

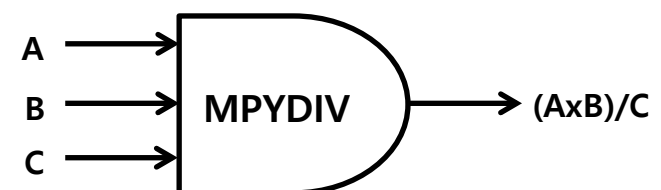
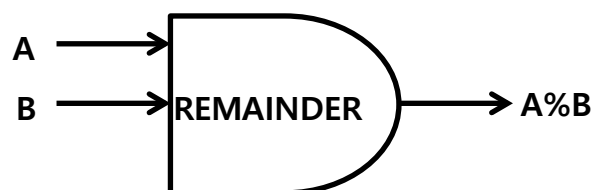
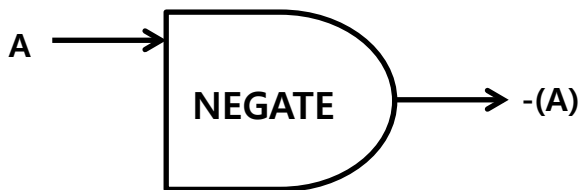
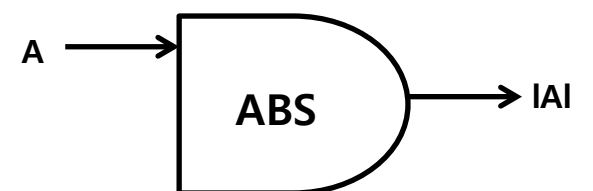
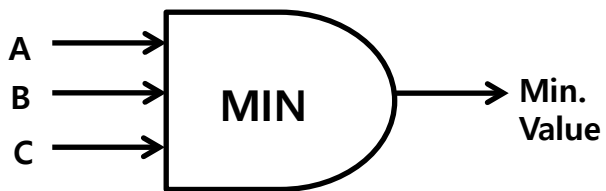
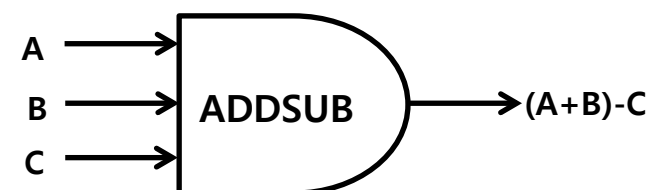
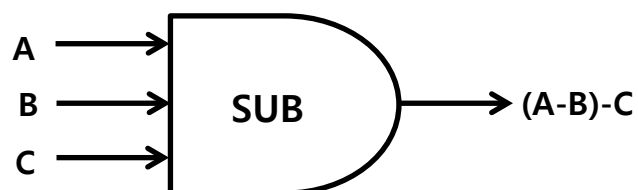
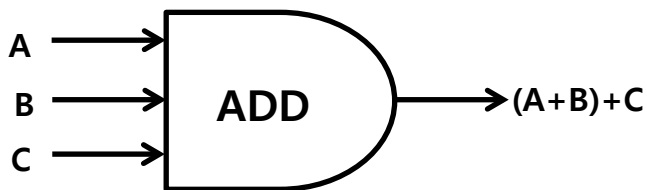
This application note gives examples of programming the user sequence function blocks in the ACN drive.

WARNING: User Sequence programming can cause motor motion and change start/stop functionality. Ensure proper safety precautions are taken to prevent injury.

- Function block groups detailed explanation – *Page 1- 9*
- Programming Examples – *Page 10 - 20*
 - Example 1 – Digital Input Counter
 - Example 2- Acceleration Time Transition
 - Example 3 - Variable speed operation with timer

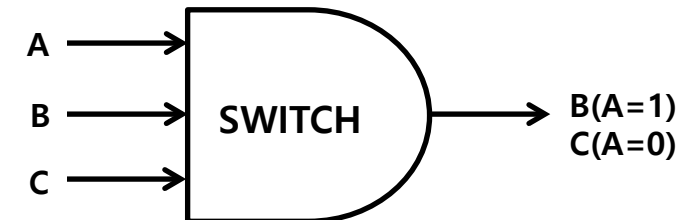
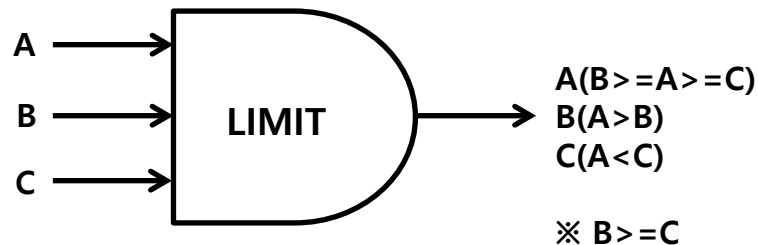
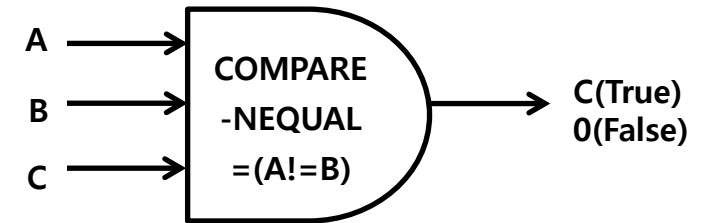
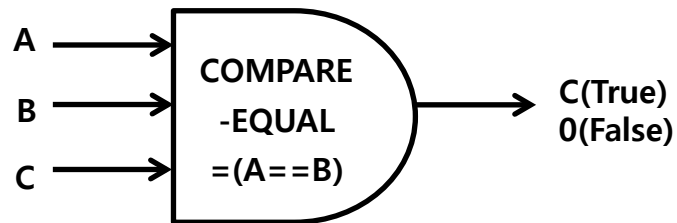
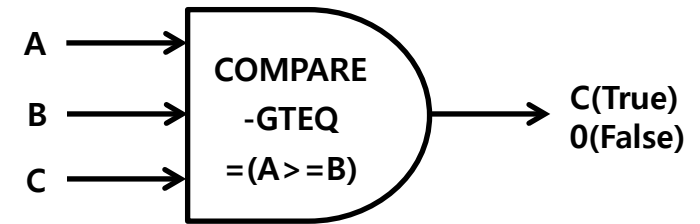
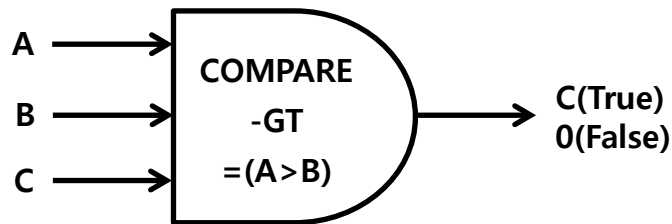
How to use Math Calculation Function Blocks

- ADD/SUB/ADDSUB: Addition/Subtraction operation. If the C parameter is 0x0000, it will be recognized as 0.
(But, Input-A and B should not 0x0000.)
- MIN/MAX: Maximum/Minimum value operation. If the C parameter is 0x0000, operate only with A,B.
- ABS/NEGATE: Absolute /Negative value operation. This operation does not use the B,or C parameter
- REMAINDER: Remainder operation. This operation does not use the C parameter.
- MPYDIV: Multiplication/Division compound operation. If the C parameter is 0x0000, operate only with A,B.

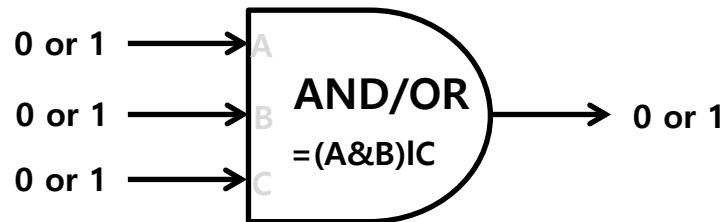
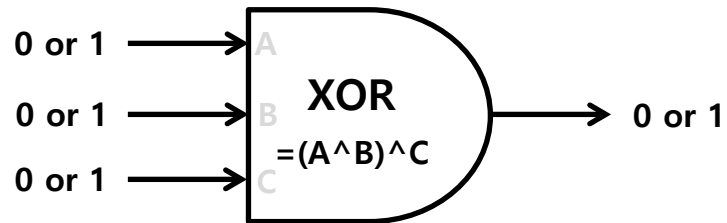
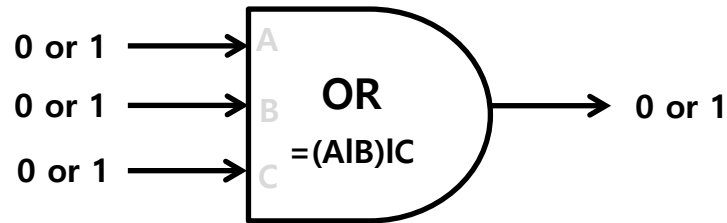
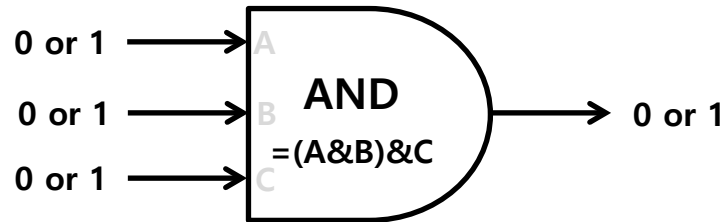


How to use Compare/Limit Function Blocks

- COMPARE is comparison function block. If the C parameter is 0x0000 and if the condition is met, the output parameter is C.
- COMPARE-GT/GTEQ: If the A is greater than B/If the A is greater or equal to B, output C, unless output 0.
- COMPARE-EQUAL/NEQUAL: If A is equal/not equal to B, output C, unless output 0.
- LIMIT: Sets a limit for the A parameter/ SWITCH: If the input at A is 1, the output will be B. If the input is 0, the output will be C.



How to use Boolean Math Function Blocks

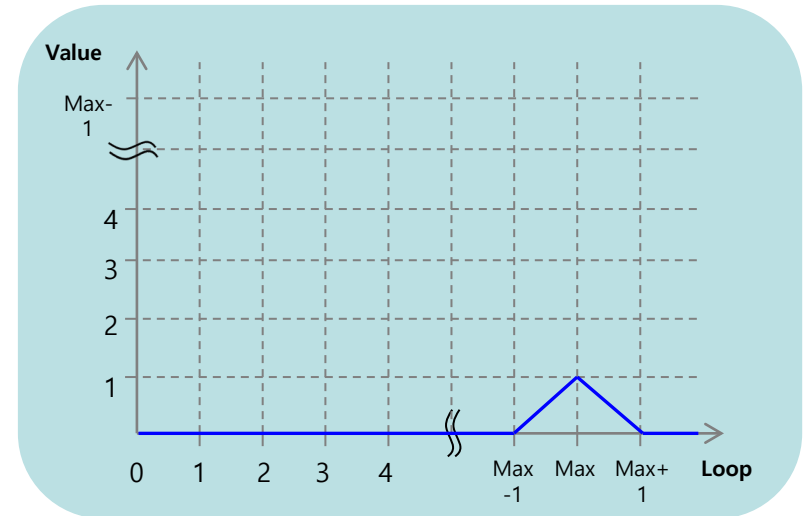
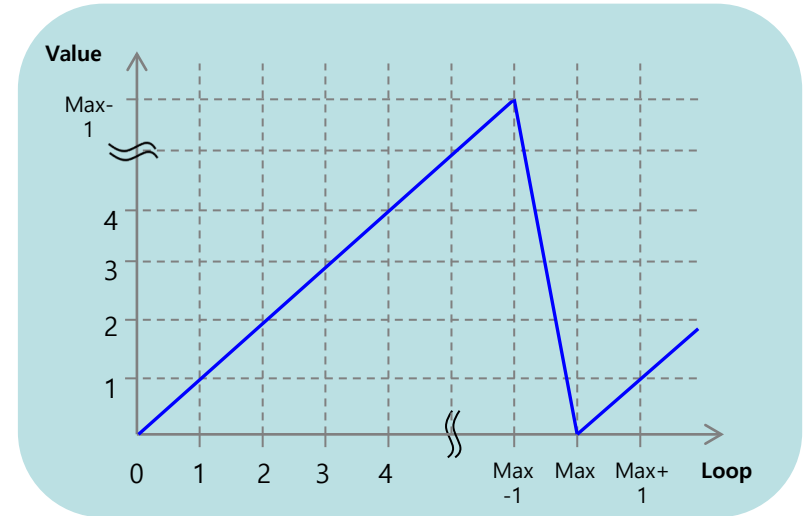
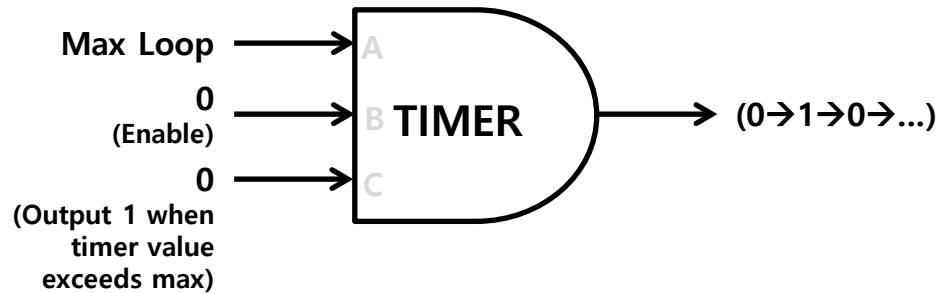
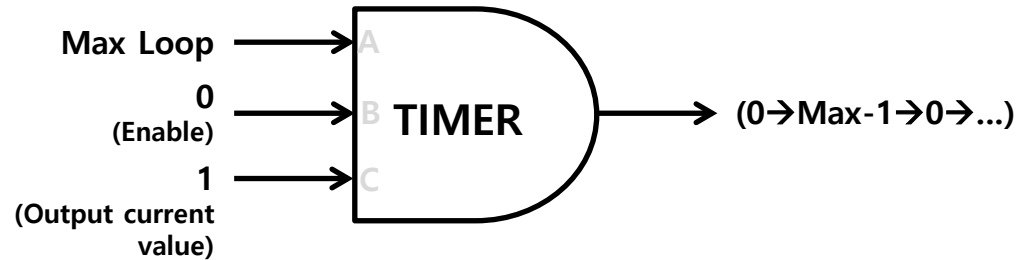


Truth Table

AND			Result	AND/OR			Result
0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	1
1	0	0	0	0	1	0	0
1	1	1	1	0	1	1	1
OR			Result	XOR			Result
0	0	0	0	0	0	0	0
0	1	1	1	0	1	1	1
1	0	1	1	1	0	1	1
1	1	1	1	1	1	0	1
0	0	0	0	1	1	1	1
0	1	1	1				
1	0	1	1				
1	1	1	0				

How to use Timer Function Blocks

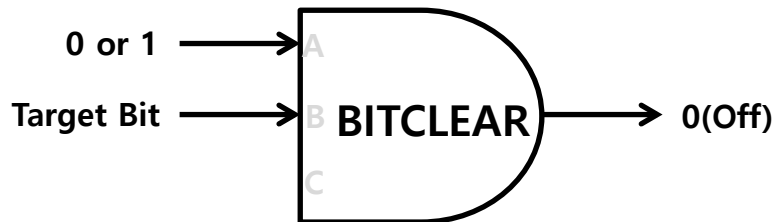
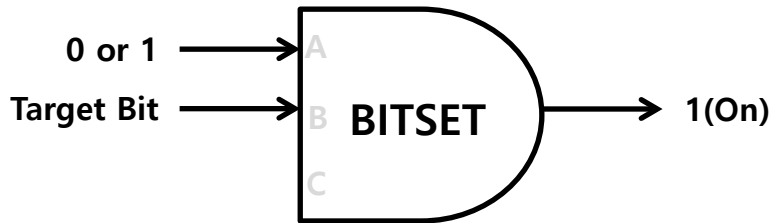
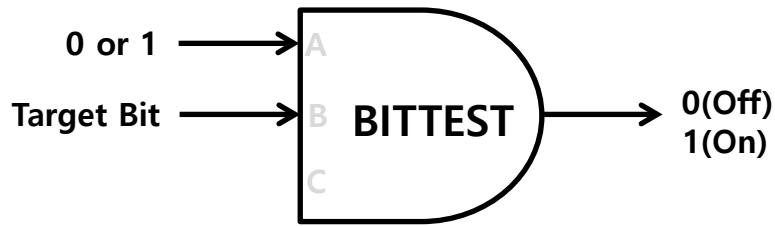
- TIMER works when B = 0
- TIMER increases 1 per every loop when C = 1
- If C is 1, adds 1 each time a user sequence completes a loop.
- C is 0, output 1 when timer value exceeds max loop.



How to use Binary Bit Function Blocks

To read or write a binary (0 or 1) bit such as a digital input, these function blocks must be used to point to the appropriate bit in a status word.

- BITTEST: If the B bit of the A parameter word is 1, the output is 1. if it is 0, the output is 0.
- BITSET: Set the B bit of the A parameter word, BITCLEAR: Reset the B bit of the A parameter word.



LCD keypad

[DI Status]



[DO Status]

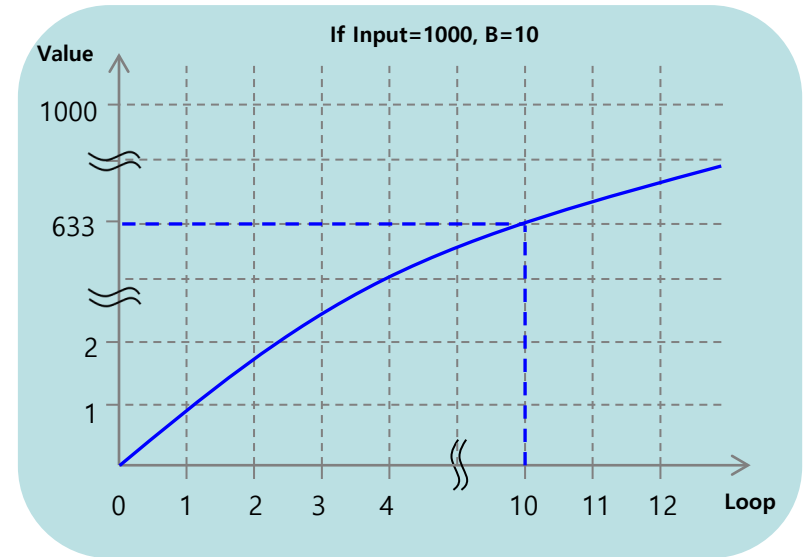
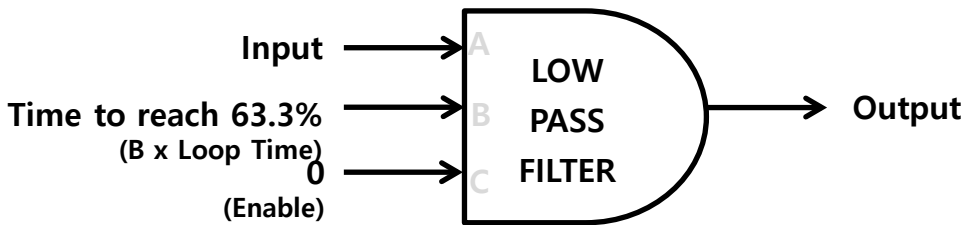


[On/Off]



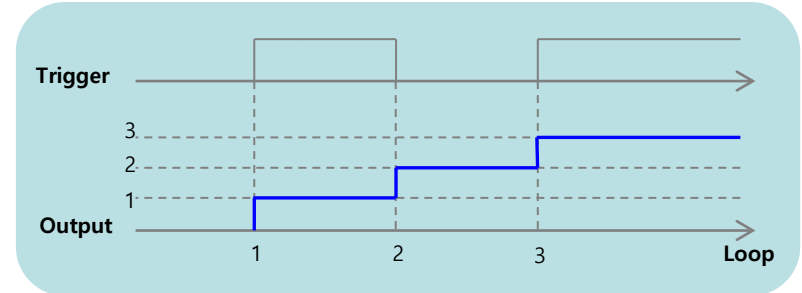
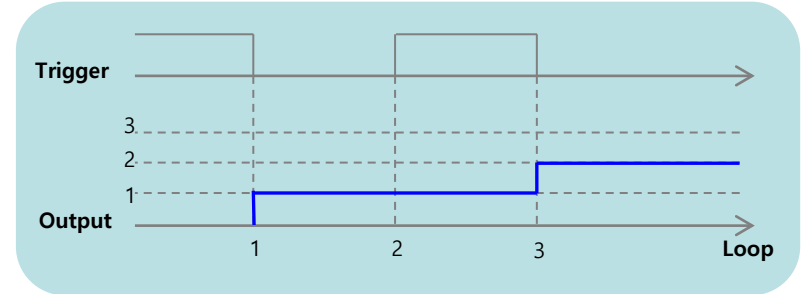
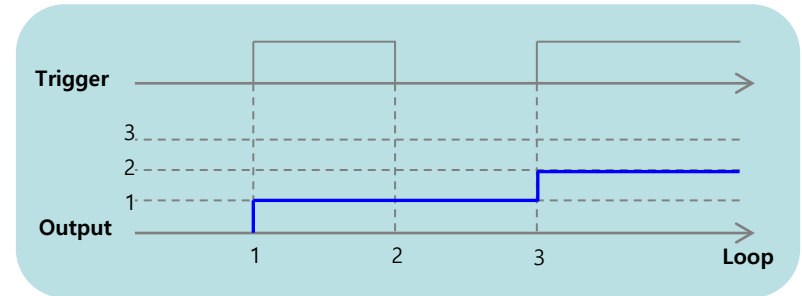
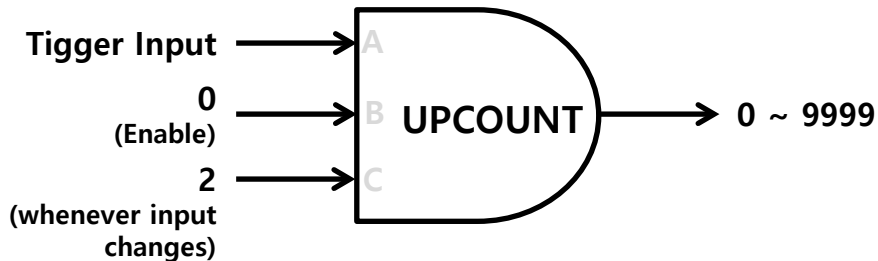
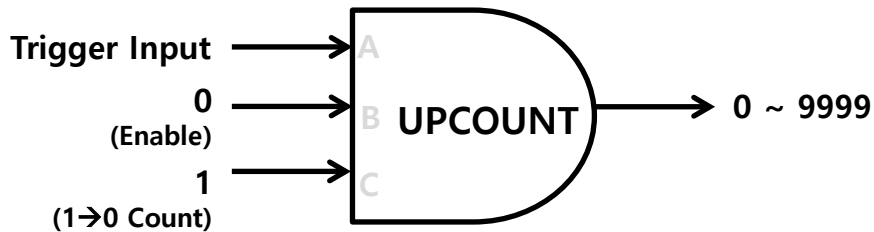
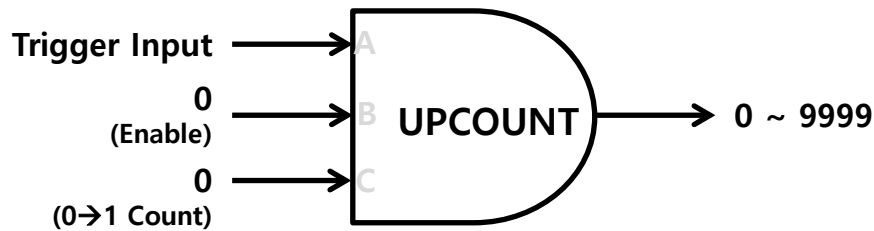
How to use Filter Function Block

- LOWPASSFILTER: The values of input A will transfer to the output until the B filter gains time constant is reached. After the value is reached, no larger output will be allowed.



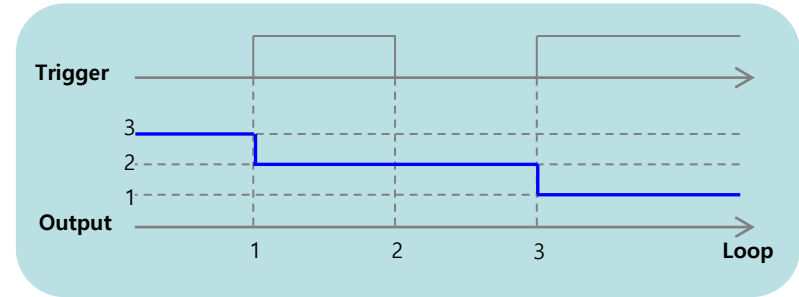
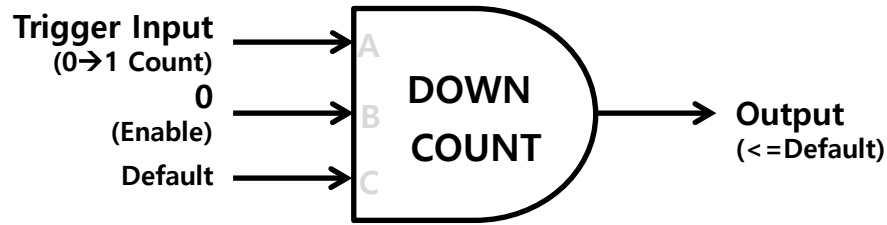
How to use Counter Function Blocks

- UPCOUNT: After receiving a trigger input (A), outputs are upcounted by C conditions.
- If the C is 0, upcount when the input at A changes from 0 to 1(Rising Edge). If the C is 1, upcount when the input at A is changed from 1 to 0(falling edge). If the C is 2, upcount whenever the input at A changes.



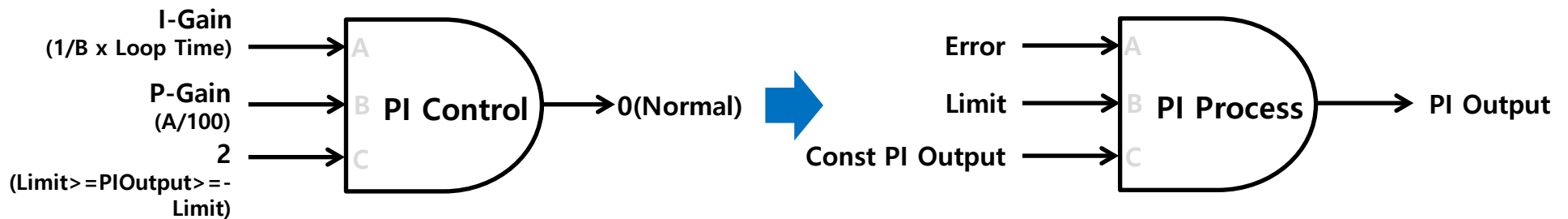
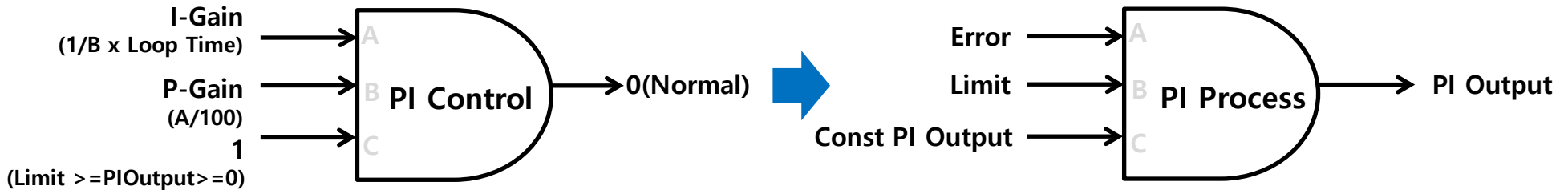
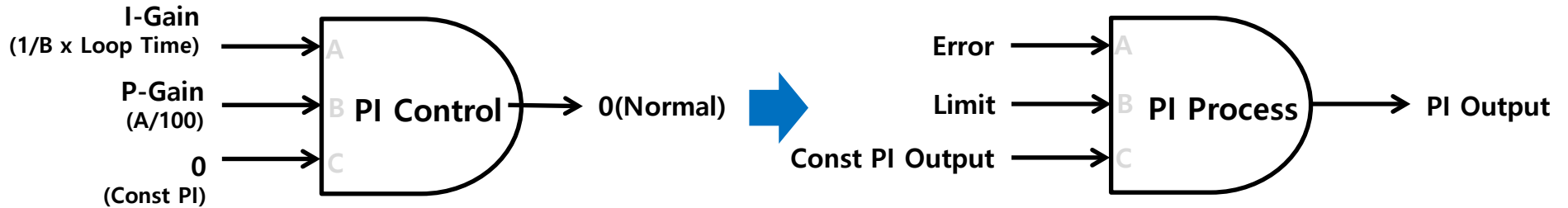
How to use Counter Function Blocks (con't)

- DOWNCOUNT: After receiving a trigger input (A), outputs are downcounted by C conditions. Downcounts when the A parameter changes from 0 to 1.



How to use PI Process Function Blocks

- PI CONTROL+PI PROCESS: P,I gain=A,B parameter input, then output as C.
- $PI\ Output = Error \times P\text{-Gain}(A/100) + [Loop \times \{Error \times I\text{-Gain}(1/B \times Loop\ Time)\}]$
- The PI process block (PI_PROCESS Block) must be used after the PI control block (PI_CONTROL Block) for proper PI control operation.



Ironhorse ACN Series AC Drive – User Sequence Programming Examples

- ✓ The following pages show common examples of user sequence programming.
- ✓ Before programming is allowed, set:
 - AP.2 = 1. This enables User Sequence.
 - US.1 = 0. User sequence must be in Stop mode for programming.
- ✓ To program these examples, use the drive keypad and navigate to the "Parameter Code" outlined in the left-hand column. Then, modify the parameter value as outlined in the Setting column. (Parenthesis shows the value programmed in the indicated register, for reference only. i.e. 1D20 is programmed with a value of 0.)

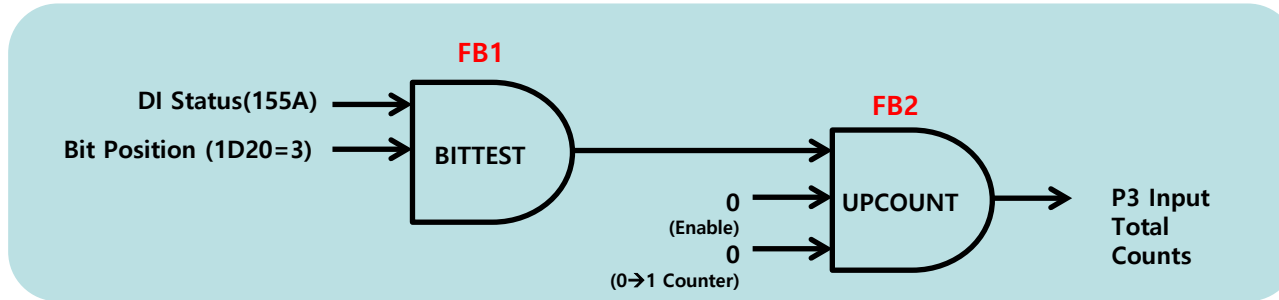
Code	Addr.	Name	Setting
UF-01	1E01	Usr Func 1	21: BITTEST
UF-02	1E02	Usr Inp 1-A	155A
UF-03	1E03	Usr Inp 1-B	1D20 (0)
UF-04	1E04	Usr Inp 1-C	-
UF-05	1E05	Usr Out 1	-

- ✓ "-" indicates no change is needed for the parameter code or the parameter is read-only.

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 1: Digital Input Counter

- ✓ This is an example for counting the number of times the P3 Input (In.67= 5 Bx)) has transitioned to the ON state. This program sequence will use the BITTEST function Block to filter the 3rd bit of the DI status word(155A). Next, that bit will be counted in the UPCOUNT block. The FB2 counter value can be read at the UF.10 (1E0A) or linked to another address through US.12

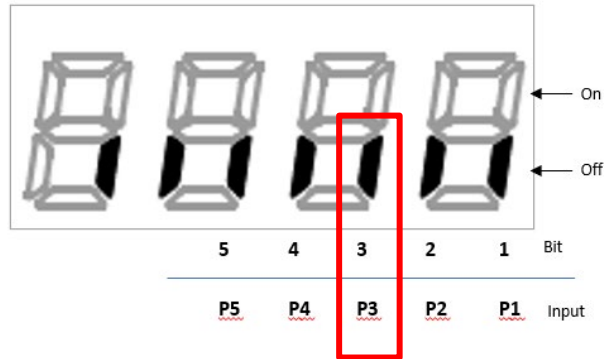


DI Status Word

Parameter: In.90

Comm Address: 155A

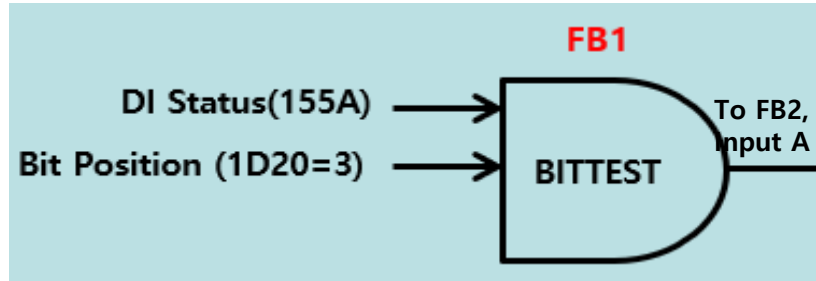
To monitor the P3 input, reference bit position 3.



Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 1: Digital Input Counter

✓ Program the drive as follows:



1. Identify variables and set constants for use in FB1:

Code	Addr.	Name	Setting
In.90	155A	DI Status	-
US-32	1D20	Void Para 2	3

2. Set FB1 Parameters

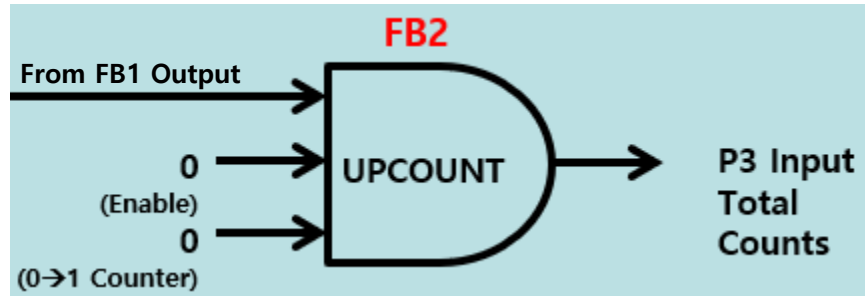
Code	Addr.	Name	Setting
UF-01	1E01	Usr Func 1	21: BITTEST
UF-02	1E02	Usr Inp 1-A	155A
UF-03	1E03	Usr Inp 1-B	1D20
UF-04	1E04	Usr Inp 1-C	-
UF-05	1E05	Usr Out 1	-

US.11—Link UserOut1

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 1: Digital Input Counter

✓ Program the drive as follows:



3. Set constants for use with FB2:

Code	Addr.	Name	Setting
US-31	1D1F	Void Para 1	0

4. Set FB2 PARAMETERS

Code	Addr.	Name	Setting
UF-06	1E06	Usr Func 2	27: UPCOUNT
UF-07	1E07	Usr Inp 2-A	1E05
UF-08	1E08	Usr Inp 2-B	1D1F
UF-09	1E09	Usr Inp 2-C	1D1F
UF-10	1E0A	Usr Out 2	-

US.12—Link UserOut2

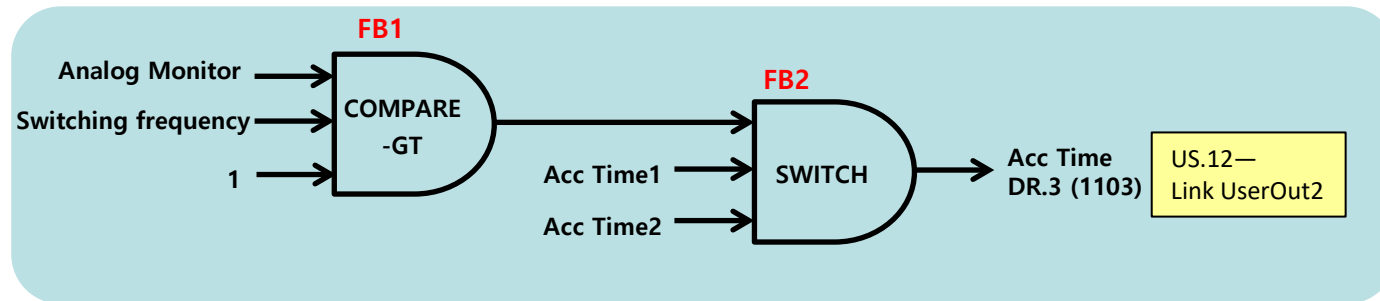
5. Set US.1=1 Run. The user function sequence will begin executing.

Results: Toggle the P3 input 5 times. Verify UF.10 = 5.

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 2 – Acceleration time transition

- ✓ This example will change the acceleration time(dr.3, 1103) depending on the value of the analog input frequency command. The Compare-GT block will monitor if the output frequency (set by the analog input) exceeds the switching frequency. When the Frequency output is greater than the Switch Frequency value, the output will be set to 1. This will cause the Acceleration time to switch from Acc Time 1 to Acc Time 2 by the Switch block.



- ✓ Program the drive as follows:

1. Identify variables and set constants for use in the program sequence:

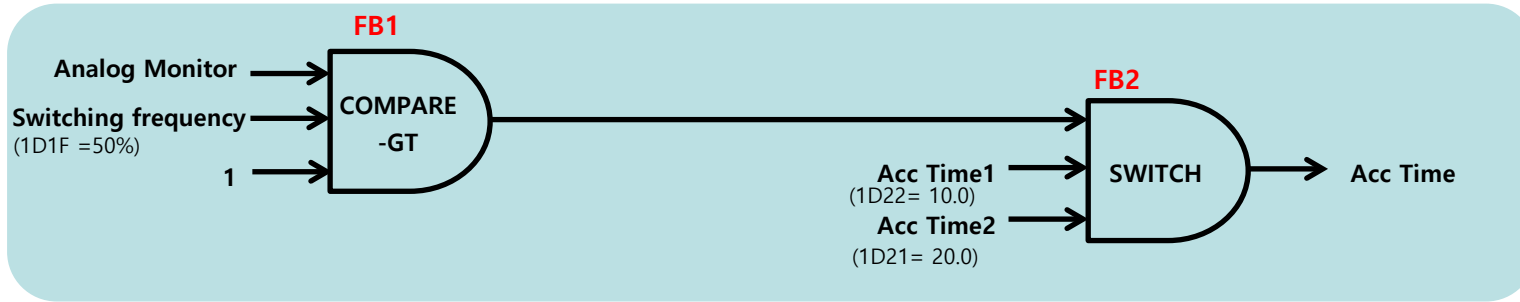
Code	Addr	Name	Setting
DR-7	1107	Freq Ref Src	2: V1
DR-2	1101	Cmd Freq	-
DR-03	1103	Accel Time	200
US-12	1D0C	Link User Out 2	1103
OU-1	1601	Analog Out1	0: Freq
OU-6	1606	Analog1 Monitor	-

Code	Addr	Name	Setting
US-31	1D1F	Void Para 1	500 (50%)
US-32	1D20	Void Para 2	1
US-33	1D21	Void Para 3	200 (20.0)
US-34	1D22	Void Para 4	100 (10.0)

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 2 – Acceleration time transition

✓ Program the drive as follows:



2. Set Function Block 1 parameters:

Code	Addr	Name	Setting
UF-01	1E01	User Func 1	11:Compare-GT
UF-02	1E02	User Input 1-A	1606
UF-03	1E03	User Input 1-B	1D1F (50%)
UF-04	1E04	User Input 1-C	1D20 (1)
UF-05	1E05	User Output 1	-

3. Set Function Block 2 parameters:

Code	Addr	Name	Setting
UF-06	1E06	User Func 2	20:SWITCH
UF-07	1E07	User Input 2-A	1E05 (Out1)
UF-08	1E08	User Input 2-B	1D22 (10.0)
UF-09	1E09	User Input 2-C	1D21 (20.0)
UF-10	1E0A	User Output 2	-

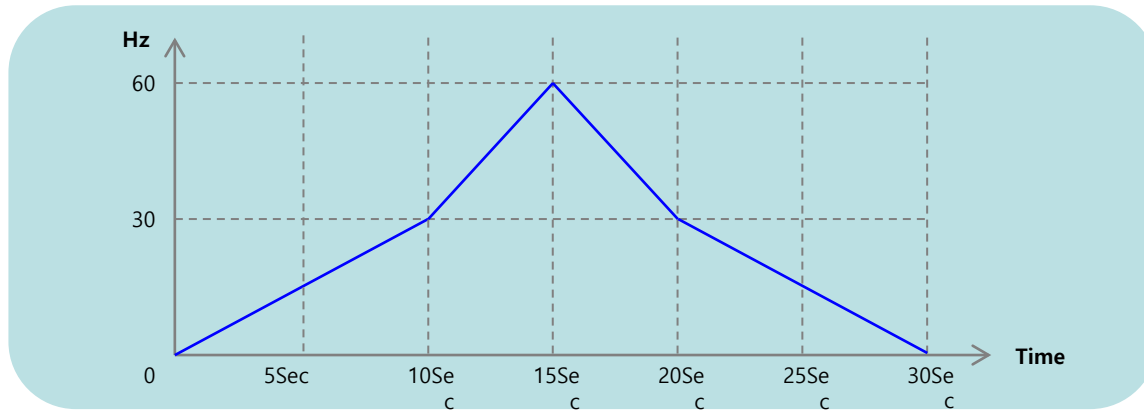
US.12—Link UserOut2 = 1103
(Dr.3 - Accel Time)

Example 2 – Acceleration time transition

✓ Program the drive as follows:

3. Change US.1=1 (Run). The user function sequence will begin executing.

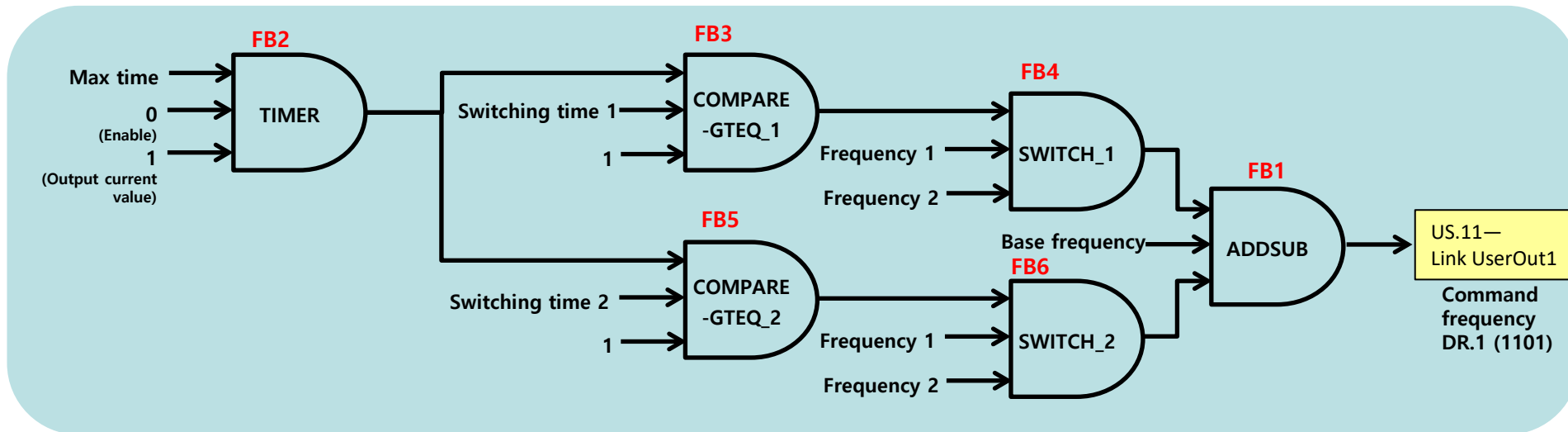
✓ **Results:** Check if accelerating takes 20 sec under 30Hz and 10 sec over 30Hz.



Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 3 – Variable speed operation with timer

- ✓ This example will change the drive speed to a preset frequency at regular intervals. Frequency is automatically changed at regular intervals by using TIMER function. The timer will be monitored by Compare GT blocks. The output of the compare blocks will enable the frequency change through the Switch blocks and the AddSub block.



- ✓ Program the drive as follows:

1. DR-1 is the Target Frequency of the drive. The output of the user program sequence will write to this value to change the drive frequency:

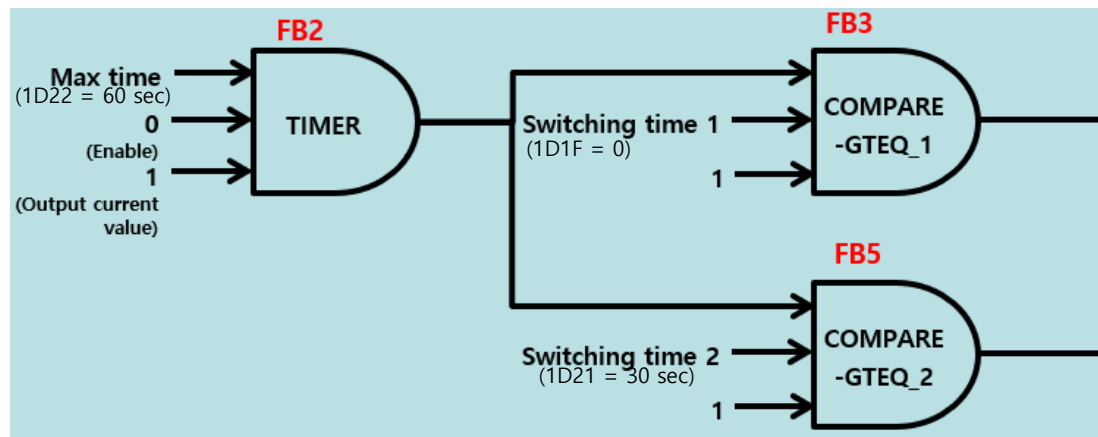
Code	Addr	Name	Setting
DR-1	1101	Target Freq	0
US-11	1D0B	Link UserOut 1	1101

2. Set constants for use in the program sequence.

Code	Addr	Name	Setting
US-31	1D1F	Void Para 1	0
US-32	1D20	Void Para 2	1
US-33	1D21	Void Para 3	30
US-34	1D22	Void Para 4	60
US-35	1D23	Void Para 5	1500
US-36	1D24	Void Para 6	4000

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 3 – Variable speed operation with timer



3. Set Function Block 2, 3 and 5 Parameters:

Code	Addr	Name	Setting
UF-6	1E06	User Func 2	14:TIMR
UF-7	1E07	User Input 2-A	1D22 (MaxTime)
UF-8	1E08	User Input 2-B	1D1F (0)
UF-9	1E09	User Input 2-C	1D20 (1)
UF-10	1E0A	User Output 2	-

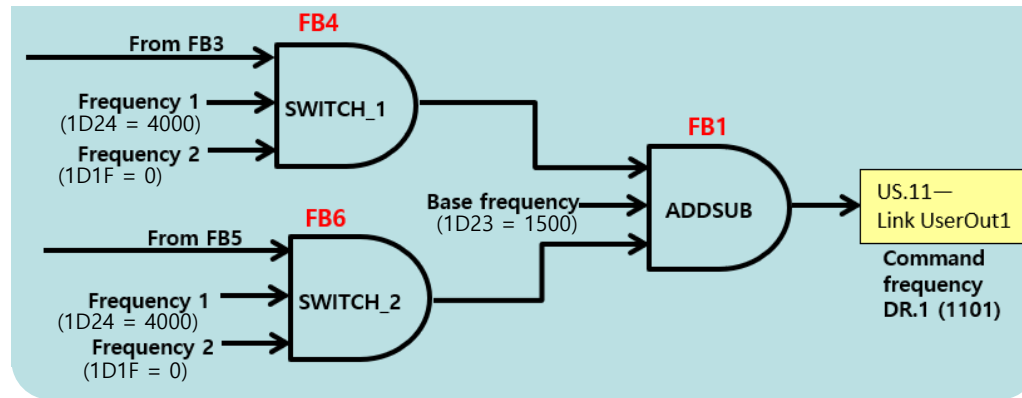
Code	Addr	Name	Setting
UF-11	1E0B	User Func 3	11: CmpGT
UF-12	1E0C	User Input 3-A	1E0A (Out2)
UF-13	1E0D	User Input 3-B	1D1F (SwTime1)
UF-14	1E0E	User Input 3-C	1D20 (1)
UF-15	1E0F	User Output 3	-

Code	Addr	Name	Setting
UF-21	1E15	User Func 5	11:Cmp GT
UF-22	1E16	User Input 5-A	1E0A(Out2)
UF-23	1E17	User Input 5-B	1D21 (SwTime2)
UF-24	1E18	User Input 5-C	1D20 (1)
UF-25	1E19	User Output 5	-

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 3 – Variable speed operation with timer

✓ Program the drive as follows:



4. Set Function Block 1, 4 and 6 Parameters:

Code	Addr	Name	Setting
UF-16	1E10	User Func 4	20:SWITCH
UF-17	1E11	User Input 4-A	1E0F (Out3)
UF-18	1E12	User Input 4-B	1D24 (Freq1)
UF-19	1E13	User Input 4-C	1D1F (Freq2)
UF-20	1E14	User Output 4	-

Code	Addr	Name	Setting
UF-26	1E1A	User Func 6	20:SWITCH
UF-27	1E1B	User Input 6-A	1E19 (Out5)
UF-28	1E1C	User Input 6-B	1D24 (Freq1)
UF-29	1E1D	User Input 6-C	1D1F (Freq2)
UF-30	1E1E	User Output 6	-

Code	Addr	Name	Setting
UF-01	1E01	User Func 1	3:ADDSUB
UF-02	1E02	User Input 1-A	1E14 (Out4)
UF-03	1E03	User Input 1-B	1D23 (Base Freq)
UF-04	1E04	User Input 1-C	1E1E (Out6)
UF-05	1E05	User Output 1	-

↓
US.11—Link UserOut1
(see Step 1)

Ironhorse ACN Series AC Drive – User Sequence Programming Examples

Example 3 – Variable speed operation with timer

✓ Program the drive as follows:

5. Change US.1=1 (Run). The user function sequence will begin executing.

✓ Results: Frequency is changed from 55.00 → 15.00 → 55.00 at every 30 sec interval.

