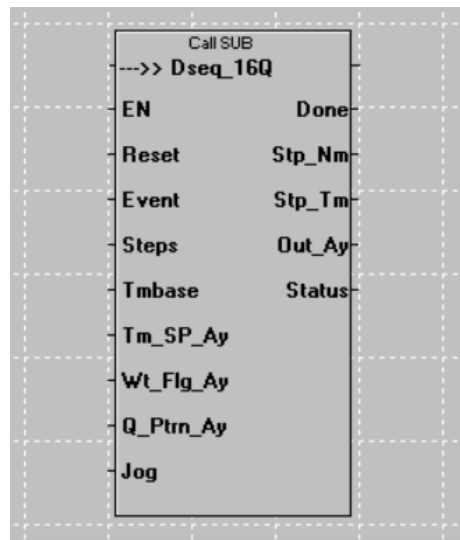**Drum Sequencer**
DSeq_16Q
User-Defined Function Block (UDFB)

Description:
The **Dseq_16Q** UDFB functions as a Drum Sequencer – supporting up to 16 steps and 16 outputs. Each of the 16 steps may complete through the expiration of the Drum Sequencer's built-in Timer or the assertion of an external Event input.

The **Dseq_16Q** UDFB has an incoming and outgoing power rail, 9 Inputs and 5 Outputs. The incoming power rail should be connected to an ALW_ON contact so it is always executed. The **Dseq_16Q** UDFB is drawn by Cscape as follows:

The **Dseq_16Q** input parameters are listed and described in the table below:

Input	Descriptive Name	Data Type
EN	Enable Drum Sequencer	BOOL
Reset	Reset Sequence	BOOL
Event	Event Input	BOOL
Steps	Total Number of Steps	UINT
Tmbase	Timer Timebase	UINT
Tm_SP_Ay	Time Setpoint Array	UINT [0..15]
Wt_Flg_Ay	Wait Flag Array	BOOL [0..15]
Q_Ptrn_Ay	Output Pattern Array	UINT [0..15]
Jog	Jog Input	BOOL

Input Details:

EN - BOOL
This is the EnableW input. It Must be ON for the UDFB to function. When it is first energized, the UDFB processes all the inputs and performs an error check. Provided there are no errors in configuration, the Drum Sequencer will then immediately begin operation with the first step. While the EN input is OFF, the Current Step Number (**Stp_Nm),** Current Step Elapsed Time (**Stp_Tm)**, and Digital Output Array (**Out_Ay)** will all have values of 0, and the Drum Sequencer Stats (**Status)** will be 0.

Reset - BOOL
The Reset Sequence (**Reset)** input restarts the Drum Sequencer from the first step. It is level sensitive, so the Drum Sequencer will be held in an initialized state until the **Reset** input turns OFF.

Event - BOOL
By default, the Event Input (**Event)** transitioning from OFF to ON causes the Drum Sequencer to advance one step. The exception is if the step has been configured to "Wait" for the Drum Sequencer Timer to expire <u>and</u> the **Event** input to be ON before advancing. This "Wait" configuration is done using the Wait Flag Array (**Wt_Flg_Ay**) input.

Steps - UINT
This is a Drum Sequencer configuration input which specifies the total number of steps in the Drum Sequencer. Legal values include 1 to 16 inclusive. If the **Steps** input is set to an illegal value, the Drum Sequencer Status (**Status**) word will enunciate an error and the Drum Sequencer will not operate.

Tmbase (UINT)
This is a Drum Sequencer configuration input which specifies the timebase for the Drum Sequencer Timer. The Timebase **(Tmbase)** configuration input is expressed in mS, and legal values include 1, 10, 100 & 1000. If **Tmbase** is set to an illegal value, the Drum Sequencer Status (**Status**) word will enunciate an error and the Drum Sequencer will not operate.

Tm_SP_Ay (UINT DIM[0..15])
This is a Drum Sequencer configuration input which specifies the Timer Setpoint for each of the Drum Sequencer steps. The **Tm_Sp_Ay** configuration input is expressed in Timebase increments previously specified by the **Tmbase** input. The **Tm_Sp_Ay** configuration input is an array of unsigned integers (UINT) with a dimension of 16. Each array element represents the Timer Setpoint for its corresponding step. Array Element 0 corresponds to Step 1, Array Element 1 corresponds to Step 2, etc. A Timer Setpoint value of 0 will cause the Step <u>NOT to advance</u> based on the Timer, but only through the **Event** input or the **Jog** input.

Wt_Flg_Ay (BOOL DIM[0..15])

This is a Drum Sequencer configuration input which species whether a step is to Wait for both the Timer Setpoint to expire <u>and</u> the **Event** input to be ON before advancing. The **Wt_Flg_Ay** is an array of Boolean values (BOOL) with a dimension of 16. Each array element represents the Wait Flag for its corresponding step. Array Element 0 corresponds to Step 1, Array Element 1 corresponds to Step 2, etc.

Q_Ptrn_Ay (UINT DIM[0..15])

This is a Drum Sequencer configuration input which specifies the pattern of the Drum Sequencer digital outputs for each step. The **Q_Ptrn_Ay** is an array of unsigned integer values with a dimension of 16.   Each array element represents the Drum Sequencer Output pattern for its corresponding step. Array Element 0 corresponds to Step 1, Array Element 1 corresponds to Step 2, etc. Each of the unsigned integers in the array is a 16-bit value where each bit represents one of the Drum Sequencer's digital outputs. The least significant of the 16-bits represents Drum Sequencer digital output #1, and the most significant of the 16-bits represents Drum Sequencer digital output #16. See the table below for a bit-by-bit map.

	MS bit															LS bit
UINT Bit Number	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Output Number	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Jog - BOOL

The **Jog** input causes the Drum Sequencer to immediately advance to the next step – regardless of how each step is configured. This input is transitional and operates only on an OFF to ON transition.

The *Dseq_16Q* output parameters are listed and described in the table below:

Output	Descriptive Name	Data Type
Done	Sequence Complete	BOOL
Stp_Nm	Current Step Number	UINT
Stp_Tm	Current Step Elapsed Time	UINT
Out_Ay	Digital Output Array	BOOL [0..15]
Status	Drum Sequencer Status	UINT

Output Details:

Done (BOOL)
This is the Done Boolean (BOOL) output. The Drum Sequencer sets the **Done** output to indicate that the final step has been completed. The total number of steps in the Drum Sequencer is specified by the Total Steps (**Steps**) configuration input. The Drum Sequencer will NOT automatically repeat, although that can be easily programmed by the user by using the **Done** output to trigger the **Reset** input elsewhere in logic.

Stp_Nm (UINT)
This is the Current Step Number unsigned integer (UINT)output. It represents the Current Step Number being executed by the Drum Sequencer. During Drum Sequencer execution, the Stp_Nm will contain an integer value 1-16.

Stp_Tm (UINT)
This is the Current Step Elapsed Time unsigned integer (UINT) output. It represents the elapsed time of the currently executed step, and it is expressed in Drum Sequencer Timer timebase increments as set by the tmbase configuration input. For example, if the **Tmbase** configuration input is set to 1000, and the **Stp_Tm** output is 5, that means that the elapsed time for the current step is 5000mS.

OUT_Ay (BOOL DIM[0..15])
This is the Drum Sequencer Digital Output Array (BOOL) with a dimension of 16. It represents the current state of the 16 Drum Sequencer digital outputs. Each array element represents one of the digital outputs. Array Element 0 corresponds to digital output 1, Array Element 2 represents digital output 2, etc. When the Drum Sequencer EN (Enable) input is OFF, all digital outputs are set to OFF. When the Drum Sequencer Reset (Reset) input is ON, all digital outputs are set to OFF. When the Drum Sequencer Complete (Done) output is ON, all digital outputs are set to the digital output pattern of the last step.

Output Details (continued):

Status (INT)
This is the Drum Sequencer Status output unsigned integer (UINT). The following values are currently supported (see table below):

0	**Not Enabled**
1	Drum Sequencer Initialized (**Reset** = ON)
2	Waiting for a Timeout **or** Event to Advance
3	Waiting for an Event to Advance
4	Waiting for a Timeout to Advance
5	Waiting for a Timeout **and** Event to Advance
6	Waiting for a Jog to Advance
7	Sequence Complete (Done)
128	Illegal **Steps** value (outside of 1-16)
129	Illegal **Tmbase** value (not 1, 10, 100, or 1000)