Time Math UDFBs
## Elpsd_Tm, Add_Days, Add_Hours, Pwroff_Tm
## User-Defined Function Blocks (UDFBs)

Description:

Traditionally, timers and counters are used to measure elapsed time in a PLC or an OCS All-in-one Controller. There are applications, however where the Real-time Clock is a better choice. In some cases, the duration of time to be measured is very long – making timers and counters less practical. In other cases, the output desired is a date, and not just a number of seconds, minutes or hours. In yet another case – it is desired to calculate how long a controller has been powered down – which means of course that timers/counters cannot be used because the controller is powered down during the measurement interval.

The Time Math UDFBs described in this document have been created with these special cases in mind.
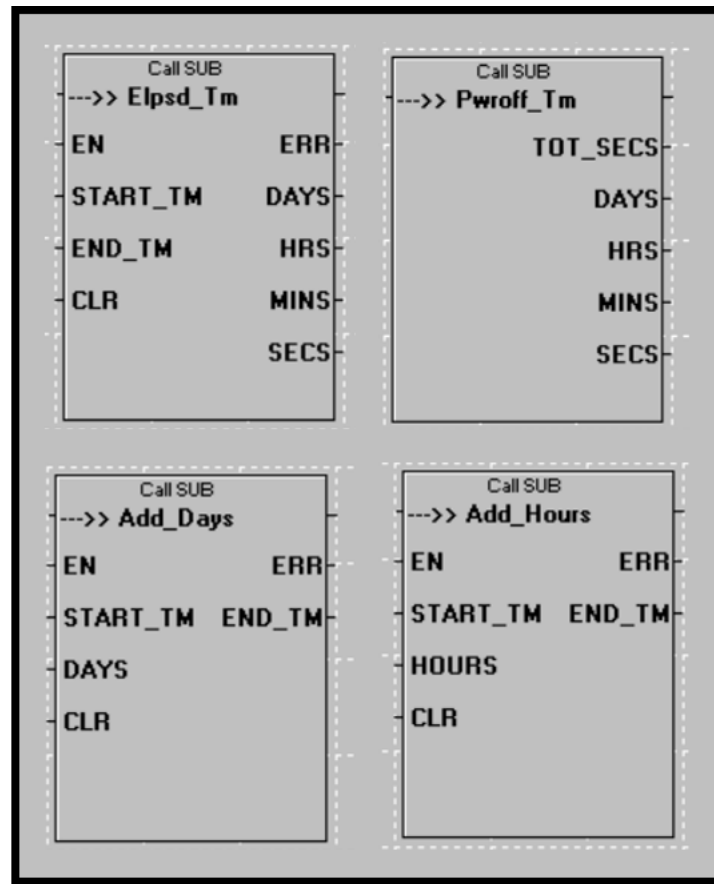
Elpsd_Tm UDFB
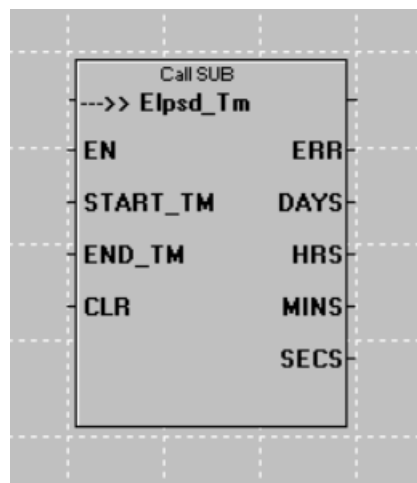
Description. This UDFB measures the time difference between two dates/times in Days, Hours, Minutes and Seconds.

Both the Start Time (Start_Tm) and End Time (End_Tm) are formatted as an UINT Variable Array – with a dimension of 6. The format of each arrayed variable follows the OCS real-time clock. In order – the integer elements of the array are seconds, minutes, hours, date, month and year. This mimics the order of the OCS real-time clock mapped to %SR44-49 – with RTC_SEC, RTC_MIN, RTC_HOUR, RTC_DATE, RTC_MON and RTC_YEAR. See the table below:

Array Index	RTC Equivalent	Legal Values	Start_Tm Array	End_Tm Array
0	RTC_SEC (%SR44)	0-59	Start_Tm[0]	End_Tm[0]
1	RTC_MIN (%SR45)	0-59	Start_Tm[1]	End_Tm[1]
2	RTC_HOUR (%SR46)	0-23	Start_Tm[2]	End_Tm[2]
3	RTC_DATE (%SR47)	1-31	Start_Tm[3]	End_Tm[3]
4	RTC_MON (%SR48)	1-12	Start_Tm[4]	End_Tm[4]
5	RTC_YEAR (%SR49)	1996-2095	Start_Tm[5]	End_Tm[5]

By following the standard format of the OCS real-time clock, the Start Time or End Time arrays can be easily captured from the real-time clock (if desired). For example, if you are seeking to calculate the elapsed time of a date/time in the past versus the current time – you could easily use MOVE functions to copy the current time into the Arrayed INT variable that you are using as the End Time (End_Tm[0] thru End_Tm[5]).

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

Input	Descriptive Name	Data Type
EN	Enable Execution (edge sensitive)	BOOL
START_TM	Start Time Array	UINT (DIM 6)
END_TM	End Time Array	UINT (DIM 6)
CLR	Set the UDFB Outputs to their default values (all 0's)	BOOL

EN - BOOL

This is the Enable input. It must transition from OFF to ON for the UDFB to execute. After executing, the UDFB outputs will remain at their values unless manually cleared through the CLR input, or until another OFF-ON transition of the EN signal occurs.

START_TM (UINT Array DIM 6)

This is the Start Time (in seconds, minutes, hours, date, month, year) to which the End Time will be compared in order to determine the elapsed time.

END_TM (UINT Array DIM 6)

This is the End Time (in seconds, minutes, hours, date, month, year) to which the Start Time will be compared in order to determine the elapsed time.

CLR - BOOL

This is the Clear Input. When this input is ON, the UDFB outputs are held at values of 0.

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

Output	Descriptive Name	Data Type
ERR	Error Bit	BOOL
DAYS	Elapsed Days	UINT
HRS	Elapsed Hours	UINT
MINS	Elapsed Minutes	UINT
SECS	Elapsed Seconds	UINT

ERR- BOOL

This is the Error Flag. It will turn ON if the UDFB is enabled (EN = ON) and the START_TM or END_TM arrays are within the legal ranges of 1-Jan-1996 through 31-Dec-2095.

DAYS - UINT

This is the number of full days of Elapsed Time between the Start Time (START_TM) and End Time (END_TM). The value range is 0-5478 (the equivalent of about 15 years). The accuracy of the UDFB with elapsed times greater than 15 years is not guaranteed.

HRS - UINT

This is the number of full hours of Elapsed Time between the Start Time (START_TM) and End Time (END_TM) AFTER the number of days have been subtracted. The value range is 0-23.
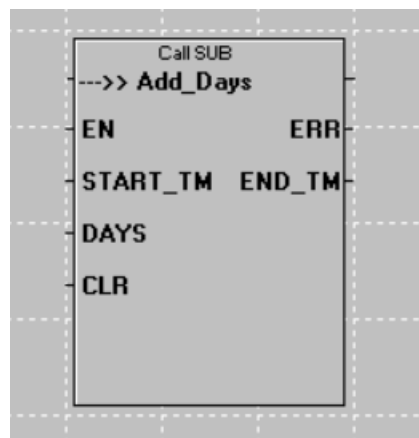
MINS - UINT

This is the number of full minutes of Elapsed Time between the Start Time (START_TM) and End Time (END_TM) AFTER the number of days and hours have been subtracted. The value range is 0-59.

SECS - UINT

This is the number of full seconds of Elapsed Time between the Start Time (START_TM) and End Time (END_TM) AFTER the number of days, hours and minutes have been subtracted. The value range is 0-59.

Add_Days

Description. This UDFB calculates an End date/time based on a Start date/time and a specified number of Days to be added to the Start.

Both the Start Time (Start_Tm) input to the UDFB and End Time (End_Tm) output of the UDFB are formatted as an UINT Variable Array – with a dimension of 6. The format of each arrayed variable follows the OCS real-time clock. In order – the integer elements of the array are seconds, minutes, hours, date, month and year. This mimics the order of the OCS real-time clock mapped to %SR44-49 – with RTC_SEC, RTC_MIN, RTC_HOUR, RTC_DATE, RTC_MON and RTC_YEAR. See the table below:

Array Index	RTC Equivalent	Legal Values	Start_Tm Array (UDFB Input)	End_Tm Array (UDFB Output)
0	RTC_SEC (%SR44)	0-59	Start_Tm[0]	End_Tm[0]
1	RTC_MIN (%SR45)	0-59	Start_Tm[1]	End_Tm[1]
2	RTC_HOUR (%SR46)	0-23	Start_Tm[2]	End_Tm[2]
3	RTC_DATE (%SR47)	1-31	Start_Tm[3]	End_Tm[3]
4	RTC_MON (%SR48)	1-12	Start_Tm[4]	End_Tm[4]
5	RTC_YEAR (%SR49)	1996-2095	Start_Tm[5]	End_Tm[5]

By following the standard format of the OCS real-time clock, the Start Time array can be easily captured from the real-time clock (if desired). For example, if you are seeking to calculate a future date starting from the current time -you can easily use MOVE functions elsewhere in logic to copy the current time into the Start_Tm array (Start_Tm[0] thru Start_Tm[5].

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

Input	Descriptive Name	Data Type
EN	Enable Execution (edge sensitive)	BOOL
START_TM	Start Time Array	UINT (DIM 6)
DAYS	Number of Days to be added to the Start Time	UINT
CLR	Clear. Sets the UDFB Output to the default date of 1-Jan 1996	BOOL

EN - BOOL

This is the Enable input. It must transition from OFF to ON for the UDFB to execute. After executing, the UDFB outputs will remain at their values unless manually cleared through the CLR input, or until another OFF-ON transition of the EN signal occurs.

START_TM (UINT Array DIM 6)

This is the Start Time (in seconds, minutes, hours, date, month, year) to which a number of DAYS will be added by the UDFB in order to calculate the End Time.

DAYS - UINT

This is the number of days to be added to the Start Time. The accuracy of the UDFB with an End Time beyond 31-Dec 2095 is not guaranteed.

CLR - BOOL

This is the Clear Input. When this input is ON, the UDFB End Time is held at its default value of 1-Jan 1996.

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

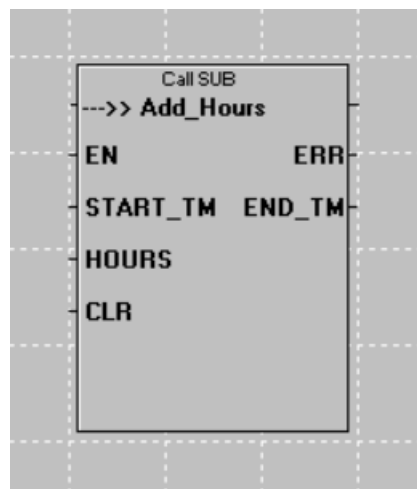| Output	Descriptive Name	Data Type
ERR	Error Bit	BOOL
END_TM	End Time Array	UINT (DIM 6)

ERR - BOOL

This is the Error Flag. It will turn ON if the UDFB is enabled (EN = ON) and the START_TM or END_TM arrays are within the legal ranges of 1-Jan-1996 through 31-Dec-2095.

END_TM (UINT Array DIM 6)

This is the calculated End Time date/time array (in seconds, minutes, hours, date, month, year) which reflects the Start Time with the specified number of DAYS added.

Add_Hours

Description. This UDFB calculates an End date/time based on a Start date/time and a specified number of Hours to be added to the Start.

Both the Start Time (Start_Tm) input to the UDFB and End Time (End_Tm) output of the UDFB are formatted as an UINT Variable Array – with a dimension of 6. The format of each arrayed variable follows the OCS real-time clock. In order – the integer elements of the array are seconds, minutes, hours, date, month and year. This mimics the order of the OCS real-time clock mapped to %SR44-49 – with RTC_SEC, RTC_MIN, RTC_HOUR, RTC_DATE, RTC_MON and RTC_YEAR. See the table below:

Array Index	RTC Equivalent	Legal Values	Start_Tm Array (UDFB Input)	End_Tm Array (UDFB Output)
0	RTC_SEC (%SR44)	0-59	Start_Tm[0]	End_Tm[0]
1	RTC_MIN (%SR45)	0-59	Start_Tm[1]	End_Tm[1]
2	RTC_HOUR (%SR46)	0-23	Start_Tm[2]	End_Tm[2]
3	RTC_DATE (%SR47)	1-31	Start_Tm[3]	End_Tm[3]
4	RTC_MON (%SR48)	1-12	Start_Tm[4]	End_Tm[4]
5	RTC_YEAR (%SR49)	1996-2095	Start_Tm[5]	End_Tm[5]

By following the standard format of the OCS real-time clock, the Start Time array can be easily captured from the real-time clock (if desired). For example, if you are seeking to calculate a future date starting from the current time -you can easily use MOVE functions elsewhere in logic to copy the current time into the Start_Tm array (Start_Tm[0] thru Start_Tm[5].

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

Input	Descriptive Name	Data Type
EN	Enable Execution (edge sensitive)	BOOL
START_TM	Start Time Array	UINT (DIM 6)
HOURS	Number of Hours to be added to the Start Time	UDINT
CLR	Clear. Sets the UDFB Output to the default date of 1-Jan 1996	BOOL

EN - BOOL
This is the Enable input. It must transition from OFF to ON for the UDFB to execute. After executing, the UDFB outputs will remain at their values unless manually cleared through the CLR input, or until another OFF-ON transition of the EN signal occurs.

START_TM (UINT Array DIM 6)
This is the Start Time (in seconds, minutes, hours, date, month, year) to which a number of HOURS will be added by the UDFB in order to calculate the End Time.

HOURS - UDINT
This is the number of hours to be added to the Start Time. It is of UDINT type. The accuracy of the UDFB with an End Time beyond 31-Dec 2095 is not guaranteed.

CLR - BOOL
This is the Clear Input. When this input is ON, the UDFB End Time is held at its default value of 1-Jan 1996.

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

| Output	Descriptive Name	Data Type
ERR	Error Bit	BOOL
END_TM	End Time Array	UINT (DIM 6)

ERR - BOOL
This is the Error Flag. It will turn ON if the UDFB is enabled (EN = ON) and the START_TM or END_TM arrays are within the legal ranges of 1-Jan-1996 through 31-Dec-2095.

END_TM (UINT Array DIM 6)
This is the calculated End Time date/time array (in seconds, minutes, hours, date, month, year) which reflects the Start Time with the specified number of HOURS added.

Pwroff_Tm UDFB
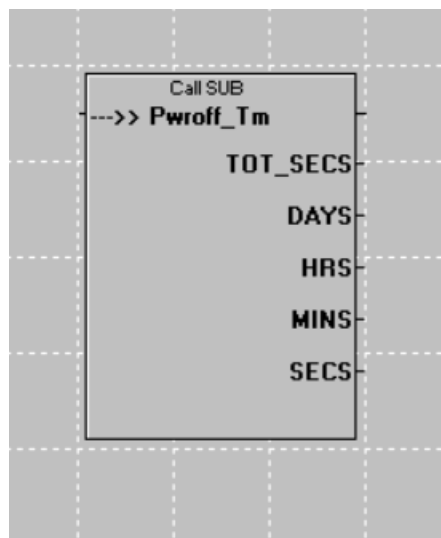
Description. This UDFB calculated how long the controller was powered down before it was last powered up. It will also calculate how long the controller was in STOP mode prior to its most recent STOP-RUN transition. The power down duration (or RUN-STOP duration) is expressed in Total Seconds – as well as Days, Hours, Minutes and Seconds.

This UDFB is unusual in that it has not inputs. It simply needs to be connected to an ALW_ON contact and have outputs assigned to it.

This UDFB depends on several System Variables – including FST_SCN (%S1), RTC_SEC (%SR44), RTC_MIN (%SR45), RTC_HOUR (%SR46), RTC_DATE (%SR47), RTC_MON (%SR48) and RTC_YEAR (%SR49). These are effectively its inputs but do not need to be explicitly connected.

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

Output	Descriptive Name	Data Type
TOT_SECS	Total Number of seconds powered down (or in STOP)	UDINT
DAYS	Days powered Down (or in STOP)	UINT
HRS	Hours powered down (or in STOP)	UINT
MINS	Minutes powered down (or in STOP)	UINT
SECS	Seconds powered down (or in STOP)	UINT

TOT_SECS - UDINT
This is the total number of seconds powered down (or in STOP) at the time of the most recent power up (or STOP-RUN transition). This is a UDINT value and can be a very large number. The accuracy of the UDFB with power down times greater than 15 years is not guaranteed.

DAYS - UINT
This is the number of full days powered down (or in STOP) at the time of the most recent power up (or STOP-RUN transition). The value range is 0-5478 (the equivalent of about 15 years). The accuracy of the UDFB with elapsed times greater than 15 years is not guaranteed.

HRS - UINT

This is the number of full hours powered down (or in STOP) at the time of the most recent power up (or STOP-RUN transition) AFTER the number of days have been subtracted. The value range is 0-23.

MINS - UINT

This is the number of full minutes powered down (or in STOP) at the time of the most recent power up (or STOP-RUN transition) AFTER the number of hours have been subtracted. The value range is 0-59.

SECS - UINT

This is the number of full seconds powered down (or in STOP) at the time of the most recent power up (or STOP-RUN transition) AFTER the number of minutes have been subtracted. The value range is 0-59.