ATtiny1614/1616/1617 Automotive

Automotive Silicon Errata and Data Sheet Clarifications

The ATtiny1614/1616/1617 Automotive devices you have received conform functionally to the current device data sheet (www.microchip.com/DS40002021), except for the anomalies described in this document. The errata described in this document will likely be addressed in future revisions of the ATtiny1614/1616/1617 Automotive devices.

Notes:

- This document summarizes all the silicon errata issues from all the silicon revisions, previous as well as current
- Refer to the Device/Revision ID section in the current device data sheet (www.microchip.com/DS40002021) for more detailed information on Device Identification and Revision IDs for your specific device, or contact your local Microchip sales office for assistance

1. Silicon Issue Summary

Legend

- **-** Erratum is not applicable.
- **X** Erratum is applicable.

Peripheral	Issue Summary	Affected Revisions	
		Rev. A	Rev. B
Device	2.2.1 On 24-Pin Automotive Devices Pin PC5 is Not Available	X	-
	2.2.2 Writing the OSCLOCK Fuse in FUSE.OSCCFG to '1' Prevents Automatic Loading of Calibration Values	X	X
AC	2.3.1 AC Interrupt Flag Not Set Unless Interrupt is Enabled	X	X
	2.3.2 False Triggers May Occur Under Certain Conditions	X	-
	2.3.3 False Triggering When Sweeping Negative Input of the AC When the Low-Power Mode is Disabled	X	-
ADC	2.4.1 SAMPDLY and ASDV Does Not Work Together With SAMPLEN	X	X
	2.4.2 Pending Event Stuck When Disabling the ADC	X	X
	2.4.3 ADC Functionality Cannot be Ensured with CLKADC Above 1.5 MHz and a Setting of 25% Duty Cycle	X	X
	2.4.4 ADC Interrupt Flags Cleared When Reading RESH	X	X
	2.4.5 Changing ADC Control Bits During Free-Running Mode not Working	X	X
	2.4.6 One Extra Measurement Performed After Disabling ADC Free-Running Mode	X	X
	2.4.7 ADC Wake-Up with WCMP	X	X
CCL	2.5.1 Connecting LUTs in Linked Mode Requires OUTEN Set to ‘1’	X	X
	2.5.2 D-latch is Not Functional	X	X
	2.5.3 The CCL Must be Disabled to Change the Configuration of a Single LUT	X	X
RTC	2.6.1 Any Write to the RTC.CTRLA Register Resets the RTC and PIT Prescaler	X	X
	2.6.2 Disabling the RTC Stops the PIT	X	X
TCA	2.7.1 Restart Will Reset Counter Direction in NORMAL and FRQ Mode	X	X
TCB	2.8.1 Minimum Event Duration Must Exceed the Selected Clock Period	X	X
	2.8.2 The TCB Interrupt Flag is Cleared When Reading CCMPH	X	X
	2.8.3 TCB Input Capture Frequency and Pulse-Width Measurement Mode Not Working with Prescaled Clock	X	X
	2.8.4 The TCA Restart Command Does Not Force a Restart of TCB	X	X
	2.8.5 CCMP and CNT Registers Operate as 16-Bit Registers in 8-Bit PWM Mode	X	X

.....continued

Peripheral	Issue Summary	Affected Revisions	
		Rev. A	Rev. B
TCD	2.9.1 TCD Event Output Lines May Give False Events	X	X
	2.9.2 TCD Auto-Update Not Working	X	-
	2.9.3 Asynchronous Input Events Not Working When TCD Counter Prescaler is Used	X	X
	2.9.4 Halting TCD and Wait for SW Restart Does Not Work if Compare Value A is '0' or Dual Slope Mode is Used	X	X
TWI	2.10.1 TIMEOUT Bits in the TWI.MCTRLA Register are Not Accessible	X	X
	2.10.2 TWI Master Mode Wrongly Detects the Start Bit as a Stop Bit	X	X
	2.10.3 TWI Smart Mode Gives Extra Clock Pulse	X	X
	2.10.4 The TWI Master Enable Quick Command is Not Accessible	X	X
USART	2.11.1 TXD Pin Override Not Released When Disabling the Transmitter	X	X
	2.11.2 Full Range Duty Cycle Not Supported When Validating LIN Sync Field	X	X
	2.11.3 Frame Error on a Previous Message May Cause False Start Bit Detection	X	X
	2.11.4 Open-Drain Mode Does Not Work When TXD is Configured as Output	X	X

2. Silicon Errata Issues

2.1 Errata Details

-	Erratum is not applicable.
X	Erratum is applicable.

2.2 Device

2.2.1 On 24-Pin Automotive Devices Pin PC5 is Not Available

On 24-pin automotive devices pin PC5 is not available.

Work around
Do not connect pin PC5 and disable input on pin (PORTC.PINTCRL5.ISC=0x4).

Affected Silicon Revisions

Rev. A	Rev. B
X	-

2.2.2 Writing the OSCLOCK Fuse in FUSE.OSCCFG to '1' Prevents Automatic Loading of Calibration Values

Writing the OSCLOCK fuse in FUSE.OSCCFG to '1' prevents the automatic loading of calibration values from the signature row. The device will run with an uncalibrated OSC20M oscillator.

Work around
Do not use OSCLOCK for locking the oscillator calibration value. The oscillator calibration value can be locked by writing LOCK in CLKCTRL.OSC20MCALIBB to '1'.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.3 AC - Analog Comparator

2.3.1 AC Interrupt Flag Not Set Unless Interrupt is Enabled

ACn.STATUS.CMP is not set if the ACn.INTCTRL.CMP is not set.

Work Around
Enable ACn.INTCTRL.CMP or use ACn.STATUS.STATE for polling.

Affected Silicon Revisions

Rev. A	Rev. B

X	X

2.3.2 False Triggers May Occur Under Certain Conditions

False triggers may occur on falling input pin:

- If the slew rate on the input signal is greater than 2 V/µs for common-mode voltage below 0.5V
- If the slew rate on the input signal is greater than 10 V/µs for common-mode voltage above 0.5V
- If the slew rate on the input signal is greater than 10 V/µs for any common-mode voltage and Low-Power mode is enabled

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	-

2.3.3 False Triggering When Sweeping Negative Input of the AC When the Low-Power Mode is Disabled

A false trigger may occur if sweeping the negative input of the AC with a negative slope, and the AC has Low-Power mode disabled.

Work Around
Enable Low-Power mode in AC.CTRLA.LPMODE.

Affected Silicon Revisions

Rev. A	Rev. B
X	-

2.4 ADC - Analog-to-Digital Converter

2.4.1 SAMPDLY and ASDV Does Not Work Together With SAMPLEN

Using SAMPCTRL.SAMPLEN at the same time as CTRLD.SAMPDLY or CTRLD.ASDV will cause an unpredictable sampling length.

Work Around
When setting SAMPCTRL.SAMPLEN greater than `0x0`, the CTRLD.SAMPDLY and CTRLD.ASDV must be cleared.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.4.2 Pending Event Stuck When Disabling the ADC

If the ADC is disabled during an event-triggered conversion, the event will not be cleared.

Work Around
Clear ADC.EVCTRL.STARTEI and wait for the conversion to complete before disabling the ADC.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.4.3 ADC Functionality Cannot be Ensured with CLK_{ADC} Above 1.5 MHz and a Setting of 25% Duty Cycle

The ADC functionality cannot be ensured if CLK_{ADC} > 1.5 MHz with ADCn.CALIB.DUTYCYC set to '1'.

Work Around
If ADC is operated with CLK_{ADC} > 1.5 MHz, ADCn.CALIB.DUTYCYC must be set to '0' (50% duty cycle).

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.4.4 ADC Interrupt Flags Cleared When Reading RESH

ADCn.INTFLAGS.RESRDY and ADCn.INTFLAGS.WCOMP are cleared when reading ADCn.RESH.

Work Around
In 8-bit mode, read ADCn.RESH to clear the flag or clear the flag directly.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.4.5 Changing ADC Control Bits During Free-Running Mode not Working

If the control signals are changed during Free-Running mode, the new configuration is not ensured in the next measurement. This is valid for the ADCn.CTRLB, ADCn.CTRLC, ADCn.SAMPCTRL, ADCn.MUXPOS, ADCn.WINLT or ADCn.WINHT registers.

Work Around
Disable ADC Free-Running mode before updating the ADCn.CTRLB, ADCn.CTRLC, ADCn.SAMPCTRL, ADCn.MUXPOS, ADCn.WINLT or ADCn.WINHT registers.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.4.6 One Extra Measurement Performed After Disabling ADC Free-Running Mode

The ADC may perform one additional measurement after clearing ADCn.CTRLA.FREERUN.

Work Around
Write ADCn.CTRLA.ENABLE to '0' to stop the Free-Running mode immediately.

Affected Silicon Revisions

Rev. A	Rev. B

X	X

2.4.7 ADC Wake-Up with WCMP

When waking up from Standby sleep mode with ADC WCMP interrupt, the ADC is disabled for a few cycles before the device enters Active mode. A new INITDLY is required before the next conversion.

Work Around
Use INITDLY before the next conversion.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.5 CCL - Configurable Custom Logic

2.5.1 Connecting LUTs in Linked Mode Requires OUTEN Set to '1'

Connecting the LUTs in linked mode requires LUTnCTRLA.OUTEN set to '1' for the LUT providing the input source.

Work Around
Use an event channel to link the LUTs, or do not use the corresponding I/O pin for other purposes.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.5.2 D-latch is Not Functional

The CCL D-latch is not functional.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.5.3 The CCL Must be Disabled to Change the Configuration of a Single LUT

To reconfigure a LUT, the CCL peripheral must first be disabled (write ENABLE in CCL.CTRLA to '0'). Writing ENABLE to '0' will disable all the LUTs, and affects the LUTs not under reconfiguration.

Work Around
None

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.6 RTC - Real-Time Counter

2.6.1 Any Write to the RTC.CTRLA Register Resets the RTC and PIT Prescaler

Any write to the RTC.CTRLA register resets the 15-bit prescaler resulting in a longer period on the current count or period.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.6.2 Disabling the RTC Stops the PIT

Writing RTC.CTRLA.RTCEN to '0' will stop the PIT.

Writing RTC.PITCTRLA.PITEN to '0' will stop the RTC.

Work Around
Do not disable the RTC or the PIT if any of the modules are used.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.7 TCA - 16-Bit Timer/Counter Type A

2.7.1 Restart Will Reset Counter Direction in NORMAL and FRQ Mode

When the TCA is configured to the NORMAL or FRQ mode (WGMODE in TCAn.CTRLB is '0x0' or '0x1'), a RESTART command or Restart event will reset the direction to default. The default is counting upwards.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.8 TCB - 16-Bit Timer/Counter Type B

2.8.1 Minimum Event Duration Must Exceed the Selected Clock Period

Event detection will fail if TCBn receives an input event with a high/low period shorter than the period of the selected clock source (CLKSEL in TCBn.CTRLA). This applies to the TCB modes (CNTMODE in TCBn.CTRLB) *Time-Out Check* and *Input Capture Frequency and Pulse-Width Measurement*.

Work Around
Ensure that the high/low period of input events is equal to or longer than the selected clock source (CLKSEL in TCBn.CTRLA) period.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.8.2 The TCB Interrupt Flag is Cleared When Reading CCMPH

TCBn.INTFLAGS.CAPT is cleared when reading TCBn.CCMPH instead of CCMPL.

Work Around
Read both TCBn.CCMPL and TCBn.CCMPH.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.8.3 TCB Input Capture Frequency and Pulse-Width Measurement Mode Not Working with Prescaled Clock

The TCB Input Capture Frequency and Pulse-Width Measurement mode may lock to Freeze state if CLKSEL in TCB.CTRLA is set to any other value than `0x0`.

Work Around
Only use CLKSEL equal to `0x0` when using Input Capture Frequency and Pulse-Width Measurement mode.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.8.4 The TCA Restart Command Does Not Force a Restart of TCB

The TCA restart command does not force restarting the TCB when TCB is running in SYNCUPD mode. TCB is restarted only after a TCA OVF.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.8.5 CCMP and CNT Registers Operate as 16-Bit Registers in 8-Bit PWM Mode

When the TCB operates in 8-bit PWM mode (CNTMODE in TCBn.CTRLB is '`0x7`'), the low and high bytes for the CNT and CCMP registers operate as 16-bit registers for read and write. They cannot be read or written independently.

Work Around
Use 16-bit register access. Refer to the data sheet for further information.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.9 TCD - 12-Bit Timer/Counter Type D

2.9.1 TCD Event Output Lines May Give False Events

The TCD event output lines can give false events.

Work Around
Use the delayed event functionality with a minimum of one cycle delay.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.9.2 TCD Auto-Update Not Working

The TCD auto-update feature is not working.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	-

2.9.3 Asynchronous Input Events Not Working When TCD Counter Prescaler is Used

When configuring the TCD to use asynchronous input events (CFG in TCDn.EVCTRLx is '0x2') and the TCD Counter Prescaler (CNTPRES in TCDn.CTRLA) is different from '0x0' events can be missed.

Work Around
Use the TCD Synchronization Prescaler (SYNCPRES in TCDn.CTRLA) instead of the TCD Counter Prescaler. Alternatively, use synchronous input events (CFG in TCDn.EVCTRLx is not '0x2') if the input events are longer than one CLK_TCD_CNT cycle.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.9.4 Halting TCD and Wait for SW Restart Does Not Work if Compare Value A is '0' or Dual Slope Mode is Used

Halting TCD and wait for software restart (INPUTMODE in TCDn.INPUTCTRLA is '0x7') does not work if compare value A is '0' (CMPASET in TCDn.CMPASET is '0x0') or Dual Slope mode is used (WGMODE in TCDn.CTRLB is '0x3').

Work Around
Configure the compare value A (CMPASET in TCDn.CMPASET) to be different from '0' and do not use Dual Slope mode (WGMODE in TCDn.CTRLB is not '0x3').

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.10 TWI - Two-Wire Interface

2.10.1 TIMEOUT Bits in the TWI.MCTRLA Register are Not Accessible

The TIMEOUT bits in the TWI.MCTRLA register are not accessible from the software.

Work Around
When initializing TWI, set BUSSTATE in TWI.MSTATUS to an IDLE state by writing 0x1 to it.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.10.2 TWI Master Mode Wrongly Detects the Start Bit as a Stop Bit

If TWI is enabled in Master mode followed by an immediate write to the MADDR register, the bus monitor recognizes the Start bit as a Stop bit.

Work Around
Wait for a minimum of two clock cycles from TWI.MCTRLA.ENABLE until TWI.MADDR is written.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.10.3 TWI Smart Mode Gives Extra Clock Pulse

TWI Master with Smart mode enabled gives an extra clock pulse on the SCL line after sending NACK.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.10.4 The TWI Master Enable Quick Command is Not Accessible

TWI.MCTRLA.QCEN is not accessible from the software.

Work Around
None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.11 USART - Universal Synchronous and Asynchronous Receiver and Transmitter

2.11.1 TXD Pin Override Not Released When Disabling the Transmitter

The USART will not release the TXD pin override if:

- The USART transmitter is disabled by writing the TXEN bit in USART.CTRLB to '0' while the USART receiver is disabled (RXEN in USART.CTRLB is '0')
- Both the USART transmitter and receiver are disabled at the same time by writing the TXEN and RXEN bits in USART.CTRLB to '0'

Work Around

There are two possible work arounds:

- Make sure the receiver is enabled (RXEN in USART.CTRLB is '1') while disabling the transmitter (writing TXEN in USART.CTRLB to '0')
- Writing to any register in the USART after disabling the transmitter will start the USART for long enough to release the pin override of the TXD pin

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.11.2 Full Range Duty Cycle Not Supported When Validating LIN Sync Field

For the LIN sync field, the USART validates each bit to be within ±15% instead of the time between falling edges as described in the LIN specification, which allows a minimum duty cycle of 43.5% and a maximum duty cycle of 57.5%.

Work Around

None.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.11.3 Frame Error on a Previous Message May Cause False Start Bit Detection

A false start bit detection will trigger if receiving a frame with RXDATAH.FERR set and reading the RXDATAL before the RxD line goes high.

Work Around

Wait for the RXD pin to go high before reading RXDATA by, for instance, polling the bit in PORTn.IN where the RXD pin is located.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

2.11.4 Open-Drain Mode Does Not Work When TXD is Configured as Output

When the USART TXD pin is configured as an output, it can drive the pin high regardless of whether the Open-Drain mode is enabled or not.

Work Around

Configure the TXD pin as an input by writing the corresponding bit in PORTx.DIR to '0' when using Open-Drain mode.

Affected Silicon Revisions

Rev. A	Rev. B
X	X

3. Data Sheet Clarifications

The following typographic corrections and clarifications are to be noted for the latest version of the device data sheet (www.microchip.com/DS40002021).

Note: Corrections are shown in **bold**. Where possible, the original bold text formatting has been removed for clarity.

3.1 Memories

3.1.1 Fuses - Factory Default Values

A clarification has been made for the *Fuse Description* section in regards to the fuse default values. The data sheet refers to these values as reset values when they should have been given as factory-programmed values. Also, they are given in both hexadecimal and binary values, which are contradicting each other.

The following sentence has been added to each sub-section of the *Fuse Description* section.

The default value given in this fuse description is the factory-programmed value, and should not be mistaken for the Reset value.

The table below lists the reset values given by the data sheet and the actual factory-programmed default values.

Fuse	Stated Reset Value in Data Sheet		Actual Factory Default on Device	
	Hexadecimal	Binary	Hexadecimal	Binary
WDTCFG	-	`b00000000	**0x00**	**`b00000000**
BODCFG	-	`b00000000	**0x00**	**`b00000000**
OSCCFG	-	`b0XXXXX01	**0x01**	**`b00000001**
TCD0CFG	-	`b00000000	**0x00**	**`b00000000**
SYSCFG0	-	`b111X0110	**0xF6**	**`b11110110**
SYSCFG1	-	`bXXXXX111	**0x07**	**`b00000111**
APPEND	-	`b00000000	**0x00**	**`b00000000**
BOOTEND	-	`b00000000	**0x00**	**`b00000000**
LOCKBIT	-	`b00000000	**0xC5**	**`b11000101**

3.2 Sleep Controller (SLPCTRL)

3.2.1 Sleep Mode Activity Overview

A clarification has been made to Table 12-2 *Sleep Mode Activity Overview*, where the single table has been split into three separate tables for clarity. Functional changes are shown in **bold**.

Table 3-1. Sleep Mode Activity Overview for Peripherals

Peripheral	Active in Sleep Mode		
	Idle	Standby	Power-Down
CPU	-	-	-
RTC	X	X(1)	**X(2)**
WDT	X	X	X
BOD	**X**	**X**	**X**

.....continued			
Peripheral	**Active in Sleep Mode**		
	Idle	**Standby**	**Power-Down**
EVSYS	**X**	**X**	**X**
CCL	X	X(1)	-
ACn			
ADCn/PTC			
TCBn			
All other peripherals	X	-	-

Notes:
1. The RUNSTBY bit of the corresponding peripheral must be set to enter the active state.
2. **PIT only.**

Table 3-2. Sleep Mode Activity Overview for Clock Sources

Clock Source	**Active in Sleep Mode**		
	Idle	**Standby**	**Power-Down**
Main clock source	X	X(1)	-
RTC clock source	X	X(1)	**X(2)**
WDT oscillator	X	X	X
BOD oscillator(3)	**X**	**X**	**X**
CCL clock source	**X**	**X(1)**	-

Notes:
1. The RUNSTBY bit of the corresponding peripheral must be set to enter the active state.
2. **PIT only.**
3. **The BOD oscillator runs only in Sampled mode.**

Table 3-3. Sleep Mode Wake-Up Sources

Wake-Up Sources	**Active in Sleep Mode**		
	Idle	**Standby**	**Power-Down**
PORT Pin Interrupt	X	X	X(1)
BOD VLM interrupt	**X**	**X**	**X**
RTC interrupts	X	X(2)	**X(3)**
TWIn Address Match interrupt	X	X	X
USARTn Start-of-Frame interrupt	**-**	**X**	-
TCBn interrupts	**X**	**X(2)**	**-**
ADCn/PTC interrupts	X	X(2)	-
ACn interrupts	**X**	**X(4)**	-
All other interrupts	X	-	-

Notes:

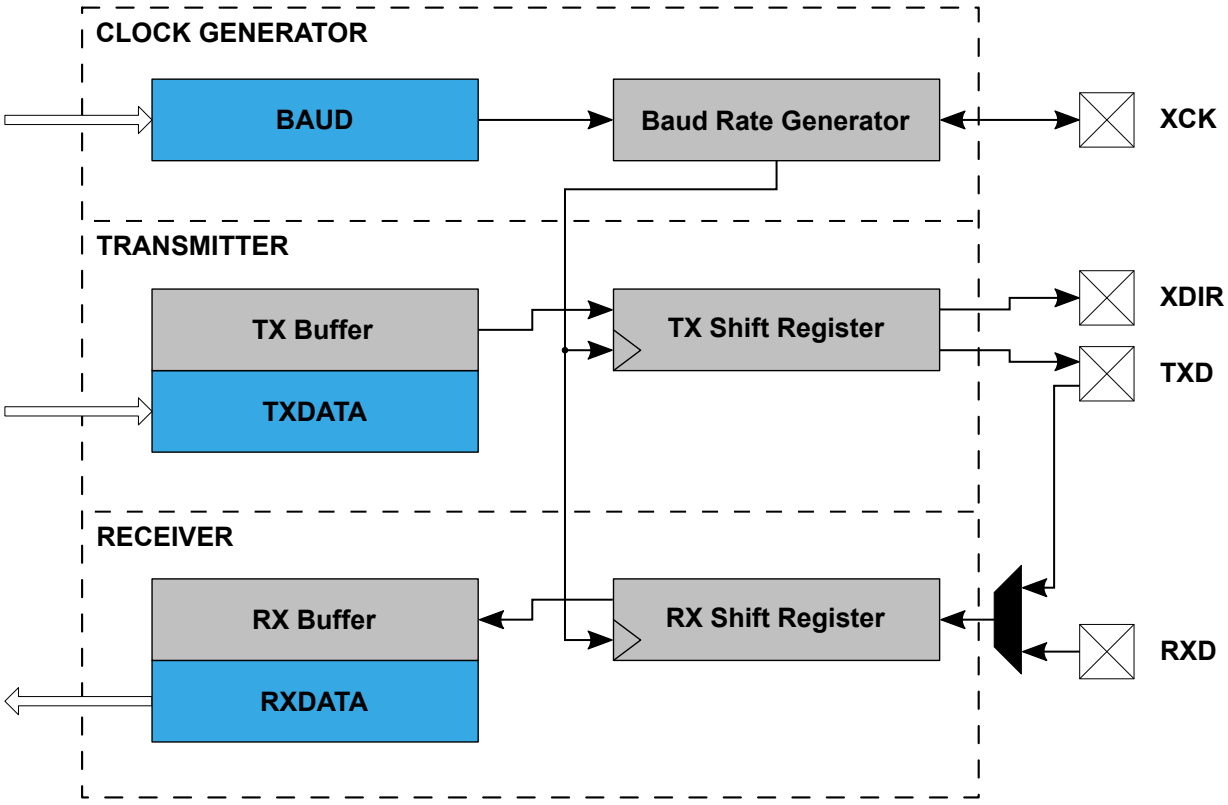
1. **The I/O pin must be configured according to *Asynchronous Sensing Pin Properties* in the PORT section.**
2. The RUNSTBY bit of the corresponding peripheral must be set to enter the active state.
3. **PIT only.**
4. **When the RUNSTDBY bit is set, the AC will operate without updating its Status register or triggering interrupts. If another peripheral has requested CLK_PER, the AC will use the clock to update the Status register and trigger interrupts.**

3.3 Universal Synchronous and Asynchronous Receiver and Transmitter (USART)

3.3.1 TXDATA Buffer

The block diagram is missing that USART TX is double-buffered from Figure 25-1 in the data sheet. Added **TX Buffer** is shown below.

Figure 3-1. Block Diagram



The following text is changed in the *Overview* section:

The transmitter consists of a **two-level** write buffer.

The following text is changed in the *Data Transmission* section:

The data transmission is initiated by loading the **Transmit Data (USARTn.TXDATAL and USARTn.TXDATAH)** registers with the data to be sent. The data in the **Transmit Data registers are moved to the TX Buffer** once it is empty and then to the Shift register once it is empty and ready to send a new frame.

3.4 Analog-to-Digital Converter (ADC)

3.4.1 Calibration

Clarifications have been made to the ADCn.CALIB.DUTYCYC register description:

- **Redundant text referring to a minimum operating voltage of 2.7V has been removed**
- **CLK_{ADC} information moved to ADC electrical characteristics**

Bit 0 - DUTYCYC Duty Cycle

This bit determines the duty cycle of the ADC clock.

Value	Description
0	50% duty cycle
1	25% duty cycle

3.5 Electrical Characteristics

3.5.1 ADC

A clarification has been made to the electrical characteristics for the ADC peripheral:

- Added a note for 50% duty cycle

Table 3-4. Clock and Timing Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
f_{ADC}	Sample rate	1.1V ≤ V_{REF}	15	-	115	ksps
		1.1V ≤ V_{REF} (8-bit resolution)	15	-	150	
		V_{REF} = 0.55V (10-bit)	7.5	-	20	
CLK_{ADC}	Clock frequency	V_{REF} = 0.55V (10-bit)	100	-	260	kHz
		1.1V ≤ V_{REF} (10-bit)	200	-	1500	
		1.1V ≤ V_{REF} (8-bit resolution)	200	-	2000(1)	
Ts	Sampling time		2	2	33	CLK_{ADC} cycles
T_{CONV}	Conversion time (latency)	Sampling time = 2 CLK_{ADC}	8.7	-	50	µs
T_{START}	Start-up time	Internal V_{REF}	-	22	-	µs

Note:

1. Clock frequencies above 1500 kHz require a 50% duty cycle.

3.5.2 AC

A clarification has been made to the electrical characteristics for the AC peripheral:

- Updated AC hysteresis max./min. characterizations
- Updated AC hysteresis typical characterizations

Table 3-5. Analog Comparator Characteristics, Low-Power Mode Disabled

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{IN}	Input voltage		-0.2	-	V_{DD}	V

.....continued						
Symbol	**Description**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
C_{IN}	Input pin capacitance	PA6	-	9	-	pF
		PA7, PB5, PB4	-	5	-	
V_{OFF}	Input offset voltage	0.7V < V_{IN} < (V_{DD} - 0.7V)	-20	±5	20	mV
		V_{IN} = [-0.2V, V_{DD}]	-40	±20	40	
I_L	Input leakage current		-	5	-	nA
T_{START}	Start-up time		-	1.3	-	µs
V_{HYS}	Hysteresis	HYSMODE=0x0	0	0	10	mV
		HYSMODE=0x1	0	10	30	
		HYSMODE=0x2	10	**30**	**90**	
		HYSMODE=0x3	20	**55**	**150**	
t_{PD}	Propagation delay	25 mV Overdrive, V_{DD} ≥ 2.7V, Low-Power mode disabled	-	50	-	ns

Table 3-6. Analog Comparator Characteristics, Low-Power Mode Enabled

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{IN}	Input voltage		0	-	V_{DD}	V
C_{IN}	Input pin capacitance	PA6	-	9	-	pF
		PA7, PB5, PB4	-	5	-	
V_{OFF}	Input offset voltage	0.7V < V_{IN} < (V_{DD} - 0.7V)	-30	±10	30	mV
		V_{IN}=[0V, V_{DD}]	-50	±30	50	
I_L	Input leakage current		-	5	-	nA
T_{START}	Start-up time		-	1.3	-	µs
V_{HYS}	Hysteresis	HYSMODE=0x0	0	0	10	mV
		HYSMODE=0x1	0	10	30	
		HYSMODE=0x2	5	**30**	90	
		HYSMODE=0x3	12	**55**	**190**	
t_{PD}	Propagation delay	25 mV Overdrive, V_{DD} ≥ 2.7V	-	150	-	ns

3.5.3 PTC Characteristics - Operating Ratings

Clarifications have been made to the electrical characteristics for the PTC peripheral:

- Redundant V_{DD} and CLK_{PER} characteristics have been removed
- CLK_{ADC} characteristics have been added

Table 3-7. Peripheral Touch Controller Characteristics - Operating Ratings

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
C_{LOAD}	Maximum load		-	48	-	pF
C_{INT}			-	30	-	pF
	Driven Shield Capacitive Drive		-	300	-	pF

.....continued						
Symbol	**Description**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
CLK_{ADC}	Supported ADC clock frequency	25% duty cycle	200	-	1500	kHz
		50% duty cycle	200	-	2000	

3.6 Typical Characteristics

3.6.1 OSC20M Characteristics

A clarification has been made to *Figure 39-67. OSC20M Internal Oscillator: Frequency vs. Temperature* and *Figure 39-68. OSC20M Internal Oscillator: Frequency vs. V_{DD}*, due to incorrect frequency ranges presented in the plots. Correct plots are shown below.

Figure 39-67. OSC20M Internal Oscillator: Frequency vs. Temperature

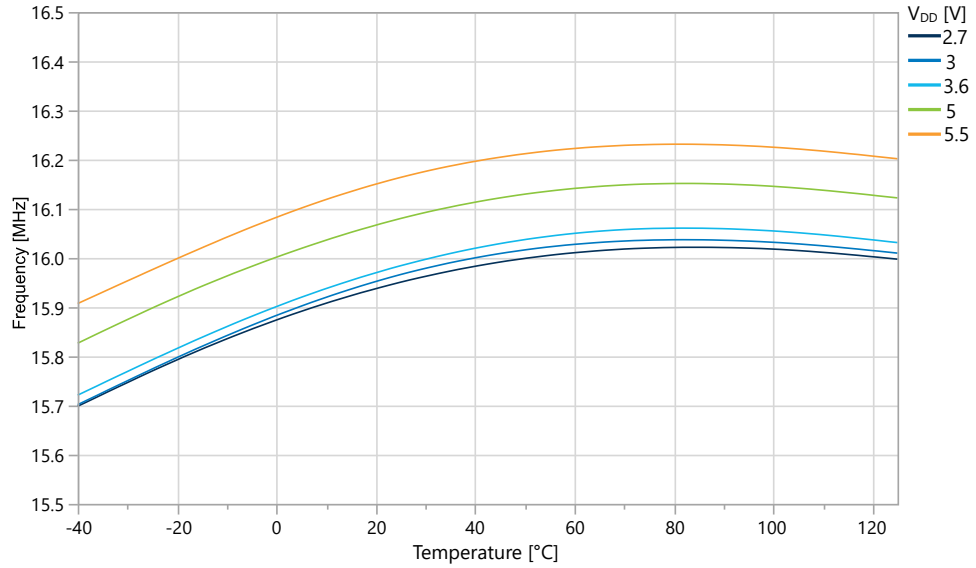
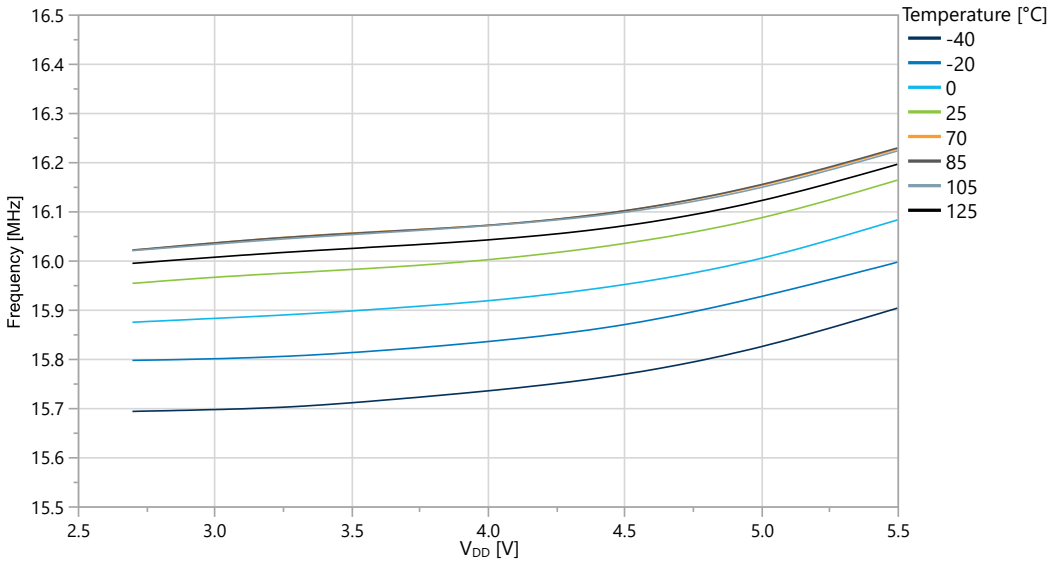


Figure 39-68. OSC20M Internal Oscillator: Frequency vs. V_{DD}



3.7 Package Drawings

3.7.1 Package Marking Information

Package marking information is missing in the data sheet. This section contains all package marking information for ATtiny1614/1616/1617 Automotive devices.

Figure 3-2. Package Marking Information

Rev. 30-009000A-AVR
11/02/2020

Legend:	XX...X	Customer-specific information or Microchip part number
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

Figure 3-3. 14-Pin SOIC

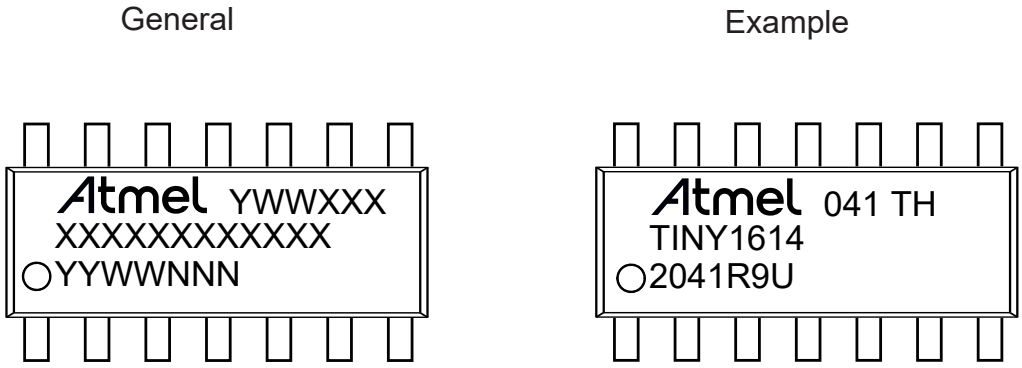


Figure 3-4. 20-Pin SOIC

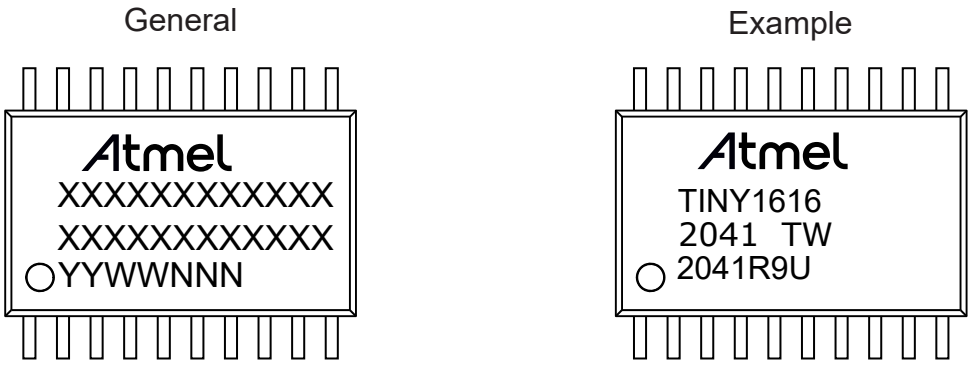


Figure 3-5. 20-Pin VQFN

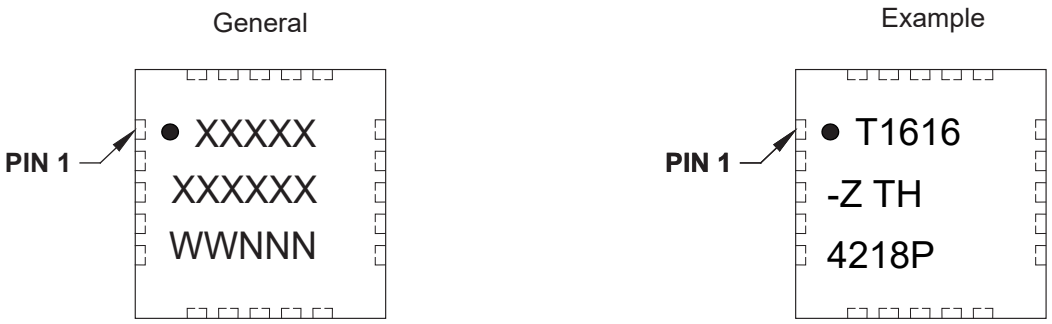
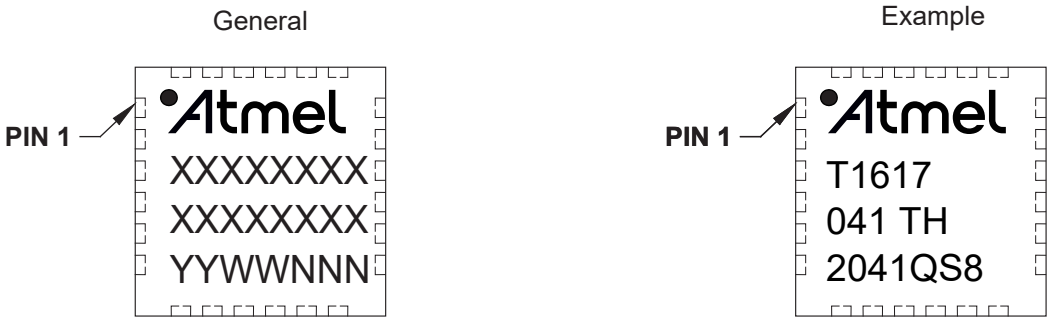


Figure 3-6. 24-Pin VQFN



3.7.2 Package Drawings

The information in the *Device and Package Maximum Weight* and *Package Reference* tables might be outdated. Refer to the RoHS information table on the device product page for up-to-date information.

The Moisture Sensitivity Level (MSL) information in the data sheet might be wrong, as this depends on the assembly site. To determine the MSL information for Microchip device shipments received from Microchip, review the label affixed to each bag, reel and inner box.

If neither the bag, reel or inner box is available, MSL information can be determined by reviewing Table 3.3 in the *Package Qualification Summary Report* posted at microchip.com/quality. The report is organized by package type and assembly site.

4. Document Revision History

Note: The document revision is independent of the silicon revision.

4.1 Revision History

Doc. Rev.	Date	Comments
E	09/2021	• Updated *Affected Silicon Revisions* table for erratum 2.2.1 On 24-Pin Automotive Devices Pin PC5 is Not Available • Added data sheet clarification: Typical Characteristics: 3.6.1 OSC20M Characteristics • Editorial updates
D	05/2021	• Added silicon revision B • Added errata: – CCL: *The CCL Must be Disabled to Change the Configuration of a Single LUT* – TCA: *Restart Will Reset Counter Direction in NORMAL and FRQ Mode* – TCB: *CCMP and CNT Registers Operate as 16-Bit Registers in 8-Bit PWM Mode* – TCD: • *Asynchronous Input Events Not Working When TCD Counter Prescaler is Used* • *Halting TCD and Wait for SW Restart Does Not Work if Compare Value A is '0' or Dual Slope Mode is Used* • Updated errata: – RTC: *Any Write to the RTC.CTRLA Register Resets the RTC and PIT Prescaler* – TWI: *TIMEOUT Bits in the TWI.MCTRLA Register are Not Accessible* • Added data sheet clarifications: – Memories: *Fuses - Factory Default Values* – SLPCTRL: *Sleep Mode Activity Overview* – USART: *TXDATA Buffer* – Package Drawings: • *Package Marking Information* • *Package Drawings*
C	06/2020	• Added errata: – Device: • *Writing the OSCLOCK Fuse in Fuse.OSCCFG to '1' Prevents Automatic Loading of Calibration Fuses* – USART: • *Full Range Duty Cycle Not Supported When Validating LIN Sync Field* • *Open-Drain Mode Does Not Work When TXD is Configured as Output* • Added clarification for electrical characteristics for AC peripheral
B	10/2019	• Updated document template • Updated errata 2.4.3 ADC Functionality • Added clarification for ADCn.CALIB.DUTYCYC register description • Added clarification for electrical characteristics of ADC and PTC peripheral
A	06/2019	Initial document release

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