CRIMSON CONTROL REFERENCE MANUAL

Prepared by Paul Plowright.

TABLE OF CONTENTS

CRIMSON CONTROL REFERENCE MANUAL

FUNCTION/OPERATOR REFERENCE

The following pages describe the various Functions and Operators available for use when writing control programs within the Control category of Crimson 3.

ABS

FUNCTION - RETURNS THE ABSOLUTE VALUE OF THE INPUT.

INPUTS

IN : ANY value.

OUTPUTS

Q : ANY Result: absolute value of IN.

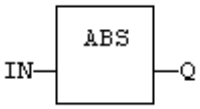
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

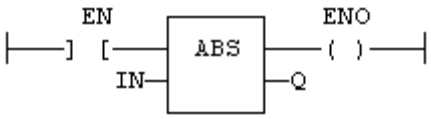
```
Q := ABS (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      ABS
      ST    Q  (* Q is: ABS (IN) *)
```

SEE ALSO

TRUNC LOG POW SQRT

ACOS ACOSL

FUNCTION - CALCULATE AN ARC-COSINE.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: arc-cosine of IN.

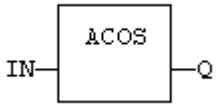
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

```
Q := ACOS (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.

IL Language

```
Op1:  LD    IN
      ACOS
      ST    Q  (* Q is: ACOS (IN) *)
```

SEE ALSO

SIN COS TAN ASIN ATAN ATAN2

+ ADD

OPERATOR - PERFORMS AN ADDITION OF ALL INPUTS.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : ANY Result: IN1 + IN2.

REMARKS

All inputs and the output must have the same type. In FBD language, the block may have up to 16 inputs. In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the ADD instruction performs an addition between the current result and the operand. The current result and the operand must have the same type.

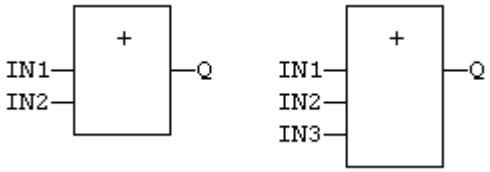
The addition can be used with strings. The result is the concatenation of the input strings.

ST LANGUAGE

```
Q := IN1 + IN2;
MyString := 'He' + 'll ' + 'o';   (* MyString is equal to 'Hello' *)
```

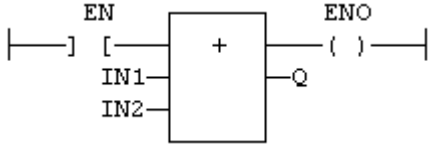
FBD LANGUAGE

The block may have up to 16 inputs:



LD LANGUAGE

The addition is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE:

```
Op1:  LD    IN1
      ADD   IN2
      ST    Q  (* Q is equal to: IN1 + IN2 *)

Op2:  LD    IN1
      ADD   IN2
      ADD   IN3
      ST    Q  (* Q is equal to: IN1 + IN2 + IN3 *)
```

SEE ALSO

- SUB * MUL / DIV

ALARM_A

FUNCTION BLOCK - ALARM WITH AUTOMATIC RESET.

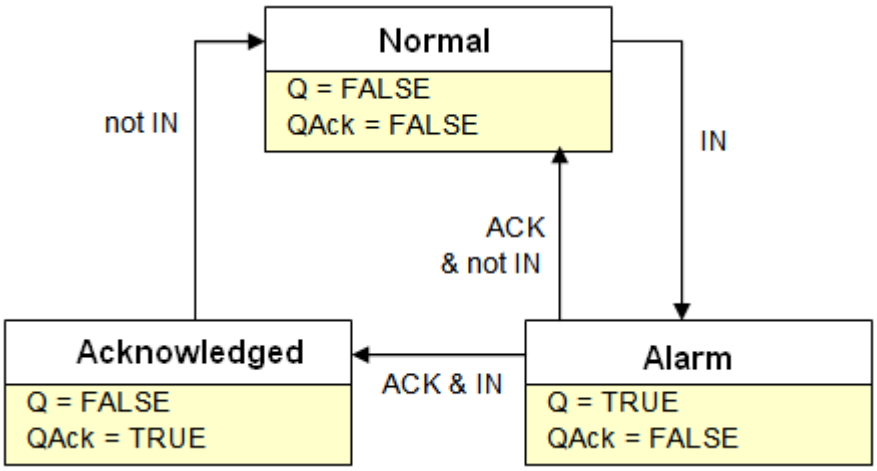
INPUTS

IN : BOOL Process signal.
ACK : BOOL Acknowledge command.

OUTPUTS

Q : BOOL *TRUE* if alarm is active.
QACK : BOOL *TRUE* if alarm is acknowledged.

SEQUENCE



REMARKS

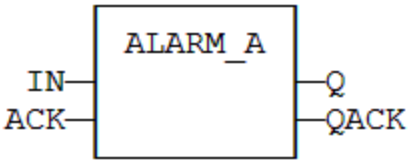
Combine this block with the LIM_ALRM block for managing analog alarms.

ST LANGUAGE

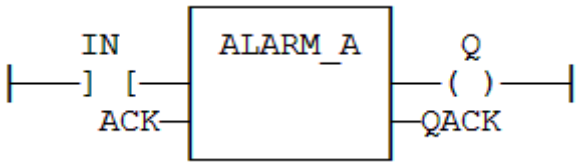
MyALARM is declared as an instance of ALARM_A function block.

```
MyALARM (IN, ACK, RST);
Q := MyALARM.Q;
QACK := MyALARM.QACK;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyALARM is declared as an instance of ALARM_A function block.

```
Op1:  CAL   MyALARM (IN, ACK, RST)
      LD    MyALARM.Q
      ST    Q
      LD    MyALARM.QACK
      ST    QACK
```

SEE ALSO

ALARM_M LIM_ALRM

ALARM_M

FUNCTION BLOCK - ALARM WITH MANUAL RESET.

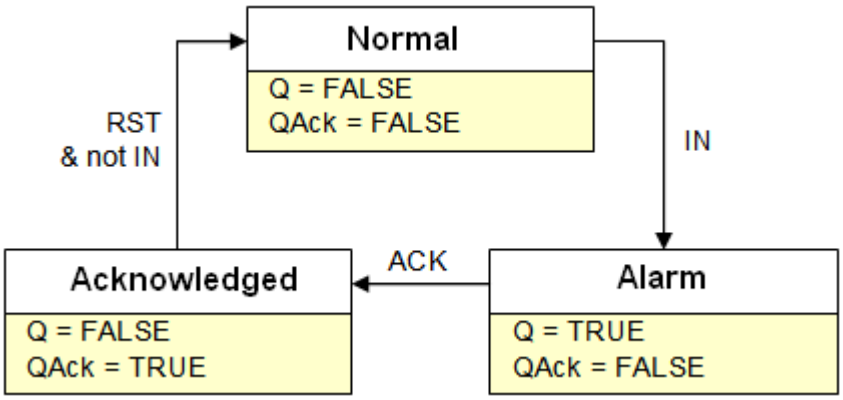
INPUTS

IN : BOOL Process signal.
ACK : BOOL Acknowledge command.
RST : BOOL Reset command.

OUTPUTS

Q : BOOL *TRUE* if alarm is active.
QACK : BOOL *TRUE* if alarm is acknowledged.

SEQUENCE



REMARKS

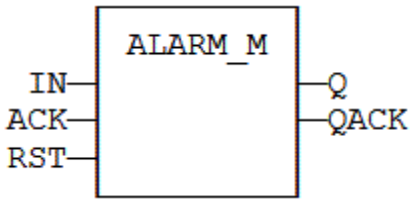
Combine this block with the LIM_ALRM block for managing analog alarms.

ST LANGUAGE

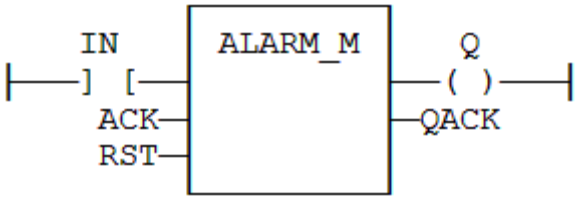
MyALARM is declared as an instance of ALARM_M function block.

```
MyALARM (IN, ACK, RST);
Q := MyALARM.Q;
QACK := MyALARM.QACK;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyALARM is declared as an instance of ALARM_M function block.

```
Op1:  CAL   MyALARM (IN, ACK, RST)
      LD    MyALARM.Q
      ST    Q
      LD    MyALARM.QACK
      ST    QACK
```

SEE ALSO

ALARM_A LIM_ALRM

AND ANDN &

OPERATOR - PERFORMS A LOGICAL AND OF ALL INPUTS.

INPUTS

IN1 : BOOL First boolean input.
IN2 : BOOL Second boolean input.

OUTPUTS

Q : BOOL Boolean AND of all inputs.

TRUTH TABLE

IN1	IN2	Q
0	0	0
0	1	0
1	0	0
1	1	1

REMARKS

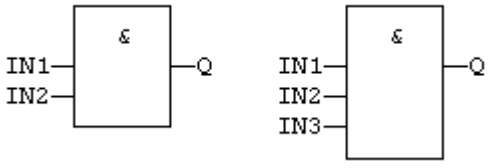
In FBD language, the block may have up to 16 inputs. The block is called "&" in FBD language. In LD language, an AND operation is represented by serialized contacts. In IL language, the AND instruction performs a logical AND between the current result and the operand. The current result must be boolean. The ANDN instruction performs an AND between the current result and the boolean negation of the operand. In ST and IL languages, "&" can be used instead of "AND".

ST LANGUAGE

```
Q := IN1 AND IN2;
Q := IN1 & IN2 & IN3;
```

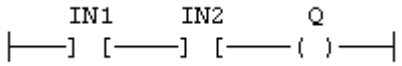
FBD LANGUAGE

The block may have up to 16 inputs:



LD LANGUAGE

Serialized contacts:



IL LANGUAGE

```
Op1:  LD    IN1
      &     IN2    (* "&" or "AND" can be used *)
      ST    Q      (* Q is equal to: IN1 AND IN2 *)
Op2:  LD    IN1
      AND   IN2
      &N    IN3    (* "&N" or "ANDN" can be used *)
      ST    Q      (* Q is equal to: IN1 AND IN2 AND (NOT IN3) *)
```

SEE ALSO

OR XOR NOT

AND_MASK

FUNCTION - PERFORMS A BIT TO BIT AND BETWEEN TWO INTEGER VALUES

INPUTS

IN : ANY First input.
MSK : ANY Second input (AND mask).

OUTPUTS

Q : ANY AND mask between IN and MSK inputs.

REMARKS

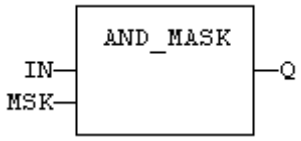
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the first parameter (IN) must be loaded in the current result before calling the function. The other input is the operands of the function.

ST LANGUAGE

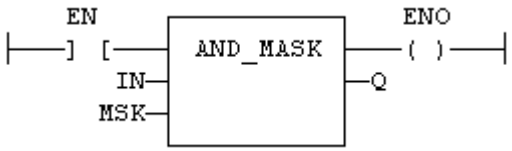
Q := AND_MASK (IN, MSK);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD          IN
      AND_MASK    MSK
      ST          Q
```

SEE ALSO

OR_MASK XOR_MASK NOT_MASK

ANY_TO_BOOL

OPERATOR - CONVERTS THE INPUT INTO BOOLEAN VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : BOOL Value converted to boolean.

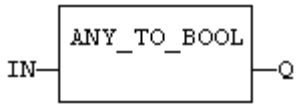
REMARKS

For DINT, REAL and TIME input data types, the result is *FALSE* if the input is 0. The result is *TRUE* in all other cases. For STRING inputs, the output is *TRUE* if the input string is not empty, and *FALSE* if the string is empty. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung is the result of the conversion. In IL Language, the ANY_TO_BOOL function converts the current result.

ST LANGUAGE

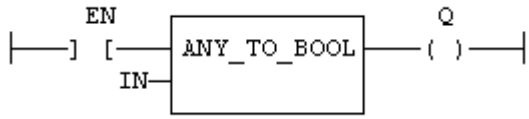
```
Q := ANY_TO_BOOL (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
The output rung is the result of the conversion.
The output rung is *FALSE* if the EN is *FALSE*.



IL LANGUAGE

```
Op1:    LD      IN
        ANY_TO_BOOL
        ST      Q
```

SEE ALSO

ANY_TO_SINT ANY_TO_INT ANY_TO_DINT ANY_TO_LINT
ANY_TO_REAL ANY_TO_LREAL ANY_TO_TIME
ANY_TO_STRING

ANY_TO_DINT / ANY_TO_UINT

OPERATOR - CONVERTS THE INPUT INTO INTEGER VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : DINT Value converted to integer.

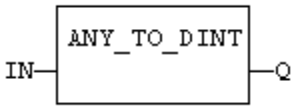
REMARKS

For BOOL input data types, the output is 0 or 1. For REAL input data type, the output is the integer part of the input real. For TIME input data types, the result is the number of milliseconds. For STRING inputs, the output is the number represented by the string, or 0 if the string does not represent a valid number. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_DINT function converts the current result.

ST LANGUAGE

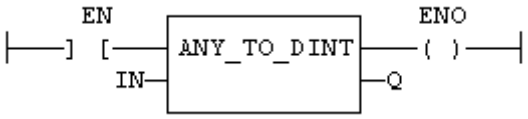
```
Q := ANY_TO_DINT (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL Language

```
Op1:  LD    IN
      ANY_TO_DINT
      ST    Q
```

SEE ALSO

ANY_TO_BOOL	ANY_TO_SINT	ANY_TO_INT	ANY_TO_LINT
ANY_TO_REAL	ANY_TO_LREAL	ANY_TO_TIME	ANY_TO_STRING

ANY_TO_INT / ANY_TO UINT

OPERATOR - CONVERTS THE INPUT INTO 16 BIT INTEGER VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : INT Value converted to 16 bit integer.

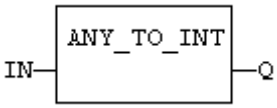
REMARKS

For BOOL input data types, the output is 0 or 1. For REAL input data type, the output is the integer part of the input real. For TIME input data types, the result is the number of milliseconds. For STRING inputs, the output is the number represented by the string, or 0 if the string does not represent a valid number. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_INT function converts the current result.

ST LANGUAGE

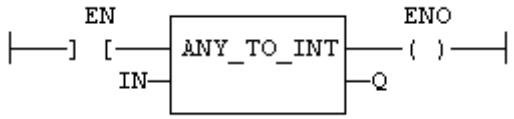
```
Q := ANY_TO_INT (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        ANY_TO_INT
        ST      Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_SINT ANY_TO_DINT ANY_TO_LINT ANY_TO_REAL ANY_TO_LREAL ANY_TO_TIME ANY_TO_STRING

ANY_TO_LINT

OPERATOR - CONVERTS THE INPUT INTO LONG (64 BIT) INTEGER VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : LINT Value converted to long (64 bit) integer.

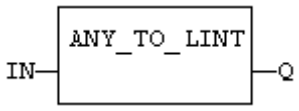
REMARKS

For BOOL input data types, the output is 0 or 1. For REAL input data type, the output is the integer part of the input real. For TIME input data types, the result is the number of milliseconds. For STRING inputs, the output is the number represented by the string, or 0 if the string does not represent a valid number. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_LINT function converts the current result.

ST LANGUAGE

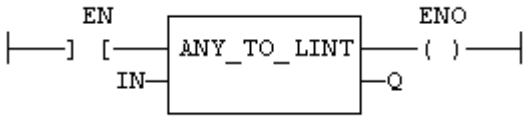
```
Q := ANY_TO_LINT (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        ANY_TO_LINT
        ST      Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_SINT ANY_TO_INT ANY_TO_DINT ANY_TO_REAL ANY_TO_LREAL ANY_TO_TIME ANY_TO_STRING

ANY_TO_LREAL

OPERATOR - CONVERTS THE INPUT INTO DOUBLE PRECISION REAL VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : LREAL Value converted to double precision real.

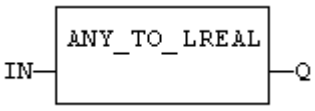
REMARKS

For BOOL input data types, the output is 0.0 or 1.0. For DINT input data type, the output is the same number. For TIME input data types, the result is the number of milliseconds. For STRING inputs, the output is the number represented by the string, or 0.0 if the string does not represent a valid number. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_LREAL function converts the current result.

ST LANGUAGE

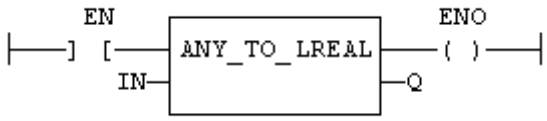
```
Q := ANY_TO_LREAL (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        ANY_TO_LREAL
        ST      Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_SINT ANY_TO_INT ANY_TO_DINT ANY_TO_LINT ANY_TO_REAL ANY_TO_TIME ANY_TO_STRING

ANY_TO_REAL

OPERATOR - CONVERTS THE INPUT INTO REAL VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : REAL Value converted to real.

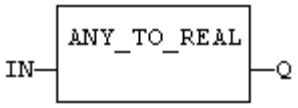
REMARKS

For BOOL input data types, the output is 0.0 or 1.0. For DINT input data type, the output is the same number. For TIME input data types, the result is the number of milliseconds. For STRING inputs, the output is the number represented by the string, or 0.0 if the string does not represent a valid number. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_REAL function converts the current result.

ST LANGUAGE

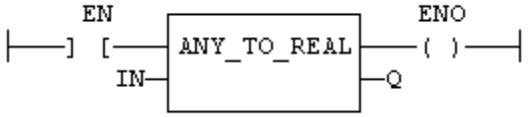
Q := ANY_TO_REAL (IN);

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD          IN
      ANY_TO_REAL
      ST          Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_SINT ANY_TO_INT ANY_TO_DINT ANY_TO_LINT ANY_TO_LREAL ANY_TO_TIME ANY_TO_STRING

ANY_TO_SINT

OPERATOR - CONVERTS THE INPUT INTO A SMALL (8 BIT) INTEGER VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : SINT Value converted to a small (8 bit) integer.

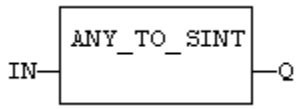
REMARKS

For BOOL input data types, the output is 0 or 1. For REAL input data type, the output is the integer part of the input real. For TIME input data types, the result is the number of milliseconds. For STRING inputs, the output is the number represented by the string, or 0 if the string does not represent a valid number. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_SINT function converts the current result.

ST LANGUAGE

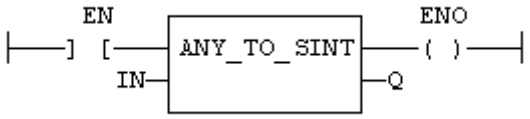
```
Q := ANY_TO_SINT (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        ANY_TO_SINT
        ST      Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_INT ANY_TO_DINT ANY_TO_LINT ANY_TO_REAL ANY_TO_LREAL ANY_TO_TIME ANY_TO_STRING

ANY_TO_STRING

OPERATOR - CONVERTS THE INPUT INTO STRING VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : STRING Value converted to string.

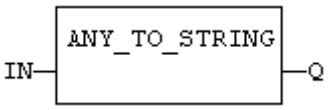
REMARKS

For BOOL input data types, the output is 1 or 0 for *TRUE* and *FALSE* respectively. For DINT, REAL or TIME input data types, the output is the string representation of the input number. This is a number of milliseconds for TIME inputs. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL language, the ANY_TO_STRING function converts the current result.

ST LANGUAGE

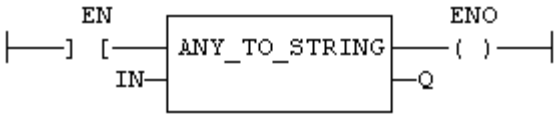
```
Q := ANY_TO_STRING (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      ANY_TO_STRING
      ST    Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_SINT ANY_TO_INT ANY_TO_DINT ANY_TO_LINT ANY_TO_REAL ANY_TO_LREAL ANY_TO_TIME

ANY_TO_TIME

OPERATOR - CONVERTS THE INPUT INTO TIME VALUE.

INPUTS

IN : ANY Input value.

OUTPUTS

Q : TIME Value converted to time.

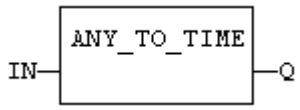
REMARKS

For BOOL input data types, the output is t#0ms or t#1ms. For DINT or REAL input data type, the output is the time represented by the input number as a number of milliseconds. For STRING inputs, the output is the time represented by the string, or t#0ms if the string does not represent a valid time. In LD language, the conversion is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL Language, the ANY_TO_TIME function converts the current result.

ST LANGUAGE

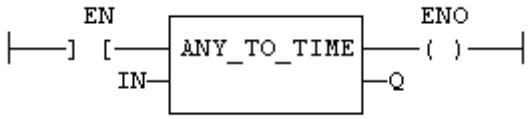
```
Q := ANY_TO_TIME (IN);
```

FBD LANGUAGE



LD LANGUAGE

The conversion is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        ANY_TO_TIME
        ST      Q
```

SEE ALSO

ANY_TO_BOOL ANY_TO_SINT ANY_TO_INT ANY_TO_DINT ANY_TO_LINT
ANY_TO_REAL ANY_TO_LREAL ANY_TO_STRING

ARRAYTOSTRING / ARRAYTOSTRINGU

FUNCTION - COPY AN ARRAY OF SINT TO A STRING.

INPUTS

SRC : SINT Source array of SINT small integers (USINT for ArrayToStringU).
DST : STRING Destination STRING.
COUNT : DINT Numbers of characters to be copied.

OUTPUTS

Q : DINT Number of characters copied.

REMARKS

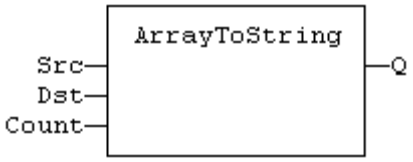
In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung.

This function copies the COUNT first elements of the SRC array to the characters of the DST string. The function checks the maximum size of the destination string and adjust the COUNT number if necessary.

ST LANGUAGE

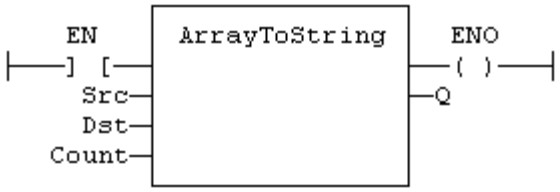
Q := ArrayToString (SRC, DST, COUNT);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

Not available.

SEE ALSO

StringToArray

ASCII

FUNCTION - GET THE ASCII CODE OF A CHARACTER WITHIN A STRING.

INPUTS

IN : STRING Input string
POS : DINT Position of the character within the string. (The first valid position is 1).

OUTPUTS

CODE : DINT ASCII code of the selected character, or 0 if position is invalid.

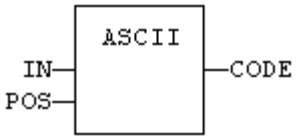
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the first parameter (IN) must be loaded in the current result before calling the function. The other input is the operand of the function.

ST LANGUAGE

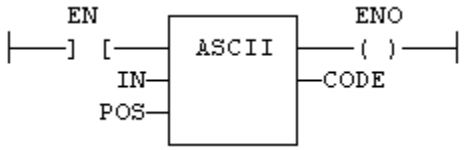
```
CODE := ASCII (IN, POS);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:    LD          IN
        AND_MASK    MSK
        ST          CODE
```

SEE ALSO

CHAR

ASIN / ASINL

FUNCTION - CALCULATE AN ARC-SINE.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: arc-sine of IN.

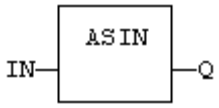
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

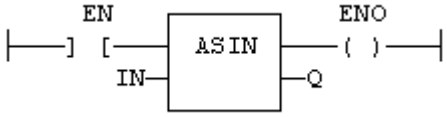
Q := ASIN (IN);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      ASIN
      ST    Q  (* Q is: ASIN (IN) *)
```

SEE ALSO

SIN COS TAN ACOS ATAN ATAN2

ATAN / ATANL

FUNCTION - CALCULATE AN ARC-TANGENT.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: arc-tangent of IN.

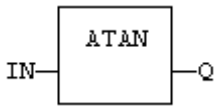
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

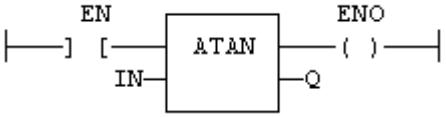
```
Q := ATAN (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      ATAN
      ST    Q  (* Q is: ATAN (IN) *)
```

SEE ALSO

SIN COS TAN ASIN ACOS ATAN2

ATOH

FUNCTION - CONVERTS STRING TO INTEGER USING HEXADECIMAL BASIS.

INPUTS

IN : STRING String representing an integer in hexadecimal format.

OUTPUTS

Q : DINT Integer represented by the string.

TRUTH TABLE (EXAMPLES)

IN	Q
“	0
‘12’	18
‘a0’	160
A0zzz’	160

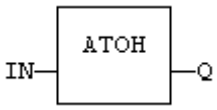
REMARKS

The function is case insensitive. The result is 0 for an empty string. The conversion stops before the first invalid character. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

Q := ATOH (IN);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.

IL LANGUAGE

```
Op1:  LD    IN
      ATOH
      ST    Q
```

SEE ALSO

HTOA

BCD_TO_BIN

FUNCTION - CONVERTS A BCD (BINARY CODED DECIMAL) VALUE TO A BINARY VALUE.

INPUTS

IN : DINT Integer value in BCD.

OUTPUTS

Q : DINT Value converted to integer, or 0 if IN is not a valid positive BCD value.

TRUTH TABLE (EXAMPLES)

IN	Q
-2	0 (invalid)
0	0
16 (16#10)	10
15 (16#0F)	0 (invalid)

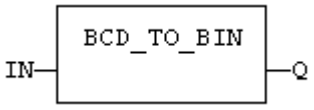
REMARKS

The input must be positive and must represent a valid BCD value. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

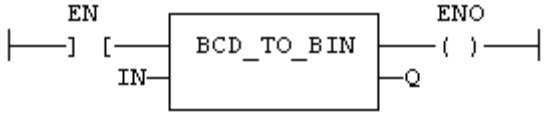
```
Q := BCD_TO_BIN (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      BCD_TO_BIN
      ST    Q
```

SEE ALSO

BIN_TO_BCD

BIN_TO_BCD

FUNCTION - CONVERTS A BINARY VALUE TO A BCD (BINARY CODED DECIMAL) VALUE.

INPUTS

IN : DINT Integer value

OUTPUTS

Q : DINT Value converted to BCD, or 0 if IN is less than 0.

TRUTH TABLE (EXAMPLES)

IN	Q
-2	0 (invalid)
0	0
10	16 (16#10)
22	34 (16#34)

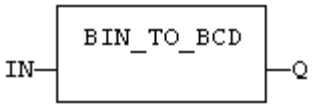
REMARKS

The input must be positive. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

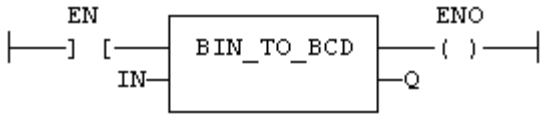
```
Q := BIN_TO_BCD (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      BIN_TO_BCD
      ST    Q
```

See Also

BCD_TO_BIN

BLINK

FUNCTION BLOCK - BLINKER.

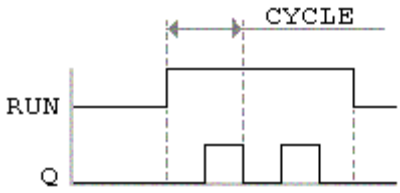
INPUTS

RUN : BOOL Enabling command.
CYCLE : TIME Blinking period.

OUTPUTS

Q : BOOL Output blinking signal.

TIME DIAGRAM



REMARKS

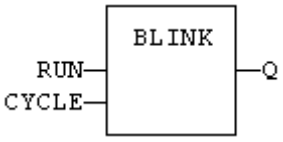
The output signal is *FALSE* when the RUN input is *FALSE*. The CYCLE input is the complete period of the blinking signal. In LD language, the input rung is the IN command. The output rung is the Q output signal.

ST LANGUAGE

MyBlinker is a declared instance of BLINK function block.

```
MyBlinker (RUN, CYCLE);
Q := MyBlinker.Q;
```

FBD LANGUAGE



LD LANGUAGE

IL LANGUAGE

MyBlinker is a declared instance of BLINK function block.

```
Op1:  CAL   MyBlinker (RUN, CYCLE)
      LD    MyBlinker.Q
      ST    Q
```

SEE ALSO

TON TOF TP

BLINKA

FUNCTION BLOCK - ASYMETRIC BLINKER.

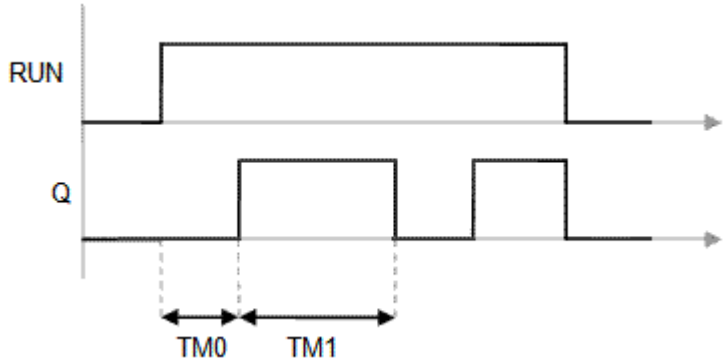
INPUTS

RUN : BOOL Enabling command.
TM0 : TIME Duration of *FALSE* state on output.
TM1 : TIME Duration of *TRUE* state on output.

OUTPUTS

Q : BOOL Output blinking signal.

TIME DIAGRAM



REMARKS

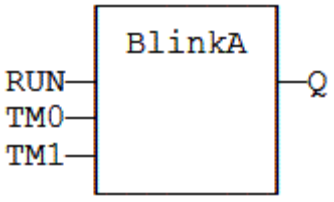
The output signal is *FALSE* when the RUN input is *FALSE*. In LD language, the input rung is the IN command. The output rung is the Q output signal.

ST LANGUAGE

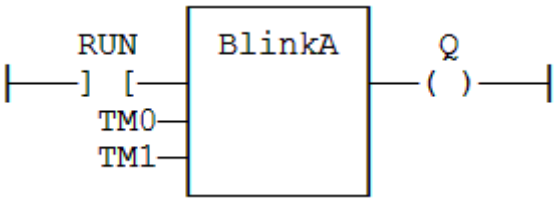
MyBlinker is a declared instance of BLINKA function block.

```
MyBlinker (RUN, TM0, TM1);
Q := MyBlinker.Q;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyBlinker is a declared instance of BLINKA function block.

```
Op1:  CAL   MyBlinker (RUN, TM0, TM1)
      LD    MyBlinker.Q
      ST    Q
```

SEE ALSO

TON TOF TP

CHAR

FUNCTION - BUILDS A SINGLE CHARACTER STRING.

INPUTS

CODE : DINT ASCII code of the wished character.

OUTPUTS

Q : STRING STRING containing only the specified character.

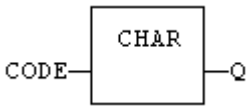
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the input parameter (CODE) must be loaded in the current result before calling the function.

ST LANGUAGE

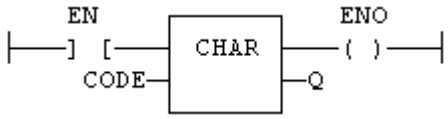
Q := CHAR (CODE);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD    CODE
      CHAR
      ST    Q
```

SEE ALSO

ASCII

CMP

FUNCTION BLOCK - COMPARISON WITH DETAILED OUTPUTS FOR INTEGER INPUTS.

INPUTS

IN1 : DINT First value.
IN2 : DINT Second value.

OUTPUTS

LT : BOOL *TRUE* if IN1 < IN2.
EQ : BOOL *TRUE* if IN1 = IN2.
GT : BOOL *TRUE* if IN1 > IN2.

REMARKS

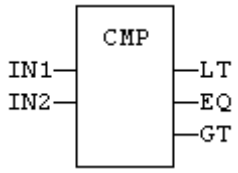
In LD language, the rung input (EN) validates the operation. The rung output is the result of LT (lower than comparison).

ST LANGUAGE

MyCmp is declared as an instance of CMP function block:

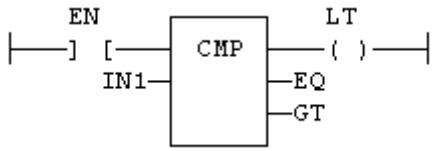
```
MyCMP (IN1, IN2);
bLT := MyCmp.LT;
bEQ := MyCmp.EQ;
bGT := MyCmp.GT;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is performed only if EN is *TRUE*:



IL LANGUAGE

MyCmp is declared as an instance of CMP function block:

```
Op1:    CAL     MyCmp (IN1, IN2)
        LD      MyCmp.LT
        ST      bLT
        LD      MyCmp.EQ
        ST      bEQ
        LD      MyCmp.GT
        ST      bGT
```

SEE ALSO

>= GE > GT = EQ <> NE <= LE < LT

CONCAT

FUNCTION - CONCATENATE STRINGS.

INPUTS

IN_1 : STRING Any string variable or constant expression.

IN_N : STRING Any string variable or constant expression.

OUTPUTS

Q : STRING Concatenation of all inputs.

REMARKS

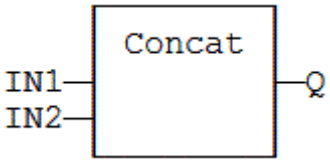
In FBD or LD language, the block may have up to 16 inputs. In IL or ST, the function accepts a variable number of inputs (at least 2).

Note that you also can use the "+" operator to concatenate strings.

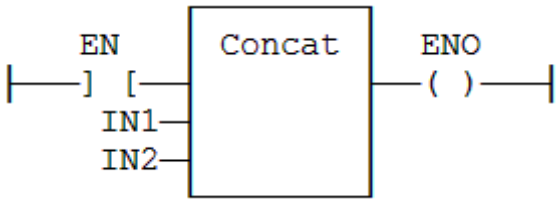
ST LANGUAGE

```
Q := CONCAT ('AB', 'CD', 'E');    (* now Q is 'ABCDE' *)
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

```
Op1:    LD          'AB'
        CONCAT      'CD'    'E'
        ST          Q  (* Q is now 'ABCDE' *)
```

COS / COSL

FUNCTION - CALCULATE A COSINE.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: cosine of IN.

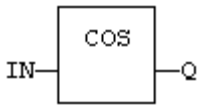
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

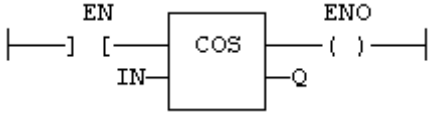
```
Q := COS (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      COS
      ST    Q       (* Q is: COS (IN) *)
```

SEE ALSO

SIN TAN ASIN ACOS ATAN ATAN2

CRC16

FUNCTION - CALCULATES A CRC16 ON THE CHARACTERS OF A STRING.

INPUTS

IN : STRING character string.

OUTPUTS

Q : INT CRC16 calculated on all the characters of the string.

REMARKS

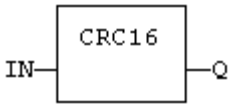
In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the input parameter (IN) must be loaded in the current result before calling the function.

The function calculates a MODBUS CRC16, initialized at 16#FFFF value.

ST LANGUAGE

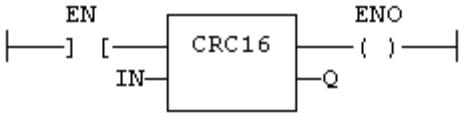
```
Q := CRC16 (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD    IN
      CRC16
      ST    Q
```

CTD / CTDR

FUNCTION BLOCK - DOWN COUNTER.

INPUTS

CD : BOOL Enable counting. Counter is decreased on each call when CD is *TRUE*.
LOAD : BOOL Re-load command. Counter is set to PV when called with LOAD to *TRUE*.
PV : DINT Programmed maximum value.

OUTPUTS

Q : BOOL *TRUE* when counter is empty, i.e. when CV = 0.
CV : DINT Current value of the counter.

REMARKS

The counter is empty (CV = 0) when the application starts. The counter does not include a pulse detection for CD input. Use R_TRIG or F_TRIG function block for counting pulses of CD input signal. In LD language, CD is the input rung. The output rung is the Q output.

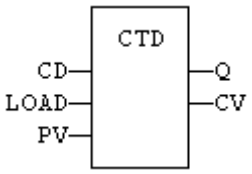
CTUr, CTDr, CTUDr function blocks operate exactly as other counters, except that all boolean inputs (CU, CD, RESET, LOAD) have an implicit rising edge detection included. Not that these counters may be not supported on some target systems.

ST LANGUAGE

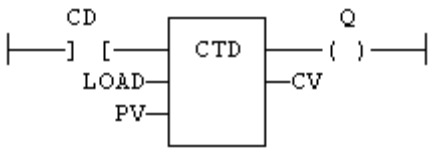
MyCounter is a declared instance of CTD function block.

```
MyCounter (CD, LOAD, PV);
Q := MyCounter.Q;
CV := MyCounter.CV;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyCounter is a declared instance of CTD function block.

```
Op1:  CAL   MyCounter (CD, LOAD, PV)
      LD    MyCounter.Q
      ST    Q
      LD    MyCounter.CV
      ST    CV
```

SEE ALSO

CTU CTUD

CTU / CTUR

FUNCTION BLOCK - UP COUNTER.

INPUTS

CU : BOOL Enable counting. Counter is increased on each call when CU is *TRUE*.
RESET : BOOL Reset command. Counter is reset to 0 when called with RESET to *TRUE*.
PV : DINT Programmed maximum value.

OUTPUTS

Q : BOOL *TRUE* when counter is full, i.e. when CV = PV.
CV : DINT Current value of the counter.

REMARKS

The counter is empty (CV = 0) when the application starts. The counter does not include a pulse detection for CU input. Use R_TRIG or F_TRIG function block for counting pulses of CU input signal. In LD language, CU is the input rung. The output rung is the Q output.

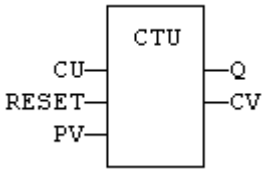
CTUr, CTDr, CTUDr function blocks operate exactly as other counters, except that all boolean inputs (CU, CD, RESET, LOAD) have an implicit rising edge detection included. Not that these counters may be not supported on some target systems.

ST LANGUAGE

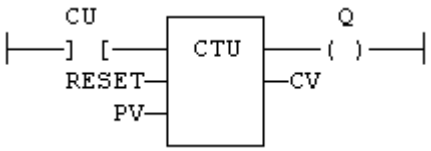
MyCounter is a declared instance of CTU function block.

```
MyCounter (CU, RESET, PV);
Q := MyCounter.Q;
CV := MyCounter.CV;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyCounter is a declared instance of CTU function block.

```
Op1:  CAL   MyCounter (CU, RESET, PV)
      LD    MyCounter.Q
      ST    Q
      LD    MyCounter.CV
      ST    CV
```

SEE ALSO

CTD CTUD

CTUD / CTUDR

FUNCTION BLOCK - UP/DOWN COUNTER.

INPUTS

CU : BOOL Enable counting. Counter is increased on each call when CU is *TRUE*.
CD : BOOL Enable counting. Counter is decreased on each call when CD is *TRUE*.
RESET : BOOL Reset command. Counter is reset to 0 called with RESET to *TRUE*.
LOAD : BOOL Re-load command. Counter is set to PV when called with LOAD to *TRUE*.
PV : DINT Programmed maximum value.

OUTPUTS

QU : BOOL *TRUE* when counter is full, i.e. when CV = PV.
QD : BOOL *TRUE* when counter is empty, i.e. when CV = 0.
CV : DINT Current value of the counter.

REMARKS

The counter is empty (CV = 0) when the application starts. The counter does not include a pulse detection for CU and CD inputs. Use R_TRIG or F_TRIG function blocks for counting pulses of CU or CD input signals. In LD language, CU is the input rung. The output rung is the QU output.

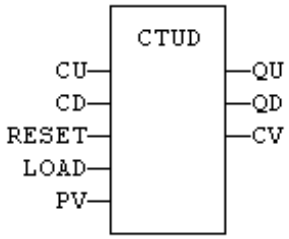
CTUr, CTDr, CTUDr function blocks operate exactly as other counters, except that all boolean inputs (CU, CD, RESET, LOAD) have an implicit rising edge detection included. Not that these counters may be not supported on some target systems.

ST LANGUAGE

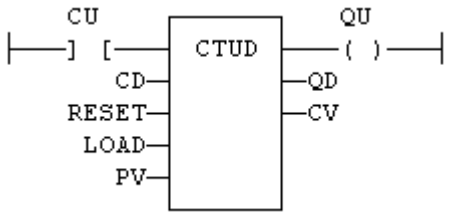
MyCounter is a declared instance of CTUD function block.

```
MyCounter (CU, CD, RESET, LOAD, PV);
QU := MyCounter.QU;
QD := MyCounter.QD;
CV := MyCounter.CV;
```

FBD LANGUAGE



LD LANGUEAGE



IL LANGUAGE

MyCounter is a declared instance of CTUD function block.

```
Op1:  CAL   MyCounter (CU, CD, RESET, LOAD, PV)
      LD    MyCounter.QU
      ST    QU
      LD    MyCounter.QD
      ST    QD
      LD    MyCounter.CV
      ST    CV
```

SEE ALSO

CTU CTD

DELETE

FUNCTION - DELETE CHARACTERS IN A STRING.

INPUTS

IN : STRING Character string.
NBC : DINT Number of characters to be deleted.
POS : DINT Position of the first deleted character (first character position is 1).

OUTPUTS

Q : STRING Modified string.

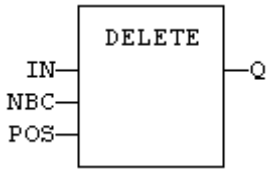
REMARKS

The first valid character position is 1. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. Other arguments are operands of the function, separated by comas.

ST LANGUAGE

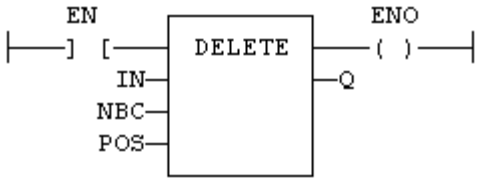
Q := DELETE (IN, NBC, POS);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL Language

```
Op1:  LD       IN
      DELETE   NBC,  POS
      ST       Q
```

SEE ALSO

+ ADD MLEN INSERT FIND REPLACE LEFT RIGHT MID

/ DIV

OPERATOR - PERFORMS A DIVISION OF INPUTS.

INPUTS

IN1 : ANY_NUM First input.
IN2 : ANY_NUM Second input.

OUTPUTS

Q : ANY_NUM Result: IN1 / IN2.

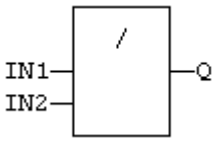
REMARKS

All inputs and the output must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the DIV instruction performs a division between the current result and the operand. The current result and the operand must have the same type.

ST LANGUAGE

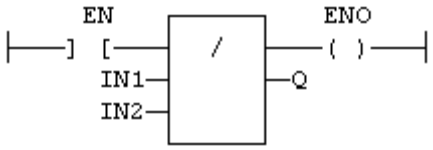
Q := IN1 / IN2;

FBD LANGUAGE



LD LANGUAGE

The division is executed only if EN is *TRUE*.
ENO is equal to EN.



IL Language

```
Op1:  LD    IN1
      DIV   IN2
      ST    Q       (* Q is equal to: IN1 / IN2 *)

Op2:  LD    IN1
      DIV   IN2
      DIV   IN3
      ST    Q       (* Q is equal to: IN1 / IN2 / IN3 *)
```

SEE ALSO

+ ADD NEG - * MUL

DTAT

FUNCTION BLOCK - GENERATE A PULSE AT GIVEN DATE AND TIME

INPUTS

YEAR :	DINT	Wished year (e.g. 2006).
MONTH :	DINT	Wished month (1 = January).
DAY :	DINT	Wished day (1 to 31).
TMOFDAY :	TIME	Wished time.
RST :	BOOL	Reset command.

OUTPUTS

QAT : BOOL Pulse signal.
QPAST : BOOL TRUE if elapsed.

ATTENTION

Real Time clock may be not available on some targets. Please refer to OEM instructions for further details about available features.

REMARKS

Parameters are not updated constantly. They are taken into account when only:

- the first time the block is called.
- when the reset input (RST) is *TRUE*.

In these two situations, the outputs are reset to *FALSE*.

The first time the block is called with RST=*FALSE* and the specified date/stamp is passed, the output QPAST is set to *TRUE*, and the output QAT is set to *TRUE* for one cycle only (pulse signal).

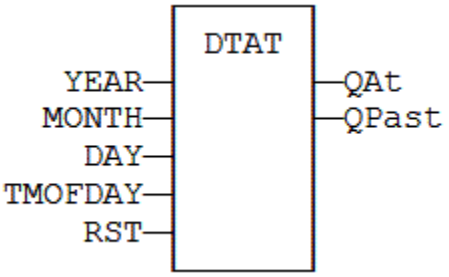
Highest units are ignored if set to 0. For instance, if arguments are year=0, month=0, day = 3, tmofday=t#10h then the block will trigger on the next 3rd day of the month at 10h.

In LD language, the block is activated only if the input rung is *TRUE*.

ST LANGUAGE

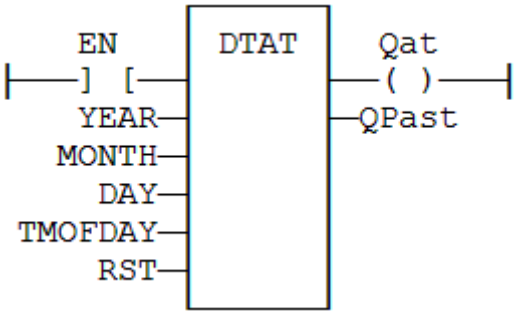
MyDTAT is a declared instance of DTAT function block.
MyDTAT (YEAR, MONTH, DAY, TMOFDAY, RST);
QAT := MyDTAT.QAT;
QPAST := MyDTATA.QPAST;

FBD LANGUAGE



LD LANGUAGE

Called only if EN is *TRUE*.



IL LANGUAGE

MyDTAT is a declared instance of DTAT function block.

```
Op1:    CAL     MyDTAT (YEAR, MONTH, DAY, TMOFDAY, RST)
        LD      MyDTAT.QAT
        ST      QAT
        LD      MyDTATA.QPAST
        ST      QPAST
```

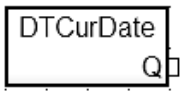
DTCURDATE

FUNCTION: GET CURRENT DATE STAMP

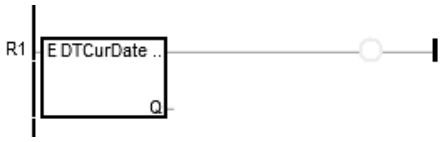
Q := DTCurDate ();

Q : DINT numerical stamp representing the current date.

FBD LANGUAGE



LD LANGUAGE



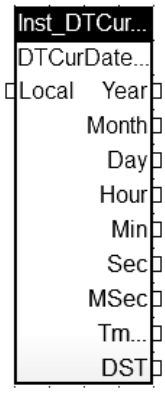
DTCURDATETIME

FUNCTION: GET CURRENT TIME STAMP (FUNCTION BLOCK)

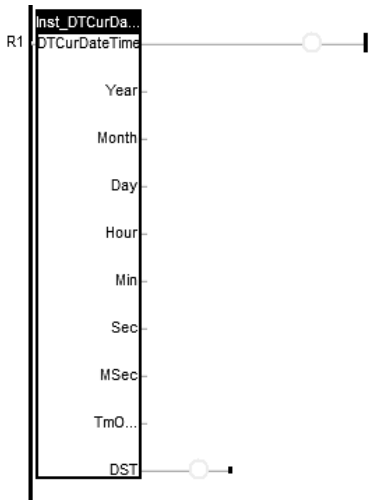
Inst_DTCurDateTime (bLocal);

bLocal :	BOOL	*TRUE* if local time is requested (GMT if *FALSE*).
.Year :	DINT	Output: current year
.Month :	DINT	Output: current month
.Day :	DINT	Output: current day
.Hour :	DINT	Output: current time: hours
.Min :	DINT	Output: current time: minutes
.Sec :	DINT	Output: current time: seconds
.MSec :	DINT	Output: current time: milliseconds
.TmOfDay :	TIME	Output: current time of day (since midnight)
.DST :	BOOL	Output: *TRUE* if Daylight Saving Time is active

FBD LANGUAGE



LD LANGUAGE


Inst_DTCurDa...
R1
DTCurDateTime
Year
Month
Day
Hour
Min
Sec
MSec
TmO...
DST

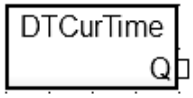
DTCURTIME

FUNCTION: GET CURRENT TIME STAMP

Q := DTCurTime ();

Q : DINT numerical stamp representing the current time of the day.

FBD LANGUAGE



LD LANGUAGE

DTDAY

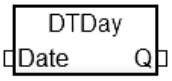
FUNCTION: EXTRACT THE DAY OF THE MONTH FROM A DATE STAMP

Q := DTDay (iDate);

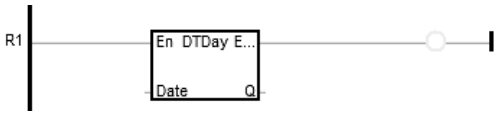
IDATE : DINT numerical stamp representing a date.

Q : DINT day of the month of the date (1..31).

FBD LANGUAGE



LD LANGUAGE



DTFORMAT

FUNCTION - FORMAT THE CURRENT DATE/TIME TO A STRING WITH A CUSTOM FORMAT

INPUTS

FMT : STRING Format string.

OUTPUTS

Q : STRING String containing formatted date or time.

ATTENTION

Real Time clock may be not available on some targets. Please refer to OEM instructions for further details about available features.

REMARKS

The format string may contain any character. Some special markers beginning with the '%' character indicates a date/time information:

%Y Year including century (e.g. 2006)
%y Year without century (e.g. 06)
%m Month (1..12)
%d Day of the month (1..31)
%H Hours (0..23)
%M Minutes (0..59)
%S Seconds (0..59)

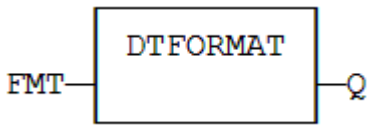
EXAMPLE

```
(* let's say we are at July 04th 2006, 18:45:20 *)
  Q := DTFORMAT ('Today is %Y/%m/%d - %H:%M:%S');
(* Q is 'Today is 2006/07/04 - 18:45:20 *)
```

ST LANGUAGE

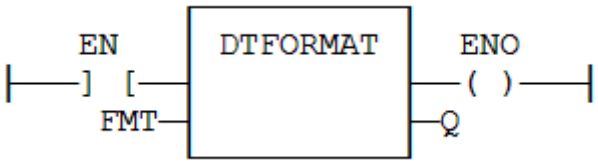
```
Q := DTFORMAT (FMT);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is TRUE.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD FMT
      DTFORMAT
      ST Q
```

DTHOUR

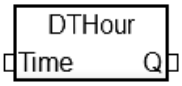
FUNCTION: EXTRACT THE HOURS FROM A TIME STAMP

Q := DTHour (iTime);

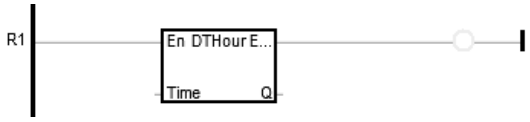
ITIME : DINT numerical stamp representing a time.

Q : DINT Hours of the time (0..23).

FBD LANGUAGE



LD LANGUAGE



DTMIN

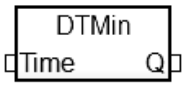
FUNCTION: EXTRACT THE MINUTES FROM A TIME STAMP

Q := DTMin (iTime);

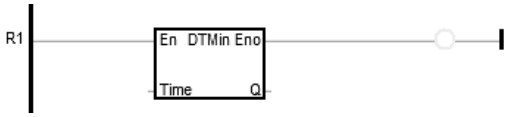
ITIME : DINT numerical stamp representing a time.

Q : DINT minutes of the time (0..59).

FBD LANGUAGE



LD LANGUAGE



DTMONTH

FUNCTION: EXTRACT THE MONTH FROM A DATE STAMP

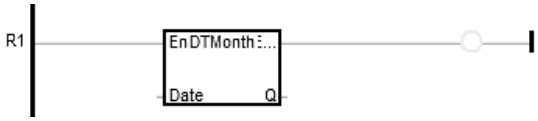
Q := DTMonth (iDate);

IDATE : DINT numerical stamp representing a date.

Q : DINT month of the date (1..12).

FBD LANGUAGE

LD LANGUAGE



DTMs

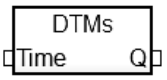
FUNCTION: EXTRACT THE MILLISECONDS FROM A TIME STAMP

Q := DTMs (iTime);

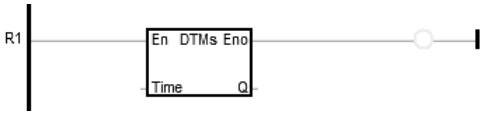
ITIME : DINT numerical stamp representing a time.

Q : DINT Milliseconds of the time (0..999).

FBD LANGUAGE



LD LANGUAGE



DTSEC

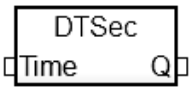
FUNCTION: EXTRACT THE SECONDS FROM A TIME STAMP

Q := DTSec (iTime);

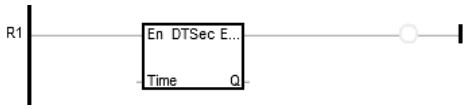
ITIME : DINT numerical stamp representing a time.

Q : DINT Seconds of the time (0..59).

FBD LANGUAGE



LD LANGUAGE



DTYEAR

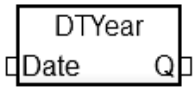
FUNCTION: EXTRACT THE YEAR FROM A DATE STAMP

Q := DTYear (iDate);

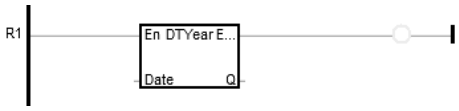
IDATE : DINT numerical stamp representing a date.

Q : DINT year of the date (ex: 2004).

FBD LANGUAGE



LD LANGUAGE



= EQ

OPERATOR - TEST IF FIRST INPUT IS EQUAL TO SECOND INPUT.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : BOOL *TRUE* if IN1 = IN2.

REMARKS

Both inputs must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung is the result of the comparison. In IL language, the EQ instruction performs the comparison between the current result and the operand. The current result and the operand must have the same type.

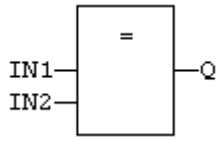
Comparisons can be used with strings. In that case, the lexical order is used for comparing the input strings. For instance, "ABC" is less than "ZX" ; "ABCD" is greater than "ABC".

Equality comparisons cannot be used with TIME variables. The reason why is that the timer actually has the resolution of the target cycle and test may be unsafe as some values may never be reached.

ST LANGUAGE

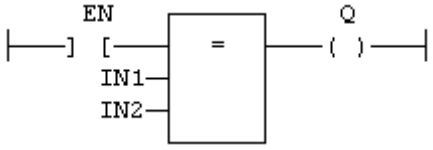
```
Q := IN1 = IN2;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*:



IL LANGUAGE

```
Op1:    LD      IN1
        EQ      IN2
        ST      Q  (* Q is true if IN1 = IN2 *)
```

See Also

> GT < LT >= GE <= LE <> NE CMP

EXP / EXPL

FUNCTION - CALCULATES THE NATURAL EXPONENTIAL OF THE INPUT.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: natural exponential of IN.

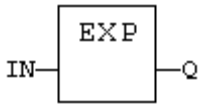
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

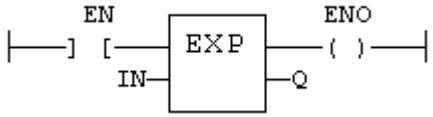
```
Q := EXP (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      EXP
      ST    Q  (* Q is: EXP (IN) *)
```

SEE ALSO

ABS TRUNC POW SQRT

EXPT

FUNCTION - CALCULATES A POWER.

INPUTS

IN : REAL Real value.
EXP : DINT Exponent.

OUTPUTS

Q : REAL Result: IN at the 'EXP' power.

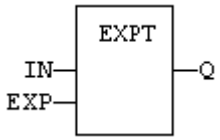
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function. The exponent (second input of the function) must be the operand of the function.

ST LANGUAGE

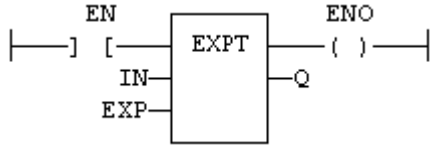
```
Q := EXPT (IN, EXP);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        EXPT    EXP
        ST      Q  (* Q is: (IN ** EXP) *)
```

See Also

ABS TRUNC LOG SQRT

F_TRIG

FUNCTION BLOCK - FALLING PULSE DETECTION.

INPUTS

CLK : BOOL Boolean signal.

OUTPUTS

Q : BOOL *TRUE* when the input changes from *TRUE* to *FALSE*.

TRUTH TABLE

CLK	CLK prev	Q
0	0	0
0	1	1
1	0	0
1	1	0

REMARKS

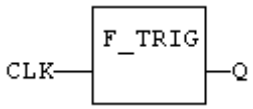
Although]P[an]N[contacts may be used in LD language, it is recommended to use declared instances of R_TRIG or F_TRIG function blocks in order to avoid unexpected behavior during an On Line change.

ST LANGUAGE

MyTrigger is declared as an instance of F_TRIG function block:

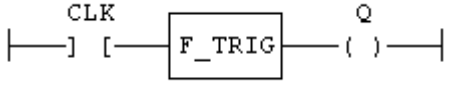
```
MyTrigger (CLK);
Q := MyTrigger.Q;
```

FBD LANGUAGE



LD LANGUAGE

The input signal is the rung - the rung is the output:



IL LANGUAGE

MyTrigger is declared as an instance of F_TRIG function block:

```
Op1:  CAL   MyTrigger (CLK)
      LD    MyTrigger.Q
      ST    Q
```

SEE ALSO

R_TRIG

FIFO

FUNCTION BLOCK - MANAGES A FIRST IN / FIRST OUT LIST.

INPUTS

PUSH : BOOL Push a new value (on rising edge).
POP : BOOL Pop a new value (on rising edge).
RST : BOOL Reset the list.
NEXTIN : ANY Value to be pushed.
NEXTOUT : ANY Value of the oldest pushed value - updated after call!
BUFFER : ANY Array for storing values.

OUTPUTS

EMPTY : BOOL *TRUE* if the list is empty.
OFLO : BOOL *TRUE* if overflow on a PUSH command.
COUNT : DINT Number of values in the list.
PREAD : DINT Index in the buffer of the oldest pushed value.
PWRITE : DINT Index in the buffer of the next push position.

REMARKS

NEXTIN, NEXTOUT and BUFFER must have the same data type and cannot be STRING.

The NEXTOUT argument specifies a variable that is filled with the oldest push value after the block is called.

Values are stored in the BUFFER array. Data is arranged as a roll over buffer and is never shifted or reset. Only read and write pointers and pushed values are updated. The maximum size of the list is the dimension of the array.

The first time the block is called, it remembers on which array it should work. If you call later the same instance with another BUFFER input, the call is considered as invalid and makes nothing. Outputs reports an empty list in this case.

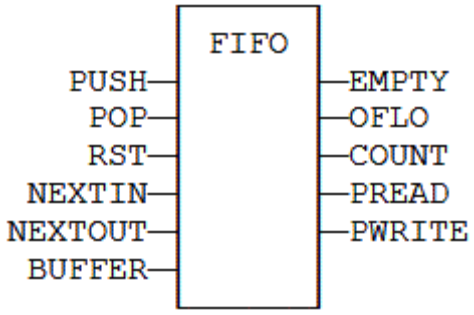
In LD language, input rung is the PUSH input. The output rung is the EMPTY output.

ST LANGUAGE

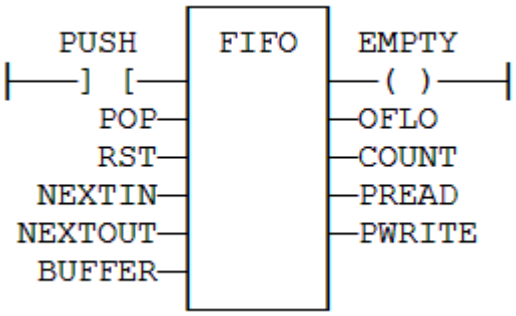
MyFIFO is a declared instance of FIFO function block.

```
SMyFIFO (PUSH, POP, RST, NEXTIN, NEXTOUT, BUFFER);
EMPTY := MyFIFO.EMPTY;
OFLO := MyFIFO.OFLO;
COUNT := MyFIFO.COUNT;
PREAD := MyFIFO.PREAD;
PWRITE := MyFIFO.PWRITE;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyFIFO is a declared instance of FIFO function block.

```
Op1:    CAL     MyFIFO (PUSH, POP, RST, NEXTIN, NEXTOUT, BUFFER)
        LD      MyFIFO.EMPTY
        ST      EMPTY
        LD      MyFIFO.OFLO
        ST      OFLO
        LD      MyFIFO.COUNT
        ST      COUNT
        LD      MyFIFO.PREAD
        ST      PREAD
        LD      MyFIFO.PWRITE
        ST      PWRITE
```

SEE ALSO

LIFO

FIND

FUNCTION - FIND POSITION OF CHARACTERS IN A STRING.

INPUTS

IN : STRING Character string.
STR : STRING String containing searched characters.

OUTPUTS

POS : DINT Position of the first character of STR in IN, or 0 if not found.

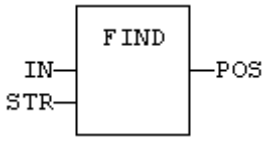
REMARKS

The first valid character position is 1. A return value of 0 means that the STR string has not been found. Search is case sensitive. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. The second argument is the operand of the function.

ST LANGUAGE

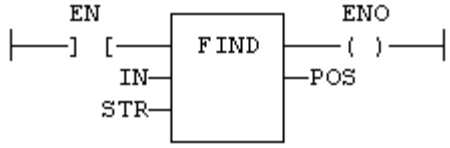
```
POS := FIND (IN, STR);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      FIND  STR
      ST    POS
```

See Also

+ADD MLEN DELETE INSERT REPLACE LEFT RIGHT MID

FLIPFLOP

FUNCTION BLOCK - FLIPFLOP BISTABLE.

INPUTS

IN : BOOL Swap command (on rising edge).
RST : BOOL Reset to *FALSE*.

OUTPUTS

Q : BOOL Output.

REMARKS

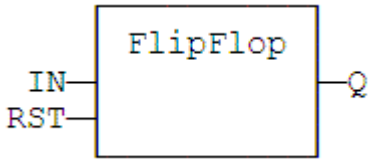
The output is systematically reset to *FALSE* if RST is *TRUE*. The output changes on each rising edge of the IN input, if RST is *FALSE*.

ST LANGUAGE

MyFlipFlop is declared as an instance of FLIPFLOP function block:

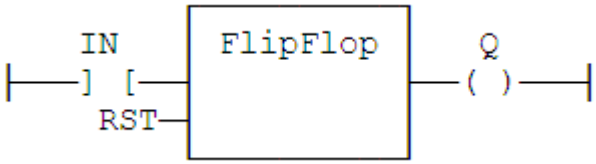
```
MyFlipFlop (IN, RST);

Q := MyFlipFlop.Q;
```

FBD LANGUAGE



LD LANGUAGE

The IN command is the rung - the rung is the output:



IL LANGUAGE

MyFlipFlop is declared as an instance of FLIPFLOP function block:

```
Op1:    CAL     MyFlipFlop (IN, RST)
        LD      MyFlipFlop.Q
        ST      Q1
```

SEE ALSO

R S SR

>= GE

OPERATOR - TEST IF FIRST INPUT IS GREATER THAN OR EQUAL TO SECOND INPUT.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : BOOL *TRUE* if IN1 >= IN2.

REMARKS

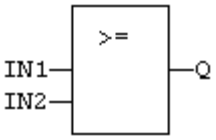
Both inputs must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung is the result of the comparison. In IL language, the GE instruction performs the comparison between the current result and the operand. The current result and the operand must have the same type.

Comparisons can be used with strings. In that case, the lexical order is used for comparing the input strings. For instance, "ABC" is less than "ZX" ; "ABCD" is greater than "ABC".

ST LANGUAGE

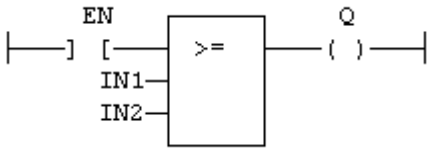
```
Q := IN1 >= IN2;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*.



IL LANGUAGE

```
Op1:    LD      IN1
        GE      IN2
        ST      Q  (* Q is true if IN1 >= IN2 *)
```

SEE ALSO

> GT < LT <= LE = EQ <> NE CMP

> GT

OPERATOR - TEST IF FIRST INPUT IS GREATER THAN SECOND INPUT.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : BOOL *TRUE* if IN1 > IN2.

REMARKS

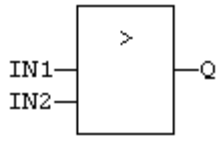
Both inputs must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung is the result of the comparison. In IL language, the GT instruction performs the comparison between the current result and the operand. The current result and the operand must have the same type.

Comparisons can be used with strings. In that case, the lexical order is used for comparing the input strings. For instance, "ABC" is less than "ZX" ; "ABCD" is greater than "ABC".

ST LANGUAGE

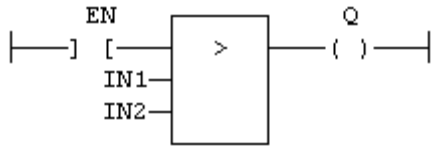
```
Q := IN1 > IN2;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*.



IL LANGUAGE

```
Op1:  LD    IN1
      GT    IN2
      ST    Q  (* Q is true if IN1 > IN2 *)
```

SEE ALSO

< LT >= GE <= LE = EQ <> NE CMP

HIBYTE

FUNCTION - GET THE MOST SIGNIFICANT BYTE OF A WORD

INPUTS

IN : UINT 16 bit register.

OUTPUTS

Q : USINT Most significant byte.

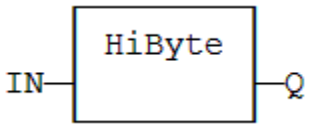
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

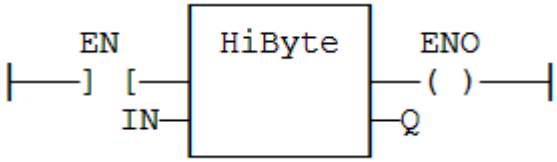
Q := HIBYTE (IN);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      HIBYTE
      ST    Q
```

SEE ALSO

LOBYTE LOWORD HIWORD MAKEWORD MAKEDWORD

HIWORD

FUNCTION - GET THE MOST SIGNIFICANT WORD OF A DOUBLE WORD.

INPUTS

IN : UDINT 32 bit register.

OUTPUTS

Q : UINT Most significant word.

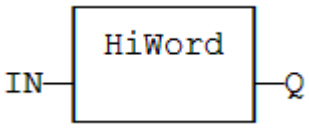
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

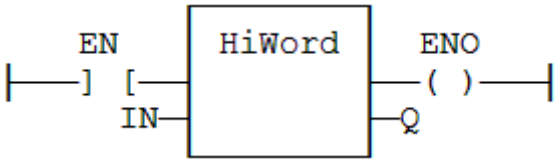
```
Q := HIWORD (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      HIWORD
      ST    Q
```

SEE ALSO

LOBYTE HIBYTE LOWORD MAKEWORD MAKEDWORD

HTOA

FUNCTION - CONVERTS INTEGER TO STRING USING HEXADECIMAL BASIS.

INPUTS

IN : DINT Integer value.

OUTPUTS

Q : STRING String representing the integer in hexadecimal format.

TRUTH TABLE (EXAMPLES)

IN	Q
0	'0'
18	'12'
160	'A0'

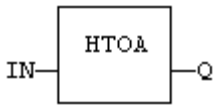
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

```
Q := HTOA (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.

IL LANGUAGE

```
Op1:  LD    IN
      HTOA
      ST    Q
```

SEE ALSO

ATOH

INSERT

FUNCTION - INSERT CHARACTERS IN A STRING.

INPUTS

IN : STRING Character string.
STR : STRING String containing characters to be inserted.
POS : DINT Position of the first inserted character (first character position is 1).

OUTPUTS

Q : STRING Modified string.

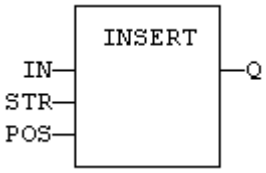
REMARKS

The first valid character position is 1. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. Other arguments are operands of the function, separated by comas.

ST LANGUAGE

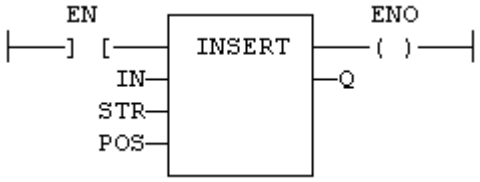
```
Q := INSERT (IN, STR, POS);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD      IN
      INSERT  STR, POS
      ST      Q
```

SEE ALSO

+ ADD MLEN DELETE FIND REPLACE LEFT RIGHT MID

LE

OPERATOR - TEST IF FIRST INPUT IS LESS THAN OR EQUAL TO SECOND INPUT.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : BOOL *TRUE* if IN1 <= IN2.

REMARKS

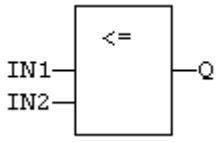
Both inputs must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung is the result of the comparison. In IL language, the LE instruction performs the comparison between the current result and the operand. The current result and the operand must have the same type.

Comparisons can be used with strings. In that case, the lexical order is used for comparing the input strings. For instance, "ABC" is less than "ZX" ; "ABCD" is greater than "ABC".

ST LANGUAGE

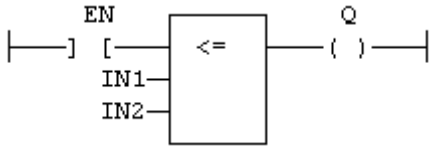
```
Q := IN1 <= IN2;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*:



IL LANGUAGE

```
Op1:    LD      IN1
        LE      IN2
        ST      Q  (* Q is true if IN1 <= IN2 *)
```

SEE ALSO

> GT < LT >= GE = EQ <> NE CMP

LEFT

FUNCTION - EXTRACT CHARACTERS OF A STRING ON THE LEFT.

INPUTS

IN : STRING Character string.
NBC : DINT Number of characters to extract.

OUTPUTS

Q : STRING String containing the first NBC characters of IN.

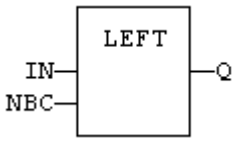
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. The second argument is the operand of the function.

ST LANGUAGE

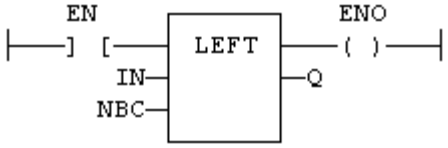
```
Q := LEFT (IN, NBC);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      LEFT  NBC
      ST    Q
```

See Also

+ ADD MLEN DELETE INSERT FIND REPLACE RIGHT MID

LEN

FUNCTION - GET THE NUMBER OF CHARACTERS IN A STRING.

INPUTS

IN : STRING Character string.

OUTPUTS

NBC : INT Number of characters currently in the string. 0 if string is empty.

REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

```
NBC := LEN (IN);
```

LIFO

FUNCTION BLOCK - MANAGES A LAST IN / FIRST OUT STACK.

INPUTS

PUSH : BOOL Push a new value (on rising edge).
POP : BOOL Pop a new value (on rising edge).
RST : BOOL Reset the list.
NEXTIN : ANY Value to be pushed.
NEXTOUT : ANY Value at the top of the stack - updated after call!
BUFFER : ANY Array for storing values.

OUTPUTS

EMPTY : BOOL *TRUE* if the stack is empty.
OFLO : BOOL *TRUE* if overflow on a PUSH command.
COUNT : DINT Number of values in the stack.
PREAD : DINT Index in the buffer of the top of the stack.
PWRITE : DINT Index in the buffer of the next push position.

REMARKS

NEXTIN, NEXTOUT and BUFFER must have the same data type and cannot be STRING.

The NEXTOUT argument specifies a variable that is filled with the value at the top of the stack after the block is called.

Values are stored in the BUFFER array. Data is never shifted or reset. Only read and write pointers and pushed values are updated. The maximum size of the stack is the dimension of the array.

The first time the block is called, it remembers on which array it should work. If you call later the same instance with another BUFFER input, the call is considered as invalid and makes nothing. Outputs reports an empty stack in this case.

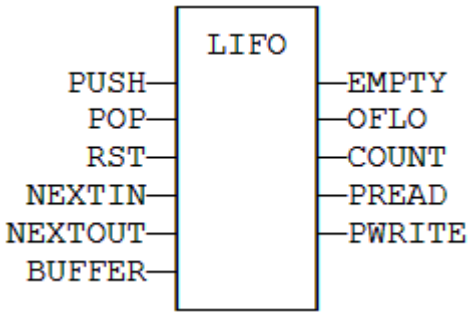
In LD language, input rung is the PUSH input. The output rung is the EMPTY output.

ST LANGUAGE

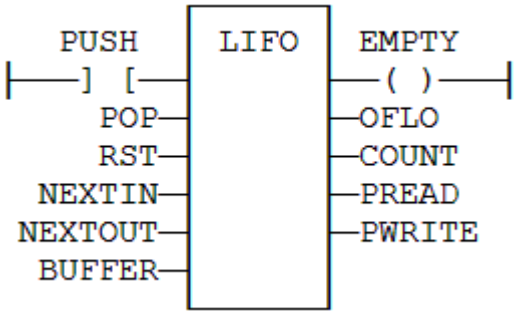
MyLIFO is a declared instance of LIFO function block.

```
MyLIFO (PUSH, POP, RST, NEXTIN, NEXTOUT, BUFFER);
EMPTY := MyLIFO.EMPTY;
OFLO := MyLIFO.OFLO;
COUNT := MyLIFO.COUNT;
PREAD := MyLIFO.PREAD;
PWRITE := MyLIFO.PWRITE;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyLIFO is a declared instance of LIFO function block.

```
Op1:  CAL   MyLIFO (PUSH, POP, RST, NEXTIN, NEXTOUT, BUFFER)
      LD    MyLIFO.EMPTY
      ST    EMPTY
      LD    MyLIFO.OFLO
      ST    OFLO
      LD    MyLIFO.COUNT
      ST    COUNT
      LD    MyLIFO.PREAD
      ST    PREAD
      LD    MyLIFO.PWRITE
      ST    PWRITE
```

SEE ALSO

FIFO

LIMIT

FUNCTION - BOUNDS AN INTEGER BETWEEN LOW AND HIGH LIMITS.

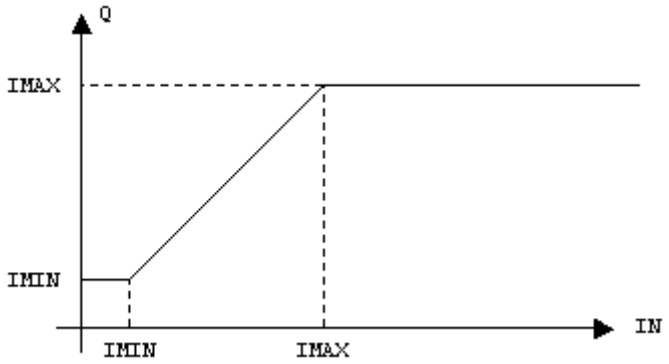
INPUTS

IMIN : DINT Low bound.
IN : DINT Input value.
IMAX : DINT High bound.

OUTPUTS

Q : DINT IMIN if IN < IMIN; IMAX if IN > IMAX; IN otherwise.

FUNCTION DIAGRAM



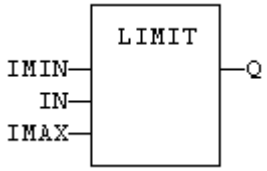
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. Other inputs are operands of the function, separated by a coma.

ST LANGUAGE

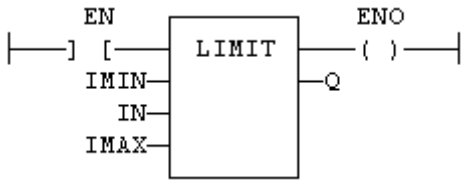
Q := LIMIT (IMIN, IN, IMAX);

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD      IMIN
      LIMIT   IN, IMAX
      ST      Q
```

SEE ALSO

MIN MAX MOD ODD

LN

FUNCTION - CALCULATES THE NATURAL LOGARITHM OF THE INPUT.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: natural logarithm of IN.

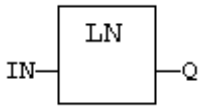
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

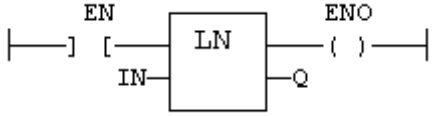
```
Q := LN (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      LN
      ST    Q  (* Q is: LN (IN) *)
```

SEE ALSO

ABS TRUNC POW SQRT

LOADSTRING

FUNCTION - LOAD A STRING FROM THE ACTIVE STRING TABLE.

INPUTS

ID : DINT ID of the string as declared in the string table.

OUTPUTS

Q : STRING Loaded string or empty string in case of error.

REMARKS

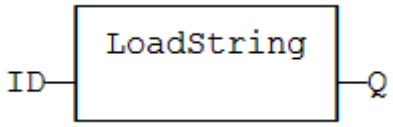
This function loads a string from the active string table and stores it into a STRING variable. The StringTable() function is used for selecting the active string table.

The ID input (the string item identifier) is an identifier such as declared within the string table resource. You don't need to "define" again this identifier. The system does it for you.

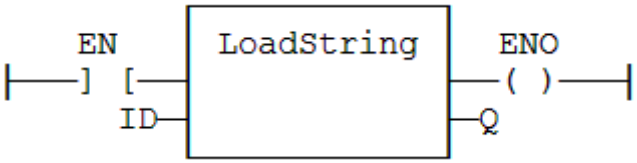
ST LANGUAGE

```
Q := LoadString (ID);
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

```
Op1:    LD      ID
        LoadString
        ST      Q
```

SEE ALSO

StringTable String tables

LOBYTE

FUNCTION - GET THE LESS SIGNIFICANT BYTE OF A WORD.

INPUTS

IN : UINT 16 bit register.

OUTPUTS

Q : USINT Lowest significant byte.

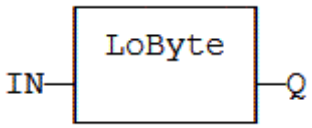
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

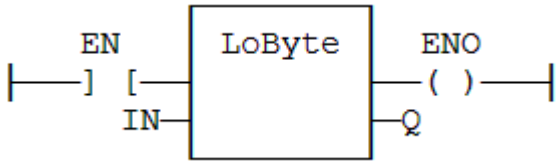
```
Q := LOBYTE (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD     IN
      LOBYTE
      ST     Q
```

SEE ALSO

HIBYTE LOWORD HIWORD MAKEWORD MAKEDWORD

LOG

FUNCTION - CALCULATES THE LOGARITHM (BASE 10) OF THE INPUT.

INPUTS

IN : REAL Real value.

OUTPUTS

Q : REAL Result: logarithm (base 10) of IN.

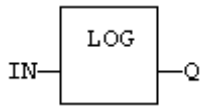
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

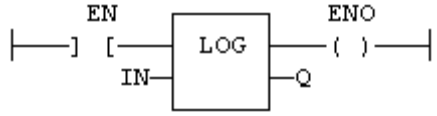
```
Q := LOG (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        LOG
        ST      Q  (* Q is: LOG (IN) *)
```

See Also

ABS TRUNC POW SQRT

LOWORD

FUNCTION - GET THE LESS SIGNIFICANT WORD OF A DOUBLE WORD.

INPUTS

IN : UDINT 32 bit register.

OUTPUTS

Q : UINT Lowest significant word.

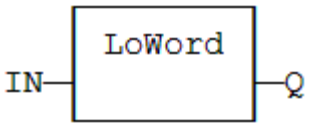
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

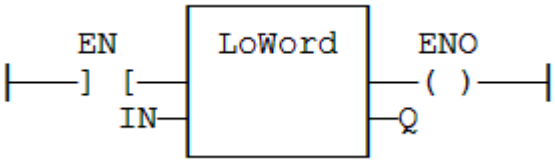
Q := LOWORD (IN);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      LOWORD
      ST    Q
```

SEE ALSO

LOBYTE HIBYTE HIWORD MAKEWORD MAKEDWORD

< LT

OPERATOR - TEST IF FIRST INPUT IS LESS THAN SECOND INPUT.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : BOOL *TRUE* if IN1 < IN2.

REMARKS

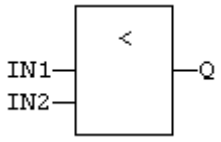
Both inputs must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung is the result of the comparison. In IL language, the LT instruction performs the comparison between the current result and the operand. The current result and the operand must have the same type.

Comparisons can be used with strings. In that case, the lexical order is used for comparing the input strings. For instance, "ABC" is less than "ZX" ; "ABCD" is greater than "ABC".

ST LANGUAGE

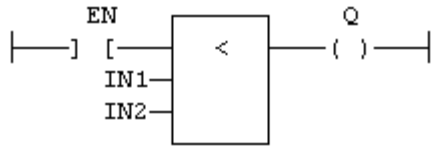
```
Q := IN1 < IN2;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*:



IL LANGUAGE

```
Op1:  LD    IN1
      LT    IN2
      ST    Q  (* Q is true if IN1 < IN2 *)
```

SEE ALSO

> GT >= GE <= LE = EQ <> NE CMP

MAKEDWORD

FUNCTION - BUILDS A DOUBLE WORD AS THE CONCATENATION OF TWO WORDS.

INPUTS

HI : UINT Highest significant word.
LO : UINT Lowest significant word.

OUTPUTS

Q : UDINT 32 bit register.

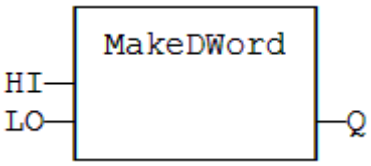
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input must be loaded in the current result before calling the function.

ST LANGUAGE

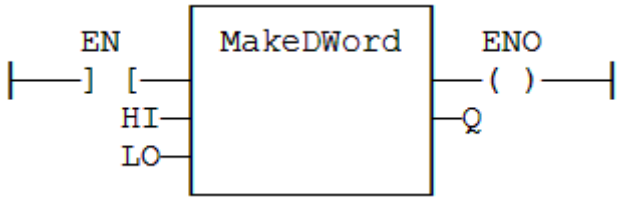
Q := MAKEDWORD (HI, LO);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL Language

Op1:	LD	HI
	MAKEDWORD	LO
	ST	Q

SEE ALSO

LOBYTE HIBYTE LOWORD HIWORD MAKEWORD

MAKEWORD

FUNCTION - BUILDS A WORD AS THE CONCATENATION OF TWO BYTES.

INPUTS

HI : USINT Highest significant byte.
LO : USINT Lowest significant byte.

OUTPUTS

Q : UINT 16 bit register.

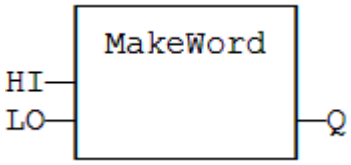
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input must be loaded in the current result before calling the function.

ST LANGUAGE

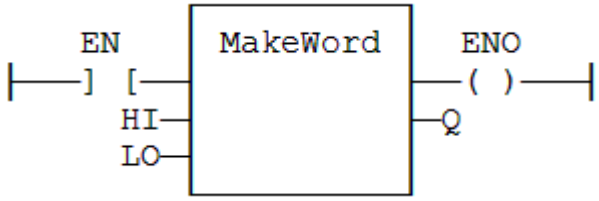
```
Q := MAKEWORD (HI, LO);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD          HI
        MAKEWORD    LO
        ST          Q
```

SEE ALSO

LOBYTE HIBYTE LOWORD HIWORD MAKEDWORD

MAX

FUNCTION - GET THE MAXIMUM OF TWO VALUES.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : ANY IN1 if IN1 > IN2; IN2 otherwise.

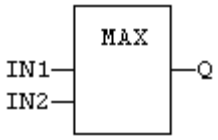
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

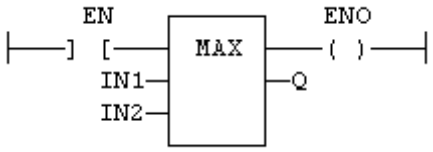
Q := MAX (IN1, IN2);

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:   LD     IN1
       MAX    IN2
       ST     Q  (* Q is the maximum of IN1 and IN2 *)
```

SEE ALSO

MIN LIMIT MOD ODD

MBSHIFT

FUNCTION - MULTIBYTE SHIFT / ROTATE.

INPUTS

Buffer : SINT/USINT Array of bytes.
Pos : DINT Base position in the array.
NbByte : DINT Number of bytes to be shifted/rotated.
NbShift : DINT Number of shifts or rotations.
ToRight : BOOL *TRUE* for right / *FALSE* for left.
Rotate : BOOL *TRUE* for rotate / *FALSE* for shift.
InBit : BOOL Bit to be introduced in a shift.

OUTPUTS

Q : BOOL *TRUE* if successful.

REMARKS

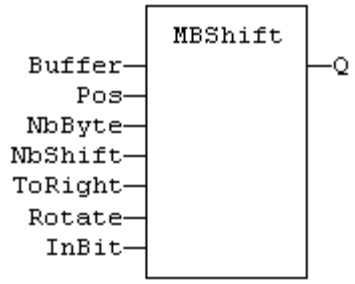
Use the ToRight argument to specify a shift to the left (*FALSE*) or to the right (*TRUE*). Use the Rotate argument to specify either a shift (*FALSE*) or a rotation (*TRUE*). In case of a shift, the InBit argument specifies the value of the bit that replaces the last shifted bit.

In LD language, the rung input (EN) validates the operation. The rung output is the result (Q).

ST LANGUAGE

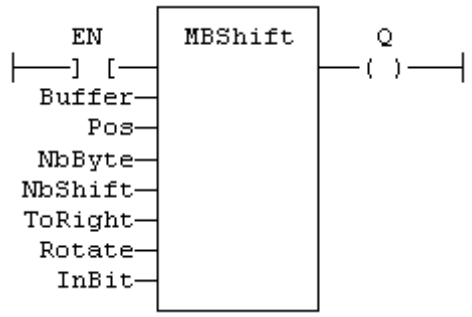
Q := MBShift (Buffer, Pos, NbByte, NbShift, ToRight, Rotate, InBit);

FBD LANGUAGE



LD LANGUAGE

The function is called only if EN is *TRUE*:



IL LANGUAGE

Not available.

MID

FUNCTION - EXTRACT CHARACTERS OF A STRING AT ANY POSITION.

INPUTS

IN : STRING Character string.
NBC : DINT Number of characters to extract.
POS : DINT Position of the first character to extract (first character of IN is at position 1).

OUTPUTS

Q : STRING String containing the first NBC characters of IN.

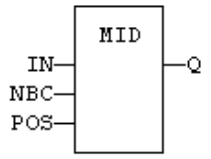
REMARKS

The first valid position is 1. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. Other argument are operands of the function, separated by comas.

ST LANGUAGE

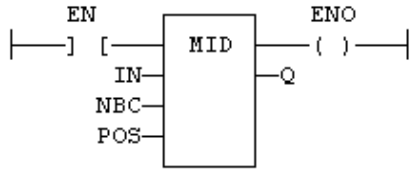
```
Q := MID (IN, NBC, POS);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        MID     NBC, POS
        ST      Q
```

See Also

+ ADD MLEN DELETE INSERT FIND REPLACE LEFT RIGHT

MIN

FUNCTION - GET THE MINIMUM OF TWO VALUES.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : ANY IN1 if IN1 < IN2; IN2 otherwise.

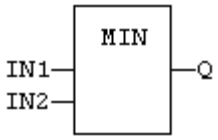
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

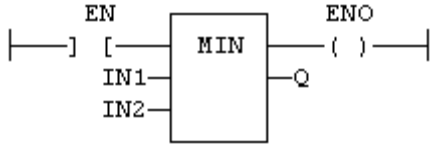
Q := MIN (IN1, IN2);

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN1
      MIN   IN2
      ST    Q  (* Q is the minimum of IN1 and IN2 *)
```

SEE ALSO

MAX LIMIT MOD ODD

MLEN

FUNCTION - GET THE NUMBER OF CHARACTERS IN A STRING.

INPUTS

IN : STRING -Character string.

OUTPUTS

NBC : DINT Number of characters currently in the string. 0 if string is empty.

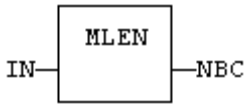
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

```
NBC := MLEN (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.

IL LANGUAGE

```
Op1:  LD    IN
      MLEN
      ST    NBC
```

SEE ALSO

+ ADD DELETE INSERT FIND REPLACE LEFT RIGHT MID

MOD / MODR / MODLR

FUNCTION - CALCULATION OF MODULO.

INPUTS

IN : DINT/REAL/LREAL Input value.
BASE : DINT/REAL/LREAL Base of the modulo.

OUTPUTS

Q : DINT/REAL/LREAL Modulo: rest of the integer division (IN / BASE).

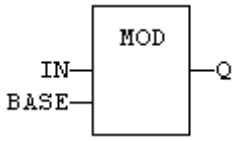
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

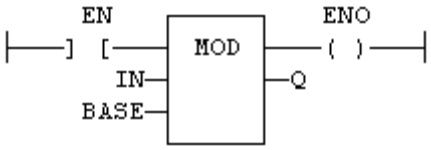
```
Q := MOD (IN, BASE);
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      MOD   BASE
      ST    Q  (* Q is the rest of integer division: IN / BASE *)
```

SEE ALSO

MIN MAX LIMIT ODD

* MUL

OPERATOR - PERFORMS A MULTIPLICATION OF ALL INPUTS.

INPUTS

IN1 : ANY_NUM First input.
IN2 : ANY_NUM Second input.

OUTPUTS

Q : ANY_NUM Result: IN1 * IN2.

REMARKS

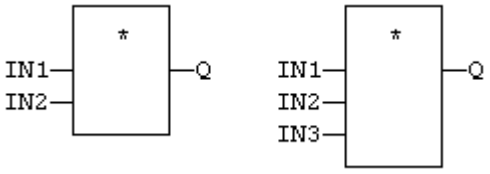
All inputs and the output must have the same type. In FBD language, the block may have up to 16 inputs. In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the MUL instruction performs a multiplication between the current result and the operand. The current result and the operand must have the same type.

ST LANGUAGE

Q := IN1 * IN2;

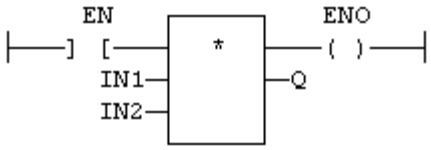
FBD LANGUAGE

The block may have up to 16 inputs:



LD LANGUAGE

The multiplication is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD    IN1
      MUL   IN2
      ST    Q  (* Q is equal to: IN1 * IN2 *)

Op2:  LD    IN1
      MUL   IN2
      MUL   IN3
      ST    Q  (* Q is equal to: IN1 * IN2 * IN3 *)
```

SEE ALSO

+ ADD - SUB / DIV

MUX4

FUNCTION - SELECT ONE OF THE INPUTS - 4 INPUTS.

INPUTS

SELECT : DINT Selection command.
IN1 : ANY First input.
IN2 : ANY Second input.
... :
IN4 : ANY Last input.

OUTPUTS

Q : ANY IN1 or IN2 ... or IN4 depending on SELECT (see truth table).

TRUTH TABLE

SELECT	Q
0	IN1
2	IN2
3	IN3
4	IN4
OTHER	0

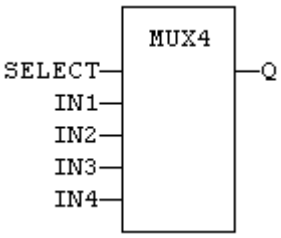
REMARKS

In LD language, the input rung (EN) enables the selection. The output rung keeps the same state as the input rung. In IL language, the first parameter (selector) must be loaded in the current result before calling the function. Other inputs are operands of the function, separated by comas.

ST LANGUAGE

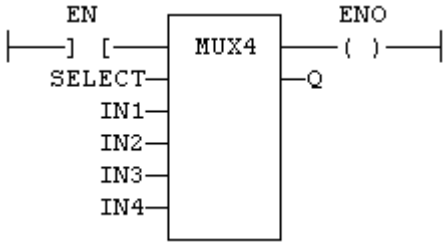
Q := MUX4 (SELECT, IN1, IN2, IN3, IN4);

FBD LANGUAGE



LD LANGUAGE

The selection is performed only if EN is *TRUE*.
ENO has the same value as EN .



IL LANGUAGE

```
Op1:  LD     SELECT
      MUX4   IN1, IN2, IN3, IN4
      ST     Q
```

SEE ALSO

SEL MUX8

MUX8

FUNCTION - SELECT ONE OF THE INPUTS - 8 INPUTS.

INPUTS

SELECT : DINT Selection command.
IN1 : ANY First input.
IN2 : ANY Second input.
... :
IN8 : ANY Last input.

OUTPUTS

Q : ANY IN1 or IN2 ... or IN8 depending on SELECT (see truth table).

TRUTH TABLE

SELECT	Q
0	IN1
1	IN2
2	IN3
3	IN4
4	IN5
5	IN6
6	IN7
7	IN8
OTHER	0

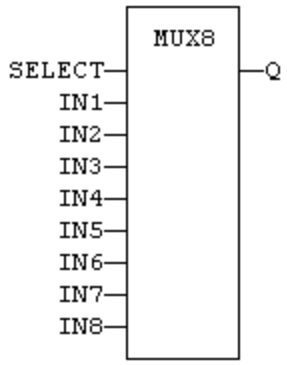
REMARKS

In LD language, the input rung (EN) enables the selection. The output rung keeps the same state as the input rung. In IL language, the first parameter (selector) must be loaded in the current result before calling the function. Other inputs are operands of the function, separated by comas.

ST LANGUAGE

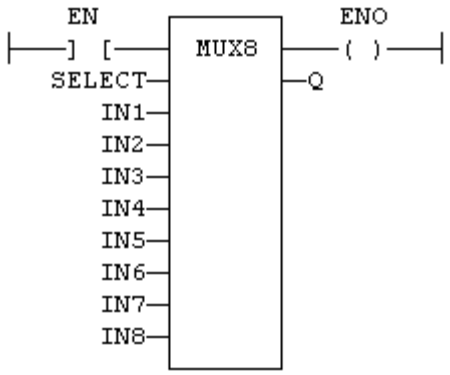
Q := MUX8 (SELECT, IN1, IN2, IN3, IN4, IN5, IN6, IN7, IN8);

FBD LANGUAGE



LD LANGUAGE

The selection is performed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD    SELECT
      MUX8  IN1, IN2, IN3, IN4, IN5, IN6, IN7, IN8
      ST    Q
```

SEE ALSO

SEL MUX4

<> NE

OPERATOR - TEST IF FIRST INPUT IS NOT EQUAL TO SECOND INPUT.

INPUTS

IN1 : ANY First input.
IN2 : ANY Second input.

OUTPUTS

Q : BOOL *TRUE* if IN1 is not equal to IN2.

REMARKS

Both inputs must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung is the result of the comparison. In IL language, the NE instruction performs the comparison between the current result and the operand. The current result and the operand must have the same type.

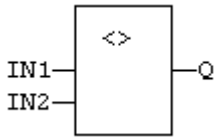
Comparisons can be used with strings. In that case, the lexical order is used for comparing the input strings. For instance, "ABC" is less than "ZX" ; "ABCD" is greater than "ABC".

Equality comparisons cannot be used with TIME variables. The reason why is that the timer actually has the resolution of the target cycle and test may be unsafe as some values may never be reached

ST LANGUAGE

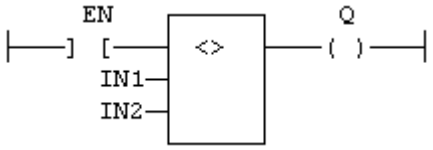
```
Q := IN1 <> IN2;
```

FBD LANGUAGE



LD LANGUAGE

The comparison is executed only if EN is *TRUE*:



IL LANGUAGE

```
Op1:  LD    IN1
      NE    IN2
      ST    Q  (* Q is true if IN1 is not equal to IN2 *)
```

See Also

> GT < LT >= GE <= LE = EQ CMP

NEG -

OPERATOR - PERFORMS AN INTEGER NEGATION OF THE INPUT.

INPUTS

IN : DINT Integer value.

OUTPUTS

Q : DINT Integer negation of the input.

TRUTH TABLE (EXAMPLES)

IN	Q
0	0
1	-1
-123	123

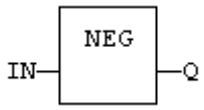
REMARKS

In FBD and LD language, the block NEG can be used. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. This feature is not available in IL language. In ST language, "-" can be followed by a complex boolean expression between parenthesis.

ST LANGUAGE

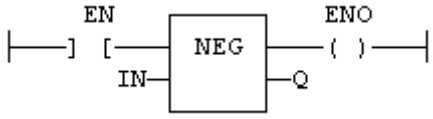
```
Q := -IN;
Q := - (IN1 + IN2);
```

FBD LANGUAGE



LD LANGUAGE

The negation is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

Not available.

NOT

OPERATOR - PERFORMS A BOOLEAN NEGATION OF THE INPUT.

INPUTS

IN : BOOL Boolean value.

OUTPUTS

Q : BOOL Boolean negation of the input.

TRUTH TABLE

IN	Q
0	1
1	0

REMARKS

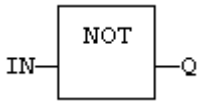
In FBD language, the block NOT can be used. Alternatively, you can use a link terminated by a o negation. In LD language, negated contacts and coils can be used. In IL language, the N modifier can be used with instructions LD, AND, OR, XOR and ST. It represents a negation of the operand. In ST language, NOT can be followed by a complex boolean expression between parenthesis.

ST LANGUAGE

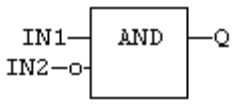
```
Q := NOT IN;
Q := NOT (IN1 OR IN2);
```

FBD LANGUAGE

Explicit use of the NOT block:

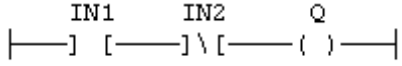


Use of a negated link: Q is IN1 AND NOT IN2:

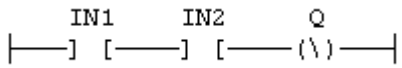


LD LANGUAGE

Negated contact: Q is: IN1 AND NOT IN2:



Negated coil: Q is NOT (IN1 AND IN2):



IL LANGUAGE

```
Op1:  LDN   IN1
      OR    IN2
      ST    Q  (* Q is equal to: (NOT IN1) OR IN2 *)

Op2:  LD    IN1
      AND   IN2
      STN   Q  (* Q is equal to: NOT (IN1 AND IN2) *)
```

See Also

AND OR XOR

NOT_MASK

FUNCTION - PERFORMS A BIT TO BIT NEGATION OF AN INTEGER VALUE.

INPUTS

IN : ANY Integer input.

OUTPUTS

Q : ANY Bit to bit negation of the input.

REMARKS

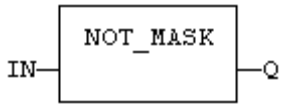
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the parameter (IN) must be loaded in the current result before calling the function.

ST LANGUAGE

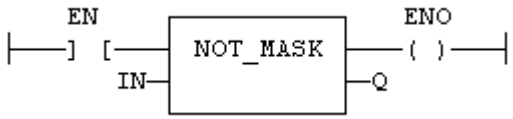
```
Q := NOT_MASK (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:    LD      IN
        NOT_MASK
        ST      Q
```

SEE ALSO

AND_MASK OR_MASK XOR_MASK

NUM_TO_STRING

FUNCTION - CONVERTS A NUMBER INTO STRING VALUE.

INPUTS

IN : ANY Input number.
WIDTH : DINT Wished length for the output string (see remarks)
DIGITS : DINT Number of digits after decimal point

OUTPUTS

Q : STRING Value converted to string.

REMARKS

This function converts any numerical value to a string. Unlike the ANY_TO_STRING function, it allows you to specify a wished length and a number of digits after the decimal points.

If WIDTH is 0, the string is formatted with the necessary length.

If WIDTH is greater than 0, the string is completed with heading blank characters in order to match the value of WIDTH.

If WIDTH is greater than 0, the string is completed with trailing blank characters in order to match the absolute value of WIDTH.

If DIGITS is 0 then neither decimal part nor point are added.

If DIGITS is greater than 0, the corresponding number of decimal digits are added. '0' digits are added if necessary.

If the value is too long for the specified width, then the string is filled with '*' characters.

EXAMPLES

```
Q := NUM_TO_STRING (123.4, 8, 2);          (* Q is ' 123.40' *)
Q := NUM_TO_STRING (123.4, -8, 2);         (* Q is '123.40 ' *)
Q := NUM_TO_STRING (1.333333, 0, 2);       (* Q is '1.33' *)
Q := NUM_TO_STRING (1234, 3, 0);           (* Q is '***' *)
```

ODD

FUNCTION - TEST IF AN INTEGER IS ODD.

INPUTS

IN : DINT Input value.

OUTPUTS

Q : BOOL *TRUE* if IN is odd. *FALSE* if IN is even.

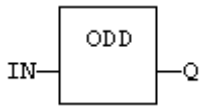
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung is the result of the function. In IL language, the input must be loaded before the function call.

ST LANGUAGE

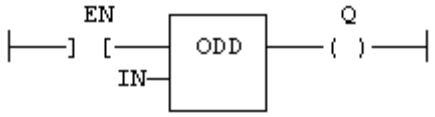
```
Q := ODD (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.



IL LANGUAGE

```
Op1:    LD      IN
        ODD
        ST      Q  (* Q is TRUE if IN is odd *)
```

SEE ALSO

MIN MAX LIMIT MOD

OR / ORN

OPERATOR - PERFORMS A LOGICAL OR OF ALL INPUTS.

INPUTS

IN1 : BOOL First boolean input.
IN2 : BOOL Second boolean input.

OUTPUTS

Q : BOOL Boolean OR of all inputs.

TRUTH TABLE

IN1	IN2	Q
0	0	0
0	1	1
1	0	1
1	1	1

REMARKS

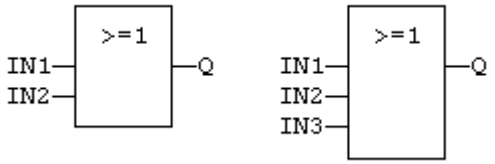
In FBD language, the block may have up to 16 inputs. The block is called >=1 in FBD language. In LD language, an OR operation is represented by contacts in parallel. In IL language, the OR instruction performs a logical OR between the current result and the operand. The current result must be boolean. The ORN instruction performs an OR between the current result and the boolean negation of the operand.

ST LANGUAGE

Q := IN1 OR IN2;
Q := IN1 OR IN2 OR IN3;

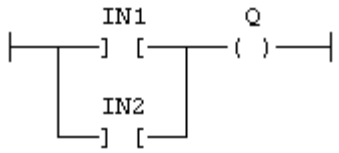
FBD LANGUAGE

The block may have up to 16 inputs:



LD LANGUAGE

Parallel contacts:



IL LANGUAGE

```
Op1:  LD    IN1
      OR    IN2
      ST    Q  (* Q is equal to: IN1 OR IN2 *)

Op2:  LD    IN1
      ORN   IN2
      ST    Q  (* Q is equal to: IN1 OR (NOT IN2) *)
```

SEE ALSO

AND XOR NOT

OR_MASK

FUNCTION - PERFORMS A BIT TO BIT OR BETWEEN TWO INTEGER VALUES.

INPUTS

IN : ANY First input.
MSK : ANY Second input (OR mask).

OUTPUTS

Q : ANY OR mask between IN and MSK inputs.

REMARKS

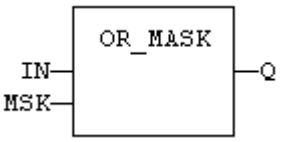
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the first parameter (IN) must be loaded in the current result before calling the function. The other input is the operands of the function.

ST LANGUAGE

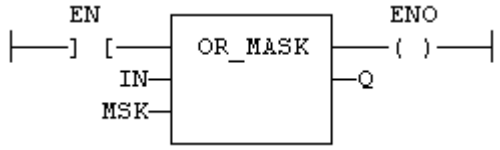
Q := OR_MASK (IN, MSK);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD        IN
      OR_MASK   MSK
      ST        Q
```

SEE ALSO

AND_MASK XOR_MASK NOT_MASK

PACK8

FUNCTION - BUILDS A BYTE WITH BITS.

INPUTS

IN0 : BOOL Less significant bit.
...
IN7 : BOOL Most significant bit.

OUTPUTS

Q : USINT Byte built with input bits.

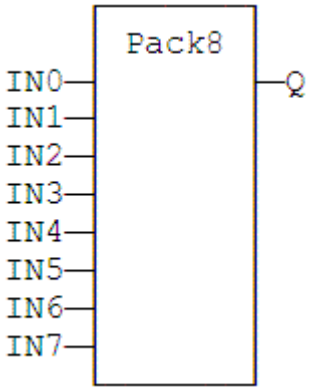
REMARKS

In LD language, the input rung is the IN0 input. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

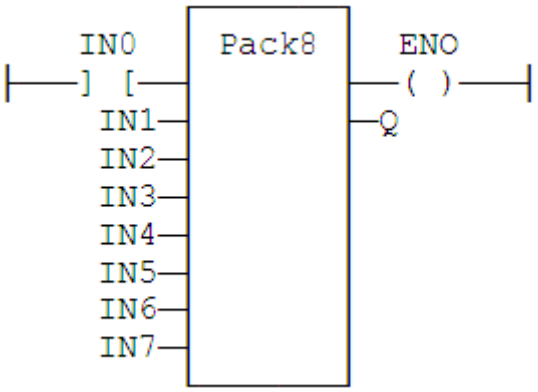
Q := PACK8 (IN0, IN1, IN2, IN3, IN4, IN5, IN6, IN7)

FBD LANGUAGE



LD LANGUAGE

ENO keeps the same value as EN.



IL LANGUAGE

Op1:	LD	IN0
	PACK8	IN1, IN2, IN3, IN4, IN5, IN6, IN7
	ST	Q

See Also

UNPACK8

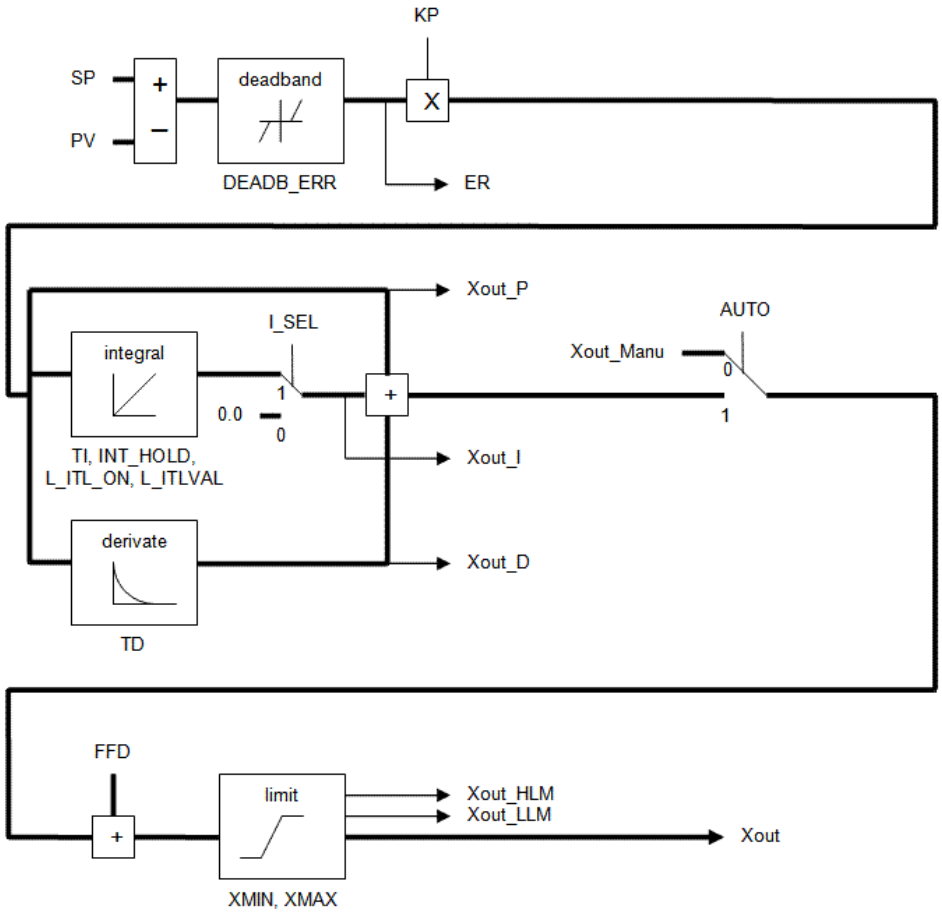
PID

FUNCTION BLOCK - PID LOOP.

Input	Type	Description
AUTO	BOOL	*TRUE* = normal mode - *FALSE* = manual mode.
PV	REAL	Process value.
SP	REAL	Set point.
Xout_Manu	REAL	Output value in manual mode.
KP	REAL	Gain.
TI	REAL	Integration factor.
TD	REAL	Derivation factor.
TS	TIME	Sampling period.
XMIN	REAL	Minimum allowed output value.
XMAX	REAL	Maximum output value.
I_SEL	BOOL	If *FALSE*, the integrated value is ignored.
INT_HOLD	BOOL	If *TRUE*, the integrated value is frozen.
I_ITL_ON	BOOL	If *TRUE*, the integrated value is reset to I_ITLVAL.
I_ITLVAL	REAL	Reset value for integration when I_ITL_ON is *TRUE*.
DEADB_ERR	REAL	Hysteresis on PV. PV will be considered as unchanged if greater than (PVprev - DEADBAND_W) and less that (PRprev + DEADBAND_W).
FFD	REAL	Disturbance value on output.

Output	Type	Description
Xout	REAL	Output command value.
ER	REAL	Last calculated error.
Xout_P	REAL	Last calculated proportional value.
Xout_I	REAL	Last calculated integrated value.
Xout_D	REAL	Last calculated derivated value.
Xout_HLM	BOOL	*TRUE* if the output valie is saturated to XMIN.
Xout_LLM	BOOL	*TRUE* if the output value is saturated to XMAX.

DIAGRAM



REMARKS

It is important for the stability of the control that the TS sampling period is much bigger than the cycle time.

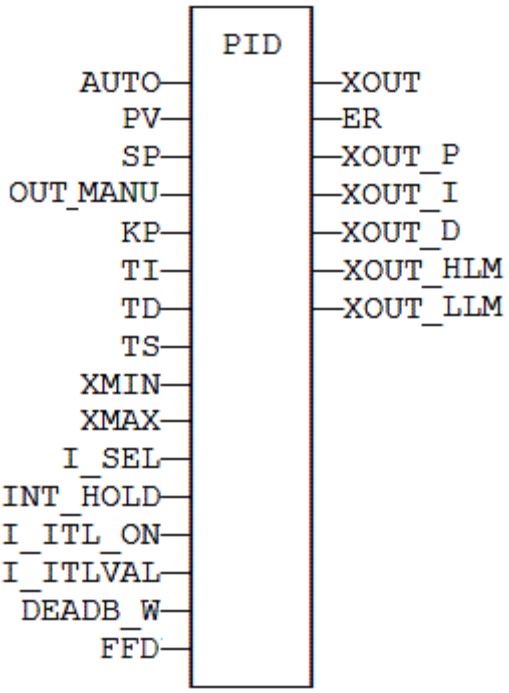
In LD language, the output rung has the same value as the AUTO input, corresponding to the input rung.

ST LANGUAGE

MyPID is a declared instance of PID function block.

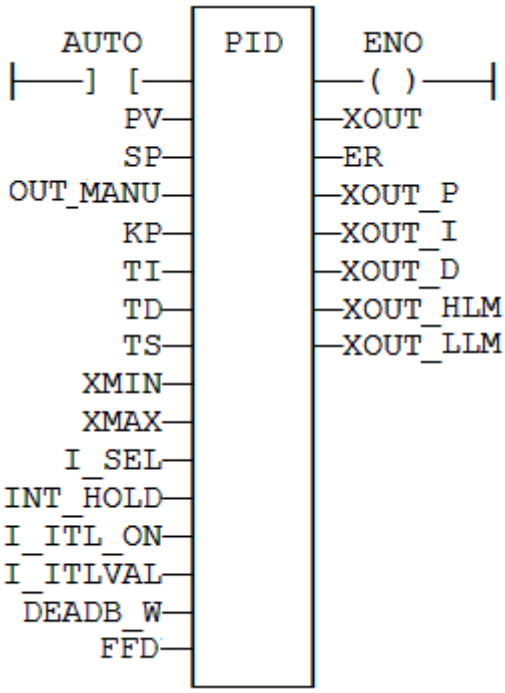
```
MyPID (AUTO, PV, SP, XOUT_MANU, KP, TI, TD, TS, XMIN, XMAX,
    I_SEL, I_ITL_ON, I_ITLVAL, DEADB_ERR, FFD);
XOUT := MyPID.XOUT;
ER := MyPID.ER;
XOUT_P := MyPID.XOUT_P;
XOUT_I := MyPID.XOUT_I;
XOUT_D := MyPID.XOUT_D;
XOUT_HLM := MyPID.XOUT_HLM;
XOUT_LLM := MyPID.XOUT_LLM;
```

FBD LANGUAGE



LD LANGUAGE

ENO has the same state as the input rung.



IL LANGUAGE

MyPID is a declared instance of PID function block.

```
Op1:  CAL   MyPID (AUTO, PV, SP, XOUT_MANU, KP, TI, TD, TS,
                   XMIN, XMAX, I_SEL, I_ITL_ON, I_ITLVAL,
                   DEADB_ERR, FFD)
      LD    MyPID.XOUT
      ST    XOUT
      LD    MyPID.ER
      ST    ER
      LD    MyPID.XOUT_P
      ST    XOUT_P
      LD    MyPID.XOUT_I
      ST    XOUT_I
      LD    MyPID.XOUT_D
      ST    XOUT_D
      LD    MyPID.XOUT_HLM
      ST    XOUT_HLM
      LD    MyPID.XOUT_LLM
      ST    XOUT_LLM
```

PLS

FUNCTION BLOCK - PULSE SIGNAL GENERATOR:

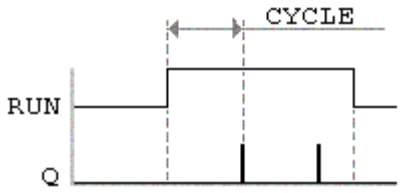
INPUTS

RUN : BOOL Enabling command.
CYCLE : TIME Signal period.

OUTPUTS

Q : BOOL Output pulse signal.

TIME DIAGRAM



REMARKS

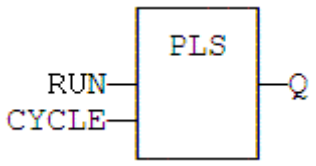
On every period, the output is set to *TRUE* during one cycle only. In LD language, the input rung is the IN command. The output rung is the Q output signal.

ST LANGUAGE

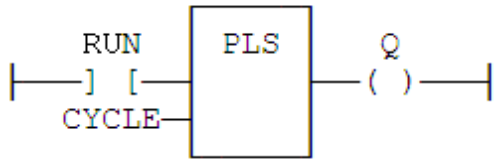
MyPLS is a declared instance of PLS function block:

```
MyPLS (RUN, CYCLE);
Q := MyPLS.Q;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyPLS is a declared instance of PLS function block:

```
Op1:   CAL    MyPLS  (RUN, CYCLE)
       LD     MyPLS.Q
       ST     Q
```

SEE ALSO

TON TOF TP

POW ** POWL

FUNCTION - CALCULATES A POWER.

INPUTS

IN : REAL/LREAL Real value.
EXP : REAL/LREAL Exponent.

OUTPUTS

Q : REAL/LREAL Result: IN at the 'EXP' power.

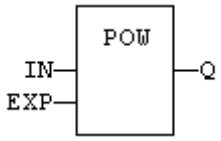
REMARKS

Alternatively, in ST language, the ** operator can be used. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function. The exponent (second input of the function) must be the operand of the function.

ST LANGUAGE

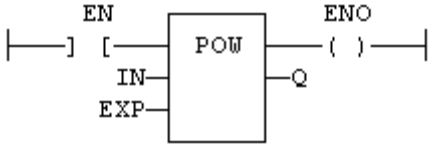
```
Q := POW (IN, EXP);
Q := IN ** EXP;
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD      IN
        POW     EXP
        ST      Q  (* Q is: (IN ** EXP) *)
```

See Also

ABS TRUNC LOG SQRT

QOR

OPERATOR - COUNT THE NUMBER OF *TRUE* INPUTS.

INPUTS

IN1 .. INn : BOOL Boolean inputs

OUTPUTS

Q : DINT Number of inputs being *TRUE*

REMARKS

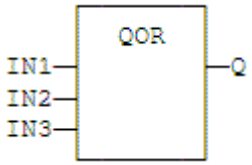
The block accept a non-fixed number of inputs.

ST LANGUAGE

```
Q := QOR (IN1, IN2);
Q := QOR (IN1, IN2, IN3, IN4, IN5, IN6);
```

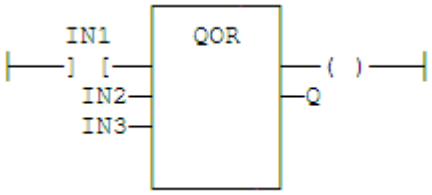
FBD LANGUAGE

The block may have up to 16 inputs:



LD Language

The block may have up to 16 inputs:



IL LANGUAGE

```
Op1:    LD      IN1
        QOR     IN2,    IN3
        ST      Q
```

R

OPERATOR - FORCE A BOOLEAN OUTPUT TO *FALSE*.

INPUTS

RESET : BOOL Condition.

OUTPUTS

Q : BOOL Output to be forced.

TRUTH TABLE

RESET	Q prev	Q
0	0	0
0	1	1
1	0	0
1	1	0

REMARKS

S and R operators are available as standard instructions in the IL language. In LD languages they are represented by (S) and (R) coils. In FBD language, you can use (S) and (R) coils, but you should prefer RS and SR function blocks. Set and reset operations are not available in ST language.

ST LANGUAGE

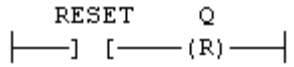
Not available.

FBD LANGUAGE

Not available. Use RS or SR function blocks.

LD LANGUAGE

Use of "R" coil:



IL LANGUAGE

```
Op1:    LD      RESET
        R       Q  (* Q is forced to FALSE if RESET is TRUE *)
                   (* Q is unchanged if RESET is FALSE *)
```

SEE ALSO

S RS SR

R_TRIG

FUNCTION BLOCK - RISING PULSE DETECTION.

INPUTS

CLK : BOOL Boolean signal.

OUTPUTS

Q : BOOL *TRUE* when the input changes from *FALSE* to *TRUE*.

TRUTH TABLE

CLK	CLK prev	Q
0	0	0
0	1	0
1	0	1
1	1	0

REMARKS

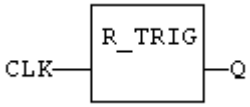
Although]P[an]N[contacts may be used in LD language, it is recommended to use declared instances of R_TRIG or F_TRIG function blocks in order to avoid unexpected behavior during an On Line change.

ST LANGUAGE

MyTrigger is declared as an instance of R_TRIG function block:

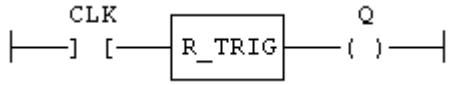
```
MyTrigger (CLK);
Q := MyTrigger.Q;
```

FBD LANGUAGE



LD LANGUAGE

The input signal is the rung - the rung is the output:



IL LANGUAGE

MyTrigger is declared as an instance of R_TRIG function block:

```
Op1:  CAL   MyTrigger (CLK)
      LD    MyTrigger.Q
      ST    Q
```

SEE ALSO

F_TRIG

REPLACE

FUNCTION - REPLACE CHARACTERS IN A STRING.

INPUTS

IN : STRING Character string.
STR : STRING String containing the characters to be inserted.
in place of NDEL removed characters.
NDEL : DINT Number of characters to be deleted before insertion of STR.
POS : DINT Position where characters are replaced (first character position is 1).

OUTPUTS

Q : STRING Modified string.

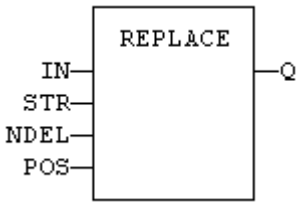
REMARKS

The first valid character position is 1. In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. Other arguments are operands of the function, separated by comas.

ST LANGUAGE

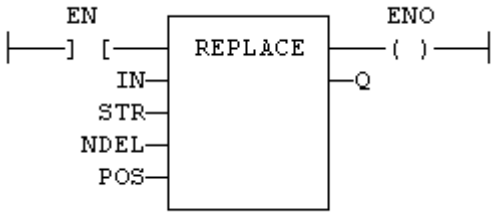
Q := REPLACE (IN, STR, NDEL, POS);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD      IN
      REPLACE STR, NDEL, POS
      ST      Q
```

See Also

+ ADD MLEN DELETE INSERT FIND LEFT RIGHT MID

RIGHT

FUNCTION - EXTRACT CHARACTERS OF A STRING ON THE RIGHT.

INPUTS

IN : STRING Character string.
NBC : DINT Number of characters to extract.

OUTPUTS

Q : STRING String containing the last NBC characters of IN.

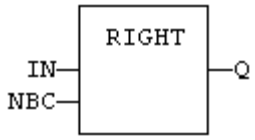
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the first input (the string) must be loaded in the current result before calling the function. The second argument is the operand of the function.

ST LANGUAGE

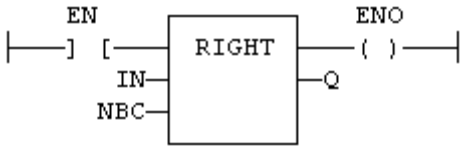
```
Q := RIGHT (IN, NBC);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD      IN
      RIGHT   NBC
      ST      Q
```

SEE ALSO

+ ADD MLEN DELETE INSERT FIND REPLACE LEFT MID

ROL

FUNCTION - ROTATE BITS OF A REGISTER TO THE LEFT.

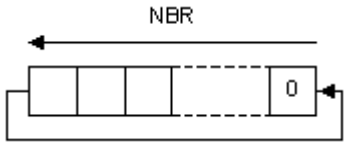
INPUTS

IN : ANY register.
NBR : ANY Number of rotations (each rotation is 1 bit).

OUTPUTS

Q : ANY Rotated register.

DIAGRAM



REMARKS

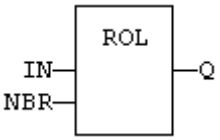
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

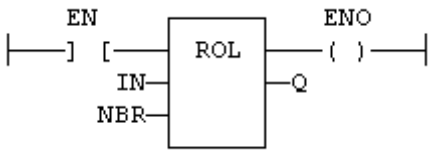
Q := ROL (IN, NBR);

FBD LANGUAGE



LD LANGUAGE

The rotation is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD   IN
      ROL  NBR
      ST   Q
```

SEE ALSO

SHL SHR ROR SHLb SHRb ROLb RORb SHLw SHRw ROLw RORw

ROOT

FUNCTION - CALCULATES THE NTH ROOT OF THE INPUT.

INPUTS

IN : REAL Real value

N : DINT Root level

OUTPUTS

Q : REAL Result: Nth root of IN

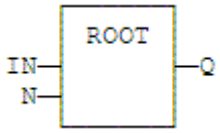
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

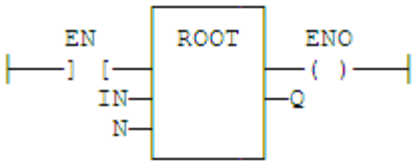
```
Q := ROOT (IN, N);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      ROOT  N
      ST    Q  (* Q is: ROOT (IN) *)
```

ROR

FUNCTION - ROTATE BITS OF A REGISTER TO THE RIGHT.

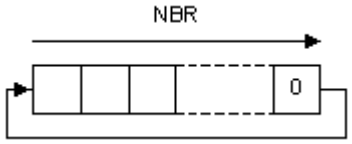
INPUTS

IN : ANY register.
NBR : ANY Number of rotations (each rotation is 1 bit).

OUTPUTS

Q : ANY Rotated register.

DIAGRAM



REMARKS

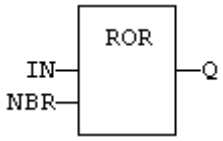
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

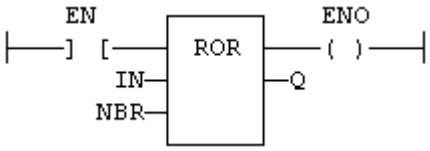
Q := ROR (IN, NBR);

FBD LANGUAGE



LD LANGUAGE

The rotation is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      ROR   NBR
      ST    Q
```

See Also

SHL SHR ROL SHLb SHRb ROLb RORb SHLw SHRw ROLw RORw

RORB ROR_SINT ROR_USINT ROR_BYTE

FUNCTION - ROTATE BITS OF A REGISTER TO THE RIGHT.

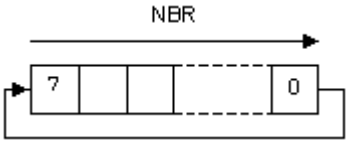
INPUTS

IN : SINT 8 bit register.
NBR : SINT Number of rotations (each rotation is 1 bit).

OUTPUTS

Q : SINT Rotated register.

DIAGRAM



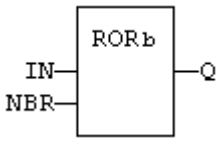
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

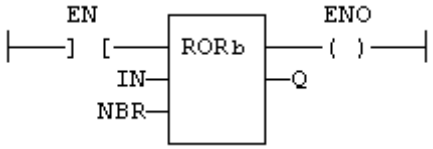
Q := RORb (IN, NBR);

FBD LANGUAGE



LD LANGUAGE

The rotation is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      RORb  NBR
      ST    Q
```

SEE ALSO

SHL SHR ROL ROR SHLb SHRb ROLb SHLw SHRw ROLw RORw

RORw ROR_INT ROR_UINT ROR_WORD

FUNCTION - ROTATE BITS OF A REGISTER TO THE RIGHT.

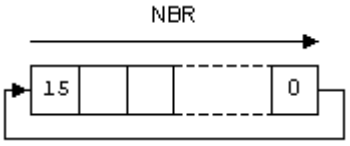
INPUTS

IN : INT 16 bit register.
NBR : INT Number of rotations (each rotation is 1 bit).

OUTPUTS

Q : INT Rotated register.

DIAGRAM



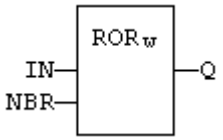
REMARKS

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

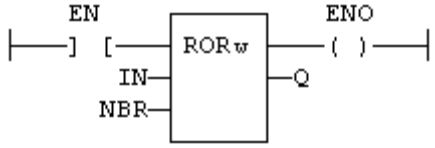
Q := RORw (IN, NBR);

FBD LANGUAGE



LD LANGUAGE

The rotation is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      RORw  NBR
      ST    Q
```

SEE ALSO

SHL SHR ROL ROR SHLb SHRb ROLb RORb SHLw SHRw ROLw

RS

FUNCTION BLOCK - RESET DOMINANT BISTABLE.

INPUTS

SET : BOOL Condition for forcing to *TRUE*.
RESET1 : BOOL Condition for forcing to *FALSE* (highest priority command).

OUTPUTS

Q1 : BOOL Output to be forced.

TRUTH TABLE

SET	RESET1	Q1 prev	Q1
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

REMARKS

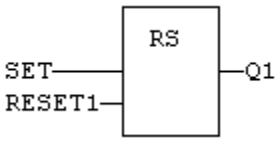
The output is unchanged when both inputs are *FALSE*. When both inputs are *TRUE*, the output is forced to *FALSE* (reset dominant).

ST LANGUAGE

MyRS is declared as an instance of RS function block:

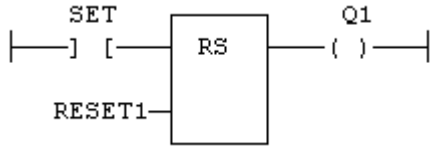
```
MyRS (SET, RESET1);
Q1 := MyRS.Q1;
```

FBD LANGUAGE



LD LANGUAGE

The SET command is the rung - the rung is the output:



IL LANGUAGE

MyRS is declared as an instance of RS function block:

```
Op1:   CAL   MyRS   (SET, RESET1)
       LD    MyRS.Q1
       ST    Q1
```

See Also

R S SR

S

OPERATOR - FORCE A BOOLEAN OUTPUT TO *TRUE*.

INPUTS

SET : BOOL Condition.

OUTPUTS

Q : BOOL Output to be forced.

TRUTH TABLE

SET	Q prev	Q
0	0	0
0	1	1
1	0	1
1	1	1

REMARKS

S and R operators are available as standard instructions in the IL language. In LD languages they are represented by (S) and (R) coils In FBD language, you can use (S) and (R) coils, but you should prefer RS and SR function blocks. Set and reset operations are not available in ST language.

ST LANGUAGE

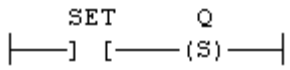
Not available.

FBD LANGUAGE

Not available. Use RS or SR function blocks.

LD LANGUAGE

Use of S coil:



IL LANGUAGE

```
Op1:  LD    SET
      S     Q     (* Q is forced to TRUE if SET is TRUE *)
                  (* Q is unchanged if SET is FALSE *)
```

SEE ALSO

R RS SR

SCALELIN

FUNCTION - SCALING - LINEAR CONVERSION.

INPUTS

IN : REAL Real value.
IMIN : REAL Minimum input value.
IMAX : REAL Maximum input value.
OMIN : REAL Minimum output value.
OMAX : REAL Maximum output value.

OUTPUTS

OUT : REAL Result: OMIN + IN * (OMAX - OMIN) / (IMAX - IMIN).

TRUTH TABLE

Inputs	OUT
IMIN >= IMAX	= IN
IN < IMIN	= OMIN
IN > IMAX	= OMAX
other	= OMIN + IN * (OMAX - OMIN) / (IMAX - IMIN)

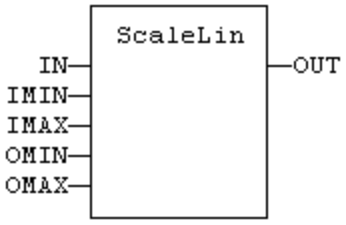
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

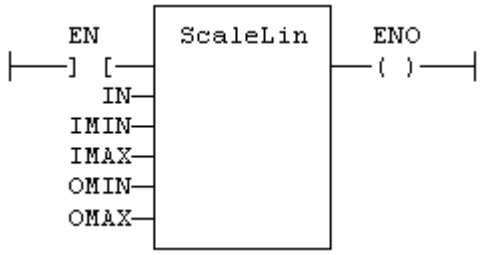
OUT := ScaleLin (IN, IMIN, IMAX, OMIN, OMAX);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

Op1:	LD	IN
	ScaleLin	IMAX, IMIN, OMAX, OMIN
	ST	OUT

SEL

FUNCTION - SELECT ONE OF THE INPUTS - 2 INPUTS.

INPUTS

SELECT : BOOL Selection command
IN0 : ANY First input
IN1 : ANY Second input

OUTPUTS

Q : ANY IN1 if SELECT is *FALSE*; IN2 if SELECT is *TRUE*

TRUTH TABLE

SELECT	Q
0	IN0
1	IN1

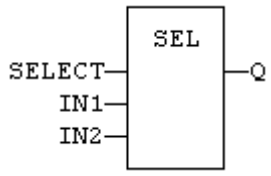
REMARKS

In LD language, the selector command is the input rung. The output rung keeps the same state as the input rung. In IL language, the first parameter (selector) must be loaded in the current result before calling the function. Other inputs are operands of the function, separated by comas.

ST LANGUAGE

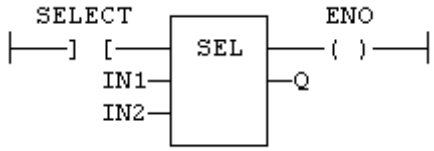
Q := SEL (SELECT, IN0, IN1);

FBD LANGUAGE



LD LANGUAGE

The input rung is the selector.
ENO has the same value as SELECT.



IL LANGUAGE

```
Op1:   LD     SELECT
       SEL    IN1, IN2
       ST     Q
```

See Also

MUX4 MUX8

SEMA

FUNCTION BLOCK - SEMAPHORE.

INPUTS

CLAIM : BOOL Takes the semaphore.
RELEASE : BOOL Releases the semaphore.

OUTPUTS

BUSY : BOOL *TRUE* if semaphore is busy.

REMARKS

The function block implements the following algorithm:

```
BUSY := mem;
if CLAIM then
    mem := TRUE;
else if RELEASE then
    BUSY := FALSE;
    mem := FALSE;
end_if;
```

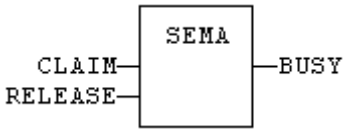
In LD language, the input rung is the CLAIM command. The output rung is the BUSY output signal.

ST LANGUAGE

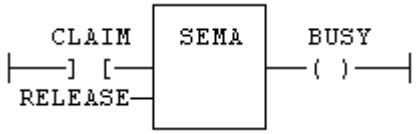
MySema is a declared instance of SEMA function block:

```
MySema (CLAIM, RELEASE);
BUSY := MyBlinker.BUSY;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MySema is a declared instance of SEMA function block:

```
Op1:    CAL     MySema  (CLAIM, RELEASE)
        LD      MyBlinker.BUSY
        ST      BUSY
```

SETBIT

FUNCTION - SET A BIT IN AN INTEGER REGISTER.

INPUTS

IN : ANY 8 to 32 bit integer register.
BIT : DINT Bit number (0 = less significant bit).
VAL : BOOL Bit value to apply.

OUTPUTS

Q : ANY Modified register.

REMARKS

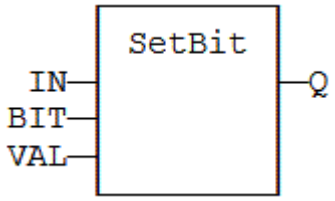
Types LINT, REAL, LREAL, TIME and STRING are not supported for IN and Q. IN and Q must have the same type. In case of invalid arguments (bad bit number or invalid input type) the function returns the value of IN without modification.

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung.

ST LANGUAGE

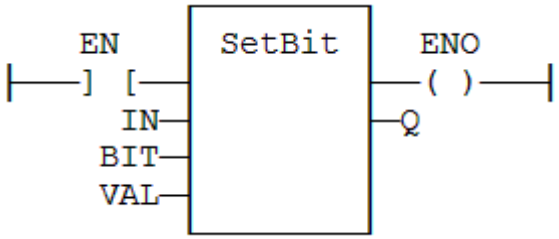
Q := SETBIT (IN, BIT, VAL);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

Not available.

SEE ALSO

TESTBIT

SETWITHIN

FUNCTION - FORCE A VALUE WHEN INSIDE AN INTERVAL

INPUTS

IN : ANY Input
MIN : ANY Low limit of the interval
MAX : ANY High limit of the interval
VAL : ANY Value to apply when inside the interval

OUTPUTS

Q : BOOL Result

TRUTH TABLE

IN	Q
IN < MIN	IN
IN > MAX	IN
MIN < IN < MAX	VAL

REMARKS

The output is forced to VAL when the IN value is within the [MIN .. MAX] interval. It is set to IN when outside the interval.

SHL

FUNCTION - SHIFT BITS OF A REGISTER TO THE LEFT.

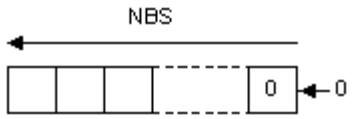
INPUTS

IN : ANY register.
NBS : ANY Number of shifts (each shift is 1 bit).

OUTPUTS

Q : ANY Shifted register.

DIAGRAM



REMARKS

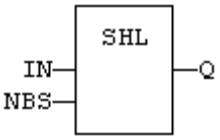
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

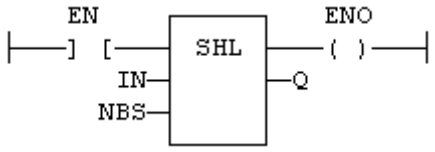
Q := SHL (IN, NBS);

FBD LANGUAGE



LD LANGUAGE

The shift is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

```
Op1:  LD   IN
      SHL  NBS
      ST   Q
```

See Also

SHR ROL ROR SHLb SHRb ROLb RORb SHLw SHRw ROLw RORw

SHR

FUNCTION - SHIFT BITS OF A REGISTER TO THE RIGHT.

INPUTS

IN : ANY register.
NBS : ANY Number of shifts (each shift is 1 bit).

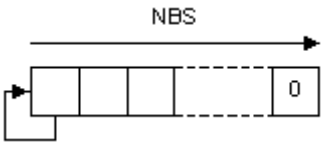
OUTPUTS

Q : ANY Shifted register.

IMPORTANT!

If the option "SHR: do not duplicate the most significant bit" is checked in the "Project settings / Advanced" box, then the most significant bit is set to *FALSE*.

If the option is not checked, then the most significant bit is duplicated:



REMARKS

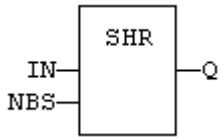
Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the state of the input rung. In IL language, the first input must be loaded before the function call. The second input is the operand of the function.

ST LANGUAGE

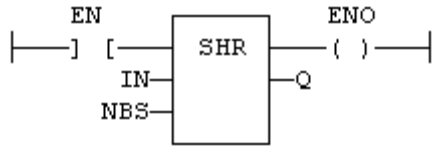
Q := SHR (IN, NBS);

FBD LANGUAGE



LD LANGUAGE

The shift is executed only if EN is *TRUE*.
ENO has the same value as EN.



IL LANGUAGE

Op1:	LD	IN
	SHR	NBS
	ST	Q

SEE ALSO

SHL ROL ROR SHLb SHRb ROLb RORb SHLw SHRw ROLw RORw

SIN SINL

FUNCTION - CALCULATE A SINE.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: sine of IN.

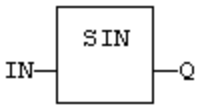
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

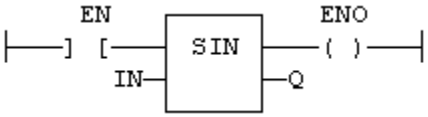
```
Q := SIN (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      SIN
      ST    Q  (* Q is: SIN (IN) *)
```

See Also

COS TAN ASIN ACOS ATAN ATAN2

SQRT SQRTL

FUNCTION - CALCULATES THE SQUARE ROOT OF THE INPUT.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: square root of IN.

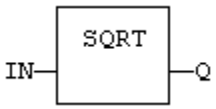
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

```
Q := SQRT (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.

IL LANGUAGE

```
Op1:  LD    IN
      SQRT
      ST    Q  (* Q is: SQRT (IN) *)
```

See Also

ABS TRUNC LOG POW

SR

FUNCTION BLOCK - SET DOMINANT BISTABLE.

INPUTS

SET1 : BOOL Condition for forcing to *TRUE* (highest priority command).
RESET : BOOL Condition for forcing to *FALSE*.

OUTPUTS

Q1 : BOOL Output to be forced.

TRUTH TABLE

SET1	RESET	Q1 prev	Q1
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1

REMARKS

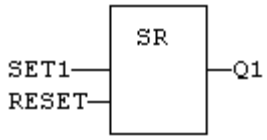
The output is unchanged when both inputs are *FALSE*. When both inputs are *TRUE*, the output is forced to *TRUE* (set dominant).

ST LANGUAGE

MySR is declared as an instance of SR function block:

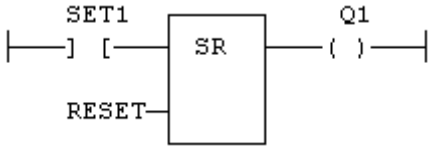
```
MySR (SET1, RESET);
Q1 := MySR.Q1;
```

FBD LANGUAGE



LD LANGUAGE

The SET1 command is the rung - the rung is the output:



IL LANGUAGE

MySR is declared as an instance of SR function block:

```
Op1:   CAL    MySR  (SET1, RESET)
       LD     MySR.Q1
       ST     Q1
```

See Also

R S RS

STRINGTABLE

FUNCTION - SELECTS THE ACTIVE STRING TABLE.

INPUTS

TABLE : STRING Name of the String Table resource - must be a constant.
COL : STRING Name of the column in the table - must be a constant.

OUTPUTS

OK : BOOL *TRUE* if OK.

REMARKS

This function selects a column of a valid String Table resource to become the active string table. The LoadString() function always refers to the active string table.

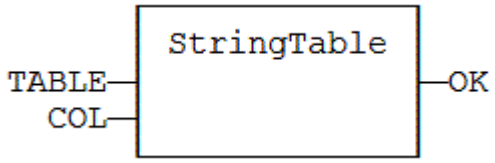
Arguments must be constant string expressions and must fit to a declared string table and a valid column name within this table.

If you have only one string table with only one column defined in your project, you do not need to call this function as it will be the default string table anyway.

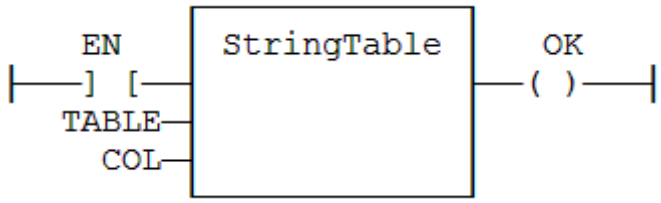
ST LANGUAGE

```
OK := StringTable ('MyTable', 'FirstColumn");
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

```
Op1:    LD              'MyTable'
        StringTable     'First Column'
        ST              OK
```

SEE ALSO

LoadString String tables

STRINGTOARRAY STRINGTOARRAYU

FUNCTION - COPIES THE CHARACTERS OF A STRING TO AN ARRAY OF SINT.

INPUTS

SRC : STRING Source STRING.
DST : SINT Destination array of SINT small integers (USINT for StringToArrayU).

OUTPUTS

Q : DINT Number of characters copied.

REMARKS

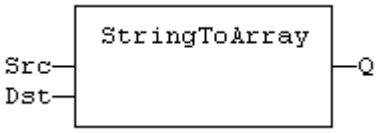
In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

This function copies the characters of the SRC string to the first characters of the DST array. The function checks the maximum size destination arrays and reduces the number of copied characters if necessary.

ST LANGUAGE

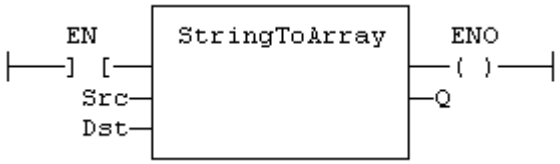
```
Q := StringToArray (SRC, DST);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:    LD              SRC
        StringToArray   DST
        ST              Q
```

SEE ALSO

ArrayToString

- SUB

OPERATOR - PERFORMS A SUBTRACTION OF INPUTS.

INPUTS

IN1 : ANY_NUM / TIME First input.
IN2 : ANY_NUM / TIME Second input.

OUTPUTS

Q : ANY_NUM / TIME Result: IN1 - IN2.

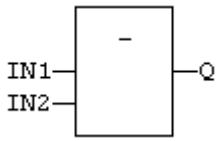
REMARKS

All inputs and the output must have the same type. In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the SUB instruction performs a subtraction between the current result and the operand. The current result and the operand must have the same type.

ST LANGUAGE

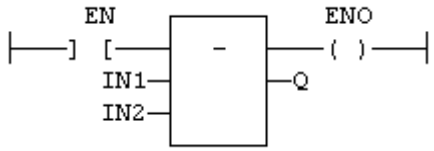
```
Q := IN1 - IN2;
```

FBD LANGUAGE



LD LANGUAGE

The subtraction is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD   IN1
      SUB  IN2
      ST   Q  (* Q is equal to: IN1 - IN2 *)

Op2:  LD   IN1
      SUB  IN2
      SUB  IN3
      ST   Q  (* Q is equal to: IN1 - IN2 - IN3 *)
```

SEE ALSO

+ ADD * MUL / DIV

TAN TANL

FUNCTION - CALCULATE A TANGENT.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: tangent of IN.

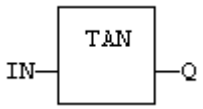
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

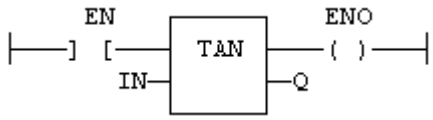
```
Q := TAN (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD    IN
      TAN
      ST    Q  (* Q is: TAN (IN) *)
```

See Also

SIN COS ASIN ACOS ATAN ATAN2

TESTBIT

FUNCTION - TEST A BIT OF AN INTEGER REGISTER.

INPUTS

IN : ANY 8 to 32 bit integer register.
BIT : DINT Bit number (0 = less significant bit).

OUTPUTS

Q : BOOL Bit value.

REMARKS

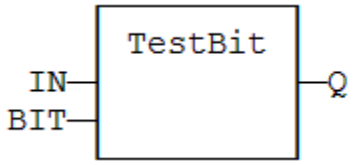
Types LINT, REAL, LREAL, TIME and STRING are not supported for IN and Q. IN and Q must have the same type. In case of invalid arguments (bad bit number or invalid input type) the function returns *FALSE*.

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung is the output of the function.

ST LANGUAGE

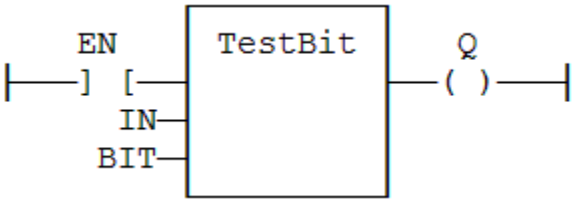
Q := TESTBIT (IN, BIT);

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.



IL LANGUAGE

Not available.

SEE ALSO

SETBIT

TMD

FUNCTION BLOCK - DOWN-COUNTING STOP WATCH.

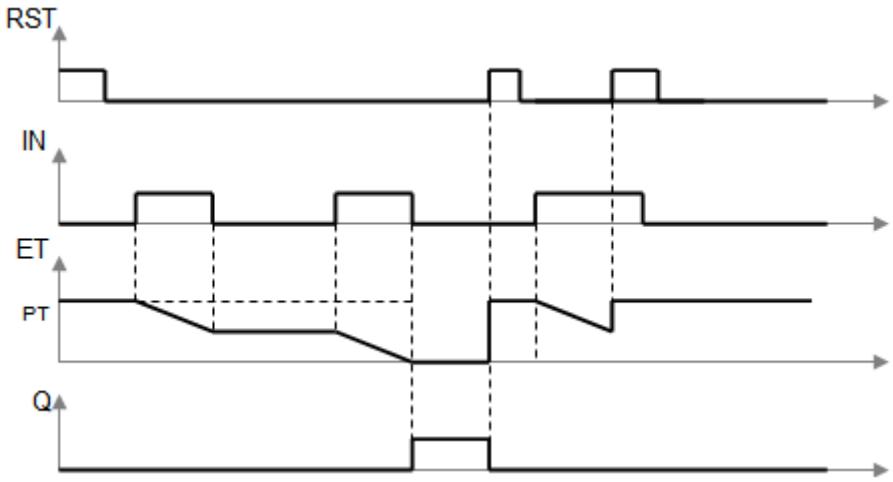
INPUTS

IN : BOOL The time counts when this input is *TRUE*.
RST : BOOL Timer is reset to PT when this input is *TRUE*.
PT : TIME Programmed time.

OUTPUTS

Q : BOOL Timer elapsed output signal.
ET : TIME Elapsed time.

TIME DIAGRAM



REMARKS

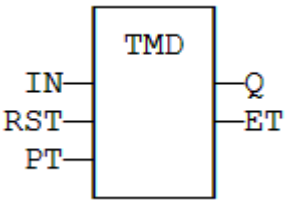
The timer counts up when the IN input is *TRUE*. It stops when the programmed time is elapsed. The timer is reset when the RST input is *TRUE*. It is not reset when IN is *FALSE*.

ST LANGUAGE

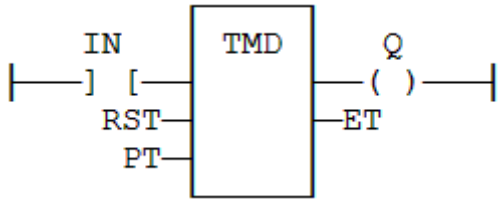
MyTimer is a declared instance of TMD function block.

```
MyTimer (IN, RST, PT);
Q := MyTimer.Q;
ET := MyTimer.ET;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyTimer is a declared instance of TMD function block.

```
Op1:    CAL     MyTimer  (IN, RST, PT)
        LD      MyTimer.Q
        ST      Q
        LD      MyTimer.ET
        ST      ET
```

SEE ALSO

TMU

TMU TMUSEC

FUNCTION BLOCK - UP-COUNTING STOP WATCH.

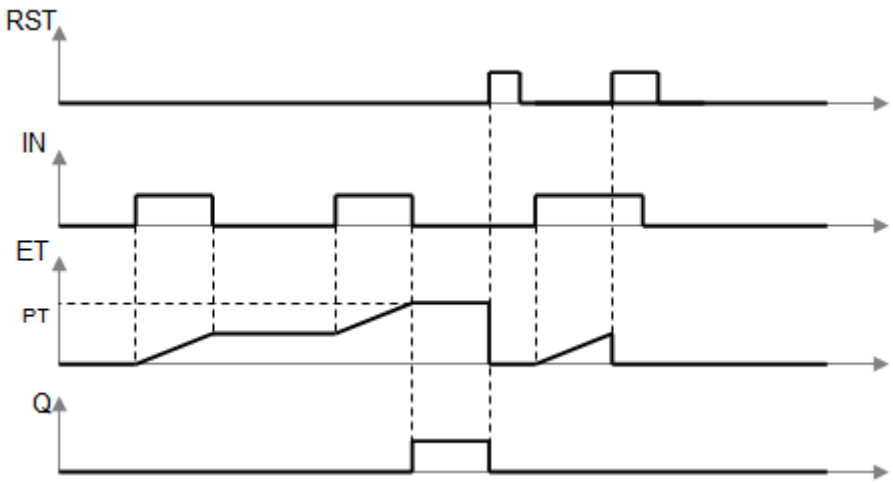
INPUTS

IN : BOOL The time counts when this input is *TRUE*.
RST : BOOL Timer is reset to 0 when this input is *TRUE*.
PT : TIME Programmed time. (TMU)
PTsec : UDINT Programmed time. (TMUsec - seconds)

OUTPUTS

Q : BOOL Timer elapsed output signal.
ET : TIME Elapsed time. (TMU)
ETsec : UDINT Elapsed time. (TMU - seconds)

TIME DIAGRAM



REMARKS

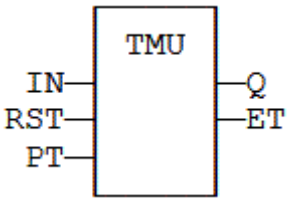
The timer counts up when the IN input is *TRUE*. It stops when the programmed time is elapsed. The timer is reset when the RST input is *TRUE*. It is not reset when IN is *FALSE*.

ST LANGUAGE

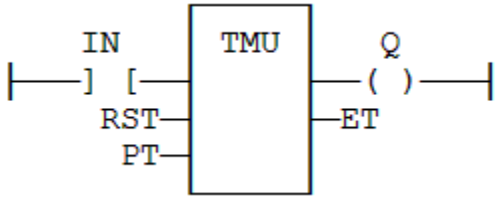
MyTimer is a declared instance of TMU function block.

```
MyTimer (IN, RST, PT);
Q := MyTimer.Q;
ET := MyTimer.ET;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyTimer is a declared instance of TMU function block.

```
Op1:  CAL   MyTimer (IN, RST, PT)
      LD    MyTimer.Q
      ST    Q
      LD    MyTimer.ET
      ST    ET
```

SEE ALSO

TMD

TOF TOFR

FUNCTION BLOCK - OFF TIMER.

INPUTS

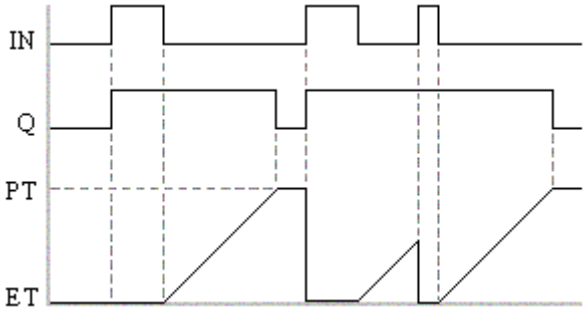
IN : BOOL Timer command.
PT : TIME Programmed time.

RST : BOOL Reset (TOFR only).

OUTPUTS

Q : BOOL Timer elapsed output signal.
ET : TIME Elapsed time.

TIME DIAGRAM



REMARKS

The timer starts on a falling pulse of IN input. It stops when the elapsed time is equal to the programmed time. A rising pulse of IN input resets the timer to 0. The output signal is set to *TRUE* on when the IN input rises to *TRUE*, reset to *FALSE* when programmed time is elapsed.

TOFR is same as TOF but has an extra input for resetting the timer.

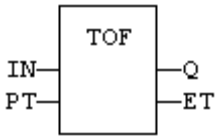
In LD language, the input rung is the IN command. The output rung is Q the output signal.

ST LANGUAGE

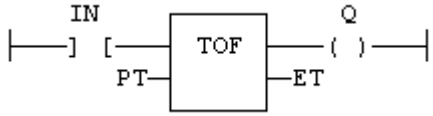
MyTimer is a declared instance of TOF function block.

```
MyTimer (IN, PT);
Q := MyTimer.Q;
ET := MyTimer.ET;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyTimer is a declared instance of TOF function block.

```
Op1:  CAL   MyTimer (IN, PT)
      LD    MyTimer.Q
      ST    Q
      LD    MyTimer.ET
      ST    ET
```

SEE ALSO

TON TP BLINK

TON

FUNCTION BLOCK - ON TIMER.

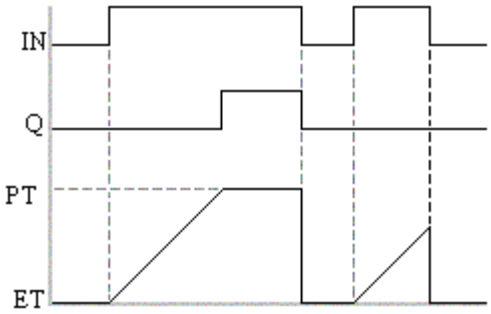
INPUTS

IN : BOOL Timer command.
PT : TIME Programmed time.

OUTPUTS

Q : BOOL Timer elapsed output signal.
ET : TIME Elapsed time.

TIME DIAGRAM



REMARKS

The timer starts on a rising pulse of IN input. It stops when the elapsed time is equal to the programmed time. A falling pulse of IN input resets the timer to 0. The output signal is set to *TRUE* when programmed time is elapsed, and reset to *FALSE* when the input command falls.

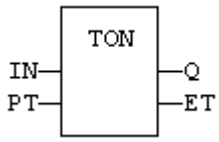
In LD language, the input rung is the IN command. The output rung is Q the output signal.

ST LANGUAGE

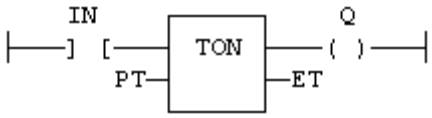
MyTimer is a declared instance of TON function block.

```
MyTimer (IN, PT);
Q := MyTimer.Q;
ET := MyTimer.ET;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyTimer is a declared instance of TON function block.

```
Op1:    CAL     MyTimer (IN, PT)
        LD      MyTimer.Q
        ST      Q
        LD      MyTimer.ET
        ST      ET
```

SEE ALSO

TOF TP BLINK

TP TPR

FUNCTION BLOCK - PULSE TIMER.

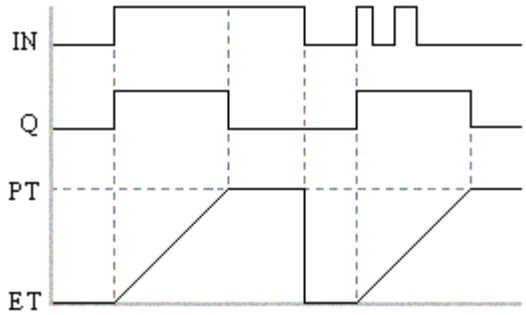
INPUTS

IN : BOOL Timer command.
PT : TIME Programmed time.
RST : BOOL Reset (TPR only).

OUTPUTS

Q : BOOL Timer elapsed output signal.
ET : TIME Elapsed time.

TIME DIAGRAM



REMARKS

The timer starts on a rising pulse of IN input. It stops when the elapsed time is equal to the programmed time. A falling pulse of IN input resets the timer to 0, only if the programmed time is elapsed. All pulses of IN while the timer is running are ignored. The output signal is set to *TRUE* while the timer is running.

TPR is same as TP but has an extra input for resetting the timer

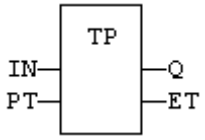
In LD language, the input rung is the IN command. The output rung is Q the output signal.

ST LANGUAGE

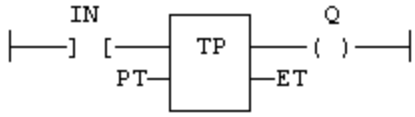
MyTimer is a declared instance of TP function block.

```
MyTimer (IN, PT);
Q := MyTimer.Q;
ET := MyTimer.ET;
```

FBD LANGUAGE



LD LANGUAGE



IL LANGUAGE

MyTimer is a declared instance of TP function block.

```
Op1:    CAL     MyTimer (IN, PT)
        LD      MyTimer.Q
        ST      Q
        LD      MyTimer.ET
        ST      ET
```

SEE ALSO

TON TOF BLINK

TRUNC TRUNCL

FUNCTION - TRUNCATES THE DECIMAL PART OF THE INPUT.

INPUTS

IN : REAL/LREAL Real value.

OUTPUTS

Q : REAL/LREAL Result: integer part of IN.

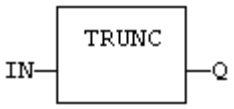
REMARKS

In LD language, the operation is executed only if the input rung (EN) is *TRUE*. The output rung (ENO) keeps the same value as the input rung. In IL, the input must be loaded in the current result before calling the function.

ST LANGUAGE

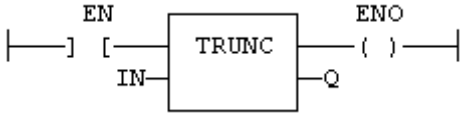
```
Q := TRUNC (IN);
```

FBD LANGUAGE



LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO keeps the same value as EN.



IL LANGUAGE

```
Op1:  LD      IN
      TRUNC
      ST      Q  (* Q is the integer part of IN *)
```

SEE ALSO

ABS LOG POW SQRT

UNPACK8

FUNCTION BLOCK - EXTRACT BITS OF A BYTE.

INPUTS

IN : USINT 8 bit register.

OUTPUTS

Q0 : BOOL Less significant bit.
...
Q7 : BOOL Most significant bit.

REMARKS

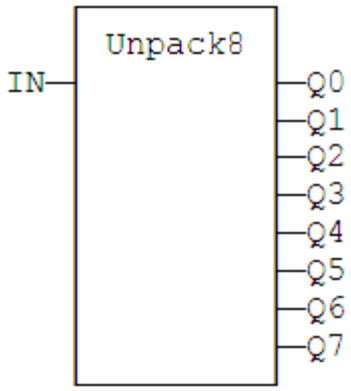
In LD language, the output rung is the Q0 output. The operation is executed only in the input rung (EN) is *TRUE*.

ST LANGUAGE

MyUnpack is a declared instance of the UNPACK8 function block.

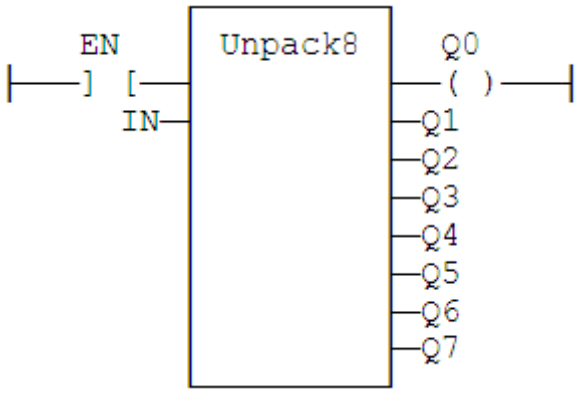
```
MyUnpack (IN);

Q0 := MyUnpack.Q0;
Q1 := MyUnpack.Q1;
Q2 := MyUnpack.Q2;
Q3 := MyUnpack.Q3;
Q4 := MyUnpack.Q4;
Q5 := MyUnpack.Q5;
Q6 := MyUnpack.Q6;
Q7 := MyUnpack.Q7;
```

FBD LANGUAGE



LD LANGUAGE

The operation is performed if EN = *TRUE*:



IL LANGUAGE

MyUnpack is a declared instance of the UNPACK8 function block.

```
Op1:  CAL   MyUnpack (IN)
      LD    MyUnpack.Q0
      ST    Q0
      (* ... *)
      LD    MyUnpack.Q7
      ST    Q7
```

SEE ALSO

PACK8

USEDEGREES

FUNCTION - SETS THE UNIT FOR ANGLES IN ALL TRIGONOMETRIC FUNCTIONS.

INPUTS

IN : BOOL If *TRUE*, turn all trigonometric functions to use degrees.
If *FALSE*, turn all trigonometric functions to use radians (default).

OUTPUTS

Q : BOOL *TRUE* if functions use degrees before the call.

REMARKS

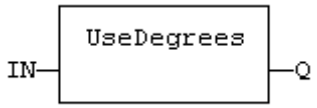
This function sets the working unit for the following functions:

Code	Function
SIN	sine
COS	cosine
TAN	tangent
ASIN	arc-sine
ACOS	arc-cosine
ATAN	arc-tangent
ATAN2	arc-tangent of Y / X

ST LANGUAGE

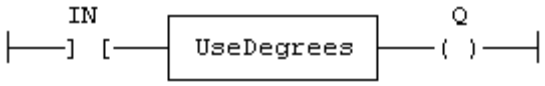
```
Q := UseDegrees (IN);
```

FBD LANGUAGE



LD LANGUAGE

Input is the rung. The rung is the output.



IL LANGUAGE

```
Op1:    LD      IN
        UseDegrees
        ST      Q
```

XOR XORN

OPERATOR - PERFORMS AN EXCLUSIVE OR OF ALL INPUTS.

INPUTS

IN1 : BOOL First boolean input.
IN2 : BOOL Second boolean input.

OUTPUTS

Q : BOOL Exclusive OR of all inputs.

TRUTH TABLE

IN1	IN2	Q
0	0	0
0	1	1
1	0	1
1	1	0

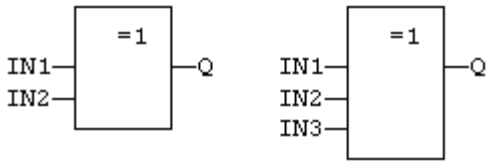
REMARKS

The block is called =1 in FBD and LD languages. In IL language, the XOR instruction performs an exclusive OR between the current result and the operand. The current result must be boolean. The XORN instruction performs an exclusive between the current result and the boolean negation of the operand.

ST LANGUAGE

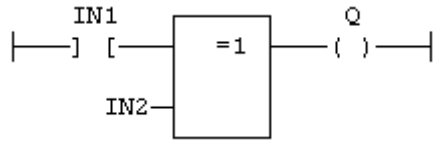
Q := IN1 XOR IN2;
Q := IN1 XOR IN2 XOR IN3;

FBD LANGUAGE



LD LANGUAGE

First input is the rung. The rung is the output:



IL LANGUAGE

```
Op1:  LD    IN1
      XOR   IN2
      ST    Q  (* Q is equal to: IN1 XOR IN2 *)

Op2:  LD    IN1
      XORN  IN2
      ST    Q  (* Q is equal to: IN1 XOR (NOT IN2) *)
```

SEE ALSO

AND OR NOT

XOR_MASK

FUNCTION - PERFORMS A BIT TO BIT EXCLUSIVE OR BETWEEN TWO INTEGER VALUES

INPUTS

IN : ANY First input.
MSK : ANY Second input (XOR mask).

OUTPUTS

Q : ANY Exclusive OR mask between IN and MSK inputs.

REMARKS

Arguments can be signed or unsigned integers from 8 to 32 bits.

In LD language, the input rung (EN) enables the operation, and the output rung keeps the same value as the input rung. In IL language, the first parameter (IN) must be loaded in the current result before calling the function. The other input is the operands of the function.

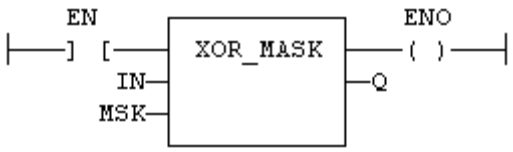
ST LANGUAGE

Q := XOR_MASK (IN, MSK);

FBD LANGUAGE

LD LANGUAGE

The function is executed only if EN is *TRUE*.
ENO is equal to EN.



IL LANGUAGE

```
Op1:  LD        IN
      XOR_MASK  MSK
      ST        Q
```

SEE ALSO

AND_MASK OR_MASK NOT_MASK