C (Counter)

Counters will increment their present count value when input signals are triggered from OFF→ON.

|	16 bits counters	32 bits counters		
Type	General	General	High speed	
Counters	C0~C199	C200~C231(C232)	C232(C233)~C242, C245~C254	C243, C244
Count direction	Count up	Count up/down		Count up
Range	0~32,767	-2,147,483,648~+2,147,483,647		0~2,147,483,647
Preset value register	Constant K or data register D (Word)	Constant K or data register D (Dword)		
Output operation	Counter will stop when preset value reached	Counter will keep on counting when preset value reached. The count value will become -2,147,483,648 if one more count is added to +2,147,483,647		Counter will keep on counting when preset value is reached. The count value will become 0 if one more count is added to +2,147,483,647

	16 bits counters	32 bits counters	
Output contact function	Ouptut Coil will be ON when counter reaches preset value.	Output coil is ON when counter reaches or is above preset value. Output coil is OFF when counter is below preset value.	Output coil is ON when counter reaches or is above preset value
High speed conparison	-	Associated devices are activated immediately when preset value is reached, i.e. independant of scan time.	-
Reset action	The present value will reset to 0 when RST instruction is executed, output coil will be OFF.		

Example:

```
LD       X0
RST      C0
LD       X1
CNT      C0  K5
LD       C0
OUT      Y0
```

When X0 = ON, RST instruction resets C0. Every time When X1 is driven, C0 will count up (add 1).

When C0 reaches the preset value K5, output coil Y0 will be ON and C0 will stop counting and ignore the signals from input X1.
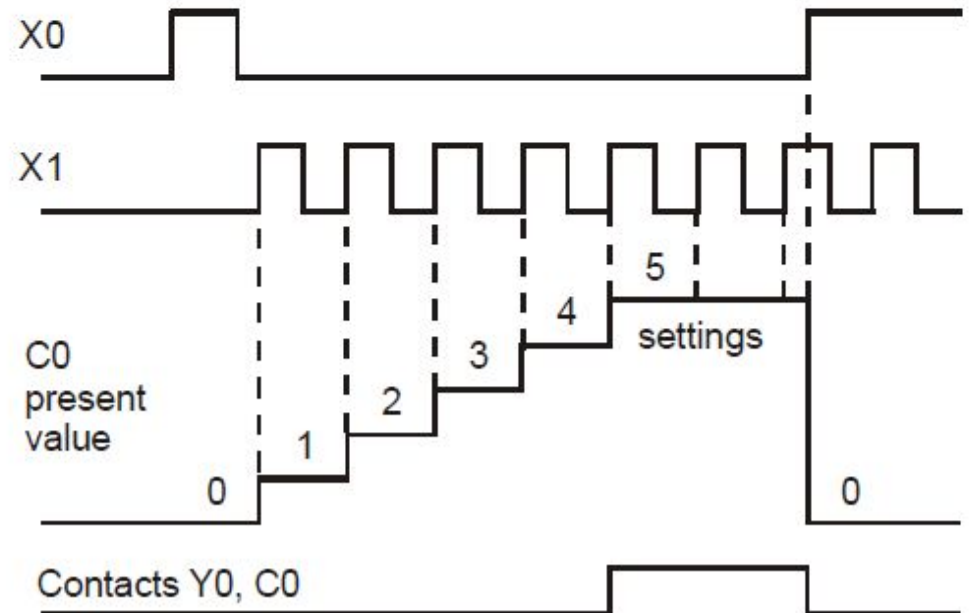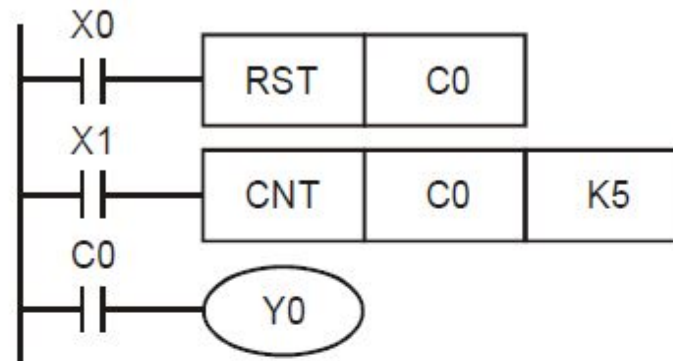
M relays M1200~M1254 are used to set the up/down counting direction for C200~C254 respectively. Setting the corresponding M relay ON will set the counter to count down.

Example:

```
LD    X10
OUT   M1200
LD    X11
RST   C200
LD    X12
CNT   C200 K-5
LD    C200
OUT   Y0
```
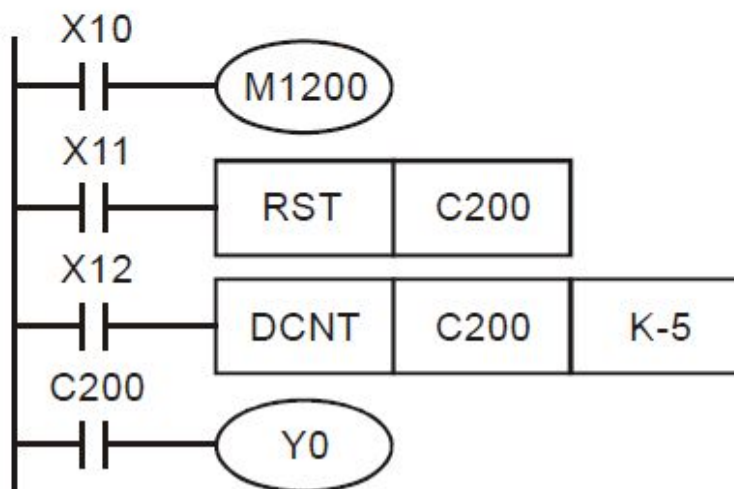
a) X10 drives M1200 to determine counting direction (up / down) of C200

b) When X11 goes from OFF to ON, RST instsruction will be executed and the PV (present value) in C200 will be cleared and contact C200 is OFF.

c) When X12 goes from Off to On, PV of C200 will count up (plus 1) or count down (minus 1).

d) When PV in C200 changes from K-6 to K-5, the contact C200 will be energized. When PV in C200 changes from K-5 to K-6, the contact of C200 will be reset.

e) If MOV instruction is applied through WPLSoft or HPP to designate a value bigger than SV to the PV register of C0, next time when X1 goes from OFF to ON, the contact C0 will be ON and PV of C0 will equal SV.
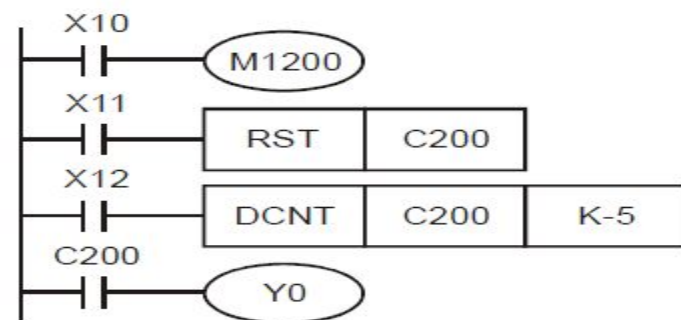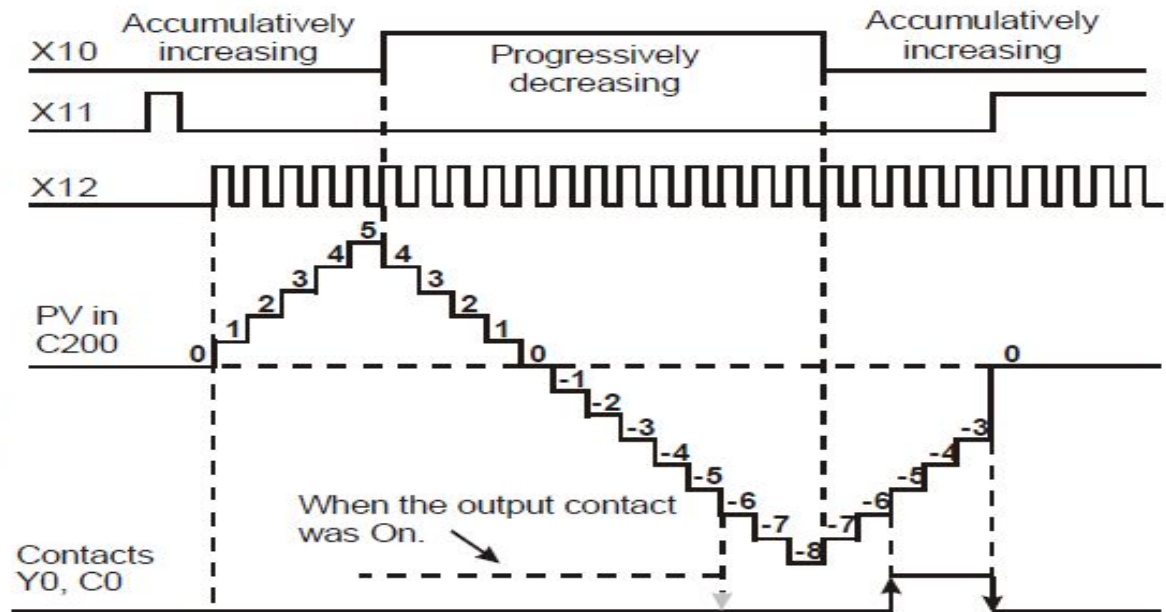
High-speed Counters

There are two types of high speed counters provided including Software High Speed Counter (SHSC) and Hardware High Speed Counter (HHSC). The same Input point (X) can be designated with only one high speed counter. Double designation on the same input or the same counter will result in syntax error when executing DCNT instruction.

Applicable Software High Speed Counters:

C \ X	1-phase input								2 phase 2 input		
	C235	C236	C237	C238	C239	C240	C241	C242	C232	C233	C234
X0	U/D								A		
X1		U/D									
X2			U/D						B		
X3				U/D							
X4					U/D					A	
X5						U/D				B	
X6							U/D				A
X7								U/D			B
R/F	M1270	M1271	M1272	M1273	M1274	M1275	M1276	M1277	-	-	-
U/D	M1235	M1236	M1237	M1238	M1239	M1240	M1241	M1242	-	-	-

U: Count up   D: Count down   A: Phase A input   B: Phase B input
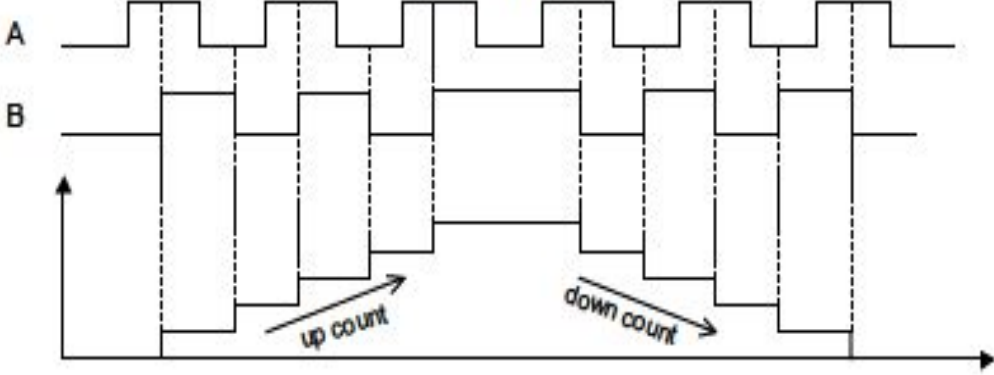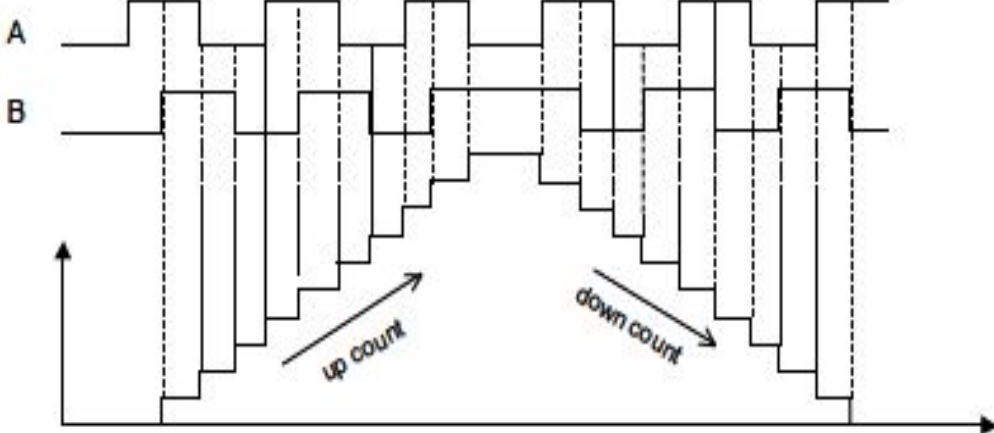
Applicable Hardware High Speed Counters:

C / X	1-phase input		1-phase 2-input						2-phase 2-input			
	C243	C244	C245	C246	C247	C248	C249	C250	C251	C252	C253	C254
X0	U		U/D	U/D	U	U			A	A		
X1	R		Dir	Dir	D	D			B	B		
X2		U					U/D	U/D			A	A
X3		R					Dir	Dir			B	B
X4				R		R				R		
X5								R				R

U: Count up   A: Phase A input   Dir: Directoin signal input
D: Count down   B: Phase B input   R: Reset signal input

2-phase 2-input counting supports double and 4 times frequency, which is selected in D1022 as the table in next page. Please refer to the below table for detailed counting wave form.

D1022	Counting mode
K2 (Double Frequency)	
K4 or other value (Quadruple frequency) (Default)	

| Counting mode		Counting wave pattern
2-phase 2 inputs	1 (Normal frequency)	A-phase / B-phase / Counting up / Counting down
	2 (Double frequency)	A-phase / B-phase / Counting up / Counting down
	4 (4 times frequency)	A-phase / B-phase / Counting up / Counting down

1-phase 1 input high-speed counter:

Example:

```
LD      X20
RST     C235
LD      X21
OUT     M1235
LD      X22
DCNT    C235 K5
LD      C235
OUT     Y0
```
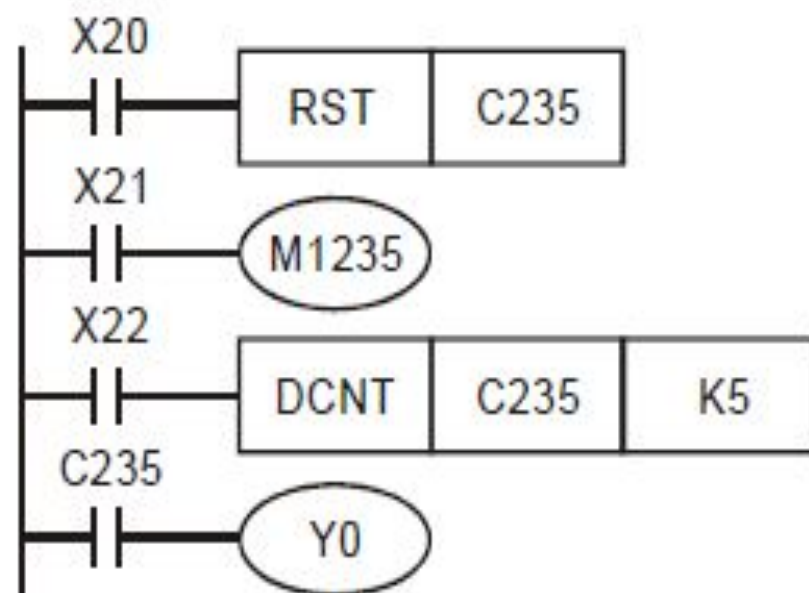
1. X21 drives M1235 to determine counting direction (Up/Down) of C235.

2. When X20 = ON, RST instsruction executes and the current value in C235 will be cleared. Contact C235 will be OFF

3. When X22 = ON, C235 receives signals from X0 and counter will count up (+1) or count down (-1).

4. When counter C235 reaches K5, contact C235 will be ON. If there is still input signal input for X0, it will keep on counting.
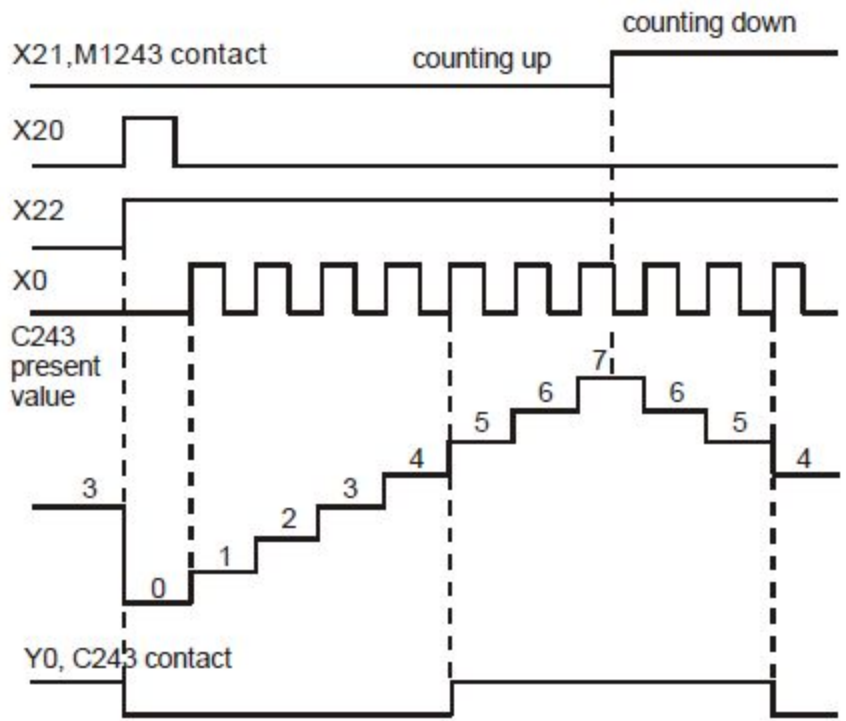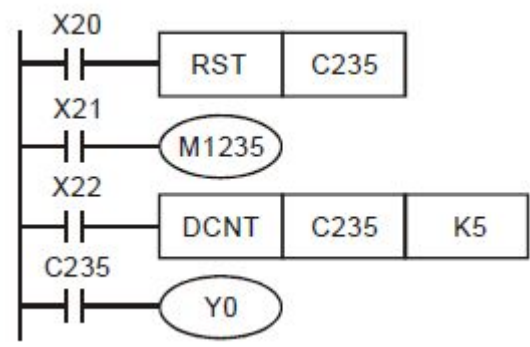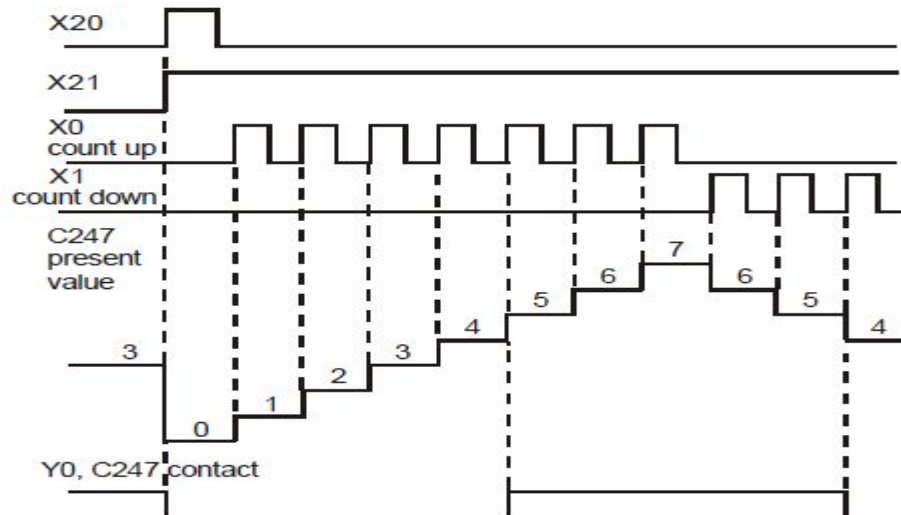
1-phase 2 inputs high-speed counter:

Example:

```
LD      X20
RST     C247
LD      X21
DCNT    C247 K5
LD      C247
OUT     Y0
```
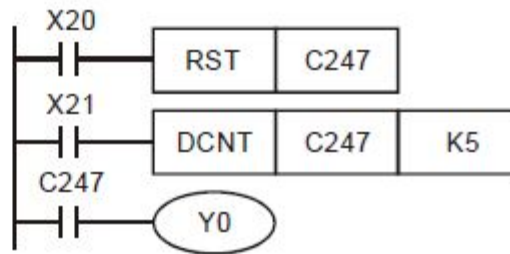
1. When X20 is ON, RST instsruction executes and the current value in C247 will be cleared. Contact C247 will be OFF.

2. When X21=ON, C247 receives count signals from X0 and counter counts up (+1), or C247 receives count signal from X1 and counter counts down (-1)

3. When C247 reaches K5, contact C247 will be ON. If there is still input signal from X0 or X1, C247 will keep on counting
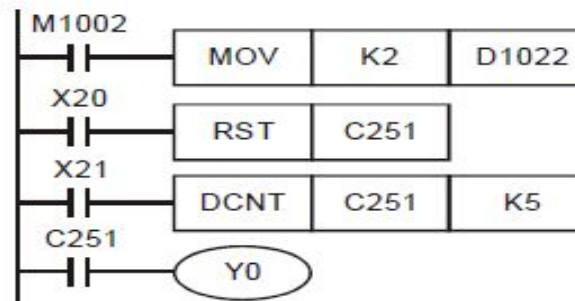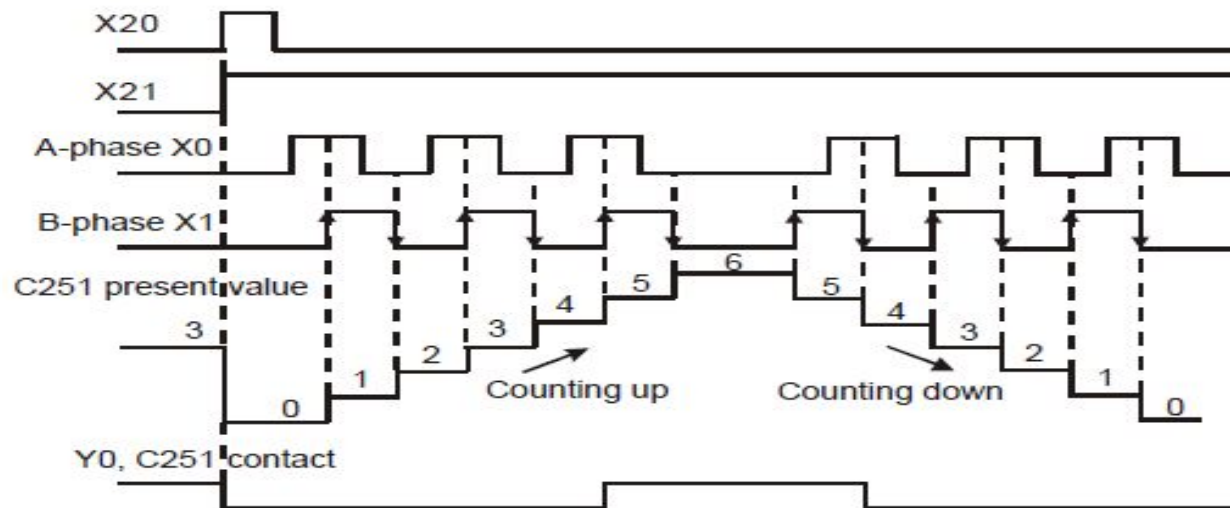
AB-phase input high-speed counter:

Example:

```
LD        M1002
MOV       K2 D1022
LD        X20
RST       C251
LD        X21
DCNT      C251 K5
LD        C251
OUT       Y0
```


1. When X20 is ON, RST instsruction executes and the current value in C251 will be cleared. Contact C251 will be OFF.

2. When X21 is ON, C251 receives A phase counting signal of X0 input terminal and B phase counting signal of X1 input terminal and executes count up or count down

3. When counter C251 reaches K5, contact C251 will be ON. If there is still input signal from X0 or X1, C251 will keep on counting

4. Counting mode can be specified as double frequency or 4-times frequency by D1022. Default: quadruple frequency.

The 2-phase 2 inputs counting mode of the high speed counters in ES/EX/SS (V5.5 and above) and SA/SX/SC series MPU is set by special D1022 with normal frequency, double frequency and 4 times frequency modes. The contents in D1022 will be loaded in in the first scan when PLC is switched from STOP to RUN.

Device No.	Function
D1022	Setting up the multiplied frequency of the counter
D1022 = K1	Normal frequency mode selected
D1022 = K2 or 0	Double frequency mode selected (default)
D1022 = K4	4 times frequency mode selected

API	Mnemonic		Operands	Function	Controllers
53	D HSCS		S₁ S₂ D	High Speed Counter Set	ES2/EX2 | SS2 | SA2 SE | SX2

Type	Bit Devices				Word devices											Program Steps
OP	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	E	F	DHSCS: 13 steps
S₁					*	*	*	*	*	*	*	*	*	*	*	
S₂												*				
D		*	*	*												

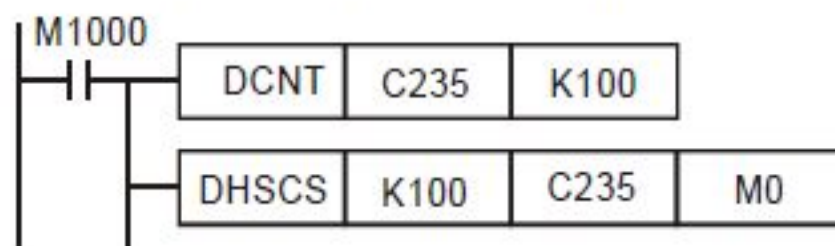|	PULSE				16-bit				32-bit			
	ES2/EX2	SS2	SA2 SE	SX2	ES2/EX2	SS2	SA2 SE	SX2	ES2/EX2	SS2	SA2 SE	SX2

Operands:

S₁: Comparative value   **S₂**: No. of high-speed counter   **D**: Compare result

Explanations:

1.   Functions related to high-speed counters adopt an interrupt process; therefore, devices specified in **D** which indicates comparison results are updated immediately. This instruction compares the present value of the designated high-speed counter **S₂** against a specified comparative value **S₁**. When the current value in counters equals **S₁**, device in **D** will be ON even when values in **S₁** and **S₂** are no longer equal.

Program Example 1:

Set/reset M0 by applying software comparator

```
 M1000
 ┤├────┬──────────────────────────────┐
       │  │ DCNT │  C235  │   K100   │ │
       │  └──────────────────────────┘ │
       │  ┌──────────────────────────┐ │
       └──┤ DHSCS │ K100 │ C235 │ M0 │ │
          └──────────────────────────┘ │
```
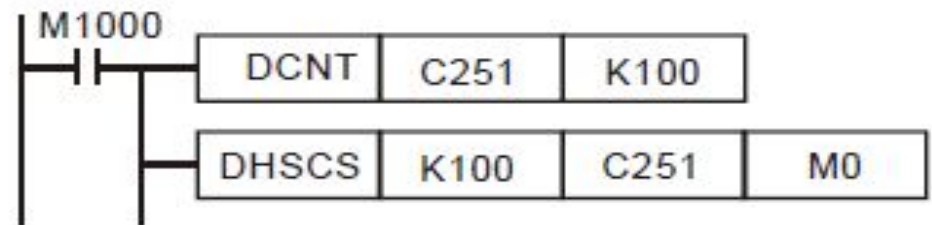
➤ When value in C235 varies from 99 to100, DHSCS instruction sets M0 ON. (M1235 = OFF, C235 counts up)

➤ When value in C235 varies from 101 to100, DHSCR instruction resets M0. (M1235 = ON, C235 counts down)

➤ Timing diagram for the comparison:
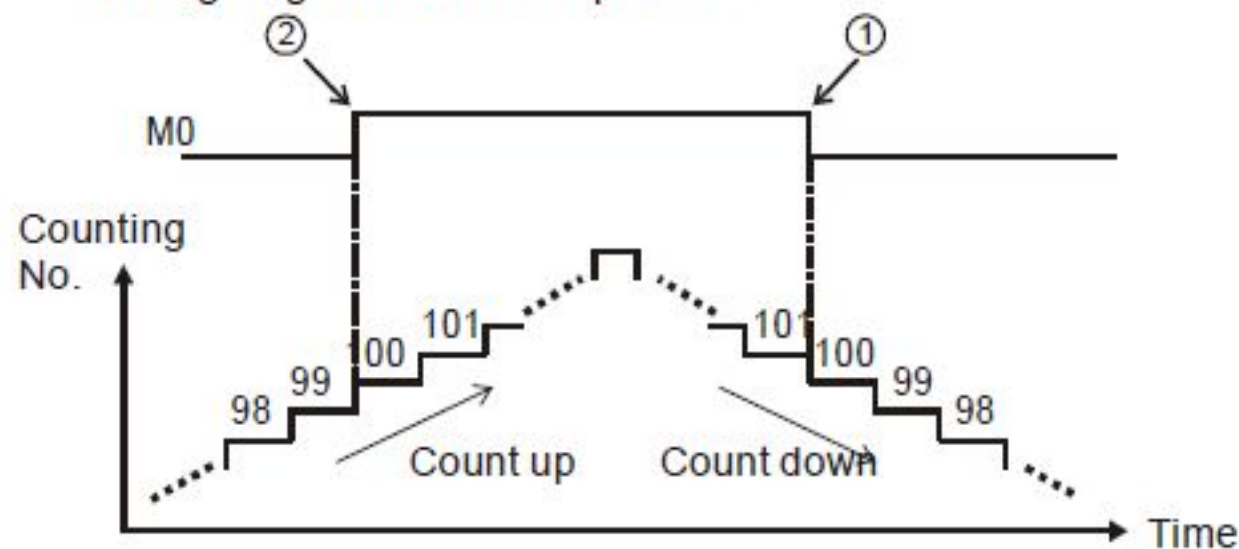
Program Example 2:

Set/reset M0 by applying hardware comparator

> When C251 counts up and the value in C251 varies from 100 to101, DHSCS instruction sets M0 ON.

> When C251 counts down and the value in C251 varies from 100 to 99, DHSCR instruction resets M0.

> Timing diagram for the comparison: