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# Chapter 1 General Introduction

## 1.1 Summary

Kinco-K5 series PLC is a small and integrated PLC .It is Kinco new thin and high performance PLC. Based on high performance, high reliability and powerful functions of K5/K2, KS series use higher level CPU. KS has CANopen port, higher speed input and output, small size for installation.

It can fit more user's requirement.

## 1.2 Product List

| Name | Order No. | Description |
|---|---|---|
| **CPU Module** | | |
| CPU105 | KS105-16DT | DC 24V, DI 8*DC24V，DO 8*DC24V.<br>1* RS232(programming port),1*RS485.<br>Expandable(max 14 modules) |
| | KS105C1-16DT | DC 24V, DI 8*DC24V，DO 8*DC24V<br>1* RS232(programming port),1*RS485,1*CAN |
| | KS105C2-16DT | DC 24V, DI 8*DC24V，DO 8*DC24V<br>1* RS232(programming port),1*RS485,2*CAN<br>Expandable(max 14 modules) |

## 1.3 Environmental Condition

Kinco-KS accords with GB/T 15969.3-2007（idt IEC61131-2：2007）standard and test specifications. The following table lists the conditions and requirements for Kinco-KS to work properly. It is the user's responsibility to ensure that the service conditions are not exceeded.

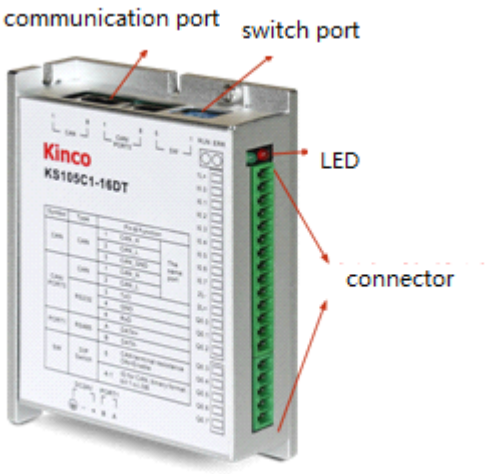
| **Transport and storage** | | |
|---|---|---|
| Ambient conditions | temperature | -40 --- +70 °C |
| | relative humidity | 10%~95%, no condensation |

| | | |
|---|---|---|
| | Altitude | Up to 3000 m |
| Mechanical conditions | Free falls | With manufacturer's original packaging, 5 falls from 1m of height. |
| Normal Operation | | |
| Ambient conditions | air temperature | Open equipment : -10 --- +55°C; Enclosed equipment: -10 --- +40°C |
| | relative humidity | 10%~95%, no condensation |
| | Altitude | Up to 2000 m |
| | Pollution degree | for use in pollution degree 2. |
| Mechanical conditions | Sinusoidal vibrations | 5<f<8.4Hz, Occasional: 3.5mm amplitude; Continuous: 1.75mm mplitude.<br>8.4<f<150, Occasional: 1.0g acceleration; Continuous: 0.5g acceleration. |
| | Shock | occasional excursions to 15g, 11 ms, half-sine, in each of 3 mutually perpendicular axes. |
| Electromagnetic compatibility (EMC) | Electrostatic discharge | ±4kV Contact, ±8kV Air. Performance criteria B. |
| | High energy surge | a.c. main power: 2KV CM, 1KV DM;<br>d.c. main power: 0.5KV CM, 0.5KV DM;<br>I/Os and Communication port: 1KVCM.<br>Performance criteria B. |
| | Fast transient bursts | main power: 2KV, 5KHz. I/Os and Communication port: 1KV, 5KHz.<br>Performance criteria B. |
| | Voltage drops and interruptions | a.c. supply: at 50Hz, 0% voltage for 1 period; 40% voltage for 10 periods; 75% voltage for 20 periods.<br>Performance criteria A. |
| Ingress Protection Rating | | IP20 |

# Chapter 2 CPU Module Introduction

## 2.1 Overview

### 2.1.1 Structure




### 2.1.2 CPU Types

Kinco-KS provides different CPU models with a diversity of features and capabilities, all the CPU use DC24V power supply. The following table describes main technical data of each CPU model.

| Parameters | KS105-16DT | KS105C1-16DT | KS105C2-16DT |
|---|---|---|---|
| Power supply | | | |
| Rated voltage | DC24V | | |
| Voltage range | DC20.4V – 28.8V | | |
| I/O | | | |
| Digital | 8*DI / 8*DO | | |

| | | | |
|---|---|---|---|
| Analog | -- | | |
| Expansion | 14 | --- | 14 |
| CAN | --- | CANopen master or CAN free potocol | |
| Serial port | PORT0,RS232, support programming protocol, MODBUS RTU slave, free protocol<br>PORT1,RS485,support programming protocol, MODBUS RTU master, free protocol | | |
| High speed counter | 4, Max 200KHz,support single and double | | |
| High speed output | 4<br>Channel 0&1&2 Max 200KHz (load resistance is less than 1.5KΩ at highest frequency)。<br>Channel 3 Max 10KHz | | |
| Interrupt | 4, I0.0-I0.3 interrupt up and down | | |
| **Storage** | | | |
| Programming | Max 4K bytes instruction | | |
| Data | M area 1K bytes; V area 4K bytes | | |
| Data backup | E2PROM, 448 bytes | | |
| Data retention | 2K bytes. Lithium battery , 3 years at normal environment | | |
| **Other** | | | |
| Timer | 256<br>1ms : 4<br>10ms : 16<br>100ms : 236 | | |
| Timer interruption | 2, 0.1ms | | |
| Counter | 256 | | |
| RTC | yes, the difference is 5 min/month at 25℃ | | |

## 2.2 Functions

### 2.2.1 CPU Status and LEDs

The CPU has two modes: STOP mode and RUN mode.

In RUN mode, the CPU executes the main scan cycle and all interrupt tasks.

In STOP mode, the CPU will set all output channels (including DO and AO) to the known values which are specified in the [**Hardware Configuration**] through Kincobuilder, and only process communication requests which comes from KincoBuilder software and other Modbus RTU master device.

- **Change CPU status**

Kinco-KS provides two ways for manually changing the CPU status:

Set all switch of CAN port [OFF],then PLC will be in STOP status.if any switch is [ON],PLC will be in RUN status. (use all 5 switches for KS105,use 1~4 switches for KS105C1,use 1~3 switches for KS105C2.

Using the operation switch (RUN/STOP); Executing [Debug] -> [RUN] or [STOP] menu command in Kincobuilder.

The following table lists the combined results of these two ways.

| **Operation Switch Position** | **KincoBuilder command** | **Actual Operation Mode** |
|---|---|---|
| Some Switch **Position** is ON | [RUN] | RUN |
| | [STOP] | STOP |
| All Switch **Position** is OFF | [RUN] | STOP |
| | [STOP] | STOP |

Besides, if CPU detects any seriously fault, it will enter STOP status immediately.

- **CPU Status LED**

The CPU module provides 4 status LEDs: **RUN**, **STOP**, **Comm.** and **Err.**

**Run, Err** LEDs show the CPU operation status.

【Run】： If CPU is in RUN status,it will turn on. If CPU is in STOP status,it will turn off.

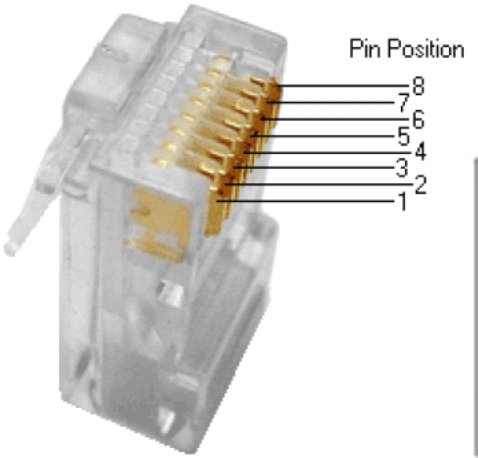
【Err.】： If CPU detects error in user program or module, it will turn on.

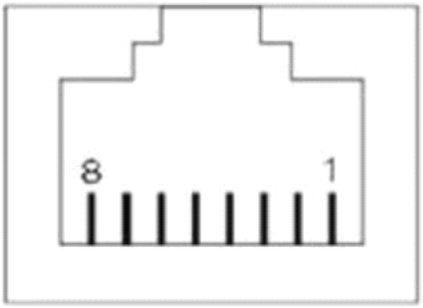
KS separates errors into three levels: Fatal error, Serious error, Normal error. When CPU detects an error, it will use different way to handle according to error level and turn on Err LED, then it will save the error code in sequence for user analysis.

### 2.2.2 Programming port and serial port

KS provides 2 communication ports,PORT1 and PORT2.It supports baudrate up to 115.2kbps.PORT1 can be used as programming port and also support Modbus RTU slave protocol and free protocol.PORT2 supports Modbus RTU protocol (as a slave or master) and free protocol.

PS232 programming port is in the RJ45 port. Pins and functions as below,




| PC (9 pin D mode) | | PLC (RJ45) |
|---|---|---|
| RxD (2) | ---------- | TXD (3) |
| TxD (3) | ---------- | RXD (6) |
| GND (5) | ---------- | GND (4) |

⚠RS232 can't insert and release with power. So we should turn off power of CPU or PC, otherwise it will break ports.

### 2.2.3 CAN port

KS105C1-16DT has 1 CAN port, CAN2.It can support CANopen master and free protocol.
KS105C2-16DT has 2 CAN port,,CAN1 and CAN2. CAN2 can support CANopen master and free protocol.CAN1 can support free protocol.

### 2.2.4 Expansion modules

KS105-16DT has expansion port, it can connect KS series expansion modules
CAN1 port of KS105C2-16DT can work as expansion port, also it support protocol. Users can use them directly without setup, PLC can identify it automatically.

### 2.2.5 High Speed Counter and High Speed Pulse Output

KS provides 4 high speed counters (HSC0~HSC3).High speed counter supports multiple modes: single phase, CW/CCW(Up/Down),AB phase (1 multiplication and 4 multiplication).All can support up to 200KHz(Include single phase and AB phase).
KS provides 4 high speed pulse outputs(Q0.0,Q0.1 and Q0.4, Q0.5).All support PTO and PWM.Q0.0 and Q0.1 ,Q0.5support up to 200KHz (The resistor of load should be less than 3KΩ),Q0.4 supports up to 10KHz.

### 2.2.6 Edge Interrupts

I0.0-I0.3 in CPU support edge interrupt function, it can execute interrupt by rising edge and falling edge of input signal. By using this function, it can capture the rising edge and falling edge of input signal quickly. For some input signal whose pulse width is less than the CPU scan time, it can respond quickly.

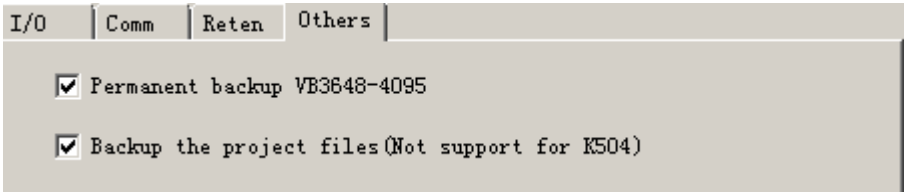
### 2.2.7 Data Retentive and Data Backup

Data retentive means the data in RAM can retain after power failure.CPU provides a lithium battery (Replaceable but un-rechargeable) for data retentive.When CPU loses power, the data in the RAM will be maintained by the lithium battery, and the retentive ranges will be left unchanged at next power on. Through **[Hardware]** configuration in KincoBuilder, user can select the type of data retentive (Such as V,C area) and the range. The life of battery is 5 years and the retaining duration is 3 years at normal temperature.

Data backup is that CPU provides an $E^2$PROM to store data permanently. At power on, the CPU will restore the data from $E^2$PROM into RAM to execute.

**Note: Because** $E^2$PROM has a writing limit of 1 million times, users should avoid to write data into data backup area frequently.

There are 448 bytes in V area for data backup (VB3648--VB4095),the data in this area will save in $E^2$PROM automatically.K2 sets VB3648--VB3902 as data backup by default,if user needs to use VB3903--VB4095 for data backup,it needs to configure in 【PLC hardware configuration】.The configuration interface is as following figure.




### 2.2.8 Real-time Clock (RTC)

The real-time clock built in the all CPU modules can provide real-time clock/calendar indication. Users need to use KincoBuilder【PLC】->【Time of Day Clock...】to set the clock when using RTC first time. Then users can use real-time clock instructions（READ_RTC、SET_RTC、RTC_W、RTC_R）.

After CPU power off, the real-time clock can be maintained by lithium battery. The life of battery is 5 years and the retaining duration is 3 years at normal temperature.

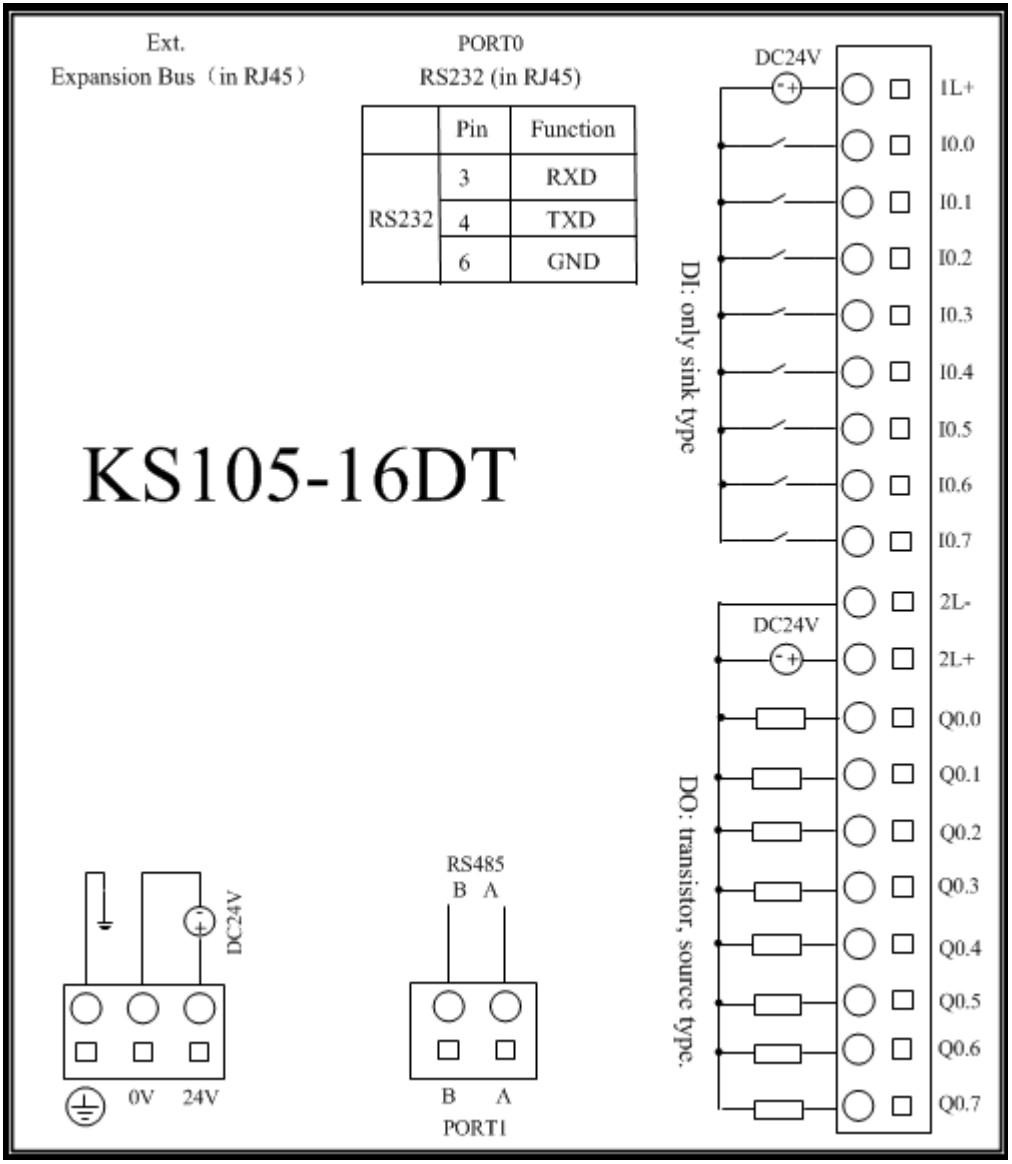
### 2.2.9 Backup Battery

KS can use certain specification lithium battery as backup battery. When PLC is power-off, it will use the backup battery to maintain real-time clock and RAM.

The backup battery is removable, user can replace new battery by themselves when the battery is empty.

The lithium battery is CR2032(3V) with connector. As shown in figure, user can order the battery separately.

## 2.3 Wiring diagram



CAN

CAN (in RJ45)

| | Pin | Function |
|---|---|---|
| CAN | 1 | CAN_H |
| | 2 | CAN_L |
| | 3 | CAN_GND |

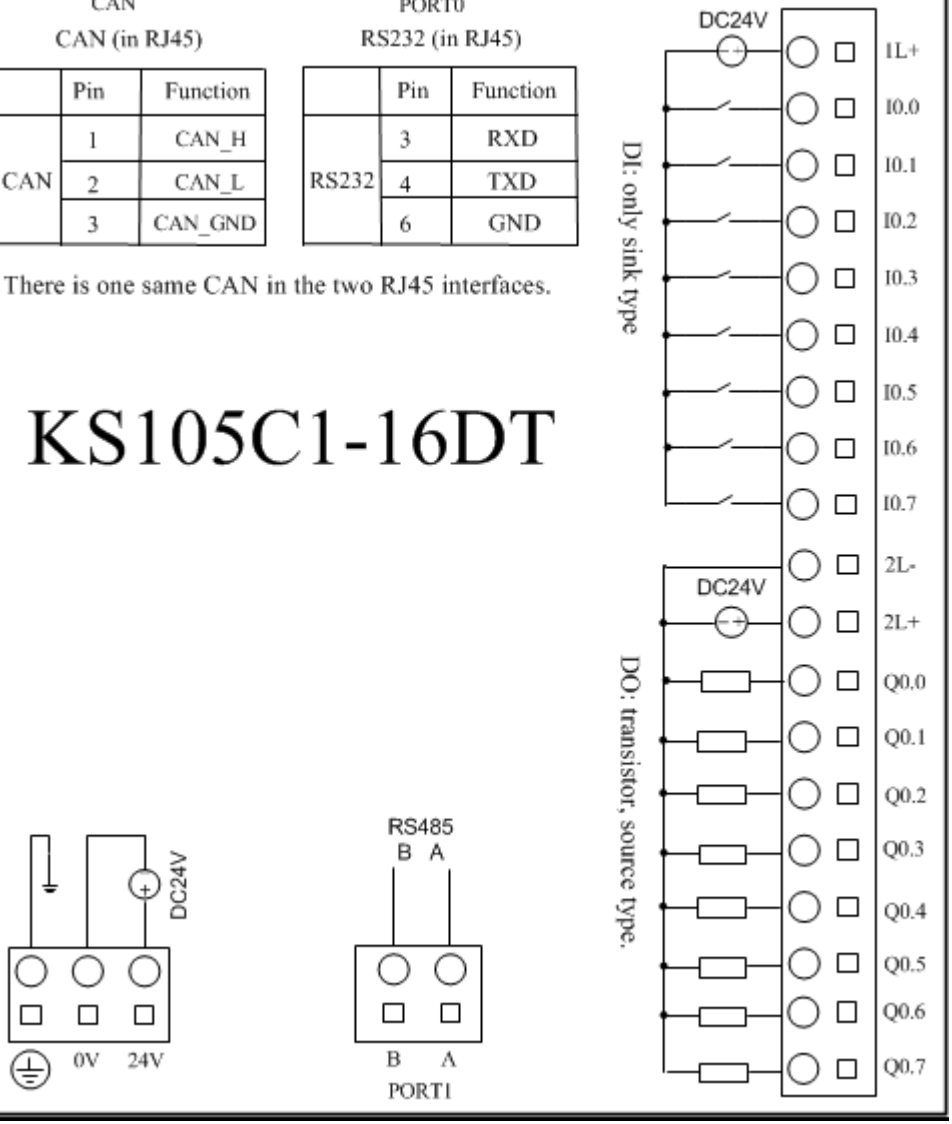
PORT0

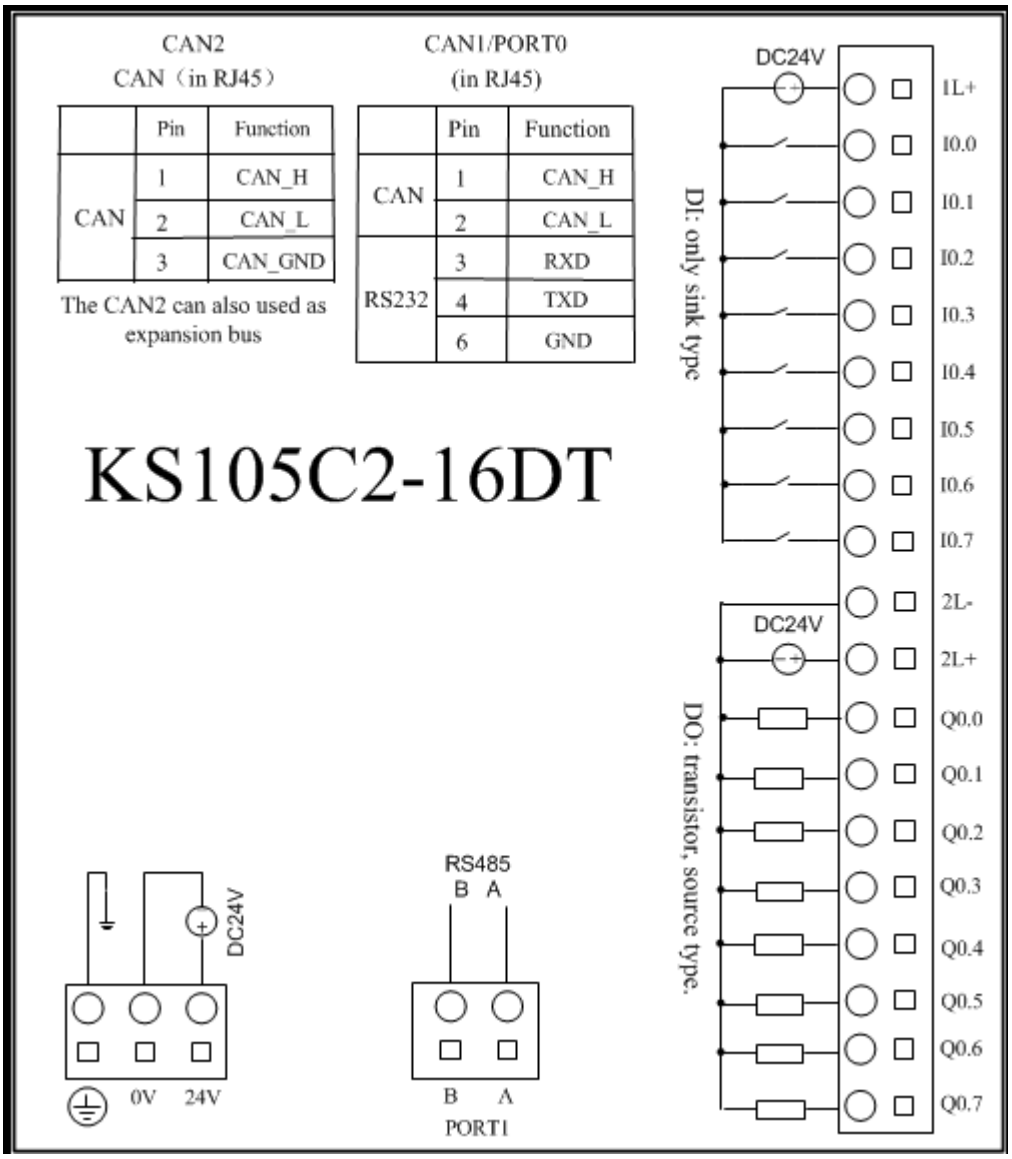
RS232 (in RJ45)

| | Pin | Function |
|---|---|---|
| RS232 | 3 | RXD |
| | 4 | TXD |
| | 6 | GND |

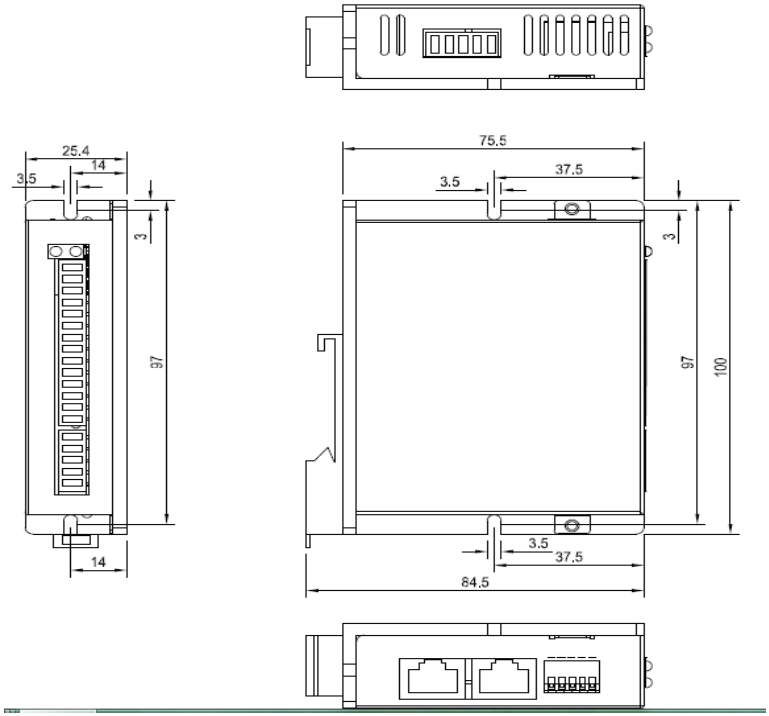
There is one same CAN in the two RJ45 interfaces.

# KS105C1-16DT




CAN2
CAN（in RJ45）
Pin
Function
CAN
1
CAN_H
2
CAN_L
3
CAN_GND
The CAN2 can also used as expansion bus
CAN1/PORT0
(in RJ45)
Pin
Function
CAN
1
CAN_H
2
CAN_L
RS232
3
RXD
4
TXD
6
GND
KS105C2-16DT
DC24V
1L+
I0.0
I0.1
I0.2
I0.3
I0.4
I0.5
I0.6
I0.7
DI: only sink type
2L-
DC24V
2L+
Q0.0
Q0.1
Q0.2
Q0.3
Q0.4
Q0.5
Q0.6
Q0.7
DO: transistor, source type.
DC24V
0V
24V
RS485
B A
B A
PORT1

## 2.4 Dimension




## 2.5 Technical Specification

➢ DI Specifications

| | |
|---|---|
| Input type | Source/Sink |
| Rated input voltage | DC 24V (Max. 30V) |
| Rated input current | 3.5mA@24VDC |
| Max input voltage of logic 0 | 5V@0.7mA |
| Minimum input voltage of logic 1 | Common channel:11V@2.0mA |
| Input filter time delay<br>· off-to-on<br>· on-to-off | <br>1.2μs<br>0.5μs; |
| Isolation between input and internal circuit | |

| | |
|---|---|
| · Mode<br>· Voltage | Opto-electrical isolation<br>500VAC/1 min |

➢ DO Specifications(Transistor type)

| | |
|---|---|
| Output type | Source |
| Rated power supply voltage | DC24V,allowance range: DC20.4V—DC28.8V.(Same as power supply) |
| Output current per channel | Rated current:200mA,max.300mA @24VDC |
| Instant impulse current per channel | 1A,less than 1s |
| Output leakage current | Max.0.5μA |
| Output impedance | Max. 0.2Ω |
| Output delay<br>· off-to-on<br>· on-to-off | <br>Common channel: 12μs; HSC channel: 0.5s;<br>Common channel: 35μs; HSC channel: 1μs; |
| Protection：<br>·Reverse polarity protection of power supply<br>·Inductive load protection<br>·Short-circuit protection<br>·Reverse polarity protection of output | <br>No<br>Yes<br>Yes<br>Yes, less than 10s. |
| Isolation between output and internal circuit<br>· Mode<br>· Voltage | <br>Opto-electrical isolation<br>500VAC/1 min |

# Chapter 3 Software Introduction

## 2.1 Overview

Based on K5, KS use same Kincobuilder software and instructions. Users can reference K5/K2 manual for most functions. The main difference is the new functions.

## 2.2 High speed counter

KS provides 4 high speed counters HSC0-HSC3.All can support up to 200KHz

High speed counter supports multiple modes: single phase, CW/CCW,AB phase (1 multiplication and 4 multiplication).

All high speed counter can support maximum 32 PV and support 32 "CV=PV" interrupts. PV can be set as relative value or absolute value. If it is relative value,

### 2.2.1 Operation Modes and Inputs of the High-speed Counters

Input signals of high-speed counter include: clock (input impulse), direction, start and reset.

In different operation modes input signals is different. Please see below:

| HSC 0 | | | | |
|---|---|---|---|---|
| **Mode** | **Description** | **I0.1** | **I0.0** | **I0.5** |
| 0 | Single-phase up/down counter with internal direction control: SM37.3 | Clock | | |
| 1 | | | Reset | |
| 2 | | | Reset | Start |
| 3 | Single-phase up/down counter with external direction control | Clock | | Direction |
| 4 | | | Reset | Direction |
| 6 | Two-phase counter with up/down clock inputs | Clock Down | Clock Up | |
| 9 | A/B phase quadrature counter | Clock A | Clock B | |

| HSC1 | | | | | |
|---|---|---|---|---|---|
| **Mode** | **Description** | **I0.4** | **I0.6** | **I0.3** | **I0.2** |
| 0 | Single-phase up/down counter with internal direction control: SM47.3 | | | Clock | |
| 1 | | Reset | | | |
| 2 | | Reset | Start | | |
| 3 | Single-phase up/down counter with external direction control | | | Clock | Direction |
| 4 | | Reset | | | Direction |
| 6 | Two-phase counter with up/down clock inputs | | | Clock Down | Clock Up |
| 7 | | Reset | | | |

| | | | | | |
|---|---|---|---|---|---|
| 9 | A/B phase quadrature counter | | | Clock A | Clock B |
| 10 | | Reset | | | |

| HSC 2 | | | |
|---|---|---|---|
| **Mode** | **Description** | **I0.4** | **I0.5** |
| 0 | Single-phase up/down counter with internal direction control:SM57.3 | | Clock |
| 9 | A/B phase quadrature counter | Clock A | Clock B |

| HSC 3 | | | |
|---|---|---|---|
| **Mode** | **Description** | **I0.6** | **I0.7** |
| 0 | Single-phase up/down counter with internal direction control:SM127.3 | | Clock |
| 9 | A/B phase quadrature counter | Clock A | Clock B |

### 2.2.2 Control Byte and Status Byte

- **Control Byte**

In SM area,each high-speed counter is assigned control byte to save its configuration data: one control word (8 bit), current value and pre-set (double-integer with 32 bit). Initial value of current assigned value. If the current value is written in the high-speed counter, it will start counting from that value. Please see below:

| HSC0 | HSC1 | HSC2 | HSC3 | Description |
|---|---|---|---|---|
| SM37.0 | SM47.0 | SM57.0 | SM127.0 | Effective electrical level of reset signal：0=high；1=low |
| SM37.1 | SM47.1 | SM57.1 | SM127.1 | Effective electrical level to start signal：0=high；1=low |
| SM37.2 | SM47.2 | SM57.2 | SM127.2 | Orthogonal counter rate：0=1x rate；1=4x rate* |
| SM37.3 | SM47.3 | SM57.3 | SM127.3 | Counting direction:0=Decrease；1=Increase |
| SM37.4 | SM47.4 | SM57.4 | SM127.4 | Write counting direction in HSC? 0= NO; 1= Yes |
| SM37.5 | SM47.5 | SM57.5 | SM127.5 | Write new pre-set value in HSC? 0= NO; 1= Yes |
| SM37.6 | SM47.6 | SM57.6 | SM127.6 | Write new current value in HSC? 0= NO; 1= Yes |
| SM37.7 | SM47.7 | SM57.7 | SM127.7 | Allow this high-speed counter? 0=NO; 1= YES |
| **HSC0** | **HSC1** | **HSC2** | **HSC3** | Description |
| SMD38 | SMD48 | SMD58 | SMD128 | Current value |
| SMD42 | SMD52 | SMD62 | SMD132 | Pre-set value |

| HSC0 | HSC1 | HSC2 | HSC3 | Description |
|---|---|---|---|---|
| SM141.0 | SM151.0 | SM161.0 | SM171.0 | Use multiple preset value:0=No. 1=Yes. |
| SM141.1 | SM151.1 | SM161.1 | SM171.1 | Preset value type:0=Absolute value. 1=Relative value. |
| SM141.2 | SM151.2 | SM161.2 | SM171.2 | Preset value comparison interrupt ("CV=PV") cyclic execution.<br>0=No. 1=Yes.<br>Note:Only valid when preset value is relative value. |
| SM141.3 | SM151.3 | SM161.3 | SM171.3 | Reserved |
| SM141.4 | SM151.4 | SM161.4 | SM171.4 | Update multiple PV segment and preset value:0=No. 1=Yes |
| SM141.5 | SM151.5 | SM161.5 | SM171.5 | Reset interrupt variable:0=Yes. 1=No. |
| SM141.6 | SM151.6 | SM161.6 | SM171.6 | Reserved |
| SM141.7 | SM151.7 | SM161.7 | SM171.7 | Reserved |
| **HSC0** | **HSC1** | **HSC2** | **HSC2** | **Description** |
| SMW142 | SMW152 | SMW162 | SMW172 | Starting value of preset value table （It is offset corresponding to VB0),it must be odd value. |

It needs to pay attention that not all the control bits of the control byte is suitable for all operation mode. For example, "Counting direction" and "Write counting direction in HSC" can be only used in mode 0,1 and 2 (Single-phase up/down counter
with internal direction control),if the operation mode is with external direction control, then these two bits will be ignored.

The control byte, current value and preset value are 0 by default after power on.

- **Status Byte**

In SM area, each high-speed counter has a status byte, which indicates the current status of high speed counter.

| HSC0 | HSC1 | HSC2 | HSC3 | Description |
|---|---|---|---|---|
| SM36.0 | SM46.0 | SM56.0 | SM126.0 | Reserved |
| SM36.1 | SM46.1 | SM56.1 | SM126.1 | Reserved |
| SM36.2 | SM46.2 | SM56.2 | SM126.2 | Reserved |
| SM36.3 | SM46.3 | SM56.3 | SM126.3 | Fault in multiple PV value table:0=No,1=Yes |

| | | | | |
|---|---|---|---|---|
| SM36.4 | SM46.4 | SM56.4 | SM126.4 | Reserved |
| SM36.5 | SM46.5 | SM56.5 | SM126.5 | Current counting direction:<br>0 = Down; 1= Up |
| SM36.6 | SM46.6 | SM56.6 | SM126.6 | Current value equal to preset value:<br>0 = No,1 = Yes |
| SM36.7 | SM46.7 | SM56.7 | SM126.7 | Current value greater than preset value:<br>0 = No,1 = Yes |
| HSC0 | HSC1 | HSC2 | HSC3 | Description |
| SMB140 | SMB150 | SMB160 | SMB170 | Current PV segment No.(Start from 0) |

### 2.2.3 Preset value (PV value) setting

KS supports up to 32 PV value for each high speed counter, and supports setting PV value as relative value or absolute value. It supports "CV=PV" interrupt cyclic execution.

Follows take HSC0 as example to describe PV value function and setting.

- **How to select "multiple PV" mode**

In the control byte of each high speed counter, there is one control bit for enable multiple preset value.

In HSC0, this control bit is SM141.0.

If SM141.0 is 0,it will use single PV value, same as K5 PLC.SMD42 is for new PV value,SM37.5 is to update this new PV value.

If SM141.0 is 1,it will use multiple PV values. In this situation,SM37.5 and SMD42 is invalid. All the PV values will be in the PV table(SMW142 is for starting address of the table),SM141.4 defines whether it use the data in PV table or not.If SM141.4 is 1,it means when HSC starts, it will get the data from PV table. If SM141.4 is 0,when HSC starts,it will ignore the data in PV table and get the data from last preset value.

- **Multiple PV table**

If using PV table,all the PV value will get from PV table.

Each HSC provides one control word which is used to set the starting address of PV table.If using multiple PV,then all PV value will get from PV table.The starting address of PV table is odd address of V area,such as 301(Means VB301).

The format of PV table is as follows.

| OFFSET (1) | Data type | Description |
|---|---|---|
| 0 | BYTE | Quantity of PV |
| 1 | DINT | First PV |
| 5 | DINT | Second PV |
| … | DINT | … |

（1） All the offset value are the offset bytes related to the table.

（2） When it is set as relative value,then the absolute value of PV data must be greater than 1,or PLC will consider the segment of multiple PV finish and count the number of PV according to this(Higher priority than setting quantity of PV).

When it is set as absolute value,the difference between two adjacent PV's absolute value must be greater than 1,or PLC will consider the segment of multiple PV finish and count the number of PV according to this(Higher priority than setting quantity of PV).

（3） "CV=PV" interrupts must execute in sequence,it means that after the counter reaches the first PV and executes interrupt,then it will compare with the second PV and so forth.

（4） PV must be set reasonably.Here takes relative value as example,if it is positive counting,PV must be greater than 0,otherwise the "CV=PV"interrupt will never execute.If it is negative counting,PV must be less than 0,otherwise the "CV=PV"interrupt will also never execute.

- **Relative value and absolute value**

In the control byte of each high speed counter, there is one control bit which is used to set PV as relative value or absolute value.

For HSC0,the control bit is SM141.1.

If SM141.1 is 0,it means PV is absolute value. When counting value is equal to PV,it will execute "CV=PV" interrupt. For example,if it sets 3 PV values,such as 1000,2000 and 3000,then when counting value reaches 1000,it will execute the first "CV=PV"interrupt. When the counting value reaches 2000,it will execute the second "CV=PV" interrupt and so forth.

If SM141.1 is 1,it means PV is relative value.If counter takes current counting value as reference,when the value it continues to count is equal to PV,it will execute "CV=PV" interrupt.For example,if it sets 3 PV values,such as 10,1000 and 1000,and the current counting value is 100 before HSC starts,then when the

counting value reaches 110,1110 and 2110,it will execute corresponding“CV=PV” interrupt.

➢ **“CV=PV”interrupt cyclic execution**

“CV=PV”interrupt cyclic execution is only valid when PV is set as relative value.

If SM141.0 is 0,it means “CV=PV” interrupt only executes once.When all interrupts finish execution,then it will stop.If it needs to execute again, it must modify the related registers and execute HSC instruction again.

If SM141.0 is 1,it means “CV=PV” interrupt is cyclic execution.When the last PV interrupt finishes execution,PLC will take the current counting value as reference to calculate new value for PV interrupt,then it will start to compare the counting value and execute “CV=PV” interrupt and so forth.This process will execute cyclically.

For example,it sets 3 PV values,such as 10,1000 and 1000.And the current counting value is 100 before HSC starts,then the value for every interrupt is as following table.

| **Current counting value** | **Interrupt times** | **First value** | **Second value** | **Third value** |
|---|---|---|---|---|
| 100 | 1st time | 110 | 1110 | 2110 |
| 2110 | 2nd time | 2120 | 3120 | 4120 |
| 4120 | 3rd time | 4130 | 5130 | 6130 |
| … | N time | … | … | … |

## 2.2.4 “CV=PV” Envent No.

When it uses single PV mode, the HSC will be fully compatible with K5 (Include “CP=PV” event No.).

When it uses multiple PV mode, the HSC will assign a new event No. for 32 PV, as shown in following table.

| **High speed counter** | **Interrupt No.** | **Description** |
|---|---|---|
| HSC0 | 64 | “CV=PV”interrupt of 1st PV |
| | 65 | “CV=PV”interrupt of 2nd PV |
| | … | …（Plus 1） |
| | 95 | “CV=PV”interrupt of 32nd PV |
| HSC1 | 96 | “CV=PV”interrupt of 1st PV |
| | 97 | “CV=PV”interrupt of 2nd PV |
| | … | …（Plus 1） |
| | 127 | “CV=PV”interrupt of 32nd PV |
| HSC2 | 128 | “CV=PV”interrupt of 1st PV |

| | | |
|---|---|---|
| | 129 | “CV=PV”interrupt of 2nd PV |
| | … | …（Plus 1） |
| | 159 | “CV=PV”interrupt of 32nd PV |
| HSC3 | 160 | “CV=PV”interrupt of 1st PV |
| | 161 | “CV=PV”interrupt of 2nd PV |
| | … | …（Plus 1） |
| | 191 | “CV=PV”interrupt of 32nd PV |

### 2.2.5 How to use high speed counter

- **Method 1:Use instructions for programming**

1)Configure the control byte of HSC and define the current value (i.e. starting value) and the preset value.

2)Use HDEF instruction to define the counter and its operation mode.

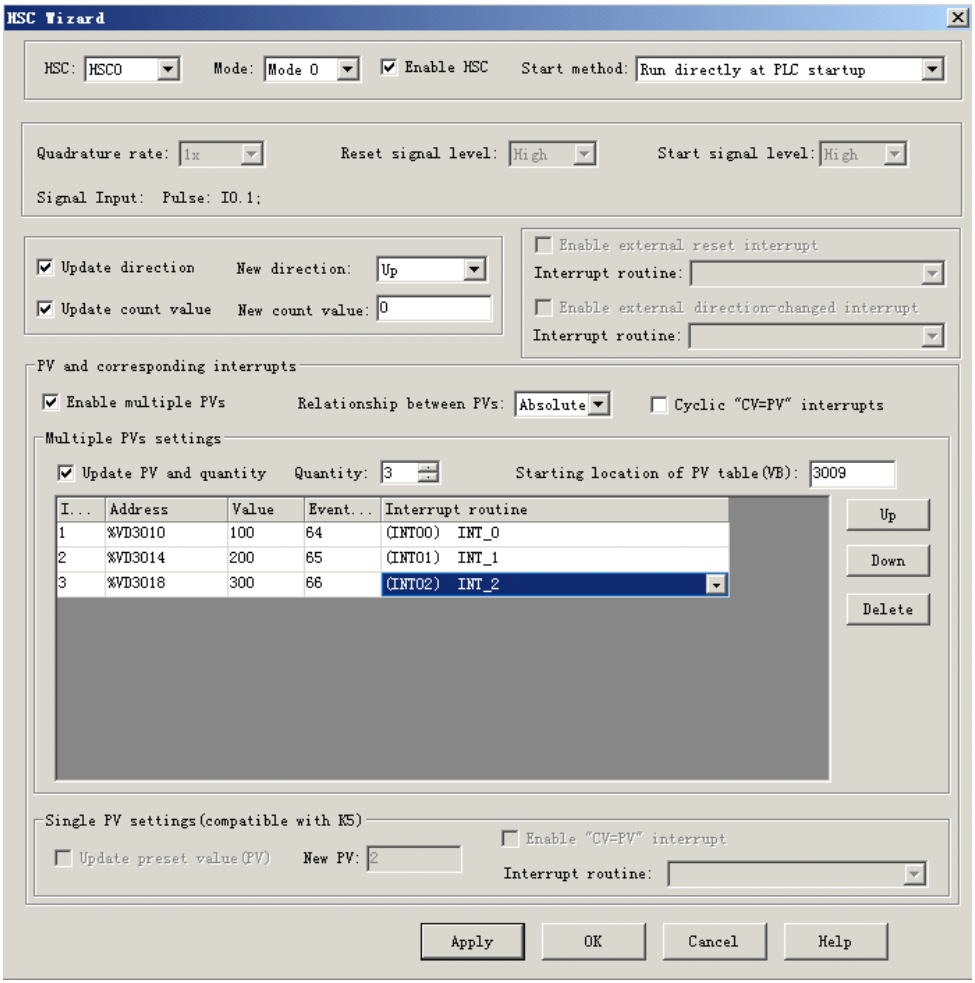
3)(Optional) Use ATCH instruction to define the interrupt routines.

4)Use HSC instruction to start the high-speed counter.

- **Method 2:Use wizard of HSC**

In K2 PLC, it provides configuration wizard for high speed counter. Users can use the wizard to configure all high speed counters and don’t need to program. The wizard is as following figure:

After using wizard to configure HSC, user also can use “**Method 1**” to modify the parameters of HSC.




How to use HSC wizard:

1） Select the counter in【HSC】.

2） Check【Enable HSC】, and then continue following configuration.

3） Select counter mode in【Mode】.

4） Select the starting mode in【Start method】.

There are two starting method:

"Using HSC instruction": If selecting this method, then it needs to execute HSC instruction to start the HSC. Before executing HSC instruction, it doesn't need to configure the registers and execute HDEF

instruction.

"Run directly at PLC startup": If selecting this method, then the HSC will start automatically after PLC power on without executing any instructions.

5） If user needs to use multiple PV mode, then check【Enable multiple PVs】and continue to configure all PV values and related 'Value' and 'Interrupt subroutine'. If checking【Update PV and quantity】, then it can adjust the value in【Quantity】to modify the number of PV.

6） If user needs to use single PV mode, then check【Update preset value(PV)】in 'Single PV settings' and modify the PV value and related interrupt subroutine.

7） For other options, please refer to the descriptions to HSC.

## 2.3 How to use high speed pulse output

Kinco-KS provides 4 channels for high speed pulse output, they are Q0.0,Q0.1 and Q0.4,Q0.5.All support PT0 and PWM output.

. Q0.0 and Q0.1,0.4 support maximum 200KHz, and Q0.5supports maximum 10KHz.

KS have one direction output channel for every high speed output. KS provide 1 direction enable control in SM area.

| | | | | |
|---|---|---|---|---|
| | Q0.0 | Q0.1 | Q0.4 | Q0.5 |
| Direction output channel | Q0.2 | Q0.3 | Q0.6 | Q0.7 |
| Direction enable Control | SM201.3 | SM231.3 | SM251.3 | SM221.3 |

Direction output channel output motor direction control signal, corotation output 0,inversion output 1.

Direction enable control can forbid or allow direction output channel. It is highest primary.

If it is forbidden, it won't output direction control signal. The channel will work as common DO.

2.3.1 High speed pulse output instruction

KS provides 3types of instructions for high speed pulse output.

1） PLS: it is used to output PTO(Single segment or multiple segments) and PWM.

**2）** Position control: There are 5 instructions, include PREL(Relative positioning), PABS(Absolute

positioning) ,PHOME(Homing), PJOG(Jogging) and PSTOP(Emergency stop). User can use these instructions to achieve positioning control easily .**Note: When using position control instructions, the frequency of output pulse must be not less than 125Hz.**

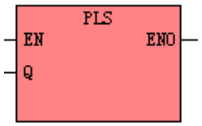
3） Following instruction PFLO_F: There are parameters such as input frequency(*F*),electronic gear ratio(*NUME*、*DENOM*), pulse number(*COUNT*) and so on, these parameters can be used as variable. The frequency of pulse output is equal to *F* multiple by electronic gear ratio. When the pulse number reaches the value *COUNT*, then it will stop output and set *DONE* bit. **Note: When using following instruction, the frequency of output pulse must be not less than 30Hz.**

### 2.3.2 How to use PLS instruction

PLS instruction can implement PTO and PWM output function.

- PTO：Pulse Train Output.
- PWM：Pulse-Width Modulation.

➢ Descriptions

| | Name | Usage | Group | Suitable for |
|---|---|---|---|---|
| **LD** | PLS |  | | K2<br>K5 |
| **IL** | PLS | PLS *Q* | U | |

| Operands | Input/Output | Data Type | Description |
|---|---|---|---|
| *Q* | Input | INT | Constant（0、1 or 2） |

The PLS instruction is used to load the corresponding configurations of the PTO/PWM from the specified SM registers and then start outputting pulse until it finish outputting pulse. The pulse output channel is specified by parameter Q, 0 means Q0.0,1 means Q0.1,2 means Q0.4.

Note: In user program, it only needs to execute PLS instruction once when it is required. It is suggested to use

edge instruction to execute PLS instruction. If executing PLS executing all the time, then it can't output normally.

- **LD**
  If EN is 1,then PLS is executed.

- **IL**
  If CR is 1,then PLS is executed. It won't influence the value of CR.

#### 2.3.2.1 High-speed Pulse Output Function

The Kinco-KS provides 4 PTO/PWM pulse generators that can be used to output PTO/PWM. Thereof, one generator is assigned to Q0.0, called PWM0 or PTO0; the second one is assigned to Q0.1, called PWM1 or PTO1,and the third one is assigned to Q0.4,called PWM2 or PTO2. The forth one is assigned to Q0.5,called PWM3 or PTO3.

The PTO/PWM pulse generators and the DO mapping area share the memory address Q0.0 ,Q0.1 and Q0.4、Q0.5. When the user program executes the high speed pulse output instructions, then the PTO/PWM generator controls the output and prohibits the normal use of this output channel.

Notice: Make sure not to use the PTO and PWM functions if Q0.0 ,Q0.1 and Q0.4 ， Q0.5 are relay-output!

➢ **PWM**

PWM provides a continuous pulse output with a variable duty cycle, and you can control the cycle time and the pulse width.

The unit of cycle time and pulse width time is microsecond(us) or millisecond(ms). The maximum value of cycle time is 65535. If the pulse width time is greater than the cycle time value, the duty cycle is set to be 100% automatically and the output is on continuously. If the pulse width time is 0, the duty cycle is set to be 0% and the output is off.

➢ **PTO**

PTO provides a square wave (50% duty cycle) output, and you can control the cycle time and the number of the output pulses. The unit of cycle time is microsecond(us) or millisecond(ms).The maximum value of cycle time is 65535.The range of pulse number is 2~4,294,967,295.If the specified pulse number is less than 2, then KInco-KS will set related error bit and prohibit the output.

PTO function provides single segment of pulse and multiple segment of pulse.

- **Single segment pulse**

In single segment pulse mode, it only executes pulse train output once after executing PLS instruction.

- **Multiple segment pulse**

In multi-segment pulse mode, CPU automatically reads the configurations of each PTO segment from a profile table located in V area and executes the related PTO segment.

The length of each segment is 8 bytes, including a cycle time value (16-bit, WORD), a reserved value (It is not used now,16-bit, INT), and a pulse number value (32-bit, DWORD).Thereof, all the pulse output frequency are the same in same segment. It uses PLS instruction to start multiple segment pulse.

In this mode, the starting address of the profile table is stored in SMW168 (corresponding to PTO0) ,SMW178 (corresponding to PTO1) and SMW268(corresponding to PTO2).Time base is configured by SM67.3 (corresponding to PTO0) ,SM77.3 (corresponding to PTO1) and SM87.3 (corresponding to PTO2). The time base can be in either microsecond or millisecond. All cycle values in the profile table must use same time base, and cannot be modified when the profile is executing.

The following table describes the format of the profile table.

| Byte offset[1] | Length | Segment | Description |
|---|---|---|---|
| 0 | 8-bit | | The number of segments (1 to 64) |
| 1 | 16-bit | 1 | Initial cycle time (2 to 65535 times of the time base) |
| 3 | 16-bit | | Reserved |
| 5 | 32-bit | | Pulse number(1 to 4,294,967,295) |
| 9 | 16-bit | 2 | Initial cycle time (2 to 65535 times of the time base) |
| 11 | 16-bit | | Reserved |
| 13 | 32-bit | | Pulse number(1 to 4,294,967,295) |

| | | | |
|---|---|---|---|
| … | | … | … |

**1** All the offsets in this column are relative to the starting position of the profile table.

*Notice: the starting position of the profile table must be an odd address in V area, e.g. VB3001.*

#### 2.3.2.2 PTO/PWM Register

Each PTO/PWM generator is provided with some registers in SM area to store its configurations, as shown in following table.

| **Q0.0** | **Q0.1** | **Q0.4** | **Q0.4** | **Description** | |
|---|---|---|---|---|---|
| SM67.0 | SM77.0 | SM97.0 | SM107.0 | PTO/PWM | Whether to update the cycle time: 0 = No; 1 = Yes |
| SM67.1 | SM77.1 | SM97.1 | SM107.1 | PWM | Whether to update pulse width time:： 0=No；1=Yes |
| SM67.2 | SM77.2 | SM97.2 | SM107.2 | PTO | Wheter to update the pulse number:： 0=No；1=Yes |
| SM67.3 | SM77.3 | SM97.3 | SM107.3 | PTO/PWM | Time base: 0=1μs；1=1ms |
| SM67.4 | SM77.4 | SM97.4 | SM107.4 | PWM | Update method: 0 = asynchronous update; 1 = synchronous update |
| SM67.5 | SM77.5 | SM97.5 | SM107.5 | PTO | Operation mode: 0 = single segment; 1 = multiple segment |
| SM67.6 | SM77.6 | SM97.6 | SM107.6 | Function selection: 0= PTO；1=PWM | |
| SM67.7 | SM77.7 | SM97.7 | SM107.7 | PTO/PWM | Enable/disable: 0=disable；1= enable |
| **Q0.0** | **Q0.1** | **Q0.4** | | **Description** | |
| SMW68 | SMW78 | SMW98 | SMW108 | PTO/PWM | Cycle time , Range:2~65535 |
| SMW70 | SMW80 | SMW100 | SMW110 | PWM | Pulse width, Range: 0~65535 |
| SMD72 | SMD82 | SMD102 | SMD112 | PTO | Pulse number, Range:1~4,294,967,295 |
| SMW168 | SMW178 | SMW218 | SMW248 | The starting location of the profile table (byte offset from V0)For multi-segment PTO operation only | |

All the default value for control byte, cycle time and pulse number are 0.The way to modify configuration of PTO/PWM is that configure related control registers first, if it is PTO multiple segment pulse, it also needs to

configure profile table, and then execute PLS instruction.

Each PTO/PWM generator also provides a status bytes in SM area, user can get the status information of PTO/PWM generator from the status bytes, as shown in following table.

| Q0.0 | Q0.1 | Q0.4 | Q0.5 | Description |
|---|---|---|---|---|
| SM66.0 | SM76.0 | SM96.0 | SM106.0 | Reserved |
| SM66.1 | SM76.1 | SM96.1 | SM106.1 | Reserved |
| SM66.2 | SM76.2 | SM96.2 | SM106.2 | Reserved |
| SM66.3 | SM76.3 | SM96.3 | SM106.3 | PWM idle: 0=No, 1=Yes |
| SM66.4 | SM76.4 | SM96.4 | SM106.4 | Whether the cycle time or pulse number of PTO is wrong: 0=No, 1=Yes<br>**Note: Cycle time and pulse number must be greater than 1.** |
| SM66.5 | SM76.5 | SM96.5 | SM106.5 | PTO profile terminated due to user command: 0=No, 1=Yes |
| SM66.6 | SM76.6 | SM96.6 | SM106.6 | Reserved |
| SM66.7 | SM76.7 | SM96.7 | SM106.7 | PTO idle: 0=No, 1=Yes |

The PTO idle bit or PWM idle bit indicate the completion of the PTO or PWM output.

#### 2.3.3.3 PTO Operations

The fallowing takes PTO0 as an example to introduce how to configure and operate the PTO/PWM generator in the user program.

There are two procedures for using PTO: Configure related control registers and initialize PTO. Execute PLS instruction.

Use SM0.1 (the first scan memory bit) to call a subroutine that contains the initialization instructions. Since SM0.1 is used, the subroutine shall be executed only once, and this reduces CPU scan time and provides a better program structure.

- **Execute the PTO (Single-Segment Operation)**

1) Set control byte SMB67 according to the desired operation.

   For example, SMB67 = B#16#85 indicates:

   - Enable the PTO/PWM function

- Select PTO operation
- Select 1μs as the time base
- Allow updating the pulse number and cycling time.

2) Set SMW68 according to desired cycle time.

3) Set SMD72 according to desired pulse number.

4) (Optional) use ATCH to attach the PTO0-complete event (event 28) to an interrupt routine to respond in real time to a PTO0-complete event.

5) Execute the *PLS* instruction to configure PTO0 and start it.

➢ **Changing the PTO Cycle Time (Single-Segment Operation)**

Follow these steps to change the PTO cycle time.

1) Set control byte SMB67 according to the desired operation.

For example, SMB67 = B#16#81 indicates:

- Enable the PTO/PWM function
- Select PTO operation
- Select 1μs as the time base
- Allow updating the cycle time value.

2) Set SMW68 according to desired cycle time.

3) Execute the *PLS* instruction to configure PTO0 and start it, then a new PTO with the updated cycle time shall be generated.

➢ **Changing the PTO Pulse Number(Single-Segment Operation)**

Follow these steps to change the PTO pulse count:

1) Set control byte SMB67 according to the desired operation.

For example, SMB67 = B#16#84 indicates:

- Enable the PTO/PWM function
- Select PTO operation

- Select 1μs as the time base
- Allow updating the pulse number

2) Set SMD72 according to desired pulse number.

3) Execute the *PLS* instruction to configure PTO0 and start it, then a new PTO with the updated pulse number shall be generated.

➢ **Execute the PTO (Multiple-Segment Operation)**

1) Set control byte SMB67 according to the desired operation.

For example, SMB67 = B#16#A0 indicates:

- Enable the PTO/PWM function
- Select PTO operation
- Select multi-segment operation
- Select 1μs as the time base

2) Set an odd number as the starting position of the profile table into SMW168.

3) Use V area to configure the profile table.

4) (Optional) Use ATCH to attach the PTO0-complete event (event 28) to an interrupt routine to respond in real time to a PTO0-complete event.

5) Execute the *PLS* instruction to configure PTO0 and start it.

#### 2.3.3.3 PWM Operations

Following takes PWM0 as an example to introduce how to configure and operate the PTO/PWM generator in the user program.

There are two procedures for using PWM: Configure related control registers and initialize PTO. Execute PLS instruction.

Use SM0.1 (the first scan memory bit) to call a subroutine that contains the initialization instructions. Since SM0.1 is used, the subroutine shall be executed only once, and this reduces CPU scan time and provides a better program structure.

➢ **Execute PWM**

1) Set control byte SMB67 according to the desired operation.

   For example, SMB67 = B#16#D3 indicates:

   - Enable the PTO/PWM function
   - Select PWM operation
   - Select 1μs as the time base
   - Allow updating the pulse width value and cycle time value

2) Set SMW68 according to desired cycle time.

3) Set SMW70 according to desired pulse width.

4) Execute the *PLS* instruction to configure PWM0 and start it.

➢ **Changing the Pulse Width for the PWM Output**

The following steps describes how to change PWM output pulse width.

1) Set control byte SMB67 according to the desired operation.

   For example, SMB67 = B#16#D2 indicates:

   - Enable the PTO/PWM function
   - Select PWM operation
   - Select 1μs as the time base
   - Allow updating the pulse width value and cycle time value

2) Set SMW70 according to desired pulse width.

3) Execute the *PLS* instruction to configure PWM0 and start it.

## 2.3.3 How to Use Position Control Instructions

### 2.3.3.1 How to Modify the Current Value of Position Control Instructions

➢ **Control Registers and Status Registers**

For the Position Control instructions,KS1 specifies a control byte for each high-speed output channel to store

its configurations. Besides, it assigns a current value register(DINT) to store the pulse number which has outputted currently (This value will increase when run forward and decrease when run reverse).The following table describes the control byte and the current value.

| Q0.0 | Q0.1 | Q0.4 | Q0.5 | **Description** |
|---|---|---|---|---|
| SMD212 | SMD242 | SMD262 | SMD226 | Read only. Current value (Increase when run forward, decrease when run reverse).It indicates the pulse number which has already outputted. |
| SMD208 | SMD238 | SDM258 | SDM222 | Read/Write. New current value. Use to modify the current value together with specific control bit. |
| Q0.0 | Q0.1 | Q0.4 | Q0.4 | Description |
| SM201.7 | SM231.7 | SM251.7 | SM221.7 | Read/Write. Emergency-Stop bit.<br>If this bit is 1, no position control instructions can be executed.<br>When executing the PSTOP instruction, this bit is set to 1 automatically, and it must be reset in the program.。 |
| SM201.6 | SM231.6 | SM251.6 | SM221.6 | Read/Write. Reset the current value or not<br>1 --- Clear the current value.<br>0 --- Maintain the current value.。 |
| SM201.5 | SM231.5 | SM251.5 | SM221.5 | Reserved |
| SM201.4 | SM231.4 | SM251.4 | SM221.4 | Read/Write. Use to modify current value.<br>1 - Modify current value.<br>0 - Maintain the current value. |
| SM201.3 | SM231.3 | SM251.3 | SM221.3 | Read/Write. Direction control bit.<br>1 --- Disable the direction output channel, it will be used as normal output.<br>0 --- Enable the direction output channel. |
| SM201.0 ~ SM201.2 | SM231.0~ SM231.2 | SM251.0~ SM251.2 | SM221.0~ SM221.2 | Reserved |

- **How to modify current value**

Each high speed output channel has one register for current value, they are SMD212,SMD242 and SMD262,SMD226.The outputted pulse number are stored in these registers. Current value registers are read

only, if user needs to modify the current value, it can use following methods.

- **Method 1**

User reset bit to clear current value.

The reset bits for 4 output channels are SM201.6、SM231.6 、SM251.6 and SM221.6.

When the reset bit is 1, PLC will set the current value as 0.Therefore, t only needs one scan time for the reset bit to activate. When it needs to use this bit, try to avoid to keep this bit always 1 and also and also avoid to set this bit while the Position Control instruction (Include PHOME, PREL, PABS, JOG and PFLO_F) is executing, otherwise the counting value may be wrong.

Following takes channel 0 as example to describe how to reset current value.

```
(* Network 0 *)
(*Based on homing signal, when it moves to homing, it requires to clear current value*)
LD          %SM0.0
PHOME    0, %M0.0, %M0.1, %M0.2, %VW0, %VW2, %VW4, %VD6, %VW10, %M0.4, %M0.5, %MB1
(* Network 1 *)
(*After PHOME finishing, it uses finishing bit “DONE” to clear current value*)
LD          %M0.4
R_TRIG
ST          %SM201.6
```

- **Method 2**

Modify current value by using following registers.

| Q0.0 | Q0.1 | Q0.4 | Q0.5 | Description |
|---|---|---|---|---|
| SMD208 | SMD238 | SDM258 | SDM222 | Read/Write. New current value. Use to modify the current value together with specific control bit. |
| SM201.4 | SM231.4 | SM251.4 | SM221.4 | Read/Write. Use to modify current value.<br>1 - Modify current value.<br>0 - Maintain the current value. 。 |

Here takes channel 0 as example to describe the method: If SM201.4 is 0,then it will maintain the current value SMD212. If SM201.4 is 1, then it will move the value of SMD208 to SMD212.When it needs to use this bit, avoid to keep this bit always 1 and also avoid to set this bit while the Position Control instruction (Include PHOME, PREL, PABS, JOG and PFLO_F) is executing, otherwise the counting value may be

wrong.

Following takes channel 0 as example to describe how to modify current value:

```
(* Network 0 *)
(*Based on homing signal, hen it moves to homing, t requires to set current value as 100.*)
LD          %SM0.0
PHOME   0, %M0.0, %M0.1, %M0.2, %VW0, %VW2, %VW4, %VD6, %VW10, %M0.4, %M0.5, %MB1
(* Network 1 *)
(*When PHOME instruction finishing, it uses finishing bit DONE to modify current value.*)
LD          %M0.4
R_TRIG
MOVE       DI#100, %SMD208
ST          %SM201.4
```

#### 2.3.3.2 Can it change maximum output frequency when position control instruction is executing?

PREL（Relative position）and PABS（Absolute position） will not change maximum output frequency when it is executing. It will read the parameters minimum frequency, maximum frequency and acceleration/deceleration time parameters when it starts, and calculates suitable acceleration/deceleration segments according to the value of these parameters, then it will start outputting pulse. During pulse outputting, PREL and PABS will not read the parameters above again, therefore, changing these parameters will not affect the pulse output.

PJOG（Jogging） will read pulse input frequency(MAXF) all the time when it is executing, and adjust the pulse output frequency according to new setting frequency.

PHOME（Homing） will read the maximum frequency (MAXF) all the time when it is running at maximum frequency but hasn’t found homing signal, and calculate acceleration or deceleration segment automatically according the new setting frequency, then it will accelerate or decelerate to new frequency to output pulse.

## 2.4 How to use CANopen

KS105C1-16DT has 1 CAN port, CAN2

KS105C2-16DT has 2 CAN ports,CAN1 and CAN2.

CAN2 support CANopen master protocol and free protocol.CAN1 support free protocol.

CANopen master function of KS is same as K5 and K2.

For free communication instruction( （CAN_INIT、CAN_WRITE、CAN_READ、CAN_RX）,CH parameters,0 is CAN1,1 is CAN2.