ANALOG DEVICES

AD917x API Specification Rev 1.1

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INTRODUCTION

PURPOSE

This document serves as a programmer's reference for using and utilizing various aspects of the ADI High Speed Converters DAC Application Program Interface (API) library for the AD917x family of DACs. It describes the general structure of the AD917x API library, provides a detail list of the API functions and its associated data structures, macros, and definitions.

SCOPE

Currently the AD917x API libraries targets the AD917x 16-bit 12 GSPS, RF Digital to Analog Converter with Channelizers

Table 1 AD917x

Target Device Name	Device Description	Device Release Status	API Release Status
AD9172	16-bit 12.6 GSPS, RF Digital to Analog Converter with Channelizers	Released	Rev 1.1.1
AD9171	16-bit 6GSPS, RF Digital to Analog Converter.	Released	Rev 1.1.1
AD9173	16-bit 12.6 GSPS, RF Digital to Analog Converter with Channelizers	Released	Rev 1.1.1

DISCLAIMER

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SOFTWARE ARCHITECTURE

The AD917x API library is a collection of APIs that provide a consistent interface to a variety of ADI High Speed Converter DAC devices. The APIs are designed so that there is a consistent interface to the devices.

The library is a software layer that sits between the application and the DAC hardware. The library is intended to serve two purposes:

1- Provide the application with a set of APIs that can be used to configure RX hardware without the need for low-level register access. This makes the application portable across different revisions of the hardware and even across different hardware modules.

2- Provide basic services to aid the application in controlling the DAC module, such as interrupt service routine, DAC high-level control and status information.

The driver does not, in any shape or form, alter the configuration or state of DAC module on its own. It is the responsibility of the application to configure the part according to the required mode of operation, poll for status, etc… The library acts only as an abstraction layer between the application and the hardware.

As an example, the application is responsible for the following:

- Configuring the JESD Interface
- Configuring the NCOs

The application should access the DAC device only through the DAC libaries exported APIs. It is not recommended for the application to access the DAC hardware device directly using direct SPI access. If the application chooses to directly access the DAC hardware this should be done in a very limited scope, such as for debug purposes and it should be understood that this practice may affect the reliability of the API functions.

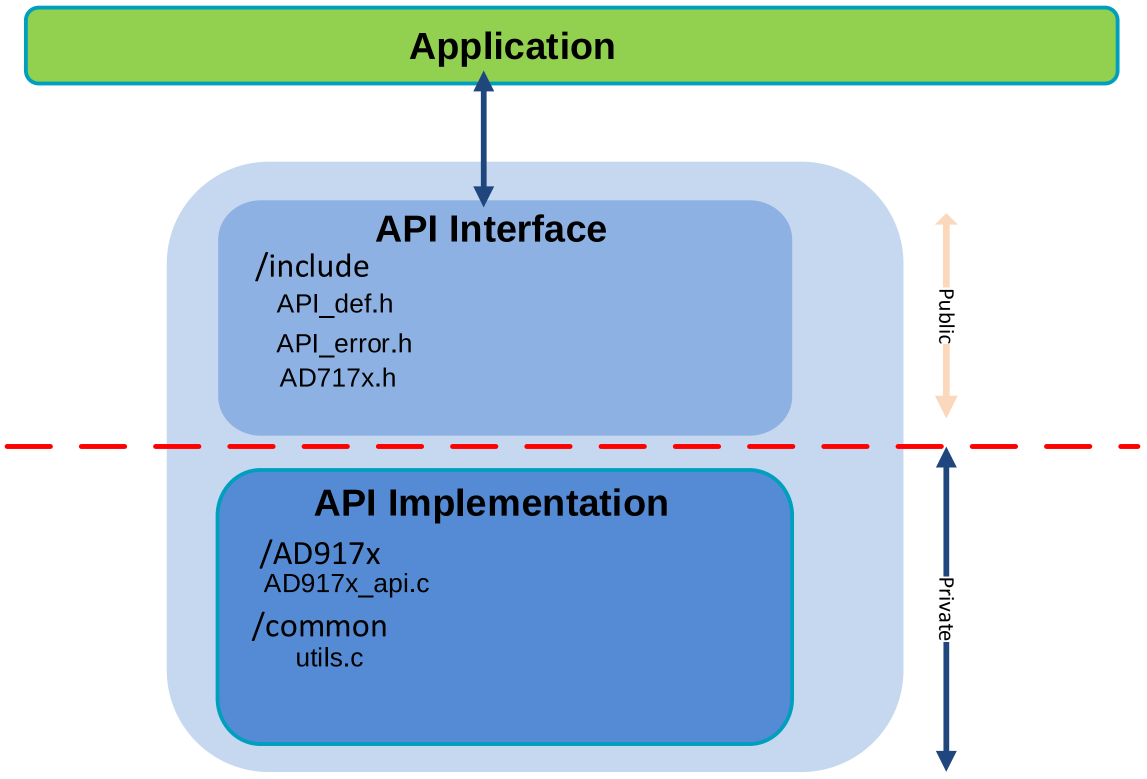


Figure 1 Simple Overview of the DAC API Architecture

FOLDER STRUCTURE

The collective files of the AD917x API library are structure as depicted in Figure 2. Each branch is explained in the following sections. The library is supplied in source format. All source files are in standard ANSI C to simply porting to any platform.

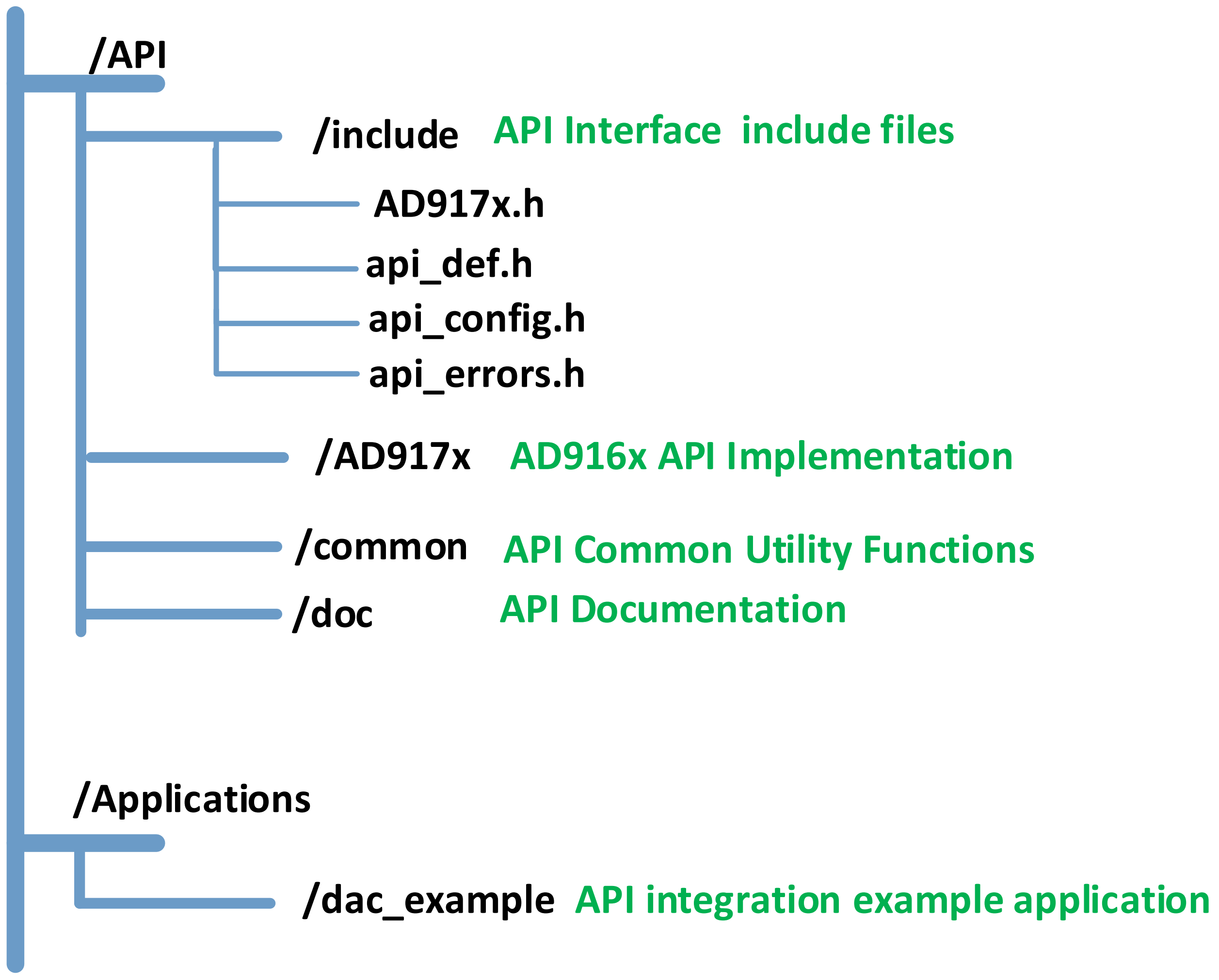

/API
/include
API Interface include files
AD917x.h
api_def.h
api_config.h
api_errors.h
/AD917x
AD916x API Implementation
/common
API Common Utility Functions
/doc
API Documentation
/Applications
/dac_example
API integration example application

Figure 2 AD917x Source Code Folder Structure

/API

The AD917x API root folder contain all the source code and documentation for the AD917x API.

/API/include

This folder contains all the API public interface files. These are the header files required by the client application.

/API/AD917x

This folder includes the main API implementation code for the AD917x DAC APIs and any private header files uses by the API. ADI maintains this code as intellectual property and all changes are at their sole discretion.

/API/common

This folder contains ADI helper functions common to all APIs, these functions are internal private functions not designed for use by client application.

/API/AD917x/doc

This folder contains the doxygen documentation for the AD917x APIs.

/Application/

This folder contains simple source code examples of how to use the DAC API. The application targets the AD917x evaluation board platform. Customers can use this example code as a guide to develop their own application based on their requirements.

API INTERFACE

OVERVIEW

The header files listed in include folder, ***/API/include***, describe public interface of the DAC API the client application. It consists of several header files listed in Table 2. Each API library will have a header file that lists its supported APIs that the client application may use to interface with the ADI device. For example, the AD917x.h header file lists all the APIs that are available to control and configure the AD917x DAC device. The other header files are used for definitions and configurations that may be used by the client application. The features of which will be described in subsequent sections.

Table 2 DAC API Interface

Device Name	Description	To be included in Client Application
AD917x.h	Lists AD917x DAC API Library exposed to client application	Yes
api_config.h	Defines the various configuration options for the DAC Module	No
api_def.h	Defines any macros/enumerations or structures or definitions common to and used by all DAC API Libraries	No
api_error.h	Defines the DAC API interface errors and error handlers common to and used by all DAC API Libraries	Yes

AD917X.H

The AD917x API library has a main interface header file AD917x.h header file that defines the software interface to the AD917x DAC. It consists of a list of API functions and a number of structures and enumerations to describe the configurations and settings that are configurable on that particular device. In addition, the DAC device handle ***ad917x_handle_t*** this is a data structure that acts a software reference to an instance to the DAC device. This handle maintains a reference to HAL functions and the configuration status of the chip. This reference shall be instantiated by the client application, initialized by the application with client specific data.

API Handle

A summary of the user configurable components of this handle structure are listed in Table 3. Refer to the ***ad917x_handle_t*** section and the ***HAL Function Pointer DataTypes*** section for full a description and more details on configuration.
The platform specific members of the structure must be configured by the client application prior to calling any API with the handle, refer to the ***DAC Hardware*** section for more details.

Table 3 Components of the DAC API handle

Structure Member	Description	User Read/Write Access	Required by API
user_data	Void Pointer to a user defined data structure. Shall be passed to all HAL functions.	Read/Write	Optional
sdo	Device SPI Interface configuration for DAC hardware	Read/Write	Yes
syncoutb	Desired Signal type for SYNCOUTB signal	Read/Write	
sysref	Desired Input coupling for sysref signal	Read/Write	
dac_freq_hz	DAC Clock Frequency in Hz. Valid range 2.9GHz to 12GHz	Read/Write	Yes
dev_xfer	Pointer to SPI data transfer function for DAC hardware	Read/Write	Yes
delay_us	Pointer to delay function for DAC hardware	Read/Write	Yes
hw_open	Pointer to platform initialization function for DAC hardware	Read/Write	Optional
hw_close	Pointer to the platform shutdown function for DAC hardware	Read/Write	Optional
event_handler	Pointer to a client event handler function for DAC device.	Read/Write	Optional

tx_en_pin_ctrl	Pointer to client application control function of DAC device TX_ENABLE pin	Read/Write	Optional
reset_pin_ctrl	Pointer to client application control function of DAC device RESETB pin	Read/Write	Optional

API_CONFIG.H

The API configuration header file, ***api_config.h,*** located in the ***/include*** folder defines the compilation build configuration options for the DAC API.

The client application in general is not required to include or modify this file.

ADI_DEF.H

The AD917x API is designed to be platform agnostic. However, it requires access to some platform functionality, such as SPI read/write and delay functions that the client application must implement and make available to the AD917x API. These functions are collectively referred to as the platform Hardware Abstraction Layer (HAL).

The HAL functions are defined by the API definition interface header file, ***adi_def.h***. The implementation of these functions is platform dependent and shall be implemented by the client application as per the client application platform specific requirements. The client application will point the AD917x API to the required platform functions on instantiation of the AD917x API handle. The following is a description of HAL components.

The AD917x API handle, ***ad917x_handle_t*** , has a function pointer member for each of the HAL functions and are listed in Table 4. The client application shall assign each pointer the address of the target platform's HAL function implementation prior to calling any DAC API.

Table 4 Short Description of HAL Functions

Function Pointer Name	**Purpose**	**Requirement**
*spi_xfer_t	Implement a SPI transaction	Required
*hw_open_t	Open and initialize ll resources and peripherals required for DAC Device	Optional
*hw_close_t	Shutdown and close any resources opened by hw_open_t	Optional
*delay_us_t	Perform a wait/thread sleep in units of microseconds	Required
*tx_en_pin_ctrl_t	Set DAC device TX_ENABLE pin high or low.	Optional
*reset_pin_ctrl_t	Set DAC device RESETB pin high or low.	Optional
*event_handler_t	Event notification handler	Optional

DAC Hardware Initialization

The client application is responsible for ensuring that all required hardware resources and peripherals required by but external to the DAC are correctly configured. The DAC API handle ***ad917x_handle_t*** defines two pointer function members to which the client application may optionally provide HAL functions to initialize these resources, ****hw_open_t*** and ****hw_close_t.*** If the client application provides valid functions via these function pointers, the DAC initialization APIs *Error! Reference source not found.* and ***ad917x_deinit*** shall call ***hw_open_t*** and ****hw_close***_t respectively to handle the initialization and shutdown of required hardware resources. If the client application chooses not use this feature, the AD917x API assumes that SPI and all the external resources for the AD917x DAC are available.

The DAC API libraries require limited access to hardware interfaces on the target platform. These are depicted in Figure 3.

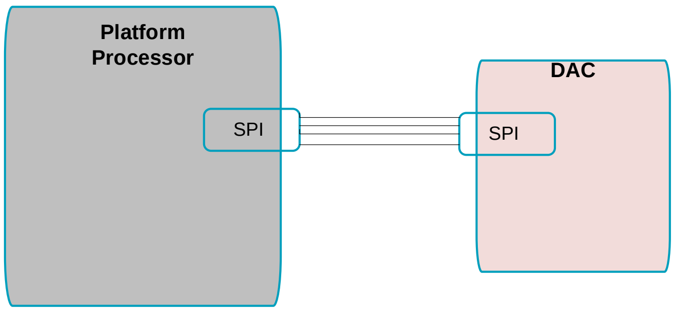


Figure 3 Hardware Controls Required By DAC API HAL

SPI Access

Access to the SPI controller that communicates with the AD917x DAC devices is required for correct operation of the API. The API requires access to a SPI function that can send SPI commands. This function ***spi_xfer_t*** is defined in detail in the next section. The DAC SPI requires 15 bit addressing with 8-bit data bytes. The AD917x DAC SPI interface supports 3 wire or 4 wire and the AD917x DAC must be configured as such to match the platform implementation. This is done during initialization via the *Error! Reference source not found.* API. Please refer to the target ADI device datasheet for full details of the SPI Interface protocol

RESETB Pin Access

Optionally access to the function that controls the AD917x DAC RESETB pin can be included in the HAL layer. This function if provided allows the API to implement a hardware reset rather than a software reset.

The HAL function ***reset_pin_ctrl_t*** is defined in detail in the next section. Please refer to the target ADI device datasheet for full details on the RESETB pin hardware connections.

System Software Functions

Delay Function

For best performance, it is recommended to provide the API access to the client application's delay function. The delay function can be a wait or sleep function depending on the client application. This function allows the API to wait the recommended microsecond between initialization steps.
The HAL function * ***delay_us_t*** is defined in detail in the next section.

HAL FUNCTION POINTER DATATYPES

*HW_OPEN_T

Description

Function pointer definition to a client application function that implements platform hardware initialization for the AD917x Device.

This function may initialize external hardware resources required by the AD917x Device and API for correct functionality as per the target platform. For example, initialization of SPI, GPIO resources, clocks etc.

If provided, this function shall be called during the DAC module initialization via API ***ad917x_init***. The API will then assume that all require external hardware resources required by the DAC are configured and it is safe to interact with the DAC device.

Synopsis

typedef void(*hw_open_t)(void *user_data);

Preconditions

Unknown- Platform Implementation.

Post conditions

It is expected that all external hardware and software resources required by the DAC API are now initialized appropriately and accessible by the DAC API.

Dependencies

Unknown- Platform Implementation

Parameters

user_data	A void pointer to a client defined structure containing any parameters/settings that may be required by the function to open the hardware for the ADI Device.

Return value

Zero shall indicate success.

Any other positive integer value may represent an error code to be returned to the application.

Notes

This function is not required to integrate the API. It is an optional feature that may be used by the client application.

*HW_CLOSE_T

Description

Function pointer to function that implements platform hardware de-initialization for the AD917x Device

This function shall close or shutdown external hardware resources required by the AD917x Device and API for correct functionality as per the target platform. For example, initialization of SPI, GPIO resources, clocks etc.

It should close and free any resources assigned in the ***hw_open_t*** function. This function if provided shall be called during the DAC module de-initialization via API ***ad917x_deinit****Error! Reference source not found.* **.** The API will then assume that all require external hardware resources required by the DAC are no longer available and it is not-safe to interact with the DAC device.

Synopsis

typedef void(*hw_close_t)(void *user_data);

Preconditions

It is expected that there are no pre-conditions to this function. All initialization required shall be performed prior to or during (via ****hw_open_t***) ***ad917x_init***.

Post conditions

It is expected that there are no post conditions to this function.

Dependencies

Unknown- Platform Implementation

Parameters

user_data	A void pointer to a client defined structure containing any parameters/settings that may be required by the function to close the hardware for the ADI Device.

Return value

Zero shall indicate success.

Any other positive integer value may represent an error code to be returned to the application.

Notes

This function is not required to integrate the API. It is an optional feature that may be used by the client application.

*SPI_XFER_T

Description

Function to implement a SPI transaction to the DAC device.

This function shall perform send a read/write SPI command to targeted ADI DAC device. The SPI implementation shall support 15-bit addressing and 8-bit data bytes. This function shall control the SPI interface including the appropriate chip select to correctly send and retrieve data to the targeted ADI DAC device over SPI.

The implementation may support 3-wire or 4-wire mode. The DAC API must be configured to support the platform implementation this is done during the DAC initialization API *Error! Reference source not found.* **.**

Once a DAC device is initialized via the *Error! Reference source not found.* API, it is expected that the API may call this function at any time.

Synopsis

typedef int(*spi_xfer_t)(void *user_data, uint8_t *indata, uint8_t *outdata, int size_bytes);

Preconditions

It is expected that there are no pre-conditions to this function. All initialization required shall be performed prior to or during (via ***hw_open_t***) *Error! Reference source not found.***.** Once a DAC device is initialized via the *Error! Reference source not found.* API, it is expected that the API may call this function at any time.

Post conditions

It is expected that there are no post conditions to this function.

Dependencies

Unknown- Platform Implementation

Parameters

user_data	A void pointer to a client defined structure containing any parameters/settings that may be required by the function to implement the SPI for the ADI Device. For example, chip select may be passed to the function via this parameter.
indata	pointer to a uint8_t array with the data to be sent on the SPI
outdata	pointer to a unit8_t array to which the data from the SPI device will be written
size_bytes	an integer value indicating the size in bytes of both indata and outdata arrays.

Return value

Zero shall indicate success.

Any other positive integer value may represent an error code to be returned to the application.

Notes

indata and outdata arrays shall be the same size.

* TX_EN_PIN_CTRL_T

Description

Function to implement set the TX_ENABLE pin of the DAC device high or low.

Once a DAC device is initialized via the ***ad917x_init*** API, it is expected that the API may call this function at any time.

Synopsis

typedef int(*tx_en_pin_ctrl_t)(void *user_data, uint8_t enable);

Preconditions

It is expected that there are no pre conditions to this function. All initialization required shall be performed prior to or during (via ****hw_open_t***) ***ad917x_init.*** Once a DAC device is initialized via the ***ad917x_init*** API, it is expected that the API may call this function at any time.

Post conditions

It is expected that there are no post conditions to this function.

Dependencies

Unknown- Platform Implementation

Parameters

user_data	A void pointer to a client defined structure containing any parameters/settings that may be required by the function to implement the SPI for the ADI Device. For example, chip select may be passed to the function via this parameter.
enable	A uint8_t value indicating the desired enable/disable setting for the tx_enable pin. A value of 1 indicates TX_ENABLE pin is set HIGH. A value of 0 indicates TX_ENABLE pin is set LOW.

Return value

Zero shall indicate success.

Any other positive integer value may represent an error code to be returned to the application.

Notes

This function is not required to integrate the API. It is an optional feature that may be used by the client application should the user which to control the pin via the API.

*RESET_PIN_CTRL_T

Description

Function to implement set the RESETB pin of the DAC device high or low.

Synopsis

typedef int(*reset_pin_ctrl_t)(void *user_data, uint8_t enable);

Preconditions

It is expected that there are no pre conditions to this function. All initialization required shall be performed prior to or during (via ***hw_open_t**) **ad917x_init.*** Once a DAC device is initialized via the ***ad917x_init*** API, it is expected that the API may call this function at any time.

Post conditions

It is expected that there are no post conditions to this function.

Dependencies

Unknown- Platform Implementation

Parameters

user_data	A void pointer to a client defined structure containing any parameters/settings that may be required by the function to implement the SPI for the ADI Device. For example, chip select may be passed to the function via this parameter.
enable	A uint8_t value indicating the desired enable/disable setting for the tx_enable pin.
	A value of 1 indicates RESETB pin is set HIGH.
	A value of 0 indicates RESETB pin is set LOW.

Return value

Zero shall indicate success.

Any other positive integer value may represent an error code to be returned to the application.

Notes

This function is not required to integrate the API. It is an optional feature that may be used by the client application should the user which to control the pin via the API. The relevant API function is ***ad917x_reset.***

* DELAY_US_T

Description

Function to implement a delay for specified number of microseconds.

Any timer hardware initialization required for the platform dependent implementation of this function must be performed prior to providing to calling any DAC APIs.

Once a DAC device is initialized via the ***ad917x_init*** API, it is expected that the API may call this function at any time.

Synopsis

typedef int(*delay_us_t)(void *user_data, int us);

Preconditions

It is expected that there are no pre conditions to this function. All initialization required shall be performed prior to or during (via ****hw_open_t***) ***ad917x_init.*** Once a DAC device is initialized via the ***ad917x_init*** API, it is expected that the API may call this function at any time.

Post conditions

It is expected that there are no post conditions to this function.

Dependencies

Unknown- Platform Implementation

Parameters

user_data A void pointer to a client defined structure containing any parameters/settings that may be required by the function to implement the delay for the ADI Device.

int us time to delay/sleep in microseconds

Return value

Zero shall indicate success.

Any other positive integer value may represent an error code to be returned to the application.

Notes

This is required for optimal performance.

Performs a blocking or sleep delay for the specified time in microseconds.

ADI API ENUMERATIONS DATATYPES

The following are a list of enumerations and datatypes that are common to and used by ADI APIs libraries including the AD917x API. They are defined in adi_def.h

ADI_CHIP_ID_T

Description

A structure detailing the AD917x Device Identification Data. Please refer to the specific DAC Data sheet for expected values.

Synopsis

```
#include api_def.h
typedef struct {
        uint8_t chip_type;
        uint16_t prod_id;
        uint8_t prod_grade;
        uint8_t dev_revision;
}adi_chip_id_t;
```

Fields

uint8_t chip_type	Chip Type
uint16_t prod_id	Product ID code
uint8_t prod_grade	Product Grade
uint8_t dev_revision	Silicon Revision.

Notes

Product ID and product grade are only available after initialization.

SIGNAL_TYPE_T

Description

A enumeration defining various signal types such as CMOS or LVDS.

Synopsis

```
#include api_def.h
typedef enum
{
        SIGNAL_CMOS = 0,
        SIGNAL_LVDS,
        SIGNAL_UNKNOWN
}signal_type_t;
```

Fields

SIGNAL_CMOS	CMOS TYPE Signal
SIGNAL_LVDS	**LVDS Type Signal**
SIGNAL_UNKNOWN	Undefined Signal Type

Notes

SIGNAL_COUPLING_T

Description

An enumeration defining AC and DC coupling modes.

Synopsis

```
#include api_def.h
typedef enum
{
        COUPLING_AC = 0,
        COUPLING_DC,
        COUPLING_DC
}signal_coupling_t;
```

Fields

COUPLING_AC	AC Coupled Signal
COUPLING_DC	DC Coupled Signal
COUPLING_DC	Undefined coupling Signal

Notes

JESD_LINK_T

Description

An enumeration of JESD Links available supported on the device.

Synopsis

```
#include api_def.h
typedef enum {
    JESD_LINK_0 = 0x0,
    JESD_LINK_1 = 0x1,
    JESD_LINK_ALL = 0xFF
}jesd_link_t;
```

Fields

JESD_LINK_0	JESD Link 0
JESD_LINK_1	JESD Link 1
JESD_LINK_ALL	ALL JESD LINKS Available

Notes

JESD_SYNCOUTB_T

Description

An enumeration of JESD SYNCOUTB Signals available on the device.

Synopsis

```
#include api_def.h
typedef enum {
        SYNCOUTB_0 = 0x0,    /**< SYNCOUTB 0 */
        SYNCOUTB_1 = 0x1,    /**< SYNCOUTB 1 */
        SYNCOUTB_0 = 0xFF  /**< ALL SYNCOUTB SIGNALS */
}jesd_syncoutb_t;
```

Fields

SYNCOUTB_0	JESD Link 0 SYNCOUTB Signal
SYNCOUTB_1	JESD Link 1 SYNCOUTB Signal
SYNCOUTB_0	ALL JESD LINKS SYNCOUTB Signals Available

Notes

JESD_SYSREF_MODE_T

Description

An enumeration of JESD SYSREF Signal modes of operation

Synopsis

```
#include api_def.h
typedef enum {
        SYSREF_NONE,
        SYSREF_ONESHOT,
        SYSREF_CONT,
        SYSREF_MON,
        SYSREF_MODE_INVLD
}jesd_sysref_mode_t;
```

Fields

SYSREF_NONE,	*No SYSREF Support*
SYSREF_ONESHOT,	*ONE-SHOT SYSREF Mode*
SYSREF_CONT,	*Continuous Sysref Synchronisation*
SYSREF_MON,	*SYSREF monitor Mode*
SYSREF_MODE_INVLD	

Notes

JESD_PARAM_T

Description

A structure defining the parameters of JESD Interface as per the JESD Specification

Synopsis

```
#include api_def.h
typedef struct {
        uint8_t jesd_L;
        uint8_t jesd_F;
        uint8_t jesd_M;
        uint8_t jesd_S;
        uint8_t jesd_HD;
        uint8_t jesd_K;
        uint8_t jesd_N;
        uint8_t jesd_NP;
        uint8_t jesd_CF;
        uint8_t jesd_CS;
        uint8_t jesd_DID;
        uint8_t jesd_BID;
        uint8_t jesd_LID0;
        uint8_t jesd_JESDV;
}jesd_param_t;
```

Members

jesd_L	JESD Lane Param L.
jesd_F	JESD Octet Param F.
jesd_M	JESD Converter Param M.
jesd_S	JESD No of Sample Param S.
jesd_HD	JESD High Density Param HD.
jesd_K	JESD multiframe Param K.
jesd_N	JESD Converter Resolution Param N.
jesd_NP	JESD Bit Packing Sample NP.
jesd_CF	JESD Param CF.
jesd_CS	JESD Param CS.
jesd_DID	JESD Device ID Param DID.
jesd_BID	JESD Bank ID. Param BID
jesd_LID0	JESD Lane ID for Lane 0 Param LIDO
jesd_JESDV	JESD Version

Notes

ERROR HANDLING

ERROR CODES

Each API return value represents a DAC API error code. The possible error codes for ADI device APIs are defined by a number of macros listed in ***api_errors.h.*** Table 5 lists the possible error codes and their meanings returned by the AD917x APIs.

If a HAL function, called by during the execution of an API, returns a non-zero value the API shall return an error code indicating that there was an error returned from a HAL function. Table 6 lists the possible errors returned by API due to a HAL function.

Table 5 API Error Code Macro definitions.

ERROR CODE	Description
API_ERROR_OK	API completed successfully
API_ERROR_SPI_SDO	API could not complete success fully due to SPI_SDO configuration in API Handle
API_ERROR_INVALID_HANDLE_PTR	API could not complete success fully due to invalid pointer to API Handle
API_ERROR_INVALID_XFER_PTR	API could not complete success fully due to invalid pointer to SPI transfer function
API_ERROR_INVALID_DELAYUS_PTR	API could not complete success fully due to invalid pointer to Delay function
API_ERROR_INVALID_PARAM	API could not complete successfully due to invalid API parameter
API_ERROR_FTW_LOAD_ACK	API could not complete successfully due to Frequency Turning Word No-ACK
API_ERROR_NCO_NOT_ENABLED	API could not complete successfully due to NCO not currently Enabled
API_ERROR_INIT_SEQ_FAIL	API could not complete successfully due to NVRAM load error.

Table 6 API HAL function Error Code Macro definitions.

ERROR CODE	Description
API_ERROR_SPI_XFER	SPI HAL function return an error during the implementation of this API
API_ERROR_US_DELAY	DELAY HAL function return an error during the implementation of this API
API_ERROR_TX_EN_PIN_CTRL	TX_ENABLE pin ctrl HAL function return an error during the implementation of this API
API_ERROR_RESET_PIN_CTRL	RESET pin ctrl HAL function return an error during the implementation of this API
API_ERROR_EVENT_HNDL	EVENT Handle HAL function return an error during the implementation of this API
API_ERROR_HW_OPEN	HW Open HAL function returned an error during the implementation of this API
API_ERROR_HW_CLOSE	HW Close HAL function returned an error during the implementation of this API

AD917X API LIBRARY

AD917X API REFERENCE HANDLE

AD917X_HANDLE_T

Description

DAC Device reference handle data structure that acts a software reference to a particular instance to of the DAC device. This reference maintains a reference to HAL functions and the configuration status of the chip.

Synopsis

#include AD917x.h

typedef struct {

void *user_data;

spi_sdo_config_t sdo;

signal_type_t syncoutb;

signal_coupling_t sysref;

uint64_t dac_freq_hz;

spi_xfer_t dev_xfer;

delay_us_t delay_us;

tx_en_pin_ctrl_t tx_en_pin_ctrl;

reset_pin_ctrl_t reset_pin_ctrl;

hw_open_t hw_open;

hw_close_t hw_close;

}ad917x_handle_t;

Members

void *user_data;

A void pointer that acts a container structure for client application data to be provided to the HAL functions. The client application must define this structure as per its platform requirements. This pointer shall be passed as the parameter to the ***hw_open_**t and ***hw_close_t** function calls to pass any client application specific data. The DAC API shall not access this data directly. The client application must initialize this member appropriately prior to calling any DAC API function.

spi_sdo_config_t sdo;

This member hold the desired SPI interface configuration, 3-wire or 4-wire, for the AD917x DAC in the client system.

spi_sdo_config_t enumerates this configuration and is defined in ***api_def.h.*** This member should be correctly configured prior to calling ***ad917x_init*** in order to ensure SPI access to the AD917x.

signal_type_t syncoutb;

This member holds the desired SYNCOUTB signal type, CMOS or LVDS for the AD917x DAC in the client system.

Signal_type_t enumerates the possible signal types and is defined in **api_def.h**.

This member should be configured prior to calling ***ad917x_init*** and ***ad917x_reset*** in order to sure correct operation for the target hardware.

signal_coupling_t sysref;

This member holds the desired ***sysref*** signal coupling mode AC or DC coupling for the AD917x DAC in the client system.

signal_coupling_t

Enumerates the possible signal types and is defined in **api_def.h**.

This member should be configured prior to calling ***ad917x_init*** and ***ad917x_reset*** in order to sure correct operation for the target hardware.

uint64_t dac_freq_hz ;

This member holds the frequency of the DAC CLK provided to the AD917x DAC in the target system.

It is important to configure this variable correctly prior to configuring the AD917x with operational modes such as NCO, JESD and data path as this value is used as reference for internal

This value should be access via the ad917x ***_set_dac_clk_***frequency API and the ***ad917x_get_dac_clk_frequency.***

spi_xfer_t dev_xfer;

A function pointer to the client application defined SPI HAL function.

Refer to ****spi_xfer_t*** section for a detailed definition of this function.

The client application must initialize this member appropriately prior to calling any DAC API function.

delay_us_t delay_us;

A function pointer to the client application defined microsecond delay HAL function.

Refer to **** delay_us_t*** section for a detailed definition of this function.

The client application must initialize this member appropriately prior to calling any DAC API function.

tx_en_pin_ctrl_t tx_en_pin_ctrl;

A function pointer to the client application's implementation of TX_ENABLE pin control function.

Refer to **** tx_en_pin_ctrl_t*** section for a detailed definition of this function.

reset_pin_ctrl_t reset_pin_ctrl;

A function pointer to the client application's implementation of RESETB pin control function, refer to ****reset_pin_ctrl_t*** section for a detailed definition of this function.

hw_open_t hw_open;

A function pointer to the client application HAL resources initialization function.

Refer to ****hw_open_t*** section for a detailed definition of this function.

hw_close_t hw_close;

A function pointer to the client application HAL resources de-initialization function.

Refer to ****hw_close_t*** section for a detailed definition of this function.

AD917X API DEFINITIONS, DATA STRUCTURES AND ENUMERATIONS

This section describes all the structures and enumerations defined by the DAC API interface.

AD917X_DDS_SELECT_T

Description

An enumeration of the Direct Digital Synthesis Blocks within the AD917x Device.

Synopsis

```
#include AD917x.h

typedef enum {
        AD917X_DDSM = 0,
        AD917X_DDSC = 1
}ad917x_dds_select_t;
```

Fields

AD917X_DDSM	Main DAC Datapath DDS
AD917X_DDSC	Channel Datapath DDS

Notes

AD917X_DAC_SELECT_T

Description

An enumeration of the DACs within the AD917x Device, used to select or target a DAC.

Synopsis

```
#include AD917x.h
typedef enum {

        AD917X_DAC_NONE = 0,
        AD917X_DAC0 = 1,
        AD917X_DAC1 = 2
}ad917x_dac_select_t;
```

Fields

AD917X_DAC_NONE	No DAC
AD917X_DAC0	DAC0
AD917X_DAC1	DAC 1

Notes

AD917X_CHANNEL_SELECT_T

Description

An enumeration of the Channelizers within the AD917x Device, used to select or target a Channelizer.

Synopsis

```
#include AD917x.h
typedef enum {
        AD917X_CH_NONE = 0,
        AD917X_CH_0 = BIT(0),
        AD917X_CH_1 = BIT(1),
        AD917X_CH_2 = BIT(2),
        AD917X_CH_3 = BIT(3),
        AD917X_CH_4 = BIT(4),
        AD917X_CH_5 = BIT(5)
}ad917x_channel_select_t;
```

Fields

AD917X_CH_NONE	No Channel
AD917X_CH_0	Channel 0
AD917X_CH_1	Channel 1
AD917X_CH_2	Channel 2
AD917X_CH_3	Channel 3
AD917X_CH_4	Channel 4
AD917X_CH_5	Channel 5

Notes

AD917X _JESD_LINK_STAT_T

Description

A structure of the JESD Interface link Status

Synopsis

#include AD917x.h

typedef struct {

uint8_t code_grp_sync_stat;

uint8_t frame_sync_stat;

uint8_t good_checksum_stat;

uint8_t init_lane_sync_stat;

}ad917x_jesd_link_stat_t;

Members

uint8_t code_grp_sync_stat;

A uint8_t bit wise representation of Code Group Sync Status for all JESD Lanes. Where bit 0 represents CGS status for Lane 0 and bit 1 represents CGS status for Lane 1 etc. A value of 1 indicates CGS status is complete, a value of 0 indicates CGS failed.

uint8_t frame_sync_stat;

A uint8_t bit wise representation of Frame Sync Status for all JESD Lanes. Where bit 0 represents Frame Sync status for Lane 0 and bit 1 represents Frame Sync status for Lane 1 etc. A value of 1 indicates Frame Synchronization status is complete, a value of 0 indicates Frame Synchronization failed.

uint8_t good_checksum_stat;

A uint8_t bit wise representation of Good Checksum Status for all JESD Lanes. Where bit 0 represents Checksum status for Lane 0 and bit 1 represents checksum status for Lane 1 etc. A value of 1 indicates valid checksum status, a value of 0 indicates checksumfailed.

uint8_t init_lane_sync_stat;

A uint8_t bit wise representation of Initial Lane Synchronization Status for all JESD Lanes. Where bit 0 represents Lane Synchronization status for Lane 0 and bit 1 represents Lane Synchronization status for Lane 1 etc. A value of 1 indicates Lane Synchronization completed, a value of 0 Lane Synchronization failed.

Notes

AD917X_JESD_SERDES_PLL_FLG_T

Description

An enumeration of the SERDES PLL Status flags.

Synopsis

```
#include AD917x.h
typedef enum
{
        AD917x_PLL_LOCK_STAT = 0x1,
        AD917x_PLL_REG_RDY= 0x2,
        AD917x_PLL_CAL_STAT=0x4,
        AD917x_PLL_LOSSLOCK=0x8
}ad917x_jesd_serdes_pll_flg_t;
```

Members

AD917X_*PLL_LOCK_STAT*	SERDES PLL lock Status Flag. When set the PLL is locked.
AD917X_PLL_REG_RDY	SERDES PLL Regulator RDY Status Flag.
AD917X_PLL_CAL_STAT	SERDES PLL VCO Calibration Status Flag.
AD917X_PLL_LOSSLOCK	SERDES PLL Upper Calibration Threshold flag.

Notes

AD917X APIS

AD917X_INIT

Description

API to initialize the DAC Module

This API must be called first before any other API calls. It performs internal API initialization of the memory and API states.

If DAC API handle member hw_open is not NULL the function to which it points shall be called to initialize DAC external resources. For example GPIO, SPI etc.

This function shall complete any universal initialization configuration of the DAC such as SPI.

Synopsis

#include AD917x.h

ADI_API int ad917x_init(ad917x_handle_t *h);

Parameters

ad917x_handle_t *h

Pointer to the client application DAC API handle for the target DAC device

Refer to ***API Handle*** section for more details.

Preconditions

If ***hw_open*** function pointer is set to NULL. DAC external hardware resources must be initialized.

Post conditions

On successful completion, DAC Module shall be in initialized state, ready for configuration.

Note although the API is now initialized, it is recommended to call the **ad917x_reset** API immediately after a call to Ad9172_init API to ensure all SPI register setting are restore to default and ADI recommendations.

Dependencies

h->dev_xfer.	DAC API handle must be initialized to valid SPI transfer function for the client application.
	Refer to ***spi_xfer_t** for full details.
h->hw_open	DAC API handle optionally may be set to valid hardware initialization function for client application. Refer to***hw_open_t.** for full details.

Return value

Any other positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

API_ERROR_HW_OPEN_FAILED

API_ERROR_INIT_SEQ_FAIL

API_ERROR_SPI_SDO

Notes

AD917X_DEINIT

Description

Shutdown the DAC Module

This API must be called last. No other API should be called after a call to this API.

It performs internal API initialization of the memory and API states and ensure targeted DAC is in good state for power down. If DAC API handle member ***hw_close_t*** is not NULL the function to which it points shall be called to de-initialize DAC external resources. This function may be used to de-initialize and release and hardware resources required by the API and AD917x Device, for example GPIO SPI etc.

Synopsis

#include AD917x.h

ADI_API int ad917x_deinit(ad917x_handle_t *h);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

On successful completion, DAC Module shall be in shutdown state.

DAC module shall need to be re-initialized via ***ad917x_init*** by client application before any further use.

Dependencies

h->dev_xfer.	DAC API handle must be initialized to valid SPI transfer function for the client application. Refer to ***spi_xfer_t.***
h->hw_close	DAC API handle optionally may be set to valid hardware initialization function for client application. Refer to****hw_close_t***.

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_HANDLE_PTR

Notes

AD917X_RESET

Description

Performs a full reset of AD917x DAC, resetting all SPI registers to their default values, restoring the desired SPI configuration and ADI recommended initialization sequence.

This API can trigger a software reset via a SPI control or trigger a hardware reset by toggling the RESETB hardware pin. In order to trigger a hardware reset the API must be provided with a client defined HAL function, ***reset_pin_ctrl_t,*** that provides the API with control over the RESETB pin on the client application.

The type of reset triggered by the API is determined by the hw_reset parameter.

Synopsis

#include AD917x.h

ADI_API int ad917x_reset(ad917x_handle_t *h, uint8_t hw_reset);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t hw_reset	a uint8_t value to indicate the type of reset to be triggered.
	A value of 1 indicates a hardware reset is to be triggered.
	A value of 0 indicates a soft reset is to be triggered.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init***API. Prior to using this function.

Post conditions

The DAC shall be fully reset followed with reconfiguration of SPI interface and ADI recommended initialization sequence.

Dependencies

h->dev_xfer.

DAC API handle must be initialized to valid SPI transfer function for the client application. Refer to ***spi_xfer_t.***

h->reset_pin_ctrl_t.

If hw reset is desired as indictated by the API parameter hw_reset the DAC API handle must be initialized to valid function that controls the RESETB for the client application. Refer to ***reset_pin_ctrl_t.***

Return value

Any positive integer value may represent an error code to be returned to the application

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_SPI_SDO

API_ERROR_INVALID_XFER_PTR

Notes

AD917X_GET_CHIP_ID

Description

API to retrieve ADI chip identification, product type and revision data.

Synopsis

#include AD917x.h

ADI_API int ad917x_get_chip_id(ad917x_handle_t *h, adi_chip_id_t *chip_id);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
adi_chip_id_t *chip_id	Pointer to a variable of type ***adi_chip_id_t*** to which the Device Identification data shall be stored.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X _SET_DAC_CLK_FREQUENCY

Description

Set the API software reference for the value of the hardware DAC clock supplied to the DAC device.

The correct value must be supplied for correct operation of the DAC features.

Synopsis

#include AD917x.h

ADI_API int ad917x_set_dac_clk_frequency(ad917x_handle_t *h, uint64_t dac_clk_freq_hz);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint64_t dac_clk_freq_hz	DAC clock frequency in Hz. DAC Clock Frequency range is 2.9 GHz to 12GHz for AD9172 and AD9173. DAC CLK Frequency range is 2.9 GHz to 6GHz for AD9171.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application. Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_GET_DAC_CLK_FREQUENCY

Description

Set the API software reference for the value of the hardware DAC clock supplied to the DAC device.

The correct value must be supplied for correct operation of the DAC features.

Synopsis

#include AD917x.h

ADI_API int ad917x_get_dac_clk_frequency(ad917x_handle_t *h, uint64_t *dac_clk_freq_hz);

Parameters

ad917x_handle_t *h

Pointer to the client application DAC API handle for the target DAC device.

Refer to ***API Handle*** section for more details.

uint64_t *dac_clk_freq_hz

Pointer to a uint64_t variable where the current DAC clock frequency value setting shall be stored. The frequency value shall be provided in Hz. DAC clock frequency in Hz.

DAC Clock Frequency range is 2.9 GHz to 12GHz for AD9172 and AD9173.

DAC CLK Frequency range is 2.9 GHz to 6GHz for AD9171.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_SET_DAC_PLL_CONFIG

Description

The AD917x may be configured to use a clock directly applied to the device as the DAC clock or may generate a DAC clock using the on chip PLL.

This API allows enabling of on-chip PLL direct configuration of the on-chip PLL parameters.

This API should be used in conjunction with ad917x_set_dac_clk_frequency

Synopsis

#include AD917x.h

ADI_API int ad917x_set_dac_pll_config(ad917x_handle_t *h, uint8_t dac_pll_en,

uint8_t m_div, uint8_t n_div, uint8_t vco_div);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t dac_pll_en	Enable for internal DAC Clock generation. If set, ref_clk_freq_khz must be set with value of reference clock applied by the system. 0 - Do not generate DAC CLK internally. 1 - Generate DAC CLK internally
uint8_t m_div	Reference Clock Pre-divider. Where M_DIVIDER = Ceiling (Fref_clk_mhz/500 MHz) Valid Range 1 to 4
uint8_t n_div	VCO Feedback Divider Ratio. Where N_DIVIDER = Fvco * M_DIVIDER/(8 * Fref_clk) Valid Range 2 -50
uint8_t vco_div	Required VCO Divider for the Desired DAC CLK, where Fdac = Fvco/VCO_DIVIDER Valid range 1-3

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

This API will configure the on chip PLL parameters for a particular dac clk frequency. The user must call the ad917x_set_dac_clk_frequency API to update API with the desired dac frequency.

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.**

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

The on-chip PLL may not be able to generate all supported DAC Clocks. A directly applied DAC clock may be required.

The AD917x datasheet should be consulted for full details of the capabilities. API_ERROR_INVALID_PARAM shall be returned if one of the parameters are outside the range of the PLL.

AD917X_GET_DAC_CLK_STATUS

Description

Get DAC CLK Status.

Synopsis

#include AD917x.h

ADI_API int ad917x_get_dac_clk_status(ad917x_handle_t *h, uint8_t *pll_lock_stat, uint8_t *dll_lock_stat);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t *pll_lock_stat	DAC PLL Lock Status 0 - DAC PLL Not Locked. 1- DAC PLL Locked.
uint8_t *dll_lock_stat	DAC PLL Lock Status 0 - DAC PLL Not Locked. 1- DAC PLL Locked.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_SET_DAC_CLK

Description

Configure the DAC Clock Input path based on a desired DAC clock frequency, the applied reference clock and the on-chip PLL.

The AD917x may be configured to use a clock directly applied to the device as the DAC clock or may generate a DAC Clock using the clock applied by the system as a reference.

This function shall calculate and apply the required on-chip PLL configuration based on the desired DAC clock frequency and the applied reference clock frequency.

This function may be used instead of the following two APIs ***ad917x_set_dac_pll_config and ad917x_set_dac_clk_frequency.***

Synopsis

#include AD917x.h

ADI_API int ad917x_set_dac_clk(ad917x_handle_t *h, uint64_t dac_clk_freq_hz,

uint8_t dac_pll_en, uint64_t ref_clk_freq_hz);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint64_t dac_clk_freq_hz	Desired DAC Clk Frequency in Hz. DAC Clock Frequency range is 2.9 GHz to 12GHz for AD9172 and AD9173. DAC CLK Frequency range is 2.9 GHz to 6GHz for AD9171.
uint8_t dac_pll_en	Enable for internal DAC PLL
uint64_t ref_clk_freq_hz	Value of reference clock frequency applied to AD917x. Set to 0 if DAC CLK is applied to the pin.

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_init API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

The on-chip PLL may not be able to generate all supported DAC Clocks. A directly applied DAC clock may be required.

The AD917x datasheet should be consulted for full details of the capabilities. API_ERROR_INVALID_PARAM shall be returned if one of the parameters are outside the range of the PLL.

AD917X_SET_CLKOUT_CONFIG

Description

The AD917x DAC provides an output clock signal generated from the DAC clk via the CLKOUT pin. This API set s CLKOUT signal configuration.

Synopsis

#include AD917x.h

ADI_API int ad917x_set_clkout_config(ad917x_handle_t *h, uint8_t l_div);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device.
	Refer to ***API Handle*** section for more details.
uint8_t l_div	Output clock divider setting. Valid range 1 to 4.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_SET_PAGE_IDX

Description

Select Page

Synopsis

#include AD917x.h

ADI_API int ad917x_set_page_idx(ad917x_handle_t *h, const unsigned int dac, const unsigned int channel);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
unsigned int dac	DAC number.
unsigned int channel	Channel number.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_GET_PAGE_IDX

Description

Get Page index

Synopsis

#include AD917x.h

ADI_API int ad917x_get_page_idx(ad917x_handle_t *h, int *dac, int *channel);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
int *dac	Pointer to the DAC number.
int *channel	Pointer to the Channel number.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.**

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_SET_CHANNEL_GAIN

Description

Sets the scalar channel gain value. It is paged by CHANNEL_PAGE in Reg08

Synopsis

#include AD917x.h

ADI_API int ad917x_set_channel_gain(ad917x_handle_t *h, const uint16_t gain);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint16_t gain	Gain value.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.**

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_GET_CHANNEL_GAIN

Description

Sets the scalar channel gain value. It is paged by CHANNEL_PAGE in Reg08

Synopsis

#include AD917x.h

ADI_API int ad917x_get_channel_gain (ad917x_handle_t *h, const uint16_t *gain);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint16_t *gain	Pointer to the gain value.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_SET_DC_CAL_TONE_AMP

Description

Sets the DC tone amplitude. This amplitude goes to both I and Q paths. It is paged by CHANNEL_PAGE in Reg08

Synopsis

#include AD917x.h

ADI_API int ad917x_set_dc_cal_tone_amp(ad917x_handle_t *h, const uint16_t amp);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint16_t amp	Calibration tone amplitude.

Preconditions

The DAC device shall be success fully initialized via a call to **ad917x_init** prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_DDSM_CAL_DC_INPUT_SET

Description

Set Main DAC Cal DC Input

Synopsis

#include AD917x.h

ADI_API int ad917x_ddsm_cal_dc_input_set(ad917x_handle_t *h, int ddsm_cal_dc_input_en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device.
	Refer to ***API Handle*** section for more details.
int ddsm_cal_dc_input_en	Enable flag:
	0 - Disabled
	1 - Enabled

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_DDSM_CAL_DC_INPUT_GET

Description

Get Main DAC Cal DC Input

Synopsis

#include AD917x.h

ADI_API int ad917x_ddsm_cal_dc_input_get(ad917x_handle_t *h, int *ddsm_cal_dc_input_en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
int *ddsm_cal_dc_input_en	Pointer to integer, where the result will be stored 0 - Disabled 1 - Enabled

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_init API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_DC_TEST_TONE_SET

Description

Set DC Test Tone enable status

Synopsis

#include AD917x.h

ADI_API int ad917x_dc_test_tone_set(ad917x_handle_t *h, int dc_test_tone_en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
int dc_test_tone_en	Enable flag 0 - Disabled 1 - Enabled

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API.

Prior to using this function.

Post conditions

None

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_DC_TEST_TONE_GET

Description

Set DC Test Tone enable status

Synopsis

#include AD917x.h

ADI_API int ad917x_dc_test_tone_get(ad917x_handle_t *h, int *dc_test_tone_en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device.
	Refer to ***API Handle*** section for more details.
int *dc_test_tone_en	Pointer to integer, where the result will be storred
	0 - Disabled
	1 - Enabled

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_init API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.**

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_NCO_CHANNEL_FREQ_GET

Description

Get a Channel NCO frequency in Hz

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_channel_freq_get(ad917x_handle_t *h, ad917x_channel_select_t channel,
int64_t *carrier_freq_hz);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_channel_select_t channel	Channel number ***AD917x_CH_0*** - Channel 0 NCO ***AD917x_CH_1*** - Channel 1 NCO ***AD917x_CH_2*** - Channel 2 NCO ***AD917x_CH_3*** - Channel 3 NCO ***AD917x_CH_4*** - Channel 4 NCO ***AD917x_CH_5*** - Channel 5 NCO
int64_t *carrier_freq_hz	Pointer to 64 bit integer, where the result frequency will be stored

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.**

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_NCO_MAIN_FREQ_GET

Description

Get a Main DAC NCO frequency in Hz

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_main_freq_get(ad917x_handle_t *h, ad917x_dac_select_t dac,
int64_t *carrier_freq_hz);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dac_select_t dac	Main data path DAC NCO select. Can be only one of: ***AD917x_DAC0*** - DAC0 NCO select ***AD917x_DAC1*** - DAC1 NCO select
int64_t *carrier_freq_hz	Pointer to 64 bit integer, where the result frequency will be stored

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_init API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application. Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_CONFIG_DATAPATH

Description

Configure the JESD DAC mode as per the desired JESD interface parameters and datapath, the DAC clk frequency and the interpolation rate.

The JESD lane rate for the configuration is calculated and returned via the lane_rate_MBPS parameter.

The API shall check the parameter values and return an error if the desired JESD interface is not supported for the desired DAC mode. Refer to the DAC datasheet for full details on the JESD configurations and DAC modes supported.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_config_datapath(ad917x_handle_t *h, uint8_t dual_en,

uint8_t jesd_mode, uint8_t ch_intpl, uint8_t main_intpl);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t dual_en	Dual Link enable setting 0 - Single Link Mode 1 - Dual Link Mode
uint8_t jesd_mode	The desired value of the pre-definded JESD link modes supported by the AD917x. Valid range 0 to 21. Based on this value the AD917x JESD interface shall be configured as per one of the supported JESD parameter configurations. Refer to the user guide for full details on the modes and the corresponding JESD settings.
uint8_t ch_intpl	The desired channel interpolation.
uint8_t main_intpl	The desired main dac data path interpolation.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init***. API prior to using this function.

Post conditions

The DAC device will set a bit to indicate if this configuration is valid/supported mode. Use ***ad917x_jesd_get_cfg_status*** API to verify the configuration validity.

Dependencies

h->dev_xfer.	DAC API handle must be initialized to valid SPI transfer function for the client application. Refer to ****spi_xfer_t.***
h->dac_freq_hz	DAC Clock value must be initialized to the correct value as per the hardware setting for correct operation of this API. Refer to ***ad917x_handle_t*** for more details on dac_freq_hz

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

AD917X_JESD_GET_CFG_PARAM

Description

API to return the all the current JESD Parameters.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_get_cfg_param(ad917x_handle_t *h, jesd_param_t *jesd_param);

Parameters

ad917x_handle_t *h Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.

jesd_param_t *jesd_param Pointer to a structure of type ***jesd_param_t*** to which the all the JESD parameters currently configured will be stored.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_SET_SYSREF_ENABLE

Description

Enable AD917x SYSREF +- Pin Input Interface for the target system SYSREF signal

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_set_sysref_enable(ad917x_handle_t *h, uint8_t en)

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t en	Enable SYSREF Input Interface 1 - Power Up SYSREF Input 0 - Power Down SYSREF Input

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_GET_SYSREF_ENABLE

Description

Configure AD917x SYSREF +- Pin Input Interface for the target system SYSREF signal

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_get_sysref_enable(ad917x_handle_t *h, uint8_t *en)

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t *en	Pointer to variable to which SYSREF Input Interface Enable status shall be stored 1 - Power Up SYSREF Input 0 - Power Down SYSREF Input

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_init API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_SET_SYNCOUTB_ENABLE

Description

Configure and enable/disable the SYNCOUT_B Output Signal.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_set_syncoutb_enable(ad917x_handle_t *h, jesd_syncoutb_t syncoutb, uint8_t en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
jesd_syncoutb_t syncoutb	Target SYNCOUTB Signal. Valid values defined by ad917x_syncoutb_t SYNCOUTB_0 SYNCOUTB_1 SYCNOUTB_ALL
uint8_t en	Enable/Disable SYNCOUTB for target SYNCOUTB signal. Range 0 to 1 0 - Disable 1 - Enable

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_GET_CFG_STATUS

Description

Returns JESD Configuration Valid Mode Status.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_get_cfg_status(ad917x_handle_t *h, uint8_t *cfg_valid);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t *cfg_valid	Pointer to a variable in which the Valid JESD Configuration status shall be stored 0 - Invalid JESD and Interpolation Mode Configured 1 - Valid JESD and Interpolation Mode Configured.

Preconditions

The DAC device shall be success fully initialized via a call to **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_SET_SCRAMBLER_ENABLE

Description

Enable or Disable the descrambler for the JESD Interface.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_set_scrambler_enable(ad917x_handle_t *h, uint8_t en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t en	Enable control for JESD Scrambler.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_SET_LANE_XBAR

Description

Configure AD917x Lane Cross Bar to route the physical JESD lanes to the desired logical lanes.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_set_lane_xbar(ad917x_handle_t *h, uint8_t physical_lane, uint8_t logical_lane);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t physical_lane	uint8_t value indicating the Physical Lanes to be routed to the serdes logical indicated by the logical_lane parameter.
uint8_t logical_lane	uint8_t value indicating the corresponding logical lane for the physical lane listed in parameter physical_lane.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_GET_LANE_XBAR

Description

Return the physical to logical lane mapping set by the configured by the current Lane Cross Bar configuration.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_get_lane_xbar(ad917x_handle_t *h, uint8_t *phy_log_map);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t phy_log_map	Pointer a 8 deep uint8_t array.Each element of the array represents the physical lane 0 – 7 and the value represents the logical lane assigned to that physical lane.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_INVERT_LANE

Description

Each logical lane can be inverted which can be used to ease routing of SERDIN signals.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_invert_lane(ad917x_handle_t *h, uint8_t logical_lane, uint8_t invert)

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t logical_lane	uint8_t value representing the SERDES logical lane for the physical lane indicated by the parameter *physical_lane.* Valid values are 0 to 7.
uint8_t invert	Desired invert status for the logical lane represented in logical_lane parameter. Set to 1 to invert. Set to 0 to de-invert.

Preconditions

The DAC device shall be success fully initialized via a call to the **ad917x_init** API prior to using this function.

This API shall be called to configure the Lane mapping prior to enabling the JESD link.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_ENABLE_DATAPATH

Description

Configure power up and enable the AD917x the JESD Interface.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_enable_datapath(ad917x_handle_t *h, uint8_t lanes_msk, uint8_t run_cal, uint8_t en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t lanes_msk	A uint8 bit wise value representing the lanes to be enabled on the JESD Interface. Where bit 0 represents lane 0, bit 1 represents lane 1 etc. Set to one to enable the respective JESD Lane, set to 0 disable the respective JESD Lane.
uint8_t run_cal	Parameter to indicate if JESD equalization routine should be run prior to enabling interface. Set to 1 to run calibration, set to 0 to disable calibration.
uint8_t en	Enable control for the JESD interface. Set to 1 to powerup and enable JESD interface. Set to 0 to disable JESD interface.

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_**init** API prior to using this function.

JESD interface should be successfully configured via **ad917x_jesd_config_datapath** *API.*

Post conditions

JESD Datapath is now enable. The status of the JESD PLL can now be verified via

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_GET_PLL_STATUS

Description

Configure power up and enable the AD917x the JESD Interface.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_get_pll_status(ad917x_handle_t *h, uint8_t *pll_status);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.

***uint8_t *pll_*status**	Pointer to the variable that will be set with the PLL status.
	bit[0] => SERDES PLL Lock Status
	bit[1] => Regulator Status
	bit[2] => Calibration Status
	bit[3] => LOSS_LOCK Status

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_**init** API prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_ENABLE_LINK

Description

Configure power up and enable the AD917x the JESD Interface.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_enable_link(ad917x_handle_t *h, jesd_link_t link, uint8_t en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
jesd_link_t link	Target Link on which to start JESD Link Bring up Procedure
uint8_t en	Enable control for the JESD Link 0 - Enable Link 1 - Disable Link

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_**init** API prior to using this function.

Post conditions

Link Should now be enabled. Status of the link may verified via **ad917x_jesd_get_link_status** API.

Dependencies

h->**dev_xfer.** DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details.

Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_JESD_GET_LINK_STATUS

Description

Configure power up and enable the AD917x the JESD Interface.

Synopsis

#include AD917x.h

ADI_API int ad917x_jesd_get_link_status(ad917x_handle_t *h,
jesd_link_t link, ad917x_jesd_link_stat_t *link_status);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
jesd_link_t link	Target Link on which to start JESD Link Bring up Procedure
ad917x_jesd_link_stat_t *link_status	Pointer to the variable of type jesd_link_status that will be set with current jesd link reaback data.

Preconditions

The DAC device shall be success fully initialized via a call to the ad917x_**init** API prior to using this function.

Post conditions

Link Should now be enabled

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.
Refer to ***spi_xfer_t.**

Return value

Any positive integer value may represent an error code to be returned to the application.
Refer to ***Error Codes*** section for full details.
Possible return values for this API error codes are as follows.
API_ERROR_OK
API_ERROR_INVALID_HANDLE_PTR
API_ERROR_INVALID_XFER_PTR
API_ERROR_INVALID_PARAM

Notes

AD917X_NCO_SET_FTW

Description

The AD917x family of DAC support a number of NCOs. This API is used to configure a particular NCO with Frequency Tuning Word, Modulus and Delta parameters.

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_set_ftw(ad917x_handle_t *h, const ad917x_dds_select_t nco, const uint64_t ftw,
const uint64_t acc_modulus, const uint64_t acc_delta);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dds_select_t nco	Channel or Main data path select AD917x_DDSM - Main data path select AD917x_DDSC - Channel data path select
uint64_t ftw	Frequency tuning word value.
uint64_t acc_modulus	Modulus value.
Uint64_t acc_delta	Delta value.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ****spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. . Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_FTW_LOAD_ACK

API_ERROR_INVALID_PARAM

Notes

AD917X_NCO_GET_FTW

Description

Get FTW, ACC and MOD values for the paged NCO. The page should be selected in advance.

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_get_ftw(ad917x_handle_t *h, const ad917x_dds_select_t nco, uint64_t *ftw, uint64_t *acc_modulus, uint64_t *acc_delta);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dds_select_t nco	Channel or Main data path select AD917x_DDSM - Main data path select AD917x_DDSC - Channel data path select
uint64_t *ftw	Pointer to a variable where the frequency tuning word value will be stored.
uint64_t *acc_modulus	Pointer to a variable where the modulus value will be stored
uint64_t *acc_delta	Pointer to a variable where the delta value will be stored.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ****spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_NCO_SET_PHASE_OFFSET

Description

Sets main datapath and/or channel datapath NCO phase offset.

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_set_phase_offset(ad917x_handle_t *h, const ad917x_dac_select_t dacs, const uint16_t dacs_po, const ad917x_channel_select_t channels, const uint16_t ch_po);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dac_select_t dacs	DAC number ***AD917x_DAC0*** - DAC0 NCO ***AD917x_DAC1*** - DAC1 NCO
uint16_t dacs_po	The phase offset value for the selected DAC(s).
ad917x_channel_select_t channels	Channel number ***AD917x_CH_0*** - Channel 0 NCO ***AD917x_CH_1*** - Channel 1 NCO ***AD917x_CH_2*** - Channel 2 NCO ***AD917x_CH_3*** - Channel 3 NCO ***AD917x_CH_4*** - Channel 4 NCO ***AD917x_CH_5*** - Channel 5 NCO.
uint16_t ch_po	The phase offset value for the selected channel(s).

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ****spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

Notes

AD917X_NCO_GET_PHASE_OFFSET

Description

Gets main datapath and/or channel datapath NCO phase offset.

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_get_phase_offset (ad917x_handle_t *h, const ad917x_dac_select_t dacs, const uint16_t *dacs_po, const ad917x_channel_select_t channels, const uint16_t *ch_po);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dac_select_t dacs	DAC number ***AD917x_DAC0*** - DAC0 NCO ***AD917x_DAC1*** - DAC1 NCO
uint16_t *dacs_po	The phase offset value for the selected DAC(s).
ad917x_channel_select_t channels	Channel number ***AD917x_CH_0*** - Channel 0 NCO ***AD917x_CH_1*** - Channel 1 NCO ***AD917x_CH_2*** - Channel 2 NCO ***AD917x_CH_3*** - Channel 3 NCO ***AD917x_CH_4*** - Channel 4 NCO ***AD917x_CH_5*** - Channel 5 NCO
uint16_t *ch_po	The phase offset value for the selected channel(s).

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ****spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

Notes

AD917X_NCO_ENABLE

Description

Enable/Disable NCOs. Enables only the DACs and Channel NCOs provided as parameters.

All other DACs and Channel NCOs are disabled.

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_enable(ad917x_handle_t *h, const ad917x_dac_select_t dacs,
const ad917x_channel_select_t channels);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dac_select_t dacs	DAC(s) to enable
	AD917x_DAC0 - DAC0 NCO
	AD917x_DAC1 - DAC1 NCO
ad917x_channel_select_t channels	Channel(s) to enable
	AD917x_CH_0 - Channel 0 NCO
	AD917x_CH_1 - Channel 1 NCO
	AD917x_CH_2 - Channel 2 NCO
	AD917x_CH_3 - Channel 3 NCO
	AD917x_CH_4 - Channel 4 NCO
	AD917x_CH_5 - Channel 5 NCO

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ****spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

Notes

AD917X_NCO_SET

Description

Set NCO to produce a desired frequency with a desired amplitude.

Synopsis

#include AD917x.h

ADI_API int ad917x_nco_set(ad917x_handle_t *h, const ad917x_dac_select_t dacs,
const ad917x_channel_select_t channels, int64_t carrier_freq_hz,
const uint16_t amplitude, int dc_test_tone_en,
int ddsm_cal_dc_input_en);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
ad917x_dac_select_t dacs	DAC(s) to select ***AD917x_DAC0*** - DAC0 NCO ***AD917x_DAC1*** - DAC1 NCO
ad917x_channel_select_t channels	Channel(s) to select ***AD917x_CH_0*** - Channel 0 NCO ***AD917x_CH_1*** - Channel 1 NCO ***AD917x_CH_2*** - Channel 2 NCO ***AD917x_CH_3*** - Channel 3 NCO ***AD917x_CH_4*** - Channel 4 NCO ***AD917x_CH_5*** - Channel 5 NCO
int64_t carrier_freq_hz	Desired carrier frequency
uint16_t amplitude	Desire amplitude.
int dc_test_tone_en	Enable Test tone.
int ddsm_cal_dc_input_en	Enable DDSM DC input.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer	DAC API handle must be initialized to valid SPI transfer function for the client application. Refer to ****spi_xfer_t.***
h->dac_freq_hz	DAC Clock value must be initialized to the correct value as per the hardware setting for correct operation of this API. Refer to **dac_freq_hz.**

Return value

Any positive integer value may represent an error code to be returned to the application

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_HANDLE_PTR

API_ERROR_INVALID_PARAM

AD917X_REGISTER_WRITE

Description

Performs SPI register write access to DAC

Synopsis

#include AD917x.h

ADI_API int ad917x_register_write (ad917x_handle_t *h, const uint16_t address, const uint8_t data);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
const uint16_t address,	A 15-bit value representing a SPI register location on the target DAC device. Refer to AD917x data sheet for valid values.
uint8_t *data	A pointer to a 8-bit variable to which the register value read over SPI shall be stored.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Postconditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ****spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_REGISTER_READ

Description

DAC Device reference handle data structure that acts a sw reference to a particular instance to of the DAC device. This reference maintains a reference to HAL functions and the status of the chip.

Synopsis

#include AD917x.h

ADI_API int ad917x_register_read(ad917x_handle_t *h, const uint16_t address, uint8_t *data);

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device.
	Refer to ***API Handle*** section for more details.
const uint16_t address,	A 15-bit value representing a SPI register location on the target DAC device.
	Refer to AD917x data sheet for valid values.
uint8_t *data	A pointer to an 8-bit variable to which the register value read over SPI shall be stored.

Preconditions

The DAC device shall be success fully initialized via a call to the ***ad917x_init*** API. Prior to using this function.

Post conditions

None

Dependencies

h->dev_xfer. DAC API handle must be initialized to valid SPI transfer function for the client application.

Refer to ***spi_xfer_t.***

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_XFER_PTR

API_ERROR_INVALID_PARAM

Notes

AD917X_GET_REVISION

Description

Get API Revision Data.

Synopsis

#include AD917x.h

ADI_API int ad917x_get_revision (ad917x_handle_t *h, uint8_t *rev_major, uint8_t *rev_minor, uint8_t *rev_rc)

Parameters

ad917x_handle_t *h	Pointer to the client application DAC API handle for the target DAC device. Refer to ***API Handle*** section for more details.
uint8_t *rev_major	Pointer to a 8 bit variable to which the Major Revision number shall be stored
uint8_t *rev_minor,	Pointer to a 8 bit variable to which the Minor Revision number shall be stored
uint8_t *rev_rc	Pointer to a 8 bit variable to which the Release Candidate Id shall be stored

Preconditions

None

Post conditions

None

Dependencies

None

Return value

Any positive integer value may represent an error code to be returned to the application.

Refer to ***Error Codes*** section for full details. Possible return values for this API error codes are as follows.

API_ERROR_OK

API_ERROR_INVALID_PARAM

Notes

BUILD AND INTEGRATION GUIDE

This section provides an overview of build and integration steps required when using the AD917x API Source code.

As ADI provides the full source code, the user can integrate and build the libraries as per their application and platform requirements. This section is intended to act as a guide to the provided source code and example build files.

BUILDING THE AD917X API LIBRARY

1. Port the Source Code

In order to build the AD917x API library the source must be ported from the ADI provided source code package to the target platform.

From the /API folder port the following folders:

/AD917x

/common

/include

2. Building the AD917x Library

Example make-files are provided to build the AD917x API library. It is located in the **/API/AD917x** folder**.** The example make-files are configured for the generation of a static library using the GCC complier on a Linux platform. Make-files may be used as is, or used as a reference to create make-files for target application platform and tool-chain see debug.mak, release.mak for tool chain and flag options.

/AD917x/makefile

/AD917x/debug.mak

/AD917x/release.mak

INTEGRATING THE AD917X API LIBRARY INTO AN APPLICATION

1. Implement the Hardware Abstraction Functions

The API requires access to a small number of platform specific, hardware and system control functions such as a system delay/sleep function or SPI bus controller functions, GPI controller. The end user must provide and implement these functions as per the AD917x API requirements.

These functions prototypes are defined in **API/include/api_def.h** and are explained in detail in DAC Hardware Initialization*Error! Reference source not found.* section of this document.

The minimum requirement is to provide the following:

a. A function to implement SPI transaction to the AD917x DAC on the target hardware.

   typedef int spi_xfer (void *user_data, uint8_t *indata, uint8_t *outdata, int size_bytes);

b. A function to implement a delay function that will implement a sleep or delay in the order of microseconds to suspend the execution of API.

   int delay_us (void *user_data, unsigned int us);

2. Include the AD917x API Interface headers

The following header files define the interface to the AD917x API and should be included in the application.

a. API/include/AD917x.h
b. API/include/api_error.h

3. Instantiate AD917x Handler

For each AD917x DAC device, the application must instantiate an AD917x handler reference. Refer to the **ad917x_handle_t** description for a full description of the AD917x handler.

For each handler instantiated by the application, all the require members of the AD917x handler must be initialized prior to calling any APIs with that handler as parameter. As per the AD917x API specification, the following members are required for correct operation of the AD917x APIs.

- dev_xfer, Pointer to SPI data transfer function for DAC hardware
- delay_us, Pointer to delay function for DAC hardware
- sdo, Device SPI Interface configuration for DAC hardware
- dac_freq_hz , DAC Clock Frequency configuration

Point handler to SPI and Delay HAL Functions

The members **dev_xfer** and **delay_us** must be set to point to the HAL function implemented by the application. (Refer to step one, **Implement the Hardware Abstraction Functions** in this list).

Appendix A provides a pseudo code example of how the handler can be instantiated with the hardware abstraction functions.

Set the SPI Interface Configuration

Another member of the handler that must be instantiated correctly is the SPI interface configuration. The hardware SPI interface to the AD917x device may be 3-wire or 4-wire depending on the target hardware. The handler must be configured appropriated base on the target application hardware. In the AD917x DAC example application, the handler is instantiated with 4-wire mode as per the AD917x evaluation platform. Refer to Appendix AError! Reference source not found. to see the handler being instantiated with SPI_SDO value, meaning 4-wire mode.

4. *Set the DAC CLK Frequency*

The AD917x device requires a hardware DAC clock input to the device. The AD917x may be provided directly with the desired DAC clock or may provide a reference clock and use the on-chip PLL to generated the DAC clock. Refer to AD917x Datasheet for full configuration options of the DAC clock.

This desired configuration will be determined the application depending on the target platform and application.

The following APIs may be used to configure the AD917x for the desired configuration.

- ***ad917x_set_dac_clk_frequency***
- ***ad917x_set_dac_pll_config***

The desired frequency of the hardware clock input to the DAC must be supplied to the via the ***dac_freq_hz*** member of the AD917x handler. This is done via the ***ad917x_set_dac_clk_frequency*** API.

Alternatively ***ad917x_set_dac_clk*** may be used to configure the on chip PLL based on the desired system's clock frequencies rather than PLL parameters.

5. *Create the application*

Using the AD917x API provided in **/API/include/AD917x.h** write the application code to initialize, configure and monitor the AD917x API as per your target application requirements.

The ADI source code package for the AD917x API provides some code example applications for using the AD917x API to configure AD917x DAC devices. These can be found in the **/Applications** folder and may be used as a reference during the development of the customer's application.

APPENDIX A

PSEUDO CODE EXAMPLE FOR AD917X HANDLE

In the pseudo code example A, shows an example of the AD917x handle being configure with the minimum client application. In the pseudo code example B, shows an example of the AD917x handle being configured with all the optional configurations.

For further details, refer to the **DAC Hardware Initialization** section and the ***ad917x_handle_t*** section for full a description and more details on configuration.

```
/*
 * \brief pseudo Code example client code to initialise AD917x
 *
 */
/*Include Client HAL implementation code*/
#include "app_hal.h"

/*Include AD917x API interface Headers*/
#include "AD917x.h"
#include "api_errors.h"
#include "api_def.h"

ad917x_handle_t app_dac_h = {
                    NULL,                       /* Client App HAL does not require any specific data*/
                    SPI_SDO,                    /* Client App HAL SPI  uses 4 Wire SPI config */
                    2000000000,                 /* Application DAC Clk Frequency */
                    &app_hal_ad916x_spi_xfer,   /* Client App HAL SPI function  for AD9164*/
                    &app_hal_ad916x_delay_us,   /* Client App HAL Delay Function */
                    0,                          /*  Client App does need API to control TX_ENABLE */
                    0,                          /*  Client App does need API to control RESETB */
                    0,                          /* Client App does want API to initialize external HW required by DAC */
                    0                           /* Client App does want API to initialize external HW required by DAC */
};

/*AD917x Dac Initialisation by Client Application*/
int app_dac_init()
{
          int dacError = API_ERROR_OK;
          ad917x_handle_t *ad917x_h = app_dac_h;
          uint8_t revision[3] = {0,0,0};
          adi_chip_id_t dac_chip_id;

          /*Initialise DAC Module*/
          dacError = ad917x_init(ad917x_h);
          if (dacError != API_ERROR_OK) {
                    return -1;
          }

          dacError = ad917x_get_chip_id(ad917x_h, &dac_chip_id);
          if (dacError != API_ERROR_OK) {
                    return -1;
          }

          dacError = ad917x_get_revision(ad917x_h,&revision[0],&revision[1],&revision[2]);
          if (dacError !=API_ERROR_OK) {
                    return APP_ERR_DAC_FAIL;
          }

          printf("*********************************************\r\n");
          printf("AD917x DAC Chip ID: %d \r\n", dac_chip_id.chip_type);
          printf("AD917x DAC Product ID: %x \r\n", dac_chip_id.prod_id);
          printf("AD917x DAC Product Grade: %d \r\n", dac_chip_id.prod_grade);
          printf("AD917x DAC Product Revision: %d \r\n", dac_chip_id.dev_revision);
          printf("AD917x Revision: %d. %d.%d \r\n", revision[0], revision[1], revision[2]);
          printf("*********************************************\r\n");

   return 0;
}
```

Figure 4 Example A, Psuedo Code AD917x Handle initialization with Minum Configuration

```
#include “app_spi.h”
#include “app_gpio.h”
#include "app_sleep.h"

/*Client Application function to Implement SPI Transfer for AD9172*/
int app_hal_ad917x_spi_xfer(void *user_data, uint8_t *wbuf, uint8_t *rbuf, int len)
{
      /*Pseudo Code example of implementing SPi transfer funtion*/


      uint16_t address;
      uint8_t value;
      uint8_t dac_chip_select;
      struct app_hal_data_t *dac_user_data;

      /*Optional: get any client defined data from user_data*/
      /*For example could be used to retrieve chip select*/
      dac_user_data = (struct app_hal_data_t *) user_data;
      dac_chip_select = dac_user_data->dac_chip_select_ref;

      /*AD916x DAC SPI transactions are always 3 bytes*/
      if (size_bytes != 3)
      {
            /* 2 bytes for adderss and 1 byte data */
            return 2;
      }

      address = wbuf[0];
      address <<= 8;
      address |= wbuf[1];
      value = wbuf[2];

      if ((address & 0x8000) == 0)
      {
            /* Write */
            app_hal_spi_write(dac_chip_select, address, value);
            rbuf[2] = 0xFF;
      }
      else
      {
            /* Read */
            /* Clear the read bit as we read from local array */
            address &= ~0x8000;

            app_hal_spi_write(dac_chip_select, address, &value);
            rbuf[2] = value;
      }
      return 0;
}

int app_hal_ad917x_delay_us(void *user_data, unsigned int time_us)
{
      /*Code to sleep or wait*/
      app_hal_sleep(time_us);
      return 0;

}
```

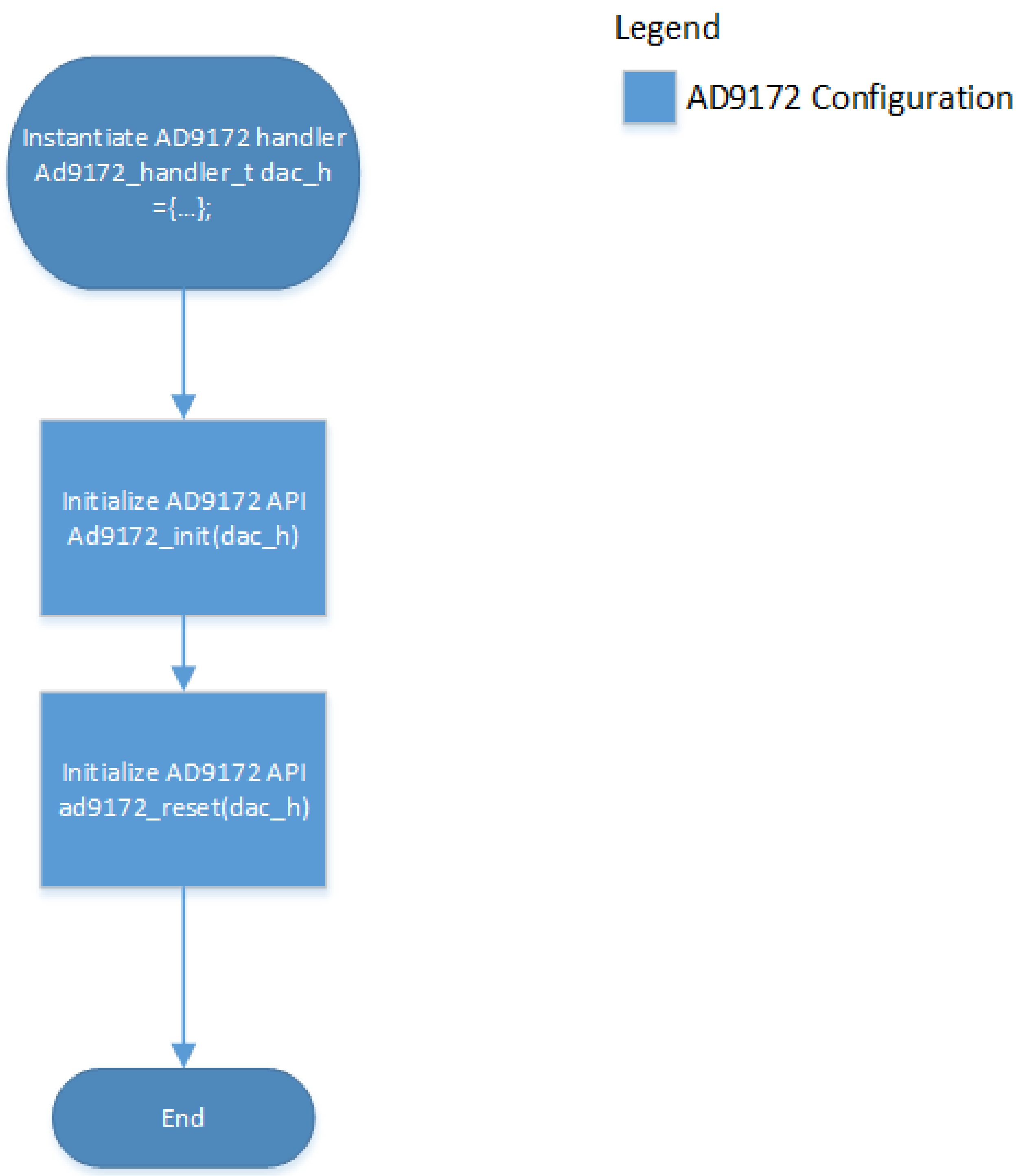
Figure 5 Psuedo Code example for Required HAL functions

```
/*
 * \brief pseudo Code example client code to initialise AD917x
 *
 */
/*Include Client HAL implementation code*/
#include "app_hal.h"

/*Include AD917x API interface Headers*/
#include "AD917x.h"
#include "api_errors.h"
#include "api_def.h"

ad917x_handle_t app_dac_h = {
                    &app_hal_user_data,                  /* Client App HAL does  require any specific data*/
                    SPI_SDO,                             /* Client App HAL SPI  uses 4 Wire SPI config */
                    2000000000,                          /* Application DAC Clk Frequency */
                    &app_hal_ad917x_spi_xfer,            /* Client App HAL SPI function  for AD9164*/
                    &app_hal_ad917x_delay_us,            /* Client App HAL Delay Function */
                    &app_hal_ad917x_set_tx_enable_pin,   /*  Client App HAL function to control TX_ENABLE */
                    &app_hal_ad917x_set_resetb_pin,      /*  Client App does need API to control RESETB */
                    &app_init_dac_hw,                    /* Client App does want API to initialize external HW required by DAC */
                    &app_shutdown_dac_hw                 /* Client App does want API to initialize external HW required by DAC */
};

/*AD917x Dac Initialisation by Client Application*/
int app_dac_init()
{
          int dacError = API_ERROR_OK;
          ad917x_handle_t *ad916x_h = app_dac_h;
          uint8_t revision[3] = {0,0,0};
          adi_chip_id_t dac_chip_id;

          /*Initialise DAC Module*/
          dacError = ad917x_init(ad917x_h);
          if (dacError != API_ERROR_OK) {
                    return -1;
          }

          dacError = ad917x_get_chip_id(ad917x_h, &dac_chip_id);
          if (dacError != API_ERROR_OK) {
                    return -1;
          }

          dacError = ad917x_get_revision(ad917x_h,&revision[0],&revision[1],&revision[2]);
          if (dacError !=API_ERROR_OK) {
                    return APP_ERR_DAC_FAIL;
          }

          printf("**********************************************\r\n");
          printf("AD917x DAC Chip ID: %d \r\n", dac_chip_id.chip_type);
          printf("AD917x DAC Product ID: %d \r\n", dac_chip_id.prod_id);
          printf("AD917x DAC Product Grade: %d \r\n", dac_chip_id.prod_grade);
          printf("AD917x DAC Product Revision: %d \r\n", dac_chip_id.dev_revision);
          printf("AD917x Revision: %d. %d.%d \r\n", revision[0], revision[1], revision[2]);
          printf("**********************************************\r\n");

   return 0;

}
```

Figure 6 Example B, Psuedo Code AD917x Handle initialization with Minimum Configuration

APPENDIX B

FLOW CHART FOR EXAMPLE AD917X INITIALISATION

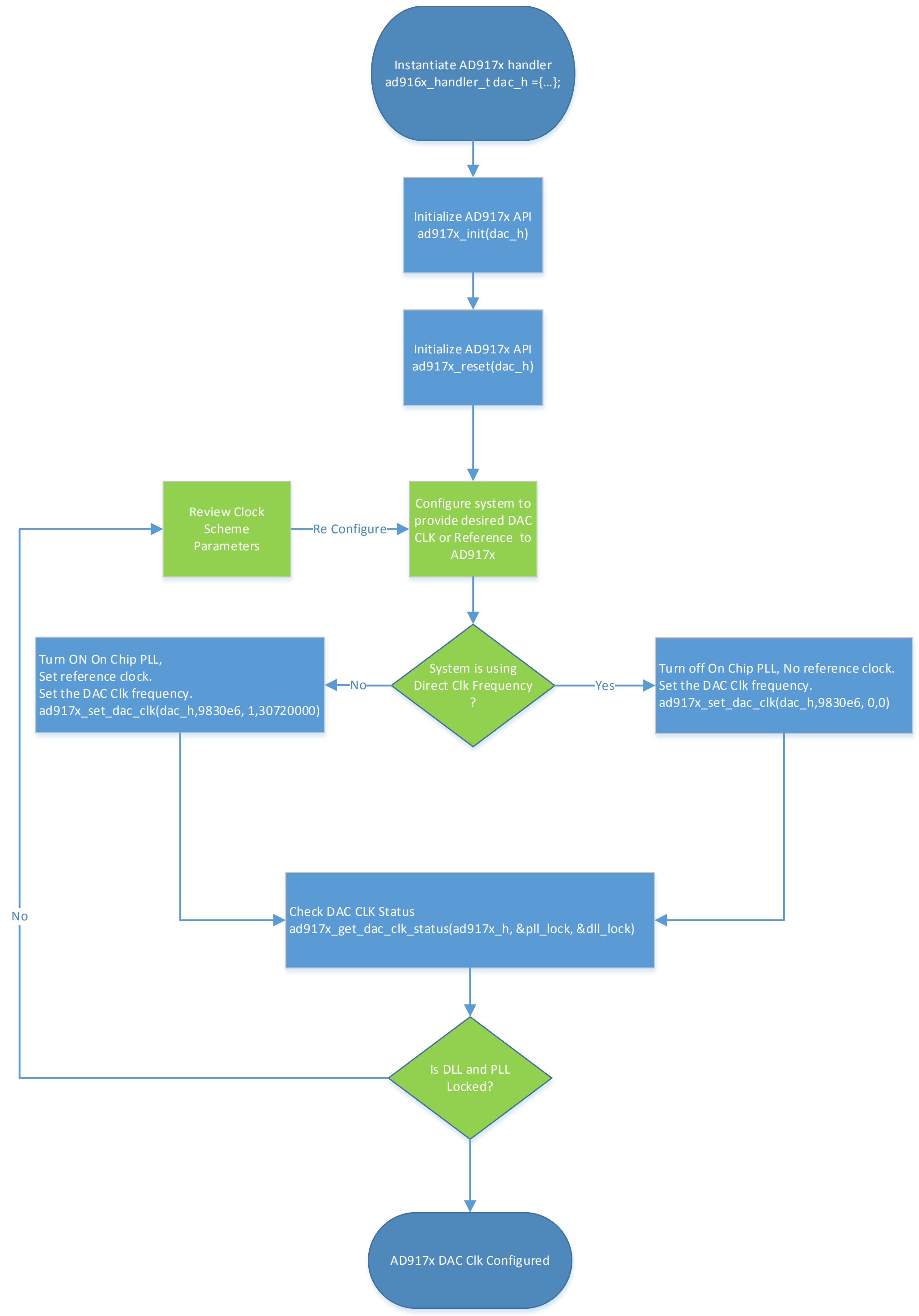

Legend
AD9172 Configuration
Instantiate AD9172 handler Ad9172_handler_t dac_h ={…};
Initialize AD9172 API Ad9172_init(dac_h)
Initialize AD9172 API ad9172_reset(dac_h)
End

FLOW CHART FOR EXAMPLE CLK CONFIGURATION

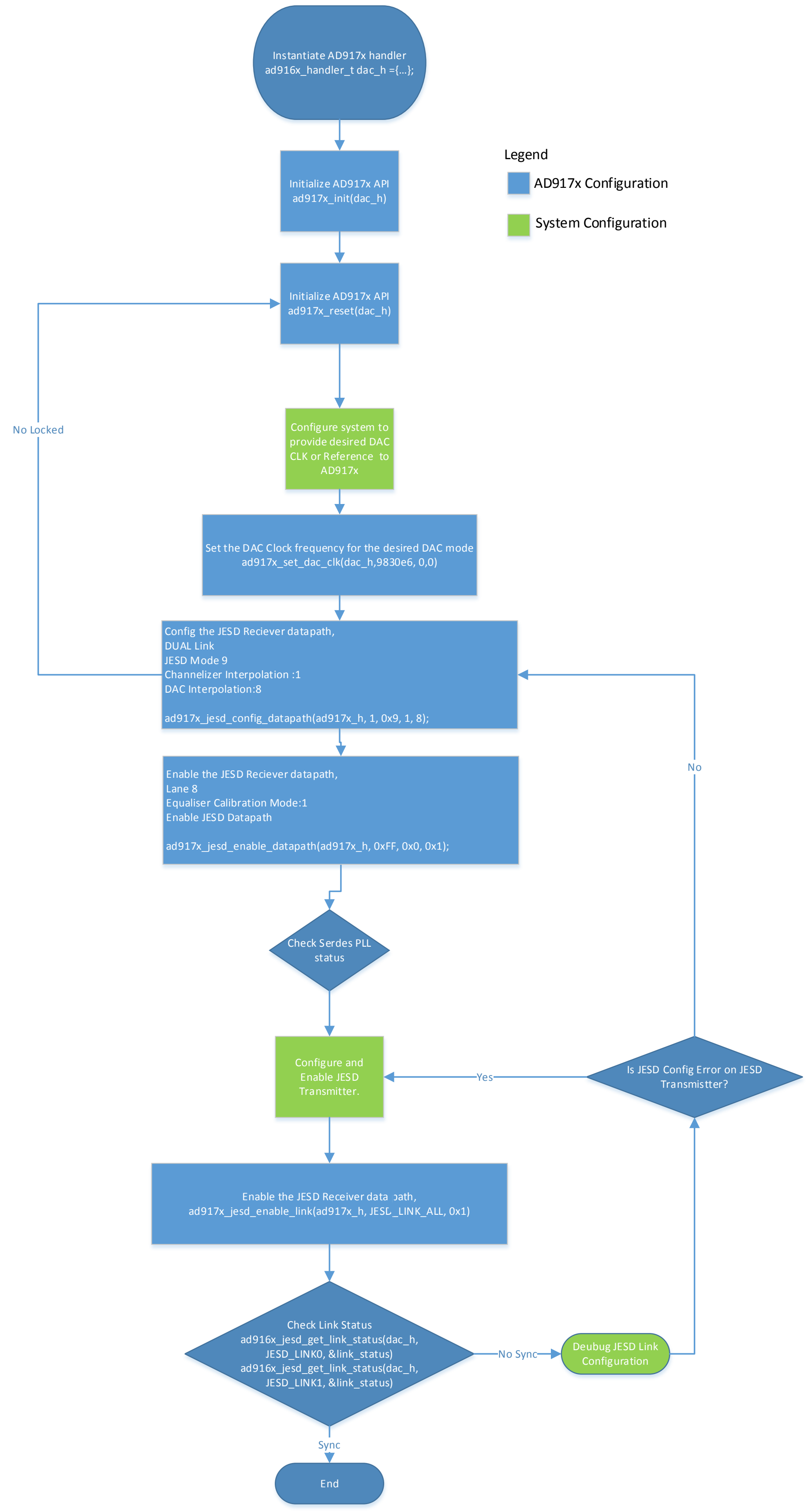
Legend

🟦 AD917x Configuration

🟩 System Configuration


Instantiate AD917x handler
ad916x_handler_t dac_h ={…};
Initialize AD917x API
ad917x_init(dac_h)
Initialize AD917x API
ad917x_reset(dac_h)
Review Clock Scheme Parameters
Re Configure
Configure system to provide desired DAC CLK or Reference to AD917x
System is using Direct Clk Frequency ?
No
Yes
Turn ON On Chip PLL,
Set reference clock.
Set the DAC Clk frequency.
ad917x_set_dac_clk(dac_h,9830e6, 1,30720000)
Turn off On Chip PLL, No reference clock.
Set the DAC Clk frequency.
ad917x_set_dac_clk(dac_h,9830e6, 0,0)
Check DAC CLK Status
ad917x_get_dac_clk_status(ad917x_h, &pll_lock, &dll_lock)
No
Is DLL and PLL Locked?
AD917x DAC Clk Configured

FLOW CHART FOR EXAMPLE JESD CONFIGURATION


Instantiate AD917x handler
ad916x_handler_t dac_h ={...};
Legend
AD917x Configuration
System Configuration
Initialize AD917x API
ad917x_init(dac_h)
Initialize AD917x API
ad917x_reset(dac_h)
No Locked
Configure system to provide desired DAC CLK or Reference to AD917x
Set the DAC Clock frequency for the desired DAC mode
ad917x_set_dac_clk(dac_h,9830e6, 0,0)
Config the JESD Reciever datapath,
DUAL Link
JESD Mode 9
Channelizer Interpolation :1
DAC Interpolation:8
ad917x_jesd_config_datapath(ad917x_h, 1, 0x9, 1, 8);
No
Enable the JESD Reciever datapath,
Lane 8
Equaliser Calibration Mode:1
Enable JESD Datapath
ad917x_jesd_enable_datapath(ad917x_h, 0xFF, 0x0, 0x1);
Check Serdes PLL status
Configure and Enable JESD Transmitter.
Yes
Is JESD Config Error on JESD Transmistter?
Enable the JESD Receiver data path,
ad917x_jesd_enable_link(ad917x_h, JESD_LINK_ALL, 0x1)
Check Link Status
ad916x_jesd_get_link_status(dac_h, JESD_LINK0, &link_status)
ad916x_jesd_get_link_status(dac_h, JESD_LINK1, &link_status)
No Sync
Deubug JESD Link Configuration
Sync
End

REVISION HISTORY

08/06/2017—Rev 1.0

Initial Release with Rev 1.0.2 API	Universal
Minor Updated with Rev 1.1.1 API	Universal