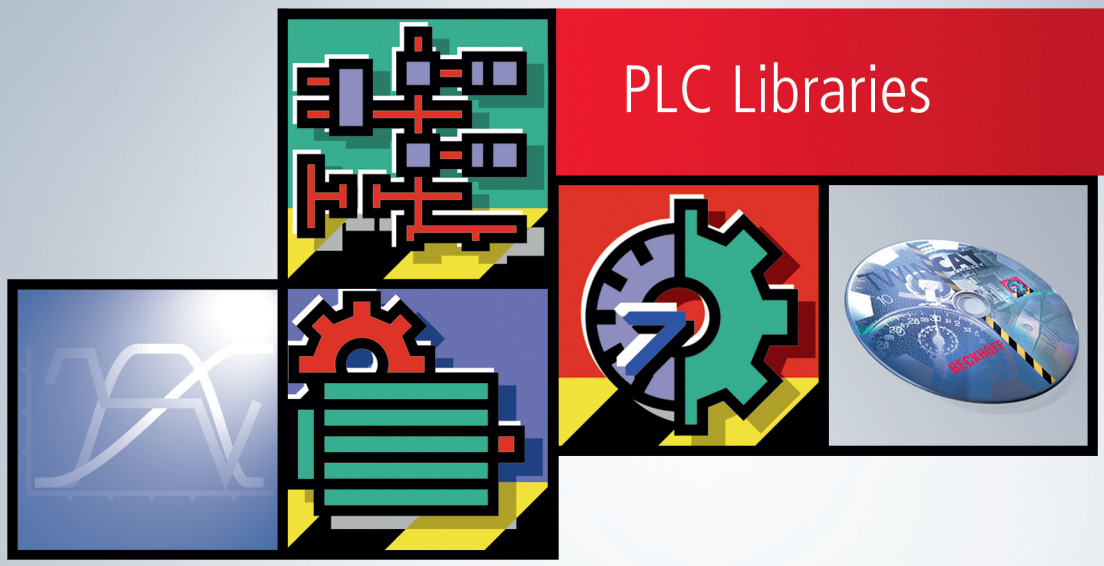
BECKHOFF New Automation Technology

Manual | EN

TX1200

TwinCAT PLC Lib: TcMath



2022-10-10 | Version: 1.1

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1 Foreword

1.1 Notes on the documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning the components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without prior announcement.
No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents:
EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702
with corresponding applications or registrations in various other countries.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.

NOTE

Damage to the environment or devices

Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

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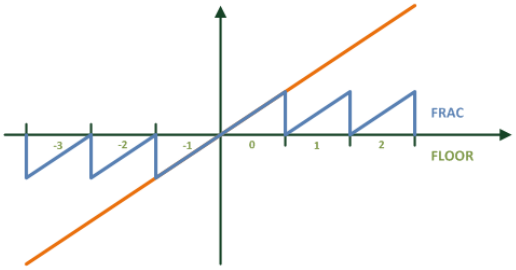
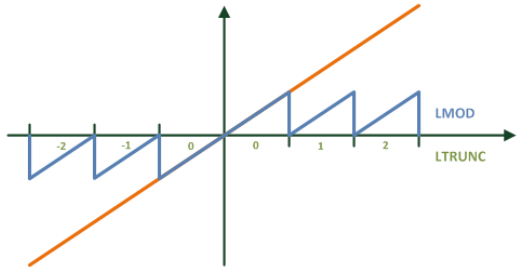
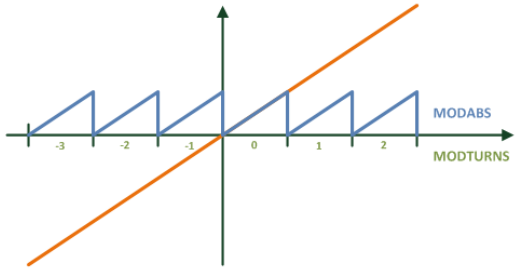
To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

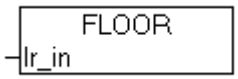
2 Overview

The TcMath.lib PLC library contains extended mathematical functions for TwinCAT PLC. The library is supplied together with TwinCAT (from version 2.9 Build 1000).

Functions

FLOOR [▶ 9]	The FLOOR function determines a integral value from a floating point number that is a fraction smaller than or equal that number.	
FRAC [▶ 10]	The FRAC function determines the decimal component of a floating point number.	
LMOD [▶ 12]	The LMOD function carries out a modulo division and returns the signed residual.	
LTRUNC [▶ 14]	The LTRUNC function determines the integral component of a floating point number.	
MODABS [▶ 15]	The MODABS function carries out a modulo division and determines the unsigned modulo value within the modulo range.	
MODTURNS [▶ 16]	The MODTURNS function carries out a modulo division and determines the signed integral component.	
F_GetVersionTcMath [▶ 17]	Returns the library version information	

3 FLOOR



The FLOOR function determines a integral value from a floating point number that is a fraction smaller than or equal that number. The resulting number is of type LREAL and is therefore not limited to the value range of integer variables.

Examples

```
FLOOR(2.8) = 2
FLOOR(-2.8) = -3
```

Similar functions: TRUNC [▶ 13], LTRUNC [▶ 14]

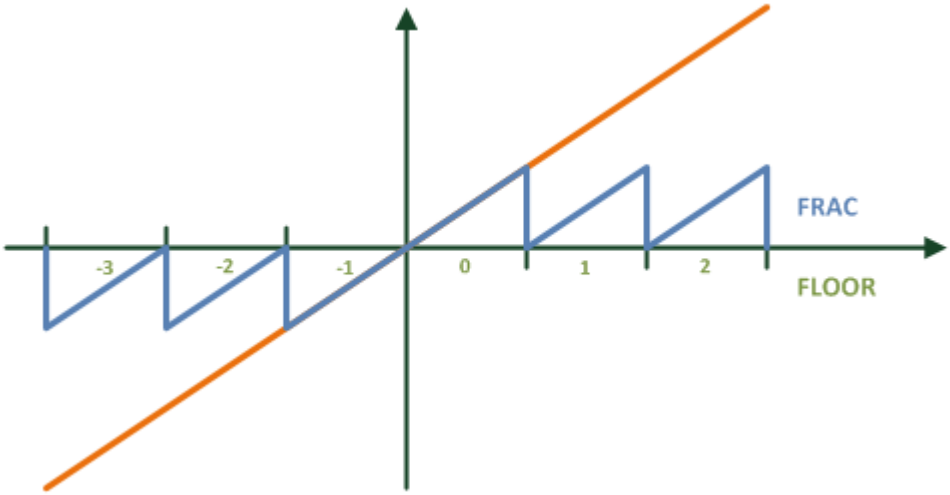
Unlike FLOOR, the LTRUNC function always determines the integral part of a number. For positive values, this number is smaller than or equal the input parameter, for negative values it is greater than or equal the input parameter.

FUNCTION FLOOR : LREAL

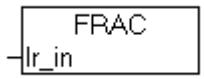
```
VAR_INPUT
    lr_in  : LREAL;
END_VAR
```

lr_in : Function parameters of type LREAL

Development environment	Target system type	PLC libraries to be linked
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	



4 FRAC



The FRAC function determines the decimal component of a floating point number.

Examples

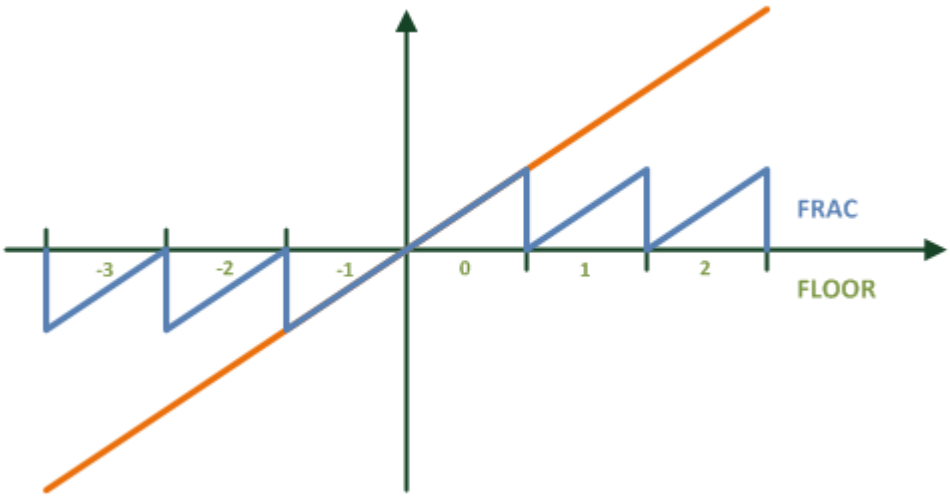
```
FRAC(2.8) = 0.8
FRAC(-2.8) = -0.8
```

FUNCTION FRAC : LREAL

```
VAR_INPUT
    lr_in  : LREAL;
END_VAR
```

lr_in : Function parameters of type LREAL

Development environment	Target system type	PLC libraries to be linked
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	



5 MOD

Modulo Division of one variable by another of the types: BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT and UDINT. The result of this function will be the remainder of the division. This result will be a whole number.

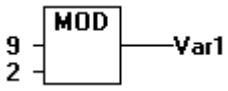
Example in IL:

```
LD 9
MOD 2
ST var1 (* Result is 1 *)
```

Example in ST:

```
var1 := 9 MOD 2;
```

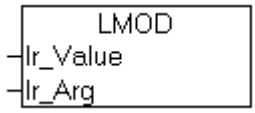
Example in FBD:



Similar Functions

LMOD [▶ 12]

6 LMOD



The LMOD function carries out a modulo division and returns the signed residual.

Examples

```
LMOD( 400.56, 360) = 40.56
LMOD( -400.56, 360) = -40.56
```

Similar functions: MOD [▶ 11], MODABS [▶ 15]

- Unlike MOD, the LMOD function operates with floating point variables and determines non-integer residuals.
- In the context of NC axes, modulo values are usually used unsigned. These can be calculated with the MODABS function.

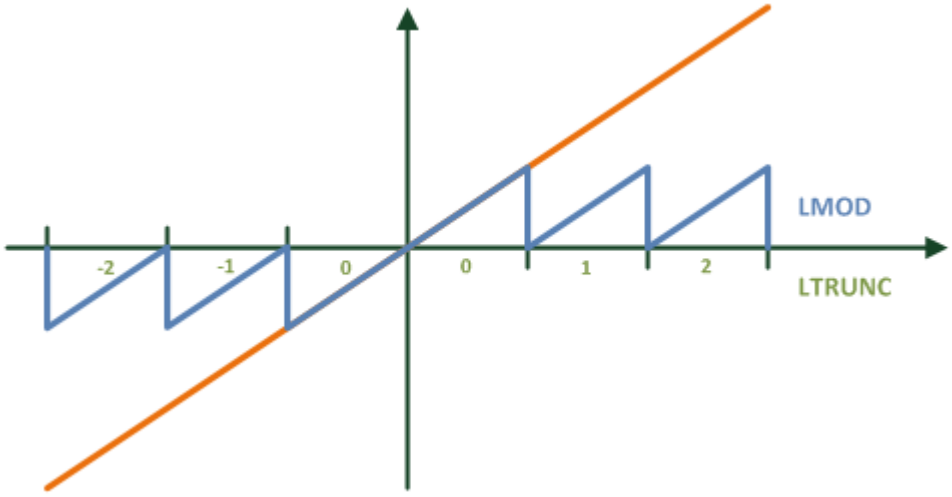
FUNCTION LMOD : LREAL

```
VAR_INPUT
    lr_Value  : LREAL;
    lr_Arg    : LREAL;
END_VAR
```

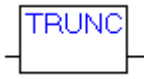
lr_Value : Input value

lr_Arg : Modulo range

Development environment	Target system type	PLC libraries to be linked
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	



7 TRUNC



Converting from REAL to INT. The whole number portion of the value will be used. When you perform a type conversion from a larger to a smaller type, you risk losing some information.

Examples in ST:

```
i:=TRUNC(1.9); (* Result is 1 *).
i:=TRUNC(-1.4); (* Result is -1 *).
```

Example in IL:

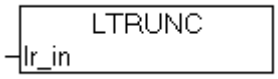
```
LD 2.7
TRUNC
GE %MW8
```

Similar Functions

LTRUNC [▶ 14]

FLOOR [▶ 9]

8 LTRUNC



The LTRUNC function determines the integral component of a floating point number.

Examples

```
LTRUNC(2.8) = 2
LTRUNC(-2.8) = -2
```

Similar functions: TRUNC [▶ 13], FLOOR [▶ 9]

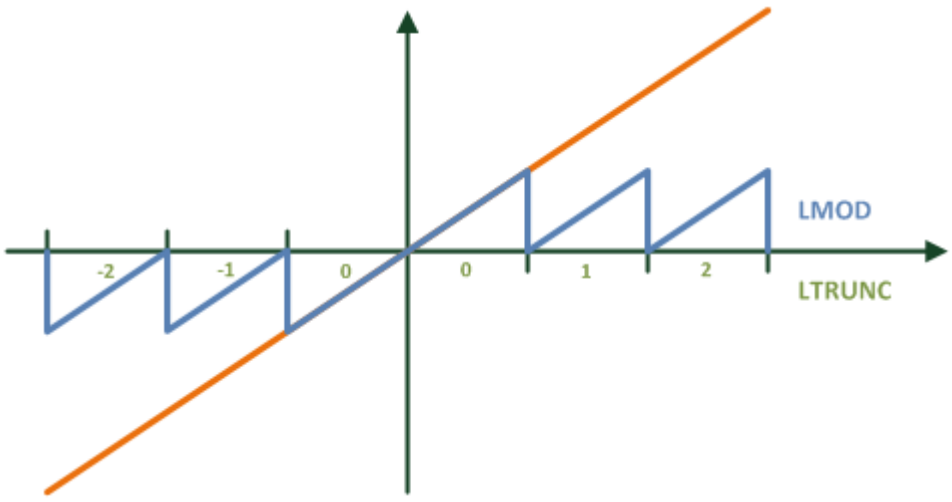
Unlike TRUNC, the result from LTRUNC is of type LREAL and is therefore not limited to the value range of integer variables.

FUNCTION LTRUNC : LREAL

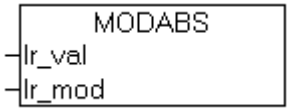
```
VAR_INPUT
    lr_in  : LREAL;
END_VAR
```

lr_in : Function parameters of type LREAL

Development environment	Target system type	PLC libraries to be linked
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	



9 MODABS



The MODABS function carries out a modulo division and determines the unsigned modulo value within the modulo range.

Examples

```
MODABS( 400.56, 360) = 40.56
MODABS( -400.56, 360) = 319,44
```

Similar functions: MOD [▶ 11], LMOD [▶ 12]

The MODABS function can be used to calculate the modulo set position of an NC axis from its absolute set position.

```
ModuloSetPosition := MODABS( NcToPlc.fPosSoll, 360 );
```

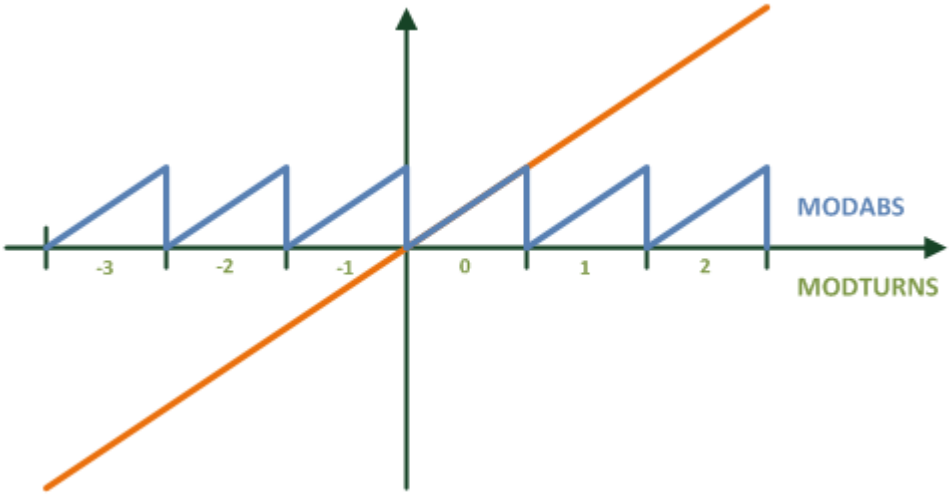
FUNCTION MODABS : LREAL

```
VAR_INPUT
    lr_val   : LREAL;
    lr_mod   : LREAL;
END_VAR
```

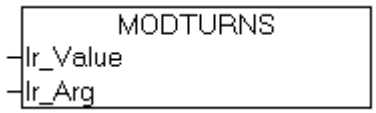
lr_val : Input value

lr_mod : Modulo range

Development environment	Target system type	PLC libraries to be linked
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	



10 MODTURNS



The MODTURNS function carries out a modulo division and determines the signed integral component (modulo periods, modulo rotations).

Examples

```
MODTURNS ( 800.56, 360) = 2
```

```
MODTURNS ( -400.56, 360) = -2
```

The MODTURNS function can be used to calculate the number of modulo rotations of an NC axis from its absolute set position.

```
ModuloSetTurns := MODTURNS ( NcToPlc.fPosSoll, 360 );
```

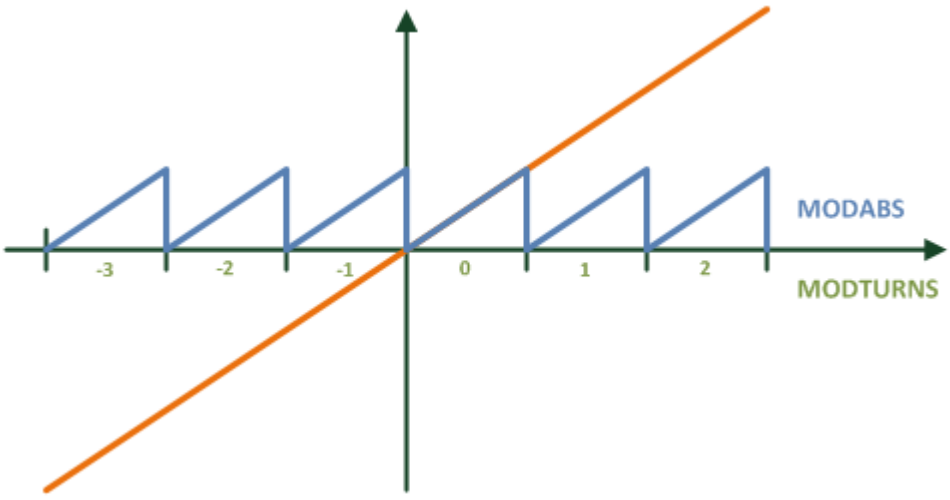
FUNCTION MODTURNS : LREAL

```
VAR_INPUT
    lr_Value  : LREAL;
    lr_Arg    : LREAL;
END_VAR
```

lr_Value : Input value

lr_Arg : Modulo range

Development environment	Target system type	PLC libraries to be linked
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	



11 F_GetVersionTcMath

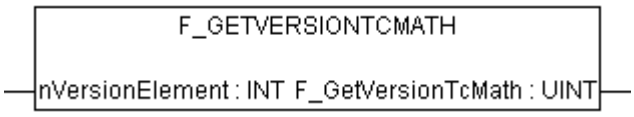


Fig. 1: F_GetVersionTcMath

The function returns library version info.

FUNCTION F_GetVersionTcMath : UINT

```
VAR_INPUT
    nVersionElement  : INT;
END_VAR
```

nVersionElement : Version parameter:

- 1 : major number;
- 2 : minor number;
- 3 : revision number;

Development environment	Target system type	PLC libraries to include
TwinCAT v2.9.0 build 1000 onwards	PC or CX (x86)	TcMath.Lib
TwinCAT v2.10.0 Build >= 1301	CX (ARM)	

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