

Communication SPECIFICATION

Beijing Sevenstar Electronic Company Ltd.

MFC/MFM

DeviceNet Interface Module

Revision 1.01

1/17/2009

Delivery

Revision History:

Date	Name	Revision	Description
12/6/2007	MCH	0.10	Initial Revision
12/10/2007	MCH	0.20	Added new parameters per AMAT Expanded Assembly section to include all instances Added more details to S-Objects (included enumerations)
1/17/2009	MCH	1.01	Delivery Revision

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1. Introduction

1.1 Document Scope

This specification describes the unit configuration, unit initialization, the DeviceNet Network Model and the interface to the Beijing Sevenstar MFC/MFM module. It describes the functionality required of the network interface module. It does not describe implementation details or specify the requirements for the PCB or enclosure.

1.2 Definitions

Network Host	–	The DeviceNet network Host (commonly a scanner card in a Programmable Controller)
Network Slave	–	A DeviceNet device which implements server functionality in a DeviceNet system
Programmable Controller	–	PLC refers to the DeviceNet Network Host.

1.3 Reference Documents

- “The CIP Networks Library Volume 1: Common Industrial Protocol”, Edition 3.1, ©2007 ODVA
- “The CIP Networks Library Volume 3: DeviceNet Adaptation of CIP”, Edition 1.3, ©2007 ODVA

1.4 Open DeviceNet Vendor Association, Inc. (ODVA - www.odva.org)

ODVA is an independent supplier organization that manages the DeviceNet specification and supports the worldwide growth of DeviceNet.

1.5 Vendor ID

The Vendor ID of Beijing Sevenstar Electronics Co. Ltd in ODVA is 1093.

2. System Operation

2.1 MAC ID / Baud Rate Configuration

Three rotary switches are defined for user configuration of the device. The three rotary switches are defined as follows:

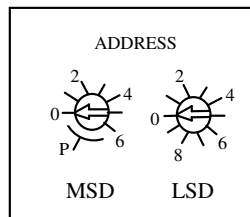


Figure I – MAC ID Rotary Switch Layout

Rotary switches S2 (MSD) and S3 (LSD) are used to select the DeviceNet MAC ID address. The valid range of addresses is 0 – 63. All combinations above 63 set the device address to the last address the device was powered up at and allow software configuration tools to modify the MAC ID address.

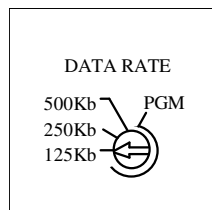


Figure II – BAUD RATE Rotary Switch Layout

Rotary switches S1 (BAUD) is used to select the DeviceNet Baud Rate. The valid range of baud rates is 0 – 3 (0 – 125K, 1 – 250K, 2 – 500K). All values above 2 set the baud rate to the last baud rate the device was powered up at and allow software configuration tools to modify the baud rate.

2.2 LED Operation

The unit provides two LED's that are visible from the front panel. The first bicolor LED supports the Network Status operation used in many DeviceNet products as presented in the following table:

Color	State	Indication
None	Off	No Power
Red	Solid	Unrecoverable Fault
	Flashing	Output error or configuration error
Green	Solid	Normal runtime operation
	Flashing	Device is in idle or not allocated to a master

Table 1 – Network Status LED Operation

The second bicolor LED provides Module Status operation used in many DeviceNet products as presented in the following table:

Color	State	Indication
None	Off	No Power
Red	Solid	Fatal Error
	Flashing	<ul style="list-style-type: none">▪ If the Network Status Led is Solid Red, DeviceNet Power isn't present▪ Baud Rate / Mac ID switch value changed, next power up uses a new configuration
Green	Solid	Normal Operation
Red/Green	Flashing	Device is in self test mode

Table 2 – Module Status Led Operation

3. DeviceNet Interface

3.1 Overview

DeviceNet™ is a low cost and open industrial network which links industrial devices (such as limit switches, photoelectric sensors and motor starters) to machine controllers over the Controller Area Network (CAN). DeviceNet eliminates expensive hardwiring and provides improved communication between devices as well as important device level diagnostics.

The following sections describe the network Object Model (the interface from DeviceNet's point-of-view).

3.2 Configuration

The unit supports the standard DeviceNet MAC ID and Baud Rate selections. MAC ID and Baud Rates can be selected from user accessible rotary switches or through DeviceNet configuration software. See section 2.2 for more details.

3.3 Initialization

The unit provides standard duplicate MAC ID detection processing during power on initialization.

3.4 Group 2 Only Slave Operation

The unit supports allocation of the DeviceNet Group 2 Master/Slave connection set through the Group 2 Unconnected message port.

3.5 Certification

The unit has been certified as a compliant DeviceNet device through an ODVA certified testing facility.

This device passed SEMI-SIG optional conformance testing.

Please contact Sevenstar agents for more details.

3.6 Identity Object (01_{HEX} - 1 Instance)

The Identity Object provides descriptive information.

3.6.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.6.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Vendor Number	UINT	50 _{DEC}	Get
2	Device Type	UINT	1A _{HEX}	Get
3	Product Code Number	UINT	DC _{HEX}	Get
4	Product Major Revision Product Minor Revision	USINT USINT	1 1	Get
5	Status Word	WORD	0	Get
6	Serial Number	UDINT	Unique 32 Bit Value	Get
7	Product Name	String of USINT	"CS220"	Get

3.6.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get Attribute Single
05 _{HEX}	No	Yes	Reset -- no attribute data -- Normal: Class 1, Instance 1, 1 byte data = 0 Out of Box: Class 1, Instance 1, 1 byte data = 1

3.7 Message Router Object (02_{HEX} - 1 Instance)

No supported attributes or services.

3.8 DeviceNet Object (03_{HEX} - 1 Instance)

3.8.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	2	Get

3.8.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Mac ID	USINT	63	Get / Set ¹
2	Baud Rate	USINT	0	Get / Set ²
5	Structure of: Allocation Choice Byte Master's Mac ID	BYTE USINT	0xFF 0	Get Get
6	MAC ID Switch Changed (since last power up)	BOOL	0	Get
7	Baud Rate Switch Changed (since last power up)	BOOL	0	Get
8	Actual MAC ID Switch Value (0-99)	USINT	63	Get
9	Actual Baud Rate Switch Value (0-9)	USINT	0	Get

3.8.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get_Attribute_Single
10 _{HEX}	No	Yes	Set_Attribute_Single

¹ When switches are used to set the MacID, the attribute is **not** settable over the DeviceNet network.

² When switches are used to set the Baud Rate, the attribute is **not** settable over the DeviceNet network.

3.9 Assembly Object (04_{HEX} – 13 Instances)

3.9.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	NV ?	Data Value	Access Rule
1	Revision	UINT	V	2	Get
2	Max Instance	UINT	V	20	Get
100	Polled Input Assembly Instance <i>(valid values are 1, 2, 4, 6, 9, 13, 14, 16, 18)</i>	UINT	NV	2	Get / Set ³
101	Polled Input Size	UINT	V	3	Get
102	Polled Output Assembly Instance <i>(valid values are 7, 8, 19, 20)</i>	UINT	NV	7	Get / Set ⁴
103	Polled Output Size	UINT	V	2	Get

3.9.2 Instance Attributes (Instances 1-2, 4, 6-9, 13-14, 16, 18-20)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
3	Data	USINT[]	0	Get / Set ⁵

INPUT INSTANCES

3.9.2.1 Instance 1 – Input – “Flow” – (MFC & MFM)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0 – 1	Flow	INT	0x31	1	6

3.9.2.2 Instance 2 – Input – “Status & Flow” – (MFC & MFM)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12
1 – 2	Flow	INT	0x31	1	6

3.9.2.3 Instance 4 – Input – “Status, Flow & Setpoint” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12
1 – 2	Flow	INT	0x31	1	6
3 – 4	Setpoint	INT	0x33	1	6

³ Changes don't take effect until power is cycled of the Polled Connection is deleted and reallocated.

⁴ Changes don't take effect until power is cycled of the Polled Connection is deleted and reallocated.

⁵ Only Output Instances are settable

3.9.2.4 Instance 6 – Input – “Status, Flow, Setpoint, Override and Valve” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12
1 – 2	Flow	INT	0x31	1	6
3 – 4	Setpoint	INT	0x33	1	6
5	Override	USINT	0x32	1	5
6 – 7	Valve	INT	0x32	1	6

3.9.2.5 Instance 9 – Input – “Status” – (MFC & MFM)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12

3.9.2.6 Instance 13 – Input – “(FP) Flow” – (MFC & MFM)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0 – 3	Flow	REAL	0x31	1	6

3.9.2.7 Instance 14 – Input – “(FP) Status & Flow” – (MFC & MFM)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12
1 – 4	Flow	REAL	0x31	1	6

3.9.2.8 Instance 16 – Input – “(FP) Status, Flow & Setpoint” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12
1 – 4	Flow	REAL	0x31	1	6
5 – 8	Setpoint	REAL	0x33	1	6

3.9.2.9 Instance 18 – Input – “(FP) Status, Flow, Setpoint, Override and Valve” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Status	BYTE	0x30	1	12
1 – 4	Flow	REAL	0x31	1	6
5 – 8	Setpoint	REAL	0x33	1	6
9	Override	USINT	0x32	1	5
10 – 13	Valve	REAL	0x32	1	6

OUTPUT INSTANCES

3.9.2.10 Instance 7 – Output – “Setpoint” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0 – 1	Setpoint	INT	0x33	1	6

3.9.2.11 Instance 8 – Output – “Override & Setpoint” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Override	USINT	0x32	1	5
1 – 2	Setpoint	INT	0x33	1	6

3.9.2.12 Instance 19 – Output – “(FP) Setpoint” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0 – 3	Setpoint	REAL	0x33	1	6

3.9.2.13 Instance 20 – Output – “(FP) Override & Setpoint” – (MFC ONLY)

Byte Index	Description	DeviceNet Data Type	Class ID	Instance ID	Attribute ID
0	Override	USINT	0x32	1	5
1 – 4	Setpoint	REAL	0x33	1	6

3.9.3 Assembly Pointers / Buffers

1. Input Integer

Byte Index	Description	DeviceNet Data Type	Included in Instances				
			1	2	4	6	9
0	Status	BYTE		Y	Y	Y	Y
1 – 2	Flow	INT	Y	Y	Y	Y	
3 – 4	Setpoint	INT			Y	Y	
5	Override	USINT				Y	
6 – 7	Valve	INT				Y	

2. Input Floating Point

Byte Index	Description	DeviceNet Data Type	Included in Instances			
			13	14	16	18
0	Status	BYTE		Y	Y	Y
1 – 4	Flow	REAL	Y	Y	Y	Y
5 – 8	Setpoint	REAL			Y	Y
9	Override	USINT				Y <i>fragmented</i>
10 – 13	Valve	REAL				Y <i>fragmented</i>

3. Output Integer

Byte Index	Description	DeviceNet Data Type	Included in Instances	
			7	8
0	Override	USINT		Y
1 – 2	Setpoint	INT	Y	Y

4. Output Floating Point

Byte Index	Description	DeviceNet Data Type	Included in Instances	
			19	20
0	Override	USINT		Y
1 – 4	Setpoint	REAL	Y	Y

3.9.4 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get_Attribute_Single
10 _{HEX}	No	Yes	Set_Attribute_Single

3.10 Connection Object (05_{HEX} - 2 Instances)

3.10.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.10.2 Instance Attributes (Instances 1 - 2)

Attribute ID	Name	DeviceNet Data Type	Data Value		Access Rule
			Instance 1 (EM)	Instance 2 (Poll)	
1	State	USINT	0 = NonExistent 3 = Established 5 = Deferred Delete	0 = NonExistent 1 = Configuring 3 = Established 4 = Timed Out	Get
2	Instance Type	USINT	0	1	Get
3	Transport Trigger	USINT	83 _{HEX}	82 _{HEX}	Get
4	Produced Connection ID	UINT	10xxxxxx011 _{BIN} xxxxxx = Node Address	01111xxxxxx _{BIN} xxxxxx = Node Address	Get
5	Consumed Connection ID	UINT	10xxxxxx100 _{BIN} xxxxxx = Node Address	10xxxxxx101 _{BIN} xxxxxx = Node Address	Get
6	Initial Comm. Character	USINT	21 _{HEX}	01 _{HEX}	Get
7	Produced Connection Size	UINT	Varies	Varies	Get
8	Consumed Connection Size	UINT	Varies	Varies	Get
9	Expected Packet Rate	UINT	2000 msec	0	Get / Set
12	Watchdog Timeout Action	USINT	3 = Deferred Delete	0 = Timeout	Get
13	Produced Connection Path Length	UINT	0	6	Get
14	Produced Connection Path	USINT Array	NULL	20h 04h 24h 02h 30h 03h	Get / Set
15	Consumed Connection Path Length	UINT	0	6	Get
16	Consumed Connection Path	USINT Array	NULL	20h 04h 24h 07h 30h 03h	Get / Set

3.10.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get_Attribute_Single
10 _{HEX}	No	Yes	Set_Attribute_Single

3.11 S-Device Supervisor Object (30_{HEX} - 1 Instance)

3.11.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.11.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	NV ?	Access Rule
3	Device Type (Mass Flow Controller / Mass Flow Meter)	SHORT STRING8	"MFC" or "MFM"	NV	Get
4	SEMI Standard Revision Level	SHORT STRING8	"E54-0997"	NV	Get
5	Manufacturer's Name	SHORT STRING20	"Beijing Sevenstar"	NV	Get
6	Manufacturer's Model Number	SHORT STRING20	"CS220 "	NV	Get
7	Software Revision Level	SHORT STRING6	"1.01"	NV	Get
8	Hardware Revision Level	SHORT STRING6	"Rev A"	NV	Get
9	Manufacturer's Serial Number	SHORT STRING30	varies	NV	Get
11	Device Status	USINT	0	V	Get
12	Exception Status	BYTE	0	V	Get
13	Exception Detail Alarm	STRUCT	0...0	V	Get
14	Exception Detail Warning	STRUCT	0...0	V	Get
15	Alarm Enable	BOOL	1	NV	Get / Set
16	Warning Enable	BOOL	1	NV	Get / Set
23	Run Hours	UDINT	0	NV	Get

3.11.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get Attribute Single
10 _{HEX}	No	Yes	Set Attribute Single
05 _{HEX}	No	Yes	Reset
06 _{HEX}	No	Yes	Start
07 _{HEX}	No	Yes	Stop
4B _{HEX}	No	Yes	Abort
4C _{HEX}	No	Yes	Recover
4E _{HEX}	No	Yes	Perform Diagnostics

3.11.4 Exception Detail Alarm / Warning

Both the Exception Detail Alarm and the Exception Detail Warning use the same byte array definitions.

Bytes 1-8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Common Exception Detail Size	= 2 (2 bytes to follow)							
Common Exception Detail Byte 0	0	0	0	0	EEPROM Exception	0	0	0
Common Exception Detail Byte 1	0	0	0	0	0	0	0	0
Device Exception Detail Size	= 1 (1 bytes to follow)							
Device Exception Detail Byte 0	Reserved	Reserved	Valve High 0	Valve Low 0	Flow Control 0	Flow High 0	Flow Low 0	Reading Valid 0/1 (warning only)
Manufacturer's Exception Detail Size	= 1 (1 byte to follow)							
Manufacturer's Exception Detail Byte 0								

Table 3 – Exception Detail Structure Definition

3.12 S-Analog Sensor Object (31_{HEX} - 1 Instance)

3.12.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.12.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	NV ?	Access Rule
3	Data Type INT = 0xC3 REAL = 0xCA	USINT	0xC3	NV	Get / Set
4	Data Units counts = 0x1001 sccm = 0x1400	ENGUNITS	0x1001	NV	Get / Set
5	Reading Valid	BOOL	1	V	Get
6	Value	based on "Data Type"	<i>varies</i>	V	Get
7	Status	BYTE	<i>varies</i>	V	Get
10	Full Scale	based on "Data Type"	<i>varies</i>	NV	Get
28	Autozero Status 0 = inactive (default) 1 = active	BOOL	0	V	Get
35	Calibration Object Instance	UINT	1	NV	Get

3.12.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get Attribute Single
10 _{HEX}	No	Yes	Set Attribute Single
4B _{HEX}	No	Yes	Zero Adjust

3.13 S-Analog Actuator Object (32_{HEX} - 1 Instance) (MFC ONLY)

3.13.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.13.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	NV ?	Access Rule
3	Data Type INT = 0xC3 REAL = 0xCA	USINT	0xC3	NV	Get / Set
4	Data Units counts = 0x1001 % = 0x1007	ENGUNITS	0x1001	NV	Get / Set
5	Override 0 = Normal 1 = Zero 2 = Maximum Value 3 = Hold Last Value 4 = Safe State (based on attr 21)	USINT	3	V	Get / Set
6	Value	based on "Data Type"	<i>varies</i>	V	Get
7	Status (always 0; no errors detected)	BYTE	0	V	Get
21	Safe State 0 = Zero 1 = Maximum Value 2 = Hold Last Value 3 = Use Safe Value (attr 22)	USINT	2	NV	Get / Set
22	Safe Value	based on "Data Type"	<i>varies</i>	NV	Get / Set

3.13.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get Attribute Single
10 _{HEX}	No	Yes	Set Attribute Single

3.14 S-Single Stage Controller Object (33_{HEX} - 1 Instance) (MFC ONLY)

3.14.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.14.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	NV ?	Access Rule
3	Data Type INT = 0xC3 REAL = 0xCA	USINT	0xC3	NV	Get / Set
4	Data Units counts = 0x1001 sccm = 0x1400	ENGUNITS	0x1001	NV	Get / Set
6	Setpoint (must be positive; get range in counts or sccm)	based on "Data Type"	varies	V	Get / Set
10	Status (always 0; no errors detected)	BYTE	0	V	Get
19	Ramp Rate	UDINT	varies	NV	Get / Set

3.14.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0 _{HEX}	Yes	Yes	Get Attribute Single
10 _{HEX}	No	Yes	Set Attribute Single

3.15 S-Gas Calibration Object (34_{HEX} - 1 Instance)

3.15.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

3.15.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	NV ?	Access Rule
3	Gas Standard Number	UINT	<i>varies</i>	NV	Get
4	Valid Sensor Instance	UINT	1	NV	Get
5	Gas Symbol	SHORT STRING	<i>varies</i>	NV	Get / Set
6	Full Scale Amount Units (only sccm supported so convert from slm if needed (slm = 1000 * sccm))	Struct of REAL ENGUNITS	<i>varies</i>	NV	Get
8	Calibration Date	DATE	<i>varies</i>	NV	Get
9	Calibration Gas Number	UINT	<i>varies</i>	NV	Get
10	Gas Correction Number	REAL	<i>varies</i>	NV	Get

3.15.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
0E _{HEX}	Yes	Yes	Get Attribute Single
10 _{HEX}	No	Yes	Set Attribute Single
4B _{HEX}	Yes	No	Get All Instances