Array Math Operations
## Ave_INT, Min_INT, Max_INT, Median_INT, Std_Dev_INT, Sum_INT
User-Defined Function Blocks (UDFBs)

Description:

The Array Math Operations UDFBs allow users to perform a variety of math operations on the data contained within a variable array. The initial release includes support for INT type variable arrays – with REAL and DINT variable array types to be released shortly thereafter. The Median UDFB supports variable arrays dimensions up to 100, and the remainder of the UDFBs in the family can support variable arrays dimensioned up to 1000.

All function blocks have an incoming and outgoing power rail, 3 Inputs and either 3 or 4 outputs. With all UDFBs in the family - the incoming power rail should be connected to an ALW_ON contact so it is always executed.

Ave_INT UDFB
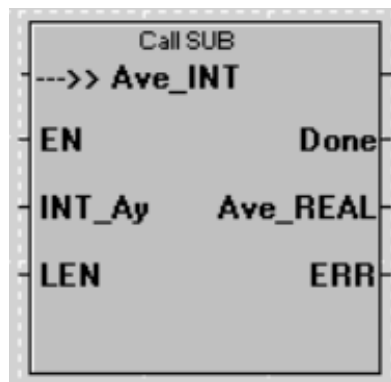
The input parameters for this UDFB are listed and described in the table below:

Input	Descriptive Name	Data Type
EN	Enable Calculation	BOOL
INT_Ay	Input Variable Array	INT Array (max DIM 1000)
LEN	LEN of Input Variable Array	UINT

EN - BOOL
This is the Enable input. It Must be ON for the UDFB to perform its calculation. When it is not energized, all outputs of the UDFB are set to 0.

INT_Ay (INT DIM[0..999]) *dimensions from 1 to 1000 are supported*
This is the variable array of INT data to be averaged. The UDFB uses the INT_Ay as its source – but does not modify the array itself.

LEN – UINT *lengths from 1 to 1000 are supported*
This variable determines how many elements in the array will be averaged. If LEN is set to an illegal value (0 or greater than 100), than the **ERR** output will be asserted.

The output parameters for this UDFB are listed and described in the table below:

Output	Descriptive Name	Data Type
Done	Calculation Complete	BOOL
Ave_REAL	Average of all values in the input array	REAL
ERR	Error Bit	BOOL

Done (BOOL)
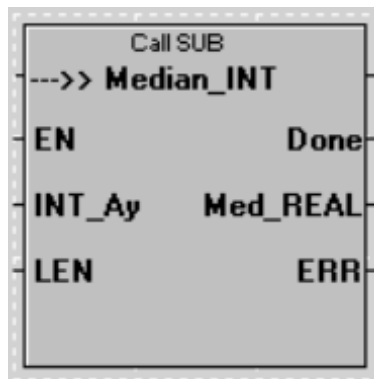The Done bit will turn ON when the calculation is complete.

Ave_REAL (REAL)
This is the Average calculated from the data values contained in the Input Variable Array.

ERR (BOOL)
If the LEN input parameter to the UDFB is set to an illegal value (0 or greater than 1000), the ERR bit will turn ON, and the UDFB will not perform the calculation.
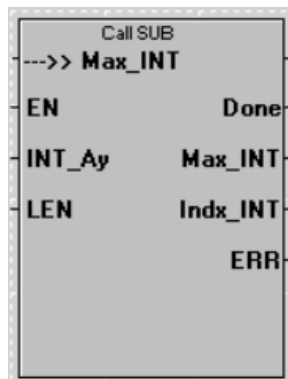
Median_INT UDFB

The Median UDFB returns the Median value in the data list represented by the Variable Array. The Input Variable Array is in INT format, but the Median is presented in REAL format.

Input	Descriptive Name	Data Type
EN	Enable Calculation	BOOL
INT_Ay	Input Variable Array	INT Array (max DIM 100)
LEN	LEN of Input Variable Array	UINT

| Output	Descriptive Name	Data Type
Done	Calculation Complete	BOOL
Med_REAL	Median of all values in the input array	REAL
ERR	Error Bit	BOOL

Max_INT UDFB

The Max UDFB returns the Maximum value in the data list represented by the Variable Array. The Input Variable Array is in INT format as is the result. In addition to returning the Maximum value found in the Variable Array – the UDFB also returns the Index location of the first instance of that Maximum value. For instance, if the Maximum value in a Variable Array is 500 (decimal), and the first instance of 500 (decimal) in the Variable Array is at Index 7, the Index returned by the UDFB will be 7.

Input	Descriptive Name	Data Type
EN	Enable Calculation	BOOL
INT_Ay	Input Variable Array	INT Array (max DIM 1000)
LEN	LEN of Input Variable Array	UINT

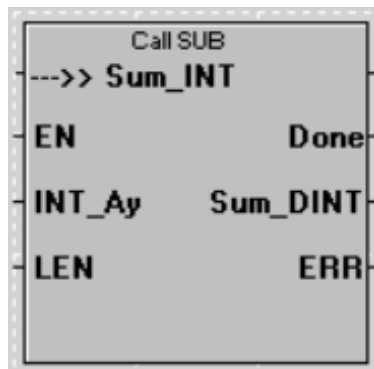| Output	Descriptive Name	Data Type
Done	Calculation Complete	BOOL
Max_INT	Maximum of all values in the input array	INT
Indx_INT	Index location of 1st instance of Maximum value	INT
ERR	Error Bit	BOOL

Min_INT UDFB
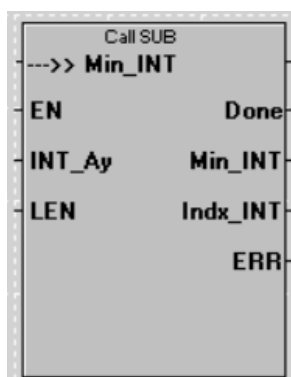
The Min UDFB returns the Minimum value in the data list represented by the Variable Array. The Input Variable Array is in INT format as is the result. In addition to returning the Minimum value found in the Variable Array – the UDFB also returns the Index location of the first instance of that Minimum value. For instance, if the Minimum value in a Variable Array is -37 (decimal), and the first instance of -37 (decimal) in the Variable Array is at Index 125, the Index returned by the UDFB will be 125.

Input	Descriptive Name	Data Type
EN	Enable Calculation	BOOL
INT_Ay	Input Variable Array	INT Array (max DIM 1000)
LEN	LEN of Input Variable Array	UINT

| Output	Descriptive Name	Data Type
Done	Calculation Complete	BOOL
Min_INT	Minimum of all values in the input array	INT
Indx_INT	Index location of 1st instance of Minimum value	INT
ERR	Error Bit	BOOL

Sum_INT UDFB

The Sum UDFB returns the Sum of all the values in the data list represented by the Variable Array. The Input Variable Array is in INT format, but the Sum is presented in DINT format.

Input	Descriptive Name	Data Type
EN	Enable Calculation	BOOL
INT_Ay	Input Variable Array	INT Array (max DIM 1000)
LEN	LEN of Input Variable Array	UINT

Output	Descriptive Name	Data Type
Done	Calculation Complete	BOOL
Sum_DINT	Sum of all values in the input array	DINT
ERR	Error Bit	BOOL

Std_Dev_INT UDFB
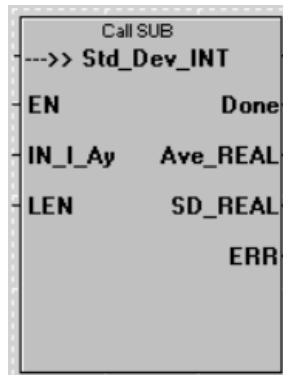
The Standard Deviation UDFB returns the Standard Deviation as well as the Average for the data list represented by the Variable Array. The Input Variable Array is in INT format and the Average and Standard Deviation outputs are in REAL format. Note that the Standard Deviation calculation performed is the Sample calculation – NOT the Population calculation.

Input	Descriptive Name	Data Type
EN	Enable Calculation	BOOL
INT_Ay	Input Variable Array	INT Array (max DIM 1000)
LEN	LEN of Input Variable Array	UINT

Output	Descriptive Name	Data Type
Done	Calculation Complete	BOOL
Ave_REAL	Average of the data values in the input array	REAL
SD_REAL	Standard Deviation of the data values in the input array	REAL
ERR	Error Bit	BOOL