

AN1392: Detailed Timing Test Results for RAIL

This application note provides information about various timing measurements that may be of interest when using RAIL to develop an application. These timings may vary based on the chip, software release, and other RF/PHY settings, so be sure to reference this document as you update software.

KEY POINTS

- Implementation approach
- About the results
- Results summary
- Detailed results for this release

1 Introduction

Users of Silicon Labs' EFR32 chips may have questions about the time it takes for various radio operations. Not all of these are easy to document with the APIs as they may vary by chip, PHY, or even software release. This document is meant to provide some of those numbers as measured on a particular release in a subset of possible situations. Note that these numbers are informational and may change from release to release or chip to chip.

Note that some users will want to create an application that sends and receives packets at specific times for a synchronized communications channel. While you can use the timings around $RAIL_StartRx()$ and $RAIL_StartTx()$ to enable that, a better approach is to use the $RAIL_StartScheduledTx()$ and $RAIL_ScheduleRx()$ APIs, which enable these synchronized operations more reliably from release to release.

2 Implementation Approach

To measure this data, Silicon Labs builds a special version of RAIL and adds some extra application software to capture radio state change events and use hardware timestamping where possible. The goal is to introduce as little overhead as possible and to build an almost stock version of the library and application. This implementation uses an interrupt handler to capture radio state transition events and timestamp them, so some overhead is introduced. Because the application is only testing, the latency from this is minimal and is largely canceled out by measuring the time difference between two state transitions.

In this release, these measurements are taken using the single protocol version of the RAIL library. Different numbers and more variables would be expected if measuring with the multiprotocol version, as it would interact with the radio scheduler for every radio operation.

3 About the Results

Below is a description of each timing measurement and how it is taken. Measurement data for each is provided in the Result section. When a limited set of options impacts the timing, results are provided for every possible set of options, to cover all use cases.

- Active Radio to Idle Time The time to transition into idle mode while in the middle of packet reception. Because the different RAIL_Idle() modes and the point in packet reception when RAIL_Idle() is called impact this time, the test is run across all idle modes and the abort is triggered at several different points.
- Channel Change Time (RX to RX) The time to transition from receive on one channel to receive on another channel. This involves the radio being idled, reconfiguring the radio for the new channel, and then restarting receive. Measured by checking the time to transition out of the Rx state and into the Rx state on the new channel.
- ConfigChannel Time The time to apply a radio channel configuration with the RAIL_ConfigChannels() API. Characterized by implementing the RAIL Utility, Protocol component in the test application.
- **EM2 to Active Radio Time** The time from EM2 sleep wakeup until the radio is ready to receive a packet in an optimal application. This includes the time to restart the HFXO on the radio board and restart the receiver. Measured both with and without resynchronizing the high frequency RAIL time base with the low frequency sleep clock in the RAIL ConfigSleepAlt() API.
- Image Rejection Calibration (IRCAL) Time The time to perform image rejection calibration. Characterized by wrapping a call to RAIL CalibrateIrAlt() and running the test several times to see how long it takes to complete.
- RAIL_Init() Time With and Without DMA The time to initialize the radio via RAIL_Init() with and without using a DMA channel to load the sequencer image. Measured by building the application with and without the RAIL Utility, DMA component and wrapping the call to RAIL Init().
- RX API Call to Actual RX Ready State Time The time from the RAIL_StartRx() function call until the receiver is active and ready for packet data. Measured from the API call until the radio enters the receive state. The idleToRx time is set to 0 µs. Also note that there may be additional receive chain delays that depend on the bitrate of your PHY so it's possible more time would be required here to successfully receive a packet.
- RX Packet Receive to Event Trigger The time from the radio packet receive operation completing until the RAIL event for packet reception is received by the application. Measured by comparing the timer tick at which the packet reception is complete to the time the user callback is triggered. This removed the PHY dependency that influenced the initial results on Series 2. The test application minimizes interrupt latency and other system overhead that can influence this time in a real-world application.
- TX API Call to Actual Transmit Time The time from calling RAIL_StartTx() until the first bit of the preamble goes on the air. Measured by computing the time from the API call being issued until the radio enters the transmit state. The idleToTx time is set to 0 µs and the Power Amplifier rampTime is configured to the default for that chip in the RAIL Utility, PA component. This test is also run over the most common RAIL_TxOptions_t values to show their impact.
- Temperature Calibration Time The time taken to perform temperature calibration. Characterized by calling RAIL CalibrateTemp() and measuring the time between leaving the receive state and completing this calibration.
- TX to RX and RX to TX Auto State Transition Times (Minimal) The minimum time required to transition from transmit to receive and vice versa. The RAIL_SetStateTiming API is used with the txToRx and rxToTx transition times set to 0 µs, to eliminate additional delays. Measured by monitoring the radio state transition time from the end of one state until the beginning of the next.

4 Results Summary

This section provides a summary across Gecko SDK Suite (GSDK) releases. The detailed results for this release are included in section 5.

- Version 2024.12.0: Minor updates
- Version 2024.6.0: Series 0/1 support has been removed from sisdk-2024.6.0 and later releases. EFR32FG12 timings will no longer be tracked in this document.
- Version 4.4.0: Moved protocol specific initialization to the initialization functions for that protocol on EFR32xG22 and newer. This resulted in a reduction in the RAIL_Init() time and a corresponding increase in the protocol specific initialization functions.
- Version 4.3.0: Minor updates.
- Version 4.2.0: Results comparisons have been added. **RX Packet Receive to Event Trigger** test method was changed to remove the PHY dependency for Series 2 parts (G23). This explains the variances from the initial results for this test.
- Version 4.1.1: Initial release. Results from RAIL included in GSDK version 4.1.1 for the EFR32FG12 and EFR32xG23 platforms.

5 Results for This Release

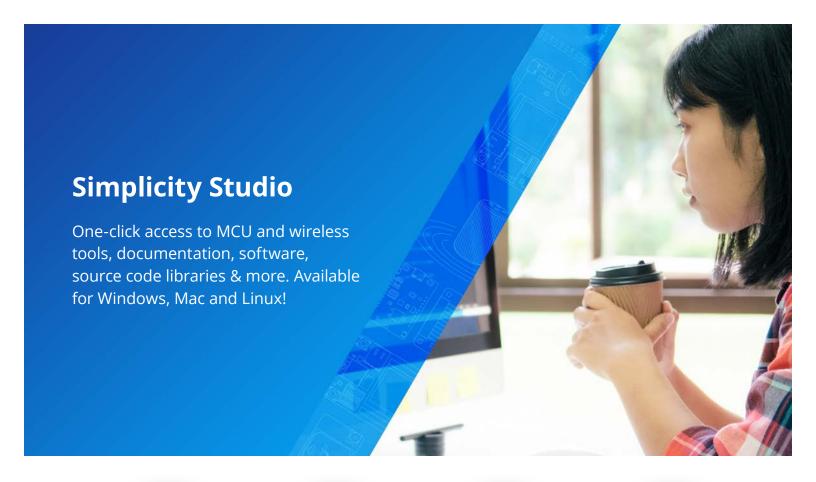
The following pages show the measurement results for this release and a comparison with the results from the previous release.

Chip Type: G23			
RAIL Timing	PHY	Average	Unit
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	111	_
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	329	+
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	2922	_
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	112	-
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7 PHY Studio 915M 2GFSK 50Kbps 25K	329 2921	_
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80 Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_30Kbps_25K PHY_Studio_915M_2GFSK_2Mbps_500K	100	
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(US): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	100	_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	100	_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	112	-
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	184	_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	184	_
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	120	+
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	121	+
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	121	_
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	112	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	205	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	203	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	123	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	123	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	123	_
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	111	
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	206	+
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	207	_
Channel Change Time (RX to RX) 0 To 0	PHY_Studio_915M_2GFSK_2Mbps_500K	162	_
Channel Change Time (RX to RX) 0 To 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	162	_
Channel Change Time (RX to RX) 0 To 0	PHY_Studio_915M_2GFSK_50Kbps_25K	162	+
Channel Change Time (RX to RX) 0 To 1	PHY_Studio_915M_2GFSK_2Mbps_500K	251	_
Channel Change Time (RX to RX) 0 To 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	252	-
Channel Change Time (RX to RX) 0 To 1 ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_50Kbps_25K PHY_Studio_915M_2GFSK_2Mbps_500K	251	us
ConfigChannel Time St_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7		us
ConfigChannel Time SL_PAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_50Kbps_25K		us
ConfigChannel Time SL_PAIL_UTIL_PROTOCOL_PNOFNIETANT ConfigChannel Time SL_PAIL_UTIL_PROTOCOL_ZWAVE_ANZ	Internal PHY	561	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_CN	Internal PHY	561	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_EU	Internal PHY	561	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_HK	Internal PHY	562	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_IL	Internal PHY	561	+
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_IN	Internal PHY	562	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_JP	Internal PHY	595	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_KR	Internal PHY	595	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_MY	Internal PHY	562	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_RU	Internal PHY	561	. us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US	Internal PHY	562	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR_END_DEVICE	Internal PHY	580	+
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR1	Internal PHY	553	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR2	Internal PHY	553	_
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_2Mbps_500K	499	+
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	499	_
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_50Kbps_25K	499	
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_2Mbps_500K	565	_
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	568	_
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_50Kbps_25K	565	_
Image Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_2Mbps_500K	200831	-
Image Rejection Calibration Time Proprietary Image Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7 PHY_Studio_915M_2GFSK_50Kbps_25K	200848 200847	_
Image Rejection Calibration Time Proprietary Image Rejection Calibration Time ZWAVE Z-Wave Region: EU-European Union Channel: 0	Internal PHY	101126	_
Image Rejection Calibration Time ZWAVE Z-Wave Region: E0-European Union Channel: 0 Image Rejection Calibration Time ZWAVE Z-Wave Region: JP-Japan Channel: 0	Internal PHY Internal PHY	201567	_
Image Rejection Calibration Time ZWAVE 2-Wave Region: Jr-Japan Channel: 0	Internal PHY	201569	_
Image Rejection Calibration Time ZWAVE 2-Wave Region: Kn-Korea Criamiet. 0 Image Rejection Calibration Time ZWAVE Z-Wave Region: USLR1-United States Long Range 1 Channel: 0	Internal PHY	101122	_
Image Rejection Calibration Time ZWAVE Z-Wave Region: OSCRI-Onited States Long Range End Device Channel: 0	Internal PHY	101023	+
Image Rejection Calibration Time ZWAVE Z-Wave Region: US-United States Channel: 0	Internal PHY	101129	_
RAIL_Init() Time with DMA	Internal PHY	1141	
RAIL_Init() Time without DMA	Internal PHY	2915	+
RX API call to actual RX ready state time Channel 0 To 0	PHY_Studio_915M_2GFSK_2Mbps_500K	136	_
RX API call to actual RX ready state time Channel 0 To 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	136	_
RX API call to actual RX ready state time Channel 0 To 0	PHY_Studio_915M_2GFSK_50Kbps_25K	136	us
RX API call to actual RX ready state time Channel 0 To 1	PHY_Studio_915M_2GFSK_2Mbps_500K	226	us
RX API call to actual RX ready state time Channel 0 To 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	226	us
RX API call to actual RX ready state time Channel 0 To 1	PHY_Studio_915M_2GFSK_50Kbps_25K	226	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_2Mbps_500K	27	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7		us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_50Kbps_25K	27	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_2Mbps_500K	_	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	_	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_50Kbps_25K		us
	PHY_Studio_915M_2GFSK_2Mbps_500K	142	lus
RX to TX Auto state transition times RX to TX Auto state transition times	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	156	

Chip Type: G23		
RAIL Timing	PHY	Average Units
RX to TX Auto state transition times	PHY_Studio_915M_2GFSK_50Kbps_25K	203 us
Temperature Calibration Time	PHY_Studio_915M_2GFSK_2Mbps_500K	122 us
Temperature Calibration Time	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	122 us
Temperature Calibration Time	PHY_Studio_915M_2GFSK_50Kbps_25K	122 us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Studio_915M_2GFSK_2Mbps_500K	155 us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	154 us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Studio_915M_2GFSK_50Kbps_25K	141 us
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_2Mbps_500K	156 us
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_50Kbps_25K	142 us
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_2Mbps_500K	156 us
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_50Kbps_25K	142 us
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_2Mbps_500K	156 us
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_50Kbps_25K	141 us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_2Mbps_500K	156 us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_50Kbps_25K	141 us
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_2Mbps_500K	148 us
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	147 us
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_50Kbps_25K	133 us
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_2Mbps_500K	157 us
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	156 us
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_50Kbps_25K	142 us
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_2Mbps_500K	156 us
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_50Kbps_25K	141 us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_2Mbps_500K	156 us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_50Kbps_25K	141 us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_2Mbps_500K	157 us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155 us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_50Kbps_25K	141 us
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_2Mbps_500K	147 us
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	147 us
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_50Kbps_25K	147 us

RAIL Timing	PHY	SISDK-2024.6.0	SISDK-2024.12.0	Diff
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY Studio 915M 2GFSK 2Mbps 500K	SISDK-2024.6.0	SISDK-2024.12.0	+
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	329		_
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	2921	2922	2 09
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	111	112	_
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	328		_
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	2921	2921	_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0 Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	99		_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0 Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_175K_III0p7 PHY_Studio_915M_2GFSK_50Kbps_25K	99		
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	112		_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY Studio 915M 2GFSK 500Kbps 175K mi0p7	182		_
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	183		_
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	119		-
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	119	121	29
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	119	121	29
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	112		_
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	202	-	_
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	202		
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	122	+	_
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	122		_
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	122		_
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80 Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	205		_
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_175K_III0p7 PHY_Studio_915M_2GFSK_50Kbps_25K	205	206	_
Channel Change Time (RX to RX) 0 To 0	PHY Studio 915M 2GFSK 2Mbps 500K	163		
Channel Change Time (RX to RX) 0 10 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	164		_
Channel Change Time (RX to RX) 0 To 0	PHY_Studio_915M_2GFSK_50Kbps_25K	164		_
Channel Change Time (RX to RX) 0 To 1	PHY_Studio_915M_2GFSK_2Mbps_500K	250	+	_
Channel Change Time (RX to RX) 0 To 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	250		
Channel Change Time (RX to RX) 0 To 1	PHY_Studio_915M_2GFSK_50Kbps_25K	250		
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_2Mbps_500K	8		-
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	8	8	3 09
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_50Kbps_25K	8	8	-
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_ANZ	Internal PHY	553		_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_CN	Internal PHY	552	561	-
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_EU	Internal PHY	552		-
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_HK	Internal PHY	553		-
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_IL	Internal PHY	552	561	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_IN	Internal PHY	553 587	562	
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_JP ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_KR	Internal PHY Internal PHY	587	595	_
ConfigChannel Time St_RAIL_UTIL_PROTOCOL_ZWAVE_KY	Internal PHY	553	562	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_RU	Internal PHY	552		_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US	Internal PHY	552	562	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR_END_DEVICE	Internal PHY	572	580	_
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR1	Internal PHY	543		
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR2	Internal PHY	544	553	3 29
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_2Mbps_500K	493	499	10
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	496	499	1
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_50Kbps_25K	497	+	_
M2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_2Mbps_500K	564	565	_
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	560	+	_
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_50Kbps_25K	566		
mage Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_2Mbps_500K	200861	200831	_
mage Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	200870		_
mage Rejection Calibration Time Proprietary mage Rejection Calibration Time ZWAVE Z-Wave Region: EU-European Union Channel: 0	PHY_Studio_915M_2GFSK_50Kbps_25K Internal PHY	200887 101120		
mage Rejection Calibration Time ZWAVE Z-Wave Region: JP-Japan Channel: 0	Internal PHY	201552	201567	_
mage Rejection Calibration Time ZWAVE Z-Wave Region: 37-3apan Channel: 0	Internal PHY	201552	201569	-
mage Rejection Calibration Time ZWAVE Z-Wave Region: NA-Rolea Charmet. 0	Internal PHY	101123	101122	_
mage Rejection Calibration Time ZWAVE Z-Wave Region: OSENE Office States Long Range End Device Channel: 0	Internal PHY	101123	101023	_
mage Rejection Calibration Time ZWAVE Z-Wave Region: US-United States Channel: 0	Internal PHY	101122		-
AlL_Init() Time with DMA	Internal PHY	1143	1141	_
IAIL_Init() Time without DMA	Internal PHY	3192		
IX API call to actual RX ready state time Channel 0 To 0	PHY_Studio_915M_2GFSK_2Mbps_500K	138	136	-1
tX API call to actual RX ready state time Channel 0 To 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	138		3 -1
X API call to actual RX ready state time Channel 0 To 0	PHY_Studio_915M_2GFSK_50Kbps_25K	138		_
X API call to actual RX ready state time Channel 0 To 1	PHY_Studio_915M_2GFSK_2Mbps_500K	225		
IX API call to actual RX ready state time Channel 0 To 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	225	+	_
X API call to actual RX ready state time Channel 0 To 1	PHY_Studio_915M_2GFSK_50Kbps_25K	225		
X pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC X pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_2Mbps_500K	27		_
X pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC X pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7 PHY_Studio_915M_2GFSK_50Kbps_25K	27		
x pkt receive to event trigger with option RAIL_RX_OPTION_STOKE_CRC X pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_50Kbps_25K PHY_Studio_915M_2GFSK_2Mbps_500K	27		_
IX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES IX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_2Mbps_300K PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	27		
X pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_50Kbps_25K	27		_
X to TX Auto state transition times	PHY_Studio_915M_2GFSK_2Mbps_500K	142		_
	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	155	+	_
IX to TX Auto state transition times	PHY_Studio_915M_2GFSK_50Kbps_25K	202		_
IX to TX Auto state transition times IX to TX Auto state transition times		126		
X to TX Auto state transition times	PHY_Studio_915M_2GFSK_2Mbps_500K			-
	PHY_Studio_915M_2GFSK_2Mbps_500K PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	126	122	2 -3
IX to TX Auto state transition times emperature Calibration Time		_		
IX to TX Auto state transition times emperature Calibration Time emperature Calibration Time	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	126 126 154	122 155	2 -3
IX to TX Auto state transition times emperature Calibration Time emperature Calibration Time emperature Calibration Time emperature Calibration Time	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7 PHY_Studio_915M_2GFSK_50Kbps_25K	126 126	122 155	2 -3 5 1 1 1

Chip Type: G23				
RAIL Timing	PHY	SISDK-2024.6.0	SISDK-2024.12.0	Diff
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_50Kbps_25K	141	142	1%
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_2Mbps_500K	155	156	1%
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_50Kbps_25K	141	142	1%
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_2Mbps_500K	155		
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_50Kbps_25K	139	141	1%
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_2Mbps_500K	154	156	1%
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_50Kbps_25K	140	141	1%
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_2Mbps_500K	147	148	1%
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	146	147	1%
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_50Kbps_25K	132	133	1%
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_2Mbps_500K	156	157	1%
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	154	156	1%
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_50Kbps_25K	141	142	1%
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_2Mbps_500K	154	156	1%
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_50Kbps_25K	140	141	1%
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_2Mbps_500K	154	156	1%
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_50Kbps_25K	140	141	. 1%
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_2Mbps_500K	154	157	2%
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	153	155	1%
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_50Kbps_25K	140	141	. 1%
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_2Mbps_500K	147	147	0%
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	146	147	1%
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_50Kbps_25K	147	147	0%





IoT Portfolio
www.silabs.com/IoT



SW/HW www.silabs.com/simplicity



Quality www.silabs.com/quality



Support & Community www.silabs.com/community

Disclaimer

Silicon Labs intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Labs products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications. Application examples described herein are for illustrative purposes only. Silicon Labs reserves the right to make changes without further notice to the product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Without prior notification, Silicon Labs may update product firmware during the manufacturing process for security or reliability reasons. Such changes will not alter the specifications or the performance of the product. Silicon Labs shall have no liability for the consequences of use of the information supplied in this document. This document does not imply or expressly grant any license to design or fabricate any integrated circuits. The products are not designed or authorized to be used within any FDA Class III devices, applications for which FDA premarket approval is required or Life Support Systems without the specific written consent of Silicon Labs. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Labs products are not designed or authorized for military applications. Silicon Labs products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons. Silicon Labs disclaims all express and implied warranties and shall not be responsible or liable for any injuries or damages related to use of a Silicon Labs p

Trademark Information

Silicon Laboratories Inc.®, Silicon Laboratories®, Silicon Labs®, Silabs® and the Silicon Labs logo®, Bluegiga®, Bluegiga Logo®, EFM®, EFM32®, EFR, Ember®, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Redpine Signals®, WiSeConnect, n-Link, EZLink®, EZRadio®, EZRadioPRO®, Gecko®, Gecko OS, Gecko OS Studio, Precision32®, Simplicity Studio®, Telegesis, the Telegesis Logo®, USBXpress®, Zentri, the Zentri logo and Zentri DMS, Z-Wave®, and others are trademarks or registered trademarks of Silicon Labs. ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings. Keil is a registered trademark of ARM Limited. Wi-Fi is a registered trademark of the Wi-Fi Alliance. All other products or brand names mentioned herein are trademarks of their respective holders.



Silicon Laboratories Inc. 400 West Cesar Chavez Austin, TX 78701 USA