SENSOR
TECHNOLOGY LTD

# ORT/RWT/SGR Series Transducer DLL Programmer’s Guide

## STCOMMDLL_V5U
## Version 5.7

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## Introduction

The DLL (dynamic link library) provides the programmer with a method of interfacing a program with an advanced ORT/RWT/SGR series transducer, without having to talk directly using the communication protocol.

The DLL simplifies the use of the USB, RS232 and Ethernet interfaces by providing a unified interface to access connected transducers; it takes care of the low-level driver access, protocol negotiation and data manipulation.

## Compatible Models

The DLL is compatible with transducers from the advanced ORT, RWT and SGR family of products. Transducers must be running firmware version 3 or higher and have digital communications enabled.

The table below lists the models that are compatible:

| Transducer Family | Model Range | Models |
|---|---|---|
| Optical (ORT) | ORT240 | ORT240/ORT241 |
| Rayleigh Wave (RWT) | RWT320 | RWT320/RWT321/RWT322 |
| | RWT340 | RWT340/RWT341/RWT342 |
| | RWT420 | RWT420/RWT421/RWT422 |
| | RWT440 | RWT440/RWT441/RWT442 |
| Strain Gauge Rotary (SGR) | SGR520 | SGR520/SGR521/SGR522 |
| | SGR540 | SGR540/SGR541/SGR542 |

Compatible transducers can be identified by the presence of a status LED and serial number greater than 12200.

## Ethernet Module

The Ethernet Module is an add-on module which adds network connectivity to our transducers. In simple terms it is a RS232 to Ethernet convertor, but that description is an over simplification, with the module capable of a lot more.

The Ethernet Module supports multiple concurrent end users, can be accessed through the internet and has support for SQL data logging. Future updates will add an embedded web server, which will host Torqview for Web.

The Ethernet Module is compatible with the models listed in the previous section, provided that they are running firmware version 4 or higher. A firmware upgrade to 5.2.1 is advised for best operation.

## Overview

The DLL was written to simplify and speed up the process of developing a custom application to interact with a transducer.

The DLL is written in C and can be used with a number of other programming languages. The function descriptions refer to C type variables, but equivalents can be used in other languages.

The functions available give access to most of the available data and control functions, the commands for accessing transducers connected by RS232, USB or Ethernet are the same.

The DLL can control up to 10 devices simultaneously, all the programmer need do is identify the required transducer by passing a device id with each function command.

## Initialising and Accessing a Transducer

Before a transducer can be accessed the DLL needs to be initialised by finding connected transducers. When the DLL initialises, it builds a device list in memory of the transducers that it finds. When a transducer is found the DLL downloads its configuration and saves the data with the transducer in the list. Device handles and connection settings are also saved. The list enables quick access to transducer configuration data and hides some of the complexity of accessing the underlying interfaces.

Transducers are opened, closed and accessed by providing a device id, the id is a reference to the device list, and uniquely identifies each connected transducer. Device id’s start at 0, and are allocated incrementally as transducers are found.

The procedure for interacting with the DLL and subsequently the transducer is detailed below:

1. Initialise the DLL – Initialise the DLL by calling the **ST_Find_Devices** or **ST_Find_Devices_Ex** functions, this will search the system for connected transducers and build up a list of the transducers found. The DLL will cache connection and configuration information from the transducers for local lookup.
2. Identify the attached transducer(s) (Optional) – Use the **ST_GETINFO** functions to identify and extract configuration information on the connected transducers.
3. Open a transducer – Use the **ST_Open_Device** function to select a transducer for use. The communication channel that the transducer is connected to is initialised and resources are allocated. Up to 10 transducers can be open for use at any time. A transducer will remain open until it is closed or the process calling the DLL exits.
4. Get data – Use the **ST_GET** and **ST_SET** functions to get data and configure settings on the selected transducer. Open transducers can be accessed at random.
5. Close a transducer – When access to a transducer is no longer needed, use the **ST_Close_Device** or **ST_Close_ALL_Devices** function to close the communication channel and free resources for the selected transducer. The DLL will automatically close all transducers when the calling process exits.

## Discovering Transducers

The transducer discovery process is part of the initialisation phase and is initiated with the **ST_Find_Devices** or **ST_Find_Devices_Ex** functions. The two find device functions perform the same purpose, but differ in search control.

The **ST_Find_Devices** function is a legacy function which is kept to maintain compatibility with existing applications. This function works hand in hand with the port helper functions, which provide a list of ports detected in the system.

The **ST_Find_Devices_Ex** function offers a higher degree of search control, it doesn't rely on the port helper functions, instead the user can specify unique search configurations or manually specify a list of ports.

For new applications, the **ST_Find_Devices_Ex** function should be used. There are two parts to the search criteria, a fixed search filter and a custom comma separated list.

The fixed search filter is comprised of one or more flags. The flags should be OR'ed together. The table below shows the search filter flags with their values and DLL definition names.

| Interface Search Flag | Interface | DLL Definition |
|---|---|---|
| 1 | Ethernet | ST_SEARCH_ETHERNET |
| 2 | RS232 | ST_SEARCH_RS232 |
| 4 | USB | ST_SEARCH_USB |
| 8 | Custom List | ST_SEARCH_CUSTOM |

These flags specify generic filter options and don't target a specific device or port. The USB filter interrogates the Operating System for devices. The RS232 filter will instruct the DLL to cycle through all detected COM ports. The Ethernet filter will send a broadcast packet on all interfaces to the default or configured port.

There is a special designation which searches all interfaces, this is selected by a zero value, or by using ST_SEARCH_ALL. ST_SEARCH_ALL is the equivalent of ST_SEARCH_ETHERNET, ST_SEARCH_RS232 and ST_SEARCH_USB.

The user can specify specific ports by using the Custom List flag, in combination with a comma separated list of ports. Each field in the list must consist of a Prefix and Value, the prefix defines the interface type, and the value defines the port designation, e.g. COM1. The table below lists the port prefixes.

| Prefix | Interface | Format | Example |
|---|---|---|---|
| NET= | Ethernet | NET=HOST:PORT | NET=192.168.1.1<br>NET=MYTRAN.CO.UK:4200 |
| | The Ethernet address can be specified in IPV4 form, or as a hostname. The port number is optional, if not specified, the DLL will use the configured default. The default can be configured in Transducer Control or Torqview. | | |
| RS232= | RS232 | RS232=PORTNAME | RS232=COM1 |
| | Specifies a specific COM port to search on. PORTNAME is the designation assigned by Windows. | | |
| = | **ST_Port_Name,<br>ST_Port_Name_EX** | =INDEX | =0 |
| | Specifying a "=" prefix, uses the index of the port specified in the port helper functions list. | | |

To demonstrate the usage of the **ST_Find_Devices_Ex** function, there are a few examples in the tables below. The devices_found and waitforcomplete parameters are present for completeness, but have no bearing on the examples.

| Example 1 | Fixed Search Filter (searchfilter) | Comma Separated List (ports) |
|---|---|---|
| Function Call | ST_Find_Devices_Ex(&devcount, ST_SEARCH_USB, 0, TRUE); | |
| Parameters | ST_SEARCH_USB | 0 |
| Description | Search for transducers on USB and wait for completion. | |

| Example 2 | Fixed Search Filter (searchfilter) | Comma Separated List (ports) |
|---|---|---|
| Function Call | ST_Find_Devices_Ex(&devcount, ST_SEARCH_ETHERNET, 0, TRUE); | |
| Parameters | ST_SEARCH_ETHERNET | 0 |
| Description | Search for transducers on ethernet and wait for completion. | |

| **Example 3** | **Fixed Search Filter (searchfilter)** | **Comma Separated List (ports)** |
|---|---|---|
| Function Call | ST_Find_Devices_Ex(&devcount, ST_SEARCH_USB \| ST_SEARCH_ETHERNET, 0, TRUE); | |
| Parameters | ST_SEARCH_USB \| ST_SEARCH_ETHERNET | 0 |
| Description | Search on Ethernet/USB and wait for completion. | |

| **Example 4** | **Fixed Search Filter (searchfilter)** | **Comma Separated List (ports)** |
|---|---|---|
| Function Call | ST_Find_Devices_Ex(&devcount, ST_SEARCH_USB \| ST_SEARCH_CUSTOM, "NET=192.168.1.1", TRUE); | |
| Parameters | ST_SEARCH_USB \| ST_SEARCH_CUSTOM | NET=192.168.1.1 |
| Description | Search on USB and individual ethernet host (192.168.1.1), and wait for completion | |

| **Example 5** | **Fixed Search Filter (searchfilter)** | **Comma Separated List (ports)** |
|---|---|---|
| Function Call | ST_Find_Devices_Ex(&devcount, ST_SEARCH_USB \| ST_SEARCH_CUSTOM, "NET=192.168.1.1,NET=enet01.sensors.co.uk:4200,RS232=COM1", TRUE); | |
| Parameters | ST_SEARCH_USB \| ST_SEARCH_CUSTOM | NET=192.168.1.1,<br>NET=enet01.sensors.co.uk:4200<br>RS232=COM1 |
| Description | Search on USB, two individual Ethernet host (192.168.1.1 and enet01.sensors.co.uk), COM1 and wait for completion | |

To aid port selection, there is a set of port helper functions. These port helper functions help notify the calling program on the filter options available. This functionality allows programmers to write an application that isn't PC specific.

The filter option list includes generic search all options for Ethernet, USB and RS232. It will also include all the RS232 ports detected by the DLL, as well as any custom network host entries, the user has added using Transducer Control or Torqview.

There are two parts to the filter retrieval process, first get the list length using the **ST_How_Many_Ports** function, then retrieve each filter from the list using the **ST_Port_Name/ST_Port_Name_EX** functions. When calling **ST_Port_Name/ST_Port_Name_EX** an index number is required to select between each filter, the index is referenced from 0 and is valid upto the list length minus 1. The index value used to retrieve the filters, is also the search index used by **ST_Find_Devices**, and is a valid list entry for **ST_Find_Devices_Ex**.

There are two modes that can be used to control the discovery process, Mode 1 - Execute and wait and Mode 2 – Execute and return.

The amount of time required for the discovery process varies depending upon the number ports on the system and the search filter used. The search filter directs the discovery process on where it should look for transducers. The filter selected will have a big impact on how long the discovery process will take and should factor in the decision on what mode to use.

Transducers connected via USB are easily found, as the operating system can be queried to see if there is a device attached. USB searches occur almost instantly. Transducers connected via RS232 are more difficult to detect, the detection process involves sending out a zero byte to request a transducer identification string, if the correct response is received, the DLL will cache the transducers configuration and continue. If a timeout or an incorrect response occurs, the DLL will switch to a different baud rate and query the transducer again, this process repeats for each of the three baud rates available. Ethernet filter options are more complex, a generic ethernet filter will send out a broadcast packet on all interfaces, and collect all responses until a timeout occurs. A specific host definition detection time will depend on network latencies, but will be almost instant for most LAN’s.

When RS232 or Ethernet is used as a search filter, it is recommended that mode 2 be used, as mode 1 can often cause your program to hang or receive the “not responding” message. If you specify a single COM port or target a single known host, this is less important. If the device is present on that port or address, the time required to initialise will be minimal.

***Mode 1 – Execute and wait***

The execute and wait mode initiates a DLL find device process and will block the calling process until a search has been completed. When the function call returns the process will have completed and is ready for the next function call. The execute and wait mode is selected by setting the waitforcomplete parameter to TRUE.

This mode requires only a single call, if the connection method is known and the filter is selected accordingly, then mode 1 is the best option.

***Mode 2 – Execute and return***

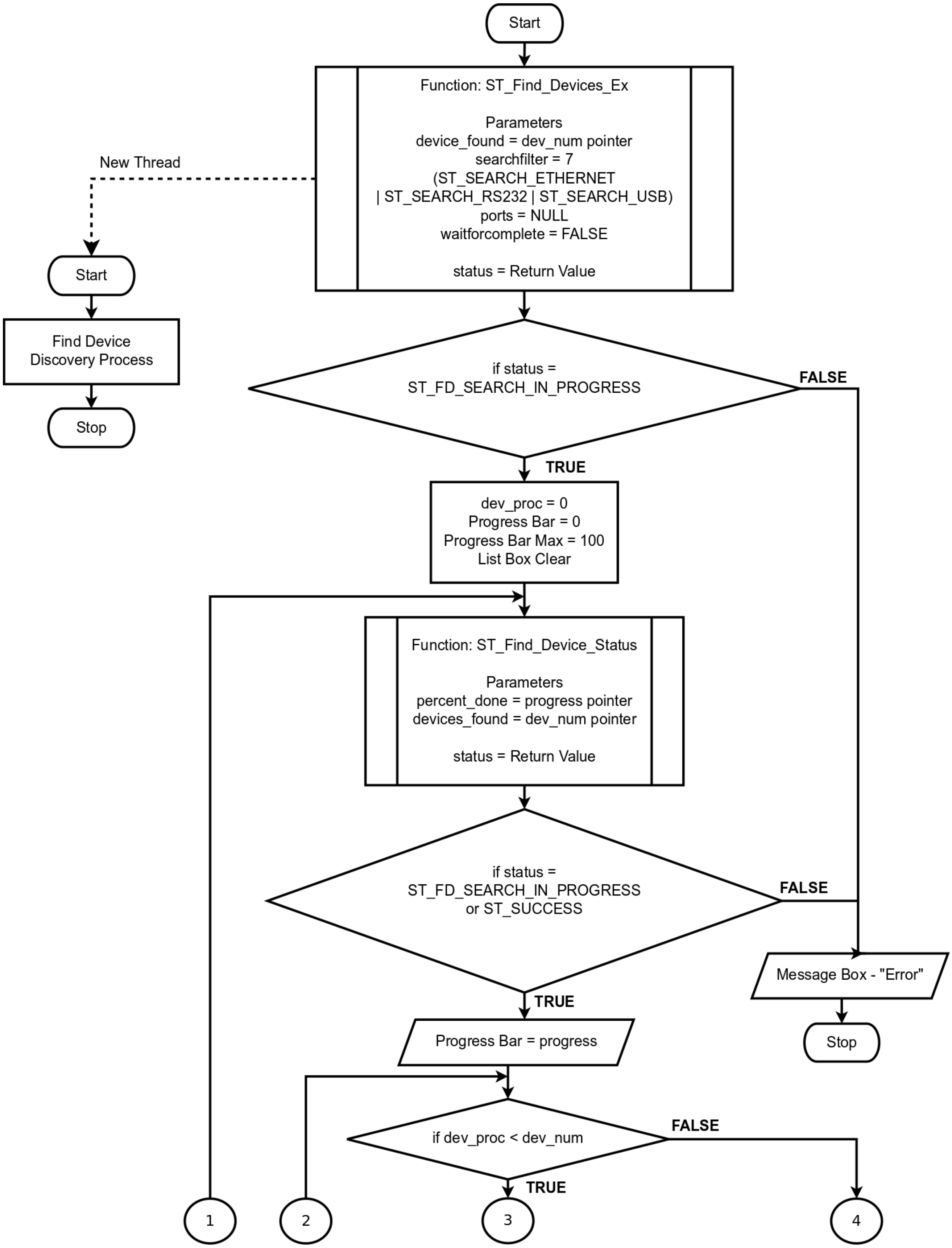
The execute and return mode initiates a DLL find device process and returns execution back to the calling process. When the find device process initiates, it spawns a new thread for the search to run in. Until the process completes you cannot open or access a transducer.

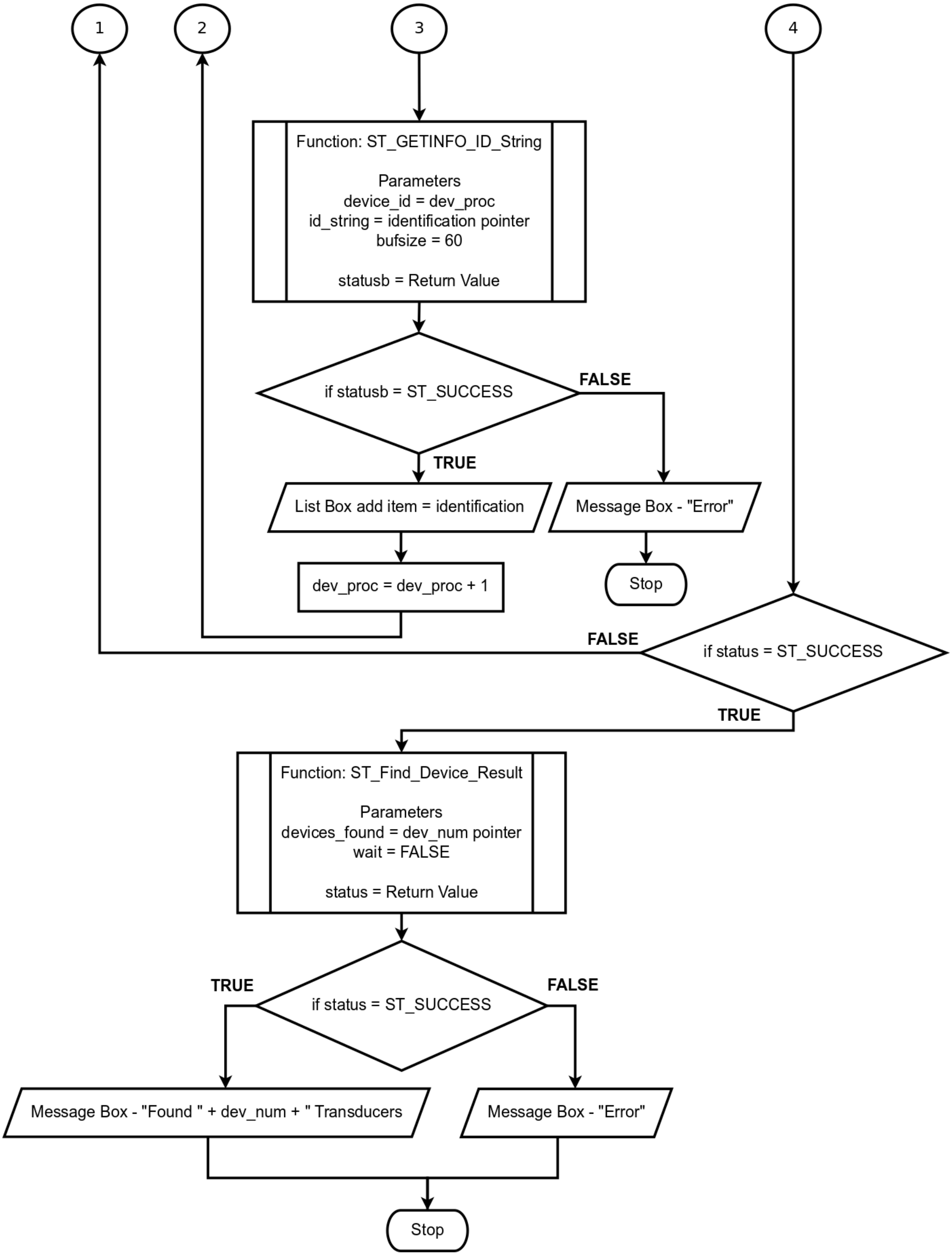
While the find device process is running it will need to be monitored for progress and completion. Process monitoring is accomplished by using the **ST_Find_Device_Status** function, which will provide information on the progress percentage and the number of devices found. The **ST_Find_Device_Status** function will return success when the find device process has completed, when this occurs, call the **ST_Find_Device_Result** function to deallocate used resources and enable devices to be openned.

While the find device process is being monitored using **ST_Find_Device_Status**, the **GET_INFO** commands can be used to retrieve information on transducers that have been found so far.

The execute and return mode is selected by setting the waitforcomplete parameter to FALSE.

The flow chart below shows an example of how to use the discovery process in mode 2. The example is based on a simple form with a progress bar and list box.




1
2
3
4
Function: ST_GETINFO_ID_String
Parameters
device_id = dev_proc
id_string = identification pointer
bufsize = 60
statusb = Return Value
if statusb = ST_SUCCESS
FALSE
TRUE
List Box add item = identification
Message Box - "Error"
dev_proc = dev_proc + 1
Stop
FALSE
if status = ST_SUCCESS
TRUE
Function: ST_Find_Device_Result
Parameters
devices_found = dev_num pointer
wait = FALSE
status = Return Value
TRUE
if status = ST_SUCCESS
FALSE
Message Box - "Found " + dev_num + " Transducers
Message Box - "Error"
Stop

## Data Block Functions

The DLL includes two block capture functions which transfer complete data sets from the connected transducer. These functions enable convenient access to all available data with a single function call.

The down side of using these block commands is the amount of data that is transferred during the transaction. The transfer time required will significantly affect the maximum achievable capture rate. If sample rate is important, you may wish to consider using the data capture mode, alternatively the single data request functions can be used.

## Torque Types

The primary purpose of the ORT/RWT/SGR series transducers is to measure torque, the torque value that is output from the transducer is run through several processes within the firmware, these processes include a filter (if enabled), frequency to torque rescaling, temperature correction and zero offset adjustment. The filter is a running average with a standard deviation cut off to remove spurious readings, the running average enables the sample throughput to be unaffected by filter size.

Once the final torque value is computed it is run though a peak torque capture algorithm. The peak torque algorithm monitors the incoming data and compares it against a set of stored values using various criteria. If the value matches the criteria, that value replaces the stored value. In most cases the criterion is related to whether the captured value is greater than the stored value.

Peak values assume a reset position on start-up, when peak values are reset they are set to zero, PeakMinMax values are set to the current torque value.

The peak torque algorithm is run on every valid torque reading captured, ensuring that no peak value is missed.

The torque value, unless specified, will always be scaled in the native unit of measurement for the transducer.

The following subsections describe the different types of peak torque.

### *Peak Torque*

The peak torque value indicates the highest torque applied to the transducer in either direction. The value is signed to indicate the direction that the torque was applied in.

### *Peak Torque with AutoReset*

The Peak Torque with Auto Reset value is similar to the Peak Torque feature, it works in the same way by recording the maximum torque, but automatically resets to zero when the current torque value drops below a configured percentage of the peak value.

The default auto reset percentage is 80%; the percentage can be configured using the "Transducer Control" program which accompanies our advanced ORT/RWT/SGR Series Transducers. Newer firmware versions offer additional customisations, see the "Transducer Control" manual.

### *Peak Torque CW*

The peak torque CW value records the highest torque value measured in the clockwise direction.

### ***Peak Torque CCW***

The peak torque CCW value records the highest torque value measured in the counter-clockwise direction.

### ***PeakMinMax***

The PeakMinMax feature monitors the captured torque values and records the lowest and highest value from a reference position. This reference is given via the **ST_RESET_Peaks** command and assumes zero on power on. An example of the PeakMinMax feature is as follows: if the reference is set to 10, then the torque value goes up by 10 and down by 12, Max would be 20 and Min would be -2.

## Speed Modes

Speed is decoded from a square wave signal, produced by a shaft mounted grating passing through an optical sensor. The frequency of the square wave indicates the rotational speed of the shaft. The transducer uses two methods for the measurement of speed, both methods run simultaneously, offer good accuracy, but differ in measurement time. Speed is always measured in revolutions per minute (RPM).

### *Slow*

The slow method uses a frequency count. Rising edges of the square wave are counted over a period of a second, and then calculated into RPM. As the name suggests this method is slow as measurements will be produced at a rate of 1 a second. This method is good if you have a fluctuating drive speed and wish to filter the captured speed value.

### *Fast*

The fast method uses a period count. The period count measures the time between rising edges of the square wave, then computes the RPM by turning the time into frequency. The fast methods measurement rate is variable and is directly related to the rotational speed of the transducer. When the rotational speed of the shaft rises above 2000 RPM, the fast method will increase the number of rising edges over which time is measured, this is done to preserve measurement accuracy.

The fast methods measurement rate can be calculated from the following tables. The measurement rate differs between the different hardware revisions, due to differing capabilities. The calculations shown are based on a standard 60 line grating.

*RWT320/340 (MKII)*

| **Rotational Speed (RPM)** | | **Update Rate (Hz)** |
|---|---|---|
| **From** | **To** | |
| 0 | | 1 Hz |
| 1 | 2000 | RPM / 2 |
| 2000 | 4000 | ((RPM – 2000 ) x 0.3227 ) + 650 |
| 4000 | 8000 | ((RPM – 4000 ) x 0.196 ) + 800 |
| 8000 | 16000 | ((RPM – 8000 ) x 0.1117 ) + 850 |
| 16000 | 32000 | ((RPM – 16000 ) x 0.058 ) + 900 |

*ORT240/RWT420/440/SGR520/540 (MKIII)*

| **Rotational Speed (RPM)** | **Update Rate (Hz)** |
|---|---|
| 0 | 1 Hz |
| < 2000 | RPM |
| > 2000 | RPM x ( 1 / ( ⌊ (RPM - 1) / 2000 ⌋ + 1 ) ) |

Both modes have their own peak monitor to record the highest measured speed.

## Temperature Sensors

The transducer monitors temperature from different sensors, these are defined as ambient, shaft and internal. The shaft temperature is the only one which is used for compensation. The transducer measures temperature in degrees Celsius.

On some models, not all sensors may be present; when a sensor is absent the value returned will be the shaft temperature.

### *Ambient*

The ambient sensor is mounted in free air, stood off from the PCB it is mounted to.

### *Shaft*

The shaft sensor is an infra-red device which is pointed directly at the centre of the shaft. In SGR type transducers, the sensor is on the shaft.

### *Internal*

The internal sensor is part of the communications processor on the main processing board.

## Time Stamp

The DLL has a primitive time stamping system based on elapsed time in milliseconds; the elapsed time is counted from a fixed point controlled by the user. The time stamp is not directly linked to the transducer readings, but should give an approximate correlation between the reading and time, provided that the commands to request data and the time stamp are called together.

The start point from which the elapsed time is counted is controlled by the **ST_Reset_TimeStamp** function. The elapsed time from the start point can be retrieved using the **ST_GET_TimeStamp** function. If the time stamp is not initialised, any call to get the elapsed time will return zero.

## Data Capture Mode

The data capture mode is a mechanism which automatically captures data from a connected transducer, at a user specified rate. Data can be captured at rates anywhere from 1 capture per second to up to 50000 captures per second.

The main purpose of the data capture mode is to extract data from a transducer at high capture rates. High capture rates are only possible when using USB and through a combination of specially optimised hardware and firmware. These optimisations are only present on ORT/RWT/SGR transducers with firmware greater than 5. For non-optimised transducers or when using RS232/Ethernet, the data capture mode will operate in an emulation mode.

The operating system timers must be capable of a 1ms resolution for the capture system to work. The DLL will request the timer resolution on initialisation and request a 1ms resolution.

The following table outlines the differences in capture rate between normal/optimised and emulation mode.

| Mode | Connection Method | Baud Rate | Maximum Capture Rate (Records Per Second) |
|---|---|---|---|
| Normal/Optimised ORT Series | USB | 12 Mbps | Up to 50000 |
| Normal/Optimised RWT Series | | | Up to 5000 |
| Normal/Optimised SGR Series | | | Up to 4000 |
| Emulated | | | 100 |
| | RS232 | 9600 bps | 5 |
| | | 38400 bps | 10 |
| | | 115200 bps | 50 |
| | Ethernet | 10/100 Mbps<br>(RS232 - 230400bps) | 100 |

The following sections give a brief overview of how the modes work.

### *Normal/Optimised – (USB and Firmware Version 5 or greater)*

The optimised mode is used when the data capture is activated with a compliant transducer using USB.

The optimised mode achieves its higher capture rates by fully utilising the bandwidth available on the USB bus. In order to achieve this, a bulk packeted buffered approach is required.

When the data capture mode is activated the DLL tells the transducer to initiate a continuous self timed capture at the users requested rate. The captured data is written to one of sixteen buffers. When a buffer is full it is marked for transfer, If no transfer is active a transfer is initiated. If a buffer is filled before the previous buffer transfer has been initiated, the newly filled buffer is chained to the previous buffer. The sixteen buffer design should protect against data loss should the DLL be starved of CPU time or the USB bus is busy. The transducer will automatically deactivate the capture mode if all sixteen buffers become filled and a seconds worth of data is lost.

Each USB transfer is 836 bytes in size and uses a dedicated transmission pipe, the use of a secondary pipe allows the transducer to respond to data requests in the normal manner. At high data rates the transducer should not be interupted with any other data request.

Each data transfer contains a header and 100 record sets. The header contains a base time stamp, record time increments, temperature readings and slow speed reading. A record set contains a single torque and fast speed reading.

The maximum capture rate achievable will depend upon the transducer technology and transducer tuning. RWT transducers are typically around 5KHz. ORT transducers are capable of capturing data at 50KHz. SGR transducers are around 4KHz.

To establish the capture rate capability of a transducer, use the **ST_GET_Capture_Rate** function, which returns the capture rate measured by the transducer.

When using this mode be aware that USB is a host controlled bus based architecture and can be effected by other bus traffic or host activity. The capture rate requested should consider the amount of data that will be generated, the number of active USB devices and the load on the host PC. It may be necessary to reduce the capture rate to achieve reliable operation.

In this mode, the capture rate and timestamp are generated from the transducers core clock. Any variance in the core clock will cause the data capture and time stamp to slide from real time, the per reading error will be very small, but over millions of cycles it may slide out.

***Emulated – (RS232, Ethernet or non-optimised transducers)***

The emulated mode is used when the connected transducer is using RS232, Ethernet or does not have the right firmware.

Emulated mode polls the transducer for data using the **ST_GET_Data_Block** function. The timestamp is applied when the data is received and is the elapsed time in microseconds from activation.

Data capture is triggered by a waitable timer, whose accuracy, resolution and prompt execution aren't guaranteed. In this mode, data capture is at the mercy of the Windows scheduler, to improve execution success the DLL raises the capture thread priority level.

### *Data Capture Mode Operation*

The data capture mode operates within its own thread and its priority is elevated to ensure CPU access. Data captures are triggered by a timer which is configured to trigger at the capture frequency. Captured data is inserted into a ring buffer which can accessed by both the capture thread and the users thread.

The ring buffer is made up of 262,144 ***CAPREC*** records (refer to the DLL Structures section for a definition). Each record contains information on one category of data, e.g. Torque, Speed, or Temperature.

The table below shows the record layout.

| **Field** | **Description** |
|---|---|
| Time | Record timestamp which is the offset in milliseconds from start. |
| Type | Type identifies the category of data. |
| Value | Data value. |

The type field is a numeric value, the table below identifies the different categories and there corresponding key values.

| **Type** | **Key Value** | **DLL Definition** |
|---|---|---|
| Torque | 0 | CAPREC_TORQUE |
| Speed (Fast) | 1 | CAPREC_SPEED_FAST |
| Speed (Slow) | 2 | CAPREC_SPEED_SLOW |
| Temperature (Shaft) | 3 | CAPREC_TEMP_SHAFT |
| Temperature (Ambient) | 4 | CAPREC_TEMP_AMB |

The ring buffer is accessed using a read and write pointer, it is important that the user reads the buffer frequently enough so as to avoid the head reaching the tail. If the buffer becomes full the data capture will terminate.

The data capture mode is activated by calling the **ST_Capture_Enable** function. The enable function requires the user to specify the capture rate that they require. The value can be anything between 1 and the maximum capture rate available. The **ST_GET_Capture_Rate** function should be used to retrieve the maximum.

The capture rate specifies the rate at which the transducer will be polled or requested to capture data. The capture rate does not directly indicate how many records will be generated per second.

The following calculations can be used to calculate the number records that will be generated from a given capture rate.

*Normal/Optimised*

$$Records = \left(\left\lceil \frac{Capture\ Rate}{100} \right\rceil \times 3\right) + (Capture\ Rate \times 2)$$

*Emulated*

$$Records = Capture\ Rate \times 5$$

Data is transferred from the ring buffer by using the **ST_GET_Capture_Data** function. The user is required to pass an array of ***CAPREC*** records and notify the function of the array depth. The function copies records from the ring buffer to the array until the array is full or there are no further records to be copied. On function completion the number records written to the array will be returned.

The array depth, **ST_GET_Capture_Data** call frequency and capture rate should all be considered when writing a program which uses the data capture mode. There is some overhead in ensuring thread syncronisation so a small array and high call frequency is not recommended.

The following table shows a sample set of data captured from a transducer. The capture is using the optimised mode and configured to run at 5Hz. The table shows 2 seconds of data.

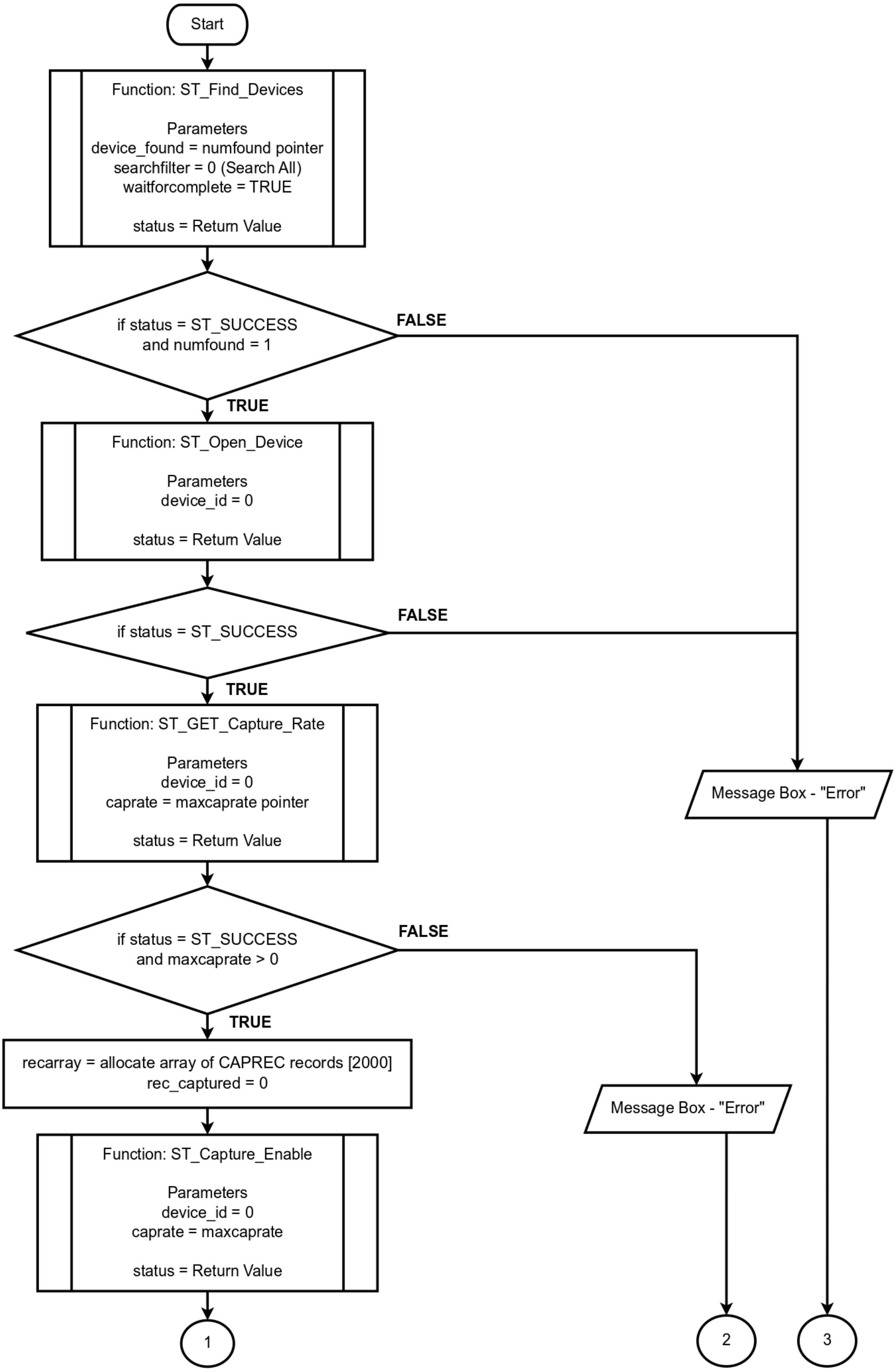
| Time | Type | Value |
|---|---|---|
| 0 | 2 | 0 |
| 0 | 3 | 25 |
| 0 | 4 | 25 |
| 0 | 0 | 0.1 |
| 0 | 1 | 0 |
| 200 | 0 | 0.1 |
| 200 | 1 | 0 |
| 400 | 0 | 0.1 |
| 400 | 1 | 0 |
| 600 | 0 | 0.1 |
| 600 | 1 | 0 |
| 800 | 0 | 0.1 |
| 800 | 1 | 0 |
| 1000 | 2 | 0 |
| 1000 | 3 | 25 |
| 1000 | 4 | 25 |
| 1000 | 0 | 0.1 |
| 1000 | 1 | 0 |
| 1200 | 0 | 0.1 |
| 1200 | 1 | 0 |
| 1400 | 0 | 0.1 |
| 1400 | 1 | 0 |
| 1600 | 0 | 0.1 |
| 1600 | 1 | 0 |
| 1800 | 0 | 0.1 |
| 1800 | 1 | 0 |

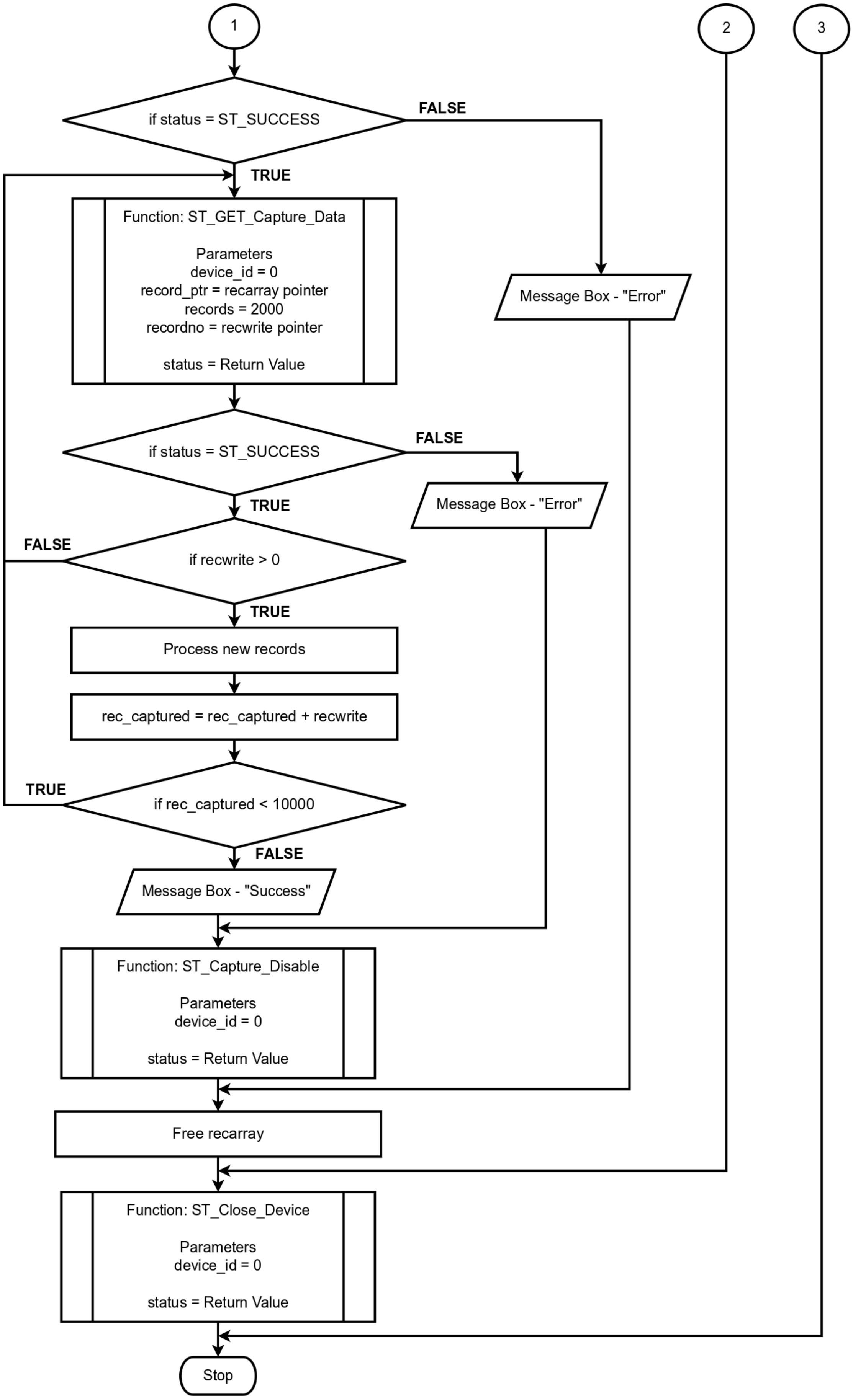
The following table shows a sample set of data captured from a transducer. The capture is using the emulated mode and configured to run at 5Hz. The table shows 1 second of data.

| Time | Type | Value |
|---|---|---|
| 0 | 0 | 0.1 |
| 0 | 1 | 0 |
| 0 | 2 | 0 |
| 0 | 3 | 25 |
| 0 | 4 | 25 |
| 200 | 0 | 0.1 |
| 200 | 1 | 0 |
| 200 | 2 | 0 |
| 200 | 3 | 25 |
| 200 | 4 | 25 |
| 400 | 0 | 0.1 |
| 400 | 1 | 0 |
| 400 | 2 | 0 |
| 400 | 3 | 25 |
| 400 | 4 | 25 |
| 600 | 0 | 0.1 |
| 600 | 1 | 0 |
| 600 | 2 | 0 |
| 600 | 3 | 25 |
| 600 | 4 | 25 |
| 800 | 0 | 0.1 |
| 800 | 1 | 0 |
| 800 | 2 | 0 |
| 800 | 3 | 25 |
| 800 | 4 | 25 |

When the capture mode is no longer required it should be stopped so that its resources can be released. To stop an active capture call the **ST_Capture_Disable** function. Once called the capture thread will be stopped and the ring buffer will be cleared and released.

The flow chart below demonstrates a simple program which uses the data capture mode to capture 10000 records at the maximum capture rate.




1
2
3
if status = ST_SUCCESS
FALSE
TRUE
Function: ST_GET_Capture_Data
Parameters
device_id = 0
record_ptr = recarray pointer
records = 2000
recordno = recwrite pointer
status = Return Value
Message Box - "Error"
if status = ST_SUCCESS
FALSE
TRUE
Message Box - "Error"
FALSE
if recwrite > 0
TRUE
Process new records
rec_captured = rec_captured + recwrite
TRUE
if rec_captured < 10000
FALSE
Message Box - "Success"
Function: ST_Capture_Disable
Parameters
device_id = 0
status = Return Value
Free recarray
Function: ST_Close_Device
Parameters
device_id = 0
status = Return Value
Stop

## DLL Dependencies

The DLL was built using Microsoft Visual Studio 2013 and requires the 2013 C Runtime Libraries. The DLL is dynamically linked to the runtime and will need to have the appropriate 2013 C Runtime Libraries installed. The CRT redistributable can be downloaded from Microsoft (https://www.microsoft.com/en-gb/download/details.aspx?id=40784).

In addition to the runtime library, a USB driver library (libusb0.dll) must be present. The library allows the DLL to interface with the transducers USB driver. Ensure that the USB DLL is accessible by STCOMMDLL_V5U.dll, either by being in the same directory or accessible via the PATH environmental variable. Older versions of the DLL required different USB drivers and dependencies. DLL version 4.1.8 switches to a unified USB driver, which supports both MKII and MKIII transducers.

## DLL Type Definitions

A number of custom defined variable types have been used in the DLL functions; the non-standard types have been defined in the table below:

| **Type Definition** | **Data Type** |
|---|---|
| ST_STATUS | unsigned long (4 bytes) |
| UCHAR | unsigned char (1 byte) |
| UINT16 | unsigned short / int (2 bytes) |
| DWORD | unsigned long (4 bytes) |
| INT32 | long (4 bytes) |
| BOOL | unsigned long (4 bytes) |
| UINT64 | unsigned long long (8 bytes) |

Most of the above types are defined in the Windows API.

***BOOL*** – The table below shows that mapping between boolean value and numeric value.

| **Boolean Value** | **Numeric Value** |
|---|---|
| TRUE | 1 |
| FALSE | 0 |

## DLL Structures

Structures are used frequently within the DLL to pass multiple related variables in a single block and passed in a single parameter.

### *ST_DATABLOCK*

The ST_DATABLOCK type is a structure that contains a complete transducer data set. The data set contains all the data that can be captured from the transducer.

The structure is split up into sub structures, each one related to a specific category of data.

***Torque***

The torque values use the native unit of measurement of the Transducer.

| **Type** | **Name** | **Description** |
|---|---|---|
| float | Torque | Current torque value. |
| float | Torque_Peak | Peak torque value. |
| float | Torque_Auto_Reset | Peak torque value with auto reset. |
| float | Torque_Peak_CW | Peak torque value in the CW direction. |
| float | Torque_Peak_CCW | Peak torque value in the CCW direction. |
| MINMAX_TMP | MinMax | Lowest/Highest torque value. |

***Speed (slow/fast modes explained in the speed section).***

All measurements are output in RPM.

| **Type** | **Name** | **Description** |
|---|---|---|
| INT32 | Slow | Current speed value from the slow capture mode. |
| INT32 | Fast | Current speed value from the fast capture mode. |
| INT32 | Slow_Peak | Peak speed value from the slow capture mode. |
| INT32 | Fast_Peak | Peak speed value from the fast capture mode. |

***Angle***

| Type | Name | Description |
|---|---|---|
| INT32 | Rotations | Shaft rotations. |
| INT32 | Degrees | Shaft rotation in degrees from reset point/last rotation. |

If an Angle sensor is not fitted, the speed pulses are used to generate the rotations and degrees in a incremental mode. The accuracy in this mode may be affected by external conditions.

***Power (slow/fast modes explained in the speed section).***

| Type | Name | Description |
|---|---|---|
| float | Watts_Slow | Power in watts calculated from the last torque and slow speed value. |
| float | Watts_Fast | Power in watts calculated from the last torque and fast speed value. |
| float | Peak_Watts_Slow | Peak power in watts, based on the speed from the slow capture mode. |
| float | Peak_Watts_Fast | Peak power in watts, based on the speed from the fast capture mode. |
| float | HP_Slow | Power in HP calculated from the last torque and slow speed value. |
| float | HP_Fast | Power in HP calculated from the last torque and fast speed value. |
| float | Peak_HP_Slow | Peak power in HP, based on the speed from the slow capture mode. |
| float | Peak_HP_Fast | Peak power in HP, based on the speed from the fast capture mode. |

***Temperature (degrees Celsius)***

| **Type** | **Name** | **Description** |
|---|---|---|
| float | Ambient | Ambient temperature. |
| float | Shaft | Shaft temperature. |

***MINMAX_TMP***

The MINMAX_TMP structure is comprised of min and max torque variables.

| **Type** | **Name** | **Description** |
|---|---|---|
| float | max | Maximum torque value from reference/reset. |
| float | min | Minimum torque value from reference/reset. |

***CAPREC***

The CAPREC structure is used with the embedded data capture mode.

| **Type** | **Name** | **Description** |
|---|---|---|
| UINT64 | time | Elapsed time in microseconds (μs). |
| UINT32 | type | Data identifer. Type defines what value is, e.g. torque/speed.<br>Refer to the Data Capture Mode section for a table of values. |
| float | value | Captured reading. |

### *ST_VERSIONS*

The ST_VERSIONS structure contains the transducer firmware revision. For firmware earlier than 5, the revision is converted from a simpler M.m format and the build is 1.

| Type | Name | Description |
|---|---|---|
| UINT32 | firm_type | Internal use descriptor |
| UINT16 | firm_rev | Fimware revision in Binary-Coded Decimal.<br>Format (Hex): 0xMMms<br>M = Major<br>m = Minor<br>s = Sub Minor<br>Example: 0x0122 = 1.2.2 |
| UINT16 | firm_build | Firmware build number |

### *ST_TRANSTATUS*

The ST_TRANSTATUS structure contains the current transducer status information. See the Transducer Status Codes section for more information.

| Type | Name | Description |
|---|---|---|
| UINT16 | ClassFlag | Status category flags |
| UINT16 | Informative | Information status conditions. |
| UINT16 | Warning | Warning status conditions. |
| UINT16 | Error | Error status conditions. |

## DLL Status Codes (ST_STATUS)

Most functions defined in the DLL return a ST_STATUS message; this message acknowledges either a successful execution or a failure of some kind.

The table below lists the status codes and associated messages, the status codes are defined in the DLL header file as listed:

| Status Code | Status Message | DLL Definition |
|---|---|---|
| 0 | Success | ST_SUCCESS |
| 1 | Busy | ST_BUSY |
| 2 | Command Active | ST_CMD_ACTIVE |
| 3 | Command Pending | ST_CMD_ACTIVE_PENDING |
| 4 | Command Complete | ST_CMD_ACTIVE_COMPLETE |
| 5 | Command Inactive | ST_CMD_INACTIVE |
| 6 | Failure | ST_FAILURE |
| 7 | Device Not Open | ST_DEVICE_NOT_OPEN |
| 8 | Checksum Error | ST_CHECKSUM_ERROR |
| 9 | Device Invalid | ST_DEVICE_INVALID |
| 10 | Buffer Too Small | ST_BUFFER_TOO_SMALL |
| 11 | Not Available In Firmware | ST_NOT_AVAILABLE_WITH_FIRMWARE |
| 12 | No Communications In Progress | ST_NO_COMMS_IN_PROCESS |
| 13 | Search In Progress | ST_FD_SEARCH_IN_PROGRESS |
| 14 | Too Many Requests | ST_TOO_MANY_REQUESTS |
| 15 | Access Violation | ST_ID_VALID_ACCESS_VIOLATION |
| 16 | Feature Not Fitted | ST_FEATURE_NOT_FITTED |
| 17 | Parameter Error | ST_PARAMETER_ERROR |
| 19 | Speed not fitted. | ST_SPEED_NOT_FITTED |
| 20 | Analog selection invalid. | ST_ANALOG_NOT_SELECTED |
| 21 | Analog channel not calibrated. | ST_ANALOG_NOT_CALIBRATED |
| 22 | Internal Flag | ST_FD_TERMINATED |
| 23 | Internal Buffer Overflow | ST_BUFFER_OVERFLOW |
| 24 | 1ms timer resolution not possible | ST_WINDOWS_TIMER_RESOLUTION |
| 25 | Ethernet request in progress. | ST_ETHREQ_IN_PROGRESS |
| 26 | Ethernet Box detected, but no compatible transducer connected. | ST_ETH_NOTRANSDUCER |
| 27 | Ethernet command not available. | ST_ETH_ACCESSVIOLATION |

## Transducer Status Codes (ST_TRANSTATUS)

The transducer status codes indicate the current status of internal processes, operational modes and identify system problems.

These status messages are divided into 3 classifications, Information, Warning and Error.

The ST_TRANSTATUS structure has an overall member parameter called ClassFlag, which indicates if there are flagged status messages for each classification. The Informative, Warning and Error member parameters indicate what the status conditions are for each classification.

The following sections define the status flags for each parameter.

### *Status Classification (ClassFlag)*

Classification flags indicate which status sections have flagged messages. Flags may be combined to indicate multiple conditions.

| Class Code | Status Message | DLL Definition |
|---|---|---|
| 0x1 | Information Class – Indicates a non-standard operational mode or condition. | ST_TRANSTATUS_CLASS_INFO |
| 0x2 | Warning Class – Indicates an operational fault, which may be either a connection problem or the transducer is operating outside of its operational parameters. | ST_TRANSTATUS_CLASS_WARN |
| 0x4 | Error Class – Indicates a system fault, either electronic or base configuration. | ST_TRANSTATUS_CLASS_ERROR |

### *Information Status (Informative)*

The Information classification indicates that a non-standard operational mode or condition is present. Flags may be combined to indicate multiple conditions.

| Class Code | Status Message | DLL Definition |
|---|---|---|
| 0x1 | Peak Mode – Indicates that Peak Mode is active. | ST_TRANSTATUS_INFO_PEAK |
| 0x2 | Analog Scaling – Indicates that a user defined data or voltage scale has been applied to either analog channel. | ST_TRANSTATUS_INFO_ANCHSCALE |
| 0x4 | Limits – Indicates that the Limits out control signal is triggered. | ST_TRANSTATUS_INFO_LIMITS |

***Warning Status (Warning)***

The Warning classification indicates an operational fault, which may be either a connection problem, something which impedes normal operation or when operating outside of its normal operating parameters. Flags may be combined to indicate multiple conditions.

| Class Code | Status Message | DLL Definition |
|---|---|---|
| 0x01 | Analog Fault CH0 – Indicates a connection fault, see operating manual. | ST_TRANSTATUS_WARN_ANCH0_SHORT |
| 0x02 | Analog Fault CH1 – Indicates a connection fault, see operating manual. | ST_TRANSTATUS_WARN_ANCH1_SHORT |
| 0x04 | Zero Offset High - A torque offset greater than 10% of FSD has been applied to the measured torque value. | ST_TRANSTATUS_WARN_ZERO_OFFHIGH |
| 0x08 | Exceeded Temp - Shaft temperature has exceeded normal operating conditions. | ST_TRANSTATUS_WARN_EXCEEDTEMP |
| 0x10 | Over Torque - Torque greater than the FSD has been applied. | ST_TRANSTATUS_WARN_OVERSCALE |
| 0x20 | Critical Over Torque - Torque greater than 120% of the FSD has been applied. | ST_TRANSTATUS_WARN_CRITOVERSCALE |
| 0x40 | Head Disconnect - The transducer head has been disconnected, see operating manual. | ST_TRANSTATUS_WARN_HEADDISCONT |

***Error Status (Error)***

The Error classification indicates a system fault, which maybe electronic or a base configuration problem.

| Class Code | Status Message | DLL Definition |
|---|---|---|
| 0x01 | Electronics Fault | ST_TRANSTATUS_ERROR_ELEC |
| 0x02 | Base Technology Fault – This error is multi use and relates to a fault in the transducers base torque technology. | ST_TRANSTATUS_ERROR_TRANTECHDEV |
| 0x04 | Failed Temperature Sensor | ST_TRANSTATUS_ERROR_FAILTEMP |
| 0x08 | Internal Voltage Error | ST_TRANSTATUS_ERROR_ERRVOLT |
| 0x10 | Base Configuration Error | ST_TRANSTATUS_ERROR_TRANCFG |
| 0x20 | | ST_TRANSTATUS_ERROR_TRANCAL |
| 0x40 | | ST_TRANSTATUS_ERROR_TRANSAW |
| 0x80 | | ST_TRANSTATUS_ERROR_TRANORT |
| 0x100 | | ST_TRANSTATUS_ERROR_TRANRSG |

## Transducer Units

Our transducers can be calibrated in one of eight different units. Functions which use a unit as a parameter, will output a numeric key value representing the unit.

The table below lists the different torque units with their key value, the unit codes are defined in the DLL header file as listed:

| Unit Code | Torque Unit | DLL Definition |
|---|---|---|
| 0 | ozf.in | ST_UNITS_OZF_IN |
| 1 | lbf.in | ST_UNITS_IBF_IN |
| 2 | lbf.ft | ST_UNITS_IBF_FT |
| 3 | gf.cm | ST_UNITS_GF_CM |
| 4 | kgf.cm | ST_UNITS_KGF_CM |
| 5 | kgf.m | ST_UNITS_KGF_M |
| 6 | mN.m | ST_UNITS_MN_M |
| 7 | N.m | ST_UNITS_NM |

## DLL Functions

The DLL provides access to most of the available data and control features of the attached transducers. The following table summarises each of the DLL functions.

| Functions | Function Description |
|---|---|
| ST_DLL_Version | DLL code version. |
| ST_How_Many_Ports | Get the filter list length. |
| ST_Port_Name | Get filter name for index. |
| ST_Port_Name_EX | Get filter name for index with filter value. |
| ST_Find_Devices | Initialise DLL and initiate find device process. |
| ST_Find_Devices_Ex | Initialise DLL and initiate find device process. |
| ST_Find_Device_Status | Get the status of the running find device process. |
| ST_Find_Device_Result | Get the result of the find device process. |
| ST_Find_Device_Terminate | Terminate a find device process. |
| ST_Open_Device | Open a transducer for use. |
| ST_Close_Device | Close an open transducer. |
| ST_Close_ALL_Devices | Close all open transducers. |
| ST_GETINFO_Model | Get transducer model number. |
| ST_GETINFO_SerialNumber | Get transducer serial number. |
| ST_GETINFO_ID_String | Get transducer ID string (model, serial, firmware). |
| ST_GETINFO_Manufacture_Date | Get transducer manufacture date. |
| ST_GETINFO_Calibration_Date | Get transducer calibration date. |
| ST_GETINFO_Customer | Get the registered customer name. |
| ST_GETINFO_ConnectionMethod | Get the connection method for the attached transducer. |
| ST_GETINFO_DeviceClass | Get transducer technology class. |
| ST_GETINFO_Firmware | Get transducer firmware revision (legacy). |
| ST_GETINFO_FirmwareEx | Get detailed transducer firmware revision. |
| ST_GETINFO_FirmwareText | Decode transducer firmware revision. |
| ST_GETINFO_FSD | Get transducer FSD value. |
| ST_GETINFO_Units | Get transducer native unit of measurement. |
| ST_GETINFO_Max_Speed | Get transducer maximum rated speed. |
| ST_GETINFO_Speed_Gratings | Get transducer grating size. |

| | |
|---|---|
| ST_Ethernet_Compatible | Ethernet compatibility check. |
| ST_GET_Data_Block[1] | Get transducer data set. |
| ST_GET_Data_Block_Extract[1] | Get transducer data set. |
| ST_GET_Torque_Select[1] | Get selected torque value. |
| ST_GET_Torque_Select_Convert[1] | Get selected torque value and convert to unit. |
| ST_GET_Torque[1] | Get current torque value. |
| ST_GET_Torque_Peak[1] | Get peak torque value. |
| ST_GET_Torque_Auto_Reset[1] | Get peak torque with auto reset value. |
| ST_GET_Torque_Peak_MinMax[1] | Get PeakMinMax value. |
| ST_GET_Speed_Fast[1] | Get fast mode speed value. |
| ST_GET_Speed_Slow[1] | Get slow mode speed value. |
| ST_GET_Power_In_Watts[1] | Get current power in Watts. |
| ST_GET_Power_In_HP[1] | Get current power in HP. |
| ST_GET_Temperature_Ambient[1] | Get ambient temperature. |
| ST_GET_Temperature_Shaft[1] | Get shaft temperature. |
| ST_GET_Temperature_Internal[1] | Get internal sensor temperature. |
| ST_GET_Torque_Filter[1] | Get current torque filter setting. |
| ST_SET_Torque_Filter[1] | Set torque filter setting. |
| ST_GET_Speed_Filter[1] | Get current speed filter setting. |
| ST_SET_Speed_Filter[1] | Set speed filter setting. |
| ST_GET_Status_Info[1] | Get transducer status. |
| ST_RESET_Peaks[1] | Reset torque, speed, power peaks. |
| ST_Zero_Transducer[1] | Zero transducer torque value. |
| ST_ZeroAverage_Transducer[1] | Zero transducer with an averaged torque value. |
| ST_Reset_TimeStamp | Initialise/reset timestamp to zero. |
| ST_GET_TimeStamp | Get elapsed time. |
| ST_Capture_Enable[1] | Enable capture mode. |
| ST_Capture_Disable[1] | Disable capture mode. |
| ST_GET_Capture_Data[1] | Get captured data. |
| ST_GET_Capture_Rate[1] | Get maximum capture rate. |

[1] Transducer must be open to use command.

### *ST_DLL_Version*

The **ST_DLL_Version** function returns the version and build of the DLL.

```
Void ST_DLL_Version(
        DWORD *version,
        DWORD *build
        );
```

***Parameters***

| | |
|---|---|
| version | pointer to a variable of type DWORD that receives the DLL version. |
| build | pointer to a variable of type DWORD that receives the DLL build number. |

***Return value***

None

***Remarks***

The format of the version number is in Binary-Coded Decimal.

Format (Hex): 0xMMms

M = Major<br>
m = Minor<br>
s = Sub Minor

Example: 0x0122 = 1.2.2

### *ST_How_Many_Ports*

The **ST_How_Many_Ports** function returns the number of searchable options/filter items.

```
ST_STATUS ST_How_Many_Ports(
        DWORD *portcount
        );
```

***Parameters***

| | |
|---|---|
| portcount | pointer to a variable of type DWORD that receives the number of items in the filter list. |

***Return value***

If successful the function will return ST_SUCCESS, if an error occurs ST_FAILURE will be returned.

***Remarks***

Use the **ST_PORT_NAME** function to retrieve the name of each filter item, list indexes are valid upto the value of portcount.

### *ST_Port_Name*

The **ST_Port_Name** function returns the filter name for the requested filter index.

```
ST_STATUS ST_Port_Name(
        DWORD portref,
        char *port_string,
        DWORD bufsize
        );
```

***Parameters***

| | |
|---|---|
| portref | index of the filter name to retrieve, valid indexes are from 0 to the number of filters in the list. |
| port_string | pointer to an array of characters to receive the filter name. The buffer size should be at least 21 characters long, but ethernet hostnames may be longer. |
| bufsize | size of the buffer passed in the port_string parameter. |

***Return value***

If successful the function will return ST_SUCCESS, if an error occurs ST_FAILURE will be returned.

***Remarks***

The returned string will be null terminated. The filter index can be used with the **ST_Find_Devices** searchindex parameter, or as an item in the ports list for **ST_Find_Devices_Ex**, i.e. =indexval.

### *ST_Port_Name_EX*

The **ST_Port_Name_EX** function returns the filter name for the requested filter index. **ST_Port_Name_EX** is the same as **ST_Port_Name**, but exposes the equivalent search filter value for use with **ST_Find_Devices_Ex**.

```
ST_STATUS ST_Port_Name_EX(
        DWORD portref,
        DWORD *filter,
        char *port_string,
        DWORD bufsize
        );
```

***Parameters***

portref — index of the filter name to retrieve, valid indexes are from 0 to the number of filters in the list.

filter — pointer to a variable of type DWORD that receives the search filter value for the selected port.

port_string — pointer to an array of characters to receive the filter name. The buffer size should be at least 21 characters long, but ethernet hostnames may be longer.

bufsize — size of the buffer passed in the port_string parameter.

***Return value***

If successful the function will return ST_SUCCESS, if an error occurs ST_FAILURE will be returned.

***Remarks***

The returned string will be null terminated. The filter index can be used with the **ST_Find_Devices** searchindex parameter, or as an item in the ports list for **ST_Find_Devices_Ex**, i.e. =indexval.

### *ST_Find_Devices*

The **ST_Find_Devices** function initialises the DLL and searches the system for connected transducers; it builds a list of connected transducers and caches configuration and connection information for each.

The **ST_Find_Devices** function should be considered a legacy function, and is kept for compatibility with existing applications. It is recommended that **ST_Find_Devices_Ex** be used for new programs. **ST_Find_Devices** calls **ST_Find_Devices_Ex** itself, moulding the parameters as required.

```
ST_STATUS ST_Find_Devices(
        DWORD *devices_found,
        DWORD searchindex,
        BOOL waitforcomplete
        );
```

***Parameters***

devices_found — pointer to a variable of type DWORD that receives the number of transducers found.

searchindex — selects the interfaces/ports that the find device process should use to find connected transducers. The searchindex relates to the index value used with the port helper functions, **ST_Port_Name** and **ST_Port_Name_EX**.

waitforcomplete — boolean value to control the execution mode of the find device process. If TRUE, mode 1 - execute and wait will be selected. If FALSE, mode 2 – execute and return will be selected. Refer to the Discovering Transducers section for more information.

***Return value***

If successful the function will return ST_SUCCESS, if the function was called with the waitforcomplete parameter set to FALSE the function will return ST_FD_SEARCH_IN_PROGRESS. If an error occurs ST_FAILURE will be returned.

***Remarks***

When using mode 2 - execute and return (waitforcomplete = FALSE) use the **ST_Find_Device_Status** function to monitor the progress of the find device process, when complete use the **ST_Find_Device_Result** function to complete the discovery process. The **ST_Find_Device_Result** function is automatically called when using mode 1 - execute and wait (waitforcomplete = TRUE).

### *ST_Find_Devices_Ex*

The **ST_Find_Devices_Ex** function initialises the DLL and searches the system for connected transducers; it builds a list of connected transducers and caches configuration and connection information for each.

```
ST_STATUS ST_Find_Devices_Ex(
        DWORD *devices_found,
        DWORD searchfilter,
        char *ports,
        BOOL waitforcomplete
        );
```

***Parameters***

devices_found — pointer to a variable of type DWORD that receives the number of transducers found.

searchfilter — selects the interfaces/ports that the find device process should use to find connected transducers. searchfilter uses the ST_SEARCH flags, see below, OR values together to select multiple:

| DLL Definition | Value | Interface |
|---|---|---|
| ST_SEARCH_ETHERNET | 1 | Ethernet |
| ST_SEARCH_RS232 | 2 | RS232 |
| ST_SEARCH_USB | 4 | USB |
| ST_SEARCH_CUSTOM | 8 | Custom List |

ports — pointer to an array of chars, containing a comma separated null terminated string of ports to search. ST_SEARCH_CUSTOM must be specified in searchfilter. Port values must be prefixed with a type, prefixes below:

| Prefix | Interface | Format |
|---|---|---|
| NET= | Ethernet | NET=HOST:PORT |
| RS232= | RS232 | RS232=PORTNAME |
| = | **ST_Port_Name,**<br>**ST_Port_Name_EX** | =INDEX |

waitforcomplete — boolean value to control the execution mode of the find device process. If TRUE, mode 1 - execute and wait will be selected. If FALSE, mode 2 – execute and return will be selected. Refer to the Discovering Transducers section for more information.

***Return value***

If successful the function will return ST_SUCCESS, if the function was called with the waitforcomplete parameter set to FALSE the function will return ST_FD_SEARCH_IN_PROGRESS. If an error occurs ST_FAILURE will be returned.

***Remarks***

When using mode 2 - execute and return (waitforcomplete = FALSE) use the **ST_Find_Device_Status** function to monitor the progress of the find device process, when complete use the **ST_Find_Device_Result** function to complete the discovery process. The **ST_Find_Device_Result** function is automatically called when using mode 1 - execute and wait (waitforcomplete = TRUE).

For an in-depth description and examples on how to use the **ST_Find_Devices_Ex** function, refer to the Discovering Transducers section.

### *ST_Find_Device_Status*

The **ST_Find_Device_Status** function returns the status of a find device process.

```
ST_STATUS ST_Find_Device_Status (
        DWORD *percent_done,
        DWORD *devices_found
        );
```

***Parameters***

| | |
|---|---|
| percent_done | pointer to a variable of type DWORD that receives the find device progress in percent. |
| devices_found | pointer to a variable of type DWORD that receives the number of transducers found by the find device process. |

***Return value***

If a transducer search has completed the function will return ST_SUCCESS, if a transducer search is still in progress ST_FD_SEARCH_IN_PROGRESS will be returned. If an error has occurred ST_FAILURE will be returned.

***Remarks***

The ideal way to use the **ST_Find_Device_Status** function is to display the progress percentage on a progress bar and as transducers are found use the **GET_INFO** functions to display identification information.

### *ST_Find_Device_Result*

The **ST_Find_Device_Result** function completes the find device process initiated by **ST_Find_Devices**. The function will deallocate the resources used by the search and enables devices to be openned.

```
ST_STATUS ST_Find_Device_Result(
        DWORD *devices_found,
        BOOL wait
        );
```

#### *Parameters*

| | |
|---|---|
| devices_found | pointer to a variable of type DWORD that receives the final number of transducers found by the search process. devices_found is only valid when the return value is ST_SUCCESS. |
| wait | boolean value to select whether the function should wait, if a find device process is still in progress. If TRUE the function will block until the find device process has completed, if FALSE and a search is still in progress ST_FD_SEARCH_IN_PROGRESS will be returned. |

#### *Return value*

If a find device process has completed successfully ST_SUCCESS will be returned, if a search process is still in progress ST_FD_SEARCH_IN_PROGRESS will be returned, if an error occurs ST_FAILURE will be returned.

#### *Remarks*

**ST_Find_Device_Result** only needs to be called when using the find device process in execute and return mode 2 (**ST_Find_Devices –** waitforcomplete = FALSE) and ideally when the **ST_GET_Process_Status** indicates completion. When using the find device process in execute and wait mode 1, the **ST_Find_Device_Result** function is automatically called.

### *ST_Find_Device_Terminate*

The **ST_Find_Device_Terminate** function terminates an active find device process. The function will deallocate the resources used by the search and clear the transducer list of all entries.

```
ST_STATUS ST_Find_Device_Terminate (void);
```

#### *Parameters*

None

#### *Return value*

If a find device process was successfully terminated the function will return ST_SUCCESS, if no search was active the function will return ST_CMD_INACTIVE, if an error occurs ST_FAILURE will be returned.

#### *Remarks*

A find device termination request can take upto 4 seconds to complete, during this time the calling process will be blocked. The function will first attempt to stop the process cleanly by triggering an event, if the thread does not finish within 4 seconds it is terminated.

### *ST_Open_Device*

The **ST_Open_Device** function opens a transducer for use with the DLL.

```
ST_STATUS ST_Open_Device(
        DWORD device_id
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to open, id's are indexed from 0 up to the number of transducers found. |

***Return value***

If a transducer is opened successfully the function will return ST_SUCCESS, if the device_id is invalid ST_DEVICE_INVALID will be returned, if an error occurs ST_FAILURE will be returned.

***Remarks***

**ST_Find_Devices** needs to have been run before a transducer can be opened.

### *ST_Close_Device*

The **ST_Close_Device** function closes an open transducer, a transducer should always be closed before a program using the DLL exits.

```
ST_STATUS ST_Close_Device(
        DWORD device_id,
        BOOL force
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to close, id's are indexed from 0 up to the number of devices found. |
| force | reserved – set to FALSE. |

***Return value***

If an open device is successfully closed, ST_SUCCESS will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, if the device_id is invalid ST_DEVICE_INVALID will be returned, if an error occurs ST_FAILURE will be returned.

### *ST_Close_ALL_Devices*

The **ST_Close_ALL_Devices** function closes all open transducers, a transducer should always be closed before a program using the DLL exits.

```
ST_STATUS ST_Close_ALL_Devices(void);
```

***Parameters***

None

***Return value***

If all open devices are closed successfully, ST_SUCCESS will be returned, if an error occurs ST_FAILURE will be returned.

### *ST_GETINFO_Model*

The **ST_GETINFO_Model** function returns the model name of the referenced transducer.

```
ST_STATUS ST_GETINFO_Model(
        DWORD device_id,
        char *model_string,
        DWORD bufsize
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the model name of. |
| model_string | pointer to an array of chars, the maximum string length is 10. |
| bufsize | length of the array passed. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_SerialNumber*

The **ST_GETINFO_SerialNumber** function returns the serial number in string form of the referenced transducer.

```
ST_STATUS ST_GETINFO_SerialNumber(
        DWORD device_id,
        char *serial_string,
        DWORD bufsize
        );
```

#### *Parameters*

| | |
|---|---|
| device_id | device id of the transducer to retrieve the serial number of. |
| serial_string | pointer to an array of chars, the maximum string length is 9. |
| bufsize | length of the array passed. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

#### *Remarks*

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_ID_String*

The **ST_GETINFO_ID_String** function returns the ID string of the referenced transducer. The ID is a generic identifier which lists the model, serial and firmware revision.

```
ST_STATUS ST_GETINFO_ID_String(
        DWORD device_id,
        char *id_string,
        DWORD bufsize
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the ID of. |
| id_string | pointer to an array of chars, the maximum string length is 59. |
| bufsize | length of the array passed. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

id_string is valid for return values of ST_SUCCESS and ST_ETH_NOTRANSDUCER.

ID string format:
    [INTERFACE] TAB TAB Model: [MODEL] TAB Serial Number: [SERIAL]

```
Example: USB        Model: RWT321-DC   Serial Number: 00000123
```

If the ethernet module is detected but no compatible transducer is attached, the id string will read:

```
NET            Model: STL_ENET01          NO TRANSDUCER
```

### *ST_GETINFO_Manufacture_Date*

The **ST_GETINFO_Manufacture_Date** function returns the manufacture date of the referenced transducer. The date format used is DD/MM/YYYY.

```
ST_STATUS ST_GETINFO_Manufacture_Date(
        DWORD device_id,
        char *manufacture_date,
        DWORD bufsize
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the manufacture date of. |
| manufacture_date | pointer to an array of chars, the maximum string length is 11. |
| bufsize | length of the array passed. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_Calibration_Date*

The **ST_GETINFO_Calibration_Date** function returns the date that the referenced transducer was last calibrated. The date format used is DD/MM/YYYY.

```
ST_STATUS ST_GETINFO_Calibration_Date(
                DWORD device_id,
                char *calibration_date,
                DWORD bufsize
                );
```

#### *Parameters*

| | |
|---|---|
| device_id | device id of the transducer to retrieve the last calibration date of. |
| calibration_date | pointer to an array of chars, the maximum string length is 11. |
| bufsize | length of the array passed. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

#### *Remarks*

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_Customer*

The **ST_GETINFO_Customer** function returns the registered customer name of the referenced transducer.

```
ST_STATUS ST_GETINFO_Customer(
                DWORD device_id,
                char *customer,
                DWORD bufsize
                );
```

#### *Parameters*

| | |
|---|---|
| device_id | device id of the transducer to retrieve the registered customer name of. |
| customer | pointer to an array of chars, the maximum string length is 60. |
| bufsize | length of the array passed. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

#### *Remarks*

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_ConnectionMethod*

The **ST_GETINFO_ConnectionMethod** function returns the name of the interface that the referenced transducer is connected to. The interface is either COM##, NET or USB.

```
ST_STATUS ST_GETINFO_ConnectionMethod(
        DWORD device_id,
        char *connection_method,
        DWORD bufsize
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the connection method of. |
| connection_method | pointer to an array of chars, the maximum string length is 7. |
| bufsize | length of the array passed. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The returned string will be null terminated. The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_DeviceClass*

The **ST_GETINFO_DeviceClass** function returns the device class of the referenced transducer. The device class identifies the type and underlying technology of the transducer.

```
ST_STATUS ST_GETINFO_DeviceClass(
        DWORD device_id,
        DWORD *DC
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the technology class of. |
| DC | pointer to a variable of type DWORD that receives the device class index. The table below can be used to decode the index. |

| **Index** | **Device Class** |
|---|---|
| 1 | RWT Integrated – SAW Device |
| 2 | ORT Integrated – Optical Device |
| 4 | Strain Gauge Device |
| 8 | RWT External – SAW Device |
| 16 | ORT External – Optical Device |
| 32 | SGR Integrated – Strain Gauge Device |
| 64 | SGR External – Strain Gauge Device |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_Firmware (Legacy)*

The **ST_GETINFO_Firmware** function returns the firmware version (legacy format) of the referenced transducer.

```
ST_STATUS ST_GETINFO_Firmware(
        DWORD device_id,
        float *firmware
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the firmware version of. |
| firmware | pointer to a variable of type float that receives the firmware version. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

This command is considered legacy, the float variable does not accurately convey the firmware revision.

### *ST_GETINFO_FirmwareEx*

The **ST_GETINFO_FirmwareEx** function returns the firmware revision and build of the referenced transducer.

```
ST_STATUS ST_GETINFO_FirmwareEx(
                DWORD device_id,
                ST_VERSIONS *verinfo
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the firmware version of. |
| verinfo | pointer to a variable of type ST_VERSIONS that receives the firmware information. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

For firmware earlier than 5, the revision is converted from a simpler M.m format and the build is 1.

### *ST_GETINFO_FirmwareText*

The **ST_GETINFO_FirmwareText** function decodes the firmware revision and build of the referenced transducer into a text string.

```
ST_STATUS ST_GETINFO_FirmwareText(
                DWORD device_id,
                char *firmwaretxt,
                DWORD bufsize);
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the firmware version of. |
| firmwaretxt | pointer to an array of chars to receive the firmware string. The maximum string length is 20. |
| bufsize | length of the array passed. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the buffer passed to the function is too small, ST_BUFFER_TOO_SMALL will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

For firmware earlier than 5, the revision is converted from a simpler M.m format and the build is 1.

Firmware Text Example: 5.2.1 Build 12345

### *ST_GETINFO_FSD*

The **ST_GETINFO_FSD** function returns the full scale rating of the referenced transducer.

```
ST_STATUS ST_GETINFO_FSD(
                DWORD device_id,
                DWORD *fsd
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the FSD of. |
| fsd | pointer to a variable of type DWORD that receives the full scale rating. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

Use the **ST_GETINFO_Units** function to get the transducers native unit of measurement for torque.

### *ST_GETINFO_Units*

The **ST_GETINFO_Units** function returns the native measurement torque unit of the referenced transducer. The FSD and all torque values use this unit as the unit of measurement.

```
ST_STATUS ST_GETINFO_Units(
                DWORD device_id,
                DWORD *units
                );
```

#### *Parameters*

| | |
|---|---|
| device_id | device id of the transducer to retrieve the measurement unit of. |
| units | pointer to a variable of type DWORD that receives the unit code. See the Transducer Units section to decode. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. For all other errors FT_FAILURE will be returned.

#### *Remarks*

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GETINFO_Max_Speed*

The **ST_GETINFO_Max_Speed** function returns the maximum speed scaling for the referenced transducer.

```
ST_STATUS ST_GETINFO_Max_Speed(
                DWORD device_id,
                DWORD *maxspeed
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the maximum speed of. |
| maxspeed | pointer to a variable of type DWORD that receives the maximum speed scaling value. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If speed isn't fitted ST_SPEED_NOT_FITTED will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

The speed value does not limit the transducers ability to measure higher speeds, but is the maximum speed that is specified by the customer. The max speed value is the maximum value that the analog output can be scaled to.

### *ST_GETINFO_Speed_Gratings*

The **ST_GETINFO_Speed_Gratings** function returns the number of slots in the speed disk grating.

```
ST_STATUS ST_GETINFO_Speed_Gratings(
        DWORD device_id,
        DWORD *gratings
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the grating size of. |
| gratings | pointer to a variable of type DWORD that receives the number of slots in the speed disk grating. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If speed isn't fitted ST_SPEED_NOT_FITTED will be returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

The speed disk grating is used to measure speed, the number of slots in the grating sets the measurement resolution.

### *ST_Ethernet_Compatible*

The **ST_Ethernet_Compatible** function returns the compatibility level between the ethernet box, transducer and DLL.

```
ST_STATUS ST_Ethernet_Compatible (
        DWORD device_id,
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve the compatibility for. |

***Return value***

If the function completes successfully and everything is OK, ST_SUCCESS will be returned. If the device_id is invalid then ST_DEVICE_INVALID will be returned. If the ethernet module is present, but no compatible transducer is attached, ST_ETH_NOTRANSDUCER is returned. If the ethernet box is running in legacy mode and a firmware upgrade is advised, ST_NOT_AVAILABLE_WITH_FIRMWARE is returned. For all other errors FT_FAILURE will be returned.

***Remarks***

The device does not need to be open to use this function and it can be called during the find device process, provided that the waitforcomplete parameter is FALSE and the device id is less than the number of devices found.

### *ST_GET_Data_Block*

The **ST_GET_Data_Block** function returns a transducer data set from the referenced transducer. The data set contains all the data that can be captured from the transducer.

```
ST_STATUS ST_GET_Data_Block(
                DWORD device_id,
                ST_DATABLOCK *dat
                );
```

#### *Parameters*

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| dat | pointer to a variable of type ST_DATABLOCK that receives the complete transducer data set. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

#### *Remarks*

The referenced device needs to be open before using this function. The torque values will be in the native unit of measurement for the transducer. The ST_DATABLOCK custom variable type is defined in the DLL Structures section of this document. The peak values can be manually reset using the **ST_RESET_Peaks** function.

### *ST_GET_Data_Block_Extract*

The **ST_GET_Data_Block_Extract** function returns the individual components of the transducer data set for the referenced transducer. The data set contains all the data that can be captured from the transducer.

```
ST_STATUS ST_GET_Data_Block_Extract(
                DWORD device_id,
                float *torque,
                float *ptorque,
                float *artorque,
                float *cwptorque,
                float *ccwptorque,
                float *mintorque,
                float *maxtorque,
                DWORD *speedfast,
                DWORD *pspeedfast,
                DWORD *speedslow,
                DWORD *pspeedslow,
                float *powerwattsfast,
                float *powerwattsslow,
                float *powerhpfast,
                float *powerhpslow,
                float *ppowerwattsfast,
                float *ppowerwattsslow,
                float *ppowerhpfast,
                float *ppowerhpslow,
                float *tmpambient,
                float *tmpshaft,
                DWORD *ticktock
                );
```

***Parameters***

device_id — device id of the transducer to retrieve the data from.

torque — pointer to a variable of type float that returns the current torque value.

ptorque — pointer to a variable of type float that returns the peak torque value.

artorque — pointer to a variable of type float that returns the auto reset torque value.

cwptorque — pointer to a variable of type float that returns the clockwise peak torque value.

ccwptorque — pointer to a variable of type float that returns the counter-clockwise peak torque value.

mintorque — pointer to a variable of type float that returns the minimum torque value from the reference/reset point.

maxtorque — pointer to a variable of type float that returns the maximum torque value from the reference/reset point

speedfast — pointer to a variable of type DWORD that returns the current speed value from the fast capture mode.

pspeedfast — pointer to a variable of type DWORD that returns the peak speed value captured from the fast capture mode.

speedslow — pointer to a variable of type DWORD that returns the current speed value from the slow capture mode.

pspeedslow — pointer to a variable of type DWORD that returns the peak speed value captured from the slow capture mode.

powerwattsfast pointer to a variable of type float that returns the current power value in watts, based on the speed from the fast capture mode.

powerwattsslow pointer to a variable of type float that returns the current power value in watts, based on the speed from the slow capture mode.

powerhpfast pointer to a variable of type float that returns the current power value in horse power, based on the speed from the fast capture mode.

powerhpslow pointer to a variable of type float that returns the current power value in horse power, based on the speed from the slow capture mode.

ppowerwattsfast pointer to a variable of type float that returns the peak power value in watts, based on the speed from the fast capture mode.

ppowerwattsslow pointer to a variable of type float that returns the peak power value in watts, based on the speed from the slow capture mode.

ppowerhpfast pointer to a variable of type float that returns the peak power value in horse power, based on the speed from the fast capture mode.

ppowerhpslow pointer to a variable of type float that returns the peak power value in horse power, based on the speed from the slow capture mode.

tmpambient pointer to a variable of type float that returns the transducers ambient temperature (degrees Celsius).

tmpshaft pointer to a variable of type float that returns the transducers shaft temperature (degrees Celsius).

ticktock pointer to a variable of type DWORD that returns the elapsed time in milliseconds from the time stamp start/reset point.

### *Return value*

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

### *Remarks*

The referenced device needs to be open before using this function. The torque values will be in the native unit of measurement for the transducer. The ticktock parameter is part of a time stamp system added to aid LabView/Torqview accurately time stamp readings, refer to the **ST_GET_TimeStamp** and **ST_Reset_TimeStamp** function descriptions, and the Time Stamp section of this document. The peak values can be manually reset using the **ST_RESET_Peaks** function.

The **ST_GET_Data_Block_Extract** function differs from the **ST_GET_Data_Block** function, one returns the components in a single block as a single parameter, while the other returns the components individually as separate parameters. The **ST_GET_Data_Block_Extract** function can be used with languages that cannot create custom types.

### *ST_GET_Torque_Select*

The **ST_GET_Torque_Select** function retrieves and returns the specified torque value for the referenced transducer.

```
ST_STATUS ST_GET_Torque_Select (
                DWORD device_id,
                DWORD torqueselect,
                float *dat
                );
```

***Parameters***

device_id — device id of the transducer to retrieve data from.

torqueselect — selects the torque value to be returned in dat. The table below shows the parameter values for the different torque types.

| DLL Definition | Value | Torque Type |
|---|---|---|
| ST_Torque_Select | 0 | Current torque |
| ST_Torque_Peak_Select | 1 | Peak torque |
| ST_Torque_Auto_Reset_Select | 2 | Peak torque with auto reset |
| ST_Torque_Peak_CW_Select | 3 | Peak clockwise torque |
| ST_Torque_Peak_CCW_Select | 4 | Peak counter-clockwise torque |
| ST_Peak_MinMax_Max_Select | 5 | Maximum torque from reference/reset |
| ST_Peak_MinMax_Min_Select | 6 | Minimum torque from reference/reset |
| ST_Peak_MinMax_Select | 7 | Maximum/Minimum torque from reference/reset (MINMAX_TMP – see remarks) |

dat — pointer to a variable of type float that returns the torque value selected by torqueselect.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. If selecting torque type 7, you will need to pass a MINMAX_TMP structure and cast the pointer to a float. The torque value will be in the native unit of measurement for the transducer. The peak torque values can be manually reset using the **ST_RESET_Peaks** function.

### *ST_GET_Torque_Select_Convert*

The **ST_GET_Torque_Select_Convert** function retrieves the specified torque value from the referenced transducer, converts the torque value into the unit of measurement specified, then returns the converted value.

```
ST_STATUS ST_GET_Torque_Select_Convert (
                DWORD device_id,
                DWORD torqueselect,
                DWORD convertto,
                float *dat
                );
```

***Parameters***

device_id        device id of the transducer to retrieve data from.

torqueselect    selects the torque value to be converted and returned in dat. The table below shows the parameter values for the different torque types.

| DLL Definition | Value | Torque Type |
|---|---|---|
| ST_Torque_Select | 0 | Current torque |
| ST_Torque_Peak_Select | 1 | Peak torque |
| ST_Torque_Auto_Reset_Select | 2 | Peak torque with auto reset |
| ST_Torque_Peak_CW_Select | 3 | Peak clockwise torque |
| ST_Torque_Peak_CCW_Select | 4 | Peak counter-clockwise torque |
| ST_Peak_MinMax_Max_Select | 5 | Maximum torque from reference/reset |
| ST_Peak_MinMax_Min_Select | 6 | Minimum torque from reference/reset |
| ST_Peak_MinMax_Select | 7 | Maximum/Minimum torque from reference/reset (MINMAX_TMP – see remarks) |

convertto        selects the unit of measurement that the selected torque value will be converted to. See the Transducer Units section for parameter values.

dat        pointer to a variable of type float that returns the converted torque value selected by torqueselect.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. If selecting torque type 7, you will need to pass a MINMAX_TMP structure and cast the pointer to a float. The peak torque values can be manually reset using the **ST_RESET_Peaks** function.

### *ST_GET_Torque*

The **ST_GET_Torque** function returns the current torque value for the referenced transducer.

```
ST_STATUS ST_GET_Torque(
                DWORD device_id,
                float *dat
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| dat | pointer to a variable of type float that receives the current torque value. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The torque value will be in the native unit of measurement for the transducer.

### *ST_GET_Torque_Peak*

The **ST_GET_Torque_Peak** function returns the peak torque value for the referenced transducer.

```
ST_STATUS ST_GET_Torque_Peak(
                DWORD device_id,
                float *dat
                );
```

***Parameters***

device_id device id of the transducer to retrieve data from.

dat pointer to a variable of type float that receives the peak torque value.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The torque value will be in the native unit of measurement for the transducer. The peak torque value can be manually reset using the **ST_RESET_Peaks** function.

### *ST_GET_Torque_Auto_Reset*

The **ST_GET_Torque_Auto_Reset** function returns the peak torque with auto reset value for the referenced transducer.

```
ST_STATUS ST_GET_Torque_Auto_Reset(
                DWORD device_id,
                float *dat
                );
```

***Parameters***

device_id device id of the transducer to retrieve data from.

dat pointer to a variable of type float that receives the peak torque with auto reset value.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The torque value will be in the native unit of measurement for the transducer. The Peak Torque with auto reset value can be manually reset using the **ST_RESET_Peaks** function.

### *ST_GET_Torque_Peak_MinMax*

The **ST_GET_Torque_Peak_MinMax** function returns the maximum and minimum torque value from a reference/reset point for the referenced transducer.

```
ST_STATUS ST_GET_Torque_Peak_MinMax(
                DWORD device_id,
                MINMAX_TMP *dat,
                BOOL reset_minmax
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| dat | pointer to a variable of type MINMAX_TMP that receives the minimum/maximum torque values. |
| reset_minmax | if TRUE the reference point for the minimum/maximum torque values is reset after value retrieval. If FALSE the minimum/maximum torque values are not reset. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The torque value will be in the native unit of measurement for the transducer. The reference point for the minimum/maximum values can be reset using the reset_minmax parameter or by using the **ST_RESET_Peaks** function.

### *ST_GET_Speed_Fast*

The **ST_GET_Speed_Fast** function returns the current fast mode speed value for the referenced transducer.

```
ST_STATUS ST_GET_Speed_Fast(
                DWORD device_id,
                DWORD *dat
                );
```

***Parameters***

device_id   device id of the transducer to retrieve data from.

dat   pointer to a variable of type DWORD that receives the current fast mode speed value.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Speed Modes section for a definition of the different speed capture modes. Speed is measured in RPM.

### *ST_GET_Speed_Slow*

The **ST_GET_Speed_Slow** function returns the current slow mode speed value for the referenced transducer.

```
ST_STATUS ST_GET_Speed_Slow(
                DWORD device_id,
                DWORD *dat
                );
```

***Parameters***

device_id   device id of the transducer to retrieve data from.

dat   pointer to a variable of type DWORD that receives the current slow mode speed value.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Speed Modes section for a definition of the different speed capture modes. Speed is measured in RPM.

### *ST_GET_Power_In_Watts*

The **ST_GET_Power_In_Watts** function returns the current power value in watts, it is derived from the current torque and speed values for the referenced transducer.

```
ST_STATUS ST_GET_Power_In_Watts(
            DWORD device_id,
            float *dat,
            DWORD speed_mode
            );
```

***Parameters***

device_id device id of the transducer to retrieve data from.

dat pointer to a variable of type float that receives the current power value in watts.

speed_mode selects the speed capture mode that the power value should be calculated from. The table below shows the parameter values for the different speed modes

| DLL Definition | Value | Speed Modes |
|---|---|---|
| ST_Speed_Slow_Select | 0 | Slow |
| ST_Speed_Fast_Select | 1 | Fast |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Speed Modes section for a definition of the different speed capture modes.

### *ST_GET_Power_In_HP*

The **ST_GET_Power_In_HP** function returns the current power value in horse power, it is derived from the current torque and speed values for the referenced transducer.

```
ST_STATUS ST_GET_Power_In_HP(
            DWORD device_id,
            float *dat,
            DWORD speed_mode
            );
```

***Parameters***

device_id device id of the transducer to retrieve data from.

dat pointer to a variable of type float that receives the current power value in horse power.

speed_mode selects the speed capture mode that the power value should be calculated from. The table below shows the parameter values for the different speed modes

| DLL Definition | Value | Speed Modes |
|---|---|---|
| ST_Speed_Slow_Select | 0 | Slow |
| ST_Speed_Fast_Select | 1 | Fast |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Speed Modes section for a definition of the different speed capture modes.

### *ST_GET_Temperature_Ambient*

The **ST_GET_Temperature_Ambient** function returns the measured ambient temperature for the referenced transducer.

```
ST_STATUS ST_GET_Temperature_Ambient(
                DWORD device_id,
                float *dat
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| dat | pointer to a variable of type float that receives the ambient temperature in degrees Celsius. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Temperature Sensors section for more information.

### *ST_GET_Temperature_Shaft*

The **ST_GET_Temperature_Shaft** function returns the measured shaft temperature for the referenced transducer.

```
ST_STATUS ST_GET_Temperature_Shaft(
                DWORD device_id,
                float *dat
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| dat | pointer to a variable of type float that receives the shaft temperature in degrees Celsius. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Temperature Sensors section for more information.

### *ST_GET_Temperature_Internal*

The **ST_GET_Temperature_Internal** function returns the measured internal temperature for the referenced transducer.

```
ST_STATUS ST_GET_Temperature_Internal(
                DWORD device_id,
                float *dat
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| dat | pointer to a variable of type float that receives the internal temperature in degrees Celsius. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Refer to the Temperature Sensors section for more information.

### *ST_GET_Torque_Filter*

The **ST_GET_Torque_Filter** function returns the current torque filter setting.

```
ST_STATUS ST_GET_Torque_Filter(
                DWORD device_id,
                DWORD *filtervalue
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| filtervalue | pointer to a variable of type DWORD that receives the current torque filter setting. A filter value of 0 equals OFF. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function.

### *ST_SET_Torque_Filter*

The **ST_SET_Torque_Filter** function configures the torque filter.

```
ST_STATUS ST_SET_Torque_Filter(
            DWORD device_id,
            DWORD filtervalue,
            BOOL save
            );
```

***Parameters***

device_id — device id of the transducer to configure.

filtervalue — configures the torque filter setting, a value greater than zero sets the number of samples used in the filter; valid values are 0(OFF), 2, 4, 8, 16, 32, 64, 128, and 256.

save — if TRUE the specified filter will be enabled, saved and retained across power cycles of the transducer. If FALSE the specified setting will be enabled, but on reset the transducer will revert back to the default or previously saved setting.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function.

### *ST_GET_Speed_Filter*

The **ST_GET_Speed _Filter** function returns the current speed filter setting.

```
ST_STATUS ST_GET_Speed _Filter(
            DWORD device_id,
            DWORD *filtervalue
            );
```

***Parameters***

device_id — device id of the transducer to retrieve data from.

filtervalue — pointer to a variable of type DWORD that receives the current speed filter setting. A filter value of 0 equals OFF.

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, if speed isn’t fitted ST_SPEED_NOT_FITTED will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function.

### *ST_SET_Speed _Filter*

The **ST_SET_Speed _Filter** function configures the speed filter.

```
ST_STATUS ST_SET_Speed _Filter(
                DWORD device_id,
                DWORD filtervalue,
                BOOL save
                );
```

#### *Parameters*

| | |
|---|---|
| device_id | device id of the transducer to configure. |
| filtervalue | configures the speed filter setting, a value greater than zero sets the number of samples used in the filter; valid values are 0(OFF), 2, 4, 8, 16, 32, 64, 128, and 256. |
| save | if TRUE the specified filter will be enabled, saved and retained across power cycles of the transducer. If FALSE the specified setting will be enabled, but on reset the transducer will revert back to the default or previously saved setting. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, if speed isn’t fitted ST_SPEED_NOT_FITTED will be returned, otherwise FT_FAILURE will be returned.

#### *Remarks*

The referenced device needs to be open before using this function.

### *ST_GET_Status_Info*

The **ST_GET_Status_Info** function retrieves the transducers current status.

```
ST_STATUS ST_GET_Status_Info (
                DWORD device_id,
                ST_TRANSTATUS *status,
                );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to retrieve data from. |
| status | pointer to a variable of type ST_TRANSTATUS that receives the transducer status information. See the Transducer Status Codes sections for more information. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function.

### *ST_RESET_Peaks*

The **ST_RESET_Peaks** function resets the stored torque, speed and power peak values as selected by the specified flags.

```
ST_STATUS ST_RESET_Peaks(
        DWORD device_id,
        DWORD reset_flags
        );
```

***Parameters***

device_id device id of the transducer to access.

reset_flags selects the stored peak value(s) to be reset. Peak values are selected by passing the flag value of the peak to be reset. Multiple peak values can be reset at the same time by combining flags, this is done by adding or OR'ing the required flag values together.

| DLL Definition | Flag Value | Value to be reset | Description |
|---|---|---|---|
| ST_Peak_Reset_Flag | 0x4 | Peak torque | Resets the peak torque to zero. |
| ST_Peak_AutoReset_Flag | 0x8 | Peak torque with auto reset | Resets the peak torque with auto reset to zero. |
| ST_Peak_CW_Flag | 0x10 | Peak torque CW | Resets the peak torque clockwise to zero. |
| ST_Peak_CCW_Flag | 0x20 | Peak torque CCW | Resets the peak torque counter-clockwise to zero. |
| ST_Peak_MinMax_Flag | 0x40 | Peak min max | Resets the min and max values to the current torque value. |
| ST_Peak_SpeedF_Reset_Flag | 0x80 | Peak fast mode speed | Resets the peak fast mode speed to zero. |
| ST_Peak_SpeedS_Reset_Flag | 0x100 | Peak slow mode speed | Resets the peak slow mode speed to zero. |
| ST_Peak_PowerF_Reset_Flag | 0x200 | Peak fast mode power | Resets the peak power using the fast speed mode to zero. |
| ST_Peak_PowerS_Reset_Flag | 0x400 | Peak slow mode power | Resets the peak power using the slow speed mode to zero. |
| ST_Peak_ANGLE_Reset_Flag | 0x800 | Angle (rotations & degrees) | Resets the rotations and degrees to zero. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. Reset all values by sending 0xFFC (ST_Peak_ALL) as the value for reset_flags.

### *ST_Zero_Transducer*

The **ST_Zero_Transducer** function zeros the tranducers torque value, this is done by recording the current torque value as an offset, the offset is then subtracted from all subsequant torque readings.

```
ST_STATUS ST_Zero_Transducer(
        DWORD device_id
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to zero. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The zero offset is lost when the transducer is power cycled.

### *ST_ZeroAverage_Transducer*

The **ST_ZeroAverage_Transducer** function zeros the tranducers torque value using a 32 sample average. The current torque value is sampled 32 times and averaged, the averaged value is then recorded as an offset and is subtracted from all subsequant torque readings.

```
ST_STATUS ST_ZeroAverage_Transducer(
        DWORD device_id
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to zero. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The zero offset is lost when the transducer is power cycled.

### *ST_Reset_TimeStamp*

The **ST_Reset_TimeStamp** function initialises and resets the time stamp counter. Calls to **ST_GET_TimeStamp** function will return the elapsed time from this reset point.

void **ST_Reset_TimeStamp**(void);

***Parameters***

None

***Return value***

None.

***Remarks***

For more information on the time stamp functionality, refer to the Time Stamp section of this document

### *ST_GET_TimeStamp*

The **ST_GET_TimeStamp** function returns the elapsed time from the start/reset point.

DWORD **ST_GET_TimeStamp** (void);

***Parameters***

None

***Return value***

Elapsed time in milliseconds from the start/reset point.

***Remarks***

If the TimeStamp counter has not been initialised using the **ST_Reset_TimeStamp** function, calls to this function will always return zero. For more information on the time stamp functionality, refer to the Time Stamp section of this document.

### *ST_Capture_Enable*

The **ST_Capture_Enable** function initialises and starts the automated capture mode. Once started, data is captured and buffered at the rate requested. Data is extracted from the buffer by using **ST_GET_Capture_Data**, and the capture is stopped by using **ST_Capture_Disable.**

```
ST_STATUS ST_Capture_Enable (
        DWORD device_id,
        DWORD caprate
        );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to access. |
| caprate | the data capture rate to be used by the capture mode. The value should be specified as the number of samples per second. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned and the capture proccess will have been started. If the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before using this function. The caprate parameter must be between 1 and the maximum supported capture rate. Use the **ST_GET_Capture_Rate** function to retieve the maximum capture rate.

The requested capture rate may not be possible due to the resolution of the capture timer. The DLL divides the timer value for a second by the capture rate, and uses that value as the timer value. The operating system timers must be capable of a 1ms resolution for the capture system to work.

### *ST_Capture_Disable*

The **ST_Capture_Disable** function stops an active data capture mode and frees all allocated resources. Captured data which has not been extracted will be purged.

```
ST_STATUS ST_Capture_Disable (
            DWORD device_id
            );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to access. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open and the capture mode active before this function can be used.

### *ST_GET_Capture_Data*

The **ST_GET_Capture_Data** function extracts data from an active data capture mode. Data is stored and transferred as record blocks, the **ST_GET_Capture_Data** function transfers these record blocks from an internal ring buffer to the users record array.

```
ST_STATUS ST_GET_Capture_Data (
                DWORD device_id,
                CAPREC *record_ptr,
                DWORD records,
                DWORD *recordno
                );
```

#### *Parameters*

|  |  |
|---|---|
| device_id | device id of the transducer where there is an active data capture. |
| record_ptr | pointer to an array of CAPREC records. |
| records | number of records in the array pointed to by record_ptr. |
| recordno | pointer to a variable of type DWORD that receives the number of records written to the array pointed to by record_ptr. |

#### *Return value*

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, if there is no active data capture mode ST_CMD_INACTIVE will be returned.

ST_BUFFER_OVERFLOW will be returned if the primary and secondary internal buffers become fully consumed. This would occur if the **ST_GET_Capture_Data** poll rate is too low, compared to the selected capture rate. The capture mode will be terminated if this occurs.

ST_NO_COMMS_IN_PROCESS will be returned if the data feed from the transducer stops. The capture mode will be terminated if this occurs.

FT_FAILURE will be returned for all other errors.

#### *Remarks*

The referenced device needs to be open and the capture mode active, before this function can be used. The size of the array passed to **ST_GET_Capture_Data** should be carefully considered, and take in to acount the configured capture rate and time between calls to **ST_GET_Capture_Data**.

### ***ST_GET_Capture_Rate***

The **ST_GET_Capture_Rate** function retrieves the maximum capture rate that can be used with the data capture mode.

```
ST_STATUS ST_GET_Capture_Rate(
            DWORD device_id,
            DWORD *caprate
            );
```

***Parameters***

| | |
|---|---|
| device_id | device id of the transducer to access. |
| caprate | pointer to a variable of type DWORD that receives the maximum data capture rate supported by the transducer/DLL. |

***Return value***

If the function completes successfully ST_SUCCESS will be returned, if the device_id is invalid then ST_DEVICE_INVALID will be returned, if the device is not open ST_DEVICE_NOT_OPEN will be returned, if the operating system does not support a 1ms timer resolution, then ST_WINDOWS_TIMER_RESOLUTION will be returned, otherwise FT_FAILURE will be returned.

***Remarks***

The referenced device needs to be open before this function can be used. The operating system timers must be capable of a 1ms resolution for the capture system to work.