Summary - FMCOMMS2/3 Digital Radio Controller Worker

Package Prefix	ocpi.core
Component	dig_radio_ctrlr
Name	dig_radio_ctrlr_fmcomms_2_3
Authoring Model	rcc
Version	1
OpenCPI Release	v1.5 (released 4/2019)

Revision History

Revision	Description of Change	Date
v1.5	Initial release.	4/2019

1 Block Diagrams

Non-parameter Properties: `request_config_lock`, `config_locks`, `unlock_config_lock`, `unlock_all`,
`data_stream_is_enabled`,
`direction_readback`,
`tuning_freq_MHz`, `bandwidth_3dB_MHz`, `sampling_rate_Msps`, `samples_are_complex`,
`valid_values_tuning_freq_MHz`,
`valid_values_bandwidth_3dB_MHz`,
`valid_values_sampling_rate_Msps`,
`valid_values_samples_are_complex`,
`gain_mode_readback`*, `gain_mode_dB`*,
`valid_values_gain_mode`*, `valid_values_gain_dB`*,
`app_inst_name_TX0_qdac`*, `app_inst_name_TX0_complex_mixer`*, `app_inst_name_TX0_cic_int`*,
`app_inst_name_TX1_qdac`*, `app_inst_name_TX1_complex_mixer`*, `app_inst_name_TX1_cic_int`*,
`app_inst_name_RX0_qadc`*, `app_inst_name_RX0_complex_mixer`*, `app_inst_name_RX0_cic_dec`*,
`app_inst_name_RX1_qadc`*, `app_inst_name_RX1_complex_mixer`*, `app_inst_name_RX1_cic_dec`*,
`bist_loopback`*

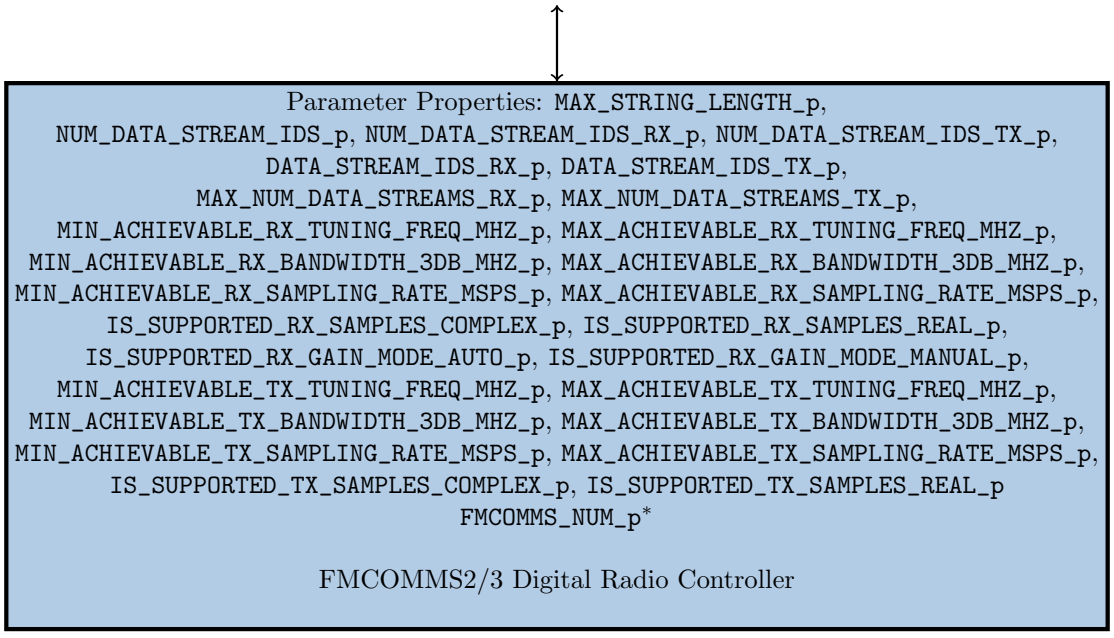

Figure 1: Worker Block Diagram.

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2 Functionality

This worker implements the dig_radio_ctrlr component spec[3] for the following Analog Devices FMC cards. The worker has a build configuration specific to each card.

- FMCOMMS2 Software Defined Radio card (2.4 GHz Optimized)[4]
- FMCOMMS3 wideband Software Defined Radio card[5]

2.1 Implementation Details

2.1.1 Slave Interfaces

This worker has a single slave interface to the ad9361_config.hdl worker. This worker also potentially accesses properties of workers specified in the following dig_radio_ctrlr_fmcomms_2_3.rcc properties:

- `app_inst_name_TX0_qdac`*
- `app_inst_name_TX0_complex_mixer`*
- `app_inst_name_TX0_cic_int`*
- `app_inst_name_TX1_qdac`*
- `app_inst_name_TX1_complex_mixer`*
- `app_inst_name_TX1_cic_int`*
- `app_inst_name_RX0_qadc`*

*indicates a non-spec property, i.e. one declared in the OWD

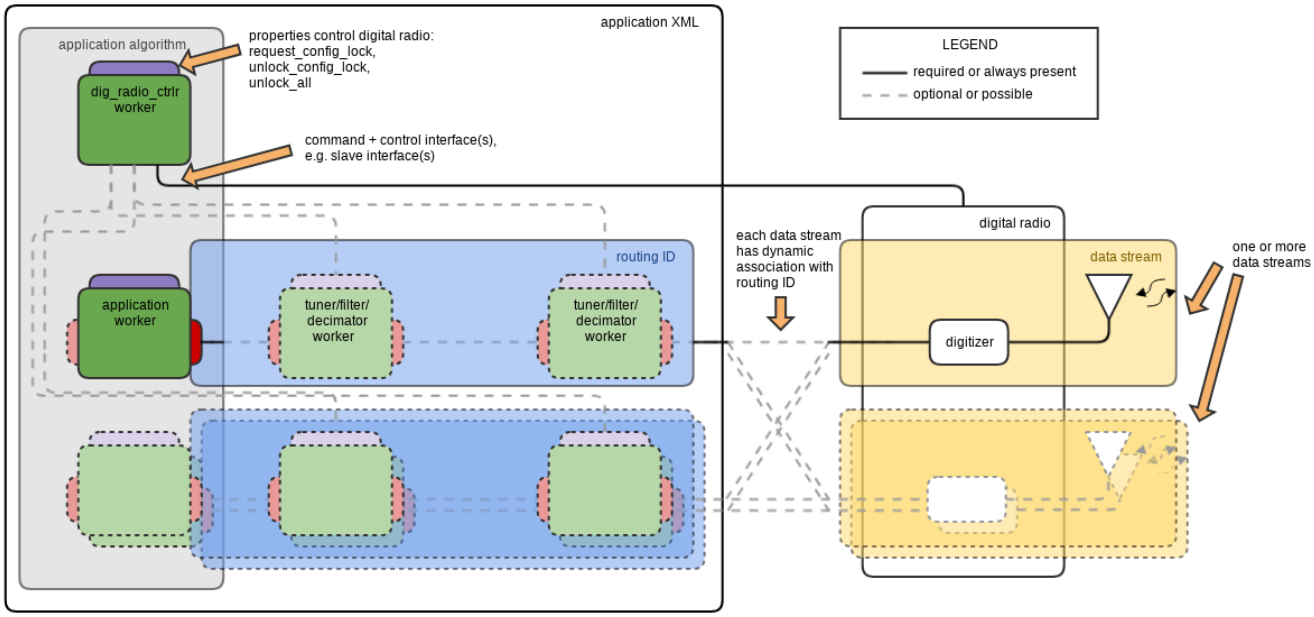

Figure 2: Digital Radio Controller - Major Concepts and Intended Usage.

- `app_inst_name_RX0_complex_mixer`*
- `app_inst_name_RX0_cic_dec`*
- `app_inst_name_RX1_qadc`*
- `app_inst_name_RX1_complex_mixer`*
- `app_inst_name_RX1_cic_dec`*

If any of these string properties have a value that is an empty string, no access is performed. The workers specified in the string properties are accessed via the ACI functions[6], e.g. setProperty().

2.1.2 Supporting C++ Classes

See the component spec datasheet [3] for a description of the supporting base classes. The RadioCtrlrFMCOMMS2TuneResamp and RadioCtrlrFMCOMMS3TuneResamp classes inherit from the RadioCtrlrNoOSTuneResamp class which is a software wrapper for Analog Device's No-OS software library[8]. The version of No-OS used is GitHub commit ID 06bfc76060d5b9767ae9aad7bf40e3648474ebb7[7]. No-OS provides command and control of the FMCOMMS2/3's AD9361 RF transceiver IC[1] via an API which ultimately controls SPI writes to the AD9361 register set. Note that the dig_radio_ctrlr_fmcomms_2_3.rcc worker does not currently expose all of the functionality of No-OS, as opposed to ad9361_config_proxy.rcc[2]. If desired, doxygen documentation can be generated for all of the supporting classes in the dig_radio_ctlr_fmcomms_2_3.rcc directory. Doxygen and either firefox or make and evince must be installed. To generate the documentation, run the following commands from the dig_radio_ctrlr_fmcomms_2_3.rcc directory:

```
cd ./supporting/
doxygen
```

The generated HTML documentation can be viewed via:

```
firefox ./html/index.html
```

The generated PDF documentation can be viewed via:

*indicates a non-spec property, i.e. one declared in the OWD

```
make -C ./latex/
evince ./latex/refman.pdf
```

2.2 Data Streams

See the component spec datasheet for *data stream*, *data stream ID* and *data stream type* concepts and definitions[3]. This worker has the following *data stream IDs*, each of which corresponds to an SMA connector on the FMCOMMS2/3 PCB:

- SMA_RX1A (can be configured for only the RX *data stream type*)
- SMA_RX2A (can be configured for only the RX *data stream type*)
- SMA_TX1A (can be configured for only the TX *data stream type*)
- SMA_TX2A (can be configured for only the TX *data stream type*)

As stated in [3], each *data stream* entry for a *config lock request* must refer to one of these *data stream IDs* and a *data stream type*.

2.3 Routing IDs

See the component spec datasheet for *routing ID* concept and definition[3]. The FMCOMMS2/3 cards support up to 4 simultaneously locked *data streams* (2 RX and 2 TX), each of which is associated with a routing ID. In keeping with recommendation in [3] for generic *routing ID* format, this worker supports the following *routing IDs*:

- RX0
- RX1
- TX0
- TX1

Each *data stream* entry for a *config lock request* must refer to one of these *routing IDs*. Note that, when any of the following worker properties contain a non-empty string, the *routing IDs* are associated with the application worker instance name specified in the string:

- `app_inst_name_TX0_qdac`*
- `app_inst_name_TX0_complex_mixer`*
- `app_inst_name_TX0_cic_int`*
- `app_inst_name_TX1_qdac`*
- `app_inst_name_TX1_complex_mixer`*
- `app_inst_name_TX1_cic_int`*
- `app_inst_name_RX0_qadc`*
- `app_inst_name_RX0_complex_mixer`*
- `app_inst_name_RX0_cic_dec`*
- `app_inst_name_RX1_qadc`*
- `app_inst_name_RX1_complex_mixer`*
- `app_inst_name_RX1_cic_dec`*

2.4 Config Lock Requests

See the component spec datasheet for *config lock request* concept and definition[3]. Each *data stream* entry for a *config lock request* must refer to an aforementioned worker-specific *data stream ID*, *data stream type*, and *routing ID*.

2.5 Detailed Component Spec Property Descriptions

See the component spec detailed property description [3].

2.6 Detailed Non-Spec Property Descriptions

2.6.1 Parameter Properties

- `FMCOMMS_NUM_p`* property
  - Valid values are 2 or 3. Used to allow worker to be parameterized for use with either FMCOMMS2 or FMCOMMS3. Application XML intended for use specific to FMCOMMS2/3 are expected to use the component selection XML attribute to restrict this value in order to enforce application requirements on intended FMCOMMS number.

2.6.2 Non-Parameter Properties - Current Value Reading

The `gain_mode_readback`* and `gain_dB`* sequence properties are used to read the current config value (locked or not) for each enabled *data stream*. Each sequence element contains the current config value for an enabled *data stream*. Worker implementations are expected to adjust this property's length such that it includes only enabled *data streams*. If no *data streams* are enabled, the sequence length is expected to be zero.

2.6.3 Non-Parameter Properties - Valid Values Reading

The `valid_values_gain_mode`* and `valid_values_gain_dB`* array properties indicate the current valid ranges of values for all *data streams*/*data stream type* combinations. Each array element contains the ranges for a single *data stream* for a single *data stream type*. It is expected that *data streams* that can be configured for either RX or TX will have a separate entry for each possible *data stream type*. Once a config is locked, it is intended that its valid ranges will only consist of a single value.

WARNING: The dig_radio_ctrlr_fmcomms_2_3.rcc worker's valid_values_tuning_freq_MHz, valid_values_bandwidth_3dB_MHz, valid_values_sampling_rate_Msps, valid_values_gain_mode*, and valid_values_gain_dB* properties do not currently function as intended due to unimplemented functionality. Each of their valid_values sequence member currently always has a sequence length of 0. Note that the valid_values_samples_are_complex* property operates as intended.

2.6.4 Application Instance Name Properties

As seen in 2 and stated in [3], each *routing ID* can be associated with one or more tuner/filter/resampler application workers. Each of the following string properties are used to associate a qadc, qdac, complex_mixer, cic_int, or cic_dec worker with a *routing ID* that falls under the command/control of the dig_radio_ctrlr_fmcomms_2_3.rcc worker.

WARNING: The phs_inc property of any complex_mixer application worker specified in the app_inst_name_RX0_complex_mixer*, app_inst_name_RX1_complex_mixer*, app_inst_name_TX0_complex_mixer*, or app_inst_name_TX1_complex_mixer* properties should *not* be modified at runtime by the ACI. Doing so could erroneously invalidate *config locks*.

Note that it is perfectly acceptable for an OAS to enforce the `R` parameter property value of the cic_int/cic_dec workers for purposes of setting decimation/interpolation values. This is acceptable because the parameter property values cannot change at runtime.

*indicates a non-spec property, i.e. one declared in the OWD

- app_inst_name_TX0_qdac*
- app_inst_name_TX0_complex_mixer*
- app_inst_name_TX0_cic_int*
- app_inst_name_TX1_qdac*
- app_inst_name_TX1_complex_mixer*
- app_inst_name_TX1_cic_int*
- app_inst_name_RX0_qadc*
- app_inst_name_RX0_complex_mixer*
- app_inst_name_RX0_cic_dec*
- app_inst_name_RX1_qadc*
- app_inst_name_RX1_complex_mixer*
- app_inst_name_RX1_cic_dec*

*indicates a non-spec property, i.e. one declared in the OWD

3 Worker Property Table(s)

For a detailed property description, see 2.6.

Table 1: Component Spec Properties.

Name	Type	Sequence Length	Array Dimensions	Accessibility	Default	Description
MAX_STRING_LENGTH_p	UShort	-	-	Parameter	1024 *	Length of all string properties.
NUM_DATA_STREAM_IDS_p	UShort	-	-	Parameter	4 *	Total number of *data stream IDs*.
NUM_DATA_STREAM_IDS_RX_p	UShort	-	-	Parameter	2 *	Total number of *data stream IDs* that can be configured for RX streaming.
NUM_DATA_STREAM_IDS_TX_p	UShort	-	-	Parameter	2 *	Total number of *data stream IDs* that can be configured for TX streaming.
DATA_STREAM_IDS_RX_p	String	-	NUM_DATA_STREAM_IDS_RX_p	Parameter	SMA_RX1A SMA_RX2A *	Defines all *data streams* on the radio that can be configured for RX streaming.
DATA_STREAM_IDS_TX_p	String	-	NUM_DATA_STREAM_IDS_TX_p	Parameter	SMA_TX1A SMA_TX2A *	Defines all *data streams* on the radio that can be configured for TX streaming.
MAX_NUM_DATA_STREAMS_RX_p	UShort	-	-	Parameter	2 *	Max number of simultaneously usable RX *data streams* available on radio.
MAX_NUM_DATA_STREAMS_TX_p	UShort	-	-	Parameter	2 *	Max number of simultaneously usable TX *data streams* available on radio.
MIN_ACHIEVABLE_RX_TUNING_FREQ_MHZ_p	Double	-	-	Parameter	FMCOMMS_NUM_p ==2 ? 2400 : 70-30.7190625 *	Min for all RX *data streams*.
MAX_ACHIEVABLE_RX_TUNING_FREQ_MHZ_p	Double	-	-	Parameter	FMCOMMS_NUM_p ==2 ? 2500 : 6000+30.72	Max for all RX *data streams*.
MIN_ACHIEVABLE_RX_BANDWIDTH_3DB_MHZ_p	Double	-	-	Parameter	0 *	Min for all RX *data streams*.
MAX_ACHIEVABLE_RX_BANDWIDTH_3DB_MHZ_p	Double	-	-	Parameter	56 *	Max for all RX *data streams*.
MIN_ACHIEVABLE_RX_SAMPLING_RATE_MSPS_p	Double	-	-	Parameter	0 *	Min for all RX *data streams*.
MAX_ACHIEVABLE_RX_SAMPLING_RATE_MSPS_p	Double	-	-	Parameter	61.44 *	Max for all RX *data streams*.
IS_SUPPORTED_RX_SAMPLES_COMPLEX_p	Bool	-	-	Parameter	true *	True if supported by any RX *data streams*.
IS_SUPPORTED_RX_SAMPLES_REAL_p	Bool	-	-	Parameter	false *	True if supported by any RX *data streams*.
IS_SUPPORTED_RX_GAIN_MODE_AUTO_p	Bool	-	-	Parameter	true *	True if supported by any RX *data streams*.
IS_SUPPORTED_RX_GAIN_MODE_MANUAL_p	Bool	-	-	Parameter	true *	True if supported by any RX *data streams*.
MIN_ACHIEVABLE_TX_TUNING_FREQ_MHZ_p	Double	-	-	Parameter	FMCOMMS_NUM_p ==2 ? 2400 : 70-30.7190625 *	Min for all RX *data streams*.
MAX_ACHIEVABLE_TX_TUNING_FREQ_MHZ_p	Double	-	-	Parameter	FMCOMMS_NUM_p ==2 ? 2500 : 6000+30.72	Max for all RX *data streams*.
MIN_ACHIEVABLE_TX_BANDWIDTH_3DB_MHZ_p	Double	-	-	Parameter	0 *	Min for all TX *data streams*.
MAX_ACHIEVABLE_TX_BANDWIDTH_3DB_MHZ_p	Double	-	-	Parameter	40 *	Max for all TX *data streams*.
MIN_ACHIEVABLE_TX_SAMPLING_RATE_MSPS_p	Double	-	-	Parameter	0 *	Min for all TX *data streams*.
MAX_ACHIEVABLE_TX_SAMPLING_RATE_MSPS_p	Double	-	-	Parameter	61.44 *	Max for all TX *data streams*.

IS_SUPPORTED_TX_SAMPLES_COMPLEX_p	Bool	-	-	Parameter	true *	True if supported by any TX *data streams*.
IS_SUPPORTED_TX_SAMPLES_REAL_p	Bool	-	-	Parameter	false *	True if supported by any TX *data streams*.
request_config_lock	Struct (see Table 2	-	-	Writable, WriteSync *	-	Configures radio hardware for requested settings and prevents settings from changing.
config_locks	Struct (see Table 4	-	-	Volatile, ReadSync *	-	Enumeration of currently locked configs.
unlock_config_lock	Struct (see Table 6	-	-	Writable, WriteSync *	-	Unlocks a *config lock* by its ID.
unlock_all	Bool	-	-	Writable, WriteSync *	-	Unlocks all existing *config. locks*.
data_stream_is_enabled	Struct (see Table 7	NUM_DATA_STREAM_IDS_p	-	Volatile, ReadSync *	-	Used to read enabled status for all *data streams*.
direction_readback	Struct (see Table 8	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync *	-	Used to read current config value (locked or not) for each enabled *data stream*.
tuning_freq_MHz	Struct (see Table 9	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync *	-	Used to read current config value (locked or not) for each enabled *data stream*.
bandwidth_3dB_MHz	Struct (see Table 10	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync *	-	Used to read current config value (locked or not) for each enabled *data stream*.
sampling_rate_Msps	Struct (see Table 11	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync *	-	Used to read current config value (locked or not) for each enabled *data stream*.
samples_are_complex	Struct (see Table 12	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync *	-	Used to read current config value (locked or not) for each enabled *data stream*.
valid_values_tuning_freq_MHz	Struct (see Table 13	-	NUM_DATA_STREAM_IDS_RX_p + NUM_DATA_STREAM_IDS_TX_p	Volatile, ReadSync *	-	Indicates the current valid ranges of values for all *data stream/data stream type* combinations.
valid_values_bandwidth_3dB_MHz	Struct (see Table 14	-	NUM_DATA_STREAM_IDS_RX_p + NUM_DATA_STREAM_IDS_TX_p	Volatile, ReadSync *	-	Indicates the current valid ranges of values for all *data stream/data stream type* combinations.
valid_values_sampling_rate_Msps	Struct (see Table 15	-	NUM_DATA_STREAM_IDS_RX_p + NUM_DATA_STREAM_IDS_TX_p	Volatile, ReadSync *	-	Indicates the current valid ranges of values for all *data stream/data stream type* combinations.
valid_values_samples_are_complex	Struct (see Table 16	-	NUM_DATA_STREAM_IDS_RX_p + NUM_DATA_STREAM_IDS_TX_p	Volatile, ReadSync *	-	Indicates the current valid ranges of values for all *data stream/data stream type* combinations.
FMCOMMS_NUM_p*	UShort	-	-	Parameter	-	Valid values are 2 or 3.
gain_mode_readback*	Struct (see)	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync	-	Reads gain mode for each *data stream*.
gain_dB *	Struct (see)	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	Volatile, ReadSync	-	Reads gain for each *data stream*.
valid_values_gain_mode*	Struct (see)	-	NUM_DATA_STREAM_IDS_RX_p + NUM_DATA_STREAM_IDS_TX_p	Volatile, ReadSync	-	Indicates the current valid ranges of values for all *data streams/data stream type* combinations.
valid_values_gain_dB *	Struct (see)	-	NUM_DATA_STREAM_IDS_RX_p	Volatile,	-	Indicates the current valid

			+ NUM_DATA_STREAM_IDS_TX_p	ReadSync		ranges of values for all *data streams/data stream type* combinations.
app_inst_name_TX0_qdac*	String	-	-	Initial, WriteSync	-	Application name of TX0 *routing ID's* qdac worker.
app_inst_name_TX0_complex_mixer*	String	-	-	Initial, WriteSync	-	Application name of TX0 *routing ID's* complex_mixer worker.
app_inst_name_TX0_cic_int*	String	-	-	Initial, WriteSync	-	Application name of TX0 *routing ID's* cic_int worker.
app_inst_name_TX1_qdac*	String	-	-	Initial, WriteSync	-	Application name of TX1 *routing ID's* qdac worker.
app_inst_name_TX1_complex_mixer*	String	-	-	Initial, WriteSync	-	Application name of TX1 *routing ID's* complex_mixer worker.
app_inst_name_TX1_cic_int*	String	-	-	Initial, WriteSync	-	Application name of TX1 *routing ID's* cic_int worker.
app_inst_name_RX0_qadc*	String	-	-	Initial, WriteSync	-	Application name of RX0 *routing ID's* qadc worker.
app_inst_name_RX0_complex_mixer*	String	-	-	Initial, WriteSync	-	Application name of RX0 *routing ID's* complex_mixer worker.
app_inst_name_RX0_cic_dec*	String	-	-	Initial, WriteSync	-	Application name of RX0 *routing ID's* cic_dec worker.
app_inst_name_RX1_qadc*	String	-	-	Initial, WriteSync	-	Application name of RX1 *routing ID's* qadc worker.
app_inst_name_RX1_complex_mixer*	String	-	-	Initial, WriteSync	-	Application name of RX1 *routing ID's* complex_mixer worker.
app_inst_name_RX1_cic_dec*	String	-	-	Initial, WriteSync	-	Application name of RX1 *routing ID's* cic_dec worker.
bist_loopback*	Enum	-	-	Volatile, ReadSync, Writable, WriteSync	disabled, loopback_AD9361-_internal, ad936-1_init_has_not_occurred	AD9361 BIST loopback mode.

Table 2: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `request_config_lock` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	config_lock_ID	String	-	-	-	Standard	-	ID used for future reference.
Member	data_streams	Struct (see Table 3)	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	-	Standard	-	

Table 3: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `request_config_lock` property's `data_streams` member.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	direction	Enum	-	-	-	RX,TX	-	-
Member	data_stream_ID	String	-	-	-	Standard	-	Set to empty or to one of the values in DATA_STREAM_IDS_RX_p or DATA_STREAM_IDS_TX_p.
Member	routing_ID	String	-	-	-	Standard	-	Usually "RXO", "TX0", "TX1", etc...

*indicates a non-spec property, i.e. one declared in the OWD, or a value specified in the OWD or build XML which overrides the spec value

Member	tuning_freq_MHz	Double	-	-	-	Standard	-	-
Member	bandwidth_3dB_MHz	Double	-	-	-	Standard	-	-
Member	sampling_rate_Msps	Double	-	-	-	Standard	-	-
Member	samples_are_complex	Bool	-	-	-	Standard	-	-
Member	gain_mode	String	-	-	-	Standard	-	Set to "null", "auto", "manual", or possibly something worker-specific.
Member	gain_dB	Double	-	-	-	Standard	-	-
Member	tolerance_tuning_freq_MHz	Double	-	-	-	Standard	-	Tolerance which will determine lock success.
Member	tolerance_bandwidth_3dB_MHz	Double	-	-	-	Standard	-	Tolerance which will determine lock success.
Member	tolerance_sampling_rate_Msps	Double	-	-	-	Standard	-	Tolerance which will determine lock success.
Member	tolerance_gain_dB	Double	-	-	-	Standard	-	Tolerance which will determine lock success.

Table 4: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 config_locks property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	config_lock_ID	String	-	-	-	Standard	-	ID of successfully requested *config lock*.
Member	data_streams	Struct (see Table 5)	MAX_NUM_DATA_STREAMS_RX_p + MAX_NUM_DATA_STREAMS_TX_p	-	-	Standard	-	

Table 5: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 config_locks property's data_streams member.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	direction_lock	Enum	-	-	-	RX,TX	-	Locked type for *data stream* specified in data_stream_ID.
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	routing_ID	String	-	-	-	Standard	-	Locked routing ID for *data stream* specified in data_stream_ID.
Member	tuning_freq_MHz	Double	-	-	-	Standard	-	Locked tuning frequency for *data stream* specified in data_stream_ID.
Member	bandwidth_3dB_MHz	Double	-	-	-	Standard	-	Locked 3dB bandwidth for *data stream* specified in data_stream_ID.-
Member	sampling_rate_Msps	Double	-	-	-	Standard	-	Locked sampling rate for *data stream* specified in data_stream_ID.
Member	samples_are_complex	Bool	-	-	-	Standard	-	Locked value for *data stream* specified in data_stream_ID.
Member	gain_mode_lock	String	-	-	-	Standard	-	Locked gain mode for *data stream* specified in data_stream_ID.-
Member	gain_dB	Double	-	-	-	Standard	-	Ignore this value if gain_mode_lock is an AGC-related value, e.g. auto.

Table 6: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 unlock_config_lock property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	config_lock_ID	String	-	-	-	Standard	-	-

Table 7: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 data_stream_is_enabled property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	data_stream_is_enabled	Bool	-	-	-	Standard	-	-

Table 8: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `direction_readback` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`direction_val`	Bool	-	-	-	Standard	-	-

Table 9: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `tuning_freq_MHz` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`tuning_freq_MHz`	Double	-	-	-	Standard	-	-

Table 10: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `bandwidth_3dB_MHz` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`bandwidth_3dB_MHz`	Double	-	-	-	Standard	-	-

Table 11: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `sampling_rate_Msps` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`sampling_rate_Msps`	Double	-	-	-	Standard	-	-

Table 12: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `samples_are_complex` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`samples_are_complex`	Bool	-	-	-	Standard	-	-

Table 13: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `valid_values_tuning_freq_MHz` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`direction_tuning`	Enum	-	-	-	RX,TX	-	-
Member	`valid_values`	Struct (see Table 17)	32	-	-	Standard	-	-

Table 14: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `valid_values_bandwidth_3dB_MHz` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	`data_stream_ID`	String	-	-	-	Standard	-	-
Member	`direction_bandwidth`	Enum	-	-	-	RX,TX	-	-
Member	`valid_values`	Struct (see Table 17)	32	-	-	Standard	-	-

Table 15: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 `valid_values_sampling_rate_Msps` property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	direction_sampling	Enum	-	-	-	RX,TX	-	-
Member	valid_values	Struct (see Table 17)	32	-	-	Standard	-	-

Table 16: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 valid_values_samples_are_complex property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	direction_samples_are	Enum	-	-	-	RX,TX	-	-
Member	valid_values	Bool	2	-	-	Standard	-	-

Table 17: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 valid_values_tuning_freq_MHz, valid_values_bandwidth_3dB, and valid_values_sampling_rate_Msps property's valid_values members.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	min	Double	-	-	-	Standard	-	-
Member	max	Double	-	-	-	Standard	-	-

Table 18: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 gain_mode_readback property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	gain_mode_readback_val	String	-	-	-	Standard	-	-

Table 19: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 gain_dB property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	gain_dB	Double	-	-	-	Standard	-	-

Table 20: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 valid_values_gain_mode property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	direction_gain_mode	Enum	-	-	-	RX,TX	-	-
Member	valid_values	String	32	-	-	Standard	-	-

Table 21: Structure declaration for dig_radio_ctrlr_fmcomms_2_3 valid_values_gain_dB property.

Type	Name	Type	Sequence Length	Array Dimensions	Accessibility/ Advanced	Valid Range	Default	Description
Member	data_stream_ID	String	-	-	-	Standard	-	-
Member	direction_gain	Enum	-	-	-	RX,TX	-	-
Member	valid_values	Struct (see Table 17)	32	-	-	Standard	-	-

4 Troubleshooting / Known Issues

Set the log level to 8 to see more info about the dig_radio_ctrlr worker's actions. The dig_radio_ctrlr_fmcomms_2_3.rcc logging includes the following:

- Enumerates the actual on-hardware values, with high precision, that were applied to the RF transceiver.
- Upon a request for a configuration value that it outside the current possible range, range of currently valid values for said configuration is given. Note that the range of valid values for any given configuration may depend on the requested values for other configurations, even for seemingly unrelated data streams, e.g. RX dependent upon TX.

Log level 10 provides even more information about currently valid values for the transceiver, including enumerating the valid values for all configurations for all data streams at any moment that one of the configurations changes. Other useful logging is as follows:

- It can be useful to set to log level 10 and grep for "ctrlr:".
- If a config lock fails because a configuration is outside of a range whose value does not make sense, set to log level 10 and grep for "configurator:". This will print the valid ranges every time a range changes.
- To determine the No-OS calls being performed, set to log level 10 and grep for "No-OS".

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