Interface documentation LLT.dll

Visual Basic

Version:	1.0
LLT.dll version:	3.9.0.2012
Date:	21.10.2019

I. About this document

The purpose of this document is to enable the reader to integrate a scanCONTROL laser profile sensor into dedicated software applications via C#. This document is based upon the application interface provided by the LLT.dll.

To get a general overview, a general introduction to the LLT.dll and the measurement principles are given at the beginning. Then the resulting measurement values are specified. This is necessary to get a basic understanding of the measurement data used in the Software. Further, the different measurement and profile data formats are explained and the data transmission types are illustrated. The general part finishes with an illustration of the limitations regarding measurement speed.

For detailed introduction into programming with the scanCONTROL SDK basic programming tasks are illustrated via example code. Detailed programming examples and a full documentation of the API support the actual implementation.

II. Versions

Version	Date	Author	State
1.0	21.10.2019	THl	Initial draft

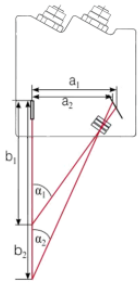
III. Content

1 Introduction

1.1 Measurement principle and data

1.1.1 Principle of optical triangulation

Like conventional laser distance sensors, scanCONTROL laser profile sensors make use of the principle of optical triangulation. The beam of a laser diode is widened by special optics and projected onto a measurement target. The receiver optic focuses the diffuse reflected light, which is then detected by a CMOS sensor matrix. To ensure that only the reflection of the projected laser line is detected, a bandpass filter is embedded right before the sensor matrix. This filter allows only light to pass, which correlates to the wavelength of the laser diode.



Based on the position of the detected laser beam within one column of the sensor matrix, the distance of one measuring point to a defined reference in the sensor (z axis) can be calculated via triangulation. Usually the bottom of the sensor is chosen as reference. The basic calculation relies on the following formula:

$$b_1 = \frac{a_1}{\tan \alpha_1}$$

The resolution in z direction is determined by the number of pixels in the z axis of the sensor matrix. As reflections are detected by more than one pixel, the center of gravity of the reflection is used to calculate the position (subpixel resolution).

According to the position of a measuring point within one row of the matrix, a distance value can be assigned to an x value (i.e. position). The number of pixels in a sensor row determines how many single measurement points are available.

The resulting measuring data is a two dimensional profile, which is calibrated to a dimensional unit ([mm]) by the sensor. This allows for either a relative or an absolute measurement. 3D measurements can be done via movement of the sensor or the target along the y axis. If a steady movement can be accomplished or if an encoder is used, a data grid with equidistantly distributed points can be generated.

1.1.2 Available measuring values

In addition to the distance and position values (Z / X) scanCONTROL sensors generate and send further information about the current measurement. This includes the intensity, reflection width, moment 0 and moment 1. Additionally the threshold used for every single point is transmitted. These values are described below:

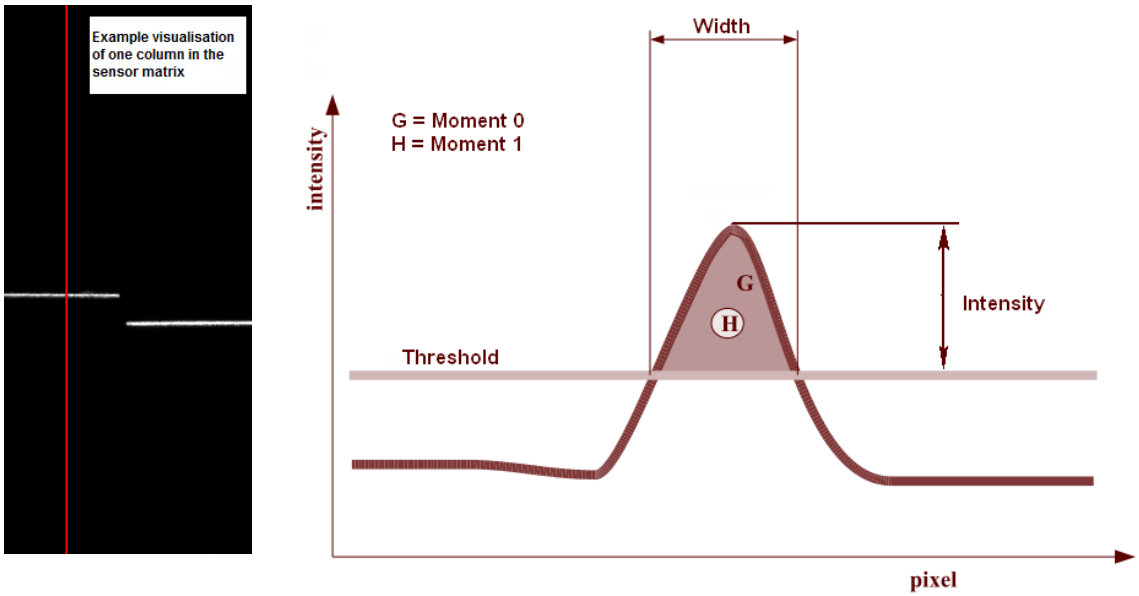


Fig. 1: How to get a measuring value from a reflection (evaluation of one sensor column)

- Distance: To get the distance (i.e. z value) of a measuring point, the center of gravity of the reflection detected by the CMOS sensor column is calculated. Based on a calibration table this value is converted to a real distance coordinate in the sensor. The value is transmitted as 16 bit unsigned integer field which has to be scaled by the sensor specific scaling factors.

- Position: The position (x value) corresponds to a pixel row of the CMOS sensor. For every column one position value is detected. Calibration to the real position is achieved by the calibration table saved on the sensor. A 16 bit unsigned integer field is transmitted which has to be scaled, too.

- Intensity: The transmitted value is the difference between the detected intensity maximum and the currently used threshold. Intensity correlates to how much light one pixel of the matrix has detected while the shutter was open. Prerequisite for detection of a reflection is that the intensity is above the threshold. A 10 bit unsigned integer field is transmitted.

- Reflection width: The reflection width correlates to the number of contiguous pixels the intensity of the current reflection is above the threshold. A 10 bit unsigned integer field is transmitted.

- Moment 0: Corresponds to the integral intensity (“area of reflection”) of the current reflection. The moment is thus defined by the integral of the intensity over the reflection width; see Fig. 1 (G). The value is transmitted as 32 bit unsigned integer field.

- Moment 1: Corresponds to the center of gravity of the reflection, which is used as foundation for calculation of positon and distance according to the calibration table. It is transmitted as 32 bit unsigned integer.

- Threshold: The Threshold used for the single measuring point, which consists of the absolute or dynamically calculated threshold and the determined backlight suppression. A 10 bit unsigned integer field is transmitted.

All of these values are in respect to the current reflection detection setting of the sensor. You can choose to detect the first or last reflection over the threshold (detected for each sensor column), the reflection with the maximum intensity or the reflection with the biggest integral intensity (“largest area”) (Fig. 2).

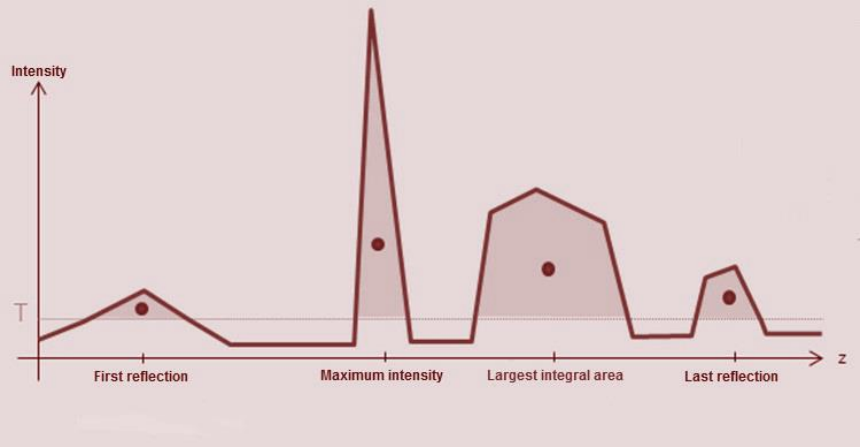


Fig. 2: Detected reflections

1.2 LLT.dll

The LLT.dll is a *Dynamic Link Library* (DLL) for the simple integration of scanCONTROL sensors into own applications. It provides an abstraction level above the direct responses of the scanCONTROL by Ethernet or the serial interface. The focus of the design of the DLL has been set on the simplicity of the interface and high performance.

The functionality includes the complete parametrization and control of the sensor, the transmission, saving and converting of measurement data in all different transmission modes. Additionally the connection monitoring between PC and scanCONTROL can be done via the DLL. Furthermore the integration of several sensors into one application is possible.

To make the DLL compatible with as many different application development systems and compilers as possible, the DDL interface has been realized with pure C functions of the *cdecl* and *stdcall* call convention. Thus the DLL may be used under C, Delphi or other programming languages which provide compatibility to the used data types or if the implementation takes care of the differences (e.g. enums in Delphi). For C++ applications an additional wrapper exists, which maps the C functions to methods of an interface class. Visual Basic applications can be realized by wrapping the DLL with P/Invoke.

This documentation shows the DLL integration with the provided Visual Basic wrapper class. The integration in C or another programming language may be derived from this documentation. For the implementation with C++ another document is available.

1.3 Loading the DLL in Visual Basic (VB)

The integration with VB is based on the Platform Invocation Services (P/Invoke), which wrap the C functions of the DLL. The necessary calls are defined in the class *CLLTI.cs*. P/Invoke enables the execution or call of native *unmanaged code* in the *managed code* environment stated by .NET. This must be considered during the software implementation process, because invocation of C functions has direct influence on garbage collection and type safety of VB.

The DLL can only be loaded dynamically, which means, the LLT.dll can be replaced by a newer version without recompiling the project. Additionally you can check if the requested function is available in the DLL. This is only necessary for the functions added after the first release. If new functions of the LLT.dll are to be used, the project has to be recompiled with the current *CLLTI.vb* class.

2 Operating Modes for profile generation (only scanCONTROL 30xx)

The scanCONTROL 30xx series provides three Operating Modes for the profile generation. Depending on the needs of the measurement task one of these can be selected.

2.1 High Resolution mode

The High Resolution mode is the standard mode for profile acquisition. The High Resolution mode provides profile data with the best Z linearity compared to the other modes.

2.2 High Speed mode

In the High Speed mode profiles can be acquired at double profile frequency (in comparison to the High Resolution mode at the same measuring field size) while losing a small degree of Z linearity.

2.3 High Dynamic Range mode (HDR)

The High Dynamic Range mode is used for target surfaces that have inhomogenous surface properties (e.g. very dark and very bright parts). Therefore a special sensor matrix feature is used to optimize the profile data of difficult surfaces while not being prone of in-motion unsharpness.

Like in the High Speed mode, the Z linearity is slightly worse than in the High Resolution mode.

3 Measurement data format

3.1 Video Mode

The Video Mode is used for transmitting the 8 bit greyscale bitmaps detected by the CMOS sensor matrix (Fig. 3). Only the actual image data is transmitted – header and mirroring of the image has to be realized externally if necessary. This data format does not have a timestamp. The measurement frequency must not exceed 25 Hz. It has to be considered that scanner of the 29xx series require a Gigabit Ethernet connection to transmit the image data with the minimal internal frequency of 25 Hz. The reason is the big image size, which leads to a necessary bandwidth of 262 Mbps (25 Hz * 1024 * 1280 * 8 bit).

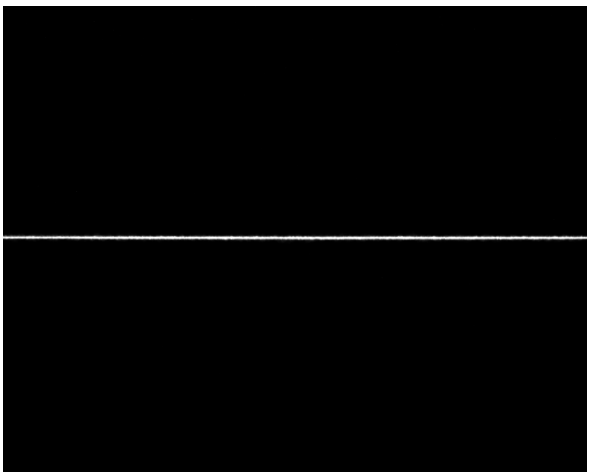


Fig. 3: Example Video Mode

Scanners of the 30xx series provide a high resolution video mode that requires a bandwidth of 445 Mbps (25 Hz * 1088 * 2048 * 8 bit) and a low resolution video mode that operates at 28 Mbps (25 Hz * 272 * 512 * 8 bit) for 100 Mbit Ethernet connections.

3.2 Single profile transmission

3.2.1 General format of profile data

By default a 64 byte wide data field is transmitted for each measuring point in single profile transmission mode. The height of the data field is determined by the set number of points per profile. The 64 bytes are divided into four stripes (peaks) with 16 bytes each. Every stripe can consist of one complete profile, but usually only the first stripe contains valid profile data. If multiple reflections are detected, the other stripes are filled as well. The last 16 bytes of each transmission contains the timestamp. That means in *Full Set* data transmission (default) the last point of the fourth stripe is overwritten.

For every point in each stripe, all information described in the previous chapter is transmitted. It is structured as following:

0..7	8..15	16..23	24..31
Res. (2 bit)	Reflection width (10 bit)	Max. Intensity (10 bit)	Threshold (10 bit)
Position (16 bit)		Distance (16 bit)	
Moment 0 (32 bit)			
Moment 1 (32 bit)			

Single measurement values are encoded in the big endian byte format. As mentioned previously position and distance data (x/z) has to be scaled with measuring range specific scaling factors. A basic illustration of the data arrangement is shown in Fig. 4.

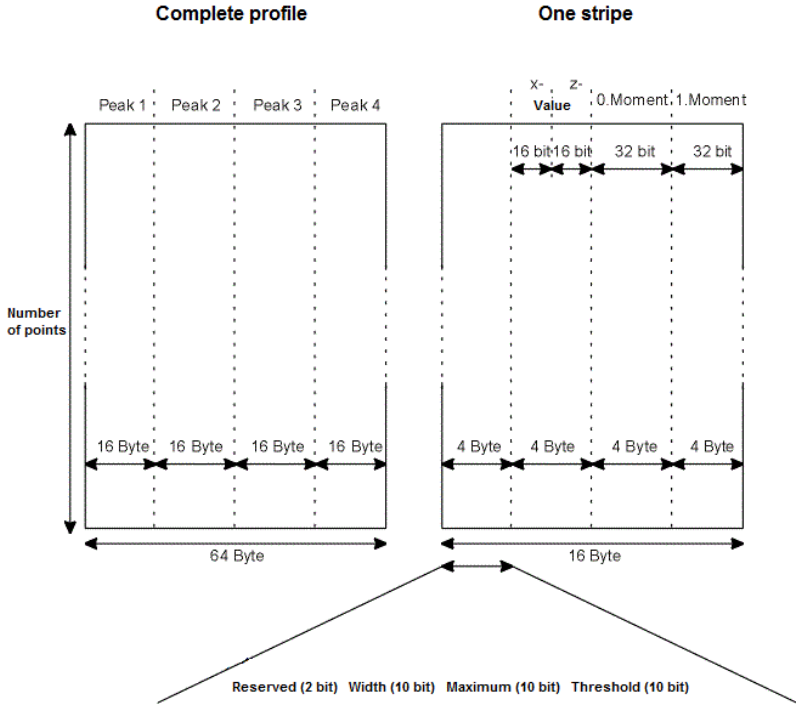


Fig. 4: Data arrangement single profile transmission

3.2.2 Timestamp information

The timestamp transmitted in the last 16 bytes includes the following key data of a measured profile (data format: unsigned integer; big endian):

- Profile counter: Incremental counter for identification of profiles; is increased by one after each measurement. The field consists of 24 bit and is thus able to count until 16777215 profiles. After that the counter is set back to zero.

- Shutter open: Contains the absolute time at which the exposure was started. The internal clock has a period of 128 seconds. The 32 bit wide field consists of a second counter, a cycle counter and a cycle offset. From these values the moment of shutter opening can be calculated.

- Edge counter: Depending on the scanner settings two times the detected encoder edges or the state of the digital inputs is transmitted. The field is 16 bit wide.

- Shutter close: Contains the absolute time at which the exposure was stopped. It is equivalent to the *shutter open* field.

The timestamp is structured like this:

<table>
<tr><td>0..7</td><td>8..15</td><td>16..23</td><td>24..31</td></tr>
<tr><td>Flags (2 bit)</td><td colspan="2">Reserved (6 bit)</td><td>Profile counter (24 bit)</td></tr>
<tr><td colspan="4">Shutter open (32 bit)</td></tr>
<tr><td colspan="2">Edge counter or DigIn (16 bit)</td><td colspan="2">Reserved (16 bit)</td></tr>
<tr><td colspan="4">Shutter close (32 bit)</td></tr>
</table>

The parts of the timestamp for shutter open/closed are compounded as following:

Seconds counter (7 bit)	Cycle counter (13 bit)	Cycle offset (12 bit)

The absolute time can be calculated via:

$$\text{Timestamp} = \text{seconds counter} + \frac{\text{cycle counter}}{8000} + \frac{\text{cycle offset}}{8000*3072}$$

(Remark: The cycle count is overflowing at 8000 and the cycle offset at 3072!)

3.2.3 CMM timestamp

If the *Coordinate Measuring Machine* (CMM) trigger is activated the format of the timestamp changes. Instead of the 16 bit encoder edge counter / the reserved field, following CMM specific information is transmitted:

CMM edge counter (16 bit)	CMM trigger flag (1 bit)	CMM active flag (1 bit)	CMM trigger impulse count (14 bit)

3.2.4 Complete measurement data set (Full Set, PROFILE)

By default all key data values described previously are transmitted. The predefined profile configuration format *Full Set* extracts all of this data from the transmission buffer. The amount of data in this configuration is represented by 64 bytes for every point of the profile. In context of the DLL this configuration is called *PROFILE*. The output encoding is big endian.

3.2.5 One stripe (QUARTER_PROFILE)

The profile configuration *QUARTER_PROFILE* extracts one stripe of the *Full Set* data. Consequently the amount of data to be evaluated is decreased. The timestamp information is attached to the measurement data, which means the amount of data is 16 byte per profile point plus 16 byte timestamp. Is has to be mentioned that the amount of transmitted data is not reduced, instead only the specified part (the selected stripe) of the data buffer is evaluated and passed to the application. Thus the data is still transmitted completely. This configuration is also encoded in big endian.

3.2.6 X/Z data (PURE_PROFILE)

With the profile configuration *PURE_PROFILE* only position and distance values are extracted from the currently set stripe. The behavior is same as in *QUARTER_PROFILE* configuration, which means the transmitted amount of data is not reduced. The data to be evaluated is reduced to 4 bytes per profile point plus 16 byte timestamp. The values are extracted in little endian encoding.

3.2.7 Partial profile (PARTIAL_PROFILE)

A partial profile (*PARTIAL_PROFILE*) is a custom cropped profile generated directly on the scanner. It is therefore possible to reduce the amount of transmitted data significantly. Also on-scanner data processing is accelerated, which is important while operating with high data rates. The size of the profile can be defined by the following four parameters:

1. *StartPoint*: First measuring point included in the profile
2. *StartPointData*: Data offset, from which byte the data of a point should be included in the profile
3. *PointCount*: Number of measuring points included in the profile counted from the *StartPoint*
4. *PointDataWidth*: Number of bytes from the *StartPointData* offset which should be included in the profile

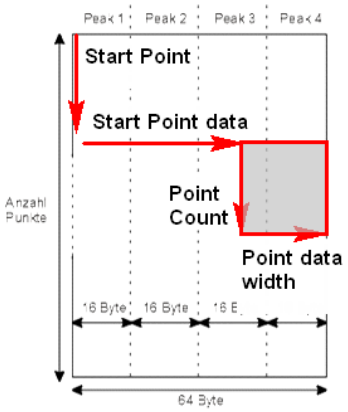


Fig. 5: Illustration Partial Profile

The reference point for setting the *StartPoint* or the *StartPointData* is the upper left edge. Counting starts with the index 0. The timestamp overwrites the last 16 bytes of the partial profile. The transmitted amount of data is reduced to (PointDataWidth x PointCount) bytes. This configuration is encoded in big endian.

3.3 Container Mode

The container mode allows combining data from several profiles into one big transmission container. The advantages of this mode include reduction of the necessary reaction intervals of the software application and of data overhead.

3.3.1 Standard Container Mode

In Standard Container Mode profiles are combined into one logical transmission container. The sensor collects data until the requested amount is reached and transmits it as one package. The maximum container size depends on the sensor (128 Mbyte / 4096 profiles). In this case the main advantage is the longer reaction time intervals in the software.

3.3.2 Rearranged Container Mode (Transposed Container Mode)

The *Rearrangement* feature enables the sensor to send only the really necessary data. The user can freely define from which stripe which measuring values should be transmitted. These values are saved continuously per profile. The timestamp can be saved in an additional field. The chosen values are collected for the set amount of profiles and then transmitted.

One rearrangement configuration often used is the so called transposed container mode. Here only the distance data is transmitted (optional: position as well). This data is then arranged as a 16-bit grey scale bitmap, which can be analyzed with standard vision tools. The width of the bitmap is determined by the number of points per profile; the height by the number of profiles in the container. The default data format is big endian, but can be changed to little endian.

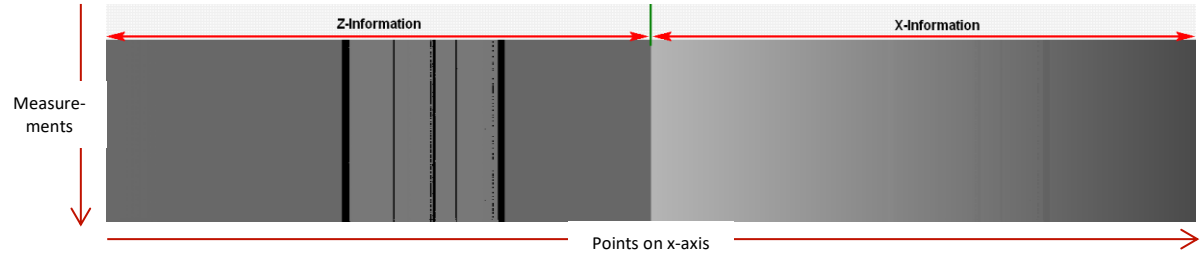


Fig. 6: Example image transposed container mode

4 Data transmission scanCONTROL sensor

4.1 Data transmission

Data transmission is started and stopped by the user application. If the transmission is active, received data is written into the receiving buffer according to the profile frequency. It can be chosen between continuous data extraction from the profile buffer (NORMAL_TRANSFER) and shot wise data extraction from the profile buffer (transmission of a defined number of profiles = SHOT_TRANSFER).

4.2 Polling of measurement data

For non-time critical application or applications which do not need all profiles or video images to be evaluated, it is possible to extract the data actively from the receiving buffer. For every poll the last profile/container/image received is copied from the buffer to an additional buffer reserved by the application, which then can be used for further evaluation. If there is no new profile since the last poll, the application is noticed.

4.3 Using callbacks

The second way of fetching data is by using a callback: For every received profile or container the callback function is executed. If the callback is finished an event is to be set. One parameter of the callback is a pointer to the currently received profile/container. The data size depends on the profile configuration set. The pointer enables the callback to copy the received data into an evaluation buffer. The callback function has to be very fast to make sure the next buffer can be fetched by the driver.

5 Measuring speed

The maximum measuring speed depends on several sensor parameters and is different for every sensor type. Additionally the given network infrastructure can be a limiting factor. If the maximum speed is exceeded data is lost and/or corrupted and thus should be completely avoided.

To avoid performance problems resulting from the network environment a Gigabit Ethernet connection should be established between PC and Sensor. Especially if sensors of the 29xx series or the 30xx series are used, 100 Mbps networks are quickly at their bandwidth limitations. Furthermore a PC with a sufficient hardware performance should be used, as a huge amount of data has to be analyzed – especially if there is more than one sensor connected.

Most of the time, the sensor speed is limited by the measuring field used by the sensor. The measuring field corresponds to the part of sensor matrix which is read out by the scanCONTROL sensor. The smaller the read out area, the faster is the maximal measuring frequency. A detailed listing of possible frequencies for each measuring field is given in the scanCONTROL *Quick Reference*, which is part of the sensor documentation. In general, only the necessary part of the matrix should be evaluated, especially during high frequency measurements.

An important parameter to consider in regard of measuring speed is the exposure time. The maximum frequency of a measuring task can be determined by calculation the reciprocal value of the exposure time. If there are advanced post processing operations configured on the sensor (SMART or GAP sensors), which can be a bottle neck as well. The duration of the current post processing can be seen in the *scanCONTROL Configuration Tools.* If the sensors are operated with higher frequencies, the basic processing can limit the speed, even without having configured post processing tasks. This can be countered by only reading out the area of the matrix which contains the points of interest and reducing the transmitted data using the partial profile configuration (e.g. only one stripe or x/z data). If the maximum sensor speed is used, it is especially important to use a configuration for lowest possible data transmission. This has no influence on the quality of measurements, because all additional points are not in the measuring field and would just contain invalid values.

6 Typical code examples with references to the SDK

The following chapter shows basic code examples for different integration steps. Complete projects with e.g. error handling can be found in the project folder of the SDK. Except for example 5.1 the sensor has to be connected prior of code execution. In some examples, registers are set (*CLLTI.SetFeature(…)*) – note that register addresses are mapped to constants in the SDK (e.g. `FEATURE_FUNCTION_EXPOSURE_TIME` for exposure time register). Detailed description of the registers can be found in Operation Manual Part B (see chapter 8.3), which is part of the scanner documentation.

6.1 Connect to the sensor

This example shows how to find a sensor and how to connect to it.

```
Dim Interfaces(5) As UInteger
Dim hLLT As UInteger = 0

// Create device handle for an ethernet scanner
hLLT = CLLTI.CreateLLTDevice(CLLTI.TInterfaceType.INTF_TYPE_ETHERNET)

// Search for scanners at the interface
CLLTI.GetDeviceInterfacesFast(hLLT, Interfaces, Interfaces.GetLength(0))

// Set device handle to first detected scanner
CLLTI.SetDeviceInterface(hLLT, Interfaces(0), 0)

// Connect
CLLTI.Connect(hLLT)
```

See API: CreateLLTDevice(), GetDeviceInterfaces(), GetDeviceInterfacesFast(), SetDeviceInterface(), Connect()

6.2 Set profile frequency and exposure time (only scanCONTROL 30xx)

This example shows how to change the profile frequency and the exposure time (shutter time) for scanCONTROL 30xx. The set value marks the time in 1 µs steps. The profile frequency cannot be set directly but is composed from the exposure time (*ExposureTime*) and the idle time (*IdleTime*). Calculation:

$$Profile\ frequency = \frac{1}{(ExposureTime + IdleTime)}$$

```
Dim ExposureTime As UInteger          = 1005
Dim IdleTime As UInteger              = 8995

// Set exposure time
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_EXPOSURE_TIME,
    (((ExposureTime Mod 10) << 12) And &HF000) +
    ((ExposureTime / 10) And &HFFF))

// Set idle time
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_IDLE_TIME,
    (((IdleTime Mod 10) << 12) And &HF000) +
    ((IdleTime / 10) And &HFFF))
```

See API: SetFeature(), FEATURE_FUNCTION_EXPOSURE_TIME, FEATURE_FUNCTION_IDLE_TIME
See Operation Manual Part B: *OpManPartB.html#exposuretime, OpManPartB.html#idletime*

The example code sets the exposure time to 1.005 ms and the profile frequency to 100 Hz. Please take a look at the SDK examples (sc30xx_HighSpeed).

6.3 Set profile frequency and exposure time

This example shows how to change the profile frequency and the exposure time (shutter time). The set value marks the time in 10 µs steps. The profile frequency cannot be set directly but is composed from the exposure time (*ExposureTime*) and the idle time (*IdleTime*). Calculation:

$$Profile\ frequency = \frac{1}{(ExposureTime + IdleTime) * 10\ \mu s}$$

```
Dim ExposureTime As UInteger          = 100
Dim IdleTime As UInteger              = 900

// Set exposure time to 1 ms (100*10 us)
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_EXPOSURE_TIME, ExposureTime)

// Set idle time to 9 ms (900*10 us)
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_IDLE_TIME, IdleTime)
```

See API: SetFeature(), FEATURE_FUNCTION_EXPOSURE_TIME, FEATURE_FUNCTION_IDLE_TIME
See Operation Manual Part B: *OpManPartB.html#exposuretime, OpManPartB.html#idletime*

The example code sets the exposure time to 1 ms and the profile frequency to 100 Hz.

6.4 Poll measurement data

This example shows how to fetch data from the sensor via active polling. To poll data the function *GetActualProfile()* copies the last received profile from the receiving buffer to an application buffer for further evaluation. After that the function *ConvertProfile2Values()* extracts the x/z data from the buffer. This function automatically calculates the position and distance values in mm according to the scaling factors.

```
Dim Resolution As UInteger
Dim scanCONTROLType As CLLTI.TScannerType

[…] // Connect

CLLTI.GetLLTType(hLLT, scanCONTROLType)

// Set buffer for complete profile and x/z values
Dim ProfileBuffer(Resolution * 64 - 1) As Byte
Dim ValueX(Resolution) As Double
Dim ValueZ(Resolution) As Double

Dim LostProfiles As UInteger = 0

// Start continous profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 1)

// Poll a profile from receiving buffer
// Hint: If no new profile has been received since the last call, the function
// returns -104. This may be used to constantly query for new data in a loop.
CLLTI.GetActualProfile(hLLT, ProfileBuffer, ProfileBuffer.GetLength(0),
                               CLLTI.TProfileConfig.PROFILE, LostProfiles))
```

```
// Convert buffer values into x/z data
CLLTI.ConvertProfile2Values(hLLT, ProfileBuffer, Resolution,
    CLLTI.TProfileConfig.PROFILE, scanCONTROLType, 0, 1, Nothing, Nothing, Nothing,
    ValueX, ValueZ, Nothing, Nothing)

// Stop continous profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 0)
```

See API: GetLLTType(), TransferProfiles(), GetActualProfile(), ConvertProfiles2Values()

6.5 Get measurement data via callback

This example shows how to fetch profile data via callback. For this purpose a callback is registered, which is executed for every received profile. The callback function copies the data from the receiving buffer and emits an event after one profile. After the profile is received the transmission is stopped.

```
Imports System.Threading
Imports System.Runtime.InteropServices

[…]

Dim Resolution As UInteger
Dim scanCONTROLType As CLLTI.TScannerType
Shared hProfileEvent As AutoResetEvent = New AutoResetEvent(False)

[…]

// Allocate buffer
Dim ProfileData(Resolution * 64 - 1) As Byte

// Define new profile event
Dim gch As GCHandle = GCHandle.Alloc(New CLLTI.ProfileReceiveMethod
                                                    (AddressOf ProfileEvent))

// Register callback function
CLLTI.RegisterCallback (hLLT, CLLTI.TCallbackType.STD_CALL, DirectCast
                                    (gch.Target, CLLTI.ProfileReceiveMethod), hLLT)

// Start continous profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 1)

// Wait for event with timeout 1 second
hProfileEvent.WaitOne(1000)

// Stop continous profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 0);

// Callback function (copies one profile into the buffer and sets the event afterwards)
Shared Sub ProfileEvent(ByVal data As Intptr, uiSize As UInteger,
                                                        uiUserData As UInteger)
   Marshal.Copy(data, ProfileData, 0, uiSize)
   hProfileEvent.Set()
End Sub
```

See API: RegisterCallback(), TransferProfiles()

6.6 Set profile filter

This example shows how to set resampling, median and average filter.

```
// Set average filter to 7 taps
Dim ProfileFilter As UInteger = CLLTI.FILTER_AVG_7

// Set median filter to 5 taps
ProfileFilter = ProfileFilter Or CLLTI.FILTER_MEDIAN_5

// Set resampling (interpolation of invalid points; alle Info; huge)
ProfileFilter = ProfileFilter Or CLLTI.FILTER_RESAMPLE_EXTRAPOLATE_POINTS Or
                CLLTI.FILTER_RESAMPLE_ALL_INFO Or CLLTI.FILTER_RESAMPLE_HUGE

// Set configured filters
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_PROFILE_FILTER, ProfileFilter)
```

See API: SetFeature(), FEATURE_FUNCTION_PROFILE_FILTER
See Operation Manual Part B: *OpManPartB.html#profilefilter*

6.7 Encoder

This example shows how to activate encoder triggering via digital inputs.

```
Dim Encoder As UInteger = 0
// Set trigger input to encoder
Dim Trigger As UInteger = CLLTI.TRIG_MODE_ENCODER
// Set digital inputs as trigger input and activate ext. triggering
Trigger = Trigger Or CLLTI.TRIG_INPUT_DIGIN Or CLLTI.TRIG_EXT_ACTIVE
// Set trigger settings
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_TRIGGER, Trigger)


// Set multi-function port to bidirectional 24V encoder mode
uint MultiPort = CLLTI.MULTI_DIGIN_ENC_INDEX | CLLTI.MULTI_LEVEL_24V
                                             | CLLTI.MULTI_ENCODER_BIDIRECT;
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_DIGITAL_IO, MultiPort);


// Read maintenance register and activate encoder
CLLTI.GetFeature(hLLT, CLLTI.FEATURE_FUNCTION_MAINTENANCE, &Encoder);
Encoder |= CLLTI.MAINTENANCE_ENCODER_ACTIVE;
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_MAINTENANCE, Encoder);
```

See API: SetFeature(), GetFeature(), FEATURE_FUNCTION_TRIGGER, FEATURE_FUNCTION_MAINTENANCE, FEATURE_FUNCTION_DIGITAL_IO
See Operation Manual Part B: *OpManPartB.html#trigger, OpManPartB.html#maintenance, OpManPartB.html#ioconfig*

6.8 External triggering

This example shows how to activate external triggering via digital inputs.

```
// Set trigger input to pos. pulse mode
Dim Trigger As UInteger = CLLTI.TRIG_MODE_PULSE Or CLLTI.TRIG_POLARITY_HIGH
// Set digital input as trigger input and activate ext. triggering
Trigger = Trigger Or CLLTI.TRIG_INPUT_DIGIN Or CLLTI.TRIG_EXT_ACTIVE
// Set trigger settings
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_TRIGGER, Trigger)

// Set multi-function port to 5V digital input triggering
Dim MultiPort As UInteger = CLLTI.MULTI_DIGIN_TRIG_ONLY Or CLLTI.MULTI_LEVEL_5V
CLLTI.SetFeature(hllt, CLLTI.FEATURE_FUNCTION_DIGITAL_IO, MultiPort)
```

See API: SetFeature(), FEATURE_FUNCTION_TRIGGER , FEATURE_FUNCTION_DIGITAL_IO
See Operation Manual Part B: *OpManPartB.html#trigger, OpManPartB.html#ioconfig*

6.9 Software profile trigger

This example shows how to trigger a profile via software profile trigger.

```
// Activate ext. triggering
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_TRIGGER, CLLTI.TRIG_EXT_ACTIVE)

// Software triggering; triggers one profile
CLLTI.TriggerProfile(hLLT)
```

See API: SetFeature(), TriggerProfile(), FEATURE_FUNCTION_TRIGGER
See Operation Manual Part B: *OpManPartB.html#trigger*

Please take a look at the SDK examples (TriggerProfile).

6.10 Software container trigger

This example shows how to trigger a container via software container trigger. To use this function, the sensor either has to be in frametrigger mode (see Digital IO configuration) or the functionality has to be activated separately by TriggerContainerEnable() / TriggerContainerDisable().

```
// Activate container trigger if necessary
CLLTI.TriggerContainerEnable(hLLT)

// Start container transfer
CLLTI.TransferProfiles(hLLT, NORMAL_CONTAINER_MODE, true)

// Trigger one container
CLLTI.TriggerContainer(hLLT)

[…] // Wait for container and fetch it from buffer

// End container transfer
CLLTI.TransferProfiles(hLLT, NORMAL_CONTAINER_MODE, false)

// Deactivate container trigger if necessary
CLLTI.TriggerContainerDisable(hLLT)
```

See API: SetFeature(), TriggerContainer(), FEATURE_FUNCTION_TRIGGER
See Operation Manual Part B: *OpManPartB.html#trigger*

Requires: Frimware version v46 or newer
Please take a look at the SDK examples (TriggerContainer).

6.11 Set peak filter

This example shows how to set the peak filters of the scanner. These filters exclude points which are not in a certain range of intensity and/or reflection width from the profile. To activate a 0 must be written to FEATURE_FUNCTION_EXTRA_PARAMETER.

```
// Set peak values
Dim min_width As Ushort        = 2   // values <2 increase noise significantly
Dim max_width As Ushort        = 1023
Dim min_intensity As Ushort    = 0
Dim max_intensity As Ushort    = 1023

CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_PEAKFILTER_WIDTH,
                                        (CUInt(max_width) << 16) + min_width)
CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_PEAKFILTER_HEIGHT,
                                    (CUInt(max_intensity) << 16) + min_intensity)

// Write 0 to EXTRA_PARAMETER register to activate the setting
CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_EXTRA_PARAMETER, 0)
```

See API: SetFeature(), FEATURE_FUNCTION_PEAKFITLTER, FEATURE_FUNCTION_EXTRA_PARAMETER
See Operation Manual Part B: *OpManPartB.html#extraparameter*

Note for scanCONTROL 27xx and scanCONTROL 26xx/29xx (Firmware version < v43):
The peak filter has to be set via the EXTRA_PARAMETER register. Please take a look at the SDK examples (advanced/LLTPeakFilter).

6.12 Compute sensor matrix regions

To set a free measuring field (Firmware versions < v43, see chapter 6.13) a region of interest (see chapter 6.14), a region of no interest or a reference region for the automatic exposure time on the sensor matrix, the percentage on the correctly rotated sensor matrix (cf. scanCONTROL Configuration Tools) have to be converted to the correct matrix values. The formulas to be used depend on the used sensor type.

```
// Percentage of measuring field
Dim start_z As Double= 25.0
Dim end_z As Double = 75.0
Dim start_x As Double = 20.0
Dim end_x As Double = 80.0

// scanCONTROL 30xx
Dim col_start As Ushort = start_x / 100 * 65535
Dim col_size As Ushort = (end_x – start_x) / 100 * 65535
Dim row_start As Ushort = start_z / 100 * 65535
Dim row_size As Ushort = (end_z – start_z) / 100 * 65535

// scanCONTROL 29xx, 27xx, 25xx
Dim col_start As Ushort = 65535 - (end_x / 100 * 65535)
Dim col_size As Ushort = (end_x – start_x) / 100 * 65535
Dim row_start As Ushort = 65535 – (end_z / 100 * 65535)
Dim row_size As Ushort = (end_z – start_z) / 100 * 65535

// scanCONTROL 26xx
Dim col_start As Ushort = 65535 - (end_x / 100 * 65535)
Dim col_size As Ushort = (end_x – start_x) / 100 * 65535
Dim row_start As Ushort = start_z / 100 * 65535
Dim row_size As Ushort = (end_z – start_z) / 100 * 65535
```

6.13 Set free measuring field

This example shows how to set the free measuring field. This setting makes it possible to define a custom size for the measuring field. It can be set via sequential register. To activate a 0 must be written to FEATURE_FUNCTION_EXTRA_PARAMETER.

```
Dim toggle As Integer = 0

// Activate free measuring field
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_ROI1_PRESET,
                                                    CLLTI.MEASFIELD_ACTIVATE_FREE)
WriteCommand(0, 0) // Reset
WriteCommand(0, 0) // Initialization
WriteCommand(2, 8) // Navigate in register
WriteValue2Register(row_start)
WriteValue2Register(row_size)
WriteValue2Register(col_start)
WriteValue2Register(col_size)
WriteCommand(0, 0) // Stop writing process

// Write command for seq. register
Shared Sub WriteCommand(command As UInteger, data As UInteger)

   CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_EXTRA_PARAMETER,
                                        (command << 9) + (toggle << 8) + data)

   If (toggle = 1) Then
          toggle = 0
   Else
          toggle = 1
   End If
End Sub

// Write value to register position
Shared Sub WriteValue2Register(value As Ushort)

   WriteCommand(1, (value/256))
   WriteCommand(1, (value Mod 256))
End Sub
```

See API: SetFeature(), FEATURE_FUNCTION_ROI1_PRESET, FEATURE_FUNCTION_EXTRA_PARAMETER
See Operation Manual Part B: *OpManPartB.html#roi1, OpManPartB.html#extraparameter*

See chapter 6.12 how to compute the correct matrix region values. Please take a look at the SDK examples (SetROIs).

6.14 Set region of interest 1 (measuring field)

This example shows how to set the region of interest 1 (free measuring field 1) on the sensor matrix. This setting makes it possible to define a custom size for the measuring field.

```
// Activate region of interest 1
CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_ROI1_PRESET, 1 << 11)

// write values to sensor
CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_ROI1_DISTANCE,
                                                  CUInt(row_start) << 16) + row_size)
CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_ROI1_POSITION,
                                                  CUInt(col_start) << 16) + col_size)

// Write 0 to Extraparameter register to activate the ROI setting
CLLTI.SetFeature(hLLT , CLLTI.FEATURE_FUNCTION_EXTRA_PARAMETER, 0)
```

See API: SetFeature(), FEATURE_FUNCTION_ROI1_PRESET, FEATURE_FUNCTION_EXTRA_PARAMETER
See Operation Manual Part B: *OpManPartB.html#roi1, OpManPartB.html#extraparameter*

See chapter 6.12 how to compute the correct matrix region values.

Note for scanCONTROL 27xx and scanCONTROL 26xx/29xx (Firmware version < v43):

Set free measuring field has to be used instead, see 6.13. Please take a look at the SDK examples (SetROIs).

6.15 Calibrate sensor position

This example shows how to calibrate the sensor position. This is useful if a horizontal mounting position cannot be achieved, but the profile has to be straight. It is possible to calibrate the x/z offset and angle. The functions *SetCustomCalibration()* and *ResetCustomCalibration()* are not integrated into the DLL, but implemented in the example program for position calibration.

```
// Sensor offset and scaling (depending on sensor type)
Dim offset As Double = 95.0
Dim scaling As Double = 0.002

// Rotation center and angle
Dim center_x As Double = -9 // mm
Dim center_z As Double = 86.7 // mm
Dim angle As Double = -45 // °

// Shift rotation center
Dim shift_x As Double = 0 // mm
Dim shift_z As Double = 0 // mm

// Set calibration
SetCustomCalibration(center_x, center_z, angle, shift_x, shift_z, offset, scaling)

// Reset calibration
ResetCustomCalibration()
```

See example program: CSharp_Calibration

Please take a look at the SDK examples (Calibration).

6.16 Use CMM trigger

With CMM triggering the scanCONTROL sensor can communicate the exact point of time at which the profile was generated. This happens via the sensor's RS422 interface.

Configuration of the CMM trigger signal can be done via the following parameters:

- Polarity: Polarity of trigger signal
- Divisor: Trigger divisor (0 deactivates CMM triggering)
- Mark-Space ratio: Mark space ratio (duty cycle) of the signal
- Skew Correction: Correction of the trigger signal offset (in 0.5 µs steps; must be smaller than half of the sensor cycle (1/profile frequency))

```
Dim Incounter As UInteger = 0
Dim CmmCount As UInteger = 0
Dim CmmTrigger As Integer= 0
Dim CmmActive As Integer = 0

Dim Timestamp(16) As Byte

// Set RS422 interface for 26xx/29xx to CMM triggering
Dim Interface As UInteger = CLLTI.MULTI_RS422_CMM;
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_DIGITAL_IO, Interface)
```

```
// Set mark space ratio
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_CMMTRIGGER, &H401)
// Set skew correction
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_CMMTRIGGER, &H801)
// Set output port
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_CMMTRIGGER, &Hc00)
// Set trigger divisor
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_CMMTRIGGER, &H1)


[…] // Transmission

// Read CMM timestamp
CLLTI.Timestamp2CmmTriggerAndInCounter(Timestamp, Incounter, CmmTrigger,
                                                              CmmActive, CmmCount)
```

See API: SetFeature(), Timestamp2CmmAndInCounter(), FEATURE_FUNCTION_DIGITAL_IO, FEATURE_FUNCTION_CMM_TRIGGER
See Operation Manual Part B: *OpManPartB.html#cmmtrigger, OpManPartB.html#ioconfig*

Before activating the trigger by setting the divisor, the CMM trigger should be configured completely. After activation the CMM trigger must not be reconfigured. Additionally the CMM trigger is not saved in the user modes, thus it has to be configured by the connected software.

Note: only supported by the scanCONTROL 26xx/27xx/29xx/30xx series.

6.17 Save profile data

This example shows how to save profile data for subsequent offline evaluation. The profiles are saved as .AVI file.

```
// Start profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 1)

// Starte saving data as .avi file
CLLTI.SaveProfiles(hLLT, AviFilename, CLLTI.TFileType.AVI)

// Wait for the period of time the profiles should be saved (1 s)
System.Threading.Thread.Sleep(1000)

// Stop saving procedure
CLLTI.SaveProfiles(hLLT, Nothing, CLLTI.TFileType.AVI)

// Stop profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 0)
```

See API: TransferProfiles(), SaveProfiles()

6.18 Container Mode for evaluation with vision tools

This example shows how to configure the data transmission for further evaluation with standard vision tools. The resulting data format enables the vision tool to work directly with the data.

```
Dim ProfileCount As UInteger = 500 // Number of profiles in one image/container
Dim LostProfiles As UInteger = 0

// Calculate flags for currently used resolution
Dim TempLog As Double = 1.0 / Math.Log(2.0)
Dim ResBits As UInteger = Math.Floor((Math.Log(Resolution) * TempLog) + 0.5)

// Set rearrangement parameters to extract z data (without timestamp) with the
// set resolution; the necessary container width is automatically set
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_PROFILE _REARRANGEMENT,
                        (CLLTI.CONTAINER_DATA_Z Or CLLTI.CONTAINER_STRIPE_1 Or
                               CLLTI.CONTAINER_DATA_LSBF Or ResBits << 12))

// Set container size
CLLTI.SetProfileContainerSize(hLLT, 0, uiProfileCount)

// Start profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_CONTAINER_MODE, 1)

// Allocate buffer (z value has 2 bytes)
Dim ContainerBuffer(Resolution * 2 * ProfileCount) As Byte

// Poll a profile from receiving buffer
// Hint: If no new container has been received since the last call, the function
// returns -104. This may be used to constantly query for new data in a loop.
CLLTI.GetActualProfile(hLLT, ContainerBuffer, ContainerBuffer.GetLength(0),
                                      CLLTI.TProfileConfig.CONTAINER, LostProfiles)

// Stop profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_CONTAINER_MODE, 0)
```

See API: SetFeature(), SetProfileContainerSize(), TransferProfiles(), GetActualProfile(), FEATURE_FUNCTION_PROFILE_REARRANGEMENT
See Operation Manual Part B: *OpManPartB.html#profilerearrangement*

6.19 Transmission of partial profiles

This example shows how to set up transmission of partial profiles. The transmitted profile corresponds to the profile configuration PURE_PROFILE with a reduced number of points. This means only the x/z data of a defined range of points is transmitted.

```
// Struct to define partial profile
Dim PartialProfile As CLLTI.TPartialProfile

[…] // Init

// Set partial profile
PartialProfile.nStartPoint = 20 // Offset 20 -> start point = 21
PartialProfile.nStartPointData = 4 // Data offset 4 bytes -> begin x data
PartialProfile.nPointCount = m_uiResolution / 2 // Half resolution
PartialProfile.nPointDataWidth = 4 // 4 bytes -> x and z (2 bytes each)
```

```
// Allocate profile buffer
Dim ProfileBuffer(PartialProfile.nPointCount * PartialProfile.nPointDataWidth) As
                                                                              Byte

// Write partial profile settings
CLLTI.SetPartialProfile(hLLT, PartialProfile)

// Start profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 1);

// Poll the next available partial profile from the buffer
CLLTI.GetActualProfile(hLLT, ProfileBuffer, ProfileBuffer.GetLength(0),
                               CLLTI.TProfileConfig.PARTIAL_PROFILE, LostProfiles)

// Convert buffer to real distance and position in mm
CLLTI.ConvertPartProfile2Values(hLLT, ProfileBuffer, ref PartialProfile,
scanCONTROLType, 0, 1, Nothing, Nothing, Nothing, ValueX, ValueZ, Nothing, Nothing)

// Stop profile transmission
CLLTI.TransferProfiles(hLLT, CLLTI.TTransferProfileType.NORMAL_TRANSFER, 0)
```

See API: SetPartialProfile(), TransferProfiles(), GetActualProfile(), ConvertPartProfile2Values()

Eventual change of the profile resolution has to be done before the partial profile configuration is sent to the sensor because calling *setResolution()* resets the partial profile setting.

6.20 Use several sensors in one application

This example shows how to use two sensors in one application.

```
// Create handle for every sensor
hLLT = CLLTI.CreateLLTDevice(CLLTI.TInterfaceType.INTF_TYPE_ETHERNET)
hLLT2 = CLLTI.CreateLLTDevice(CLLTI.TInterfaceType.INTF_TYPE_ETHERNET)

// Search available interfaces
CLLTI.GetDeviceInterfacesFast(hLLT, auiInterfaces, auiInterfaces.GetLength(0))

// Set interfaces
CLLTI.SetDeviceInterface(hLLT, auiInterfaces(0), 0)
CLLTI.SetDeviceInterface(hLLT2, auiInterfaces(1), 0);

// Connect both sensors
CLLTI.Connect(hLLT)
CLLTI.Connect(hLLT2)

[…]

// Set Event
Dim gch As GCHandle = GCHandle.Alloc(New CLLTI.ProfileReceiveMethod
                                                        (AddressOf ProfileEvent))

// Register callback scanner 1
CLLTI.RegisterCallback (hLLT, CLLTI.TCallbackType.STD_CALL, DirectCast
                                    (gch.Target, CLLTI.ProfileReceiveMethod), hLLT)
// Register callback scanner 2
CLLTI.RegisterCallback (hLLT, CLLTI.TCallbackType.STD_CALL, DirectCast
                                   (gch.Target, CLLTI.ProfileReceiveMethod), hLLT2)
```

```
[…] // Start of transmission equivalent

// Callback function with separation of sensor data
Shared Sub ProfileEvent(ByVal data As Intptr, uiSize As UInteger,
                                                        uiUserData As UInteger)

   If (uiSize > 0) Then

      If (uiUserData == hLLT) Then
         // Daten Sensor 1
      End If

      If (uiUserData == hLLT2) Then
         // Daten Sensor 2
      End If

   End If

End Sub
```

See API: CreateLLTDevice(), GetDeviceInterfacesFast(), SetDeviceInterface(), Connect(), RegisterCallback(),

Please take a look at the SDK examples (MultiLLTs).

6.21 Error message if sensor connection is lost

This example shows how to register a callback for error message handling. This is especially important in case of a lost sensor connection. In this context a Message Box is generated in a Windows Forms application.

```
// Event: Push connect button
Private Sub ConnectButton_click(sender as Object, e As System.EventArgs)

    If (CLLTI.Connect(hLLT) < CLLTI.GENERAL_FUNCTION_OK) Then
       Return
    Else
       MessageBox.Show("Sensor connected!")
    End If

    Dim windowHandle As IntPtr = New WindowInteropHelper(Me).Handle

    Dim source As HwndSource = HwndSource.FromHwnd(windowHandle)
    source.AddHook(New HwndSourceHook(AddressOf WndProc))

   // Register error message
   CLLTI.RegisterErrorMsg(CLLTI.RegisterErrorMsg(hLLT, &H400, windowHandle, 0))
End Sub

// Override WndProc
Private Function WndProc(hwnd As IntPtr, msg As Integer, wParam As IntPtr,
                                 lParam As IntPtr, ByRef handled As Boolean) As IntPtr

   If (msg = &H400) Then
      // Error handling if error code "Connection lost"
      If (CInt(lParam) = CLLTI.ERROR_CONNECTIONLOST) Then
         // Show message box if connection is lost
         MessageBox.Show("Connection to scanner lost");
      End If
   End If

   Return IntPtr.Zero
End Function
```

See API: RegisterErrorMsg()

6.22 Read temperature

This example shows how to read the core temperature of the sensor. The value describes the temperature in 0.1 K steps.

```
Dim Temperature As UInteger = 0

// Prior to temperature reading 0x86000000 has to be written to the register
CLLTI.SetFeature(hLLT, CLLTI.FEATURE_FUNCTION_TEMPERATURE,
                                                    CLLTI.TEMP_PREPARE_VALUE)

// Read temperature
CLLTI.GetFeature(hLLT, CLLTI.FEATURE_FUNCTION_TEMPERATURE, Temperature)
```

See API: SetFeature(), FEATURE_FUNCTION_TEMPERATURE
See : *OpManPartB.html#temperature*

6.23 Calculate and set packet delay

This example shows how to determine the minimal and maximal packet delay times for a sensor. This is necessary for network infrastructures with more than one scanner connected to a switch. The packet delay depends on the parameters packet size, network bandwidth, the amount of data to be transmitted and the number of sensors. The amount of data can be calculated from the profile configuration used and the profile frequency set. The minimal packet delay can be calculated as following:

$$PD_{min} = (Number\ of\ sensors - 1) * \frac{Packet\ size}{Network\ bandwidth}$$

The maximum delay is calculated like this:

$$PD_{max} = \left(1000 * \frac{\frac{1000}{Profile\ frequency}}{\frac{KByte\ per\ profile * 1024}{Packet\ size} + 1} - \frac{Packet\ size}{Network\ bandwidth} \right) * 0{,}8$$

The value to be configured has to be within these borders. For every connected sensor the same packet delay must be set. The scanners then are trying to find a transmission slot on their own. Once a sensor finds a free slot, it uses it permanently for sending packets.
To set the value, the following code has to be executed (here a value of 50 µs is set):

```
Dim PacketDelay As UInteger = 50

// Set packet delays in us
CLLTI.SetFeature(CLLTI.FEATURE_FUNCTION_PACKET_DELAY, PacketDelay);
```

See API: SetFeature(), FEATURE_FUNCTION_PACKET_DELAY

7 API

This chapter lists the complete API (Application Program Interface). Every function is illustrated with its parameters and return values.

7.1 Instance functions

- **CreateLLTDevice ()**

```
Function
   CreateLLTDevice(CLLTI.TInterfaceType iInterfaceType) As UInteger
End Function
```

Set and return a device handle (sensor instance) in the DLL for scanCONTROL communication – depending on the connection interface.

Parameter

iInterfaceType Type of interface (InterfaceType)

Return value

New device handle (0x0 or 0xFFFFFFFF → Error: No device handle created)
General error codes

- **GetInterfaceType ()**

```
Function
   GetInterfaceType(pLLT As UInteger) As Integer
End Function
```

Query the currently assigned interface type for a sensor instance.

Parameter

pLLT Device handle

Return value

Value InterfaceType (0x0 or 0xFFFFFFFF → Error)
General error codes

- **InterfaceType**

Available interface types:

InterfaceType	Value	Description
INTF_TYPE_UNKNOWN	0	Error value if GetInterfaceType () fails; not to be set with CreateLLTDevice()
INTF_TYPE_SERIAL	1	Connection via serial interface
INTF_TYPE_FIREWIRE	2	Connection via Firewire bus (deprecated)

INTF_TYPE_ETHERNET	3	Connection via Ethernet interface

- **DelDevice ()**

```
Function
   DelDevice(pLLT As UInteger) As Integer
End Function
```

Delete sensor instance prior to unloading of the DLL. All currently set parameters are preserved on the sensor, except the driver parameters *Packet size*, *Buffer count* and *Profile config*.

Parameter

pLLT Device handle

Return value

General return values

7.2 Interface functions

- **GetDeviceInterfaces () / GetDeviceInterfacesFast ()**

```
Function
   GetDeviceInterfaces(pLLT As UInteger, pInterfaces As UInteger(),
      nSize As Integer) As Integer
End Function

Function
   GetDeviceInterfacesFast(pLLT As UInteger,
      pInterfaces As UInteger(), nSize As Integer) As Integer
End Function
```

Query the available scanCONTROL device interfaces at the PCs interface cards. The returned device interfaces are IP addresses of the connected sensors. *GetDeviceInterfacesFast()* (Ethernet interface only) is significantly faster in small Ethernet networks.

Parameter

pLLT Device handle
pInterfaces Array for available interfaces (IP; Node ID)
nSize Size of array

Return value

Number of device interfaces found
General error codes
Specific return values:

ERROR_GETDEVINTERFACES_WIN_NOT_SUPPORTED	-250	Function is only available for Windows 2000 or higher
ERROR_GETDEVINTERFACES_REQUEST_COUNT	-251	The size of the passed field is to small
ERROR_GETDEVINTERFACES_INTERNAL	-253	A error occurred during the scanCONTROL enumeration

- **SetDeviceInterface ()**

```
Function
   SetDeviceInterface(pLLT As UInteger, nInterface As UInteger,
      nAdditional As Integer) As Integer
End Function
```

Assign a scanCONTROL device interface to a sensor instance in the DLL. The additional parameter may optionally include which host IP address to use. This is useful if more than one network interface card is available.

Parameter

pLLT	Device handle
nInterface	Interface of scanCONTROL to be connected
nAdditional	IP address of host (optional)

Return value

General return values

Specific return value:

ERROR_GETDEVINTERFACES_CONNECTED	-252	The scanCONTROL is connected, call *Disconnect()*

- **SetDiscoveryBroadcastTarget ()**

```
Function
   SetDiscoveryBroadcastTarget(pLLT As UInteger, nNetworkAddress As UInteger,
      nSubnetMask As UInteger) As Integer
End Function
```

Set the local sender address that is used for discovery packets in context of the Ethernet broadcast. Useful if more than one network interface card is available.

Parameter

pLLT	Device handle
nNetworkAddress	Sender IP address
nSubnetMask	Sender subnet mask

Return value

General return values

7.3 Connection functions

- **Connect ()**

```
Function
   Connect(pLLT As UInteger) As Integer
End Function
```

Connect to the scanCONTROL sensor assigned to the device handle. Only possible if a valid device interface is assigned (via *SetDeviceInterface()*).

Parameter

pLLT Device handle

Return value

General return values

Specific return values:

ERROR_CONNECT_LLT_COUNT	-300	There is no scanCONTROL connected to the computer or the driver is not installed correctly.
ERROR_CONNECT_SELECTED_LLT	-301	The selected interface is not available -> choose a new interface with *SetDeviceInterface()*
ERROR_CONNECT_ALREADY_CONNECTED	-302	There is already a scanCONTROL connected with this ID
ERROR_CONNECT_LLT_NUMBER_ALREADY_USED	-303	The requested scanCONTROL is already used by another instance -> choose another scanCONTROL with *SetDeviceInterface()*
ERROR_CONNECT_SERIAL_CONNECTION	-304	The scanCONTROL by serial interface could not be connected -> choose another scanCONTROL with *SetDeviceInterface()*

- **Disconnect ()**

```
Function
   Disconnect(pLLT As UInteger) As Integer
End Function
```

Disconnect from scanCONTROL sensor. All set parameters are preserved on the sensor, except the driver parameters *Packet size*, *Buffer count* and *Profile config*.

Parameter

pLLT Device handle

Return value

General return values

7.4 Identification functions

- **GetDeviceName ()**

```
Function
   GetDeviceName(pLLT As UInteger, sbDevName As StringBuilder,
      nDevNameSize As Integer, sbVenName As StringBuilder, nVenNameSize As Integer)
      As Integer
End Function
```

Query device name and vendor name of scanCONTROL sensor.

Parameter

pLLT Device handle

sbDevName Device name array

sbDevNameSize Size of DevName buffer

sbVenName Vendor name array
sbVenNameSize Size of VenName buffer

Return value

General return values

Specific return values:

ERROR_GETDEVICENAME_SIZE_TOO_LOW	-1	The size of a buffer is too small
ERROR_GETDEVICENAME_NO_BUFFER	-2	No buffer has been passed

- **GetLLTVersions ()**

```
Function
   GetLLTVersions(pLLT As UInteger, ByRef pDSP As UInteger,
      ByRef pFPGA1 As UInteger, ByRef pFPGA2 As UInteger) As Integer
End Function
```

Query Firmware version of scanCONTROL sensor.

Parameter

pLLT Device handle
uiDSP Firmware version DSP
uiFPGA1 Firmware version FPGA1
uiFPGA2 Firmware version FPGA2

Return value

General return values

- **GetLLTType ()**

```
Function
   GetLLTType(pLLT As UInteger, ByRef CLLTI.ScannerType As TScannerType)
      As Integer
End Function
```

Query measuring range and type of scanCONTROL sensor.

Parameter

pLLT Device handle
ScannerType Scanner type and measuring range

Return value

General return values

- **ScannerType**

ScannerType	Value	scanCONTROL type	Measuring range
StandardType	-1	-	-

scanCONTROL27xx_25	1000	27xx	25 mm
scanCONTROL27xx_100	1001	27xx	100 mm
scanCONTROL27xx_50	1002	27xx	50 mm
scanCONTROL26xx_25	2000	26xx	25 mm
scanCONTROL26xx_50	2002	26xx	50 mm
scanCONTROL26xx_100	2001	26xx	100 mm
scanCONTROL29xx_25	3000	29xx	25 mm
scanCONTROL29xx_50	3002	29xx	50 mm
scanCONTROL29xx_100	3001	29xx	100 mm
scanCONTROL29xx_10	3003	29xx	10 mm
scanCONTROL30xx_25	4000	30xx	25mm
scanCONTROL30xx_50	4001	30xx	50mm
scanCONTROL25xx_25	5000	25xx	25mm
scanCONTROL25xx_50	5002	25xx	50mm
scanCONTROL25xx_100	5001	25xx	100mm

7.5 Feature functions

7.5.1 Features / Parameter

- **GetFeature ()**

```
Function
   GetFeature(pLLT As UInteger, feature As UInteger, ByRef pValue As UInteger)
      As Integer
End Function
```

Query currently set parameter value / Check availability of a feature according to the table in chapter 7.5.2.

Parameter

pLLT	Device handle
Function	Register address of function (FEATURE or INQUIRY)
pValue	Value read from sensor

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_WRONG_FEATURE_ADRESS	-155	The address of the selected property is wrong

- **SetFeature ()**

```
Function
   SetFeature(pLLT As UInteger, Feature As UInteger, Value As UInteger)
      As Integer
End Function
```

Set feature parameter.

Parameter

pLLT	Device handle
Function	Register address of function (FEATURE)
Value	Value to be written to sensor

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_WRONG_FEATURE_ADRESS	-155	The address of the selected property is wrong

7.5.2 Features / Parameter

The following paragraph illustrates how to use the FEATURE and INQUIRY registers. INQUIRY registers are used for confirmation of function availability and feature classification. FEATURE registers are used for querying and setting parameter values. The LSB is Bit 0.

The value read from the INQUIRY register can classify a parameter of the FEATURE register. To do so, the register defines the minimum and maximum value of the feature, if there is an automatic functionality and if the feature is available for the connected sensor type:

31	30..26	25	24	23..12	11..0
Feature avail. (1 bit)	Res. (5 bit)	Auto (1 bit)	Res. (1 bit)	Min. value (12 bit)	Max. value (12 bit)

The value of the FEATURE register can be interpreted aided by the Operation Manual Part B.

Example: Laser

Feature name	Inquiry address	Status and control address	Default setting
Laser	0xfffff0f00524	0xfffff0f00824	0x82000002

Bit	Function
1..0	Laser Power **0** OFF **1** reduced power **2** full power
11	Pulsed Mode Enable The laser is switched on only in the first half of the measurement interval. Additionally the external trigger output is delayed by half of the measurement interval (or 180 degrees). A synchronised slave sensor would measure during the master's idle time. It is recommended to set up Exposure Time < Idle Time.

Fig. 7: Excerpt from Operation Manual Part B

Thus the register address to be written to for changing the laser power is 0xf0f00824. Bits for adjusting the laser power are 0 and 1. The value $0\ |_{\mathrm{dec}}$ corresponds with laser off, $1\ |_{\mathrm{dec}}$ with reduced and $2\ |_{\mathrm{dec}}$ with full laser power. Bit 11 activates the laser pulse mode.

- **SERIAL_NUMBER**

FEATURE_FUNCTION_SERIAL_NUMBER FEATURE_FUNCTION_SERIAL (deprecated)	&HF0000410UI

Query the serial number of the connected sensor. This register is read-only.

- **CALIBRATION_SCALE and CALIBRATION_OFFSET**

FEATURE_FUNCTION_CALIBRATION_SCALE	&HF0A00000UI
FEATURE_FUNCTION_CALIBRATION_OFFSET	&HF0A00004UI

Query the scaling and the offset value of the connected sensor. This register is read-only.
Note: Only supported by scanCONTROL 30xx series.

- **LASER**

FEATURE_FUNCTION_LASER FEATURE_FUNCTION_LASERPOWER (deprecated)	&HF0F00824UI
INQUIRY_FUNCTION_LASER INQUIRY_FUNCTION_LASERPOWER (deprecated)	&HF0F00524UI

Query and control of the laser power: 0 (off), 1 (reduced), 2 (full). Depending on the device, the polarity of the external laser switch-off or the laser pulse mode can be set. The profile transmitted directly after setting the laser power might be corrupted.
See *OpManPartB.html#laser* or *#laserpower* for the specific type of sensor.

- **ROI1_PRESET**

FEATURE_FUNCTION_ROI1_PRESET FEATURE_FUNCTION_MEASURINGFIELD (deprecated)	&HF0F00880UI
INQUIRY_FUNCTION_ROI_PRESET INQUIRY_FUNCTION_MEASURINGFIELD (deprecated)	&HF0F00580UI

Querying or setting of a region of interest on the sensor array or activation of the advanced region of interest configuration. The profile transmitted directly after setting the ROI might be corrupted.
See *OpManPartB.html#roi1* or *#zoom* for the specific type of sensor.
An overview over available predefined measuring fields and the corresponding maximum frequencies can be found in the sensor specific QuickReference.html.

- **ROI1**

FEATURE_FUNCTION_ROI1_POSITION FEATURE_FUNCTION_FREE_MEASURINGFIELD_X (depr.)	&HF0B0200CUI
FEATURE_FUNCTION_ROI1_DISTANCE FEATURE_FUNCTION_FREE_MEASURINGFIELD_Z (depr.)	&HF0B02008UI

Set the start point and size of the X and Z axis of the region of interest 1. Values can go from 0 to 65535. The sensors matrix rotation has to be considered. To activate a 0 has to be written to FEATURE_FUNCTION_EXTRA_PARAMETER.
Requires: Firmware v43 or newer (with Firmware < v43 use EXTRA_PARAMETER register to set the ROI)
See *OpManPartB.html#roi1 or #extraparameter* for the specific type of sensor.

- **ROI1_TRACKING**

FEATURE_FUNCTION_ROI1_TRACKING_DIVISOR FEATURE_FUNCTION_DYNAMIC_TRACK_DIVISOR (depr.)	&HF0B02010UI
FEATURE_FUNCTION_ROI1_TRACKING_FACTOR FEATURE_FUNCTION_DYNAMIC_TRACK_FACTOR (depr.)	&HF0B02014UI

Set the encoder-controlled measuring field tracking function. To activate a 0 has to be written to FEATURE_FUNCTION_EXTRA_PARAMETER.
Requires: Firmware v43 or newer (with Firmware < v43 use EXTRA_PARAMETER register)
See *OpManPartB.html#roi1 or #extraparameter* for the specific type of sensor.

- **IMAGE_FEATURES**

FEATURE_FUNCTION_IMAGE_FEATURES	&HF0B02100UI

Register to activate/deactivate region of interest 2, region of no interest, exposure automatic reference region on the sensor matrix. Set the operating mode of the sensor.
Note: Only supported by scanCONTROL 30xx series.
See *OpManPartB.html#image_sensor_features* for the specific type of sensor.

- **ROI2**

FEATURE_FUNCTION_ROI2_POSITION	&HF0B02108UI
FEATURE_FUNCTION_ROI2_DISTANCE	&HF0B02104UI

Set the start point and size of the X and Z axis of the region of interest 2. Values can go from 0 to 65535. The sensors matrix rotation has to be considered.
Note: Only supported by scanCONTROL 30xx series.
See *OpManPartB.html#roi2* for the specific type of sensor.

- **RONI**

FEATURE_FUNCTION_RONI_POSITION	&HF0B02110UI
FEATURE_FUNCTION_RONI_DISTANCE	&HF0B0210CUI

Set the start point and size of the X and Z axis of the region of no interest. Values can go from 0 to 65535. The sensors matrix rotation has to be considered.
Note: Only supported by scanCONTROL 30xx series.
See *OpManPartB.html#roni* for the specific type of sensor.

- **TRIGGER**

FEATURE_FUNCTION_TRIGGER	&HF0F00830UI
INQUIRY_FUNCTION_TRIGGER	&HF0F00530UI

Query and control of the trigger mode setting. The profile transmitted directly after setting the trigger mode can be corrupted. In context of changing the trigger mode, the trigger interface is to be changed (see *DIGITAL_IO*). Changing the trigger settings resets the profile counter.
See *OpManPartB.html#trigger* for the specific type of sensor.

- **EXPOSURE_TIME**

FEATURE_FUNCTION_EXPOSURE_TIME FEATURE_FUNCTION_SHUTTERTIME (deprecated)	&HF0F0081CUI
INQUIRY_FUNCTION_EXPOSURE_TIME INQUIRY_FUNCTION_SHUTTERTIME (deprecated)	&HF0F0051CUI

Query and control of the exposure time in 10 µs steps. The value can be set between 1 and 4095. The automatic exposure mode can be set with this register as well.
See *OpManPartB.html#exposuretime* or *#shutter* for the specific type of sensor.

- **EA_REFERENCE_REGION**

FEATURE_FUNCTION_EA_REFERENCE_REGION_POSITION	&HF0B02118UI
FEATURE_FUNCTION_EA_REFERENCE_REGION_DISTANCE	&HF0B02114UI

Set the start point and size of the X and Z axis of the reference region for the automatic

exposure time. Values can go from 0 to 65535. The sensors matrix rotation has to be considered.
Note: Only supported by scanCONTROL 30xx series.
See *OpManPartB.html#exposureautomatic* for the specific type of sensor.

- **EXPOSURE_AUTOMATIC_LIMITS**

FEATURE_FUNCTION_EXPOSURE_AUTOMATIC_LIMITS	&HF0F00834UI
INQUIRY_FUNCTION_EXPOSURE_AUTOMATIC_LIMITS	&HF0F00534UI

Set the lower and upper limit for the automatic exposure algorithm. Values can go from 0 to 4095 (in 10 µs steps).
Note: Only supported by scanCONTROL 30xx series.
See *OpManPartB.html#exposureautomatic* for the specific type of sensor.

- **IDLE_TIME**

FEATURE_FUNCTION_IDLE_TIME FEATURE_FUNCTION_IDLETIME (deprecated)	&HF0F00800UI
INQUIRY_FUNCTION_IDLE_TIME INQUIRY_FUNCTION_IDLETIME (deprecated)	&HF0F00500UI

Query and control of the idle time in 10 µs steps. The value can be set between 1 and 4095. If the automatic exposure mode is activated, the idle time is automatically adjusted to match the intended profile frequency.
See *OpManPartB.html#idletime* for the specific type of sensor.

- **PROFILE_PROCESSING**

FEATURE_FUNCTION_PROFILE_PROCESSING FEATURE_FUNCTION_PROCESSING_PROFILEDATA (depr.)	&HF0F00804UI
INQUIRY_FUNCTION_PROFILE_PROCESSING INQUIRY_FUNCTION_PROCESSING_PROFILEDATA (depr.)	&HF0F00504UI

Query and control of profile processing parameter, like e.g. deactivation of the calibration, profile mirroring, measurement data post-processing, reflection determination or advanced exposure settings.
See *OpManPartB.html#profileprocessing* or *#processingprofile* for the specific type of sensor.

- **THRESHOLD**

FEATURE_FUNCTION_THRESHOLD	&HF0F00810UI
INQUIRY_FUNCTION_THRESHOLD	&HF0F00510UI

Query and control of the threshold for measurement data acquisition. For targets with multiple reflections, increasing the threshold can improve the raw data. Optionally the dynamic threshold can be activated in this context.

See *OpManPartB.html#threshold* for the specific type of sensor.

- **MAINTENANCE**

FEATURE_FUNCTION_MAINTENANCE FEATURE_FUNCTION_MAINTENANCEFUNCTIONS (depr.)	&HF0F0088CUI
INQUIRY_FUNCTION_MAINTENANCE INQUIRY_FUNCTION_MAINTENANCEFUNCTIONS (depr.)	&HF0F0058CUI

Query and control of internal maintenance settings (e.g. encoder counter).
See *OpManPartB.html#maintenance* for the specific type of sensor.

- **ANALOGFREQUENCY**

FEATURE_FUNCTION_ANALOGFREQUENCY	&HF0F00828UI
INQUIRY_FUNCTION_ANALOGFREQUENCY	&HF0F00528UI

Interrogating and setting of the frequency for the analogue output (only scanCONTROL 28xx). The frequency may be set between 0 and 150 whereat the counting value is equal to the frequency in kHz. At the setting of 0 kHz the analogue output will be turned off which is reasonable at profile frequencies higher than 500 Hz for avoiding an overflow in the analogue output.
Note: Only supported by scanCONTROL 28xx series.
See *OpManPartB.html#focus* for the specific type of sensor.

- **ANALOGOUTPUTMODES**

FEATURE_FUNCTION_ANALOGOUTPUTMODES	&HF0F00820UI
INQUIRY_FUNCTION_ANALOGOUTPUTMODES	&HF0F00520UI

Setting of the analogue output modes (only scanCONTROL 28xx). E.g. the voltage range and the polarity of the analogue outputs may be shifted.
Note: Only supported by scanCONTROL 28xx series.
See *OpManPartB.html#gain* for the specific type of sensor.

- **CMM_TRIGGER**

FEATURE_FUNCTION_CMM_TRIGGER FEATURE_FUNCTION_CMMTRIGGER (deprecated)	&HF0F00888UI
INQUIRY_FUNCTION_CMM_TRIGGER INQUIRY_FUNCTION_CMMTRIGGER (deprecated)	&HF0F00588UI

Configuration of the optional CMM triggers. The configuration of the CMM triggers consists of 4 instruction words. These instruction words have to be written successively. Only the last written instruction word can be read from the sensor.
Note: only supported by the scanCONTROL 26xx/27xx/29xx/30xx series
See *OpManPartB.html#cmmtrigger* for the specific type of sensor.

- **PROFILE_REARRANGEMENT**

FEATURE_FUNCTION_PROFILE_REARRANGEMENT FEATURE_FUNCTION_REARRANGEMENT_PROFILE (depr.)	&HF0F0080CUI
INQUIRY_FUNCTION_PROFILE_REARRANGEMENT INQUIRY_FUNCTION_REARRANGEMENT_PROFILE (depr.)	&HF0F0050CUI

Parametrization of profile information to be transmitted in the transposed Container Mode.
See *OpManPartB.html#profilerearrangement* or *#rearrangementprofile* for the specific type of sensor.

- **PROFILE_FILTER**

FEATURE_FUNCTION_PROFILE_FILTER	&HF0F00818UI
INQUIRY_FUNCTION_PROFILE_FILTER	&HF0F00518UI

Applying Resampling, Median-Filter and/or Average-Filter.
See *OpManPartB.html#profilefilter* for the specific type of sensor.

- **DIGITAL_IO**

FEATURE_FUNCTION_DIGITAL_IO FEATURE_FUNCTION_RS422_INTERFACE_FUNCTION (depr.)	&HF0F008C0UI
INQUIRY_FUNCTION_DIGITAL_IO INQUIRY_FUNCTION_RS422_INTERFACE_FUNCTION (depr.)	&HF0F005C0UI

Parameter to configure the RS422 interface or digital inputs.
See *OpManPartB.html#ioconfig or #capturesize* for the specific type of sensor.

- **PACKET_DELAY**

FEATURE_FUNCTION_PACKET_DELAY	&HD08UI

Ethernet packet delay to operate several scanners connected to a switch. The parameter is set in µs. The range is from 0 to 1000µs.

- **TEMPERATURE**

FEATURE_FUNCTION_TEMPERATURE	&HF0F0082CUI
INQUIRY_FUNCTION_TEMPERATURE	&HF0F0052CUI

Read sensor temperature in 0.1 K steps. Before the temperature can be read, the temperature measurement has to be triggered by writing 0x86000000 to the feature register.
See *OpManPartB.html#temperature* for the specific type of sensor.

- **EXTRA_PARAMETER**

FEATURE_FUNCTION_EXTRA_PARAMETER FEATURE_FUNCTION_SHARPNESS (deprecated)	&HF0F00808UI
INQUIRY_FUNCTION_EXTRA_PARAMETER INQUIRY_FUNCTION_SHARPNESS (deprecated)	&HF0F00508UI

Register for setting the peak filter, free measuring field and angle/offset calibration. The values are set via multiple write operations to the register. Only the last written value can be read back. Since DLL version 3.7 / sensor firmware v43, this register is mainly used to activate certain register settings.
See *OpManPartB.html#extraparameter or #sharpness* for the specific type of sensor.

- **PEAKFILTER**

FEATURE_FUNCTION_PEAKFILTER_WIDTH	&HF0B02000UI
FEATURE_FUNCTION_PEAKFILTER_HEIGHT	&HF0B02004UI

Set the minimum and maximum width/height of the peak filter. Values can go from 0 to 1023.
Requires: Firmware v43 or newer (with Firmware < v43 use EXTRA_PARAMETER register)

- **CALIBRATION**

FEATURE_FUNCTION_CALIBRATION_0 - 7	&HF0B02020UI - &HF0B0203CUI

Set the calibration offset and angle. To activate a 0 has to be written to FEATURE_FUNCTION_EXTRA_PARAMETER.
Requires: Firmware v43 or newer (with Firmware < v43 use EXTRA_PARAMETER register)

7.6 Special feature functions

7.6.1 Software trigger

- **TriggerProfile ()**

```
Function
   TriggerProfile(pLLT As UInteger) As Integer
End Function
```

Execute a software trigger signal to trigger one profile.
Parameter
pLLT Device handle

Return value
General return values

- **TriggerContainer ()**

```
Function
   TriggerContainer(pLLT As UInteger) As Integer
End Function
```

Execute a software trigger signal to trigger one container.

Parameter
pLLT Device handle

Return value
General return values

Requires: Firmware v46 or newer
The sensor has to be in frametrigger mode (see Digital IO) to be able to use this function. Otherwise, the trigger container mode has to be activated with the subsequent function calls.

- **TriggerContainerEnable ()**
- **TriggerContainerDisable ()**

```
Function
   TriggerContainerEnable(pLLT As UInteger) As Integer
End Function

Function
   TriggerContainerDisable(pLLT As UInteger) As Integer
End Function
```

Activate/deactivate the trigger container mode to be able to use TriggerContainer() without set frametrigger mode (see Digital IO).

Parameter
pLLT Device handle

Return value
General return values

7.6.2 Profile configuration

- **GetProfileConfig ()**

```
Function
   GetProfileConfig(pLLT As UInteger, ByRef pValue As TProfileConfig) As Integer
End Function
```

Query of the current profile configuration.

Parameter
pLLT Device handle

pValue Profile configuration read from sensor

Return value

General return values

- **SetProfileConfig ()**

```
Function
   SetProfileConfig(pLLT As UInteger, Value As TProfileConfig) As Integer
End Function
```

Profile configuration to be set for data transmission.

Parameter

pLLT Device handle
Value Profile configuration to be set

Return value

General return values

Specific return value:

ERROR_ SETGETFUNCTIONS_WRONG _PROFILE_CONFIG	-152	The requested profile configuration is not available

- **ProfileConfig**

Available ProfileConfig settings:

Value name	Value	Description
PROFILE	1	Profile data of all four stripes
PURE_PROFILE	2	Reduced profile data of one stripe (only position and distance values)
QUARTER_PROFILE	3	Profile data of one stripe
PARTIAL_PROFILE	5	Partial profile which has been restricted by *SetPartialProfile()*
CONTAINER	1	Container data
VIDEO_IMAGE	1	Video image of the scanCONTROL

7.6.3 Profile resolution / Points per profile

- **GetResolution ()**

```
Function
   GetResolution(pLLT As UInteger, ByRef pValue As UInteger) As Integer
End Function
```

Query of the currently set profile resolution / measuring points per profile.

Parameter

pLLT	Device handle
pValue	Profile resolution queried

Return value

General return values

- **SetResolution ()**

```
Function
   SetResolution(pLLT As UInteger, Value As UInteger) As Integer
End Function
```

Set the profile resolution / points per profile. For changing the resolution, the profile data transmission has to be stopped. After changing the resolution all partial profile settings are lost.

Parameter

pLLT	Device handle
Value	Profile resolution to be set

Return value

General return values

Specific return value:

ERROR_ SETGETFUNCTIONS_NOT _SUPPORTED_RESOLUTION	-153	The requested resolution is not supported

- **GetResolutions ()**

```
Function
   GetResolutions(pLLT As UInteger, pValue As UInteger(), nSize As Integer)
     As Integer
End Function
```

Query of available profile resolutions.

Parameter

pLLT	Device handle
pValue	Array with available profile resolutions
nSize	Size of array

Return value

Number of available resolutions

General return values

ERROR_ SETGETFUNCTIONS_NOT _SUPPORTED_RESOLUTION	-156	The size of the passed field is too small

7.6.4 Container size

- **GetProfileContainerSize ()**

```
Function
   GetProfileContainerSize(pLLT As UInteger, ByRef pWidth As UInteger,
      ByRef pHeight As UInteger) As Integer
End Function
```

Query of currently set container size.

Parameter

pLLT	Device handle
pWidth	Container width queried
pHeight	Container height queried

Return value

General return values

- **SetProfileContainerSize ()**

```
Function
   SetProfileContainerSize(pLLT As UInteger, nWidth As UInteger,
      nHeight As UInteger) As Integer
End Function
```

Set container size. The container width is set automatically if *SetFeature(FEATURE_FUNCTION_PROFILE_REARRANGEMENT)* is called. The height can be freely set from 0 to the maximum container height and determines how many profiles are transmitted within one container. The container height shouldn't be higher than three times the profile frequency.
If the "connection of successive profiles" (see *OpManPartB.html#profilerearrangement or OpManPartB.html#rearrangementprofile)* is activated, the height * width of an image has to be an integral multiple of 16384. If it is tried to set up another height value, the height will be adjusted automatically to the next matching value. Additionally the error value GENERAL_FUNCTION_CONTAINER_MODE_HEIGHT_CHANGED will be returned for indicating the changes.

Parameter

pLLT	Device handle
Width	Container width to be set
Height	Container height to be set

Return value

General return values
Specific return values:

ERROR_SETGETFUNCTIONS_WRONG _PROFILE_SIZE	-157	The size for the container is wrong

ERROR_SETGETFUNCTIONS_MOD_4	-158	The container width is not divisible by 4

- **GetMaxProfileContainerSize ()**

```
Function
   GetMaxProfileContainerSize(pLLT As UInteger, ByRef pMaxWidth As UInteger,
      ByRef pMaxHeight As UInteger) As Integer
End Function
```

Query the maximal possible container size. If the maximum width is 64, the container mode is not supported by the connected scanCONTROL.

Parameter

pLLT	Device handle
pMaxWidth	Maximum container width
pMaxHeight	Maximum container height

Return value

General return values

7.6.5 Main reflection

- **GetMainReflection ()**

```
Function
   GetMainReflection(pLLT As UInteger, ByRef pValue As UInteger) As Integer
End Function
```

Query the currently set main reflection, to be extracted by the profile configurations *PURE_PROFILE* or *QUARTER_PROFILE*.

Parameter

pLLT	Device handle
pValue	Value of main reflection queried

Return value

General return values

- **SetMainReflection ()**

```
Function
   SetMainReflection(pLLT As UInteger, pValue As UInteger) As Integer
End Function
```

Set the main reflection (stripe), from which the profile data is extracted if *PURE_PROFILE* or *QUARTER_PROFILE* is used. The index of the stripe to be used ranges from 0 for the 1st stripe to 3 for the 4th stripe.

Parameter

pLLT	Device handle
Value	Main reflection to be set

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_REFLECTION_NUMBER_TOO_HIGH	-154	The index of the stripe to be put out is greater than 3

7.6.6 Number of buffers

A high buffer count is useful when using high profile frequencies, slow computing hardware and/or a PC with a lot of background activity. For container and video mode transmission maximum four buffers are recommended.

- **GetBufferCount ()**

```
Function
   GetBufferCount(pLLT As UInteger, ByRef pValue As UInteger) As Integer
End Function
```

Query the set number of buffers in the driver for data transmission.

Parameter

pLLT	Device handle
Value	Buffer count queried

Return value

General return values

- **SetBufferCount ()**

```
Function
   SetBufferCount(pLLT As UInteger, pValue As UInteger) As Integer
End Function
```

Set the number of buffers in the driver for data transmission.

Parameter

pLLT	Device handle
Value	Buffer count to be set

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_WRONG_BUFFER_COUNT	-150	Count of the required buffer does not lie in the range of >=2 and <= 200

7.6.7 Allocated buffer for profile polling

- **GetHoldBuffersForPolling ()**

```
Function
   GetHoldBuffersForPolling(pLLT As UInteger,
      ByRef puiHoldBuffersForPolling As UInteger) As Integer
End Function
```

Query the number of buffers allocated for polling profile with *GetActualProfile().*

Parameter

pLLT	Device handle
puiHoldBuffersForPolling	Buffer count queried

Return value

General return values

- **SetHoldBuffersForPolling ()**

```
Function
   SetHoldBuffersForPolling(pLLT As UInteger,
      uiHoldBuffersForPolling As UInteger) As Integer
End Function
```

Setting the profile count that the llt.dll may hold for *GetActualProfile()*; the buffer is set up as FIFO in case the set value is greater than 0. A larger count lets the LLT.dll hold more profiles before profiles will be dropped. This decreases the risk of profile loss. The count must not be higher than half the total buffer count. Default value: 1.

Parameter

pLLT	Device handle
uiHoldBuffersForPolling	Buffer count set

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_WRONG_BUFFER_COUNT	-150	Bufer count is not in the range of >=2 and <= 200

7.6.8 Packet size

scanCONTROL supports the packet sizes 128, 256, 512, 1024, 2048 and 4096 bytes. For Ethernet connections, packets larger than 1024 bytes require the support of jumbo frames by all devices, especially by the receiving network card.

- **GetPacketSize ()**

```
Function
   GetPacketSize(pLLT As UInteger, ByRef pValue As UInteger) As Integer
End Function
```

Query the active packet size of the Ethernet streaming packets.

Parameter

pLLT	Device handle
pValue	Packet size queried

Return value

General return values

- **SetPacketSize ()**

```
Function
   SetPacketSize(pLLT As UInteger, pValue As UInteger) As Integer
End Function
```

Set the active packet size of the Ethernet streaming packets. This packet size has to be between the minimum and maximum packet size.

Parameter

pLLT	Device handle
Value	Packet size to be set

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_PACKET_SIZE	-151	The requested packet size is not supported

- **GetMinMaxPacketSize ()**

```
Function
   GetMinMaxPacketSize(pLLT As UInteger, ByRef pMinPacketSize As ULong,
      ByRef pMaxPacketSize As ULong) As Integer
End Function
```

Query the minimum and maximum packet sizes of the Ethernet streaming packets.

Parameter

pLLT	Device handle
pMinPacketSize	Minimal packet size settable
pMaxPacketSize	Maximal packet size settable

Return value

General return values

7.6.9 Loading and saving of user modes

Loading and storing the user mode. All settings of a scanCONTROL can be stored in a user mode so that all settings become active again immediately after a reset or restart. This is particularly expedient for post processing applications. Loading the user mode cannot be performed during an active profile / container transmission. User mode 0 can only be loaded as it contains the factory settings.

- **GetActualUserMode ()**

```
Function
   GetActualUserMode(pLLT As UInteger,
      ByRef pActualUserMode As UInteger, ByRef pUserModeCount As UInteger)
      As Integer
End Function
```

Query the last loaded user mode / parameter queue. The scanCONTROL 25xx/26xx/27xx/29xx/30xx series support 16 user modes.

Parameter

pLLT	Device handle
pActualUserMode	Currently loaded user mode
pUserModeCount	Available user modes

Return value

General return values

- **ReadWriteUserModes ()**

```
Function
   ReadWriteUserModes(pLLT As UInteger, nWrite As Integer, nUserMode As UInteger)
      As Integer
End Function
```

Loading or storing a user mode. If nWrite is 0, the user mode specified by nUserMode is loaded; otherwise the current settings are stored to this user mode. After loading of a user mode the sensor must be reconnected.

Parameter

pLLT	Device handle
nWrite	Loading (0) or saving (other than 0) of an user mode
nUserMode	User mode to be loaded or saved

Return value

General return values

Specific return values:

ERROR_SETGETFUNCTIONS_USER_MODE_TOO_HIGH	-160	The specified user mode number is not available
ERROR_SETGETFUNCTIONS_USER_MODE_FACTORY_DEFAULT	-161	User mode 0 cannot be overwritten (factory settings)

7.6.10 Timeout for communication supervision to the sensor

Setting and reading the heartbeat timeout in milliseconds to monitor the connection between LLT.dll and scanCONTROL device. This is the time between two monitoring packets. A connection abort will occur if the device does not receive packets after three times the set up value. Especially while debugging, a heartbeat timeout set too small is reason for connection loss.

- **GetEthernetHeartbeatTimeout ()**

```
Function
   GetEthernetHeartbeatTimeout(pLLT As UInteger, ByRef pValue As UInteger)
      As Integer
End Function
```

Query the set heartbeat timeout.

Parameter

pLLT	Device handle
pValue	Heartbeat timeout queried

Return value

General return values

- **SetEthernetHeartbeatTimeout ()**

```
Function
   SetEthernetHeartbeatTimeout(pLLT As UInteger, pValue As UInteger) As Integer
End Function
```

Set the heartbeat timeout in ms. Values between 500 and 1.000.000.000 ms are allowed.

Parameter

pLLT	Device handle
Value	Heartbeat timeout to be set

Return value

General return values

Specific return value:

ERROR_SETGETFUNCTIONS_HEARTBEAT_TOO_HIGH	-162	Parameter value too large

7.6.11 Set file size for saving data

- **GetMaxFileSize ()**

```
Function
   GetMaxFileSize(pLLT As UInteger, ByRef pValue As UInteger) As Integer
End Function
```

Query the maximum file size for saving profile data in byte.

Parameter

pLLT	Device handle
pValue	Maximum file size queried

Return value

General return values

- **SetMaxFileSize ()**

```
Function
   SetMaxFileSize(pLLT As UInteger, pValue As UInteger) As Integer
End Function
```

Set maximum file size for saving profile data in byte. If this size is reached the saving process is stopped.

Parameter

pLLT	Device handle
Value	Maximum file size to be set

Return value

General return values

7.7 Register functions

7.7.1 Register callback for profile reception

These callbacks are, after they have been registered, called after the receipt of a profile/ container and have as parameter a pointer to the profile/container data, the corresponding size of a data field and an pUserData parameter.
The callback is intended for the processing of profiles / containers with a high profile frequency. During the callback profiles / container may be copied in a buffer for a later or a processing synchrony or asynchrony to the callback. A processing during the callback is not recommendable as for the time the callback needs for processing the LLT.dll is not able to fetch new profiles / container from the driver. Possibly by this it may amount to profile/container failures.
The profile / container data in the buffer passed by the callback must not be changed.

- **RegisterCallback ()**

```
Function
   RegisterCallback(pLLT As UInteger, tCallbackType As TCallbackType,
      tReceiveProfiles As ProfileReceiveMethod, pUserData As UInteger) As Integer
End Function
```

Register the callback which is called every time a profile is received.

Parameter

pLLT	Device handle

tCallbackType	Call convention (0: stdcall; 1: c_decl)
tReceiveProfiles	Callback function to be registered
pUserData	Userdata for distinguishing sensors

Return value

General return values

- **CallbackType**

Callback Type	Value	Description
STD_CALL	0	The callback is working with stdcall (TNewProfile_s)
C_DECL	1	The callback is working with cdecl (TNewProfile_c)

7.7.2 Register error message for error handling

- **RegisterErrorMsg ()**

```
Function
   RegisterErrorMsg(pLLT As UInteger, Msg As UInteger, hWnd As IntPtr,
      WParam As UIntPtr) As Integer
End Function
```

Register an error message.

Parameter

pLLT	Device handle
Msg	Message ID
hWnd	Handle (e.g. Window)
WParam	Identification parameter

Return value

General return values

- **WParam (error ID)**

Available error parameter:

Constant of return value	Value	Description
ERROR_SERIAL_COMM	1	Error during the serial data transfer. Possibly the profile frequency is too high.
ERROR_SERIAL_LLT	7	ScanCONTROL could not interpret the commando or a parameter out of the validity area has been send.
ERROR_CONNECTIONLOST	10	The connection to the scanCONTROL has been interrupted (scanCONTROL has been switched off, reset or the Ethernet cable has been removed). Please send a *Disconnect()* for being able to reconnect. This message is only send at a connection by Ethernet

ERROR_STOPSAVING	100	The saving of the profiles is finished (maximum data size reached)

7.8 Profile transmission functions

7.8.1 Start/stop profiles transmission

- **TransferProfiles ()**

```
Function
   TransferProfiles(pLLT As UInteger, TransferProfileType As TTransferProfileType,
      nEnable As Integer) As Integer
End Function
```

Start or stop profile transmission. After the first start of a transfer it may take up to 100 ms before the first profiles/container arrive via callback or can be fetched via *GetActualProfile()*. If a transfer is terminated, the function waits automatically till the driver has returned all buffers.

Parameter

pLLT	Device handle
TransferProfileType	Profile transfer type
nEnable	Start (1) or stop (0) transmission

Return value

Size of profile/container
General return values
Specific return value:

ERROR_PROFTRANS_PACKET_SIZE_TOO_HIGH	-107	Packet size is too high
ERROR_PROFTRANS_CREATE_BUFFERS	-108	Buffers could not be reserved → restart PC
ERROR_PROFTRANS_WRONG_PACKET_SIZE_FOR_CONTAINER	-109	Packet size does not match container settings, see *setPacketSize()*

- **TransferProfileType**

Available TransferProfileTypes:

Constant return value	Value	Description
NORMAL_TRANSFER	0	Activation of a continuous transfer of profiles
SHOT_TRANSFER	1	Activation of a demand-based transfer of profiles (the transfer is always activated by *MultiShot()*)
NORMAL_CONTAINER_MODE	2	Activation of a continuous transfer in the container mode
SHOT_CONTAINER_MODE	3	Activation of a demand-based transfer in the container mode (the transfer is always activated by *MultiShot()*)

7.8.2 Transmission of sensor matrix image / start/stop Video Mode

- **TransferVideoStream ()**

```
Function
   TransferVideoStream(pLLT As UInteger, TransferVideoType As TTransferVideoType,
      nEnable As Integer, ByRef pWidth As UInteger, ByRef pHeight As UInteger)
      As Integer
End Function
```

Start or stop transmission of video images of the sensor matrix (Video Mode). Maximum video frame rate is 25 pictures per second. Video pictures are fetched per *GetActualProfile()*. The Callback cannot be used for video image transmission.

Parameter

pLLT	Device handle
videoType	Video transmission type
nEnable	Start (1) or stop (0) transmission
pWidth	Width of received image
pHeight	Height of received image

Return value

General return values

Specific return values:

ERROR_PROFTRANS_PACKET_SIZE _TOO_HIGH	-107	The packet size is bigger than the available one -> adjust a smaller packet size by *SetPacketSize()*
ERROR_PROFTRANS_CREATE_BUFFERS	-108	The buffer for the driver could not be created duly -> possibly restart the PC

- **TransferVideoType**

Available TransferVideoTypes:

Constant return value	Value	Description
VIDEO_MODE_0	0	Low resolution image of matrix
VIDEO_MODE_1	1	Full size image of matrix

7.8.3 Transmission of a specified number of profiles / container

- **MultiShot ()**

```
Function
   MultiShot(pLLT As UInteger, nCount As UInteger) As Integer
End Function
```

Request the transmission of a specified number of profiles / containers. The amount of

profiles / container is passed in the parameter nCount. You can fetch between 1 and 65535 profiles / container.

Note: MultiShot() does not trigger the sensor to deliver a profile or a container. It only passes the most recent profile(s)/container(s) in the buffer to the application so that GetActualProfile or the Callback deliver only the number of specified profile(s)/container(s) instead of a continuous sequence of profile(s)/container(s).

Parameter

pLLT Device handle
nCount Number of requested profiles/container

Return value

General return values
Specific return values:

ERROR_PROFTRANS_SHOTS_NOT_ACTIVE	-100	The SHOT_TRANSFER mode or the SHOT_CONTAINER_MODE mode is not activated -> restart profile transfer
ERROR_PROFTRANS_SHOTS_COUNT_TOO_HIGH	-101	The number of requested profiles / container is bigger than 65535
ERROR_PROFTRANS_MULTIPLE_SHOTS_ACTIV	-111	A MultiShot request is active -> call *MultiShot(0)* for abort

7.8.4 Transmission of profiles via serial interface

- **GetProfile ()**

```
Function
   GetProfile(pLLT As UInteger) As Integer
End Function
```

Profile transfer via serial interface. This function is only available for the serial interface.

Parameter

pLLT Device handle

Return value

General return values

7.8.5 Fetch current profile / container / video image

- **GetActualProfile ()**

```
Function
   GetActualProfile(pLLT As UInteger, pBuffer As Byte(), nBuffersize As Integer,
      ProfileConfig As TProfileConfig, ByRef pLostProfiles As UInteger) As Integer
End Function
```

Fetching the active profile/container/video image from the LLT.dll.

Parameter

pLLT Device handle

pBuffer	Transmission buffer
nBuffersize	Size of transmission buffer
ProfileConfig	Profile configuration of transmission
pLostProfiles	Lost profiles

Return value

Number of bytes copied into buffer
General return values
Specific return values:

ERROR_PROFTRANS_WRONG_PROFILE_CONFIG	-102	Not able to convert the loaded profile into the requested profile configuration
ERROR_PROFTRANS_FILE_EOF	-103	The end-of-file during the loading of profiles has been reached
ERROR_PROFTRANS_NO_NEW_PROFILE	-104	Since the last call of *GetActualProfile()* no new profile has been received
ERROR_PROFTRANS_BUFFER_SIZE_TOO_LOW	-105	The buffer size of the passed buffer is too small
ERROR_PROFTRANS_NO_PROFILE_TRANSFER	-106	The profile transfer has not been started and no file is loaded

7.8.6 Convert profile data

- **ConvertProfile2Values ()**

```
Function
   ConvertProfile2Values(pLLT As UInteger, pProfile As Byte(),
      nResolution As UInteger, ProfileConfig As TProfileConfig,
      ScannerType As TScannerType, nReflection As UInteger,
      nConvertToMM As Integer, pWidth As UShort(), pMaximum As UShort(),
      pThreshold As UShort(), pX As Double(), pZ As Double(), pM0 As UInteger(),
      pM1 As UInteger()) As Integer
End Function
```

Conversion of profile data in coordinates and further measuring point information. The size of the data arrays must correspond to the profile resolution.

Parameter

pLLT	Device handle
pProfile	Profile buffer
nResolution	Points per profile
ProfileConfig	Profile configuration of transmission
ScannerType	Scanner type
nReflection	Profile stripe to be evaluated
nConvertToMM	Convert x/z data to millimeters
pWidth	Array for reflection width
pMaximum	Array for maximum intensity
pThreshold	Array for threshold setting
pX	Array for position values
pZ	Array for distance values
pM0	Array for moment 0
pM1	Array for moment 1

Return value

General return values

Additional return values in case of success

Specific return value:

ERROR_PROFTRANS_REFLECTION_NUMBER_TOO_HIGH	-110	The count of the requested stripes is bigger than 3

- **ConvertPartProfile2Values ()**

```
Function
   ConvertPartProfile2Values(pLLT As UInteger, pProfile As Byte(),
      ByRef ProfileConfig As TPartialProfile, ScannerType As TScannerType,
      nReflection As UInteger, nConvertToMM As Integer, pWidth As UShort(),
      pMaximum As UShort(), pThreshold As UShort(), pX As Double(), pZ As Double(),
      pM0 As UInteger(), pM1 As UInteger()) As Integer
End Function
```

Conversion of partial profile data in coordinates and further measuring point information. The size of the data arrays must correspond to the PointCount of the PARTIAL_PROFILE parameter.

Parameter

pLLT	Device handle
pProfile	Profile buffer
PartialProfile	Partial profile
ScannerType	Scanner type
nReflection	Profile stripe to be evaluated
nConvertToMM	Convert x/z data to millimeters
pWidth	Array for reflection width
pMaximum	Array for maximum intensity
pThreshold	Array for threshold setting
pX	Array for position values
pZ	Array for distance values
pM0	Array for moment 0
pM1	Array for moment 1

Return value

General return values

Additional return values in case of success

Specific return value:

ERROR_PROFTRANS_REFLECTION_NUMBER_TOO_HIGH	-110	The count of the requested stripes is bigger than 3

- **Return values in case of success**

If the return value was >0, the set bits of the value describe which arrays have been filled:

Bit	Constant	Description
8	CONVERT_WIDTH	The array for the reflection width has been filled with data

9	CONVERT_MAXIMUM	The array for the maximum intensity has been filled with data
10	CONVERT_THRESHOLD	The array for the threshold has been filled with data
11	CONVERT_X	The array for the position coordinates has been filled with data
12	CONVERT_Z	The array for the distance coordinates has been filled with data
13	CONVERT_M0	The array for the M0 has been filled with data
14	CONVERT_M1	The array for the M1 has been filled with data

7.9 Is functions

- **IsInterfaceType ()**

```
Function IsInterfaceType(pLLT As UInteger, iInterfaceType As Integer) As Integer
End Function
```

Query of currently used interface.

Parameter

pLLT Device handle
iInterfaceType Integer value of interface type

Return value

Specific return values:

IS_FUNC_YES	1	Interrogated state or connection is active
IS_FUNC_NO	0	Interrogated state or connection is not active

- **IsTransferingProfiles()**

```
Function
   IsTransferingProfiles(pLLT As UInteger) As Integer
End Function
```

Query of transmission state, i.e. if the transmission is active or not.

Parameter

pLLT Device handle

Return value

Specific return values:

IS_FUNC_YES	1	Interrogated state or connection is active

IS_FUNC_NO	0	Interrogated state or connection is not active

7.10 Functions for transmission of partial profiles

The scanCONTROL offers the possibility to restrict the transferred profile. The advantage of this procedure is the reduced size of the transferred data. Furthermore, the unused ranges of a profile may be cut out already directly in the scanCONTROL.

- **GetPartialProfile ()**

```
Function
   GetPartialProfile(pLLT As UInteger, ByRef pPartialProfile As TPartialProfile)
      As Integer
End Function
```

Query the current partial profile setting set on the scanCONTROL.

Parameter

pLLT	Device handle
pPartialProfile	Reference to partial profile structure

Return value

General return values

- **SetPartialProfile ()**

```
Function
   SetPartialProfile(pLLT As UInteger, ByRef pPartialProfile As TPartialProfile)
      As Integer
End Function
```

By using this function the partial profile transfer of the scanCONTROL can be adjusted. Before setting the partial profile parameters, the profile configuration has to be set to PARTIAL_PROFILE. All parameter of the *SetPartialProfile()* function always have to be a multiple of the respective nUnitSize of the function *GetPartialProfileUnitSize()*.

Parameter

pLLT	Device handle
pPartialProfile	Reference to partial profile structure to be set

Return value

General return values

Specific return values:

ERROR_PARTPROFILE_NO_PART_PROF	-350	The profile configuration is not set to PARTIAL_PROFILE -> call SetProfileConfig(PARTIAL_PROFILE);
ERROR_PARTPROFILE_TOO_MUCH_BYTES	-351	The count of bytes per point is too high -> change nStartPointData or nPointDataWidth
ERROR_PARTPROFILE_TOO_MUCH_POINTS	-352	The count of points is too high -> change nStartPoint or nPointCount

ERROR_PARTPROFILE_NO_POINT_COUNT	-353	nPointCount or nPointDataWidth is 0
ERROR_PARTPROFILE_NOT_MOD_UNITSIZE_POINT	-354	nStartPoint or nPointCount are not a multiple of nUnitSizePoint
ERROR_PARTPROFILE_NOT_MOD_UNITSIZE_DATA	-355	nStartPointData or nPointDataWidth are not a multiple of nUnitSizePointData

- **GetPartialProfileUnitSize ()**

```
Function
   GetPartialProfileUnitSize(pLLT As UInteger, ByRef pUnitSizePoint As UInteger,
      ByRef pUnitSizePointData As UInteger) As Integer
End Function
```

This function returns the increments for adjusting the partial profile.

Parameter

pLLT	Device handle
pUnitSizePoint	UnitSizePoint size
pUnitSizePointData	UnitSizePointData size

Return value

General return values

7.11 Timestamp extraction functions

- **Timestamp2TimeAndCount ()**

```
Function
   Timestamp2TimeAndCount(pBuffer As Byte(), ByRef dTimeShutterOpen As Double,
      ByRef dTimeShutterClose As Double, ByRef uiProfileCount As UInteger)
      As Integer
End Function
```

This function evaluates the whole timestamp of a profile. It returns the internal timestamp of the beginning and the end of the shutter interval and the consecutive profile numbers.

Parameter

pBuffer	Reference to timestamp bytes of profile buffer
dTimeShutterOpen	Timestamp shutter open
dTimeShutterClosed	Timestamp shutter closed
uiProfileCount	Profile count

Return value

General return values

- **Timestamp2CmmTriggerAndInCounter ()**

```
Function
   Timestamp2CmmTriggerAndInCounter(pBuffer As Byte(),
      ByRef pInCounter As UInteger, ByRef pCmmTrigger As Integer,
      ByRef pCmmActive As Integer, ByRef pCmmCount As UInteger) As Integer
End Function
```

This function evaluates only the optional part of the timestamp of a profile. It returns the reading of the internal counter, the CmmTrigger and CmmActive flags as well as the CMM trigger counter.

Parameter

pBuffer	Reference to timestamp bytes of profile buffer
pInCounter	Internal counter
pCmmTrigger	Flag CMM trigger *active*
pCmmActive	*Flag CMM active*
pCmmCount	Trigger count

Return value

General return values

7.12 Post processing functions

In context of post processing the scanCONTROL may apply several modules to the profiles. These modules are only available in the SMART / GAP options of the sensor.

7.12.1 Read and write Post-Processing parameters

- **ReadPostProcessingParameter ()**

```
Function
   ReadPostProcessingParameter(pLLT As UInteger, ByRef pParameter As UInteger,
      nSize As UInteger) As Integer
End Function
```

Read post processing parameters.

Parameter

pLLT	Device handle
pParameter	Post processing parameter array
nSize	Size of post processing parameter array (max. 1024 DWORDs)

Return value

General return values

- **WritePostProcessingParameter ()**

```
Function WritePostProcessingParameter(pLLT As UInteger,
                        ByRef pParameter As UInteger, nSize As UInteger) As Integer
End Function
```

Write post processing parameters.

Parameter

pLLT	Device handle
pParameter	Post processing parameter array
nSize	Size of post processing parameter array (max. 1024 DWORDs)

Return value

General return values

7.12.2 Extract post processing results

- **ConvertProfile2ModuleResult ()**

```
Function
   ConvertProfile2ModuleResult(pLLT As UInteger, pProfileBuffer As Byte(),
      nProfileBufferSize As UInteger, pModuleResultBuffer As Byte(),
      nResultBufferSize As UInteger, ByRef pPartialProfile As TPartialProfile)
      As Integer
End Function
```

Extract post processing results from profile data. These overwrite the position and distance coordinates of the fourth stripe.

Parameter

pLLT	Device handle
pProfileBuffer	Profile buffer
nProfileBufferSize	Size of profile buffer
pModuleResultBuffer	Result buffer
nResultBufferSize	Size of result buffer
pPartialProfile	Reference to partial profile (optional)

Return value

Number of bytes copied into buffer
General error codes
Specific return values:

ERROR_POSTPROCESSING_NO_PROF_BUFFER	-200	No profile buffer has been passed
ERROR_POSTPROCESSING_MOD_4	-201	The parameter nStartPointData or nPointDataWidth is not divisible by 4
ERROR_POSTPROCESSING_NO_RESULT	-202	No result block could be found in the profile
ERROR_POSTPROCESSING_LOW_BUFFERSIZE	-203	The buffer size for the result is too small
ERROR_POSTPROCESSING_WRONG_RESULT_SIZE	-204	The size of the result block in the profile is not correct

7.13 Functions for loading and saving profile data

7.13.1 Save profile data

- **SaveProfiles ()**

```
Function
   SaveProfiles(pLLT As UInteger, pFilename As StringBuilder,
      FileType As TFileType) As Integer
End Function
```

Saving of profiles. The profiles thereby are saved with the active profile configuration. The file name has to be indicated including extension. For finishing the saving *SaveProfiles(NULL, 0)* has to be called. If the maximum file size is reached during saving, an error message with the ERROR_STOPSAVING (see RegisterErrorMsg) value is sent.

Parameter

pLLT	Device handle
pFileName	Name of file to be saved
FileType	File type

Return value

General return values

Specific return values:

ERROR_LOADSAVE_WRITING_LAST_BUFFER	-50	Error in the deactivation of the saving the last profile of the file could be damaged or not all have been saved
ERROR_LOADSAVE_AVI_NOT_SUPPORTED	-58	The operating system don't support the AVI format, please use windows 2000 or better
ERROR_LOADSAVE_WRONG_PROFILE_CONFIG	-60	The profile configuration or the file type mismatch to the transferred profiles/containers/video-pictures
ERROR_LOADSAVE_NOT_TRANSFERING	-61	The profile transfer is not active

- **FileType**

Available FileTypes. It is recommended to use the AVI-file format, this format is supported by the scanCONTROL Software from Micro-Epsilon:

FileType	Value	Description
AVI	0	AVI file
CSV	1	CSV file (profile data only)
BMP	2	BMP file (video image data only)
CSV_NEG	3	CSV file (profile data only) with mirrored z axis

7.13.2 Load profile data

- **LoadProfiles ()**

```
Function
   LoadProfiles(pLLT As UInteger, pFilename As StringBuilder,
      ByRef pPartialProfile As TPartialProfile,
      ByRef pProfileConfig As TProfileConfig, ByRef pScannerType As TScannerType,
      ByRef pRearrengementProfile As UInteger) As Integer
End Function
```

Loading of profiles from an *.AVI file. All *.AVI files can be loaded which are saved with the LLT.dll or the scanCONTROL programs from Micro-Epsilon. After loading the file, the single profiles in the file may be read out by the function *GetActualProfile()*. For terminating the file load LoadProfiles(NULL, NULL, NULL, NULL, NULL) has to be called.

The profile configuration of the loaded profile should always correspond to the profile configuration of the LoadProfiles function. Additionally at saved profile configuration of PROFILE also QUARTER_PROFILE and PURE_PROFILE or at QUARTER_PROFILE also PURE_PROFILE may be read out.

Parameter

pLLT	Device handle
pFileName	Name of file to be loaded
pPartialProfile	Partial profile (optional)
pProfileConfig	Profile configuration
pScannerType	Scanner type
pRearrangementProfile	Rearrangement register value

Return value

Number of loaded profiles/container
General error codes
Specific return values:

ERROR_LOADSAVE_WHILE_SAVE_PROFILE	-51	File cannot be loaded, as saving is active
ERROR_LOADSAVE_NO_PROFILELENGTH_POINTER	-52	No pointer for the profile length has been passed
ERROR_LOADSAVE_NO_LOAD_PROFILE	-53	The filename is NULL, but no file is currently loaded
ERROR_LOADSAVE_STOP_ALREADY_LOAD	-54	On file has already been loaded, the loading has been stopped
ERROR_LOADSAVE_CANT_OPEN_FILE	-55	Cannot open file
ERROR_LOADSAVE_INVALID_FILE_HEADER	-56	The file header of the file to be loaded is wrong
ERROR_LOADSAVE_AVI_NOT_SUPPORTED	-58	The operating system don't support the AVI format, please use windows 2000 or better
ERROR_LOADSAVE_NO_REARRANGEMENT_POINTER	-59	The reference to pRearrengementProfile is NULL

7.13.3 Navigation in a loaded file

- **LoadProfilesGetPos ()**

```
Function
   LoadProfilesGetPos(pLLT As UInteger, ByRef pActualPosition As UInteger,
      ByRef pMaxPosition As UInteger) As Integer
End Function
```

Query the number of profiles in a file and the current reading position.

Parameter

pLLT	Device handle
pActualPosition	Current reading position
pMaxPosition	Maximum reading position

Return value

General return values

- **LoadProfilesSetPos ()**

```
Function
   LoadProfilesSetPos(pLLT As UInteger, nNewPosition As UInteger) As Integer
End Function
```

Set reading position in a loaded file.

Parameter

pLLT	Device handle
pNewPosition	Position from which should be read (0 sets the first profile)

Return value

General return values

Specific return value:

ERROR_LOADSAVE_FILE_POSITION_TOO_HIGH	-57	The requested position is bigger than or equal to the maximum position

7.14 Special CMM trigger functions

The special CMM trigger functions simplify the starting and terminating of the profile transfer with activated CMM trigger. Additionally the profiles with active CMM trigger may be saved in a file. The CMM trigger is only available for certain options of the scanCONTROL.

Note: only supported by the scanCONTROL 26xx/27xx/29xx/30xx series

- **StartTransmissionAndCmmTrigger ()**

```
Function
   StartTransmissionAndCmmTrigger(pLLT As UInteger, nCmmTrigger As UInteger,
      TransferProfileType As TTransferProfileType, nProfilesForerun As UInteger,
      pFilename As StringBuilder, FileType As TFileType, Timeout As UInteger)
      As Integer
End Function
```

Start profile transmission with activated CMM trigger.

The StartTransmissionAndCmmTrigger function starts first profile transfer without forwarding the profiles thereby by callback. If the transmission was successful, i.e. the requested count of profiles has been transferred without failure, the first CMM trigger command with the divisor is sent to the scanCONTROL. Afterwards it is waiting for the first profile with active CMM trigger flag. From this profile on all further profiles are forwarded by callback. Additionally, if a file name has been passed, the saving of the profiles with the passed file name is started.

If a timeout occurs during the waiting for the profile, the function will be aborted. It is recommended to set nProfilesForerun to half the profile rate (e.g. 500 profiles at 1000 Hz) and the nTimeout to 3000 ms.

Parameter

pLLT	Device handle
nCmmTrigger	First indicator word of the CMM trigger, which contains the divisor and the polarity
TransferProfileType	Profile type of transmission
nProfilesForerun	Count of the continuous received profiles from which a stable data transfer is adopted
pFileName	File name for the file to be saved
pFileType	File format of the saved file
nTimeout	Timeout in ms

Return value

General return values

Specific return values:

ERROR_CMMTRIGGER_NO_DIVISOR	-400	Divisor has to be > 0
ERROR_CMMTRIGGER_TIMEOUT_AFTER_TRANSFERPROFILES	-401	After *TransferProfiles()* no profiles have been received
ERROR_CMMTRIGGER_TIMEOUT_AFTER_SETCMMTRIGGER	-402	After setting of the CMM trigger not enough profiles with active CMM trigger have been received

- **StopTransmissionAndCmmTrigger ()**

```
Function
   StopTransmissionAndCmmTrigger(pLLT As UInteger, nCmmTriggerPolarity As Integer,
      nTimeout As UInteger) As Integer
End Function
```

Stop profile transmission with activated CMM trigger.
The *StopTransmissionAndCmmTrigger()* function first stops the CMM trigger, by setting the divisor to 0 (but thereby taking into account the passed polarity). Afterwards it is waiting for the first profile without active CMM trigger flag. This profile and all the following will not be forwarded by callback, the profile transfer will be stopped and in case of active saving the saving will be terminated.

If a timeout occurs during waiting for the first profile without active CMM trigger flag, the function will be aborted. It is reasonable to indicate a time between 100 and 500 ms for the nTimeout.

Parameter

pLLT	Device handle
nCmmTriggerPolarity	Polarity of CMM triggers (0 = low active, 1 = high active)
nTimeout	Timeout in ms

Return value

General return values
Specific return value:

ERROR_CMMTRIGGER_TIMEOUT_AFTER_SETCMMTRIGGER	- 402	After setting the CMM trigger no profile with deactivated CMM trigger has been received

7.15 Error value conversion function

- **TranslateErrorValue ()**

```
Function
   TranslateErrorValue(pLLT As UInteger, errValue As Integer, pString As Byte(),
      nStringSize As Integer) As Integer
End Function
```

Conversion of an error value to an error text.

Parameter

pLLT	Device handle
ErrorValue	Error value
pString	Buffer for output string
nStringSize	String size

Return value

Number of characters copied to the buffer
General error codes

Specific return values:

ERROR_TRANSERRORVALUE_WRONG_ERROR_VALUE	- 450	A wrong error value has been passed
ERROR_TRANSERRORVALUE_BUFFER_SIZE_TO_LOW	-451	The size of the passed buffer is too small for the string

7.16 Save configuration

- **ExportLLTConfig ()**

```
Function
   ExportLLTConfig(pLLT As UInteger, pFileName As StringBuilder) As Integer
End Function
```

Exporting the current configuration of the scanCONTROL. This configuration file contains all relevant parameters and is primarily intended for post processing applications. The file format complies with the communications protocol for the serial connection with the scanCONTROL. The configuration files created thus can be transmitted to the scanCONTROL without changes via the serial port using a terminal program or via ImportLLTConfig.

Parameter

pLLT	Device handle
pFileName	Name of file to be exported

Return value

General return values
Return values of GetFeature()
Specific return value:

ERROR_READWRITECONFIG_CANT_CREATE_FILE	-500	The specified file cannot be created

- **ExportLLTConfigString ()**

```
Function
   ExportLLTConfigString(pLLT As UInteger, ByRef bConfigData As Byte,
      nSize As UInteger) As Integer
End Function
```

Exporting the current configuration of the scanCONTROL. This configuration string contains all relevant parameters and is primarily intended for post processing applications. The string format complies with the communications protocol for the serial connection with the scanCONTROL. The configuration string created thus can be transmitted to the scanCONTROL without changes via the serial port using a terminal program or via ImportLLTConfigString.

Parameter

pLLT	Device handle
bConfigData	byte array for config data
nSize	byte array size

Return value

General return values
Return values of GetFeature()
Specific return value:

ERROR_READWRITECONFIG_QUEUE_TO_SMALL	-502	Data array to small

- **ImportLLTConfig ()**

```
Function
   ImportLLTConfig(pLLT As UInteger, pFileName As StringBuilder,
      bIgnoreCalibration As Boolean) As Integer
End Function
```

Reads and sets the sensor parameters exported by ExportLLTConfig and is also able to read .sc1-files as long as they've been saved with scanCONTROL Configuration Tools Version 5.2 or newer. The ignore calibration flag specifies if the custom calibration of the sensor is also imported from the file.

Parameter

pLLT	Device handle
pFileName	Name of file to be exported
bIgnoreCalibration	if true, do not import calibration data from file

Return value

General return values
Specific return value:
Return values of SetFeature()

ERROR_READWRITECONFIG_CANT_OPEN_FILE	-502	The specified file cannot be opened
ERROR_READWRITECONFIG_FILE_EMPTY	-503	The specified file is empty
ERROR_READWRITE_UNKNOWN_FILE	-504	The imported data has not the expected format

- **ImportLLTConfigString ()**

```
Function
   ImportLLTConfigString(pLLT As UInteger, ByRef pConfigData As Byte,
      nSize As Integer, bIgnoreCalibration As Boolean) As Integer
End Function
```

Reads and sets the sensor parameters exported by ExportLLTConfigString. The ignore calibration flag specifies if the custom calibration of the sensor is also imported from the string.

Parameter

pLLT	Device handle
bConfigData	byte array with config data
nSize	byte array size

bIgnoreCalibration if true, do not import calibration data from file

Return value

General return values
Return values of SetFeature()
Specific return value:

ERROR_READWRITE_UNKNOWN_FILE	-504	The imported data has not the expected format

- **SaveGlobalParameter ()**

```
Function
   SaveGlobalParameter(pLLT As UInteger) As Integer
End Function
```

Save IP configuration and calibration independent of user mode.

Parameter

pLLT Device handle

Return value

General return values

8 Appendix

8.1 General return values

All functions of the interface return an int value as return value. If the return value of a function is greater than or equal to GENERAL_FUNCTION_OK respectively '1', the function has been successful; if the return value is GENERAL_FUNCTION_NOT_AVAILABLE respectively '0' or negative, an error occurred.
Some functions may also return GENERAL_FUNCTION_CONTAINER_MODE_HEIGHT_CHANGED respectively '2'. If this return value appears, the size of the image in the container mode has changed.

For the differentiation of the single return values several constants are available. In the following table all general return values which may be returned by functions are listed. For the single functional groups additionally there may also be special return / error values.

Constant return value	Value	Description
GENERAL_FUNCTION_CONTAINER_MODE_HEIGHT_CHANGED	2	Function successfully executed, but the image size for the container mode has changed
GENERAL_FUNCTION_OK	1	Function successfully executed
GENERAL_FUNCTION_NOT_AVAILABLE	0	This function is not available, possibly using a new DLL or switching to the Ethernet mode
ERROR_GENERAL_WHILE_LOAD_PROFILE	-1000	Function could not be executed as the loading of profiles is active

ERROR_GENERAL_NOT_CONNECTED	-1001	There is no connection to the scanCONTROL -> call *Connect()*
ERROR_GENERAL_DEVICE_BUSY	-1002	The connection to the scanCONTROL is interfered or disconnected -> reconnect and check interface of the scanCONTROL
ERROR_GENERAL_WHILE_LOAD_PROFILE_OR_GET_PROFILES	-1003	Function could not be executed as either the loading of profiles or the profile transfer is active
ERROR_GENERAL_WHILE_GET_PROFILES	-1004	Function could not be executed as the profile transfer is active
ERROR_GENERAL_GET_SET_ADDRESS	-1005	The address could not be read or written. Possibly a too old firmware is used
ERROR_GENERAL_POINTER_MISSING	-1006	A required pointer is set NULL
ERROR_GENERAL_WHILE_SAVE_PROFILES	-1007	Function could not be executed as the saving of profiles is active
ERROR_GENERAL_SECOND_CONNECTION_TO_LLT	-1008	A second instance is connected to this scanCONTROL via Ethernet or the serial port. Please close the second instance

8.2 SDK examples overview

The sample programs in the project directory are intended as examples for the integration of the scanCONTROL in own projects. They are available as executable projects with the complete source code.

Name	Description
GetProfiles_Poll	Transfer of profiles to the LLT.dll and pick up of profiles in polling mode
GetProfiles_Callback	Transfer of profiles to the LLT.dll and pick up of profiles with a callback
GetProfiles_Callback_Extended	Transfer of profiles to the LLT.dll and pick up of profiles with a callback with advanced scanner configuration
MultiShot	Transfer of a defined count of profiles from the scanCONTROL
PartialProfile	Transfer of partial profiles
LoadSave	Loading and saving of profiles
ContainerMode	Transfer of profile containers respectively grey scale maps
VideoMode	Transfer of video images from the sensor matrix
MultiLLT	Usage of more than one scanCONTROL in one program
CMMTrigger	Usage of the optional programmable trigger (CMM trigger)
LLTPeakFilter	Set peak filter, free measuring field and dynamic, encoder defined measuring field

RegisterErrorMessage_Minimal	Register error message for lost connection. Notice via Message Box.
RegisterErrorMessageWPF	Register error message for lost connection. Notice via Windows presentation foundation.
Calibration	Set sensor calibration (angle, offset)
SetROIs	Set ROIs on sensor array
sC30xx_HighSpeed	Configure scanCONTROL 30xx in High-Speed mode
TriggerProfile	Shows how to software-trigger one profile
TriggerContainer	Shows how to software-trigger one container
ReadPPPResults	Shows how to read out post processing results from profiles

8.3 Supporting documentation

[1] Operation Manual PartB 2600: Interface Specification for scanCONTROL 2600 Device Family; Ethernet and Serial Port; Supplement B to the scanCONTROL 2600 Manual; MICRO-EPSILON Optronic GmbH;

[2] Operation Manual PartB 2700: Interface Specification for scanCONTROL 2700 Device Family; Firewire (IEEE 1394) Bus, Ethernet and Serial Port; Supplement B to the scanCONTROL 2700 Manual; MICRO-EPSILON Optronic GmbH;

[3] Operation Manual PartB 2800: Interface Specification for scanCONTROL 2800 Device Family; Firewire (IEEE 1394) Bus and Serial Port; Supplement B to the scanCONTROL 2800 Manual; MICRO-EPSILON Optronic GmbH;

[4] Operation Manual PartB 2900: Interface Specification for scanCONTROL 2900 Device Family; Ethernet and Serial Port; Supplement B to the scanCONTROL 2900 Manual; MICRO-EPSILON Optronic GmbH;

[5] scanCONTROL 2600 Quick Reference; Brief Introduction to scanCONTROL 2600 Device Family; MICRO-EPSILON Optronic GmbH;

[6] scanCONTROL 2700 Quick Reference; Brief Introduction to scanCONTROL 2700 Device Family; MICRO-EPSILON Optronic GmbH;

[7] scanCONTROL 2800 Quick Reference; Brief Introduction to scanCONTROL 2800 Device Family; MICRO-EPSILON Optronic GmbH;

[8] scanCONTROL 2900 Quick Reference; Brief Introduction to scanCONTROL 2900 Device Family; MICRO-EPSILON Optronic GmbH;

[9] Interface documentation for LLT-DLL; MICRO-EPSILON Optronic GmbH;

[10] Operation Manual PartB 3000: Interface Specification for scanCONTROL 3000 Device Family; Ethernet and Serial Port; Supplement B to the scanCONTROL 3000 Manual; MICRO-

EPSILON Optronic GmbH;

[11] scanCONTROL 3000 Quick Reference; Brief Introduction to scanCONTROL 3000 Device Family; MICRO-EPSILON Optronic GmbH;

[12] Operation Manual PartB 2500: Interface Specification for scanCONTROL 2500 Device Family; Ethernet and Serial Port; Supplement B to the scanCONTROL 2500 Manual; MICRO-EPSILON Optronic GmbH;

[13] scanCONTROL 2500 Quick Reference; Brief Introduction to scanCONTROL 2500 Device Family; MICRO-EPSILON Optronic GmbH;