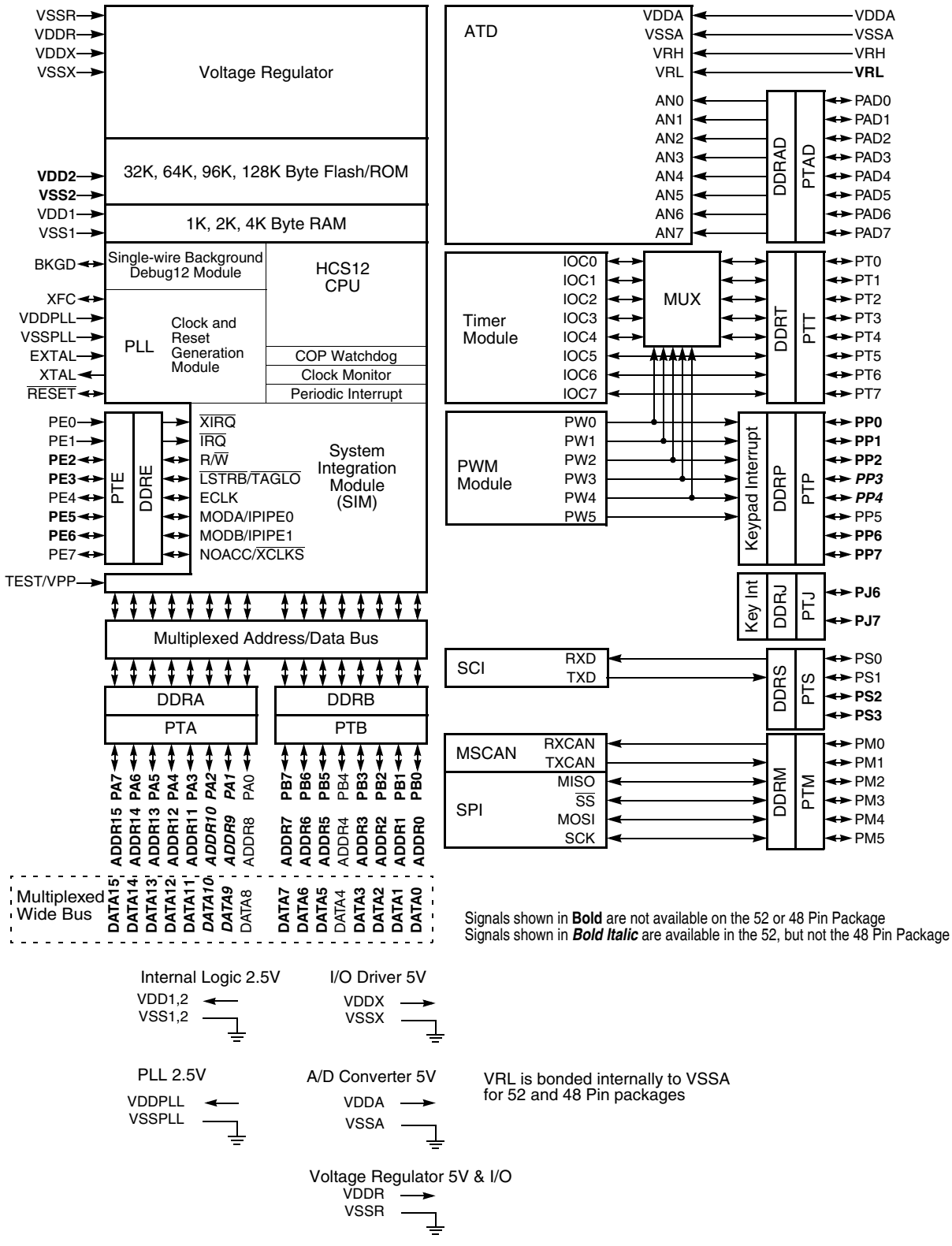
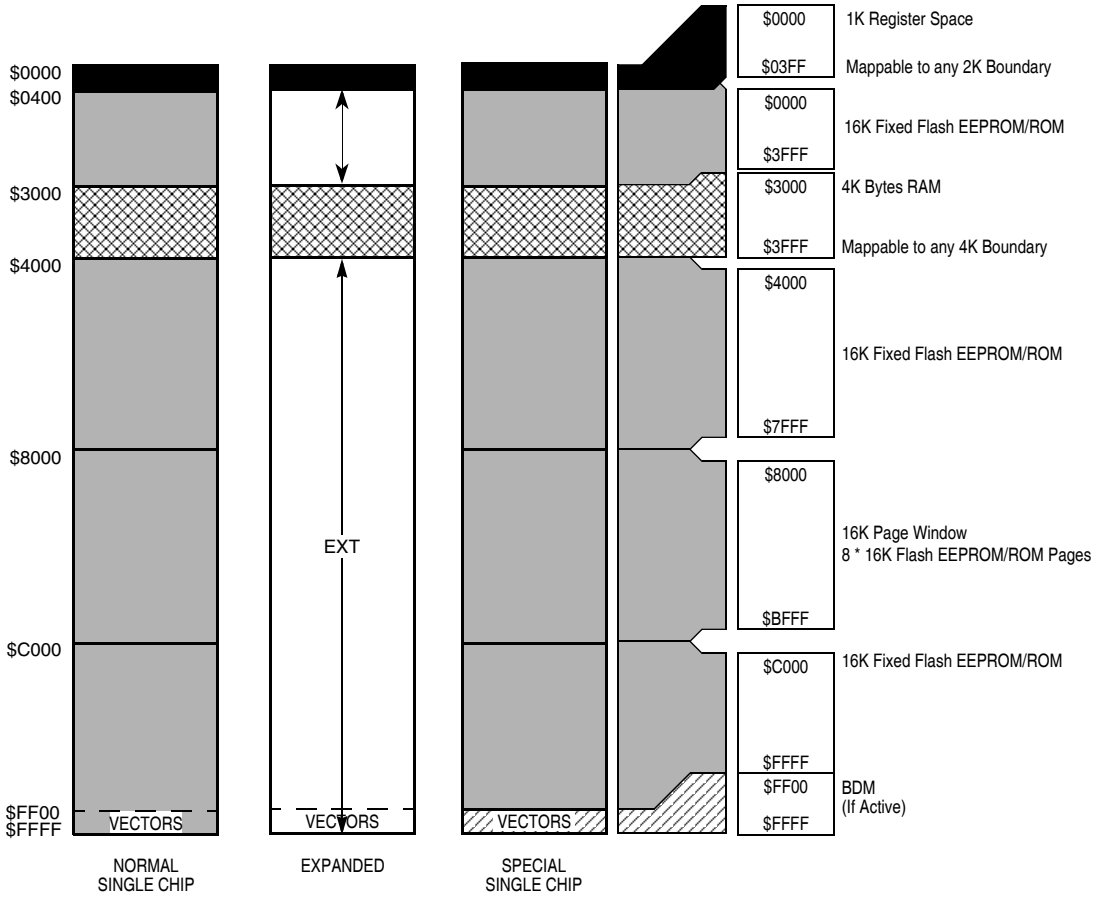


Figure 1. Block Diagram

5 User Configurable Memory Maps

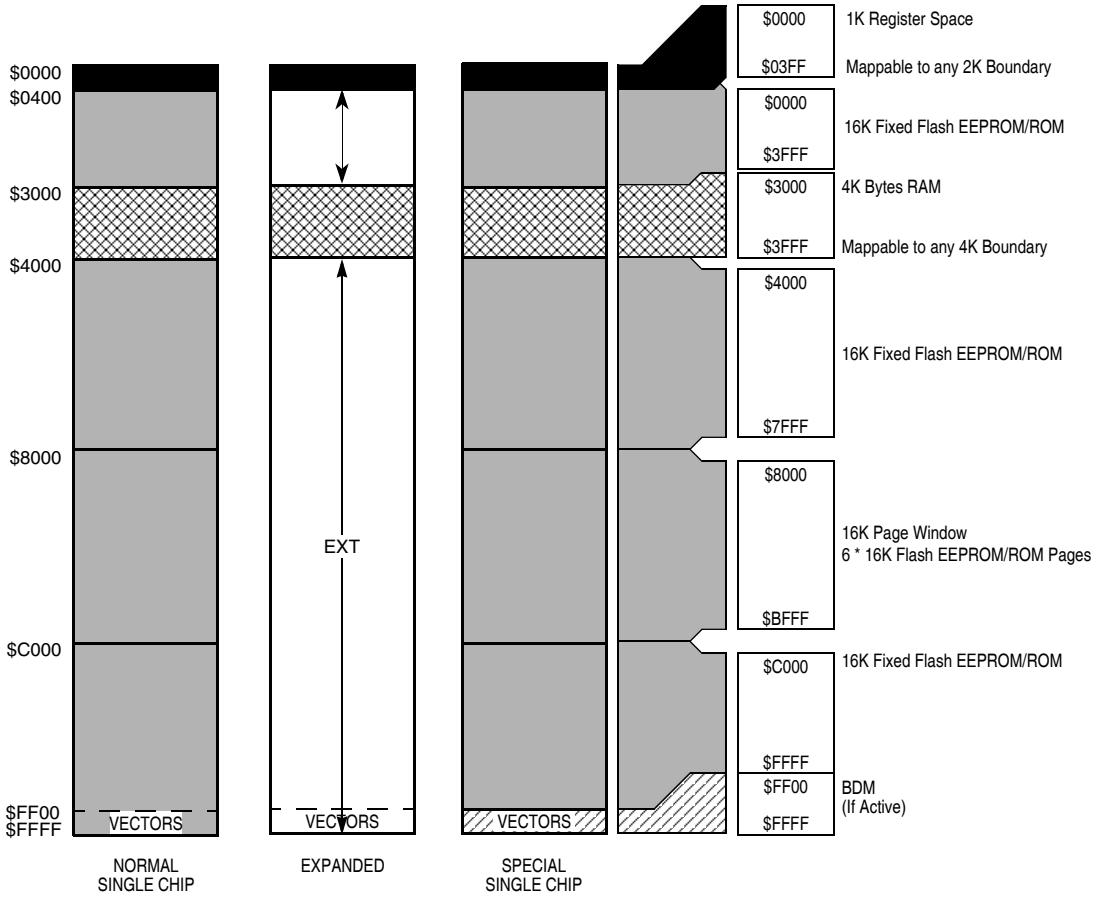


The figure shows a useful map, which is not the map out of reset. After reset the map is:

$0000 - $03FF: Register Space
$0000 - $0FFF: 4K RAM (only 3K visible $0400 - $0FFF)

Flash Erase Sector Size is 1024 Bytes

Figure 2. MCxS12C128 User Configurable Memory Map

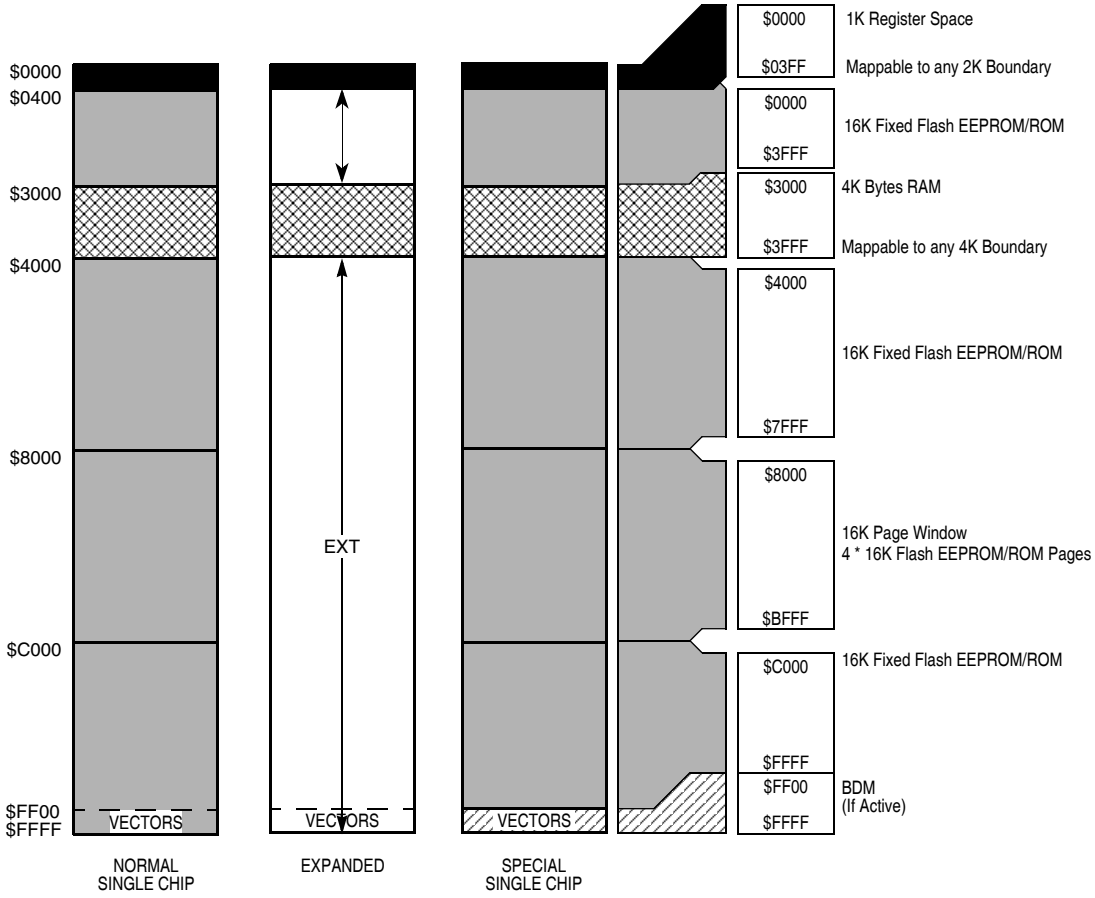


The figure shows a useful map, which is not the map out of reset. After reset the map is:

$0000 - $03FF: Register Space
$0000 - $0FFF: 4K RAM (only 3K visible $0400 - $0FFF)

Flash Erase Sector Size is 1024 Bytes

Figure 3. MCxS12C96 User Configurable Memory Map

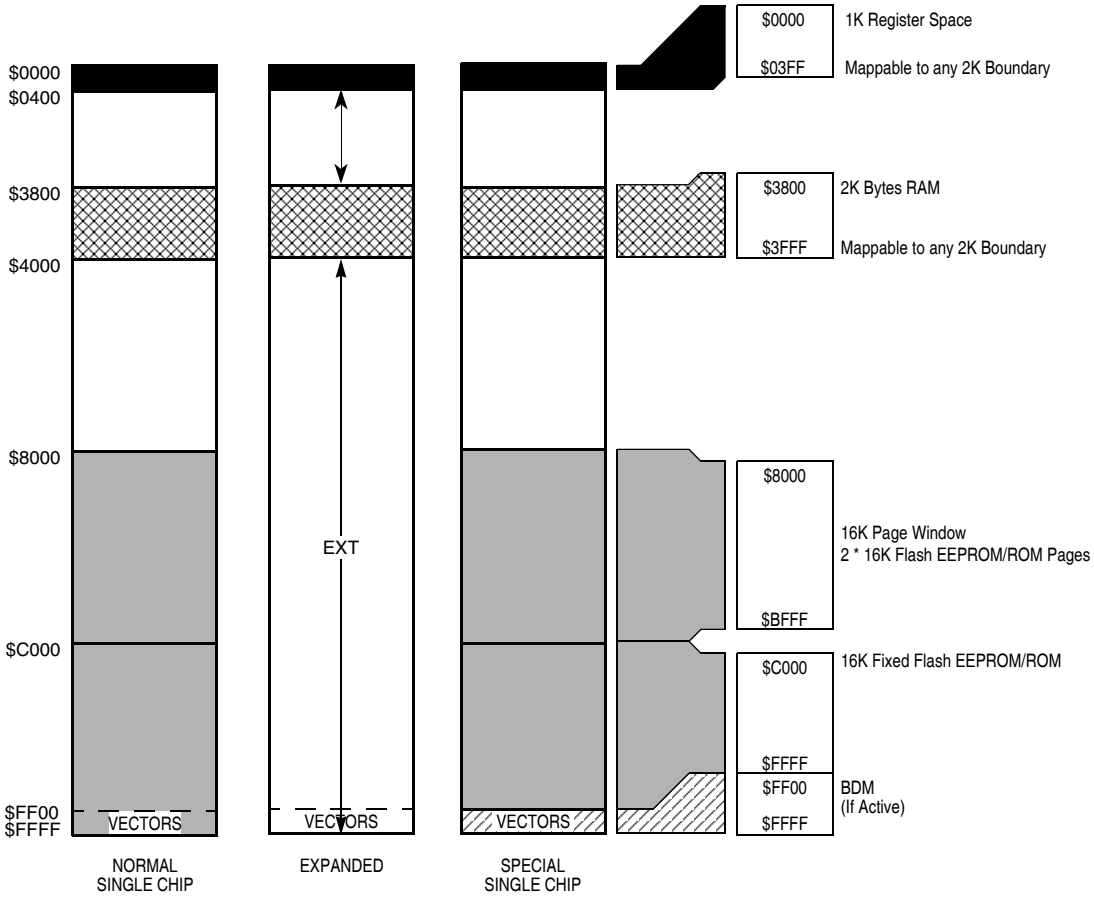


The figure shows a useful map, which is not the map out of reset. After reset the map is:

$0000 - $03FF: Register Space
$0000 - $0FFF: 4K RAM (only 3K visible $0400 - $0FFF)

Flash Erase Sector Size is 512 Bytes

Figure 4. MCxS12C64 User Configurable Memory Map

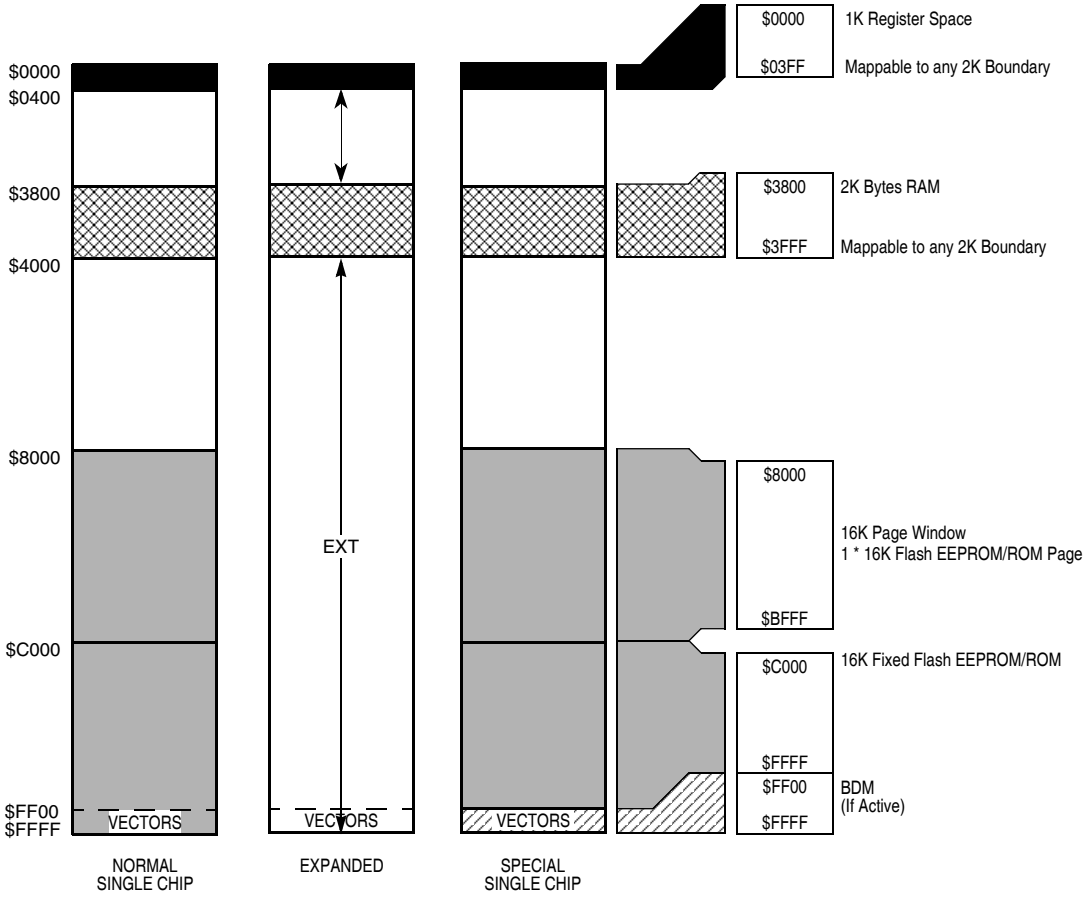


The figure shows a useful map, which is not the map out of reset. After reset the map is:

$0000 - $03FF: Register Space
$0800 - $0FFF: 2K RAM

Flash Erase Sector Size is 512 Bytes

Figure 5. MCxS12C32 User Configurable Memory Map

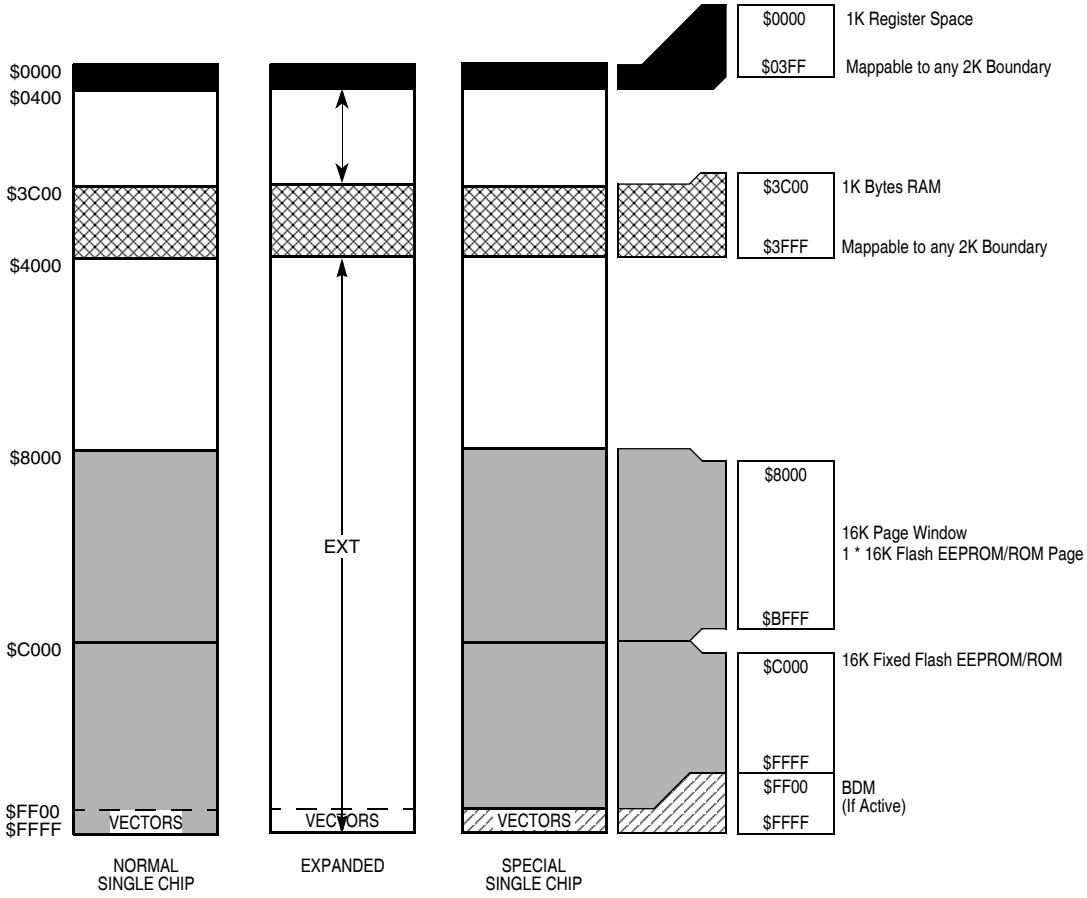


The figure shows a useful map, which is not the map out of reset. After reset the map is:

$0000 - $03FF: Register Space
$0800 - $0FFF: 2K RAM

Flash Erase Sector Size is 512 Bytes

Figure 6. MCxS12C16 User Configurable Memory Map



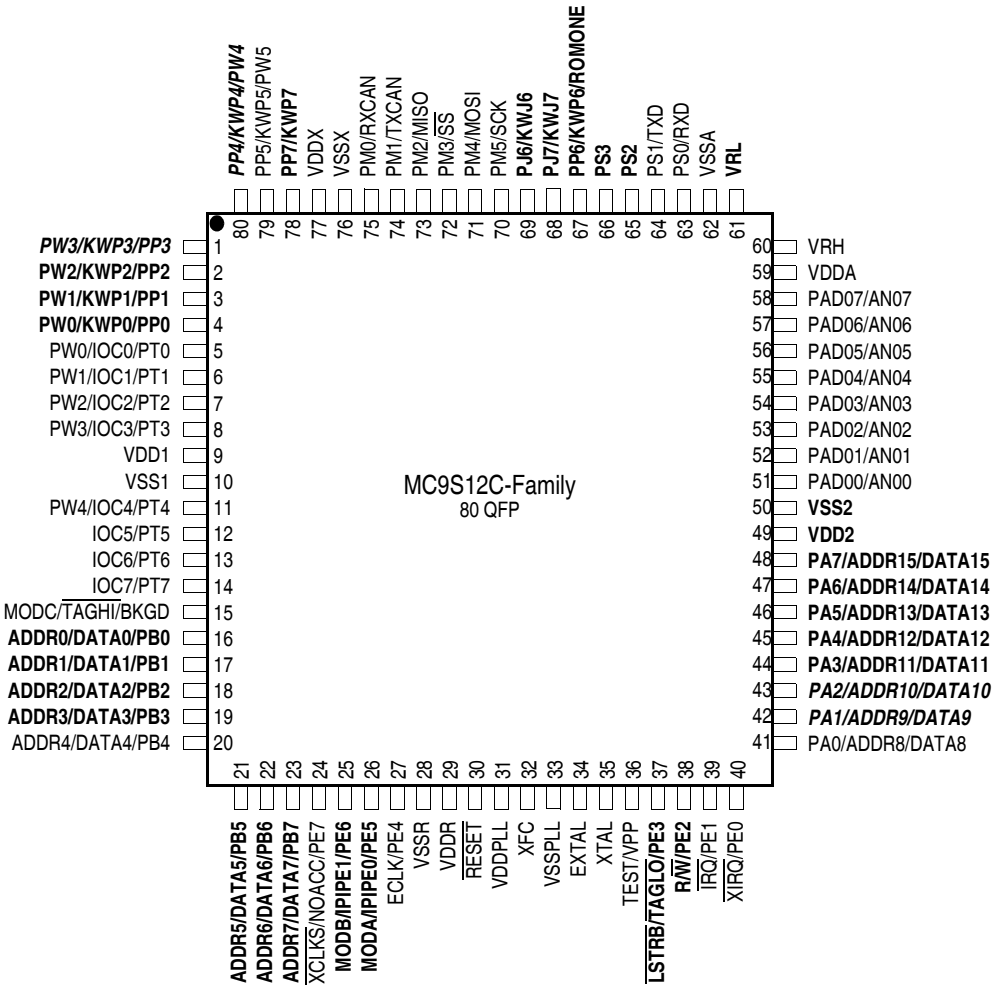
The figure shows a useful map, which is not the map out of reset. After reset the map is:

$0000 - $03FF: Register Space
$0C00 - $0FFF: 1K RAM

Flash Erase Sector Size is 512 Bytes

Figure 7. MCxS12GC16 User Configurable Memory Map

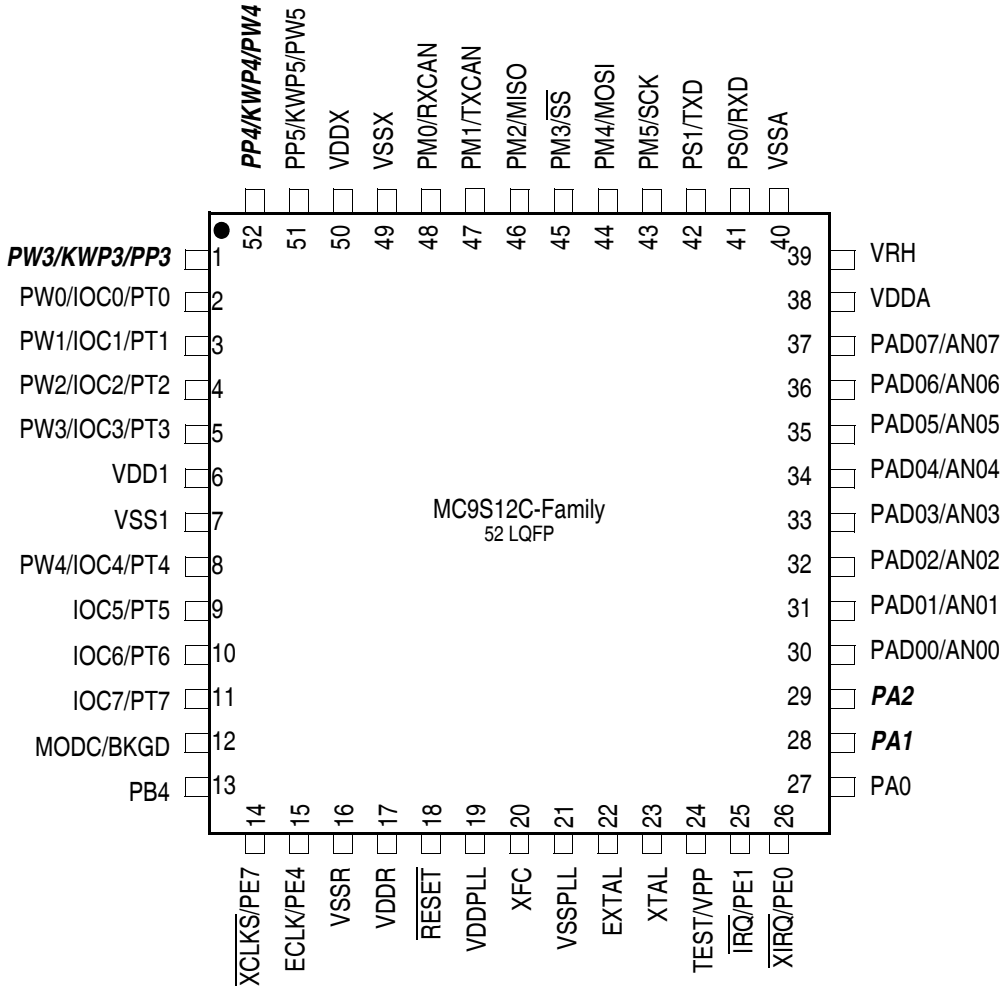
6 Pin Assignments



Signals shown in **Bold** are not available on the 52 or 48 Pin Package
Signals shown in ***Bold Italic*** are available in the 52, but not the 48 Pin Package

Figure 8. Pin Assignments for 80-pin QFP for MC9S12C-Family

!!! Pin-out is Subject to Change !!!



* Signals shown in **Bold** are not available on the 48 Pin Package

Figure 9. Pin Assignments for 52-pin LQFP for MC9S12C-Family

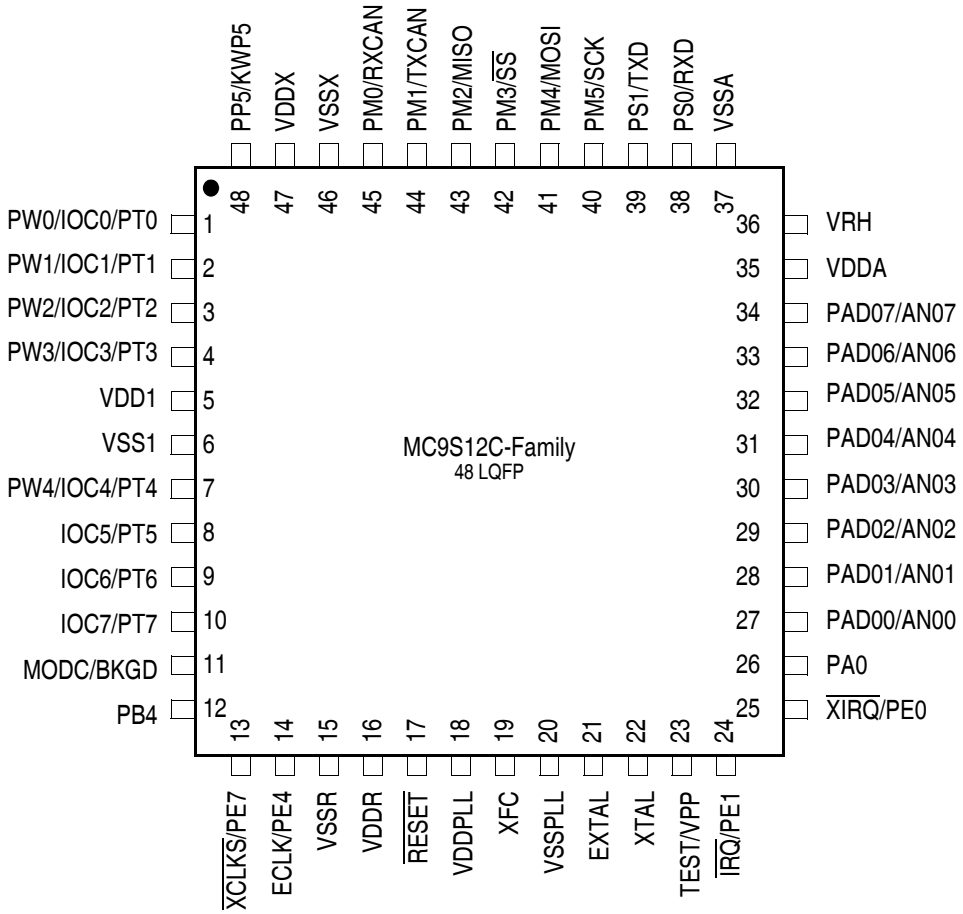
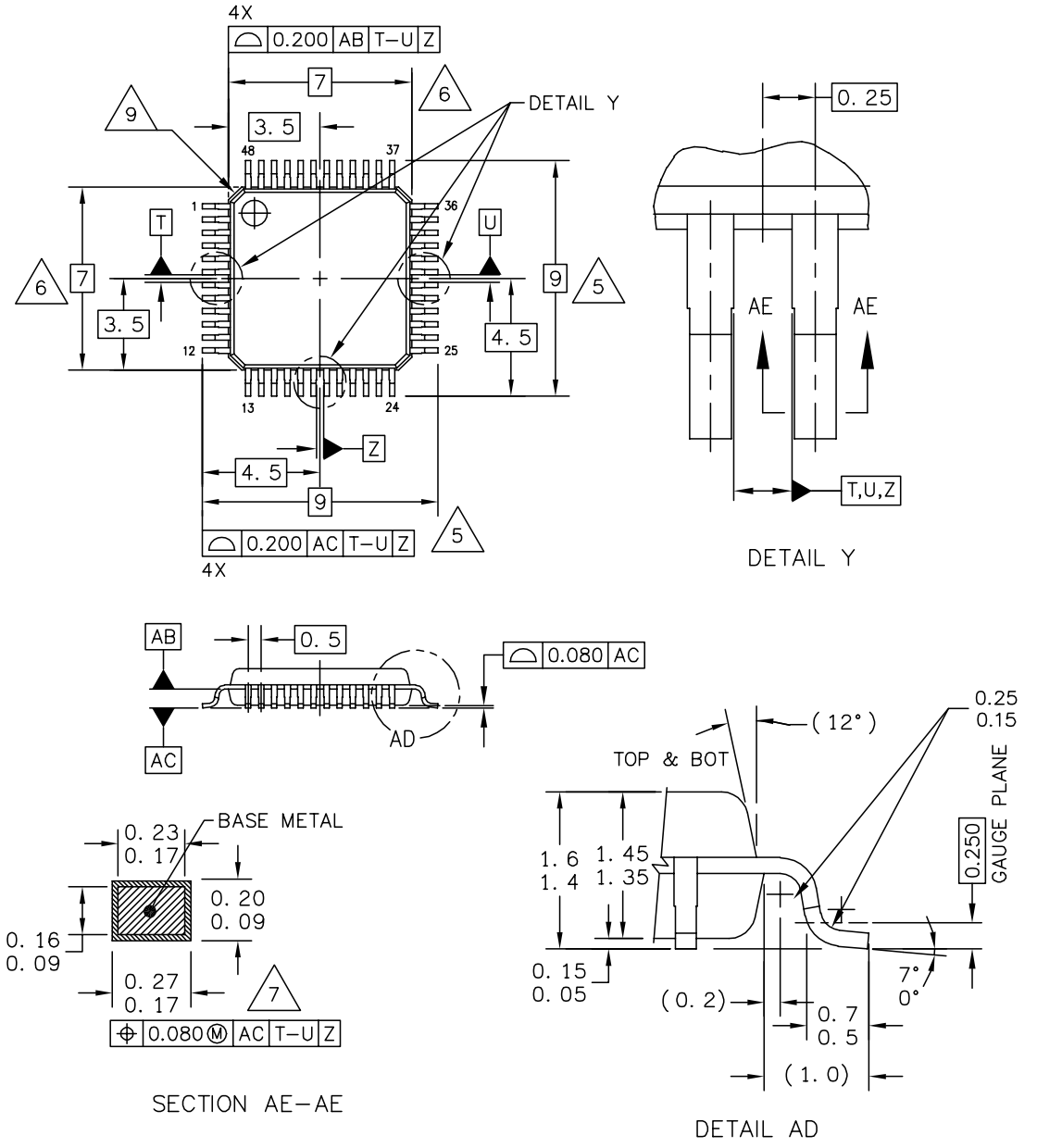


Figure 10. Pin Assignments for 48-pin LQFP for MC9S12C-Family

7 Package Mechanical Information

Refer to the following pages for detailed package dimensions.



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TITLE: LQFP, 48 LEAD, 0.50 PITCH (7.0 X 7.0 X 1.4)	DOCUMENT NO: 98ASH00962A	REV: G
	CASE NUMBER: 932-03	14 APR 2005
	STANDARD: JEDEC MS-026-BBC	

NOTES:

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE AB IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS T, U, AND Z TO BE DETERMINED AT DATUM PLANE AB.
5. DIMENSIONS TO BE DETERMINED AT SEATING PLANE AC.
6. DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE AB.
7. THIS DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED 0.350.
8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076.
9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

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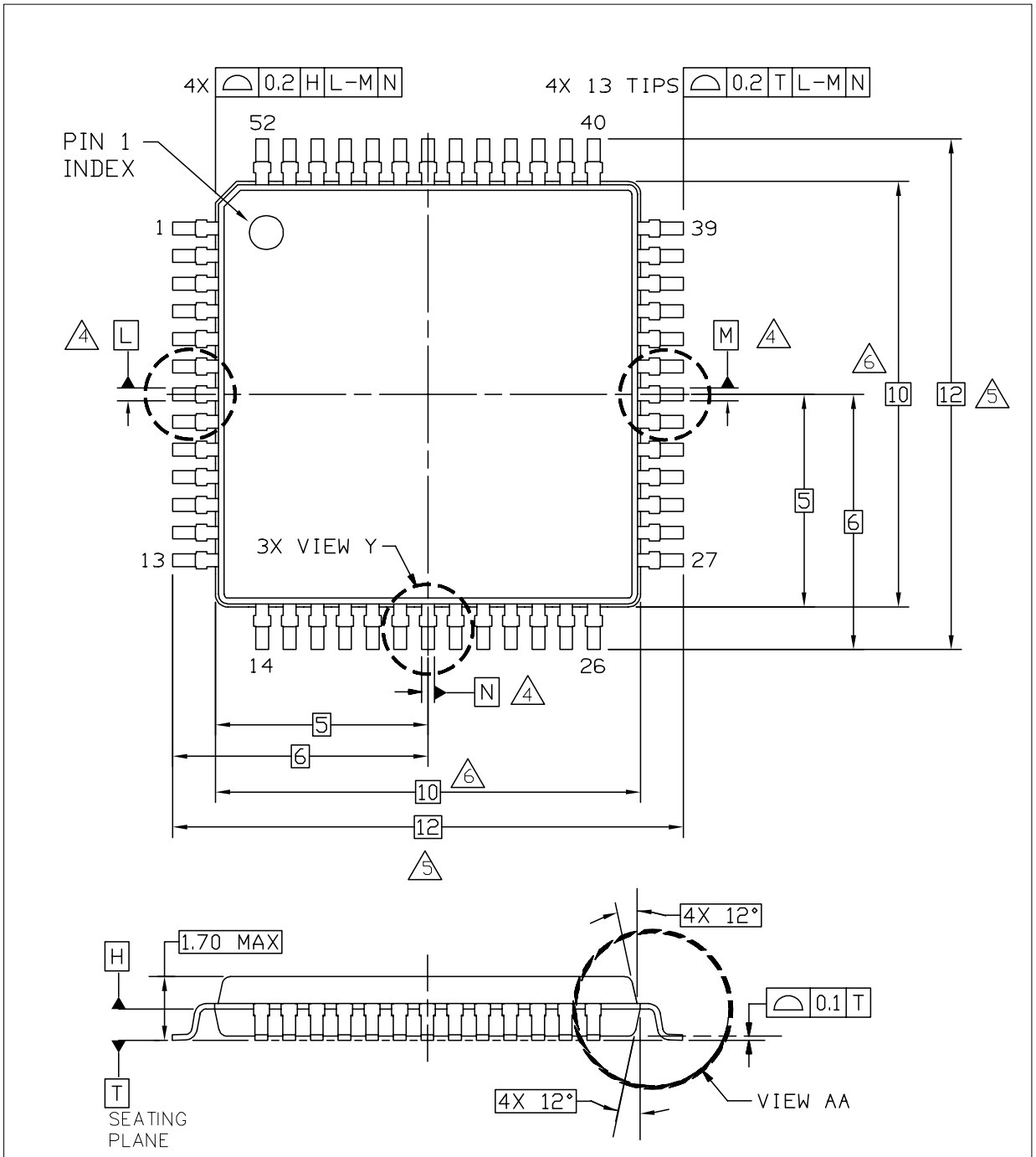
	CASE NUMBER: 932-03	14 APR 2005
	STANDARD: JEDEC MS-026-BBC	



MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

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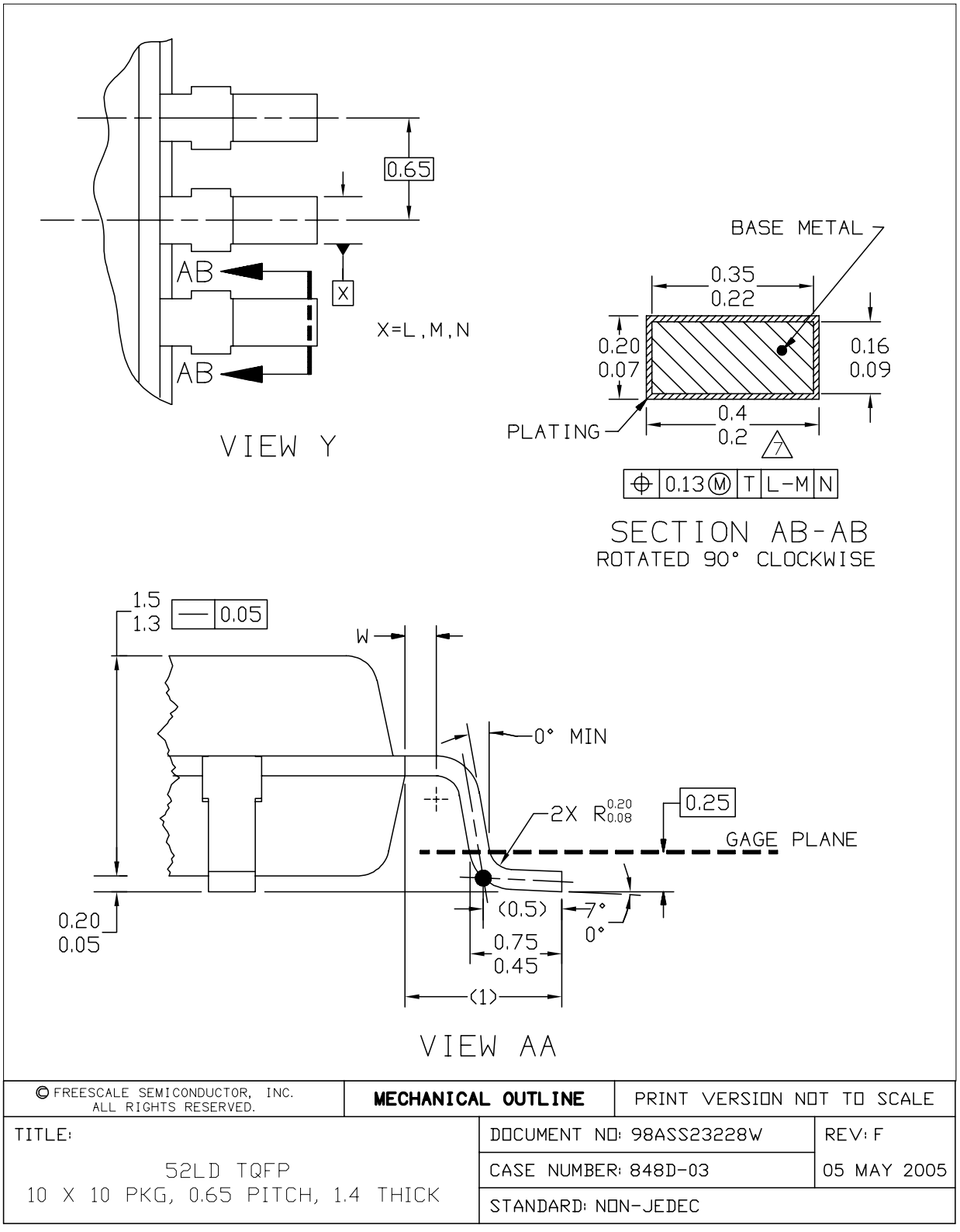
52LD TQFP 10 X 10 PKG, 0.65 PITCH, 1.4 THICK	CASE NUMBER: 848D-03	05 MAY 2005
	STANDARD: NON-JEDEC	



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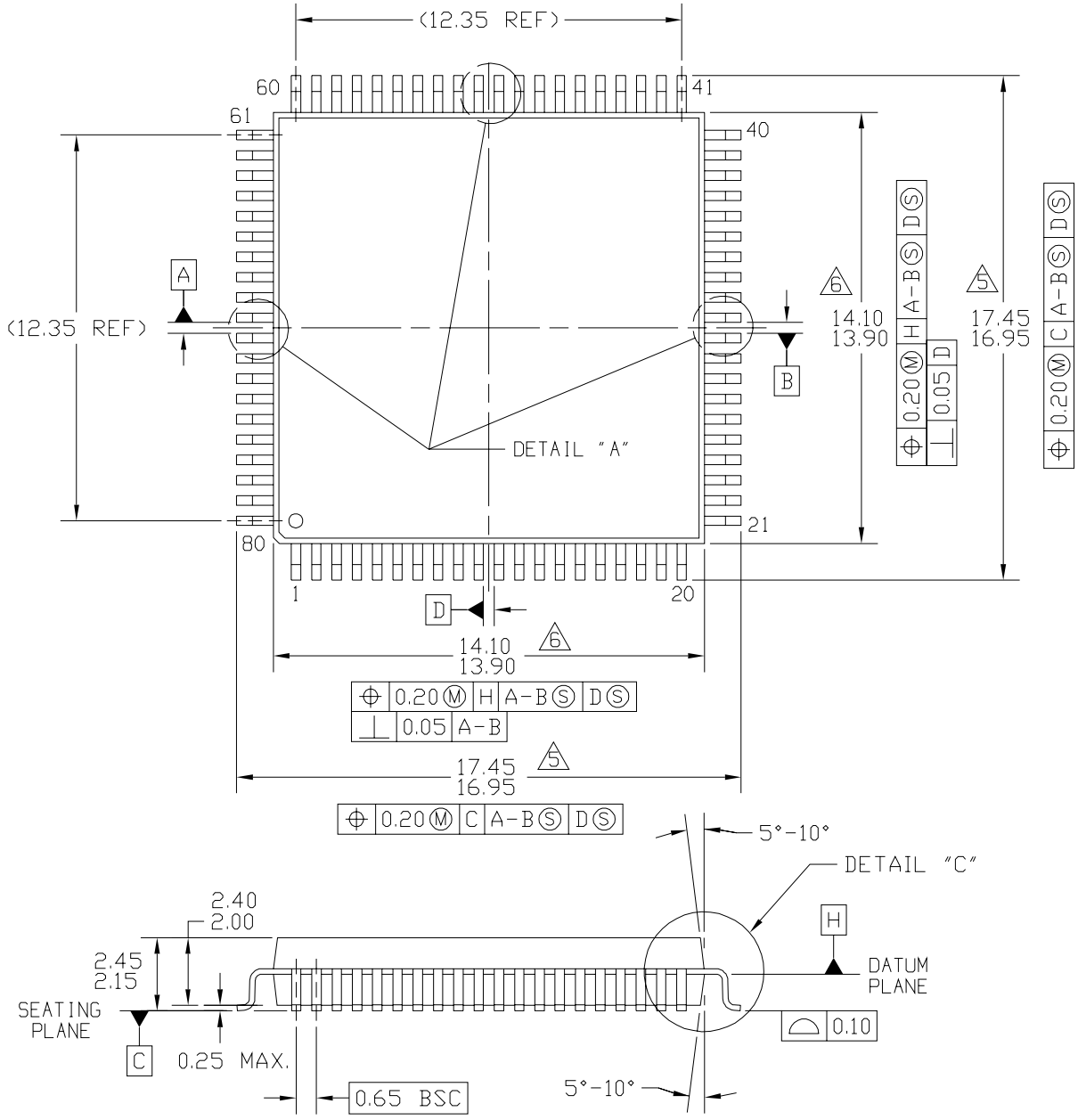
	CASE NUMBER: 848D-03	05 MAY 2005
	STANDARD: NON-JEDEC	

NOTES

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M. 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE H IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS L, M, AND N TO BE DETERMINED AT DATUM PLANE H.
5. DIMENSIONS TO BE DETERMINED AT SEATING PLANE T.
6. DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 PER SIDE. DIMENSIONS DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
7. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED 0.46. MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD OR PROTRUSION 0.07.

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASS23228W	REV: F
52LD TQFP 10 X 10 PKG, 0.65 PITCH, 1.4 THICK	CASE NUMBER: 848D-03	05 MAY 2005
	STANDARD: NON-JEDEC	



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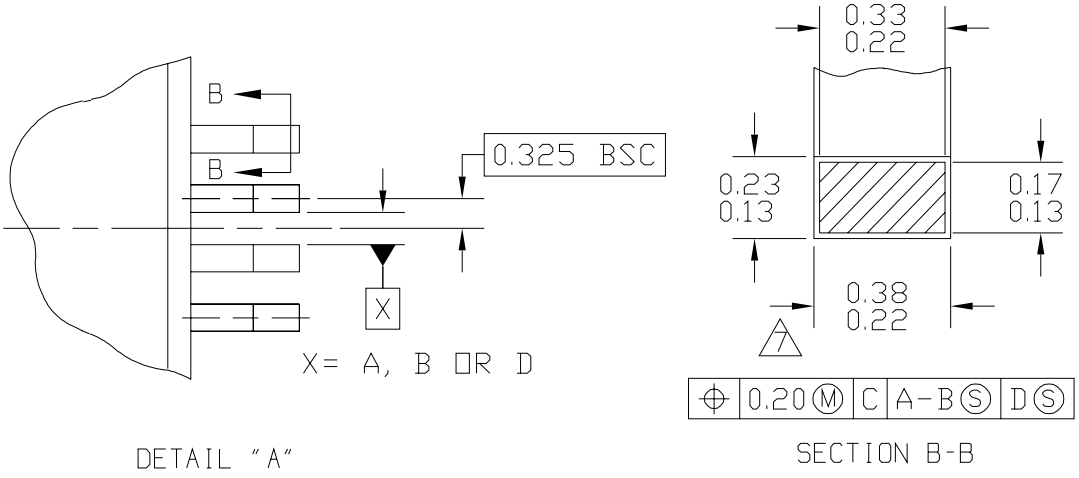
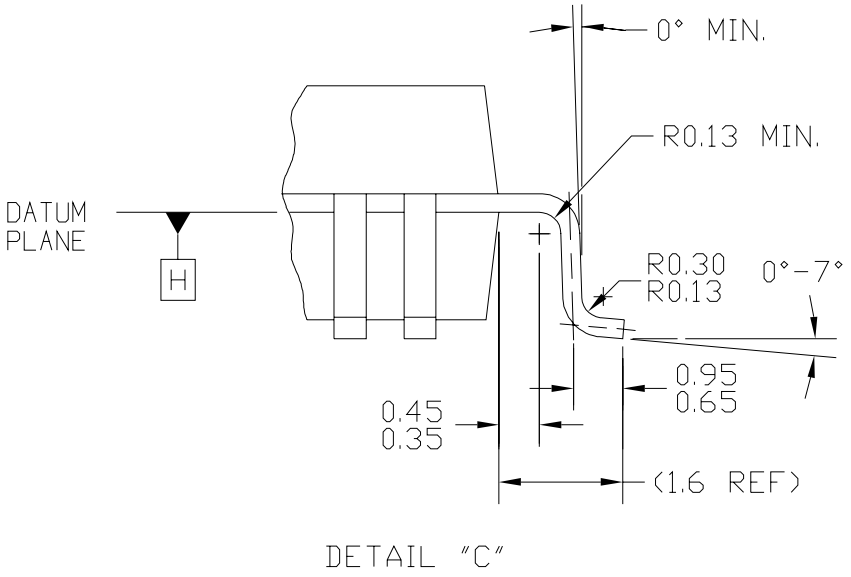
TITLE: QUAD FLAT PACKAGE, 80 LEAD, 14 X 14 X 2.2 PKG, 0.65 LEAD PITCH	DOCUMENT NO: 98ASB42846B	REV: C
	CASE NUMBER: 841B-02	20 MAY 2005
	STANDARD: NON-JEDEC	





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TITLE: QUAD FLAT PACKAGE, 80 LEAD, 14 X 14 X 2.2 PKG, 0.65 LEAD PITCH	DOCUMENT NO: 98ASB42846B	REV: C
	CASE NUMBER: 841B-02	20 MAY 2005
	STANDARD: NON-JEDEC	

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS A-B AND -D- TO BE DETERMINED AT DATUM PLANE -H-.
5. DIMENSIONS TO BE DETERMINED AT SEATING PLANE -C-.
6. DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 PER SIDE. DIMENSIONS DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
7. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF THE DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

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	CASE NUMBER: 841B-02	20 MAY 2005
	STANDARD: NON-JEDEC	

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Rev. 5, 03/2006

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