

# OpenCPI

## Zipper TX Component Data Sheet

OpenCPI Release: v2.3.4

## Deprecation Notice:

Beginning with OpenCPI Version 1.5, support for Lime Microsystems' Zipper card is now deprecated. This document will not be updated any further.

## Summary - Zipper TX

|                   |                            |
|-------------------|----------------------------|
| Name              | zipper_tx                  |
| Worker Type       | Frontend Interface (Proxy) |
| OpenCPI Release   | v2.3.4                     |
| Last Update       | 4/2019                     |
| Component Library | ocpi.assets.cards          |
| Workers           | zipper_tx.rcc              |
| Tested Platforms  | alst4, ml605, zed          |

## Functionality

This worker is used to control the TX portion the Zipper RF daughter card. Each property has a max, min, and step value associated with it. These associated properties are available to be used by application developers for reading back information about the functionality of the interface during runtime if necessary.

This worker implements a common interface that is intended to be used across multiple platforms. All platforms will have the same property interface to allow applications to be ported seamlessly to other platforms. It is also intended to be a simple interface that encompasses functionality that all TX interfaces will have but not any specialty functionality that only some TX interfaces will have.

There are two known limitations when using this worker:

- 1) When used in addition to the RX frontend interface, there must be a 1 MHz offset between the TX and RX center frequencies, due to a limitation with the Lime transceiver device on the Zipper RF daughter card.
- 2) Due to a limitation of the framework, this component must appear after the TX control proxies in an application XML.

## Worker Implementation Details

This worker controls the filtering, gain, tuning frequency, and the sample rate of the Zipper RF daughter card transmitter. Each of these are described below in their own section.

### Filtering

In the RF section of the transmitter, there are no filtering elements.

The baseband section has a variable low pass filter that is located in the LMS6002D transceiver.

### Gain

The RF section only has one device which is a VGA in the LMS6002D transceiver.

The baseband section only has one device which is a VGA in the LMS6002D transceiver.

### Tuning

The LMS6002D transceiver converts the signal from baseband to RF using one mixing phase.

## Sample Rate

The sampling clock domain originates from the CLK4 and CLK5 output of a SI5338 clock generator. CLK4 is connected directly to the FPGA and used as the sampling clock in the FPGA. CLK5 is expected to be set to the same value as CLK 4 and this is routed to the LMS6002D as a sampling clock.

## Block Diagrams

### Top level

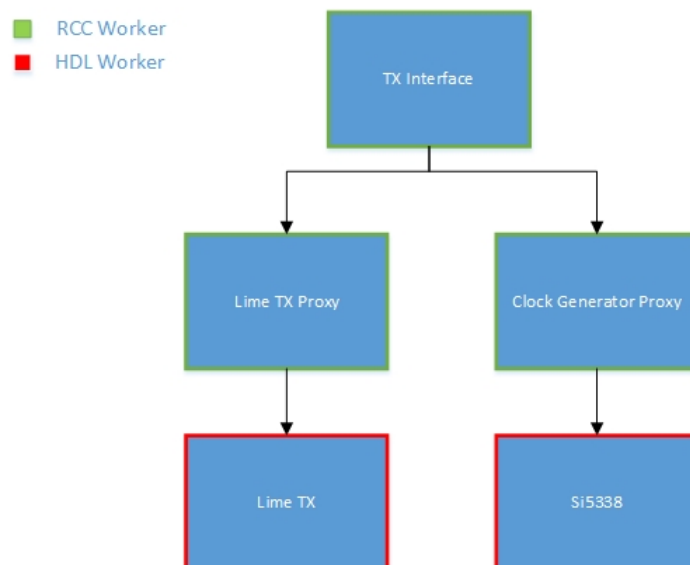


Figure 1: Top Level Block Diagram

### TX Hardware

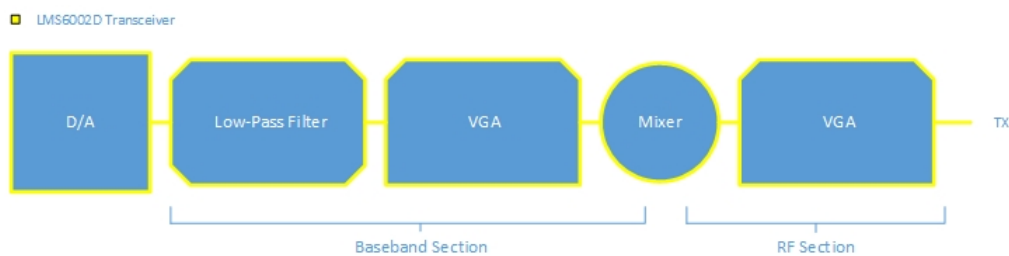


Figure 2: Hardware Block Diagram

## Source Dependencies

- `ocpi.assets/hdl/devices/zipper_tx.rcc/zipper_tx.cc`

## Component Spec Properties

| Name                         | Type   | Sequence Length | Array Dimensions | Accessibility      | Valid Range | Default | Usage                                                                                                                                                                              |
|------------------------------|--------|-----------------|------------------|--------------------|-------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| rf_gain_dB                   | double | -               | -                | Readable, Writable | -           | 0       | The value of the RF gain stage of the transmitter                                                                                                                                  |
| rf_gain_max_dB               | double | -               | -                | Volatile, Writable | -           | 0       | Maximum valid value for RF gain                                                                                                                                                    |
| rf_gain_min_dB               | double | -               | -                | Volatile, Writable | -           | 0       | Minimum valid value for RF gain                                                                                                                                                    |
| rf_gain_step_dB              | double | -               | -                | Volatile, Writable | -           | 0       | Minimum granularity for changes in RF gain                                                                                                                                         |
| bb_gain_dB                   | double | -               | -                | Readable, Writable | -           | 0       | The value of the baseband gain stage of the transmitter                                                                                                                            |
| bb_gain_max_dB               | double | -               | -                | Volatile, Writable | -           | 0       | Maximum valid value for baseband gain                                                                                                                                              |
| bb_gain_min_dB               | double | -               | -                | Volatile, Writable | -           | 0       | Minimum valid value for baseband gain                                                                                                                                              |
| bb_gain_step_dB              | double | -               | -                | Volatile, Writable | -           | 0       | Minimum granularity for changes in baseband gain                                                                                                                                   |
| frequency_MHz                | double | -               | -                | Readable, Writable | -           | 0       | The value for the tuned center frequency of the outgoing RF samples                                                                                                                |
| frequency_max_MHz            | double | -               | -                | Volatile, Writable | -           | 0       | Maximum valid value for frequency                                                                                                                                                  |
| frequency_min_MHz            | double | -               | -                | Volatile, Writable | -           | 0       | Minimum valid value for frequency                                                                                                                                                  |
| frequency_step_MHz           | double | -               | -                | Volatile, Writable | -           | 0       | Minimum granularity for changes in frequency                                                                                                                                       |
| sample_rate_MHz              | double | -               | -                | Readable, Writable | -           | 0       | Sample rate of the outgoing RF samples                                                                                                                                             |
| sample_rate_max_MHz          | double | -               | -                | Volatile, Writable | -           | 0       | Maximum valid value for sample rate                                                                                                                                                |
| sample_rate_min_MHz          | double | -               | -                | Volatile, Writable | -           | 0       | Minimum valid value for sample rate                                                                                                                                                |
| sample_rate_step_MHz         | double | -               | -                | Volatile, Writable | -           | 0       | Minimum granularity for changes in sample rate                                                                                                                                     |
| rf_cutoff_frequency_MHz      | double | -               | -                | Readable, Writable | -           | 0       | The effective cutoff frequency, i.e. half of the bandwidth, for all filtering that is done in the RF stage of the transmitter. There is no RF filtering stage on this transmitter. |
| rf_cutoff_frequency_max_MHz  | double | -               | -                | Volatile, Writable | -           | 0       | Maximum valid value for RF cutoff frequency                                                                                                                                        |
| rf_cutoff_frequency_min_MHz  | double | -               | -                | Volatile, Writable | -           | 0       | Minimum valid value for RF cutoff frequency                                                                                                                                        |
| rf_cutoff_frequency_step_MHz | double | -               | -                | Volatile, Writable | -           | 0       | Minimum granularity for changes in RF cutoff frequency                                                                                                                             |
| bb_cutoff_frequency_MHz      | double | -               | -                | Readable, Writable | -           | 0       | The effective cutoff frequency, i.e. half of the bandwidth, for all filtering that is done in the baseband stage of the transmitter.                                               |
| bb_cutoff_frequency_max_MHz  | double | -               | -                | Volatile, Writable | -           | 0       | Maximum valid value for baseband cutoff frequency                                                                                                                                  |
| bb_cutoff_frequency_min_MHz  | double | -               | -                | Volatile, Writable | -           | 0       | Minimum valid value for baseband cutoff frequency                                                                                                                                  |
| bb_cutoff_frequency_step_MHz | double | -               | -                | Volatile, Writable | -           | 0       | Minimum granularity for changes in baseband cutoff frequency                                                                                                                       |

# Worker Properties

## zipper\_tx.rcc

| Type         | Name                         | Type | Sequence Length | Array Dimensions | Accessibility/Advanced | Valid Range  | Default | Usage                                                                                                                                |
|--------------|------------------------------|------|-----------------|------------------|------------------------|--------------|---------|--------------------------------------------------------------------------------------------------------------------------------------|
| SpecProperty | rf_gain_dB                   | -    | -               | -                | WriteSync              | 0-25         | 4       | The value of the RF gain stage of the transmitter                                                                                    |
| SpecProperty | rf_gain_max_dB               | -    | -               | -                | -                      | 25           | 25      | Maximum valid value for RF gain                                                                                                      |
| SpecProperty | rf_gain_min_dB               | -    | -               | -                | -                      | 0            | 0       | Minimum valid value for RF gain                                                                                                      |
| SpecProperty | rf_gain_step_dB              | -    | -               | -                | -                      | 1            | 1       | Minimum granularity for changes in RF gain                                                                                           |
| SpecProperty | bb_gain_dB                   | -    | -               | -                | WriteSync              | -35 - -4     | -4      | The value of the baseband gain stage of the transmitter                                                                              |
| SpecProperty | bb_gain_max_dB               | -    | -               | -                | -                      | -4           | -4      | Maximum valid value for baseband gain                                                                                                |
| SpecProperty | bb_gain_min_dB               | -    | -               | -                | -                      | -35          | -35     | Minimum valid value for baseband gain                                                                                                |
| SpecProperty | bb_gain_step_dB              | -    | -               | -                | -                      | 1            | 1       | Minimum granularity for changes in baseband gain                                                                                     |
| SpecProperty | frequency_MHz                | -    | -               | -                | WriteSync              | 232.5 - 3720 | 500     | The value for the tuned center frequency of the outgoing RF samples                                                                  |
| SpecProperty | frequency_max_MHz            | -    | -               | -                | -                      | 3720         | 3720    | Maximum valid value for frequency                                                                                                    |
| SpecProperty | frequency_min_MHz            | -    | -               | -                | -                      | 232.5        | 232.5   | Minimum valid value for frequency                                                                                                    |
| SpecProperty | frequency_step_MHz           | -    | -               | -                | -                      | 0.1          | 0.1     | Minimum granularity for changes in frequency                                                                                         |
| SpecProperty | sample_rate_MHz              | -    | -               | -                | WriteSync              | 0.5 - 40     | 0.5     | Sample rate of the outgoing RF samples                                                                                               |
| SpecProperty | sample_rate_max_MHz          | -    | -               | -                | -                      | 40           | 40      | Maximum valid value for sample rate                                                                                                  |
| SpecProperty | sample_rate_min_MHz          | -    | -               | -                | -                      | 0.5          | 0.5     | Minimum valid value for sample rate                                                                                                  |
| SpecProperty | sample_rate_step_MHz         | -    | -               | -                | -                      | 1            | 1       | Minimum granularity for changes in sample rate                                                                                       |
| SpecProperty | rf_cutoff_frequency_max_MHz  | -    | -               | -                | -                      | -1           | -1      | Maximum valid value for RF cutoff frequency. -1 means that no settings exist to change for RF cutoff frequency.                      |
| SpecProperty | rf_cutoff_frequency_min_MHz  | -    | -               | -                | -                      | -1           | -1      | Minimum valid value for RF cutoff frequency. -1 means that no settings exist to change for RF cutoff frequency                       |
| SpecProperty | rf_cutoff_frequency_step_MHz | -    | -               | -                | -                      | -1           | -1      | Minimum granularity for changes in RF cutoff frequency. -1 means that no settings exist to change for RF cutoff frequency            |
| SpecProperty | bb_cutoff_frequency_MHz      | -    | -               | -                | WriteSync              | 0.125-14     | 10      | The effective cutoff frequency, i.e. half of the bandwidth, for all filtering that is done in the baseband stage of the transmitter. |
| SpecProperty | bb_cutoff_frequency_max_MHz  | -    | -               | -                | -                      | 14           | 14      | Maximum valid value for baseband cutoff frequency                                                                                    |
| SpecProperty | bb_cutoff_frequency_min_MHz  | -    | -               | -                | -                      | 0            | 0       | Minimum valid value for baseband cutoff frequency                                                                                    |
| SpecProperty | bb_cutoff_frequency_step_MHz | -    | -               | -                | -                      | 0.125        | 0.125   | Minimum granularity for changes in baseband cutoff frequency                                                                         |

## Performance and Resource Utilization

**zipper\_tx.rcc**

| Processor Type | Processor Frequency | Run Function Time |
|----------------|---------------------|-------------------|
| TBD            | TBD                 | TBD               |

## References

- 1) LMS6002D Datasheet, [www.limemicro.com](http://www.limemicro.com)