DeviceNet Slave Device

CAN-2088D

User's Manual

Warranty

Without contrived damage, all products manufactured by ICP DAS are warranted in one year from the date of delivery to customers.

Warning

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Contents

1 Introduction

1.1 Overview

PWM (Pulse width modulation) is a powerful technique for controlling analog circuits. It uses digital outputs to generate a waveform with variant duty cycle and frequency to control analog circuits. CAN-2088D is a DeviceNet slave module and it has 8 PWM output channels and 8 digital inputs. It can be used to develop powerful and cost effective analog control system.

1.2 Hardware Specifications

PWM Output:

- Output Channels: 8 (Source)
- Scaling Resolution: 16-bit (1 ~ 128 µs for each step).
- Frequency Range: 0.2 Hz ~ 500 kHz (non-continuous, and the min. unit of the high/low level of the signal is 1 us).
- Duty Cycle: 0.1% ~ 99.9%.
- PWM Mode: Burst Counting, Continuous mode.
- Burst Counter: 1 ~ 65535.
- Trigger Mode: Hardware or software trigger.
- Hardware Trigger Mode: Trigger start & trigger stop.
- Max Load Current: 1 mA.
- Intra-module Isolation, Field to Logic: 2500 Vrms.
- ESD Protection: 4 kV Contact for each channel.

Digital Input:

- Input Channels: 8 (Sink).
- Input Type: One common for all digital input.
- On Voltage Level: +5.5 ~ +30 V.
- Off Voltage Level: <+3.5 V.
- Counter Frequency: 500 kHz Max.
- Max. Counts: 32-bit (0 ~ 4294967295)
- Input Impedance: 2.2 kΩ, 0.5 W
- Intra-module Isolation, Field to Logic: 2500 Vrms
- ESD Protection: 4 kV Contact for each channel

Others:

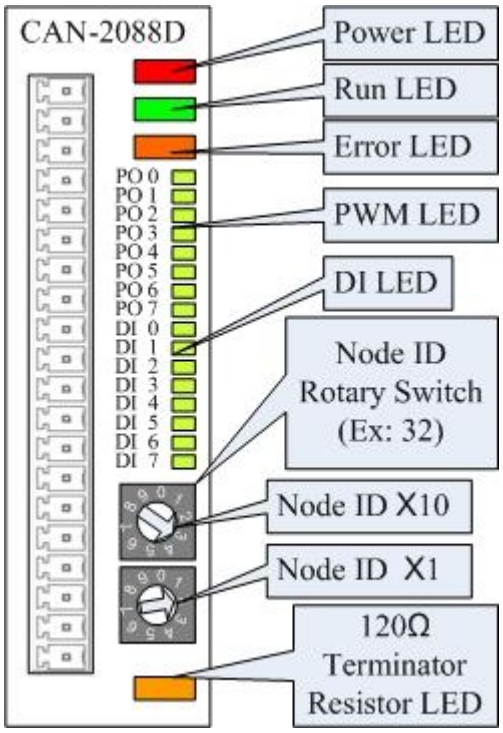
- LED: 1 as power indicator, 1 as terminator resistor, 2 as DeviceNet status, 8 as PWM and 8 as DI indicator.
- Power Requirement: +10 ~ +30 V_{DC}, 3.5 W.
- Operating Temperature: -25 ~ 75 ℃.
- Storage Temperature: -30 ~ 80 ℃.
- Humidity: 10 to 90% RH, Non-condensing.
- Dimensions: 32.3 mm x 99 mm x 77.5 mm (W x L x H) Detail.

1.3 Features

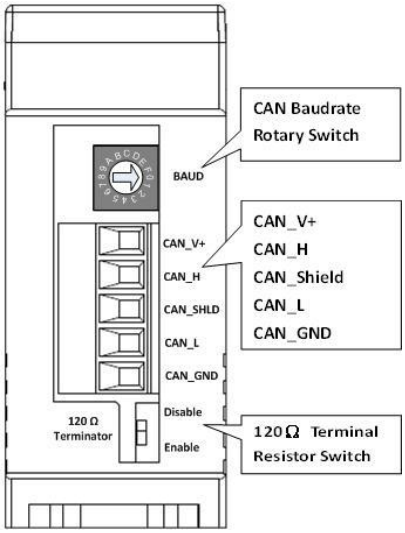
- DeviceNet general I/O slave devices.
- Comply with DeviceNet specification Volume I, Release 2.0 & Volume II, Release 2.0
- Group 2 Only Server (non UCMM-capable)
- Support Predefined Master/Slave Connection Set
- Connection supported:
  - 1 connection for Explicit Messaging
  - 1 connection for Polled I/O
  - 1 connection for Bit-Strobe I/O connection
- Support DeviceNet heartbeat and shutdown messages
- Provide EDS file for standard DeviceNet master interface.
- Automatic generation of PWM outputs by hardware, without software intervention.
- 0.2 Hz ~ 500 kHz (non-continuous) PWM output frequency with 0.1%~99.9% duty cycle configuration.
- Software and hardware trigger mode for PWM output.
- Support individual or synchronous PWM output in software trigger mode.
- Each digital input channel provides high-speed counter functionality.
- DI channel can be configured as simple digital input channel or hardware trigger source of the PWM output.
- NET, MOD and PWR DeviceNet status Led indictors

2 Hardware

2.1 Structure



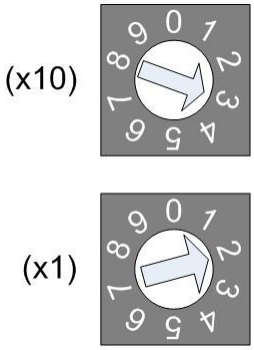
(Top View)



(Bottom View)

2.2 The Node ID & Baud rate Rotary Switch

The rotary switches for node ID configure the node ID of CAN-2088D module. These two switches are for the tens digit and the units digit of node ID. The node ID value of this demo picture is 32.



Node ID rotary switch

The rotary switch for baud rate handles the CAN baud rate of CAN-2088D module. The relationship between the rotary switch value and the practical baud rate is presented in the following table.

Baud rate rotary switch

Rotary Switch Value	Baud rate (kbps)
0	125
1	250
2	500

2.3 LED Description

PWR LED

The CAN-2088D needs the power of 10 ~ 30 VDC. Under a normal connection, a good power supply and a correct voltage selection, as the unit is turned on, the LED will light up in red.

NET LED

The NET LED indicates the current status of the DeviceNet communication link.

condition	status	indicates
Init Off	Off line	Device is not online
Off	Connection timeout	I/O connection timeout
Flashing	On line	Device is on line, but not communicating
Init solid	Link failed	(Critical) Device has detected an error that has rendered it incapable of communicating on the link; for example, detected a duplicate node address or network configuration error
Solid	On line, communicating	Device is online and communicating

MOD LED

This LED provides the devices status. It indicates whether or not the device is operating properly.

condition	status	indicates
Off	Normal	
Solid	Critical fault	Device has unrecoverable fault.
Flashing	Non_critical fault	Device has recoverable fault to recover. If users want to fix the problem, reconfiguring device's MAC ID or resetting device may work.

Terminal Resistor LED

When enable the 120Ω terminal resistor, the LED will turn on.

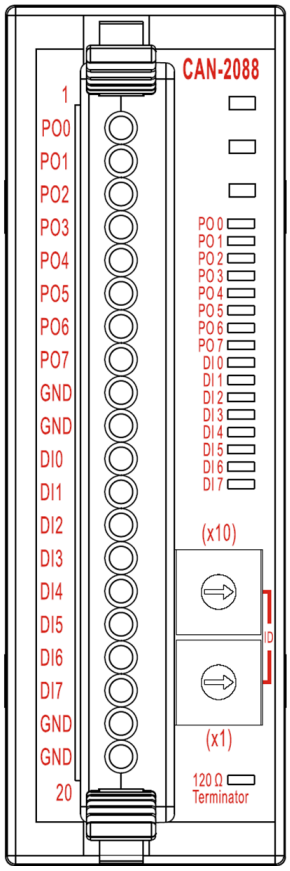
PWM LED

If the PWM LED turns on, it means that the channel of PWM is sending pulse.

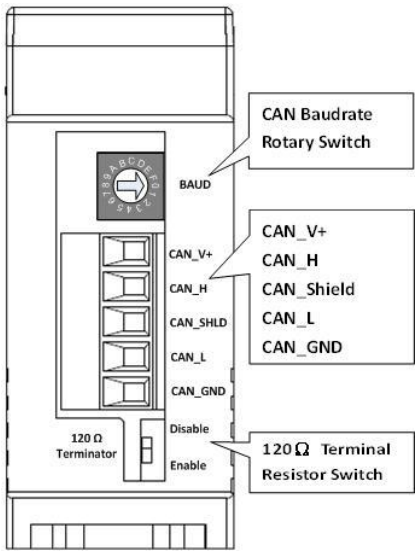
DI LED

If the DI LED turns on, it means that the channel of DI is receiving an ON-Voltage-Level digital signal.

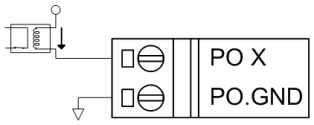
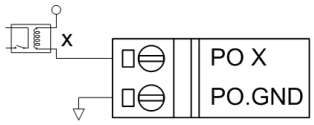
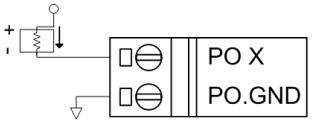
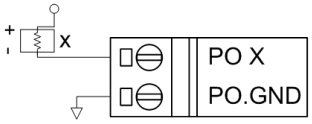
2.4 PIN Assignment

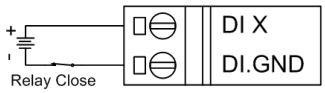
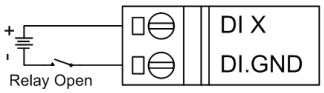
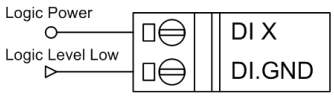
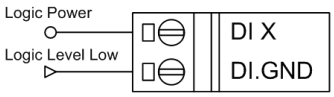
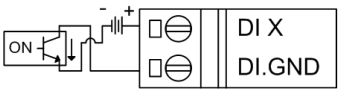
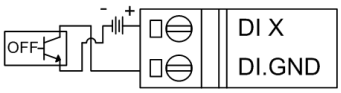
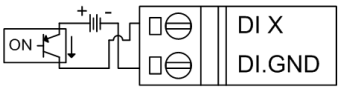
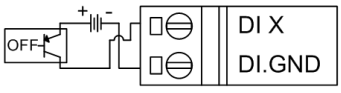


Terminal No.	Pin Assignment
01	PO.0
02	PO.1
03	PO.2
04	PO.3
05	PO.4
06	PO.5
07	PO.6
08	PO.7
09	PO.GND
10	PO.GND
11	DI.0
12	DI.1
13	DI.2
14	DI.3
15	DI.4
16	DI.5
17	DI.6
18	DI.7
19	DI.GND
20	DI.GND

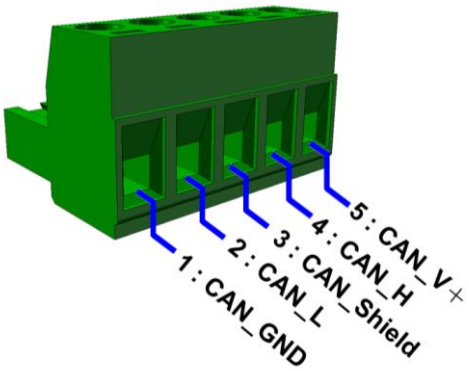


2.5 Wire Connection

Output Type	ON State LED ON Readback as 1	OFF State LED OFF Readback as 0
Drive Relay	Relay On	Relay Off
		
Resistance Load		
		

Input Type	ON State LED ON Readback as 1	OFF State LED OFF Readback as 0
Relay Contact	Relay On	Relay Off
		
TTL/CMOS Logic	Voltage > 10 V	Voltage < 4 V
		
NPN Output	Open Collector On	Open Collector Off
		
PNP Output	Open Collector On	Open Collector Off
		

5-pin screw terminal block



3 DeviceNet Profile Area

This section documents the detailed functions for each object class that is implemented in the CAN-2088D DeviceNet network.

3.1 DeviceNet Statement of Compliance

General Device Data

Device Information	Description
Version Description of DeviceNet Specification	Volume I, Release 2.0 & Volume II, Release 2.0
Vendor Name	ICP DAS
Device Profile Name	CAN-2088D
Production Revision	1.1

DeviceNet Physical Conformance Data

Item	Description
DeviceNet status LED Support	Yes
MAC ID Setting	Switch (0 ~ 63)
Default MAC ID	1
Communication Baud Rate Setting	Switch (125, 250, 500 kbps)
Default Baud Rate	125 kbps
Predefined Master/Slave Connection Set	Group 2 Only Server

3.2 Identity Object (Class ID: 0x01)

This object provides the identification of and general information about the device.

Class Attribute (Instance ID=0)

Attribute ID	Attribute name	Data Type	Method	Value
0x01	Revision	UINT	Get	0001
0x02	Max Instance	UINT	Get	1

Class Service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes

Instance Attribute (Instance ID=1)

Attribute ID	Description	Method	DeviceNet Data Type	Value
1	Vendor	Get	UINT	803
2	Product type	Get	UINT	0x00
3	Product code	Get	UINT	0x600
4	Major. Minor of firmware version	Get	Struct of USINT USINT	1.1
5	Status	Get	WORD	-
6	Serial number	Get	UDINT	1
7	Product name	Get	Short_String	CAN-2088D
10	Heartbeat Interval	Get/Set	USINT	0(default)

Instance Service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes
0x10	Set_Attribute_Single	Yes
0x05	Reset	Yes

Note: Use the Instance Service 0x05 will reboot the device.

3.3 Connection Object (Class ID:0x05)

This section presents the externally visible characteristics of the Connection Objects associated with the Predefined Master/Slave Connection Set within slave devices.

The default IO connection path is as follow.

Connection Path	Class ID	Instance ID	Attribute ID
Poll Produced	0x04	0x66	0x03
Poll Consumed	0x04	0x64	0x03
Bit Strobe Produced	0x04	0x66	0x03
Bit Strobe Consumed	0x04	0x64	0x03

Connection Instance ID	Description
1	References the Explicit Messaging Connection into the Server
2	References the Poll I/O Connection
3	References the Bit–Strobe I/O Connection

3.4 Assembly Object (Class ID: 0x04)

The Assembly Object binds attributes of multiple objects, which allows data to or from each object to be sent or received over a single connection. Assembly objects can be used to bind input data or output data. The terms of ”input” and ”output” are defined from the network’s point of view. An input will produce data on the network and an output will consume data from the network.

Class attribute (Instance ID=0)

Attribute ID	Attribute name	Data Type	Method	Value
0x01	Revision	UINT	Get	1
0x02	Max Instance	UINT	Get	0x0A

Class service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes

Instance ID

Instance ID	OUTPUT	INPUT
0x64	Clear channel 0 ~ 7 DI counter	Get 0 ~ 7 DI counter clear Flag
0x65	Set channel 0 ~ 7 Config. to default	Get 0 ~ 7 Config. to default Flag
0x66		Get channel 0 ~ 7 DI value
0x67		Get channel 0 ~ 7 DI counter
0x68	Set channel 0 ~ 7 sync mode	Get channel 0 ~ 7 sync mode
0x69	Set channel 0 ~ 7 hardware trig mode	Get channel 0 ~ 7 hardware trig mode
0x6A	Set channel 0 ~ 7 output type	Get channel 0 ~ 7 output type
0x6B	Set channel 0 ~ 7 PWM period	Get channel 0 ~ 7 PWM period
0x6C	Set channel 0 ~ 7 PWM duty	Get channel 0 ~ 7 PWM duty
0x6D	Set channel 0 ~ 7 PWM burst count	Get channel 0 ~ 7 PWM burst count
0x6E	Set channel 0 ~ 7 PWM start/stop	Get channel 0 ~ 7 PWM start/stop

Contents of Each Assembly Object Instance

Instance ID	Description	Type	Method	Default Value
0x64	Clear channel 0 DI counter … Clear channel 7 DI counter	USINT … USINT	Get/Set	0x00 … 0x00
0x65	Channel 0 Configuration to default … Channel 7 Configuration to default	USINT … USINT	Get/Set	0x00 … 0x00
0x66	Get channel 0 DI value … Get channel 7 DI value	USINT … USINT	Get	0x00 … 0x00
0x67	Get channel 0 DI counter … Get channel 7 DI counter	UDINT … UDINT	Get	0x00000000 … 0x00000000
0x68	Channel 0 sync mode … Channel 7 sync mode	USINT … USINT	Get/Set	0x00 … 0x00
0x69	Channel 0 hardware trig mode … Channel 7 hardware trig mode	USINT … USINT	Get/Set	0x00 … 0x00
0x6A	Channel 0 output type … Channel 7 output type	USINT … USINT	Get/Set	0x01 … 0x01
0x6B	Channel 0 PWM period … Channel 7 PWM period	UDINT … UDINT	Get/Set	0x00000002 … 0x00000002
0x6C	Channel 0 PWM duty … Channel 7 PWM duty	UINT … UINT	Get/Set	0x01F4 … 0x01F4
0x6D	Channel 0 PWM burst count … Channel 7 PWM burst count	UINT … UINT	Get/Set	0x00 … 0x00
0x6E	Channel 0 PWM start/stop … Channel 0 PWM start/stop	USINT … USINT	Get/Set	0x00 … 0x00

Parameter description of Assembly Object Instance

Instance ID	Data Range	Parameter Description
0x64	0x01: Clear	Clear channel**x** DI counter
0x65	0x01: Set to default	Set channel**x** configuration to default value
0x66	0x00 or 0x01	Channel**x** digital input value
0x67	0x00000000 ~ 0xFFFFFFFF	Channel**x** high speed digital input counter value
0x68	0x00: disable sync 0x01: enable sync	Channel**x** with sync output.
0x69	0x00: disable 0x01: start trig 0x02: stop trig	Channel**x** trigger status. The DI ch0 is the trig of PO ch0, and DI ch1 is the trig of PO ch1, and so on. When DI value is changed, the PO will be triggered.
0x6A	0x00: Burst Counting mode 0x01: Continue mode	Channel**x** output mode
0x6B	0x00000002 ~ 0x004C4B40 (0.2 Hz ~ 500 kHz)	Channel**x** frequency range. The frequency range is non-continuous. 0x00000001 => 0.1 Hz
0x6C	0x0001 ~ 0x03E7 (1‰ ~ 999‰)	Channel**x** high duty mille. 0x0001 => 1‰ low duty mille = (1000 – high duty) ‰
0x6D	0x0001 ~ 0xFFFF	Channel**x** Burst counting value, only for burst counting mode.
0x6E	0x00: stop output 0x01: start output	Channel**x** start or stop to output pulse.

Note: x is channel number of module

Instance attribute (Instance ID=0x64~0x6E)

Attribute ID	Description	Method	DeviceNet Data Type	Value
0x03	Data	Get/Set	OUTPUT/ INPUT	Dependent on instance ID

Instance service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes
0x10	Set_Attribute_Single	Yes

3.5 Application Object1 (Class ID: 0x64)

Application objects are the interfaces between an application and the DeviceNet Layer. The attributes of application Objects contain the data for the application, which are accessed and exchanged via DeviceNet. DeviceNet accesses application data by invoking read and write functions. These functions need to be provided by an Application Object. DeviceNet provides Get_Attribute_Single and Set_ Attribute_Single to read and write CAN-2088D module.

Application Object1 defines pulse output channels and digital input channels configuration.

Class attribute (Instance ID=0)

Attribute ID	Attribute name	Data Type	Method	Value
0x01	Revision	UINT	Get	1
0x02	Max Instance	UINT	Get	0x08

Class service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes

Instance ID

Instance ID	Description
0x01	PO&DI channel 0 configuration
0x02	PO&DI channel 1 configuration
0x03	PO&DI channel 2 configuration
0x04	PO&DI channel 3 configuration
0x05	PO&DI channel 4 configuration
0x06	PO&DI channel 5 configuration
0x07	PO&DI channel 6 configuration
0x08	PO&DI channel 7 configuration

Instance attribute (Instance ID=0x01~0x08)

Attribute ID	Description	Method	Data Type	Default Value
0x01	Clear DI counter	Get/Set	USINT	0x00
0x02	Set configuration to default	Get/Set	USINT	0x00
0x03	DI value	Get	USINT	0x00
0x04	DI counter	Get	UDINT	0x00000000
0x05	Sync mode	Get/Set	USINT	0x00
0x06	Hardware trigger mode	Get/Set	USINT	0x00
0x07	Output type	Get/Set	USINT	0x01
0x08	PWM period	Get/Set	UDINT	0x00000002
0x09	PWM duty	Get/Set	UINT	0x01F4
0x0A	PWM burst count	Get/Set	UINT	0x0000
0x0B	PWM start/stop	Get/Set	USINT	0x00

Parameter description of Application Object1 attributes

Attribute ID	Data Range	Parameter Description
0x01	0x01: Clear	Clear channel**x** DI counter
0x02	0x01: Set to default	Set channel**x** configuration to default value
0x03	0x00 or 0x01	Channel**x** DI value
0x04	0x00000000 ~ 0xFFFFFFFF	Channel**x** high speed digital input counter value
0x05	0x00: disable sync 0x01: enable sync	Channel**x** with sync output.
0x06	0x00: disable 0x01: start trigger 0x02: stop trigger	Channel**x** trigger status. The DI ch0 is the trig of PO ch0, and DI ch1 is the trig of PO ch1, and so on. When DI value is changed, the PO will be triggered.
0x07	0x00: Burst Counting mode 0x01: Continue Counting mode	Channel**x** output mode
0x08	0x00000002 ~ 0x004C4B40 (0.2 Hz ~ 500 kHz)	Channel**x** frequency range. The frequency range is non-continuous. 0x00000001 => 0.1 Hz
0x09	0x0001 ~ 0x03E7 (1‰ ~ 999‰)	Channel**x** high duty mille. 0x0001 => 1‰ low duty mille = (1000 – high duty) ‰

0x0A	0x0001 ~ 0xFFFF	Channel**x** Burst counting value, only for burst counting mode.
0x0B	0x00: stop output 0x01: start output	Channel**x** start or stop to output pulse.

Note: x is channel number of module, dependent on instance ID setting

Instance service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes
0x10	Set_Attribute_Single	Yes

3.6 Application Object2 (Class ID: 0x65)

Application Object2 defines some configuration that used for all pulse output channels and digital input channels.

Class attribute (Instance ID=0)

Attribute ID	Attribute name	Data Type	Method	Value
0x01	Revision	UINT	Get	1
0x02	Max Instance	UINT	Get	0x01

Class service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes

Instance attribute (Instance ID=1)

Attribute ID	Description	Method	Data Type	Default Value
0x01	DI value	Get/Set	USINT	0x00
0x02	Sync channel start/stop	Get/Set	USINT	0x00000000
0x03	Save all Configuration to EEPROM	Set	USINT	-

Parameter description of Application Object2 attributes

Attribute ID	Data Range	Parameter Description
0x01	DI value	DI value: per bit to per channel data DI channel 0, 5 on => DI vaue: 0x21
0x02	0x00: stop sync channels 0x01: start sync channels	Set sync channels start or stop to output pulse
0x03	0x01: Use default configuration 0x02: Save all Configuration to EEPROM	0x01: After restarting the device, configuration will become factory setting. 0x02: Save all channels configuration into EEPROM

Instance service

Service Code	Service name	Support
0x0E	Get_Attribute_Single	Yes
0x10	Set_Attribute_Single	Yes

4 Application

Application Object1 (Class ID:0x64) lists all the parameters of the module. Each Instance ID is corresponding to the different cahnnels. By using “Set/Get Attribute Single” service, user can read/write the parameters of each channel.

Example1:

Clear channel0 DI counter.

(Class ID: 0x64, Instance ID: 0x01, Attribute ID 0x01).

If the node ID of the CAN-2088D is 1, and the master (ID: 0x0A) has completed “Explicit” connection with the device. By setting the value of attribute ID 0x01 to be 0x01, the channel 0 of the DI counter becomes 0.

IDENTIFIER BITS											RTR	Data Length	8-byte Data (byte) (HEX)							
		Destination MAC ID																		
10	9	8	7	6	5	4	3	2	1	0			0	1	2	3	4	5	6	7
1	0	0	0	0	0	0	1	1	0	0	0	6	0A	10	64	01	01	01	--	--

Master → **Slave (CAN-2088D)**

IDENTIFIER BITS											RTR	Data Length	8-byte Data (byte) (HEX)							
		Source MAC ID																		
10	9	8	7	6	5	4	3	2	1	0			0	1	2	3	4	5	6	7
1	0	0	0	0	0	0	1	0	1	1	0	2	0A	90	--	--	--	--	--	--

Slave (CAN-2088D) → **Master**

Set the value 0x01 to the Application Object1 with Instance ID 0x01 and Attribute ID 0x01. After sending the “Set Attribute Single”, the slave device will response 0x90 to mean setting OK. Then channel 0 of the DI counter will be set to zero.

By changing the Instance ID and Attribute ID of the Application Object, you can set other parameters of this device.

Example2:

Get DI data of channel 0 (Class ID: 0x64, Instance ID: 0x01, Attribute ID 0x03). If the node ID of the CAN-2088D is 1, and the master (ID: 0x0A) has completed “Explicit” connection with the device. By getting the value of the object with attribute ID 0x03, you can get the DI data of channel 0.

IDENTIFIER BITS											RTR	Data Length	8-byte Data (byte) (HEX)							
		Destination MAC ID																		
10	9	8	7	6	5	4	3	2	1	0			0	1	2	3	4	5	6	7
1	0	0	0	0	0	0	1	1	0	0	0	5	0A	0E	64	01	03	--	--	--

Master → **Slave (CAN-2088D)**

IDENTIFIER BITS											RTR	Data Length	8-byte Data (byte) (HEX)							
		Source MAC ID																		
10	9	8	7	6	5	4	3	2	1	0			0	1	2	3	4	5	6	7
1	0	0	0	0	0	0	1	0	1	1	0	3	0A	8E	00	--	--	--	--	--

Master ← **Slave (CAN-2088D)**

Get the value of Application Object1 with Instance ID 0x01 and Attribute ID 0x03. After sending the “Get Attribute Single”, the slave device will response the DI data of channel 0 on byte 2.

By changing the Instance ID and Attribute ID of the Application Object, you can get other parameters of this device.

The attribute 0x0B of Application Object1 can control the module to start or stop the pulse output of each channel. Each Instance ID is mapped to each channel. Attribute 0x07 can decide the PWM method of each channel. If you select the Burst Counting mode, the attribute 0x0A must be set to decide how many pulse you want to output. You can set 1 ~ 65535 to the attribute 0x0A and use attribute 0x0B to start or stop the pulse output. When set the attribute 0x0B to 1, the channel will output the specific pulses with one burst cyclic and the value of attribute 0x0B becomes to 0. For example, set the channel 0 (Instance ID: 0x01) to the Burst Counting mode and set the attribute 0x0A to 100. When user set the attribute 0x0B to 1, this channel will output 100 pulses, and then stop to send. If you select the Continue Counting mode, the attribute 0x0A will be useless. When users set the attribute 0x0B to 1 on Continue Counting mode, the channel will start to output the pulse cyclically until the attribute is set to 0. If you want to change the frequency of the pulses, you can set the value 2 ~ 5000000 to the attribute 0x08. The unit is 0.1 Hz, therefore, the pulse with 0.2 Hz ~ 500 kHz can be applied.

The attribute 0x09 is the pulse duty. If set the attribute to value 300, it means that the pulse width of the high duty is 300‰ and the one of low duty is 700‰. The attribute 0x06 can set the DI channel to be the hardware trigger of the PWM output channel. When set the value 1 to the object of the instance ID 0x01 with attribute 0x06, it means that the DI channel 0 will loss the DI functions and become a hardware trigger of PWM output channel 0. In this case, if the value of DI channel 0 is changed, the channel 0 of PWM output will start to output pulse.

The attribute 0x05 of Application Object1 and the attribute 0x02 of Application Object2 can control the channel of the PWM module to output synchronous. If user wish channel 0 ~ 3 of the PWM module output the pulse synchronously, set the value 1 to the Application Object1 Instance 0x01 ~ 0x04 with attribute 0x05. Then, set the value 1 to the Application Object2 with Instance 0x01 and attribute 0x02. These 4 channels (channel 0 ~ 3) will start to output pulse at the same time (their first low-to-high edge will be triggered at the same time, but the period may be different because of different pulse width).

Appendix A: Dimension