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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	S08
Core Size	8-Bit
Speed	20MHz
Connectivity	I²C, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	12
Program Memory Size	8KB (8K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	512 x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 8x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	16-VQFN Exposed Pad
Supplier Device Package	16-QFN-EP (5x5)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mc9s08qg84cffer

NOTE

When an alternative function is first enabled, it is possible to get a spurious edge to the module. User software should clear out any associated flags before interrupts are enabled. Table 2-1 shows the priority if multiple modules are enabled. The highest priority module will have control over the pin. Selecting a higher priority pin function with a lower priority function already enabled can cause spurious edges to the lower priority module. It is recommended that all modules that share a pin be disabled before enabling anther module.

After entering active background mode, the CPU is held in a suspended state waiting for serial background commands rather than executing instructions from the user application program.

Background commands are of two types:

- Non-intrusive commands, defined as commands that can be issued while the user program is running. Non-intrusive commands can be issued through the BKGD pin while the MCU is in run mode; non-intrusive commands can also be executed when the MCU is in the active background mode. Non-intrusive commands include:
  - Memory access commands
  - Memory-access-with-status commands
  - BDC register access commands
  - The BACKGROUND command
- Active background commands, which can only be executed while the MCU is in active background mode. Active background commands include commands to:
  - Read or write CPU registers
  - Trace one user program instruction at a time
  - Leave active background mode to return to the user application program (GO)

The active background mode is used to program a bootloader or user application program into the FLASH program memory before the MCU is operated in run mode for the first time. When the MC9S08QG8/4 is shipped from the Freescale factory, the FLASH program memory is erased by default unless specifically noted, so there is no program that could be executed in run mode until the FLASH memory is initially programmed. The active background mode can also be used to erase and reprogram the FLASH memory after it has been previously programmed.

For additional information about the active background mode, refer to the Development Support chapter.

3.5 Wait Mode

Wait mode is entered by executing a WAIT instruction. Upon execution of the WAIT instruction, the CPU enters a low-power state in which it is not clocked. The I bit in the condition code register (CCR) is cleared when the CPU enters wait mode, enabling interrupts. When an interrupt request occurs, the CPU exits wait mode and resumes processing, beginning with the stacking operations leading to the interrupt service routine.

While the MCU is in wait mode, there are some restrictions on which background debug commands can be used. Only the BACKGROUND command and memory-access-with-status commands are available while the MCU is in wait mode. The memory-access-with-status commands do not allow memory access, but they report an error indicating that the MCU is in either stop or wait mode. The BACKGROUND command can be used to wake the MCU from wait mode and enter active background mode.

4.3 Register Addresses and Bit Assignments

The registers in the MC9S08QG8/4 are divided into these groups:

- Direct-page registers are located in the first 96 locations in the memory map; these are accessible with efficient direct addressing mode instructions.
- High-page registers are used much less often, so they are located from 0x1800 and above in the memory map. This leaves more room in the direct page for more frequently used registers and RAM.
- The nonvolatile register area consists of a block of 16 locations in FLASH memory at 0xFFB0–0xFFBF. Nonvolatile register locations include:
  - — NVPROT and NVOPT are loaded into working registers at reset.
  - — An 8-byte backdoor comparison key that optionally allows a user to gain controlled access to secure memory.

  Because the nonvolatile register locations are FLASH memory, they must be erased and programmed like other FLASH memory locations.

Direct-page registers can be accessed with efficient direct addressing mode instructions. Bit manipulation instructions can be used to access any bit in any direct-page register. Table 4-2 is a summary of all user-accessible direct-page registers and control bits.

The direct page registers in Table 4-2 can use the more efficient direct addressing mode that requires only the lower byte of the address. Because of this, the lower byte of the address in column one is shown in bold text. In Table 4-3 and Table 4-4, the whole address in column one is shown in bold. In Table 4-2, Table 4-3, and Table 4-4, the register names in column two are shown in bold to set them apart from the bit names to the right. Cells that are not associated with named bits are shaded. A shaded cell with a 0 indicates this unused bit always reads as a 0. Shaded cells with dashes indicate unused or reserved bit locations that could read as 1s or 0s.

Table 4-2. Direct-Page Register Summary

Address	Register Name	Bit 7	6	5	4	3	2	1	Bit 0
0x00**00**	**PTAD**	0	0	PTAD5	PTAD4	PTAD3	PTAD2	PTAD1	PTAD0
0x00**01**	**PTADD**	0	0	PTADD5	PTADD4	PTADD3	PTADD2	PTADD1	PTADD0
0x00**02**	**PTBD**	PTBD7	PTBD6	PTBD5	PTBD4	PTBD3	PTBD2	PTBD1	PTBD0
0x00**03**	**PTBDD**	PTBDD7	PTBDD6	PTBDD5	PTBDD4	PTBDD3	PTBDD2	PTBDD1	PTBDD0
0x00**04**– 0x00**0B**	Reserved	— —	— —	— —	— —	— —	— —	— —	— —
0x00**0C**	**KBISC**	0	0	0	0	KBF	KBACK	KBIE	KBMOD
0x00**0D**	**KBIPE**	KBIPE7	KBIPE6	KBIPE5	KBIPE4	KBIPE3	KBIPE2	KBIPE1	KBIPE0
0x00**0E**	**KBIES**	KBEDG7	KBEDG6	KBEDG5	KBEDG4	KBEDG3	KBEDG2	KBEDG1	KBEDG0
0x00**0F**	**IRQSC**	0	IRQPDD	0	IRQPE	IRQF	IRQACK	IRQIE	IRQMOD
0x00**10**	**ADCSC1**	COCO	AIEN	ADCO	ADCH				
0x00**11**	**ADCSC2**	ADACT	ADTRG	ACFE	ACFGT	—	—	—	—
0x00**12**	**ADCRH**	0	0	0	0	0	0	ADR9	ADR8
0x00**13**	**ADCRL**	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0

5.8.1 Interrupt Pin Request Status and Control Register (IRQSC)

This direct page register includes status and control bits, which are used to configure the IRQ function, report status, and acknowledge IRQ events.

	7	6	5[1]	4	3	2	1	0
R	0	IRQPDD	0	IRQPE	IRQF	0	IRQIE	IRQMOD
W						IRQACK		
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 5-2. Interrupt Request Status and Control Register (IRQSC)

[1] Bit 5 is a reserved bit that must always be written to 0.

Table 5-3. IRQSC Register Field Descriptions

Field	Description
6 IRQPDD	**Interrupt Request (IRQ) Pull Device Disable** — This read/write control bit is used to disable the internal pullup device when the IRQ pin is enabled (IRQPE = 1) allowing for an external device to be used. 0 IRQ pull device enabled if IRQPE = 1. 1 IRQ pull device disabled if IRQPE = 1.
4 IRQPE	**IRQ Pin Enable** — This read/write control bit enables the IRQ pin function. When this bit is set the IRQ pin can be used as an interrupt request. 0 IRQ pin function is disabled. 1 IRQ pin function is enabled.
3 IRQF	**IRQ Flag** — This read-only status bit indicates when an interrupt request event has occurred. 0 No IRQ request. 1 IRQ event detected.
2 IRQACK	**IRQ Acknowledge** — This write-only bit is used to acknowledge interrupt request events (write 1 to clear IRQF). Writing 0 has no meaning or effect. Reads always return 0. If edge-and-level detection is selected (IRQMOD = 1), IRQF cannot be cleared while the IRQ pin remains at its asserted level.
1 IRQIE	**IRQ Interrupt Enable** — This read/write control bit determines whether IRQ events generate an interrupt request. 0 Interrupt request when IRQF set is disabled (use polling). 1 Interrupt requested whenever IRQF = 1.
0 IRQMOD	**IRQ Detection Mode** — This read/write control bit selects either edge-only detection or edge-and-level detection. See Section 5.5.2.2, "Edge and Level Sensitivity," for more details. 0 IRQ event on falling edges only. 1 IRQ event on falling edges and low levels.

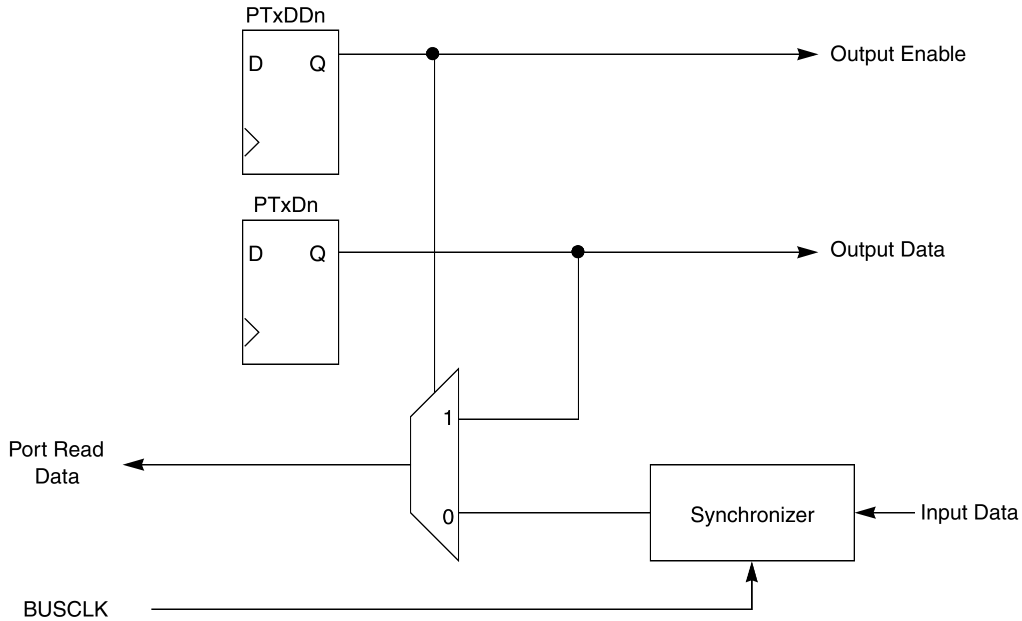


Figure 6-1. Parallel I/O Block Diagram

The data direction control bit (PTxDDn) determines whether the output buffer for the associated pin is enabled, and also controls the source for port data register reads. The input buffer for the associated pin is always enabled unless the pin is enabled as an analog function or is an output-only pin.

When a shared digital function is enabled for a pin, the output buffer is controlled by the shared function. However, the data direction register bit will continue to control the source for reads of the port data register.

When a shared analog function is enabled for a pin, both the input and output buffers are disabled. A value of 0 is read for any port data bit where the bit is an input (PTxDDn = 0) and the input buffer is disabled. In general, whenever a pin is shared with both an alternate digital function and an analog function, the analog function has priority such that if both the digital and analog functions are enabled, the analog function controls the pin.

It is a good programming practice to write to the port data register before changing the direction of a port pin to become an output. This ensures that the pin will not be driven momentarily with an old data value that happened to be in the port data register.

6.2 Pin Control — Pullup, Slew Rate, and Drive Strength

Associated with the parallel I/O ports is a set of registers located in the high page register space that operate independently of the parallel I/O registers. These registers are used to control pullups, slew rate, and drive strength for the pins.

6.4.3 Port B Registers

This section provides information about the registers associated with the parallel I/O ports.

Refer to tables in Chapter 4, "Memory Map and Register Definition," for the absolute address assignments for all parallel I/O. This section refers to registers and control bits only by their names. A Freescale Semiconductor-provided equate or header file normally is used to translate these names into the appropriate absolute addresses.

6.4.3.1 Port B Data (PTBD)

	7	6	5	4	3	2	1	0
R W	PTBD7	PTBD6	PTBD5	PTBD4	PTBD3	PTBD2	PTBD1	PTBD0
Reset:	0	0	0	0	0	0	0	0

Figure 6-10. Port B Data Register (PTBD)

Table 6-6. PTBD Register Field Descriptions

Field	Description
7:0 PTBD[7:0]	**Port B Data Register Bits** — For port B pins that are inputs, reads return the logic level on the pin. For port B pins that are configured as outputs, reads return the last value written to this register. Writes are latched into all bits of this register. For port B pins that are configured as outputs, the logic level is driven out the corresponding MCU pin. Reset forces PTBD to all 0s, but these 0s are not driven out the corresponding pins because reset also configures all port pins as high-impedance inputs with pullups disabled.

6.4.3.2 Port B Data Direction (PTBDD)

	7	6	5	4	3	2	1	0
R W	PTBDD7	PTBDD6	PTBDD5	PTBDD4	PTBDD3	PTBDD2	PTBDD1	PTBDD0
Reset:	0	0	0	0	0	0	0	0

Figure 6-11. Data Direction for Port B (PTBDD)

Table 6-7. PTBDD Register Field Descriptions

Field	Description
7:0 PTBDD[7:0]	**Data Direction for Port B Bits** — These read/write bits control the direction of port B pins and what is read for PTBD reads. 0 Input (output driver disabled) and reads return the pin value. 1 Output driver enabled for port B bit n and PTBD reads return the contents of PTBDn.

Chapter 8
Analog Comparator (S08ACMPV2)

8.1 Introduction

The analog comparator module (ACMP) provides a circuit for comparing two analog input voltages or for comparing one analog input voltage to an internal reference voltage. The comparator circuit is designed to operate across the full range of the supply voltage (rail-to-rail operation).

Figure 8-1 shows the MC9S08QG8/4 block diagram with the ACMP highlighted.

8.1.1 ACMP Configuration Information

When using the bandgap reference voltage for input to ACMP+, the user must enable the bandgap buffer by setting BGBE =1 in SPMSC1; see Section 5.8.8, "System Power Management Status and Control 1 Register (SPMSC1)". For the value of the bandgap voltage reference see Section A.5, "DC Characteristics".

To use ACMPO, the BKGDPE bit in SOPT1 must be cleared. This will disable the background debug mode and on-chip ICE.

8.1.2 ACMP/TPM Configuration Information

The ACMP module can be configured to connect the output of the analog comparator to TPM input capture channel 0 by setting ACIC in SOPT2. With ACIC set, the TPMCH0 pin is not available externally regardless of the configuration of the TPM module.

8.2 External Signal Description

The ACMP has two analog input pins, ACMP+ and ACMP– and one digital output pin ACMPO. Each of these pins can accept an input voltage that varies across the full operating voltage range of the MCU. As shown in Figure 8-2, the ACMP– pin is connected to the inverting input of the comparator, and the ACMP+ pin is connected to the comparator non-inverting input if ACBGS is a 0. As shown in Figure 8-2, the ACMPO pin can be enabled to drive an external pin.

The signal properties of ACMP are shown in Table 8-1.

Table 8-1. Signal Properties

Signal	Function	I/O
ACMP–	Inverting analog input to the ACMP. (Minus input)	I
ACMP+	Non-inverting analog input to the ACMP. (Positive input)	I
ACMPO	Digital output of the ACMP.	O

8.3 Register Definition

The ACMP includes one register:

- An 8-bit status and control register

Refer to the direct-page register summary in the memory section of this data sheet for the absolute address assignments for all ACMP registers.This section refers to registers and control bits only by their names and relative address offsets.

Some MCUs may have more than one ACMP, so register names include placeholder characters to identify which ACMP is being referenced.

9.2.1 Analog Power (V_{DDAD})

The ADC analog portion uses V_{DDAD} as its power connection. In some packages, V_{DDAD} is connected internally to V_{DD}. If externally available, connect the V_{DDAD} pin to the same voltage potential as V_{DD}. External filtering may be necessary to ensure clean V_{DDAD} for good results.

9.2.2 Analog Ground (V_{SSAD})

The ADC analog portion uses V_{SSAD} as its ground connection. In some packages, V_{SSAD} is connected internally to V_{SS}. If externally available, connect the V_{SSAD} pin to the same voltage potential as V_{SS}.

9.2.3 Voltage Reference High (V_{REFH})

V_{REFH} is the high reference voltage for the converter. In some packages, V_{REFH} is connected internally to V_{DDAD}. If externally available, V_{REFH} may be connected to the same potential as V_{DDAD}, or may be driven by an external source that is between the minimum V_{DDAD} spec and the V_{DDAD} potential (V_{REFH} must never exceed V_{DDAD}).

9.2.4 Voltage Reference Low (V_{REFL})

V_{REFL} is the low reference voltage for the converter. In some packages, V_{REFL} is connected internally to V_{SSAD}. If externally available, connect the V_{REFL} pin to the same voltage potential as V_{SSAD}.

9.2.5 Analog Channel Inputs (ADx)

The ADC module supports up to 28 separate analog inputs. An input is selected for conversion through the ADCH channel select bits.

9.3 Register Definition

These memory mapped registers control and monitor operation of the ADC:

- Status and control register, ADCSC1
- Status and control register, ADCSC2
- Data result registers, ADCRH and ADCRL
- Compare value registers, ADCCVH and ADCCVL
- Configuration register, ADCCFG
- Pin enable registers, APCTL1, APCTL2, APCTL3

9.3.1 Status and Control Register 1 (ADCSC1)

This section describes the function of the ADC status and control register (ADCSC1). Writing ADCSC1 aborts the current conversion and initiates a new conversion (if the ADCH bits are equal to a value other than all 1s).

9.6.2 Sources of Error

Several sources of error exist for A/D conversions. These are discussed in the following sections.

9.6.2.1 Sampling Error

For proper conversions, the input must be sampled long enough to achieve the proper accuracy. Given the maximum input resistance of approximately 7kΩ and input capacitance of approximately 5.5 pF, sampling to within 1/4LSB (at 10-bit resolution) can be achieved within the minimum sample window (3.5 cycles @ 8 MHz maximum ADCK frequency) provided the resistance of the external analog source (R_{AS}) is kept below 5 kΩ.

Higher source resistances or higher-accuracy sampling is possible by setting ADLSMP (to increase the sample window to 23.5 cycles) or decreasing ADCK frequency to increase sample time.

9.6.2.2 Pin Leakage Error

Leakage on the I/O pins can cause conversion error if the external analog source resistance (R_{AS}) is high. If this error cannot be tolerated by the application, keep R_{AS} lower than V_{DDAD} / (2^N*I_{LEAK}) for less than 1/4LSB leakage error (N = 8 in 8-bit mode or 10 in 10-bit mode).

9.6.2.3 Noise-Induced Errors

System noise which occurs during the sample or conversion process can affect the accuracy of the conversion. The ADC accuracy numbers are guaranteed as specified only if the following conditions are met:

- There is a 0.1 μF low-ESR capacitor from V_{REFH} to V_{REFL}.
- There is a 0.1 μF low-ESR capacitor from V_{DDAD} to V_{SSAD}.
- If inductive isolation is used from the primary supply, an additional 1 μF capacitor is placed from V_{DDAD} to V_{SSAD}.
- V_{SSAD} (and V_{REFL}, if connected) is connected to V_{SS} at a quiet point in the ground plane.
- Operate the MCU in wait or stop3 mode before initiating (hardware triggered conversions) or immediately after initiating (hardware or software triggered conversions) the ADC conversion.
  - For software triggered conversions, immediately follow the write to the ADCSC1 with a WAIT instruction or STOP instruction.
  - For stop3 mode operation, select ADACK as the clock source. Operation in stop3 reduces V_{DD} noise but increases effective conversion time due to stop recovery.
- There is no I/O switching, input or output, on the MCU during the conversion.

There are some situations where external system activity causes radiated or conducted noise emissions or excessive V_{DD} noise is coupled into the ADC. In these situations, or when the MCU cannot be placed in wait or stop3 or I/O activity cannot be halted, these recommended actions may reduce the effect of noise on the accuracy:

- Place a 0.01 μF capacitor (C_{AS}) on the selected input channel to V_{REFL} or V_{SSAD} (this will improve noise issues but will affect sample rate based on the external analog source resistance).

11.4.1.1 START Signal

When the bus is free; i.e., no master device is engaging the bus (both SCL and SDA lines are at logical high), a master may initiate communication by sending a START signal. As shown in Figure 11-8, a START signal is defined as a high-to-low transition of SDA while SCL is high. This signal denotes the beginning of a new data transfer (each data transfer may contain several bytes of data) and brings all slaves out of their idle states.

11.4.1.2 Slave Address Transmission

The first byte of data transferred immediately after the START signal is the slave address transmitted by the master. This is a seven-bit calling address followed by a R/W bit. The R/W bit tells the slave the desired direction of data transfer.

1 = Read transfer, the slave transmits data to the master.
0 = Write transfer, the master transmits data to the slave.

Only the slave with a calling address that matches the one transmitted by the master will respond by sending back an acknowledge bit. This is done by pulling the SDA low at the 9th clock (see Figure 11-8).

No two slaves in the system may have the same address. If the IIC module is the master, it must not transmit an address that is equal to its own slave address. The IIC cannot be master and slave at the same time. However, if arbitration is lost during an address cycle, the IIC will revert to slave mode and operate correctly even if it is being addressed by another master.

11.4.1.3 Data Transfer

Before successful slave addressing is achieved, the data transfer can proceed byte-by-byte in a direction specified by the R/W bit sent by the calling master.

All transfers that come after an address cycle are referred to as data transfers, even if they carry sub-address information for the slave device

Each data byte is 8 bits long. Data may be changed only while SCL is low and must be held stable while SCL is high as shown in Figure 11-8. There is one clock pulse on SCL for each data bit, the MSB being transferred first. Each data byte is followed by a 9th (acknowledge) bit, which is signalled from the receiving device. An acknowledge is signalled by pulling the SDA low at the ninth clock. In summary, one complete data transfer needs nine clock pulses.

If the slave receiver does not acknowledge the master in the 9th bit time, the SDA line must be left high by the slave. The master interprets the failed acknowledge as an unsuccessful data transfer.

If the master receiver does not acknowledge the slave transmitter after a data byte transmission, the slave interprets this as an end of data transfer and releases the SDA line.

In either case, the data transfer is aborted and the master does one of two things:

- Relinquishes the bus by generating a STOP signal.
- Commences a new calling by generating a repeated START signal.

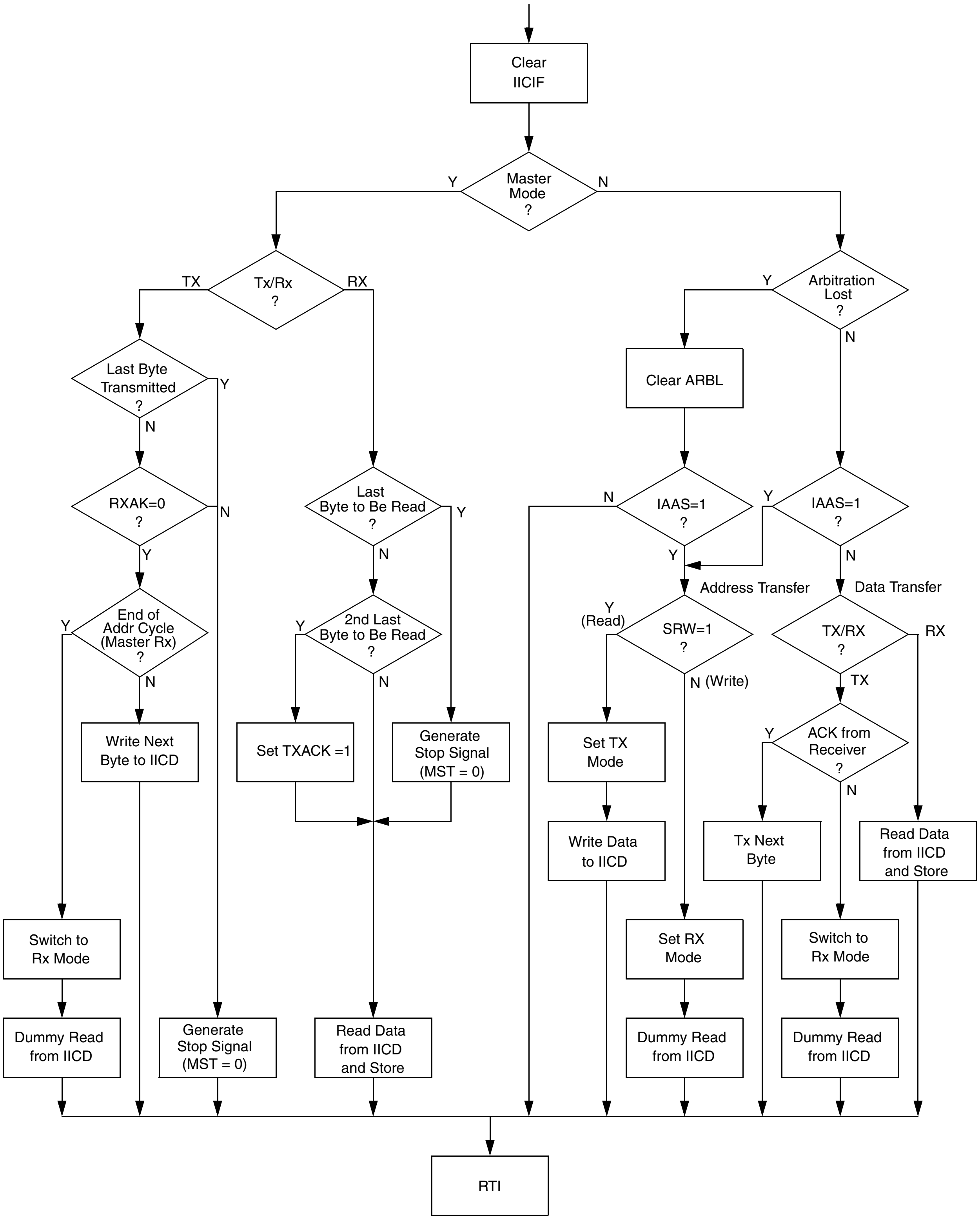


Figure 11-11. Typical IIC Interrupt Routine

Chapter 14
Serial Communications Interface (S08SCIV3)

14.1 Introduction

Figure 14-1 shows the MC9S08QG8/4 block diagram with the SCI highlighted.

Table 14-2. SCIBDL Register Field Descriptions

Field	Description
7:0 SBR[7:0]	**Baud Rate Modulo Divisor** — These 13 bits are referred to collectively as BR, and they set the modulo divide rate for the SCI baud rate generator. When BR = 0, the SCI baud rate generator is disabled to reduce supply current. When BR = 1 to 8191, the SCI baud rate = BUSCLK/(16×BR). See also BR bits in Table 14-1.

14.2.2 SCI Control Register 1 (SCIC1)

This read/write register is used to control various optional features of the SCI system.

	7	6	5	4	3	2	1	0
R W	LOOPS	SCISWAI	RSRC	M	WAKE	ILT	PE	PT
Reset	0	0	0	0	0	0	0	0

Figure 14-7. SCI Control Register 1 (SCIC1)

Table 14-3. SCIC1 Register Field Descriptions

Field	Description
7 LOOPS	**Loop Mode Select** — Selects between loop back modes and normal 2-pin full-duplex modes. When LOOPS = 1, the transmitter output is internally connected to the receiver input. 0 Normal operation — RxD and TxD use separate pins. 1 Loop mode or single-wire mode where transmitter outputs are internally connected to receiver input. (See RSRC bit.) RxD pin is not used by SCI.
6 SCISWAI	**SCI Stops in Wait Mode** 0 SCI clocks continue to run in wait mode so the SCI can be the source of an interrupt that wakes up the CPU. 1 SCI clocks freeze while CPU is in wait mode.
5 RSRC	**Receiver Source Select** — This bit has no meaning or effect unless the LOOPS bit is set to 1. When LOOPS = 1, the receiver input is internally connected to the TxD pin and RSRC determines whether this connection is also connected to the transmitter output. 0 Provided LOOPS = 1, RSRC = 0 selects internal loop back mode and the SCI does not use the RxD pins. 1 Single-wire SCI mode where the TxD pin is connected to the transmitter output and receiver input.
4 M	**9-Bit or 8-Bit Mode Select** 0 Normal — start + 8 data bits (LSB first) + stop. 1 Receiver and transmitter use 9-bit data characters start + 8 data bits (LSB first) + 9th data bit + stop.
3 WAKE	**Receiver Wakeup Method Select** — Refer to Section 14.3.3.2, "Receiver Wakeup Operation" for more information. 0 Idle-line wakeup. 1 Address-mark wakeup.
2 ILT	**Idle Line Type Select** — Setting this bit to 1 ensures that the stop bit and logic 1 bits at the end of a character do not count toward the 10 or 11 bit times of the logic high level by the idle line detection logic. Refer to Section 14.3.3.2.1, "Idle-Line Wakeup" for more information. 0 Idle character bit count starts after start bit. 1 Idle character bit count starts after stop bit.

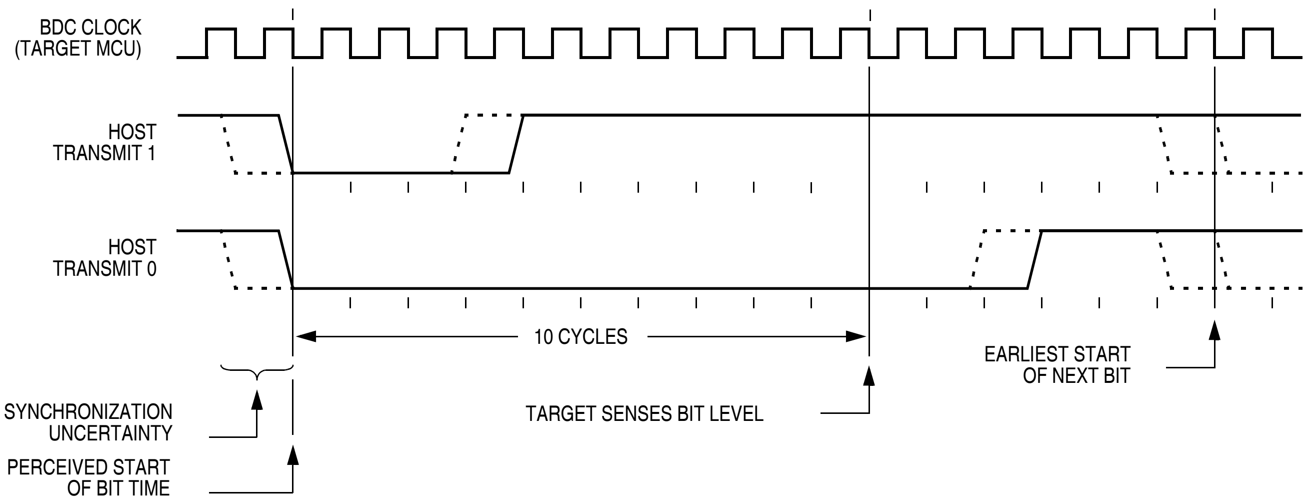


Figure 17-2. BDC Host-to-Target Serial Bit Timing

Figure 17-3 shows the host receiving a logic 1 from the target HCS08 MCU. Because the host is asynchronous to the target MCU, there is a 0-to-1 cycle delay from the host-generated falling edge on BKGD to the perceived start of the bit time in the target MCU. The host holds the BKGD pin low long enough for the target to recognize it (at least two target BDC cycles). The host must release the low drive before the target MCU drives a brief active-high speedup pulse seven cycles after the perceived start of the bit time. The host should sample the bit level about 10 cycles after it started the bit time.

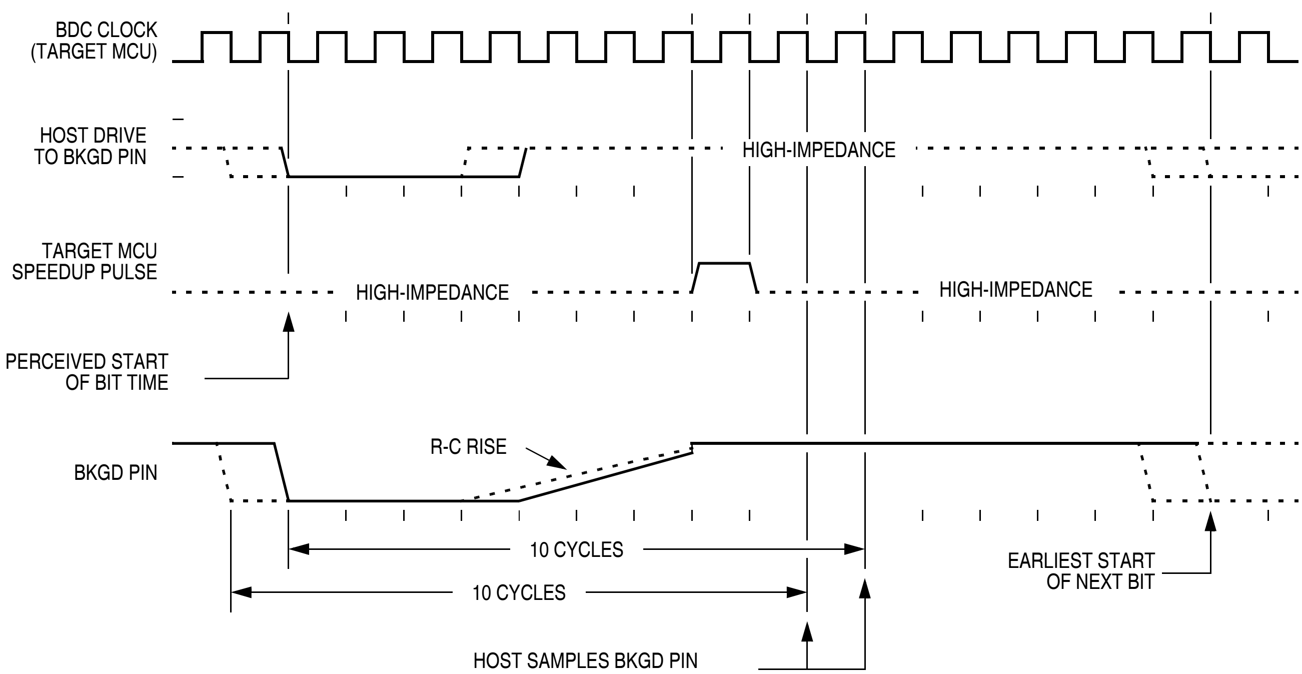


Figure 17-3. BDC Target-to-Host Serial Bit Timing (Logic 1)

17.4.3.7 Debug Control Register (DBGC)

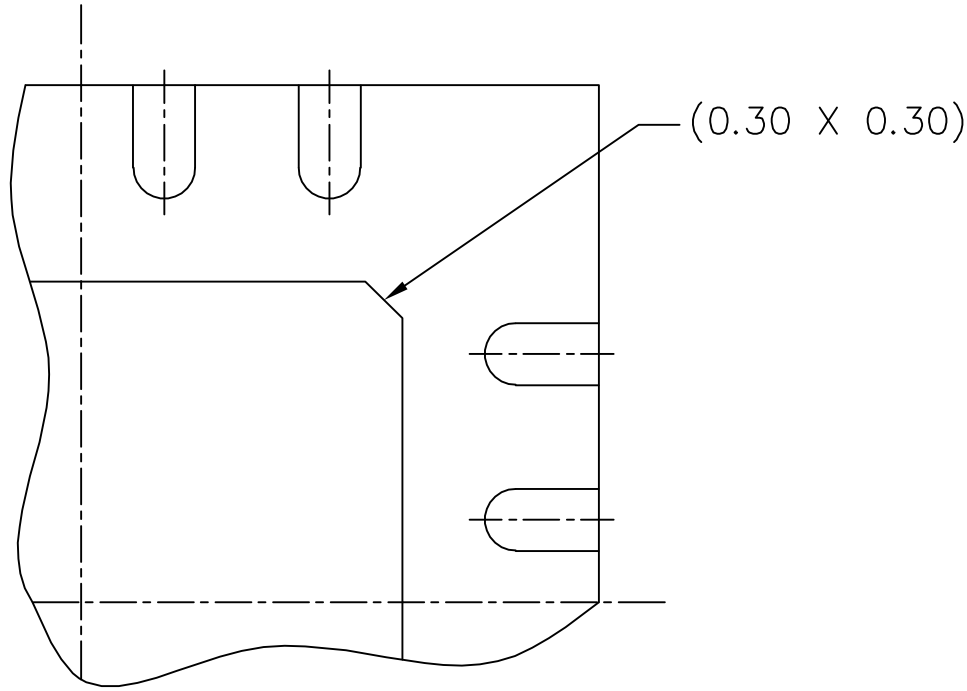
This register can be read or written at any time.

	7	6	5	4	3	2	1	0
R W	DBGEN	ARM	TAG	BRKEN	RWA	RWAEN	RWB	RWBEN
Reset	0	0	0	0	0	0	0	0

Figure 17-7. Debug Control Register (DBGC)

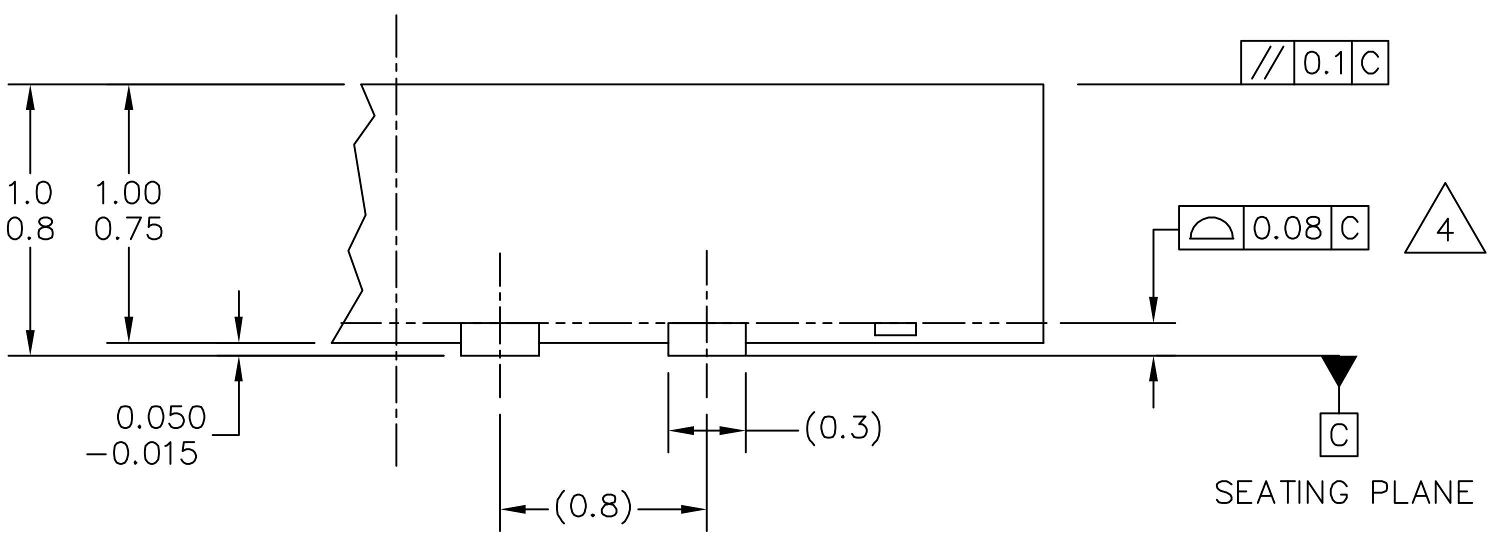
Table 17-4. DBGC Register Field Descriptions

Field	Description
7 DBGEN	**Debug Module Enable** — Used to enable the debug module. DBGEN cannot be set to 1 if the MCU is secure. 0 DBG disabled 1 DBG enabled
6 ARM	**Arm Control** — Controls whether the debugger is comparing and storing information in the FIFO. A write is used to set this bit (and ARMF) and completion of a debug run automatically clears it. Any debug run can be manually stopped by writing 0 to ARM or to DBGEN. 0 Debugger not armed 1 Debugger armed
5 TAG	**Tag/Force Select** — Controls whether break requests to the CPU will be tag or force type requests. If BRKEN = 0, this bit has no meaning or effect. 0 CPU breaks requested as force type requests 1 CPU breaks requested as tag type requests
4 BRKEN	**Break Enable** — Controls whether a trigger event will generate a break request to the CPU. Trigger events can cause information to be stored in the FIFO without generating a break request to the CPU. For an end trace, CPU break requests are issued to the CPU when the comparator(s) and R/W meet the trigger requirements. For a begin trace, CPU break requests are issued when the FIFO becomes full. TRGSEL does not affect the timing of CPU break requests. 0 CPU break requests not enabled 1 Triggers cause a break request to the CPU
3 RWA	**R/W Comparison Value for Comparator A** — When RWAEN = 1, this bit determines whether a read or a write access qualifies comparator A. When RWAEN = 0, RWA and the R/W signal do not affect comparator A. 0 Comparator A can only match on a write cycle 1 Comparator A can only match on a read cycle
2 RWAEN	**Enable R/W for Comparator A** — Controls whether the level of R/W is considered for a comparator A match. 0 R/W is not used in comparison A 1 R/W is used in comparison A
1 RWB	**R/W Comparison Value for Comparator B** — When RWBEN = 1, this bit determines whether a read or a write access qualifies comparator B. When RWBEN = 0, RWB and the R/W signal do not affect comparator B. 0 Comparator B can match only on a write cycle 1 Comparator B can match only on a read cycle
0 RWBEN	**Enable R/W for Comparator B** — Controls whether the level of R/W is considered for a comparator B match. 0 R/W is not used in comparison B 1 R/W is used in comparison B



DETAIL M

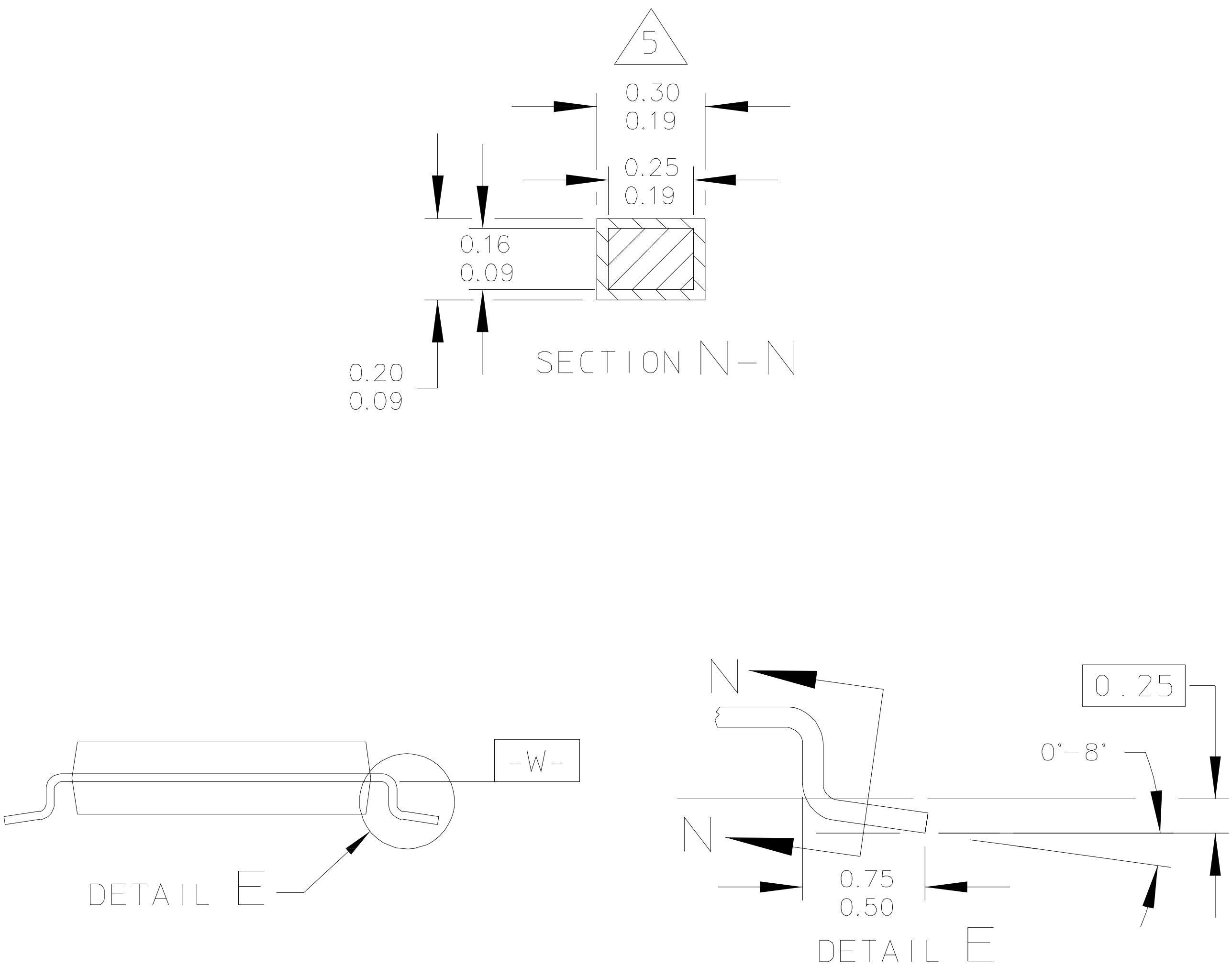
PIN 1 BACKSIDE IDENTIFIER



DETAIL G

VIEW ROTATED 90° CW

	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED QUAD FLAT NON-LEADED PACKAGE (QFN) 16 TERMINAL, 0.8 PITCH (5 X 5 X 1) CASE OUTLINE		DOCUMENT NO: 98ARE10614D	REV: 0
		CASE NUMBER: 1679-01	23 MAR 2005
		STANDARD: FREESCALE	



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TITLE: 16 LD TSSOP, PITCH 0.65MM	DOCUMENT NO: 98ASH70247A	REV: B
	CASE NUMBER: 948F-01	19 MAY 2005
	STANDARD: JEDEC	

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. THE COMPLETE JEDEC DESIGNATOR FOR THIS PACKAGE IS: HP-VFDFP-N.
4. COPLANARITY APPLIES TO LEADS AND DIE ATTACH PAD.
5. MIN. METAL GAP SHOULD BE 0.2MM.

	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: THERMALLY ENHANCED DUAL FLAT NO LEAD PACKAGE (DFN) 8 TERMINAL, 0.8 PITCH (4 X 4 X 1)	DOCUMENT NO: 98ARL10557D	REV: B
	CASE NUMBER: 1452-02	28 DEC 2005
	STANDARD: NON-JEDEC	

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