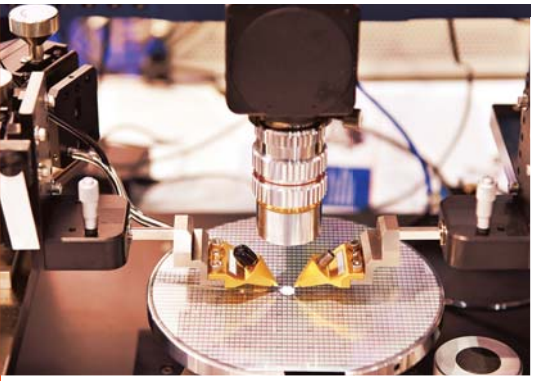
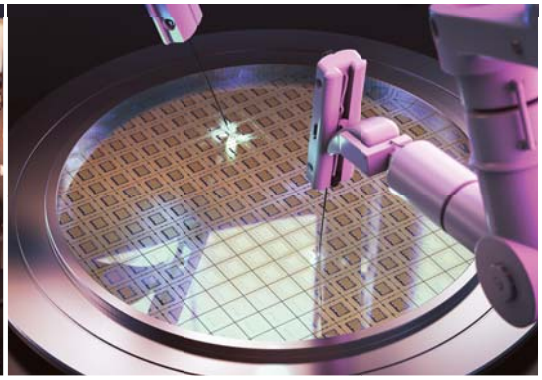
DeviceNet Total System Integration Solution





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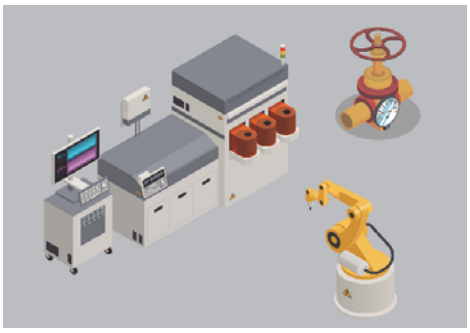


Content

CH1 ICP DAS DeviceNet Product Solution

ICP DAS has been deeply involved in DeviceNet technology for many years and has developed a series of DeviceNet products, including PCI interface cards, converters, PACs, gateways and remote I/O modules.We provide complete hardware solutions to meet various DeviceNet applications to help you solve problems related to data collection and calculation, transmission distance extension, network topology limitations, communication interface conversion and noise suppression, etc., so that you can easily achieve various DeviceNet application projects.

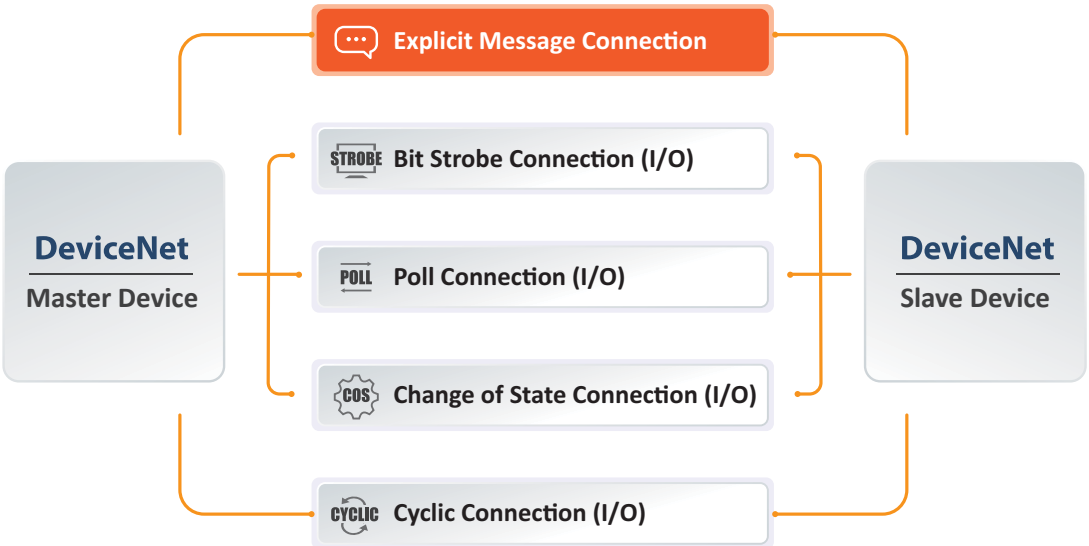
1.1 DeviceNet Introduction and Advantages

The DeviceNet industrial communication protocol is based on the strong CAN bus, which can maintain a high degree of security and excellent communication performance in harsh environments full of noise. It is generally regarded as one of the important measures of safety and stability in the industry.

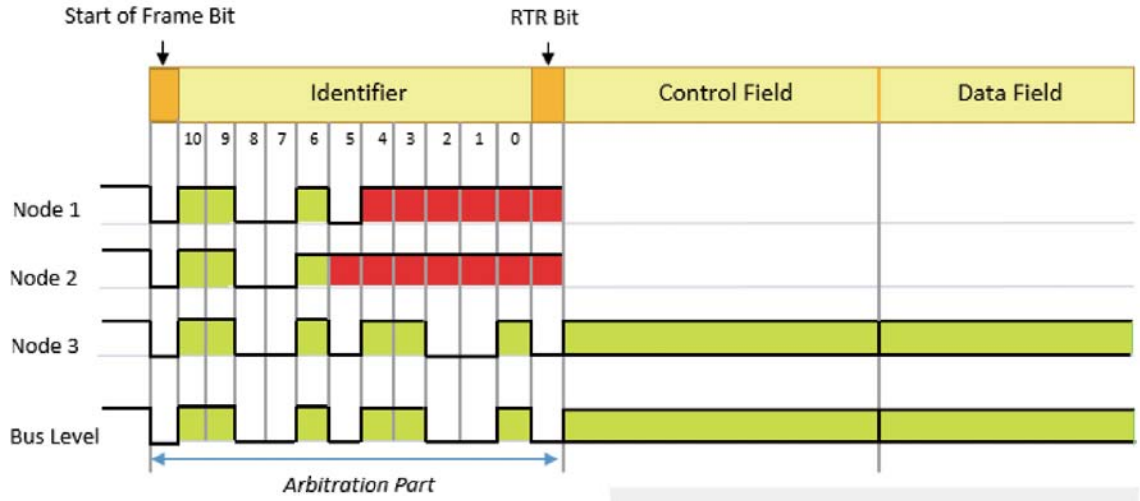
DeviceNet is an open communication protocol that enables various industrial devices to work together and share information in real time on the DeviceNet network.

1.2 DeviceNet Protocols and Features

According to DeviceNet standard, Master and Slave exchange data based on connection. While the connection is created, Master/Slave node can transfer messages in Explicit way. DeviceNet can establish a fast IO connection, which can quickly exchange IO data on the DeviceNet network. Poll is the rapid exchange of input and output data between master and slave nodes. Bit-strobe is a connection method in which the master node sends a request to multiple slave nodes, and the slave nodes transmit the input data to the master node. Change of state (event-triggered) or Cyclic (time-triggered) is a communication method in which the master or slave node sends IO data, and then the receiving node responds to the acknowledgement message.



There are multiple devices in the DeviceNet network transmitting data, how to avoid packet collision? DeviceNet has a unique packet arbitration mechanism of the CAN bus. When the nodes on the CAN bus detect that the bus is idle, two or more nodes send data at the same time, which will trigger the unique arbitration mechanism of the CAN bus to avoid data transmission errors. The priority level of the CAN packet is determined by the ID of the CAN packet. There are two electrical states on the CAN bus. State 0 is dominant and 1 is recessive. If both dominant and recessive electrical states appear on the CAN bus, the state of the CAN bus will be regarded as a dominant state. In the arbitration, a CAN packet with the highest priority will be successfully sent, ensuring that the highest-level packet can be transmitted smoothly and improving the utilization of the bus.



Due to its high reliability and low implementation cost, DeviceNet has been widely used in a variety of applications, from simple photoelectric switches, temperature sensors, to complex air pressure valves for semiconductor manufacturing, can see the trace of DeviceNet.

At present, DeviceNet is widely used in the monitoring markets in America and Asia, and its system solutions have also achieved significant growth in Europe. Up to now,there are more than 500 companies in the world providing DeviceNet-related products. It is not difficult to find its excellent stability in various industrial applications.

Feature

1. **Reduced wiring and network complexity**
2. **Real-time monitoring the production capacity and yield rate**
3. **Reduced installation cost and time**
4. **Improve security and stability of system**
5. **Flexible network scalability and provide rapid troubleshooting**

mks PEPPERL+FUCHS FESTO

SMC Allen-Bradley KEYENCE SICK Sensor Intelligence.

1.3 DeviceNet Solution

DeviceNet Master Products	
PISO-DNM100U	1 Port Intelligent DeviceNet Master Universal PCI Board
I-8124W	1 Port DeviceNet Master Module
I-7565-DNM	USB Interface DeviceNet Master Converter

DeviceNet Gateway Products	
GW-7243D	DeviceNet Slave to Modbus TCP/RTU/ASCII Master Gateway
GW-7434D	Modbus TCP/RTU/ASCII Slave to DeviceNet Master Gateway

DeviceNet Remote IO Products	
CAN-2053D	DeviceNet Slave Module of 16-channel Isolated DI
CAN-2054D	DeviceNet Slave Module of 8-channel Isolated DI, 8-channel Isolated DO
CAN-2057D	DeviceNet Slave Module of 16-channel Isolated DO
CAN-2017D	DeviceNet Slave Module of 8-channel AI
CAN-2018D/S	DeviceNet Slave Module of 8-channel Thermocouple Input
CAN-2024D	DeviceNet Slave Module of 4-channel AO
CAN-2088D	DeviceNet Slave Module of 8-channel PWM Output, 8-channel High Speed Counter Input
CAN-8124	DeviceNet Slave I/O Unit with 1 I/O Slot
CAN-8224	DeviceNet Slave I/O Unit with 2 I/O Slot
CAN-8424	DeviceNet Slave I/O Unit with 4 I/O Slot

CH2 DeviceNet Master Series

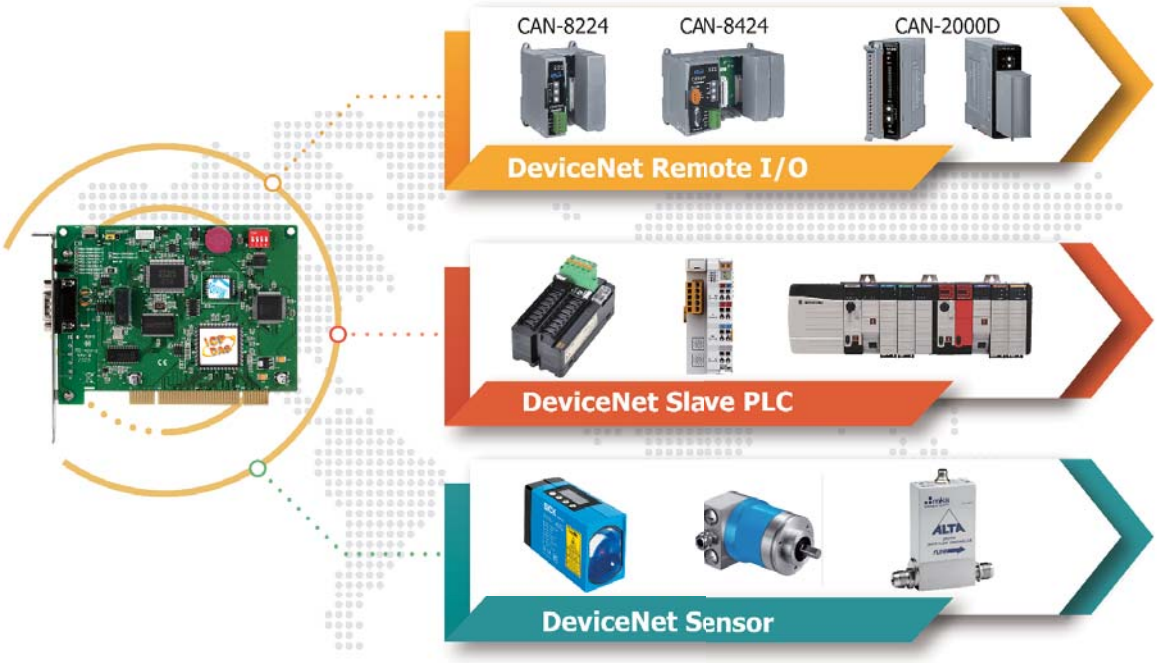
DeviceNet Master series products launched by ICP DAS contain CPU and small operating system.The intelligent product design can operate the DeviceNet master firmware independently, and a single CPU can speed up the processing of a large number of DeviceNet network packets. Master the data of all DeviceNet slave stations, and immediately respond to output commands to IO slave stations, which can easily meet the requirements of real-time monitoring.The independent CPU architecture can effectively simplify the complexity of developers and shorten the development time, and can provide a very efficient data exchange API.

2.1 One Port Intelligent DeviceNet Master PCI Board

PISO-DNM100U

PISO-DNM100U is a DeviceNet Master PCI board with an independent CAN communication interface. Based on the built-in high-efficiency CPU, it can operate DeviceNet firmware independently, and use DPRAM to communicate with PCI bus, which can greatly reduce the burden of the control system and provide an efficient control method. Supporting the server functions of Group 2 and UCMM, an intelligent DeviceNet master station solution, can be widely used in factory automation, building automation and automation equipment.

- 1 Port Intelligent DeviceNet Master Universal PCI Board
- Support bulk IO data read-and-write function
- Supports BoardID, which can be easily identified by inserting multiple cards
- Built-in independent high-performance CPU, DeviceNet master communication is more efficient
- DeviceNet Version: Volume I & II, Release 2.0
- Programmable master MAC ID and baud rate
- Support Group 2 and UCMM connection
- Support I/O Operation Mode: Poll, Bit-Strobe and Change Of State/Cyclic
- Each I/O Length: max. 512 bytes (input and output)
- Pre-slave can connect up to 63 slave devices

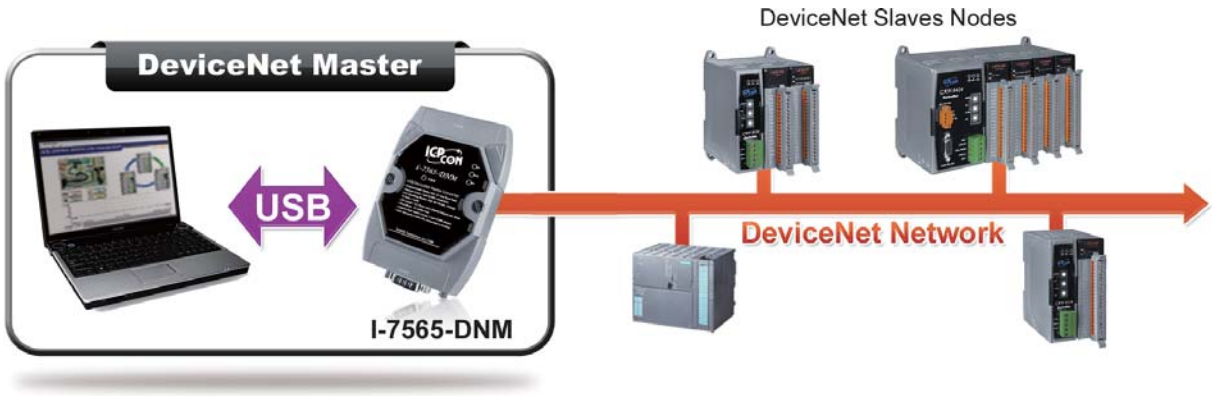


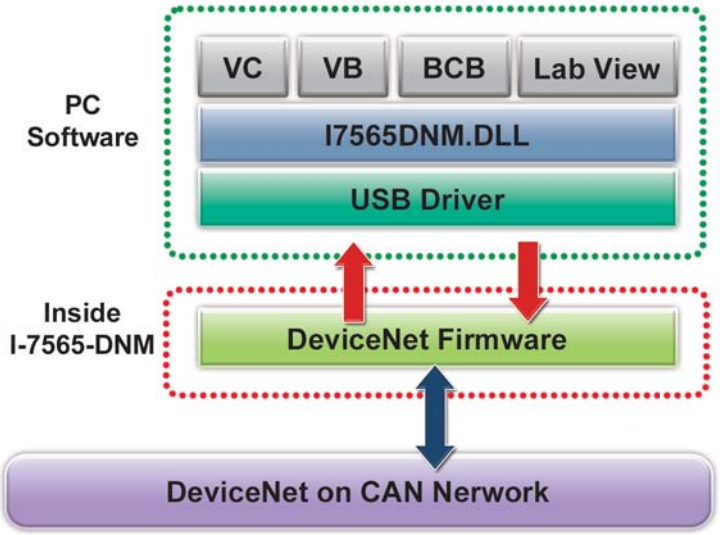
2.2 USB Interface DeviceNet Master Converter

I-7565-DNM

I-7565-DNM can represent an economic solution of DeviceNet application and be a DeviceNet master device on the DeviceNet network. It is a "Predefined Master-Slave connection Set". I-7565-DNM supports Group 2 only Server and UCMM functions to communication with slave devices. It has an independent CAN bus communication port and has the ability to cover a wide range of DeviceNet applications. It can be installed on almost any windows-based system. It is popularly applied in the industrial automation, building automation, vehicle, marine, and embedded control network.

- Compliant with USB 1.1/2.0 Full Speed Specification
- DeviceNet Version: Volume I & II, Release 2.0
- Programmable of the master MAC ID and baud rate
- Support Group 2 and UCMM connection methods
- Supports automatically searching for slave devices
- Automatically distinguish slave devices in Group 2 and UCMM modes
- Support Baud rate 125 k, 250 k, 500 k
- Pre-slave can connect up to 63 slave devices
- Support adding or removing devices online
- Support automatic reconnection
- Free windows software development tools
- Each I/O Length: max. 512 bytes (input and output)
- Support I/O Operation Mode: Poll, Bit-Strobe and Change Of State/Cyclic
- Driver support Windows XP/7/8.1/10 & Linux
- No external power supply required



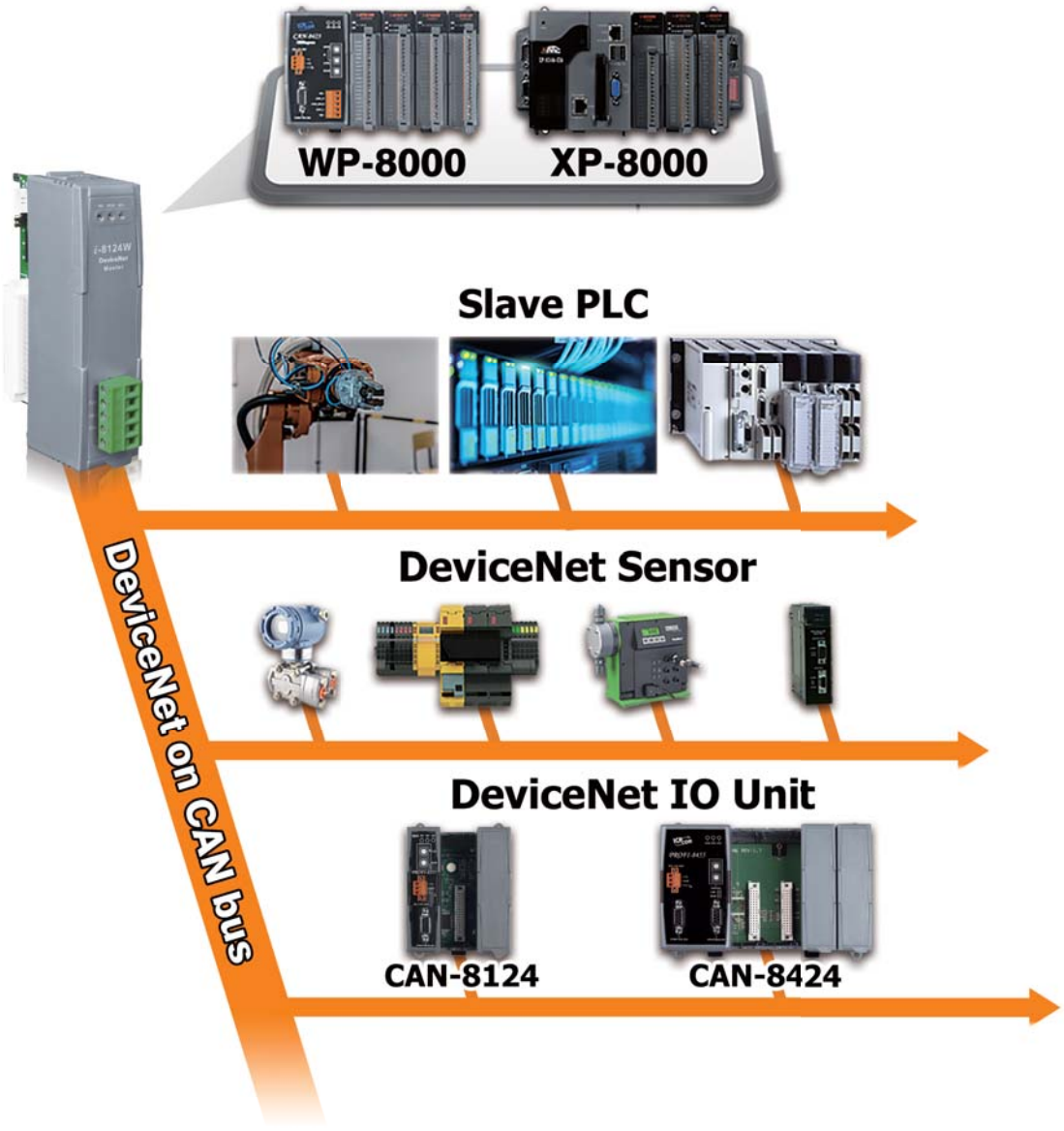


2.3 High-speed Intelligent DeviceNet Master Module

I-8124W

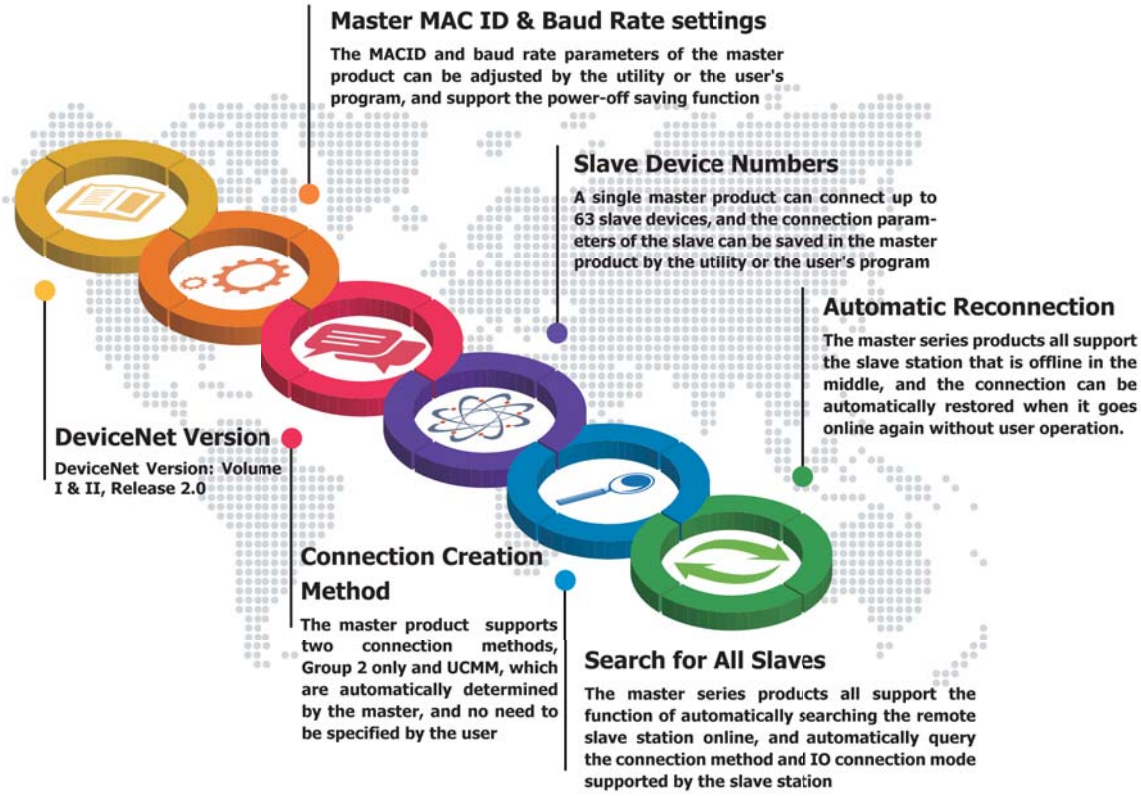
I-8124W is a DeviceNet master module with CAN communication interface. It can be used with XPAC, WinPAC, and ViewPAC series PACs. Based on the built-in high-efficiency CPU, it can operate DeviceNet firmware independently, and use DPRAM to communicate with bulk IO data, which can greatly reduce the burden of the control system. I-8124W supports Group 2 only Server and UCMM, an intelligent DeviceNet master station solution, can be widely used in factory automation, building automation and automation equipment.

- High-efficiency DeviceNet master module
- Compatible with XPAC, WinPAC, ViewPAC series high-performance controllers
- Support bulk IO data read-and-write function
- Built-in independent high-performance CPU makes communication more efficient
- DeviceNet Version: Volume I & II, Release 2.0
- Programmable master MAC ID and Baud rate
- Support Group 2 and UCMM connection
- Support I/O Operation Mode: Poll, Bit-Strobe and Change Of State/Cyclic
- Each I/O Length: max. 512 bytes (input and output)
- Pre-slave can connect up to 63 slave devices



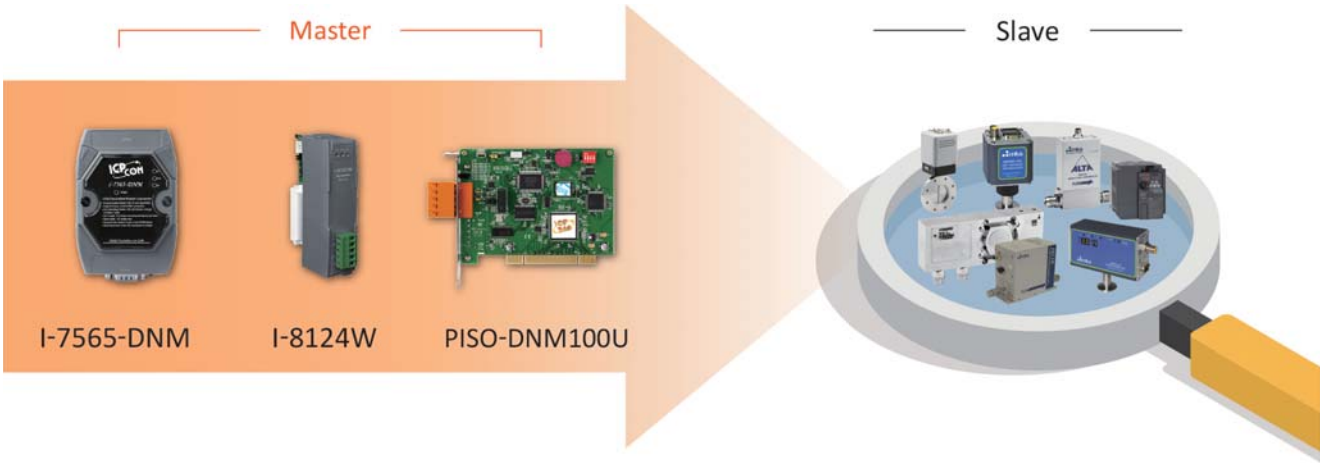
2.4 Product Advantages of DeviceNet Master

Master Product Features



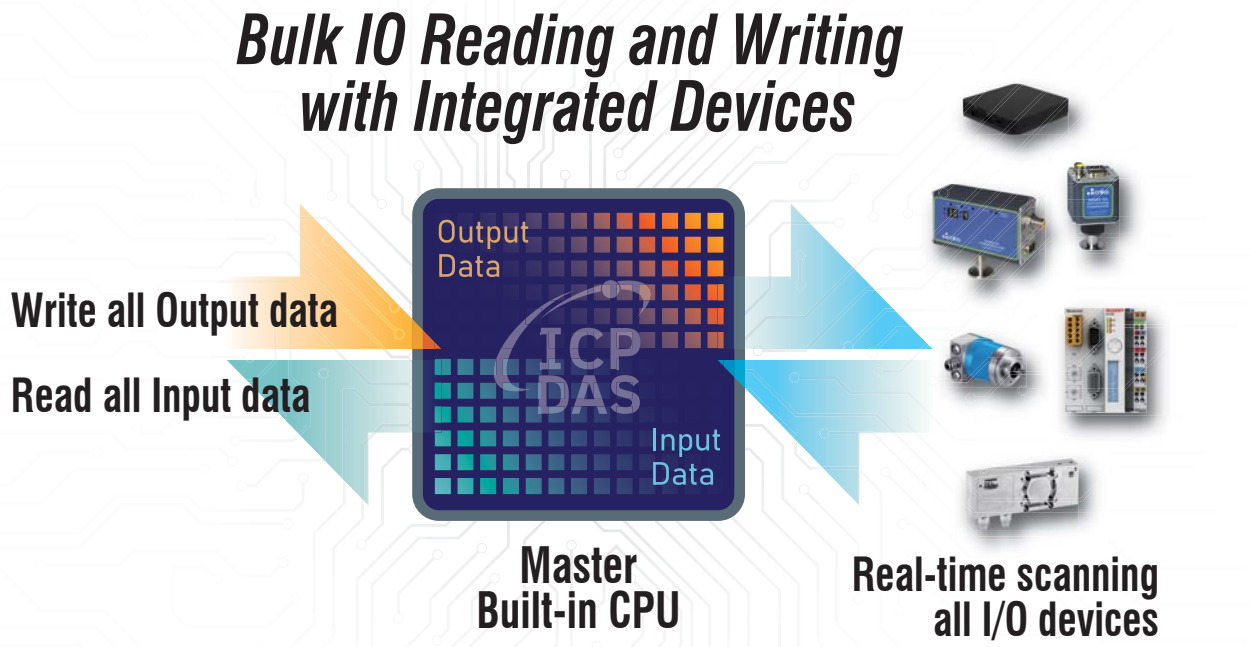
Automatically Search for DeviceNet Slave Devices

The DeviceNet master series products of ICP DAS have all support the function of automatically searching for remote devices which is convenient for users to quickly find all. In addition, the parameters required for device connection can also be found, which can avoid loading the EDS file (electronic device description file) of all devices one by one.The DNM_Utility, management software on the Master side, users can drag and drop the searched devices to the connection list, which is quite fast and convenient to establish the monitoring network of DeviceNet.

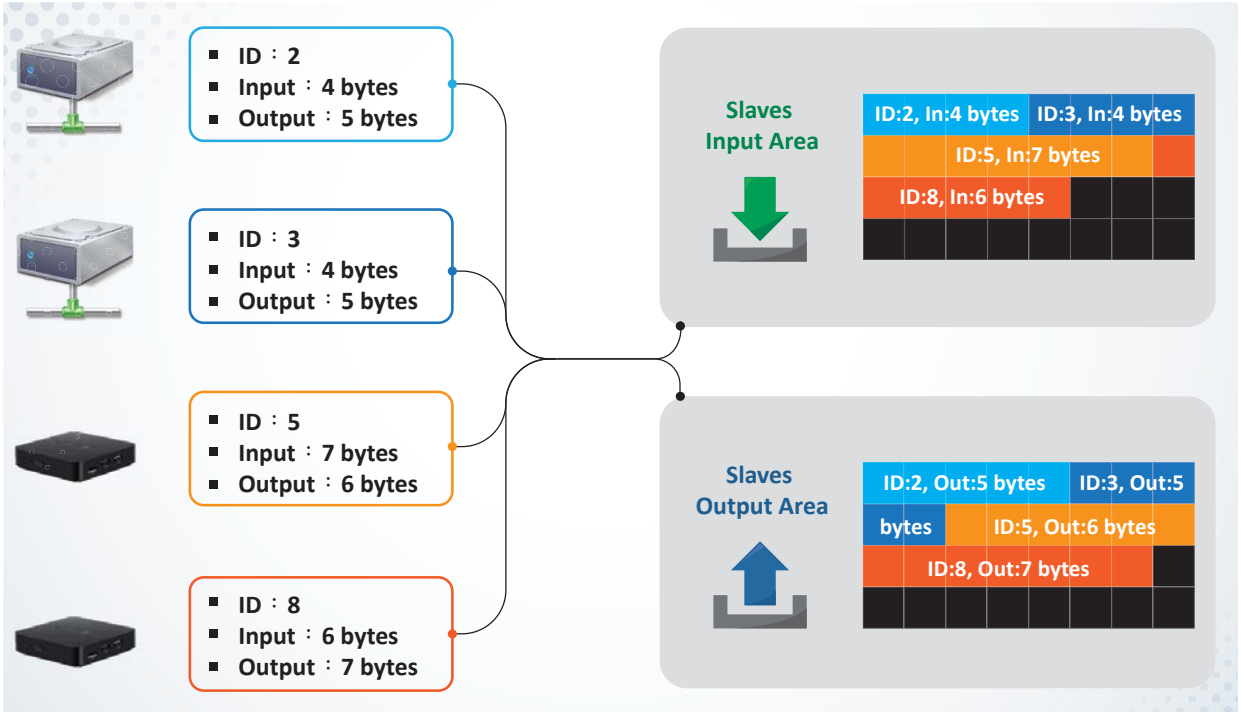


Break the Limits of the Device: Support Bulk IO Read-and-Write Across Devices

In traditionally the program developer on the master side has to sequentially read and write IO data for all remote devices, which is quite inefficient and difficult to manage each IO point. The DeviceNet Master series products from ICP DAS have an innovative and high-performance mechanism which is designed to support the function of bulk I/O read-and-write. A physical memory block is provided inside the product, allowing users to read and write data of all remote devices at one time, which is very convenient and efficient. Users can use this function to develop higher-end industrial applications.The following figure shows the architecture diagram of the whole batch read and write:



There are two memory areas in DeviceNet Master Series: one is "Remote Input Area" and the other is "Remote Output Area".The input data of all devices in the DeviceNet network will be placed in the "Remote Input Area"; the same, the output data will be concentrated in the "Remote Output Area". Users can read and write in these areas in one batch, which is equivalent to reading and writing to all remote devices.



DeviceNet Management Software

DNM_Utility is a free graphical DeviceNet management software. Users can easily integrate DeviceNet industrial devices, and provide convenient management and read-write functions. The software can scan all remote devices in the DeviceNet network, and store the device list in the storage unit of the master product, which can still be saved normally even if the power is turned off.When the DNM_Utility is connected to the DeviceNet device, the management software automatically reads the name and I/O status of each device. These features can help you easily monitor all devices in the network, reducing the burden of development.

Three Steps to Connect Remote Devices

With the DNM_Utility management software, after connecting to the DeviceNet network, users can quickly connect to remote devices with just three simple steps, easily organize the overall IO deployment and read the instant status of all remote IOs.Through ICP DAS DeviceNet host series products, the built-in high-efficiency CPU handles complex protocol handshake actions, which not only centrally manages the scattered IO information, but also reads the real-time batch of remote information, allowing users to control more smoother and efficient.

1 Search

Search the whole remote devices and save them.

2 Start

Start to communicate all the remote devices.

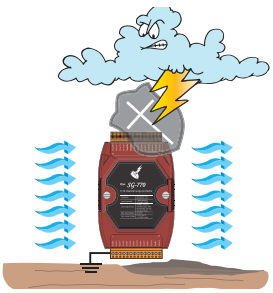
3 Remote Data

Read and write the real-time I/O data to the remote devices.

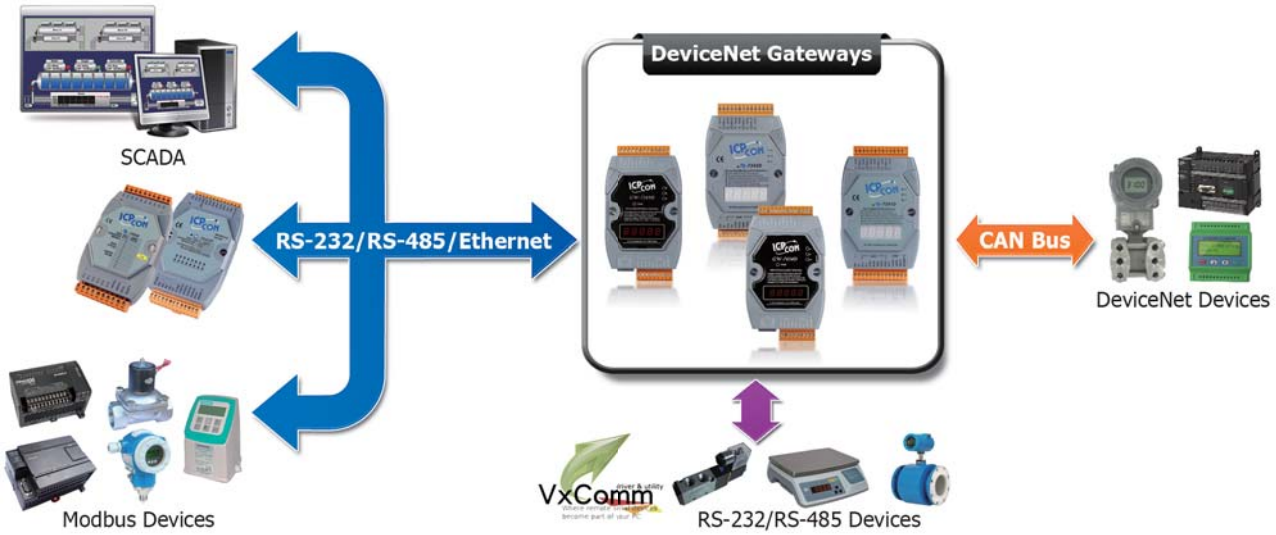
Easy to Start Developing DeviceNet System

All master series products of ICP DAS provide a complete and easy-to-use C language function library, which supports most programming language tools on the market. Users only need to call the corresponding function API, which can greatly shorten the development time.

Network topology can be elastically expanded

Product	Function Features	Application Structure
Surge Protector SG-770 	SG-770 offers 7 differential or 14 single-ended for surge protection. Each of channels supports 0 V ~ ±30 V signal and each of channels is protected for surge achieves 6 kV.	
Isolated CAN Signal Reapeater I-7531-FD 	I-7531-FD is a CAN/CAN FD signal repeater, which can connect two or more CAN networks with the same baud rate. Users can use different numbers of I-7531-FD to combine tree-shaped and star-shaped CAN network topology.	
CAN Bridge I-7532M-FD 	I-7532M-FD is a local CAN/CAN FD (CAN with Flexible Data-Rate) bridge used to establish an extend communication distance with different baud rate and support messages transform between CAN and CAN FD networks.	**Extend CAN working distance** 

CH3 DeviceNet Protocol Gateway Series

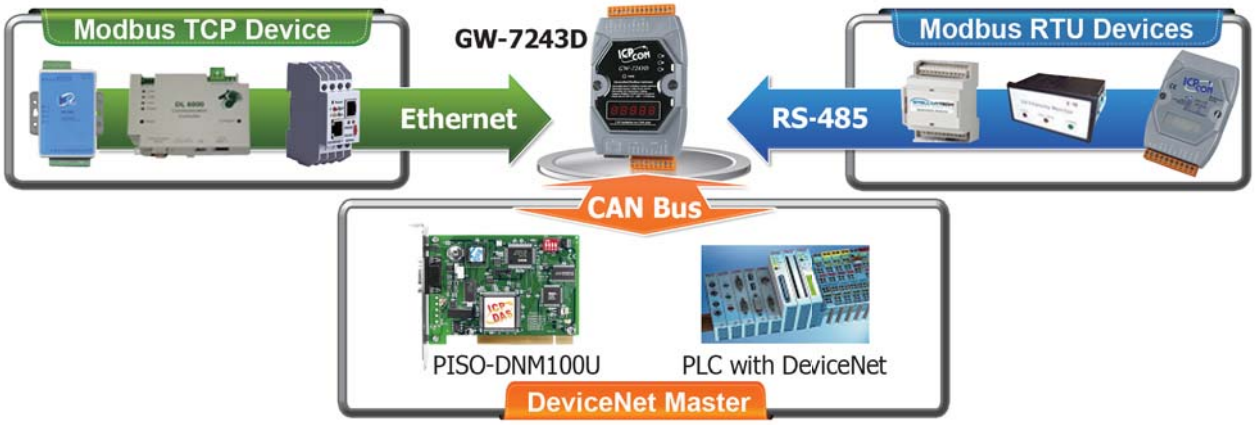


3.1 DeviceNet Slaves and Modbus TCP/RTU/ASCII Master Gateway

GW-7243D

The GW-7243D offers the DeviceNet slave and Modbus master function. In the DeviceNet network, the module acts as a Group 2 Only Server device, and waits the connection with the DeviceNet master. In the Modbus network, the GW-7243D is a master device, and cyclically access the Modbus slave devices. Both the Modbus TCP client and Modbus RTU/ASCII master interfaces of the GW-7243D can work simultaneously. This is helpful to build the applications easily and quickly.

- "Group 2 Only Server" DeviceNet subscriber
- I/O Operation Mode: Explicit, Polling
- Maximum support 4 Modbus TCP devices
- Maximum support 5 Modbus TCP commands for each Modbus TCP device
- Maximum support 10 Modbus RTU/ASCII commands for each COM port
- Support Modbus function Code: 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x0F, 0x10

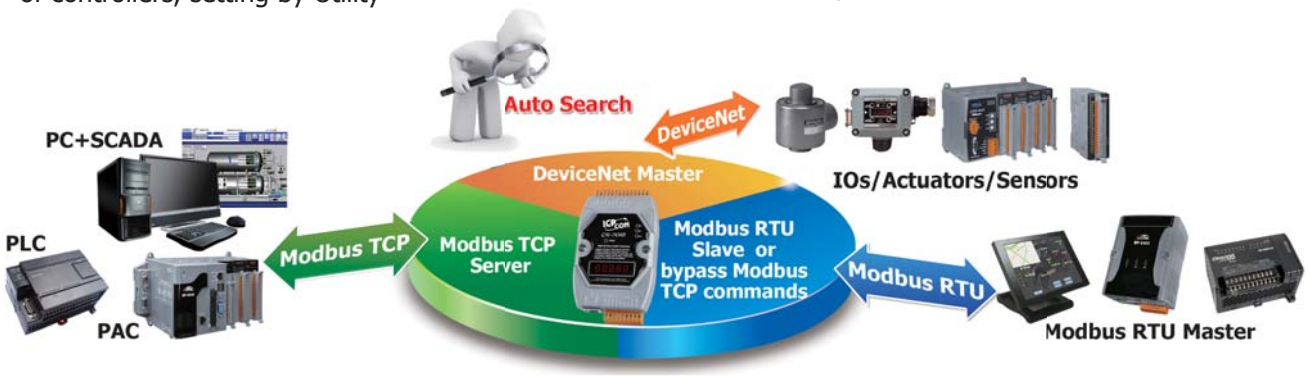


3.2 Modbus TCP/RTU/ASCII Slave and DeviceNet Master Gateway

GW-7434D

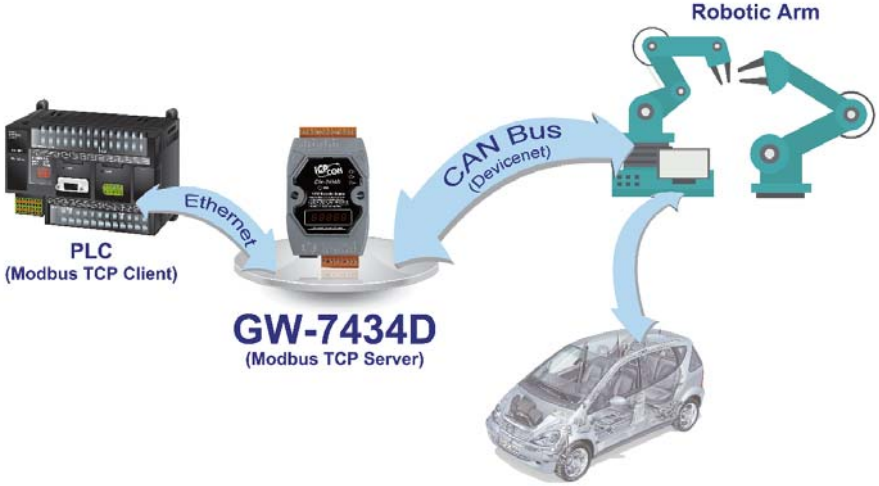
The GW-7434D is an economic solution that provides a communication protocol transformation between the DeviceNet protocol and the Modbus TCP protocol. This module solves the problem to connect an existing DeviceNet network to the Ethernet-based PLC, HMI or SCADA for setting up a control or monitoring system. The GW-7434D offers the Predefined Master connection Set function and Group 2 only Server function as a DeviceNet master.

- Supports up to 63 DeviceNet devices
- Predefined Master/Slave Connection Set
- Supports I/O Operation Mode: Poll, Bit-Strobe and Change Of State/Cyclic
- Converts a single Modbus TCP device into multi Modbus RTU devices, setting by Utility
- Supports VxComm technique for every COM ports of controllers, setting by Utility
- Programmable DeviceNet transfer-rate 125K, 250K, 500K
- Devicenet I/O Length: 128 bytes max. (Input/Output) per DeviceNet slave
- Total DeviceNet I/O Length: 1280 bytes max. (Input/Output) for all DeviceNet slaves
- Supports DeviceNet I/O mapping up to 512 bytes of Modbus I/O data



Robotic Arm Control

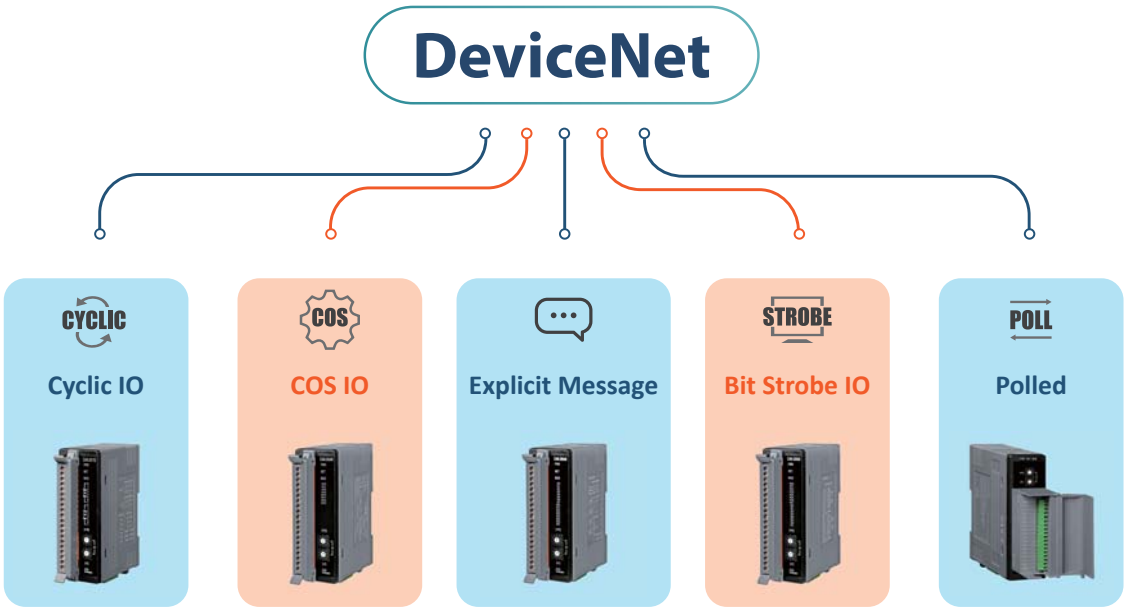
The application of robotic arm in industrial automation is quite popularity. The accuracy and durability of robotic arm can reduce the unpredictability of human problems. The multi-axis robot arm is widely used in automobile manufacturers, auto parts and electronics-related industries. The robotic arm can improve product technology and quality, and these are mostly early work can be done by robotic arms. For product quality, the precision and zero error of robotic arm control has its advantages spontaneously, and it can help proprietor to reduce time-consuming and human resources. The customer use PLC which has Ethernet interface and Modbus TPC protocol to control robotic arm with DeviceNet protocol for moving and polishing vehicle body.



CH4 DeviceNet Remote IO Series

Advantages of DeviceNet IO Modules

CAN-2xxxD and CAN-8x24 series are DeviceNet IO modules. Comply with DeviceNet pecification Volume I/ II Release 2.0. They are especially designed for combining sensors and actuators into DeviceNet network. Diversity of digital/ analog IOs with using for temperature, pressure or flow sensore, DeviceNet IO modules can auto-respond when changing on data from Event Trigger or Timer Trigger. All of them provide corresponding EDS file for standard DeviceNet master interface to describe those supported DeviceNet I/O operation modes such as: Poll, Bit-Strobe, COS/Cyclic, so that DeviceNet master can easily read status from DIO.



4.1 Analog I/O Modules

Model	Analog Input			Analog Output	
	Channels	Input Range	Sensor	Channels	Output Range
CAN-2017D	8	±10 V, ±5 V, ±1 V, ±500 mV, ±150 mV, ±20 mA (with external 125 Ω resistor)	-	-	-
CAN-2018D/S	8	±2.5 V, ±1 V, ±500 mV, ±100 mV, ±50 mV, ±15 mV, ±20 mA (with external 125 Ω resistor)	Thermocouple (J, K, T, E. R. S, B, N, C)	-	-
CAN-2024D	-	-	-	4	0 ~ +5 V, ±5 V, 0 ~ +10 V, ±10 V, 0 ~ 20 mA, 4 ~ 20 mA

4.2 Digital I/O Modules

Model	Analog Input			Analog Output		
	Channels	Contact	Sink/Source	Channels	Type	Sink/Source
CAN-2053D	16	wet	Sink/Source	-	-	-
CAN-2054D	8	wet	Sink/Source	8	Open Collector	Sink
CAN-2057D	-	-	-	16	Open Collector	Sink

4.3 Counter/PWM Modules

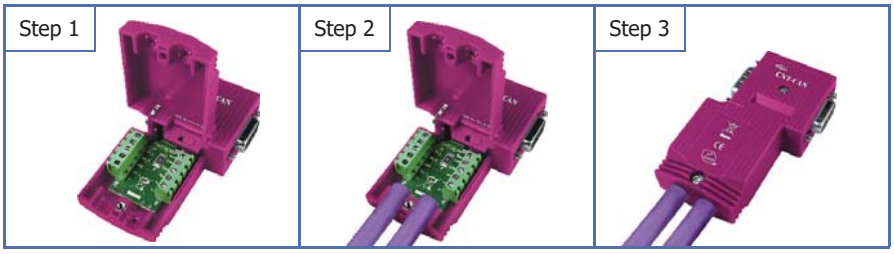
Model	Counter Input				PWM Output			
	Channels	Signal	Resolution	Speed	Channels	Load Current	Resolution	Speed
CAN-2088D	8	Up Counter	32 bit	500 kHz	8	1 mA	16 bit	500 kHz

4.4 DeviceNet IO Unit

Model	Product Description
CAN-8124-G	DeviceNet Slave, 1 slot unit
CAN-8224-G	DeviceNet Slave, 2 slot unit
CAN-8424-G	DeviceNet Slave, 4 slot unit

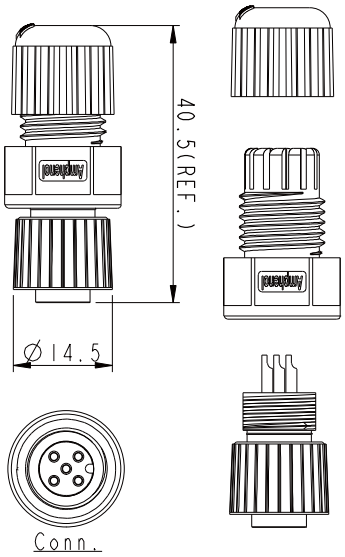
4.5 Accessories

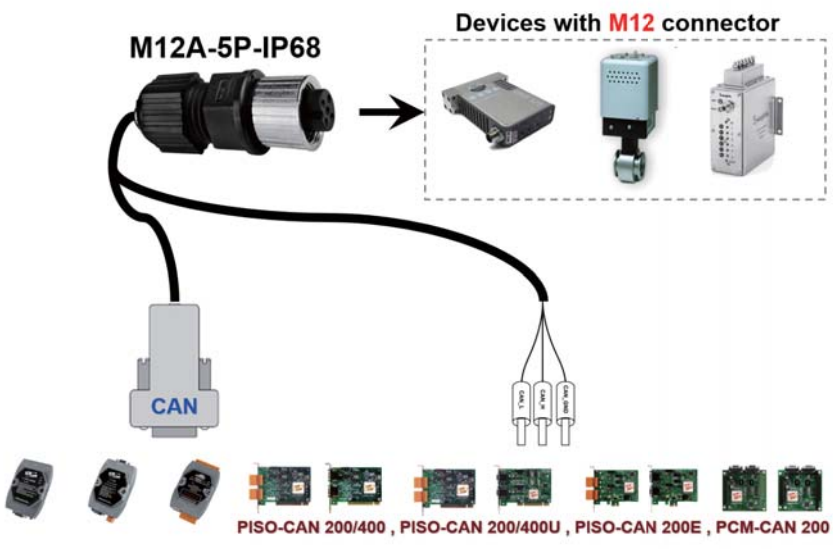
Optional CAN bus connector: CNT-CAN



Installation

Optional CAN bus connector: M12A-5P-IP68



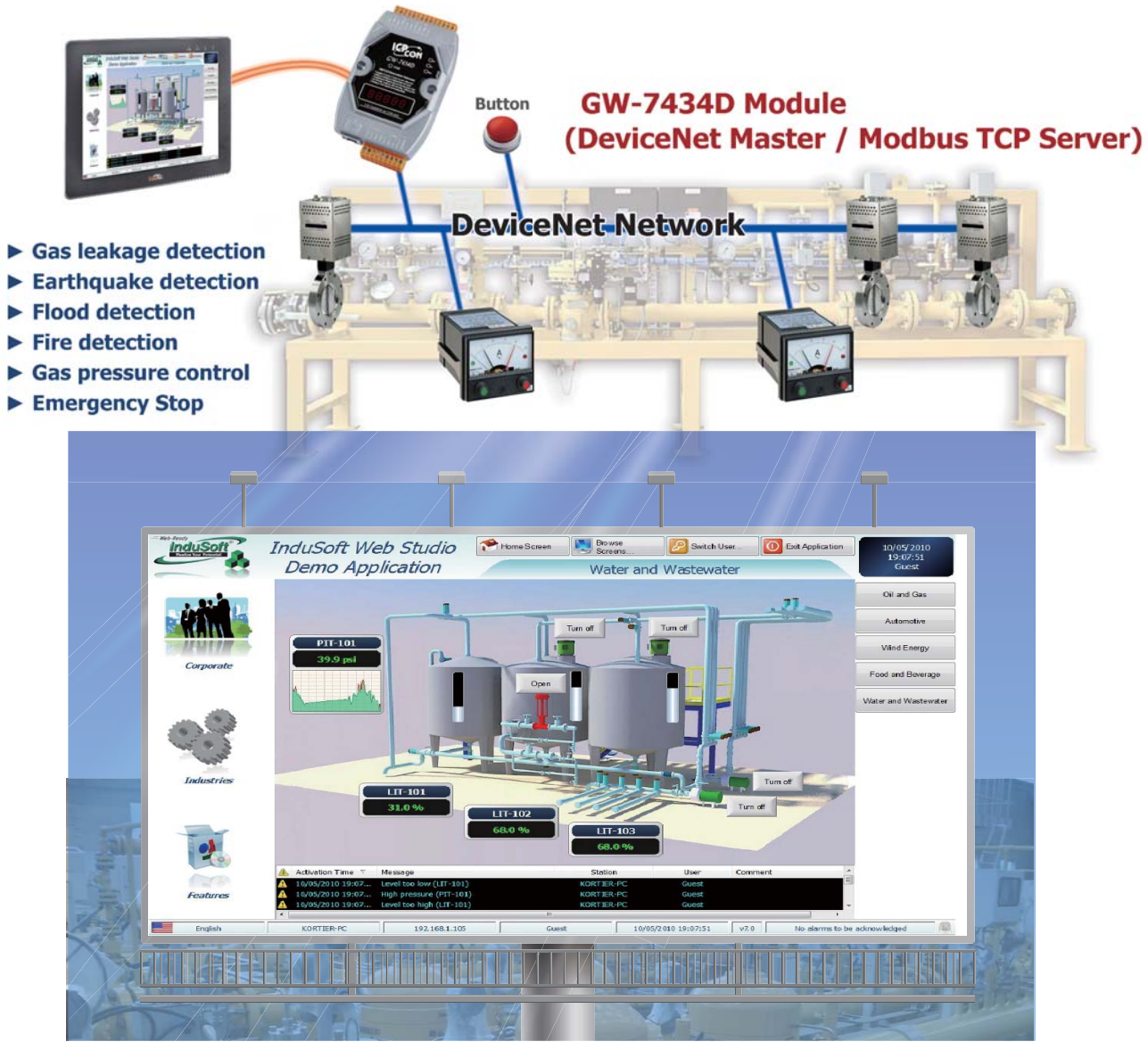


CH5 Applications

5.1 DeviceNet Natural Gas Decompression Control Station

Natural gas companies use high-pressure gas supply to quickly transport natural gas to the user end, but the user end needs to be decompressed before it can be used safely, so a natural gas decompression station is set up to reduce the pressure at the gas supply source. Natural gas is an important basic energy source for people's life and industrial and commercial development, and the gas transmission decompression stations scattered in various places have become the monitoring gatekeepers of the terminal safety gas transmission pipeline system.

This decompression system adopts DeviceNet communication network to connect various sensing devices and regulating valves and other important devices. In the system, HMI is used to monitor the sensing data of DeviceNet, and at the same time, the on-site data is provided to the gas supply company in real time. HMI uses GW-7434D to connect the DeviceNet sensor on site, collects various data such as gas supply and pressure, and can automatically adjust pressure and flow calculation. In addition to detecting gas leakage, the monitoring system also has intelligent automation functions such as pressure monitoring, flood detection, earthquake detection and fire detection, which can quickly cut off the natural gas supply and prevent disasters in the event of a crisis and automatically notify the gas supply company to deal with.



5.2 Application of PISO-DNM100U in LCD Panel Factory

Due to the rapid development of LCD technology and its unique power-saving features, LCDs are widely used in electronic or electrical products in daily life. The technology of the LCD manufacturing industry has been continuously improved. From wafer growth, coating, driver IC manufacturing to panel assembly, many manufacturers have put into production, one of which is a key material - glass substrate, which is mainly used in thin film transistors and color filters on displays. There are five basic requirements for producing this component:

(1) The glass composition must not contain metal, so as to avoid the movement of metal ions into the transistor array, resulting in a short circuit.

(2) The glass should be able to withstand high temperature, about 500 degree Celsius.

(3) Chemical resistance, glass cannot react with chemicals.

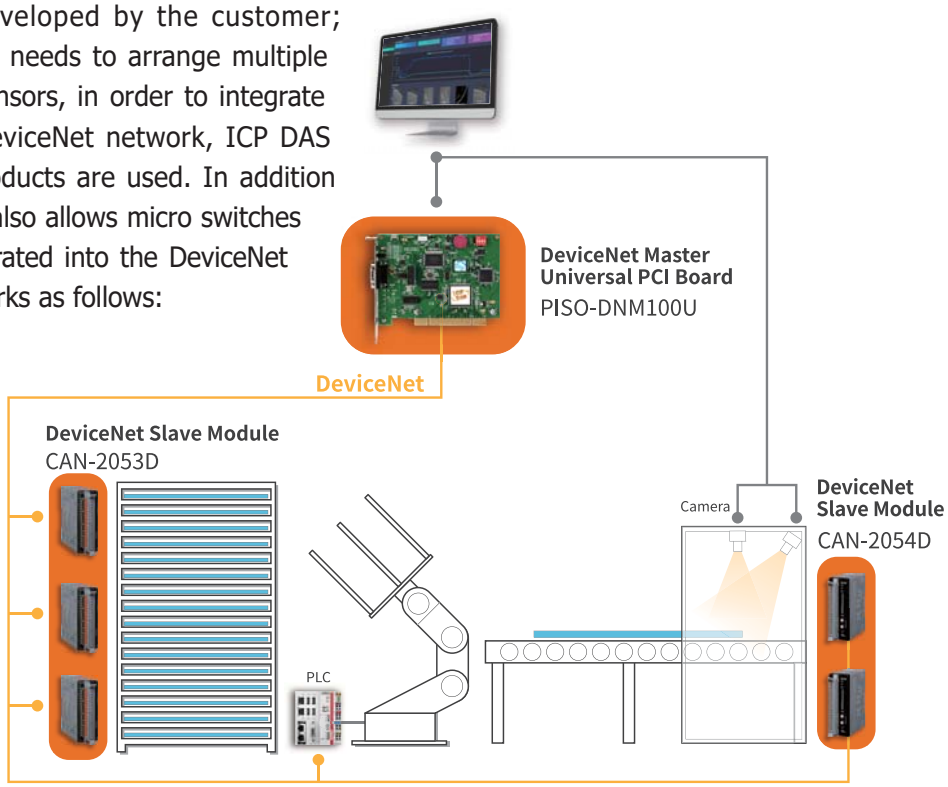
(4) The glass strain point needs to be high enough to not deform at high temperatures.

(5) The glass texture should be uniform and free of air bubbles.

LCD glass plays an essential role in the entire production process of LCD panels, and the yield of glass substrates is even more important. The design of this system focuses on checking whether the glass has bubbles or cracks. The PISO-DNM100U controller is a perfect selection for use as a DeviceNet master device, utilizing only a small amount of CPU resources to achieve real-time control requirements, thereby improving product yield and system stability, together with excellent scalability.

System Structure and Operation

The design of the whole system is mainly to check whether the glass has defects such as bubbles or cracks. The glass must be put into the conveyor belt by the robot arm for visual inspection.This robot arm is composed of Beckhoff PLC with DeviceNet communication interface and the control program developed by the customer; furthermore, since the system needs to arrange multiple micro switches and various sensors, in order to integrate these information into the DeviceNet network, ICP DAS CAN-2053D DeviceNet I/O products are used. In addition to saving installation space, it also allows micro switches and sensors to be easily integrated into the DeviceNet network. The whole system works as follows:



5.3 Chemical Vapor Deposition (CVD) in Semiconductor Factory and Application of DeviceNet Monitoring System

As the semiconductor technology improves every day, process yield requirements are also rising for the large number of electronic products. Therefore, the production capacity and yield control become more important in each semiconductor production process. In the semiconductor manufacturing process, the thin-film process is more complex and more particles. The main process equipment of the thin-film process is "Chemical Vapor Deposition" (CVD) machine which can often be seen on TV with the robot arm holding a wafer and feeding into chamber. That is the operation of the CVD machine. The thin film will be grown on the wafer in the CVD chamber by the silicon, silicon dioxide or other metal materials. These materials are not only attached to the wafer, but also are attached to the inner wall of the chamber. For a long time, the inner wall will accumulate a grate amount of particles in the chamber. Those particles would affect the yield of the wafer. Due to the CVD machine operates automatically in a sealed room, the production stability should highly be monitored and controlled. Appling a steady and rapid monitoring system become the future trend. DeviceNet is a cost effective solution to one kind application of control area network. It reduces the connection wires between devices and provides rapid troubleshooting function. This system utilizes XP-8341 and I-8124W as the controlling center of the remote I/O devices.The I-8124W provides DeviceNet master engine to collect the remote I/O data, including pneumatic valve "MKS 683" and Beckhoff DeviceNet I/O. XP-8341 exists an operating program to control the situation in the chamber. It is important to control the reacting time of the wafer in the chamber which have some kind of gas inside. After tuning timing and pressure parameter, this series equipment has been developed successfully and works in some semiconductor factories.

System Architecture:

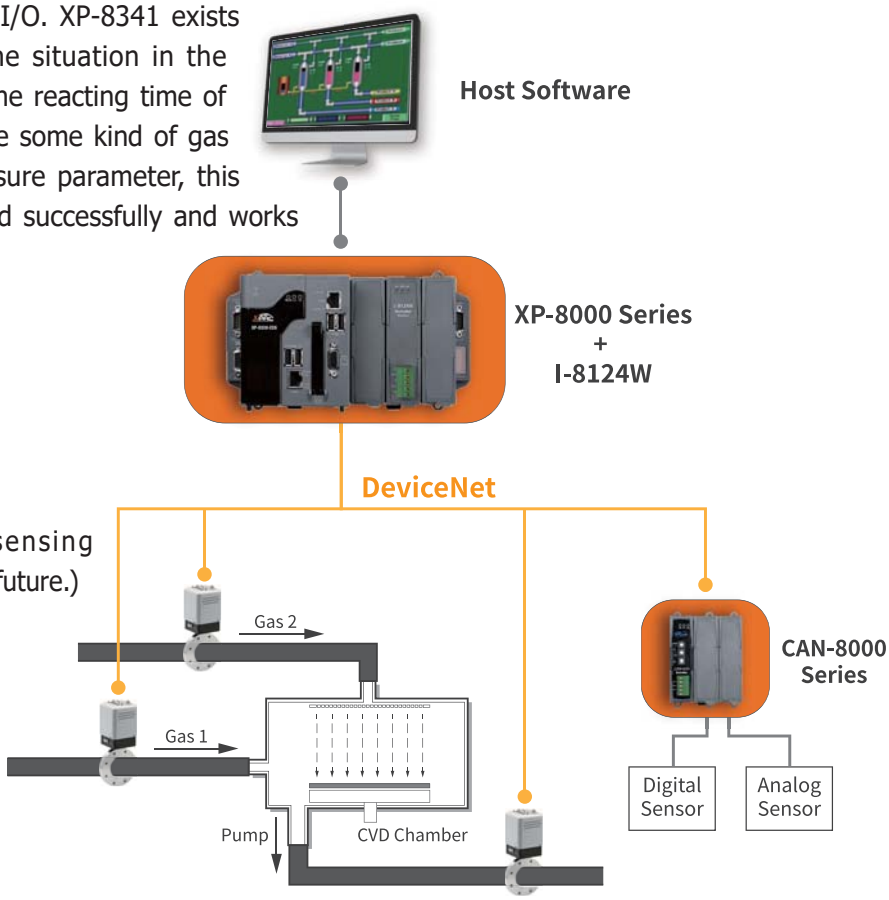
I-8124W: DeviceNet master

DeviceNet Slave: Beckhoff PLC

DeviceNet Slave: CAN-8124

DeviceNet Slave: MKS 683

(Flexibility to expand any sensing elements and I/O modules in the future.)

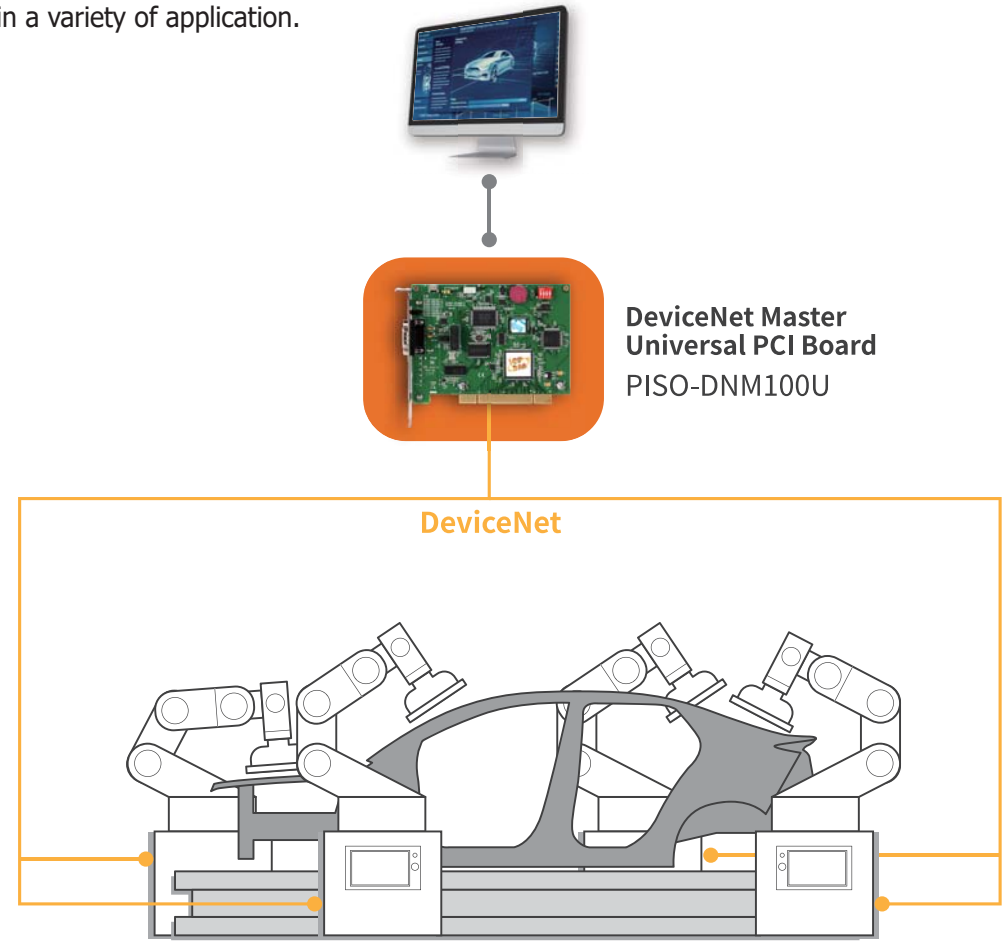


I-8124W is one of ICP DAS' DeviceNet Master product line, featuring high efficiency and high stability. It not only provides drivers for different platforms, but also provides DeviceNet development kits, which can freely develop monitoring software platforms and improve the application range of the overall system. This application in the monitoring system of the chemical vapor deposition machine not only improves the product yield and system stability, but also has system scalability.

5.4 Polishing System Integrated with DeviceNet Robotic Arm

The metal products industry is a leader in the manufacturing industry. In response to different fields, metal processing will use different surface processing technologies, such as corrosion resistance, thermal conductivity, wear resistance and so on. In the metal manufacturing process, the secondary processing (grinding and polishing) after casting and forging is highly dependent on manual experience for real-time and subtle manipulation due to the complex surface of the workpiece. Therefore, the grinding and polishing process is gradually introduced into the robot arm. With the adjustment feedback of grinding force and visual inspection after polishing, the robot arm can ensure the quality of mass production, can break through the threshold of complex workpiece surface processing with more detailed movements, and can surpass the quality of manual polishing.

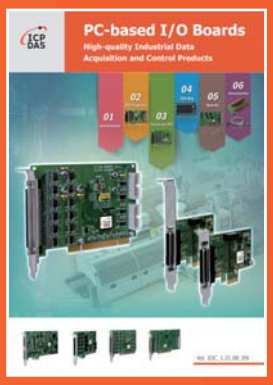
A manufacturer of metal grinding and polishing has introduced DeviceNet robotic arms. When the sheet metal is treated with anti-rust treatment, tiny spots or particles that are difficult to see with the naked eye will appear on the surface of the sheet metal parts. These defects will affect the subsequent coating quality. Therefore, six grinding and polishing robot arms are set up on the production line to process different parts of the car body sheet metal and quickly remove these spots, particles or dust. In the future, visual inspection of surface roughness is expected to be added to rework or generate alarms for more serious defects. Automated machinery plays an important role in labor-intensive and high-risk work, and is suitable for introduction in grinding and polishing processes. The high reliability and low implementation cost of DeviceNet products have been widely used in a variety of application.



The application of robotic arm in industrial automation is quite popularity. It is mainly used instead of manual labor or time-consuming work. The accuracy and durability of robotic arm can reduce the unpredictability of human problems. The robotic arm can improve product technology and quality, and these are mostly early work can be done by robotic arms. For product quality, the precision and zero error of robotic arm control has its advantages spontaneously, and it can help proprietor to reduce time-consuming and human resources.

Industrial Fieldbus

- RS-485
- Industrial Ethernet
- Profinet
- CAN bus
- CANopen
- Devicenet
- J1939
- PROFIBUS
- HART
- Ethernet/IP
- BACnet



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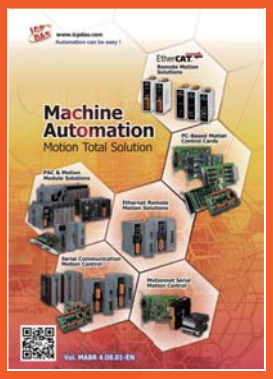
- Pumping Station IoT Application
- BA Smart Building IoT Application
- Robotic Arm Co-operation Application



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