Standard WSA Library

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Contents

1 Introduction

The wsa_lib is a library with high level interfaces to a WSA device. It abstracts away the actual low level interface and communication through the connection of choice, and subsequently all the controls or commands to the WSA. It allows you to easily control the WSA4000 through standardized command syntax, such as SCPI, to get WSA status, set gain, set centre frequency, etc., and perform data acquisition.

The wsa_lib supports SCPI for control command syntax and VRT for packet.

1.1 How to use the library

The wsa_lib is designed using mixed C/C++ languages. To use the library, you need to include the header file, wsa_lib.h, in files that will use any of its functions to access a WSA, and a link to the wsa_lib.lib.

2 Data Structure Index

2.1 Data Structures

Here are the data structures with brief descriptions:

3 File Index

3.1 File List

Here is a list of all files with brief descriptions:

4 Data Structure Documentation

4.1 wsa_descriptor Struct Reference

This structure stores WSA information.

Data Fields

- char prod_name [50]
- char prod_serial [20]
- char prod_version [20]
- char rfe_name [50]
- char rfe_version [20]
- char fw_version [20]
- char intf_type [20]
- uint64_t inst_bw
- uint32_t max_sample_size
- uint64_t max_tune_freq
- uint64_t min_tune_freq
- uint64_t freq_resolution
- int max_if_gain
- int min_if_gain
- float abs_max_amp [NUM_RF_GAINS]

4.1.1 Field Documentation

4.1.1.1 float abs_max_amp

An array storing the absolute maximum RF input level in dBm for each quantized RF gain setting of the RFE. Operating a WSA device at these absolute maximums may cause damage to the device.

4.1.1.2 uint64_t freq_resolution

The frequency resolution in Hz that a WSA's centre frequency can be incremented.

4.1.1.3 char fw_version

The firmware version currently in the WSA.

4.1.1.4 uint64_t inst_bw

The WSA instantaneous bandwidth in Hz.

4.1.1.5 char intf_type

The interface method to a WSA. Available: "TCPIP" ("USB" TBD).

4.1.1.6 int max_if_gain

The maximum IF gain in dB that a WSA's RFE can be set.

4.1.1.7 uint32_t max_sample_size

The maximum number of continuous I and Q data samples the WSA can capture per frame.

4.1.1.8 uint64_t max_tune_freq

The maximum frequency in Hz that a WSA's RFE can be tuned to.

4.1.1.9 int min_if_gain

The minimum IF gain in dB that a WSA's RFE can be set.

4.1.1.10 uint64_t min_tune_freq

The minimum frequency in Hz that a WSA's RFE can be tuned to.

4.1.1.11 char prod_name

WSA product name.

4.1.1.12 char prod_serial

WSA product serial number.

4.1.1.13 char prod_version

WSA product version number.

4.1.1.14 char rfe_name

WSA product name.

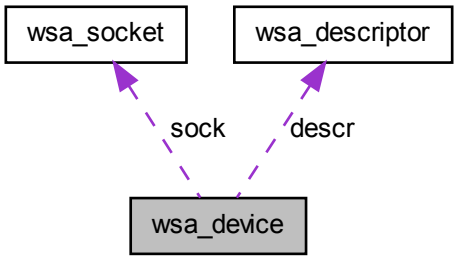
4.1.1.15 char rfe_version

WSA product version number.

4.2 wsa_device Struct Reference

A structure containing the components associate with each WSA device.

Collaboration diagram for wsa_device:



Data Fields

- struct wsa_descriptor descr
- struct wsa_socket sock

4.2.1 Field Documentation

4.2.1.1 struct wsa_descriptor descr

The information component of the WSA, stored in wsa_descriptor.

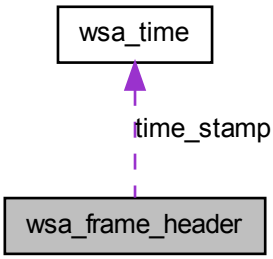
4.2.1.2 struct wsa_socket sock

The socket structure component of the WSA, used for TCPIP connection.

4.3 wsa_frame_header Struct Reference

This structure contains header information related to each frame read by wsa_read_frame().

Collaboration diagram for wsa_frame_header:



Data Fields

- uint32_t sample_size
- struct wsa_time time_stamp

4.3.1 Field Documentation

4.3.1.1 uint32_t sample_size

Number of {I, Q} samples pairs per WSA data frame.

4.3.1.2 struct wsa_time time_stamp

The time when a data frame capture begins, stored in wsa_time structure.

4.4 wsa_resp Struct Reference

This structure contains the response information for each query.

Data Fields

- int64_t status
- char output [MAX_STR_LEN]

4.4.1 Field Documentation

4.4.1.1 char output

The char pointer to an output string responded to a query.

4.4.1.2 int32_t status

The status of the query. Positive number when success, negative when failed.

4.5 wsa_socket Struct Reference

A structure containing the socket parameters used for creating TCP/IP connection for control and data acquisition.

Data Fields

- SOCKET cmd
- SOCKET data

4.5.1 Field Documentation

4.5.1.1 SOCKET cmd

The command socket for command controls and queries. The port used for this socket is 37001.

4.5.1.2 SOCKET data

The data socket used for streaming of data. The port used for this socket is 37000.

4.6 wsa_time Struct Reference

This structure contains the time information. It is used for the time stamp in a frame header.

Data Fields

- uint32_t sec
- uint64_t psec

4.6.1 Field Documentation

4.6.1.1 uint64_t psec

Nanoseconds after the second (0 - 999 999 999).

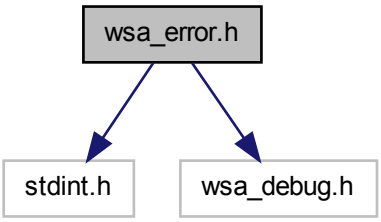
4.6.1.2 uint32_t sec

The number of seconds elapsed since 00:00 hours, Jan 1, 1970 UTC.

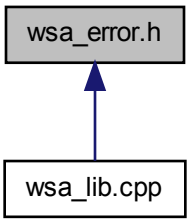
5 File Documentation

5.1 wsa_error.h File Reference

Include dependency graph for wsa_error.h:



This graph shows which files directly or indirectly include this file:



Defines

- #define LNEG_NUM (-10000)
- #define WSA_ERR_NOWSA (LNEG_NUM - 1)
- #define WSA_ERR_INVIPADDRESS (LNEG_NUM - 2)
- #define WSA_ERR_NOCTRLPIPE (LNEG_NUM - 3)
- #define WSA_ERR_UNKNOWNPRODSER (LNEG_NUM - 4)
- #define WSA_ERR_UNKNOWNPRODVSN (LNEG_NUM - 5)
- #define WSA_ERR_UNKNOWNFWRVSN (LNEG_NUM - 6)
- #define WSA_ERR_UNKNOWNRFEVSN (LNEG_NUM - 7)
- #define WSA_ERR_PRODOBSOLETE (LNEG_NUM - 8)
- #define WSA_ERR_QUERYNORESP (LNEG_NUM - 9)
- #define WSA_ERR_WSANOTRDY (LNEG_NUM - 101)

- #define WSA_ERR_WSAINUSE (LNEG_NUM - 102)
- #define WSA_ERR_SETFAILED (LNEG_NUM - 103)
- #define WSA_ERR_OPENFAILED (LNEG_NUM - 104)
- #define WSA_ERR_INITFAILED (LNEG_NUM - 105)
- #define WSA_ERR_INVADCCORRVALUE (LNEG_NUM - 106)
- #define WSA_ERR_INVINTFMETHOD (LNEG_NUM - 201)
- #define WSA_ERR_INVIPHOSTADDRESS (LNEG_NUM - 202)
- #define WSA_ERR_USBNOTAVBL (LNEG_NUM - 203)
- #define WSA_ERR_USBOPENFAILED (LNEG_NUM - 204)
- #define WSA_ERR_USBINITFAILED (LNEG_NUM - 205)
- #define WSA_ERR_ETHERNETNOTAVBL (LNEG_NUM - 206)
- #define WSA_ERR_ETHERNETCONNECTFAILED (LNEG_NUM - 207)
- #define WSA_ERR_ETHERNETINITFAILED (LNEG_NUM - 209)
- #define WSA_ERR_WINSOCKSTARTUPFAILED (LNEG_NUM - 210)
- #define WSA_ERR_SOCKETSETFUPFAILED (LNEG_NUM - 211)
- #define WSA_ERR_INVAMP (LNEG_NUM - 301)
- #define WSA_ERR_NODATABUS (LNEG_NUM - 401)
- #define WSA_ERR_READFRAMEFAILED (LNEG_NUM - 402)
- #define WSA_ERR_INVSAMPLESIZE (LNEG_NUM - 403)
- #define WSA_ERR_SIZESETFAILED (LNEG_NUM - 404)
- #define WSA_ERR_NOTIQFRAME (LNEG_NUM - 405)
- #define WSA_ERR_FREQOUTOFBOUND (LNEG_NUM - 601)
- #define WSA_ERR_INVFREQRES (LNEG_NUM - 602)
- #define WSA_ERR_FREQSETFAILED (LNEG_NUM - 603)
- #define WSA_ERR_PLLLOCKFAILED (LNEG_NUM - 604)
- #define WSA_ERR_INVRFGAIN (LNEG_NUM - 801)
- #define WSA_ERR_INVIFGAIN (LNEG_NUM - 802)
- #define WSA_ERR_IFGAINSETFAILED (LNEG_NUM - 803)
- #define WSA_ERR_RFGAINSETFAILED (LNEG_NUM - 804)
- #define WSA_ERR_INVRUNMODE (LNEG_NUM - 1001)
- #define WSA_ERR_INVTRIGID (LNEG_NUM - 1201)
- #define WSA_ERR_INVSTOPFREQ (LNEG_NUM - 1202)
- #define WSA_ERR_STARTOOB (LNEG_NUM - 1203)
- #define WSA_ERR_STOPOOB (LNEG_NUM - 1204)
- #define WSA_ERR_INVSTARTRES (LNEG_NUM - 1205)
- #define WSA_ERR_INVSTOPRES (LNEG_NUM - 1206)
- #define WSA_ERR_INVTRIGRANGE (LNEG_NUM - 1207)
- #define WSA_ERR_INVDWELL (LNEG_NUM - 1208)
- #define WSA_ERR_INVNUMFRAMES (LNEG_NUM - 1209)
- #define WSA_ERR_CMDSENDFAILED (LNEG_NUM - 1501)
- #define WSA_ERR_CMDINVALID (LNEG_NUM - 1502)
- #define WSA_ERR_RESPUNKNOWN (LNEG_NUM - 1503)
- #define WSA_ERR_INVANTENNAPORT (LNEG_NUM - 1601)
- #define WSA_ERR_ANTENNASETFAILED (LNEG_NUM - 1602)
- #define WSA_ERR_INVFILTERMODE (LNEG_NUM - 1603)
- #define WSA_ERR_FILTERSETFAILED (LNEG_NUM - 1604)
- #define WSA_ERR_INVCALIBRATEMODE (LNEG_NUM - 1605)
- #define WSA_ERR_CALIBRATESETFAILED (LNEG_NUM - 1606)

- #define WSA_ERR_INVRFESETTING (LNEG_NUM - 1607)
- #define WSA_ERR_FILECREATEFAILED (LNEG_NUM - 1900)
- #define WSA_ERR_FILEOPENFAILED (LNEG_NUM - 1901)
- #define WSA_ERR_FILEREADFAILED (LNEG_NUM - 1902)
- #define WSA_ERR_FILEWRITEFAILED (LNEG_NUM - 1903)
- #define WSA_ERR_INVNUMBER (LNEG_NUM - 2000)
- #define WSA_ERR_INVREGADDR (LNEG_NUM - 2001)
- #define WSA_ERR_MALLOCFAILED (LNEG_NUM - 2002)
- #define WSA_ERR_UNKNOWN_ERROR (LNEG_NUM - 2003)

Functions

- const char * _wsa_get_err_msg (int16_t err_id)

5.1.1 Define Documentation

5.1.1.1 #define LNEG_NUM (-10000)

5.1.1.2 #define WSA_ERR_ANTENNASETFAILED (LNEG_NUM - 1602)

5.1.1.3 #define WSA_ERR_CALIBRATESETFAILED (LNEG_NUM - 1606)

5.1.1.4 #define WSA_ERR_CMDINVALID (LNEG_NUM - 1502)

5.1.1.5 #define WSA_ERR_CMDSENDFAILED (LNEG_NUM - 1501)

5.1.1.6 #define WSA_ERR_ETHERNETCONNECTFAILED (LNEG_NUM - 207)

5.1.1.7 #define WSA_ERR_ETHERNETINITFAILED (LNEG_NUM - 209)

5.1.1.8 #define WSA_ERR_ETHERNETNOTAVBL (LNEG_NUM - 206)

5.1.1.9 #define WSA_ERR_FILECREATEFAILED (LNEG_NUM - 1900)

5.1.1.10 #define WSA_ERR_FILEOPENFAILED (LNEG_NUM - 1901)

5.1.1.11 #define WSA_ERR_FILEREADFAILED (LNEG_NUM - 1902)

5.1.1.12 #define WSA_ERR_FILEWRITEFAILED (LNEG_NUM - 1903)

5.1.1.13 #define WSA_ERR_FILTERSETFAILED (LNEG_NUM - 1604)

5.1.1.14 #define WSA_ERR_FREQOUTOFBOUND (LNEG_NUM - 601)

5.1.1.15 #define WSA_ERR_FREQSETFAILED (LNEG_NUM - 603)

5.1.1.16 #define WSA_ERR_IFGAINSETFAILED (LNEG_NUM - 803)

5.1.1.17 #define WSA_ERR_INITFAILED (LNEG_NUM - 105)

5.1.1.18 #define WSA_ERR_INVADCCORRVALUE (LNEG_NUM - 106)

5.1.1.19 #define WSA_ERR_INVAMP (LNEG_NUM - 301)

5.1.1.20 #define WSA_ERR_INVANTENNAPORT (LNEG_NUM - 1601)

5.1.1.21 #define WSA_ERR_INVCALIBRATEMODE (LNEG_NUM - 1605)

5.1.1.22 #define WSA_ERR_INVDWELL (LNEG_NUM - 1208)

5.1.1.23 #define WSA_ERR_INVFILTERMODE (LNEG_NUM - 1603)

5.1.1.24 #define WSA_ERR_INVFREQRES (LNEG_NUM - 602)

5.1.1.25 #define WSA_ERR_INVIFGAIN (LNEG_NUM - 802)

5.1.1.26 #define WSA_ERR_INVINTFMETHOD (LNEG_NUM - 201)

5.1.1.27 #define WSA_ERR_INVIPADDRESS (LNEG_NUM - 2)

5.1.1.28 #define WSA_ERR_INVIPHOSTADDRESS (LNEG_NUM - 202)

5.1.1.29 #define WSA_ERR_INVNUMBER (LNEG_NUM - 2000)

5.1.1.30 #define WSA_ERR_INVNUMFRAMES (LNEG_NUM - 1209)

5.1.1.31 #define WSA_ERR_INVREGADDR (LNEG_NUM - 2001)

5.1.1.32 #define WSA_ERR_INVRFESETTING (LNEG_NUM - 1607)

5.1.1.33 #define WSA_ERR_INVRFGAIN (LNEG_NUM - 801)

5.1.1.34 #define WSA_ERR_INVRUNMODE (LNEG_NUM - 1001)

5.1.1.35 #define WSA_ERR_INVSAMPLESIZE (LNEG_NUM - 403)

5.1.1.36 #define WSA_ERR_INVSTARTRES (LNEG_NUM - 1205)

5.1.1.37 #define WSA_ERR_INVSTOPFREQ (LNEG_NUM - 1202)

5.1.1.38 #define WSA_ERR_INVSTOPRES (LNEG_NUM - 1206)

5.1.1.39 #define WSA_ERR_INVTRIGID (LNEG_NUM - 1201)

5.1.1.40 #define WSA_ERR_INVTRIGRANGE (LNEG_NUM - 1207)

5.1.1.41 #define WSA_ERR_MALLOCFAILED (LNEG_NUM - 2002)

5.1.1.42 #define WSA_ERR_NOCTRLPIPE (LNEG_NUM - 3)

5.1.1.43 #define WSA_ERR_NODATABUS (LNEG_NUM - 401)

5.1.1.44 #define WSA_ERR_NOTIQFRAME (LNEG_NUM - 405)

5.1.1.45 #define WSA_ERR_NOWSA (LNEG_NUM - 1)

5.1.1.46 #define WSA_ERR_OPENFAILED (LNEG_NUM - 104)

5.1.1.47 #define WSA_ERR_PLLLOCKFAILED (LNEG_NUM - 604)

5.1.1.48 #define WSA_ERR_PRODOBSOLETE (LNEG_NUM - 8)

5.1.1.49 #define WSA_ERR_QUERYNORESP (LNEG_NUM - 9)

5.1.1.50 #define WSA_ERR_READFRAMEFAILED (LNEG_NUM - 402)

5.1.1.51 #define WSA_ERR_RESPUNKNOWN (LNEG_NUM - 1503)

5.1.1.52 #define WSA_ERR_RFGAINSETFAILED (LNEG_NUM - 804)

5.1.1.53 #define WSA_ERR_SETFAILED (LNEG_NUM - 103)

5.1.1.54 #define WSA_ERR_SIZESETFAILED (LNEG_NUM - 404)

5.1.1.55 #define WSA_ERR_SOCKETSETFUPFAILED (LNEG_NUM - 211)

5.1.1.56 #define WSA_ERR_STARTOOB (LNEG_NUM - 1203)

5.1.1.57 #define WSA_ERR_STOPOOB (LNEG_NUM - 1204)

5.1.1.58 #define WSA_ERR_UNKNOWN_ERROR (LNEG_NUM - 2003)

5.1.1.59 #define WSA_ERR_UNKNOWNFWRVSN (LNEG_NUM - 6)

5.1.1.60 #define WSA_ERR_UNKNOWNPRODSER (LNEG_NUM - 4)

5.1.1.61 #define WSA_ERR_UNKNOWNPRODVSN (LNEG_NUM - 5)

5.1.1.62 #define WSA_ERR_UNKNOWNRFEVSN (LNEG_NUM - 7)

5.1.1.63 #define WSA_ERR_USBINITFAILED (LNEG_NUM - 205)

5.1.1.64 #define WSA_ERR_USBNOTAVBL (LNEG_NUM - 203)

5.1.1.65 #define WSA_ERR_USBOPENFAILED (LNEG_NUM - 204)

5.1.1.66 #define WSA_ERR_WINSOCKSTARTUPFAILED (LNEG_NUM - 210)

5.1.1.67 #define WSA_ERR_WSAINUSE (LNEG_NUM - 102)

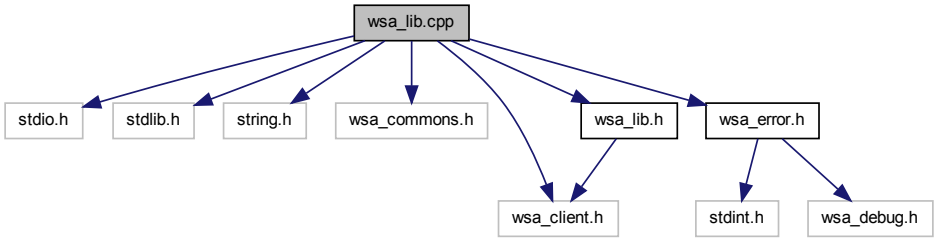
5.1.1.68 #define WSA_ERR_WSANOTRDY (LNEG_NUM - 101)

5.1.2 Function Documentation

5.1.2.1 const char* _wsa_get_err_msg (int16_t *err_id*)

5.2 wsa_lib.cpp File Reference

Include dependency graph for wsa_lib.cpp:



Functions

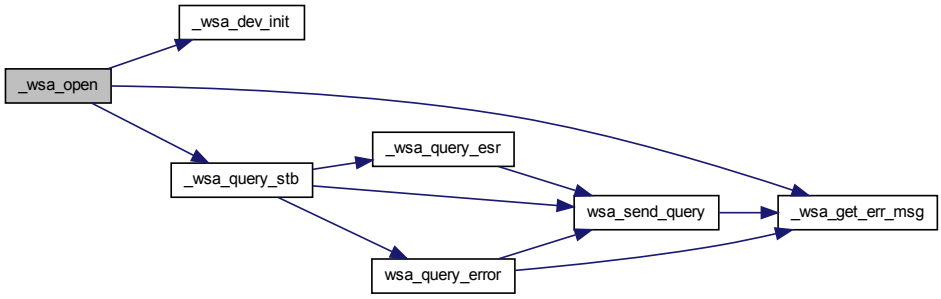
- char * wsa_query_error (struct wsa_device *dev)
- int16_t _wsa_dev_init (struct wsa_device *dev)
- int16_t _wsa_open (struct wsa_device *dev)
- int16_t _wsa_query_stb (struct wsa_device *dev, char *output)
- int16_t _wsa_query_esr (struct wsa_device *dev, char *output)
- int16_t wsa_connect (struct wsa_device *dev, char *cmd_syntax, char *intf_method)
- int16_t wsa_disconnect (struct wsa_device *dev)
- int16_t wsa_list_devs (char **wsa_list)
- int16_t wsa_send_command (struct wsa_device *dev, char *command)
- int16_t wsa_send_command_file (struct wsa_device *dev, char *file_name)
- struct wsa_resp wsa_send_query (struct wsa_device *dev, char *command)
- int16_t wsa_read_status (struct wsa_device *dev, char *output)
- const char * wsa_get_error_msg (int16_t err_code)
- int16_t wsa_read_frame (struct wsa_device *dev, struct wsa_frame_header *header, char *data_buf, uint32_t sample_size, uint32_t time_out)
- int32_t wsa_decode_frame (char *data_buf, int16_t *i_buf, int16_t *q_buf, uint32_t sample_size)

5.2.1 Function Documentation

5.2.1.1 int16_t _wsa_dev_init (struct wsa_device * *dev*)

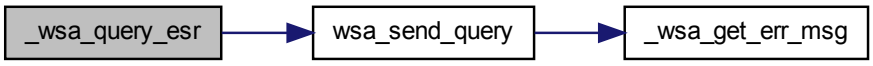
5.2.1.2 int16_t _wsa_open (struct wsa_device * *dev*)

Here is the call graph for this function:



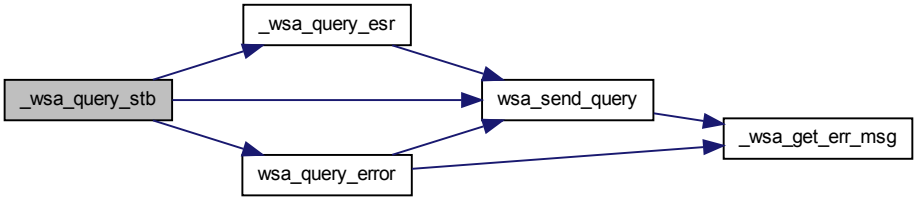
5.2.1.3 int16_t _wsa_query_esr (struct wsa_device * *dev*, char * *output*)

Here is the call graph for this function:



5.2.1.4 int16_t _wsa_query_stb (struct wsa_device * *dev*, char * *output*)

Here is the call graph for this function:



5.2.1.5 int16_t wsa_connect (struct wsa_device * *dev*, char * *cmd_syntax*, char * *intf_method*)

Connect to a WSA through the specified interface method **intf_method**, and communicate control commands in the format of the given command syntax.

After successfully connected, this function will also do:

- Check for any errors in WSA
- Gather information for the WSA's descriptor

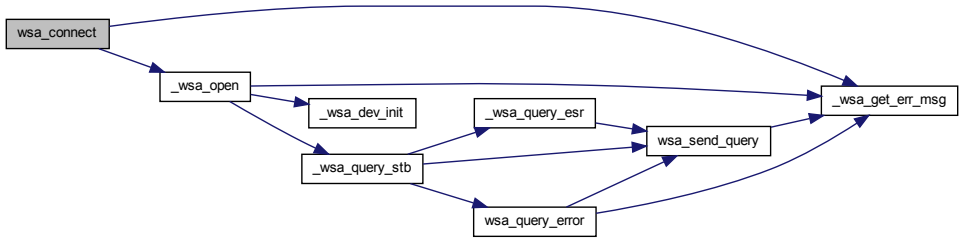
Parameters

dev	- A pointer to the WSA device structure to be connected/establised.
cmd_syntax	- A char pointer to store standard for control commands communication to the WSA. Currently supported standard command syntax type is: SCPI.
intf_method	- A char pointer to store the interface method to the WSA. Possible methods: • With USB, use: "USB" (check if supported with the WSA version used). • With LAN, use: "TCPIP::<Ip address of the WSA>[::<cmd port,data port>]". The ports' number if not entered will be defaulted to: – command port: 37001 – data port: 37000 However, if port forwarding method is used to forward different ports to the required ports eventually, then you can enter the ports in the format and the ***order*** *as* specified. Example: "TCPIP::192.168.1.1" or "TCPIP::192.168.1.1::37001,37001"

Returns

0 on success, or a negative number on error.

Here is the call graph for this function:



5.2.1.6 int32_t wsa_decode_frame (char * *data_buf*, int16_t * *i_buf*, int16_t * *q_buf*, uint32_t *sample_size*)

Decodes the raw **data_buf** buffer containing frame(s) of I & Q data bytes and returned the I and Q buffers of data with the size determined by the **sample_size** parameter.

Note: the **data_buf** size is assumed as **sample_size** * 4 bytes per sample

Parameters

data_buf	- A char pointer buffer containing the raw I and Q data in in bytes to be decoded into separate I and Q buffers. Its size is assumed to be the number of 32-bit sample_size words multiply by 4 (i.e. sizeof(data_buf) = sample_size ∗ 4 bytes per sample).
i_buf	- A 16-bit signed integer pointer for the unscaled, I data buffer with size specified by the **sample_size**.
q_buf	- A 16-bit signed integer pointer for the unscaled, Q data buffer with size specified by the **sample_size**.
sample_size	- A 32-bit unsigned integer number of {I, Q} sample pairs to be decoded from **data_buf**. The frame size is limited to a maximum number, **max_sample_size**, listed in the **wsa_descriptor** structure.

Returns

The number of samples decoded, or a 16-bit negative number on error.

5.2.1.7 int16_t wsa_disconnect (struct wsa_device ∗ *dev*)

Close the device connection if one is started, stop any existing data capture, and perform any necessary clean ups.

Parameters

dev	- A pointer to the WSA device structure to be closed.

Returns

0 on success, or a negative number on error.

5.2.1.8 const char∗ wsa_get_error_msg (int16_t *err_code*)

Returns a message string associated with the given **err_code** that is returned from a **wsa_lib** function.

Parameters

err_code	- The negative WSA error code, returned from a WSA function.

Returns

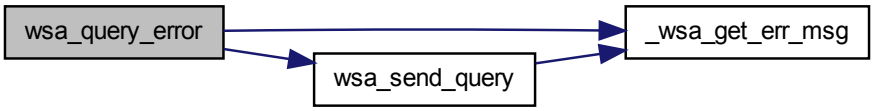
A char pointer to the error message string.

Here is the call graph for this function:

5.2.1.9 int16_t wsa_list_devs (char ** *wsa_list*)

5.2.1.10 char * wsa_query_error (struct wsa_device * *dev*)

Here is the call graph for this function:



5.2.1.11 int16_t wsa_read_frame (struct wsa_device * *dev*, struct wsa_frame_header * *header*, char * *data_buf*, uint32_t *sample_size*, uint32_t *time_out*)

Reads a frame of data. *Each* frame consists of a header and a buffer of data of length determined by the **sample_size** parameter (i.e. sizeof(**data_buf**) = **sample_size** * 4 bytes per sample).

Each I and Q samples is 16-bit (2-byte) wide, signed 2-complement. The raw data_buf contains alternatively 2-byte Q follows by 2-byte I, so on. In another words, the I & Q samples are distributed in the raw data_buf as follow:

```
data_buf = IQIQIQIQ... = <2 bytes I><2 bytes Q><...>
```

The bytes can be decoded, as an example, as follow:

```
Let takes the first 4 bytes of the \b data_buf, for example, then:

        int16_t I = data_buf[3] << 8 + data_buf[2];
        int16_t Q = data_buf[1] << 8 + data_buf[0];

And so on for N number of samples:

        int16_t I[i] = data_buf[i+3] << 8 + data_buf[i+2];
        int16_t Q[i] = data_buf[i+1] << 8 + data_buf[i];

where i = 0, 1, 2, ..., (N - 2), (N - 1).
```

Alternatively, the **data_buf** can be passed to wsa_decode_frame() to have I and Q splitted up and stored into separate int16_t buffers. The wsa_decode_frame() function is useful for later needs of decoding the data bytes when a large amount of raw data (multiple frames) has been captured for instance.

Remarks

This function does not set the **sample_size** to WSA at each capture in order to minimize the delay between captures. The number of samples per frame must be sent to WSA at least once during the WSA powered on. For example, with SCPI, do:

```
wsa_send_command(dev, "TRACE:IQ:POINTS 1024\n");
```

Parameters

dev	- A pointer to the WSA device structure.
header	- A pointer to **wsa_frame_header** structure to store information for the frame.
data_buf	- A char pointer buffer to store the raw I and Q data in in bytes. Its size is determined by the number of 32-bit **sample_size** words multiply by 4 (i.e. sizeof(**data_buf**) = **sample_size** ∗ 4 bytes per sample, which is automatically done by the function).
sample_size	- A 32-bit unsigned integer sample size (i.e. number of {I, Q} sample pairs) per data frame to be captured. The size is limited to a maximum number, **max_sample_size**, listed in the **wsa_descriptor** structure.
time_out	- The time, in milliseconds, to wait for a packet from a WSA before time out.

Returns

A 4-bit frame count number that starts at 0, or a 16-bit negative number on error.

5.2.1.12 int16_t wsa_read_status (struct wsa_device ∗ *dev*, char ∗ *output*)

Query the status of the WSA box for any event and store the output response(s) in the **output** parameter.

Remarks

This function is equivalent to the SCPI command "∗STB?".

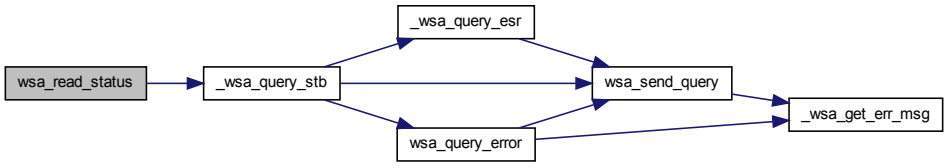
Parameters

dev	
output	- a char pointer to the output result message of the query

Returns

0 if successfully queried, or a negative number upon errors.

Here is the call graph for this function:



5.2.1.13 int16_t wsa_send_command (struct wsa_device ∗ *dev*, char ∗ *command*)

Send the control command string to the WSA device specified by **dev**. The commands format must be written according to the specified standard syntax in wsa_connect().

Remarks

To send query command, use wsa_send_query() instead.

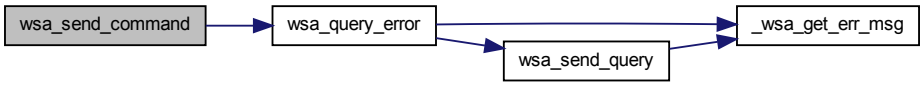
Parameters

dev	- A pointer to the WSA device structure.
command	- A char pointer to the control command string written in the format specified by the syntax standard in wsa_connect()

Returns

Number of bytes sent on success, or a negative number on error.

Here is the call graph for this function:



5.2.1.14 int16_t wsa_send_command_file (struct wsa_device * *dev*, char * *file_name*)

Read command line(s) stored in the given **file_name** and send each line to the WSA.

Remarks

- Assuming each command line is for a single function followed by a new line.
- Currently read only SCPI commands. Other types of commands, TBD.

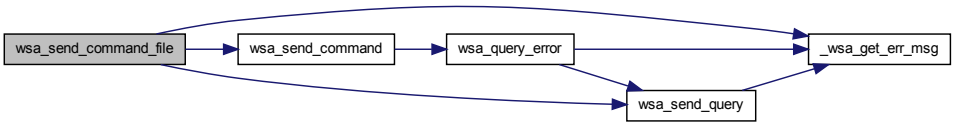
Parameters

dev	- A pointer to the WSA device structure.
file_name	- A pointer to the file name

Returns

Number of command lines at success, or a negative error number.

Here is the call graph for this function:



5.2.1.15 struct wsa_resp wsa_send_query (struct wsa_device * *dev*, char * *command*) [read]

Send query command to the WSA device specified by **dev**. The commands format must be written according to the specified command syntax in wsa_connect() (ex. SCPI).

Parameters

dev	- A pointer to the WSA device structure.
command	- A char pointer to the query command string written in the format specified by the command syntax in wsa_connect().

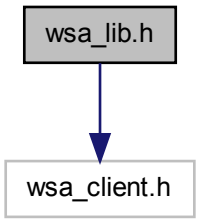
Returns

The result stored in a wsa_resp struct format.

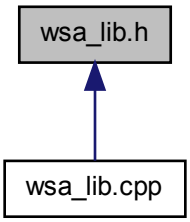
Here is the call graph for this function:

5.3 wsa_lib.h File Reference

Include dependency graph for wsa_lib.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- struct wsa_descriptor

  This structure stores WSA information.
- struct wsa_time

  This structure contains the time information. It is used for the time stamp in a frame header.
- struct wsa_frame_header

  This structure contains header information related to each frame read by wsa_read_frame().
- struct wsa_socket

  A structure containing the socket parameters used for creating TCP/IP connection for control and data acquisition.
- struct wsa_device

  A structure containing the components associate with each WSA device.
- struct wsa_resp

  This structure contains the response information for each query.

Defines

- #define FALSE 0
- #define TRUE 1
- #define NUM_RF_GAINS 5
- #define SCPI "SCPI"

Enumerations

- enum wsa_gain { WSA_GAIN_HIGH = 1, WSA_GAIN_MED, WSA_GAIN_LOW, WSA_GAIN_VLOW }

Functions

- int16_t wsa_connect (struct wsa_device *dev, char *cmd_syntax, char *intf_method)
- int16_t wsa_disconnect (struct wsa_device *dev)
- int16_t wsa_list_devs (char **wsa_list)
- int16_t wsa_send_command (struct wsa_device *dev, char *command)
- int16_t wsa_send_command_file (struct wsa_device *dev, char *file_name)
- struct wsa_resp wsa_send_query (struct wsa_device *dev, char *command)
- int16_t wsa_read_status (struct wsa_device *dev, char *output)
- const char * wsa_get_error_msg (int16_t err_code)
- int16_t wsa_read_frame (struct wsa_device *dev, struct wsa_frame_header *header, char *data_buf, uint32_t sample_size, uint32_t time_out)
- int32_t wsa_decode_frame (char *data_buf, int16_t *i_buf, int16_t *q_buf, uint32_t sample_size)

5.3.1 Define Documentation

5.3.1.1 #define FALSE 0

5.3.1.2 #define NUM_RF_GAINS 5

5.3.1.3 #define SCPI "SCPI"

5.3.1.4 #define TRUE 1

5.3.2 Enumeration Type Documentation

5.3.2.1 enum wsa_gain

Defines the RF quantized gain settings available for the radio front end (RFE) of the WSA.

Enumerator:

WSA_GAIN_HIGH High RF amplification. Value 1.

WSA_GAIN_MED Medium RF amplification.

WSA_GAIN_LOW Low RF amplification.

WSA_GAIN_VLOW Very low RF amplification.

5.3.3 Function Documentation

5.3.3.1 int16_t wsa_connect (struct wsa_device * *dev*, char * *cmd_syntax*, char * *intf_method*)

Connect to a WSA through the specified interface method **intf_method**, and communicate control commands in the format of the given command syntax.

After successfully connected, this function will also do:

- Check for any errors in WSA
- Gather information for the WSA's descriptor

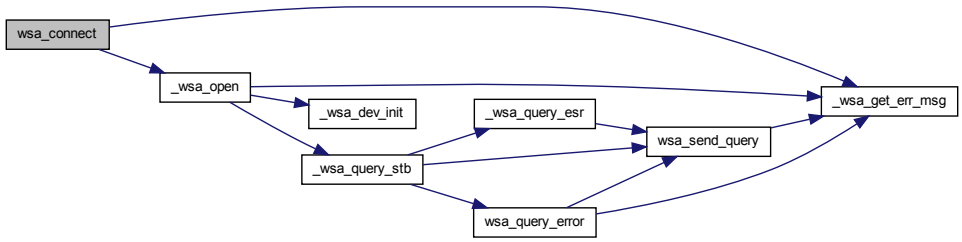
Parameters

dev	- A pointer to the WSA device structure to be connected/establised.
cmd_syntax	- A char pointer to store standard for control commands communication to the WSA. Currently supported standard command syntax type is: SCPI.
intf_method	- A char pointer to store the interface method to the WSA. Possible methods: • With USB, use: "USB" (check if supported with the WSA version used). • With LAN, use: "TCPIP::<Ip address of the WSA>[::<cmd port,data port>]". The ports' number if not entered will be defaulted to: – command port: 37001 – data port: 37000 However, if port forwarding method is used to forward different ports to the required ports eventually, then you can enter the ports in the format and the ***order*** *as* specified. Example: "TCPIP::192.168.1.1" or "TCPIP::192.168.1.1::37001,37001"

Returns

0 on success, or a negative number on error.

Here is the call graph for this function:



5.3.3.2 int32_t wsa_decode_frame (char * *data_buf,* int16_t * *i_buf,* int16_t * *q_buf,* uint32_t *sample_size*)

Decodes the raw **data_buf** buffer containing frame(s) of I & Q data bytes and returned the I and Q buffers of data with the size determined by the **sample_size** parameter.

Note: the **data_buf** size is assumed as **sample_size** * 4 bytes per sample

Parameters

data_buf	- A char pointer buffer containing the raw I and Q data in in bytes to be decoded into separate I and Q buffers. Its size is assumed to be the number of 32-bit sample_size words multiply by 4 (i.e. sizeof(data_buf) = sample_size * 4 bytes per sample).
i_buf	- A 16-bit signed integer pointer for the unscaled, I data buffer with size specified by the **sample_size**.
q_buf	- A 16-bit signed integer pointer for the unscaled, Q data buffer with size specified by the **sample_size**.

sample_size	- A 32-bit unsigned integer number of {I, Q} sample pairs to be decoded from **data_buf**. The frame size is limited to a maximum number, **max_sample_size**, listed in the **wsa_descriptor** structure.

Returns

The number of samples decoded, or a 16-bit negative number on error.

5.3.3.3 int16_t wsa_disconnect (struct wsa_device * *dev*)

Close the device connection if one is started, stop any existing data capture, and perform any necessary clean ups.

Parameters

dev	- A pointer to the WSA device structure to be closed.

Returns

0 on success, or a negative number on error.

5.3.3.4 const char* wsa_get_error_msg (int16_t *err_code*)

Returns a message string associated with the given **err_code** that is returned from a **wsa_lib** function.

Parameters

err_code	- The negative WSA error code, returned from a WSA function.

Returns

A char pointer to the error message string.

Here is the call graph for this function:

5.3.3.5 int16_t wsa_list_devs (char ** *wsa_list*)

5.3.3.6 int16_t wsa_read_frame (struct wsa_device * *dev,* struct wsa_frame_header * *header,* char * *data_buf,* uint32_t *sample_size,* uint32_t *time_out*)

Reads a frame of data. *Each* frame consists of a header and a buffer of data of length determined by the **sample_size** parameter (i.e. sizeof(**data_buf**) = **sample_size** * 4 bytes per sample).

Each I and Q samples is 16-bit (2-byte) wide, signed 2-complement. The raw data_buf contains alternatively 2-byte Q follows by 2-byte I, so on. In another words, the I & Q samples are distributed in the raw data_buf as follow:

```
data_buf = IQIQIQIQ... = <2 bytes I><2 bytes Q><...>
```

The bytes can be decoded, as an example, as follow:

```
Let takes the first 4 bytes of the \b data_buf, for example, then:

        int16_t I = data_buf[3] << 8 + data_buf[2];
        int16_t Q = data_buf[1] << 8 + data_buf[0];

And so on for N number of samples:

        int16_t I[i] = data_buf[i+3] << 8 + data_buf[i+2];
        int16_t Q[i] = data_buf[i+1] << 8 + data_buf[i];

where i = 0, 1, 2, ..., (N - 2), (N - 1).
```

Alternatively, the **data_buf** can be passed to wsa_decode_frame() to have I and Q splitted up and stored into separate int16_t buffers. The wsa_decode_frame() function is useful for later needs of decoding the data bytes when a large amount of raw data (multiple frames) has been captured for instance.

Remarks

This function does not set the **sample_size** to WSA at each capture in order to minimize the delay between captures. The number of samples per frame must be sent to WSA at least once during the WSA powered on. For example, with SCPI, do:

```
wsa_send_command(dev, "TRACE:IQ:POINTS 1024\n");
```

Parameters

dev	- A pointer to the WSA device structure.
header	- A pointer to **wsa_frame_header** structure to store information for the frame.
data_buf	- A char pointer buffer to store the raw I and Q data in in bytes. Its size is determined by the number of 32-bit **sample_size** words multiply by 4 (i.e. sizeof(**data_buf**) = **sample_size** * 4 bytes per sample, which is automatically done by the function).
sample_size	- A 32-bit unsigned integer sample size (i.e. number of {I, Q} sample pairs) per data frame to be captured. The size is limited to a maximum number, **max_sample_size**, listed in the **wsa_descriptor** structure.
time_out	- The time, in milliseconds, to wait for a packet from a WSA before time out.

Returns

A 4-bit frame count number that starts at 0, or a 16-bit negative number on error.

5.3.3.7 int16_t wsa_read_status (struct wsa_device * *dev*, char * *output*)

Query the status of the WSA box for any event and store the output response(s) in the **output** parameter.

Remarks

This function is equivalent to the SCPI command "*STB?".

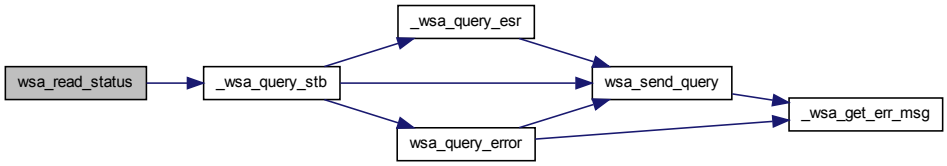
Parameters

dev	
output	- a char pointer to the output result message of the query

Returns

0 if successfully queried, or a negative number upon errors.

Here is the call graph for this function:



5.3.3.8 int16_t wsa_send_command (struct wsa_device * *dev*, char * *command*)

Send the control command string to the WSA device specified by **dev**. The commands format must be written according to the specified standard syntax in wsa_connect().

Remarks

To send query command, use wsa_send_query() instead.

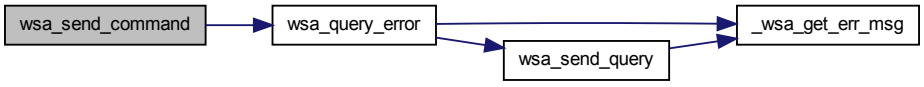
Parameters

dev	- A pointer to the WSA device structure.
command	- A char pointer to the control command string written in the format specified by the syntax standard in wsa_connect()

Returns

Number of bytes sent on success, or a negative number on error.

Here is the call graph for this function:



5.3.3.9 int16_t wsa_send_command_file (struct wsa_device * *dev*, char * *file_name*)

Read command line(s) stored in the given **file_name** and send each line to the WSA.

Remarks

- Assuming each command line is for a single function followed by a new line.
- Currently read only SCPI commands. Other types of commands, TBD.

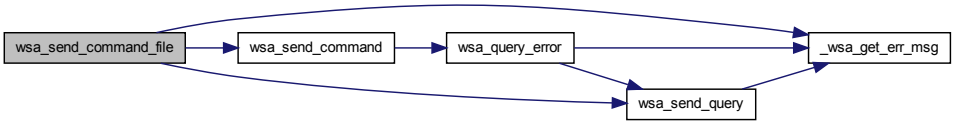
Parameters

dev	- A pointer to the WSA device structure.
file_name	- A pointer to the file name

Returns

Number of command lines at success, or a negative error number.

Here is the call graph for this function:



5.3.3.10 struct wsa_resp wsa_send_query (struct wsa_device * *dev*, char * *command*) [read]

Send query command to the WSA device specified by **dev**. The commands format must be written according to the specified command syntax in wsa_connect() (ex. SCPI).

Parameters

dev	- A pointer to the WSA device structure.
command	- A char pointer to the query command string written in the format specified by the command syntax in wsa_connect().

Returns

The result stored in a wsa_resp struct format.

Here is the call graph for this function:

5.4 wsa_lib.txt File Reference

Contain some code documents for wsa_lib.h.

5.4.1 Detailed Description

Index