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AMBE-3000™ Vocoder Chip
Designer's Notes

Version 1.1
April, 2017

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1 Introduction

This document provides design details to aid hardware and software engineers in implementing the AMBE-3000™ vocoder chip into customized communication systems.

2 Reset Behavior

To avoid startup latency problems the system should be designed to supply a cascading reset. This means that once the system host processor is fully functional it should bring the AMBE-3000™ Vocoder Chip out of reset using RESETn signal. The AMBE-3000™ Vocoder Chip should then supply the CODEC_RESETn signal to bring the codec out of reset. Employing reset in this cascading fashion will allow each device to be up and running in proper sequence so that no data is lost.

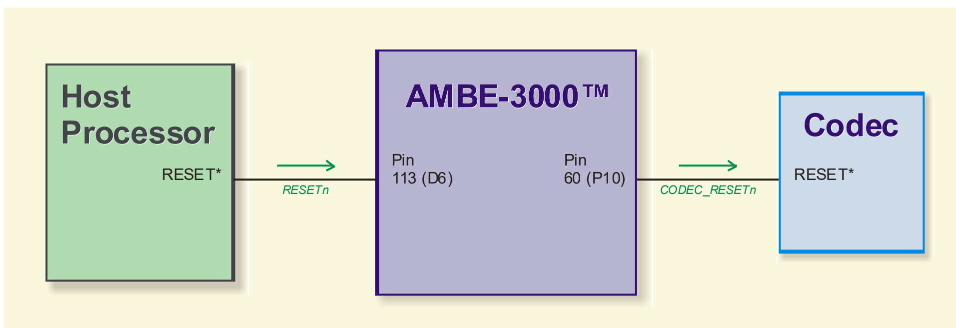

Figure 1 Cascading Resets

Care should be taken with the AMBE-3000™ Vocoder Chip RESET pin (LQFP pin 113, BGA pin D6). The RESET pin is considered an I/O port and will function as such when a SOFT RESET packet (PKT_RESET or PKT_RESETSOFTCFG) is sent to the device. This means that when a SOFT RESET packet is issued, the AMBE-3000™ Vocoder Chip will pull the RESET pin low for a short period of time (approximately 20 µs). The designer should avoid having the AMBE-3000™ Vocoder Chip's RESET pin be shared on the system reset line or a reset with other components on the board if there is a chance that a SOFT RESET may be called for in the design.

3 Reset to Ready Packet Timing

RESET release to PKT_ READY is 20 ms MAX, 17 ms TYPICAL.
SOFT reset to PKT_READY = ~ 7 ms

4 Behavior of RTSn and TX_RDY following a RESET

Following a RESET, there is a short period where the TX_RDY signal is set high by the AMBE-3000. During this short period reading of the TX_RDY should be avoided. The TX_RDY hold off period is approximately 1 ms following a reset.

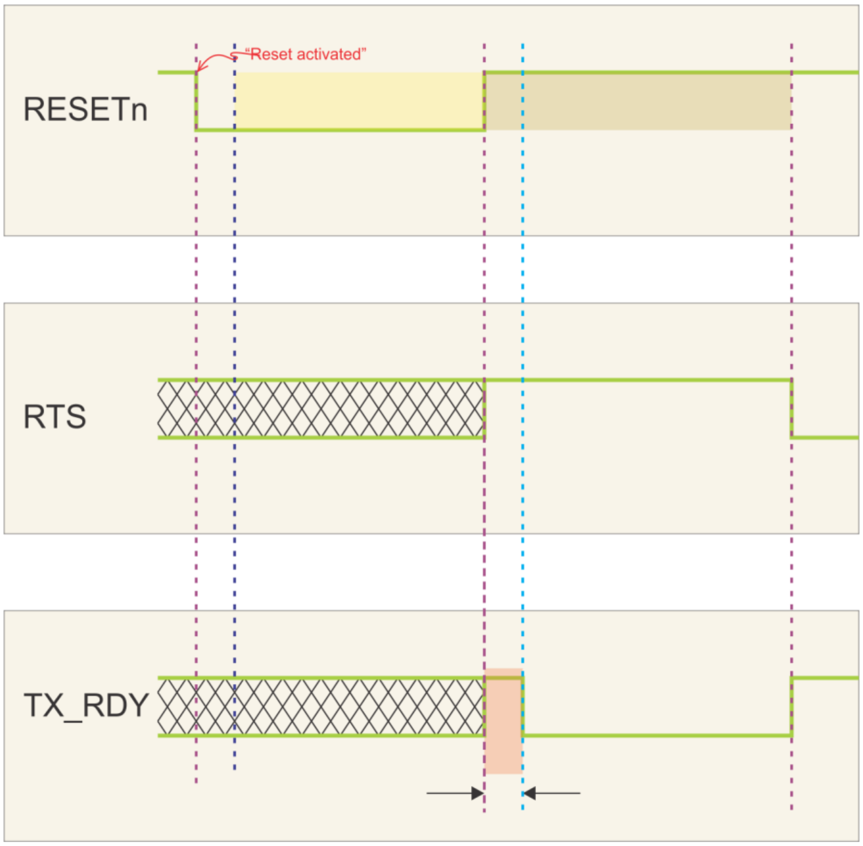

Figure 2 TX_RDY after Reset

5 Boot Mode

A good technique for smooth operation and data transfer is to design the system so that the AMBE-3000™ Vocoder Chip boots into Packet Mode on start-up. This will allow the AMBE-3000™ Vocoder Chip to be sitting idle and ready to receive configuration packets, independent of the channel interface being used. The user can then configure the AMBE-3000™ Vocoder Chip as needed. This method is beneficial because it puts the chip in a known state until it is ready to be utilized. Figure 3 Switching between Packet Mode and Codec Mode shows a flow chart of the events needed to switch between the two modes.

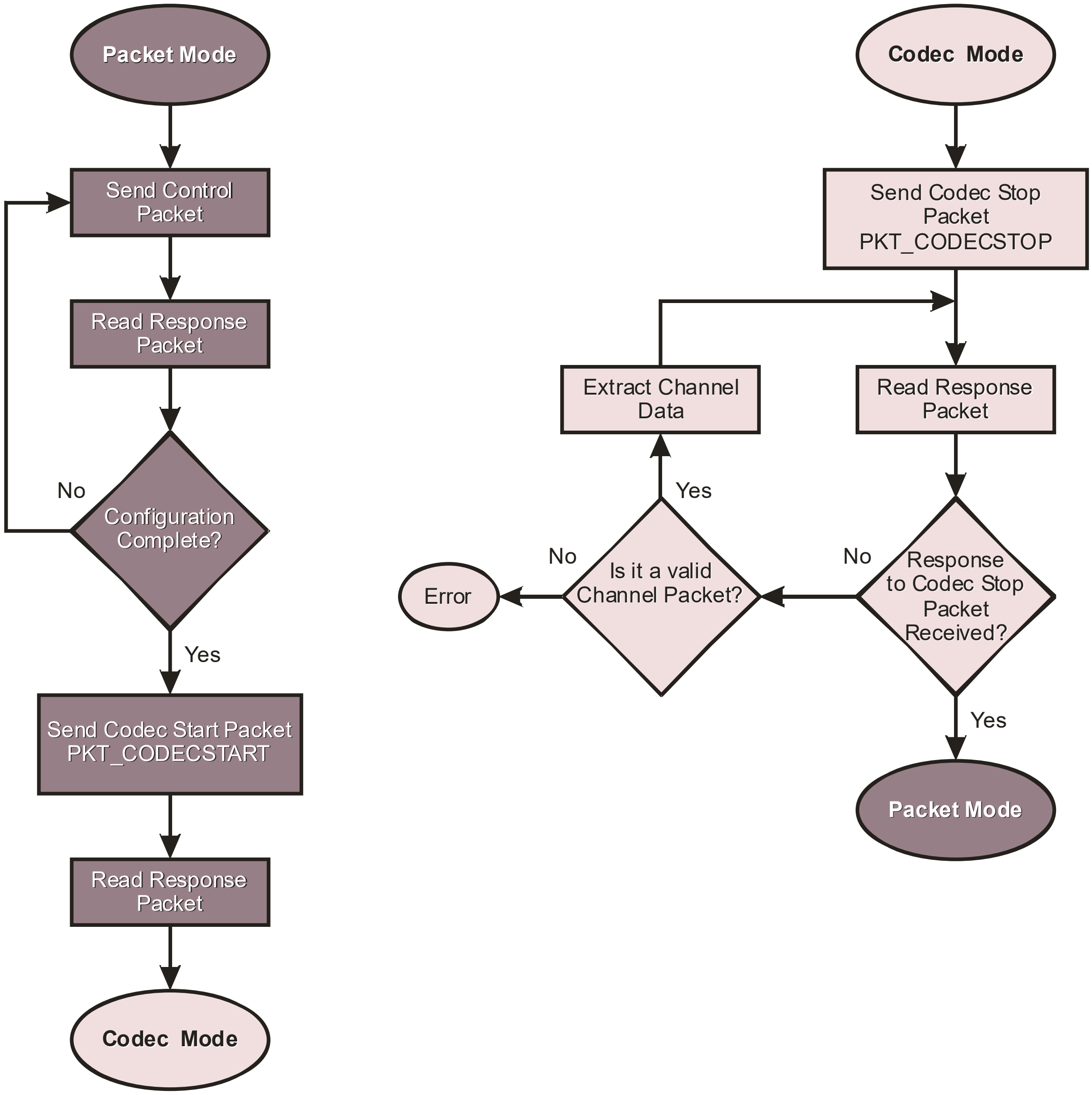

Figure 3 Switching between Packet Mode and Codec Mode

6 Timing of channel packets in Codec Mode

6.1 Timing of channel transmit packets in Codec Mode

6.1.1 When **Skew Control is not used**, the AMBE-3000™ vocoder chip outputs one packet per 20 ms. TX_RDY goes high once every 20 ms.

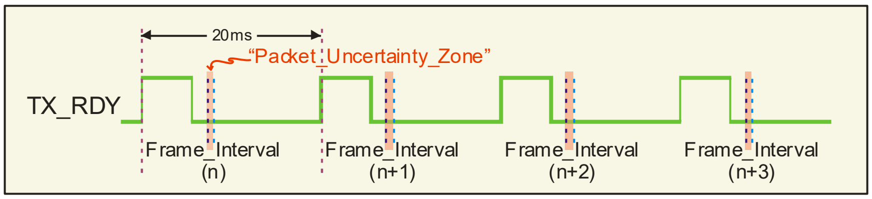

Figure 4 TX_RDY with Skew Control Off

6.1.2 When **Skew Control is used,** the AMBE-3000™ vocoder chip outputs one packet per each TX_RQST 0 to 1 transition. TX_RDY goes high approximately 5.625 ms after TX_RQST 0 to 1 transition. TX_RDY goes high once every 20 ms.

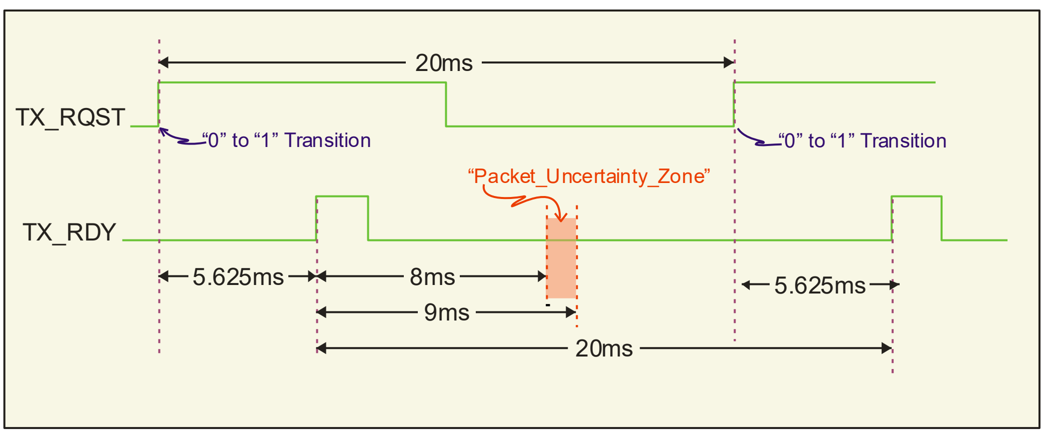

Figure 5 TX_RDY with Skew Control On

6.2 Timing of channel receive packets in Codec Mode

In general, every time the AMBE-3000™ vocoder chip transmits a packet it should also receive a packet.

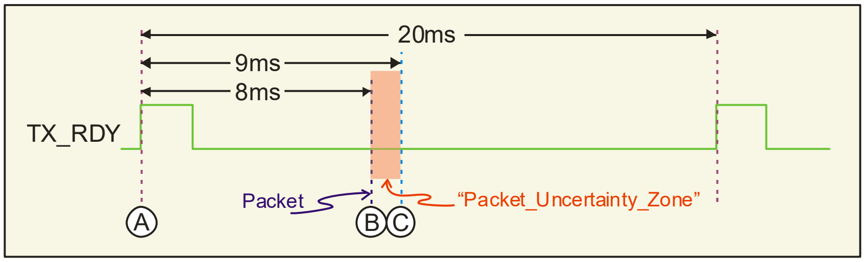

Table 1 TX_RDY Timing

At time "A" the AMBE-3000™ Vocoder Chip sets TX_RDY high

When using the PPT packet interface
the reading of a packet from the PPT can begin.

When using the UART or MCBSP packet interface
the AMBE-3000™ Vocoder Chip will begin transmitting a channel packet.

During each 20 ms frame interval as indicated by the TX_RDY signal, the decoder should receive exactly one packet. Between time "B" and "C" (the "Packet_Uncertainty_Zone") the vocoder should not receive any channel packets.

The following figure illustrates the simplest way to send packets to the AMBE-3000™ Vocoder Chip

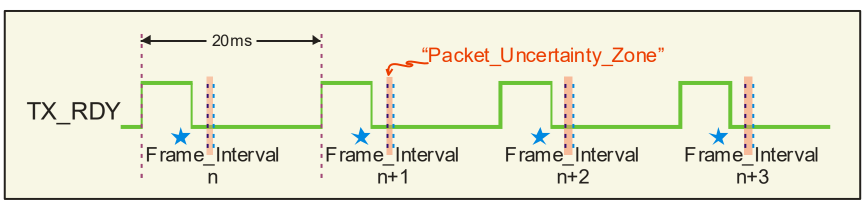

Table 2 TX_RDY Frame Interval

In the above figure packets are transmitted to the AMBE-3000™ Vocoder Chip with a fixed-period of 20 ms. The AMBE-3000™ Vocoder Chip must receive exactly one channel packet per frame period and the "Packet_Uncertainty_Zone" should be avoided.

The following figure shows some examples of packet timing that are aperiodic

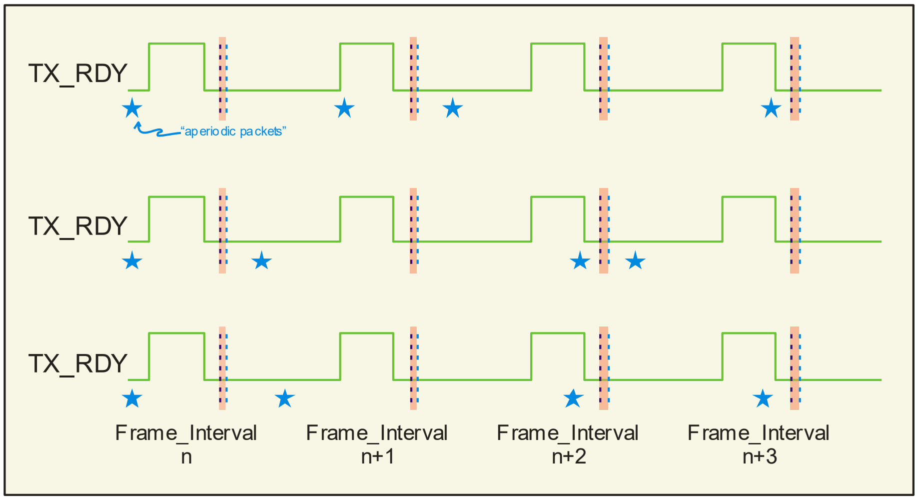

Table 3 TX_RDY Frame interval Examples

When the AMBE-3000™ Vocoder Chip receives a packet during the "Packet_Uncertain_Zone" it is indeterminate which frame interval will be assigned to the packet. If the AMBE-3000™ Vocoder Chip does not receive any packets during a frame interval, then the decoder will fill in the gap by synthesizing a frame of speech using the model parameters from the prior speech frame. This is known as a frame repeat. If two packets are received during a frame interval then the older channel packet will be discarded.

Note that infrequent "erasure frames" and "frame repeats" can be acceptable in a system and may be a suitable way to account for differences in the transmit and receive clocks.

Note that the frame intervals are defined relative to TX_RDY which is assumed to be synchronous with transmitted frames.

7 Use of PKT_PRODID and PKT_VERSTRING

An easy way to verify the AMBE-3000™ Vocoder Chip is running and ready to process data is to check for the output of the READY packet. However, in order to prove the communication to the AMBE-3000™ Vocoder Chip is operating properly it is best to send a packet to the chip and verify the AMBE-3000™ Vocoder Chip returns the expected value. Two good known packets to send are the PKT_PRODID and PKT_VERSTRING. These two packets have known return values and can easily be compared to validate proper operation.

PKT_PRODID
`0x61 0x00 0x01 0x00 0x30`

Response Example:
`0x61 0x00 0x0E 0x00 0x30 0x41 0x4D 0x42 0x45 0x33 0x30 0x30 0x30 0x53 0x41 0x54 0x46 0x00`

`AMBE-3000R`

****

PKT_VERSTRING
`0x61 0x00 0x01 0x00 0x31`

Response Example:

```
0x61 0x00 0x31 0x00 0x31 0x56 0x31 0x32 0x30 0x2E 0x45 0x31
0x30 0x30 0x2E 0x58 0x58 0x58 0x58 0x2E 0x43 0x31 0x30 0x36
0x2E 0x47 0x35 0x31 0x34 0x2E 0x52 0x30 0x30 0x39 0x2E 0x42
0x30 0x30 0x31 0x30 0x34 0x31 0x31 0x2E 0x43 0x30 0x30 0x32
0x30 0x32 0x30 0x38 0x00
```

*In the above packets, parity has been disabled.

`V100.E100.XXXX.C106.G514.R007.A0030608.C0020208`
Where the value after the "R" indicates the software release. For more information refer to the AMBE-3000 User's Manual.

8 Vocoder State

In systems that require the ability to encode/decode different subsequent audio streams the vocoder state in the AMBE-3000™ Vocoder Chip would need to be reset back to the initial state. This will ensure that new audio streams will not be using state data from a previous unrelated audio stream. To clear out any old vocoder state information the designer should send a PKT_INIT to the AMBE-3000™ Vocoder Chip in between each different audio stream. This will reset the chip back to the default state and allow it to encode/decode properly.

Issue a PKT_CODECSTOP:
`0x61 0x00 0x01 0x2B`

Issue PKT_INIT:
`0x61 0x00 0x02 0x0B 0x03`

Issue a PKT_CODECSTART
`0x61 0x00 0x02 0x00 0x2A XxXX`*
*See Table 57 on page 60 of the AMBE-3000™ User's Manual.

9 UART TX Pin State

When designing a system using the UART interface on the AMBE-3000™ Vocoder Chip it is necessary that the UART_TX pin (pin 111 QFP – pin C7 BGA) be held high at boot. This will ensure the AMBE-3000™ Vocoder Chip will start in the proper configuration. If the UART is not used in your design it can be left unconnected (there is an internal pull up resistor).

10 Input Buffer Sizes

When the device is operated in packet mode it can be beneficial to write more than one packet to the device so that the encoder/decoder remain busy processing data at all times.

	AMBE-3000F/R
TXBUFF	700 bytes
RXBUFF	760 bytes

This is large enough to accommodate a speech packet and a channel packet, two speech packets or several channel packets. For reference, please see the USB-3000™ Manual page 32 (section 4.8) for a detailed description of Using Pending Packets to Improve Throughput.