



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 μ s. 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 receive packet timestamp provided by RAIL to the time the user callback is triggered. Because several RX options can impact this timing (such as `RAIL_RX_OPTION_STORE_CRC` and `RAIL_RX_OPTION_TRACK_ABORTED_FRAMES`), different combinations of options were tested. 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 μ s 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 μ s, 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 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.

Chip Type: G12			
RAIL Timing	PHY	Average	Units
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	IEEE802154_2P4GHZ	600.48	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_2Mbps_500K	109.08	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	329	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_50Kbps_25K	2920.96	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	IEEE802154_2P4GHZ	600.48	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_2Mbps_500K	112.36	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	328.92	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_50Kbps_25K	2921.08	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	IEEE802154_2P4GHZ	51.76	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_2Mbps_500K	45.48	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	46.24	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_50Kbps_25K	45.72	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	IEEE802154_2P4GHZ	134.48	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_2Mbps_500K	107.72	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	128.24	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_50Kbps_25K	128.88	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	IEEE802154_2P4GHZ	43.56	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_2Mbps_500K	42.76	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	43.4	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_50Kbps_25K	43.52	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	IEEE802154_2P4GHZ	126.64	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_2Mbps_500K	112.16	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	125.44	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_50Kbps_25K	125.48	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	IEEE802154_2P4GHZ	44.76	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_2Mbps_500K	44.84	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	44.6	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Datasheet_915M_2GFSK_50Kbps_25K	44.24	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	IEEE802154_2P4GHZ	128.08	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_2Mbps_500K	111.96	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	127.24	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Datasheet_915M_2GFSK_50Kbps_25K	127.44	us
Channel Change Time (RX to RX) 0 to 0 Rx To Rx	PHY_Datasheet_915M_2GFSK_2Mbps_500K	88.96	us
Channel Change Time (RX to RX) 0 to 0 Rx To Rx	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	92.06	us
Channel Change Time (RX to RX) 0 to 0 Rx To Rx	PHY_Datasheet_915M_2GFSK_50Kbps_25K	87.18	us
Channel Change Time (RX to RX) 0 to 1 Rx To Rx	PHY_Datasheet_915M_2GFSK_2Mbps_500K	132.46	us
Channel Change Time (RX to RX) 0 to 1 Rx To Rx	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	129.6	us
Channel Change Time (RX to RX) 0 to 1 Rx To Rx	PHY_Datasheet_915M_2GFSK_50Kbps_25K	129.88	us
Channel Change Time (RX to RX) 20 to 20 Rx To Rx	IEEE802154_2P4GHZ	89.1	us
Channel Change Time (RX to RX) 20 to 21 Rx To Rx	IEEE802154_2P4GHZ	127.68	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_BLE_1MBPS	Internal PHY	300.68	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_BLE_2MBPS	Internal PHY	309.18	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_2P4GHZ	Internal PHY	264.52	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_2P4GHZ_ANTDIV	Internal PHY	264.52	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_2P4GHZ_ANTDIV_COEX	Internal PHY	264.44	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_2P4GHZ_COEX	Internal PHY	264.46	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_GB868_863MHZ	Internal PHY	258.48	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_GB868_915MHZ	Internal PHY	258.52	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Datasheet_915M_2GFSK_2Mbps_500K	5.36	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	5.5	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Datasheet_915M_2GFSK_50Kbps_25K	5.32	us
EM2 to Active Radio Time No SYNC	IEEE802154_2P4GHZ	591.6	us
EM2 to Active Radio Time No SYNC	PHY_Datasheet_915M_2GFSK_2Mbps_500K	596.2	us
EM2 to Active Radio Time No SYNC	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	592.9	us
EM2 to Active Radio Time No SYNC	PHY_Datasheet_915M_2GFSK_50Kbps_25K	593.2	us
EM2 to Active Radio Time With SYNC	IEEE802154_2P4GHZ	633.5	us
EM2 to Active Radio Time With SYNC	PHY_Datasheet_915M_2GFSK_2Mbps_500K	635.2	us
EM2 to Active Radio Time With SYNC	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	634.8	us
EM2 to Active Radio Time With SYNC	PHY_Datasheet_915M_2GFSK_50Kbps_25K	629.7	us
Image Rejection Calibration Time BLE 1Mbps	Internal PHY	21.44	us
Image Rejection Calibration Time BLE 2Mbps	Internal PHY	21.54	us
Image Rejection Calibration Time IEEE 802.15.4	Internal PHY	21.44	us
Image Rejection Calibration Time Proprietary	IEEE802154_2P4GHZ	150158.5	us
Image Rejection Calibration Time Proprietary	PHY_Datasheet_915M_2GFSK_2Mbps_500K	150102.78	us
Image Rejection Calibration Time Proprietary	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	150158.5	us
Image Rejection Calibration Time Proprietary	PHY_Datasheet_915M_2GFSK_50Kbps_25K	96727	us
RAIL_Init() Time with DMA	Internal PHY	696	us
RAIL_Init() Time without DMA	Internal PHY	1577	us
RX API call to actual RX ready state time Channel 0 -> 0	PHY_Datasheet_915M_2GFSK_2Mbps_500K	71.92	us
RX API call to actual RX ready state time Channel 0 -> 0	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	75.18	us
RX API call to actual RX ready state time Channel 0 -> 0	PHY_Datasheet_915M_2GFSK_50Kbps_25K	70.12	us
RX API call to actual RX ready state time Channel 0 -> 1	PHY_Datasheet_915M_2GFSK_2Mbps_500K	115.66	us
RX API call to actual RX ready state time Channel 0 -> 1	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	112.48	us
RX API call to actual RX ready state time Channel 0 -> 1	PHY_Datasheet_915M_2GFSK_50Kbps_25K	112.88	us
RX API call to actual RX ready state time Channel 20 -> 20	IEEE802154_2P4GHZ	72.3	us

Chip Type: G12			
RAIL Timing	PHY	Average	Units
RX API call to actual RX ready state time Channel 20 -> 21	IEEE802154_2P4GHZ	110.72	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	IEEE802154_2P4GHZ	25.06	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Datasheet_915M_2GFSK_2Mbps_500K	18.76	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	18.76	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Datasheet_915M_2GFSK_50Kbps_25K	18.44	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	IEEE802154_2P4GHZ	88.92	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Datasheet_915M_2GFSK_2Mbps_500K	26.54	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	50.68	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Datasheet_915M_2GFSK_50Kbps_25K	338.68	us
RX to TX Auto state transition times	IEEE802154_2P4GHZ	106.12	us
RX to TX Auto state transition times	PHY_Datasheet_915M_2GFSK_2Mbps_500K	129.86	us
RX to TX Auto state transition times	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	129.8	us
RX to TX Auto state transition times	PHY_Datasheet_915M_2GFSK_50Kbps_25K	129.7	us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	IEEE802154_2P4GHZ	118.02	us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Datasheet_915M_2GFSK_2Mbps_500K	113.44	us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	113.52	us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Datasheet_915M_2GFSK_50Kbps_25K	113.44	us
TX API call to actual transmit time with option ANTENNA 0	IEEE802154_2P4GHZ	118	us
TX API call to actual transmit time with option ANTENNA 0	PHY_Datasheet_915M_2GFSK_2Mbps_500K	113.9	us
TX API call to actual transmit time with option ANTENNA 0	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	113.72	us
TX API call to actual transmit time with option ANTENNA 0	PHY_Datasheet_915M_2GFSK_50Kbps_25K	113.76	us
TX API call to actual transmit time with option ANTENNA 1	IEEE802154_2P4GHZ	118	us
TX API call to actual transmit time with option ANTENNA 1	PHY_Datasheet_915M_2GFSK_2Mbps_500K	114	us
TX API call to actual transmit time with option ANTENNA 1	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	114.06	us
TX API call to actual transmit time with option ANTENNA 1	PHY_Datasheet_915M_2GFSK_50Kbps_25K	114	us
TX API call to actual transmit time with option CCA ONLY	IEEE802154_2P4GHZ	118.02	us
TX API call to actual transmit time with option CCA ONLY	PHY_Datasheet_915M_2GFSK_2Mbps_500K	113.86	us
TX API call to actual transmit time with option CCA ONLY	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	113.82	us
TX API call to actual transmit time with option CCA ONLY	PHY_Datasheet_915M_2GFSK_50Kbps_25K	113.84	us
TX API call to actual transmit time with option CCA PEAK RSSI	IEEE802154_2P4GHZ	118	us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Datasheet_915M_2GFSK_2Mbps_500K	113.84	us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	113.86	us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Datasheet_915M_2GFSK_50Kbps_25K	113.8	us
TX API call to actual transmit time with option Default	IEEE802154_2P4GHZ	111.02	us
TX API call to actual transmit time with option Default	PHY_Datasheet_915M_2GFSK_2Mbps_500K	107	us
TX API call to actual transmit time with option Default	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	107	us
TX API call to actual transmit time with option Default	PHY_Datasheet_915M_2GFSK_50Kbps_25K	107	us
TX API call to actual transmit time with option REMOVE CRC	IEEE802154_2P4GHZ	119	us
TX API call to actual transmit time with option REMOVE CRC	PHY_Datasheet_915M_2GFSK_2Mbps_500K	114.42	us
TX API call to actual transmit time with option REMOVE CRC	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	114.58	us
TX API call to actual transmit time with option REMOVE CRC	PHY_Datasheet_915M_2GFSK_50Kbps_25K	114.5	us
TX API call to actual transmit time with option RESEND	IEEE802154_2P4GHZ	118	us
TX API call to actual transmit time with option RESEND	PHY_Datasheet_915M_2GFSK_2Mbps_500K	113.98	us
TX API call to actual transmit time with option RESEND	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	113.98	us
TX API call to actual transmit time with option RESEND	PHY_Datasheet_915M_2GFSK_50Kbps_25K	114	us
TX API call to actual transmit time with option SYNC WORD ID 1	IEEE802154_2P4GHZ	118.02	us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Datasheet_915M_2GFSK_2Mbps_500K	113.82	us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	113.84	us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Datasheet_915M_2GFSK_50Kbps_25K	113.9	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	IEEE802154_2P4GHZ	147	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Datasheet_915M_2GFSK_2Mbps_500K	139	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	139	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Datasheet_915M_2GFSK_50Kbps_25K	139	us
Temperature Calibration Time	IEEE802154_2P4GHZ	67.2	us
Temperature Calibration Time	PHY_Datasheet_915M_2GFSK_2Mbps_500K	63.94	us
Temperature Calibration Time	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	69.3	us
Temperature Calibration Time	PHY_Datasheet_915M_2GFSK_50Kbps_25K	69.6	us
Tx To Rx Auto state transition times	IEEE802154_2P4GHZ	79.12	us
Tx To Rx Auto state transition times	PHY_Datasheet_915M_2GFSK_2Mbps_500K	91.78	us
Tx To Rx Auto state transition times	PHY_Datasheet_915M_2GFSK_500Kbps_175K_miOp7	89.28	us
Tx To Rx Auto state transition times	PHY_Datasheet_915M_2GFSK_50Kbps_25K	91.3	us

Chip Type: G23	PHY	Average	Unit:
RAIL Timing			
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	149.4	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	366.68	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	2958.88	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	149.2	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	366.8	us
Active Radio to Idle Time with Idle Mode: 0 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	2958.84	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	87.44	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	87.32	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	87.36	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	147.4	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	170.4	us
Active Radio to Idle Time with Idle Mode: 1 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	170.92	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	106.96	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	106.4	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	106.92	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	149.28	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	190.4	us
Active Radio to Idle Time with Idle Mode: 2 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	189.96	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_2Mbps_500K	109.36	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	109.72	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 0	PHY_Studio_915M_2GFSK_50Kbps_25K	109.36	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_2Mbps_500K	149.32	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	193.36	us
Active Radio to Idle Time with Idle Mode: 3 and Idle Delay(Us): 80	PHY_Studio_915M_2GFSK_50Kbps_25K	193.12	us
Channel Change Time (RX to RX) 0 to 0 Rx To Rx	PHY_Studio_915M_2GFSK_2Mbps_500K	162.74	us
Channel Change Time (RX to RX) 0 to 0 Rx To Rx	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	162.68	us
Channel Change Time (RX to RX) 0 to 0 Rx To Rx	PHY_Studio_915M_2GFSK_50Kbps_25K	162.76	us
Channel Change Time (RX to RX) 0 to 1 Rx To Rx	PHY_Studio_915M_2GFSK_2Mbps_500K	252.38	us
Channel Change Time (RX to RX) 0 to 1 Rx To Rx	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	252.28	us
Channel Change Time (RX to RX) 0 to 1 Rx To Rx	PHY_Studio_915M_2GFSK_50Kbps_25K	252.58	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_GB868_863MHZ	Internal PHY	433.12	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_IEEE802154_GB868_915MHZ	Internal PHY	457.52	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_2Mbps_500K	6.04	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	6.18	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_PROPRIETARY	PHY_Studio_915M_2GFSK_50Kbps_25K	6.06	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_ANZ	Internal PHY	761.56	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_CN	Internal PHY	759.86	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_EU	Internal PHY	759.92	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_HK	Internal PHY	760.4	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_IL	Internal PHY	759.86	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_IN	Internal PHY	759.86	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_JP	Internal PHY	783.46	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_KR	Internal PHY	782.86	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_MY	Internal PHY	760.5	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_RU	Internal PHY	759.88	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US	Internal PHY	759.9	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR1	Internal PHY	754.54	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR2	Internal PHY	754.38	us
ConfigChannel Time SL_RAIL_UTIL_PROTOCOL_ZWAVE_US_LR_END_DEVICE	Internal PHY	772.68	us
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_2Mbps_500K	568.6	us
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	567.7	us
EM2 to Active Radio Time No SYNC	PHY_Studio_915M_2GFSK_50Kbps_25K	568.2	us
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_2Mbps_500K	622.6	us
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	619.8	us
EM2 to Active Radio Time With SYNC	PHY_Studio_915M_2GFSK_50Kbps_25K	619.6	us
Image Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_2Mbps_500K	200845.2	us
Image Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	200854.2	us
Image Rejection Calibration Time Proprietary	PHY_Studio_915M_2GFSK_50Kbps_25K	200855.58	us
Image Rejection Calibration Time ZWAVE Z-Wave Region: US-United States Channel: 0	Internal PHY	200868.8	us
Image Rejection Calibration Time ZWAVE Z-Wave Region: USLR1-United States Long Range 1 Channel: 0	Internal PHY	200866.7	us
Image Rejection Calibration Time ZWAVE Z-Wave Region: USLR1-United States Long Range 1 Channel: 1	Internal PHY	200865.5	us
Image Rejection Calibration Time ZWAVE Z-Wave Region: USLR1-United States Long Range 1 Channel: 2	Internal PHY	200875.2	us
Image Rejection Calibration Time ZWAVE Z-Wave Region: USLR1-United States Long Range 1 Channel: 3	Internal PHY	200871	us
Image Rejection Calibration Time ZWAVE Z-Wave Region: USLRED-United States Long Range End Device Channel: 1	Internal PHY	200852.2	us
RAIL_Init() Time with DMA	Internal PHY	1298	us
RAIL_Init() Time without DMA	Internal PHY	3806	us
RX API call to actual RX ready state time Channel 0 -> 0	PHY_Studio_915M_2GFSK_2Mbps_500K	128.98	us
RX API call to actual RX ready state time Channel 0 -> 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	129.02	us
RX API call to actual RX ready state time Channel 0 -> 0	PHY_Studio_915M_2GFSK_50Kbps_25K	129.02	us
RX API call to actual RX ready state time Channel 0 -> 1	PHY_Studio_915M_2GFSK_2Mbps_500K	218.82	us
RX API call to actual RX ready state time Channel 0 -> 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	218.7	us
RX API call to actual RX ready state time Channel 0 -> 1	PHY_Studio_915M_2GFSK_50Kbps_25K	218.76	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_2Mbps_500K	33.7	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	48.76	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_STORE_CRC	PHY_Studio_915M_2GFSK_50Kbps_25K	206.74	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_2Mbps_500K	33.76	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	48.8	us
RX pkt receive to event trigger with option RAIL_RX_OPTION_TRACK_ABORTED_FRAMES	PHY_Studio_915M_2GFSK_50Kbps_25K	206.76	us
RX to TX Auto state transition times	PHY_Studio_915M_2GFSK_2Mbps_500K	163.46	us
RX to TX Auto state transition times	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	178.76	us
RX to TX Auto state transition times	PHY_Studio_915M_2GFSK_50Kbps_25K	333.94	us

Chip Type: G23			
RAIL Timing	PHY	Average	Unit:
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Studio_915M_2GFSK_2Mbps_500K	186.16	us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.22	us
TX API call to actual transmit time with option ALT PREAMBLE LEN 128	PHY_Studio_915M_2GFSK_50Kbps_25K	186.26	us
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_2Mbps_500K	186.26	us
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.14	us
TX API call to actual transmit time with option ANTENNA 0	PHY_Studio_915M_2GFSK_50Kbps_25K	186.2	us
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_2Mbps_500K	186.22	us
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.14	us
TX API call to actual transmit time with option ANTENNA 1	PHY_Studio_915M_2GFSK_50Kbps_25K	186.26	us
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_2Mbps_500K	186.12	us
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.24	us
TX API call to actual transmit time with option CCA ONLY	PHY_Studio_915M_2GFSK_50Kbps_25K	186.32	us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_2Mbps_500K	186.28	us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.16	us
TX API call to actual transmit time with option CCA PEAK RSSI	PHY_Studio_915M_2GFSK_50Kbps_25K	186.22	us
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_2Mbps_500K	178	us
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	177.9	us
TX API call to actual transmit time with option Default	PHY_Studio_915M_2GFSK_50Kbps_25K	178	us
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_2Mbps_500K	187.3	us
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	187.32	us
TX API call to actual transmit time with option REMOVE CRC	PHY_Studio_915M_2GFSK_50Kbps_25K	187.16	us
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_2Mbps_500K	186.22	us
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.32	us
TX API call to actual transmit time with option RESEND	PHY_Studio_915M_2GFSK_50Kbps_25K	186.12	us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_2Mbps_500K	186.22	us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.32	us
TX API call to actual transmit time with option SYNC WORD ID 1	PHY_Studio_915M_2GFSK_50Kbps_25K	186.26	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_2Mbps_500K	186.54	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	186.52	us
TX API call to actual transmit time with option WAIT FOR AUTO ACK	PHY_Studio_915M_2GFSK_50Kbps_25K	186.52	us
Temperature Calibration Time	PHY_Studio_915M_2GFSK_2Mbps_500K	119.82	us
Temperature Calibration Time	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	119.54	us
Temperature Calibration Time	PHY_Studio_915M_2GFSK_50Kbps_25K	119.96	us
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_2Mbps_500K	143.38	us
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_500Kbps_175K_mi0p7	143.44	us
Tx To Rx Auto state transition times	PHY_Studio_915M_2GFSK_50Kbps_25K	143.56	us

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