Application Note

Fast Bring-up on AFE81xx

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ABSTRACT

This document describes the fast bring-up feature in AFE81xx family devices. Typically, an AFE bring-up with all Power Up Calibrations takes 4 seconds for an 8T8R Configuration. With pre-computed calibration results stored in AFE's on-chip non-volatile memory the bring-up time can be reduced to less than 400ms. This feature is applicable in various scenario in munition applications where fast boot up time is required for the end system.

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Trademarks

1 Introduction

RF Transceivers are used to communicate data, voice, and video information over the wireless communication medium as electromagnetic waves. The transceivers are widely deployed in systems such as telecommunication (base stations), RADAR, aerospace research, ammunition, and so on. The next generation of wireless communication is setting a high-performance bar for wireless transceivers with tighter power constraints, which also increases the receivers complexity.

The increased complexity also demands higher configuration/bring-up time of these devices since a large number of blocks has to be properly programmed to function as expected. The Bring-Up Time of the transceiver is very critical, especially in ammunition-related deployments. This is because the transceiver needs to engage and has to transmit or receive data within milliseconds of the launch of the weapon for real-time processing of the trajectory which is very crucial.

2 Fast Bring-up on AFE81xx

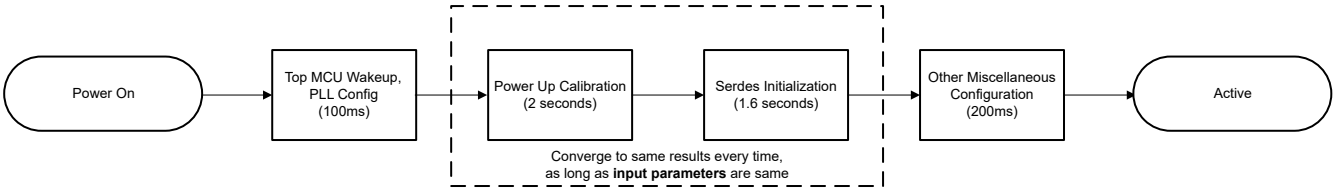

Figure 2-1. Normal Bring-up Flow

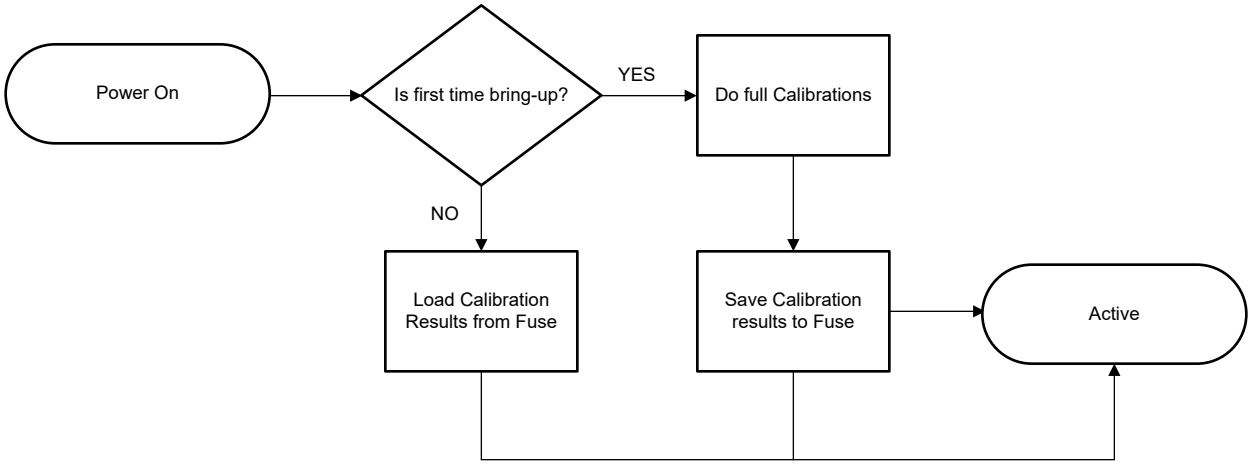

Figure 2-2. Fast Bring-up Flow

3 Fast Bring-up Sequence

During first time bring-up, the result of the calibration is saved to the on-chip non-volatile (fuse) memory. Calibration Results are then loaded from fuse memory for subsequent bring-ups. Fuse blow is One-Time-Process, that is done during customer factory calibration when all system parameters are finalized. Faster bring-up time is achieved (368ms) at the cost of flexibility of input parameters.

4 Input Parameter Constraint

Input parameters, including input clock frequency, ADC Rate, DAC Rate, NCO frequencies, SERDES lane rate, interface rate has to be fixed before doing the fuse blow. PLL calibration values change if input clock frequency changes. The serdes calibration change with lane rate and link configuration. The serdes automatically adjusts timings designed for timing margins, so this adapts to any minor variations (within limits). However, in modular system, the AFE and FPGAs can be on different boards. If backend board changes (from calibrated board) with different link equalization, there can be need for JESD link re-equalization.

5 Calibration Memory

The memory type is e-Fuse. An e-Fuse is an array of electronically programmable fuses. As data is stored by physically blowing the fuses, so there is no limit on data retention period. Since this is one time blow fuses, as a standard option, the re-calibration is not possible.

6 Fuse Blow Requirement

For the one-time fuse blow, the Vpp supply (device pin V17) needs to go to 1.8V. By default, this has to be 0V. A switch circuit is required to control this voltage as shown in Figure 6-1. The select (SEL) signal is generated by the AFE81xx on a GPIO pin when the 1.8V has to be enabled. Apart from this, no additional sequence is required to perform the fuse blow. The device library takes care of the same.

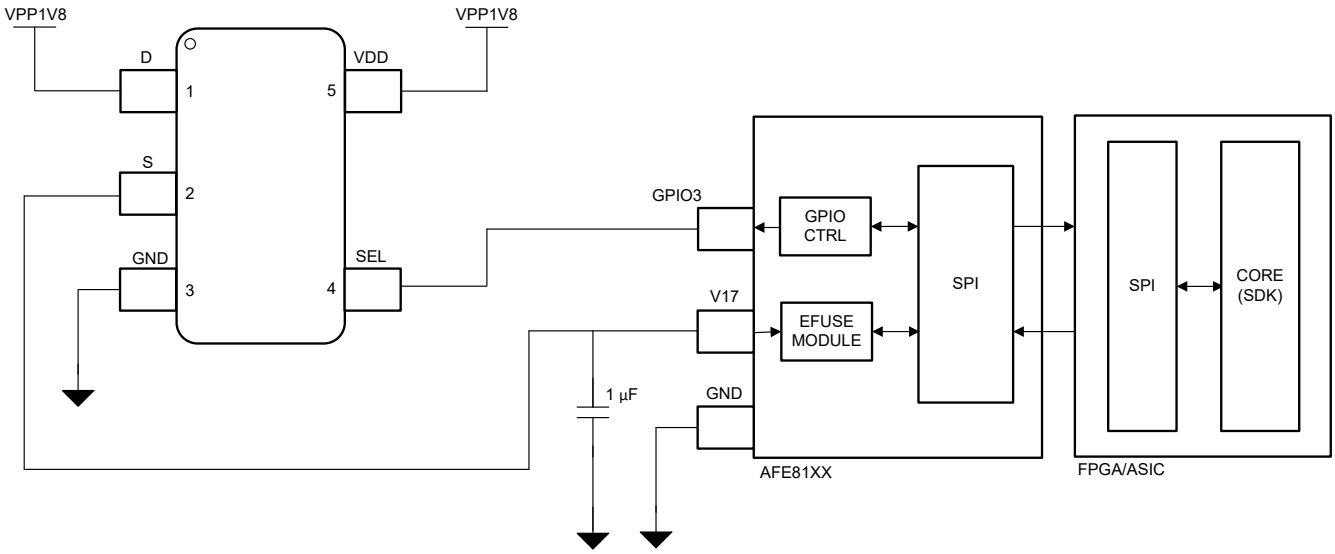

Figure 6-1. Fuse Blow Circuit

7 Drifts and Aging

The calibration values are expected to remain valid across time or temperature for given system settings (input clock, serdes configuration, lane rate and so on) The fast bring-up forces initial operating point for blocks that need power up calibration. For example, the during normal power up calibration, the device converges to designed for PLL setting as per input clock frequency. In fast bring-up case, the device uses stored values to lock PLL on input clock. Clearly, this does not affect the PLL's ability to lock or track input clock across time or temperature variations. This also does not limit the internal real-time calibrations of device.

8 Device Bring-up Time

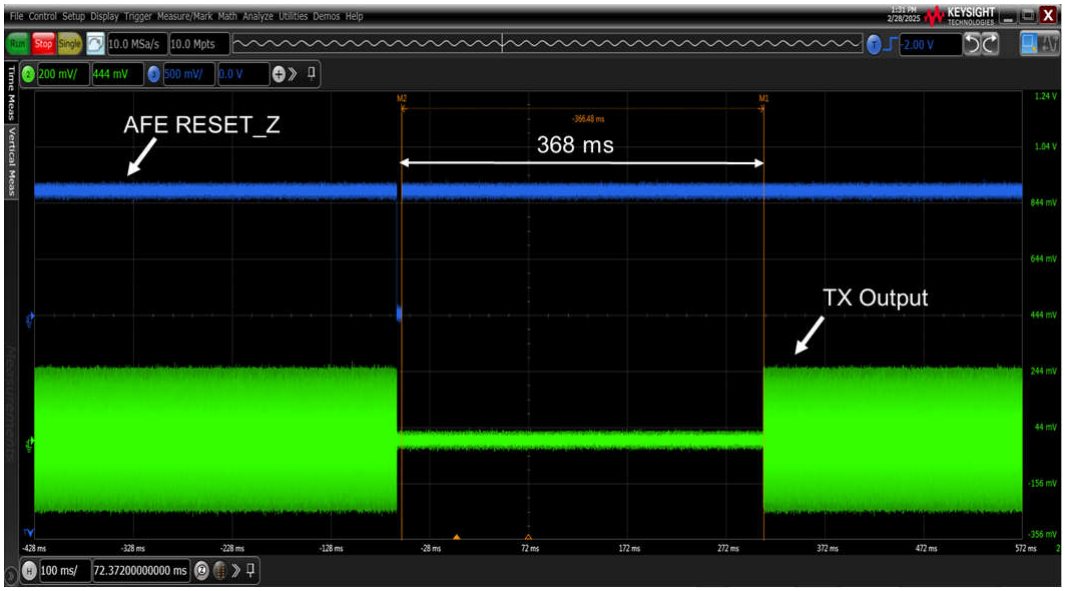

Figure 8-1. Bring-up Time Measured on Scope

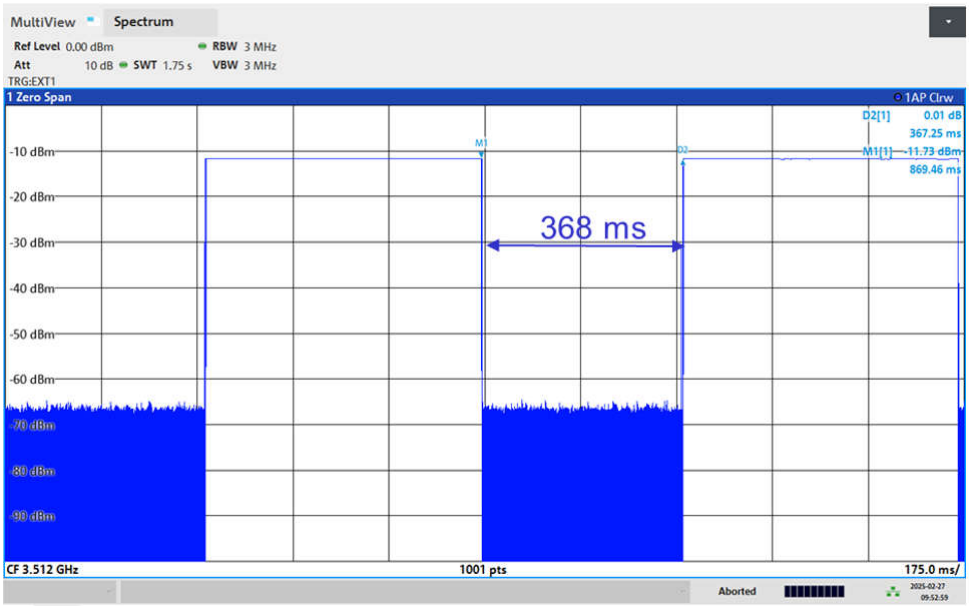

Figure 8-2. TX Tone Out Power after Device Reset and Fast Bring-up

9 Summary

The fast bring-up mode feature is currently supported in the AFE81xx device libraries. With this feature enabled, the bring up time of this AFE can be reduced by 10x at the cost of flexibility of input parameters post the initial calibration. The sub-500ms wakeup time achieved through this enables this AFE to be deployed in systems with ultra-fast boot time requirement without any compromise in performance.

10 References

- Texas Instruments, *AFE8190 16-Channel RF Transceiver with Feedback Paths*, data sheet.

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