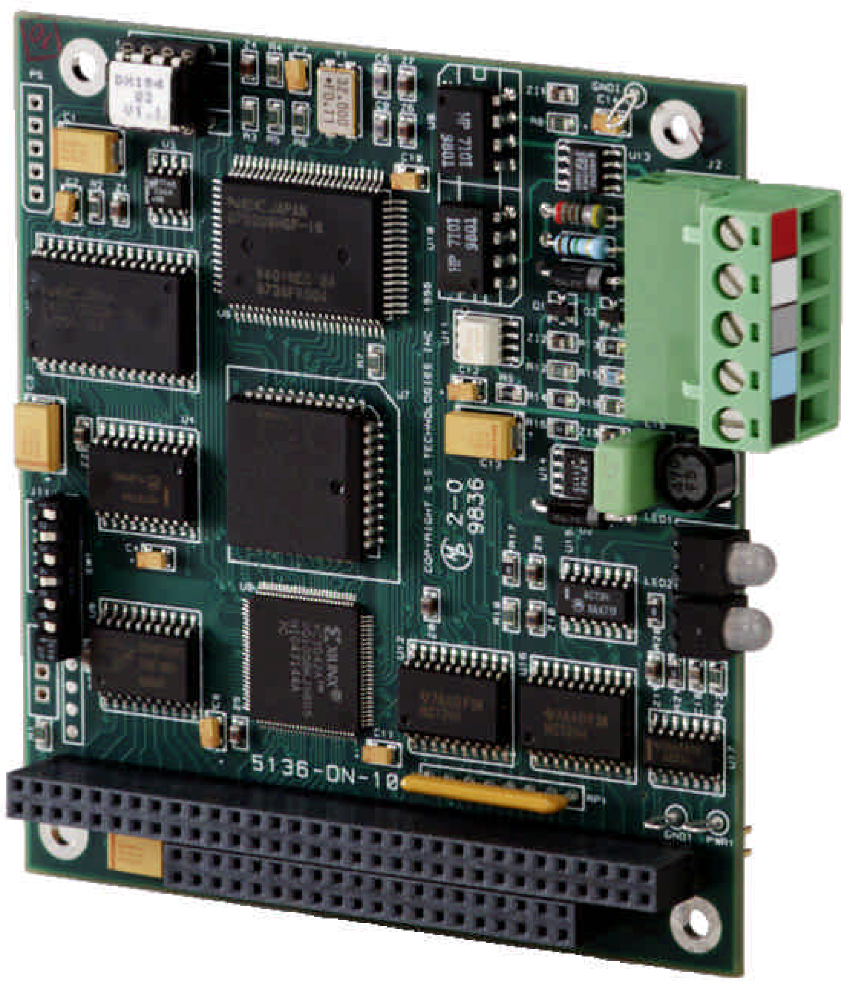
Technical Manual

SMART TRAC™ DeviceNet Card



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Warnings, Cautions and Notes

WARNING

A statement of conditions which MUST BE OBSERVED to prevent personal injury or death.

WARNING - ESD

A statement of conditions which must be observed to prevent damage to components due to ESD (ElectroStatic Discharge) and to prevent personal injury or death.

CAUTION

A statement of conditions which must be observed to prevent undesired equipment faults, Smart Trac AC1 system degradation and damage to equipment.

IMPORTANT

A statement of conditions which should be observed during Smart Trac AC DeviceNet setup or operation to ensure dependable service.

NOTE: Notes indicate information that is in addition to a discussion of the topic in adjoining text. Alternatively, it may limit or restrict the paragraph(s) that follow(s) to specific models or conditions.

TIP - Tips indicate information that should make a procedure easier or more efficient.

General Safety Precautions - Warnings

Important safety information follows. Please *read and understand* all precautions listed below before proceeding with the specification, installation, set-up or operation of your Smart Trac AC1. Failure to follow any of the following precautions may result in personal injury or death, or damage to the equipment.

WARNING - ESD

The Control Printed Circuit Board (PCB) employs CMOS Integrated Circuits that are easily damaged by static electricity. Use proper ElectroStatic Discharge (ESD) procedures when handling the Control PCB. See Smart Trac AC1 Technical Manual for details. Failure to comply may result in damage to equipment and/or personal injury.

Important Warranty Information.

Do not modify your Smart Trac AC1, its components, or any of the procedures contained in the technical documentation supplied by MagneTek. Any modification of this product by the user is not the responsibility of MagneTek and will void the warranty.

Smart Trac DeviceNet Card

General Capabilities

Adding the Smart Trac DeviceNet Card to your Smart Trac AC1 makes it fully compatible with other industrial devices (i.e., drives, limit switches, operator interfaces, programmable controllers) conforming to the DeviceNet standard. It also complies with CAN (Controller Area Network) specification 2.0, parts A and B, Standard Frame Identifiers.

The card also conforms to PC/104 specifications and has its own central processing unit (CPU). It supports DeviceNet data rates of 125 Kbaud, 250 Kbaud and 500 Kbaud.

While DeviceNet supports up to 64 nodes identified by MAC IDs, the Smart Trac DeviceNet card uses one MAC ID, leaving 63 other device nodes available to be addressed.

The Smart Trac DeviceNet driver supports Polled I/O and Bit Strobed I/O connections as well as explicit messaging. It supports all ODVA (Open DeviceNet Vendor Association) approved devices.

Smart Trac AC1 on a DeviceNet Network

With a Smart Trac DeviceNet card and driver installed and connected to a DeviceNet network, the Smart Trac AC1 communicates in a Master/Slave relationship (as opposed to peer-to-peer). A Smart Trac AC1 with an installed Smart Trac DeviceNet card serves as Master of a DeviceNet network. The Master gathers and distributes I/O data for the process controller. It also gathers I/O data from Slave devices and distributes the data to Slave devices.

On a DeviceNet Master/Slave network, a Master device "owns" a Slave device. A Slave device can be "owned" by only one Master. Except for a check for duplicate MAC IDs, a slave cannot initiate communication transactions unless it has been told to do so by its Master. The Master (in this case, the Smart Trac DeviceNet card) scans its Slave devices based on a scan list that it contains. The Slaves' MAC IDs appear in the Master's scan list of I/O addresses to be scanned by the card at specified intervals.

Smart Trac systems support single master networks. Only one Smart Trac DeviceNet Card is allowed per network.

Specifications

- 16 MHz V40 microprocessor with 128 Kbytes RAM
- Software configurable interrupts 2, 5 and 7 (7 normally used)
- DeviceNet compatible 5-pin connector
- Network status bicolor indicator
- Operating temperature 32° to 104°F (0° to 40° C)
- Storage temperature -4° F to 140°F (-20° to 60° C)
- Operating Humidity 5% to 90% non-condensing
- Supports standard DeviceNet baud rates of 125, 250 and 500 baud
- UCMM capable and supports Group 1, 2, and 3 dynamic connections.
- Accepts shielded twisted pair cable compatible with target network

Quick Start

1. Check DIP switch settings on the card against the default settings (see “Default Settings"). You should use default settings except in only unusual situations. Your Smart Trac Field Engineer can help you if you need assistance.
2. Power OFF your Smart Trac AC1.
3. Install the card in your Smart Trac AC1 in a PC/104 option card position (on top of the Smart Trac Ethernet Card or another PC/104 option card).
4. Connect the DeviceNet network cable.
5. If your power supply is not on a common circuit breaker with the Smart Trac AC1, power up your DeviceNet network.
6. Power up your Smart Trac AC1.
7. Test your card installation.

DeviceNet Basics

Introduction

Originally developed by Bosch for the automotive industry, DeviceNet is a low-cost communications protocol to connect industrial devices (i.e., limit switches, sensors, bar code readers, variable frequency drives, panel displays and operator interfaces) to a network. DeviceNet provides an open network standard with high noise immunity, suitable to industrial environments. The protocol includes device-level diagnostics. It allows the addition of other devices on a network without cycling power to the network.

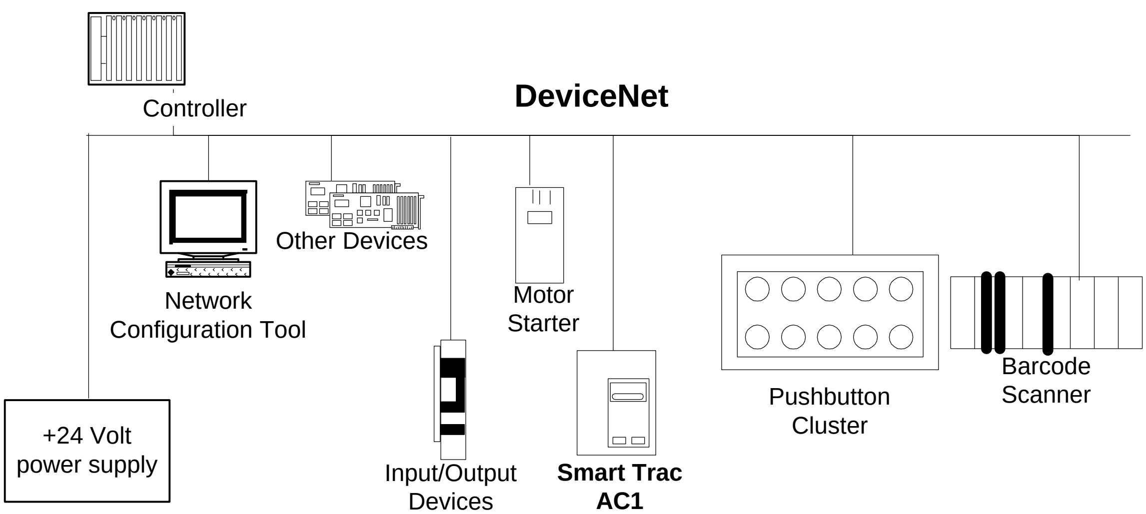

Figure 1. Typical DeviceNet Network configuration

The Open Systems Interconnect (OSI), established in 1984 by the ISO (International Standards Organization), divides network functions into seven layers: Physical, Data Link, Network, Transport, Session, Presentation and Application Protocol. DeviceNet provides the Application Protocol (highest level 7), Data Link Layer (layer 2), Physical Layer (layer 1) and Transmission Media (a sublevel of level 1, sometimes referred to as an eighth layer 0).

DeviceNet incorporates the CAN protocol to provide the Data Link Layer.

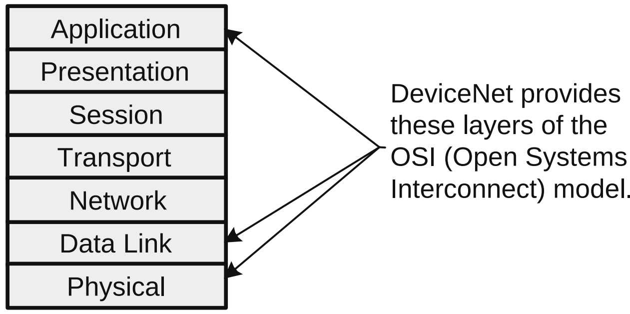

Figure 2. DeviceNet and the OSI Model

- The Physical Layer transforms data into bits that are sent across the physical media.
- The Data Link layer determines access to the network media in terms of frames. Its Media Access Control (MAC) sublayer is responsible for physical addressing.
- The Network Layer routes data through a large network.
- The Transport Layer provides end-to-end, reliable connections, often in terms of segments.
- The Session Layer allows users to establish connections using intelligently chosen names in packets.
- The Presentation Layer negotiates data exchange formats, also in terms of packets.
- Finally, the Application Layer provides the interface between the user's application and the network through messages.

Data is said to move from layer to layer within the seven layers of the OSI model. CAN (Controller Area Network)-based, DeviceNet permits networking of up to 64 nodes, called *Media Access Control Identifiers*, or MAC-IDs. CAN defines the syntax or form of the data movement. By adhering to the CAN specification and using CAN Controller chips, DeviceNet completely defines the Data Link layer of the OSI model.

DeviceNet Network Topology

Devices on DeviceNet networks are physically connected together in a *linear bus topology*. All devices on the network are connected to one primary trunk cable. You must install terminating resistors at the end of the trunk line. You may install drop lines with lengths of up to 6 meters (20 feet) to attach one or more nodes. The maximum number of drop lines and their lengths are subject to maximum drop cable distances (see Table 1). DeviceNet allows for branching structures only on the drop line. See "Figure 3 " for a typical DeviceNet topology. In the figure, the thick line represents the trunk line of the network. Thin lines represent drop lines.

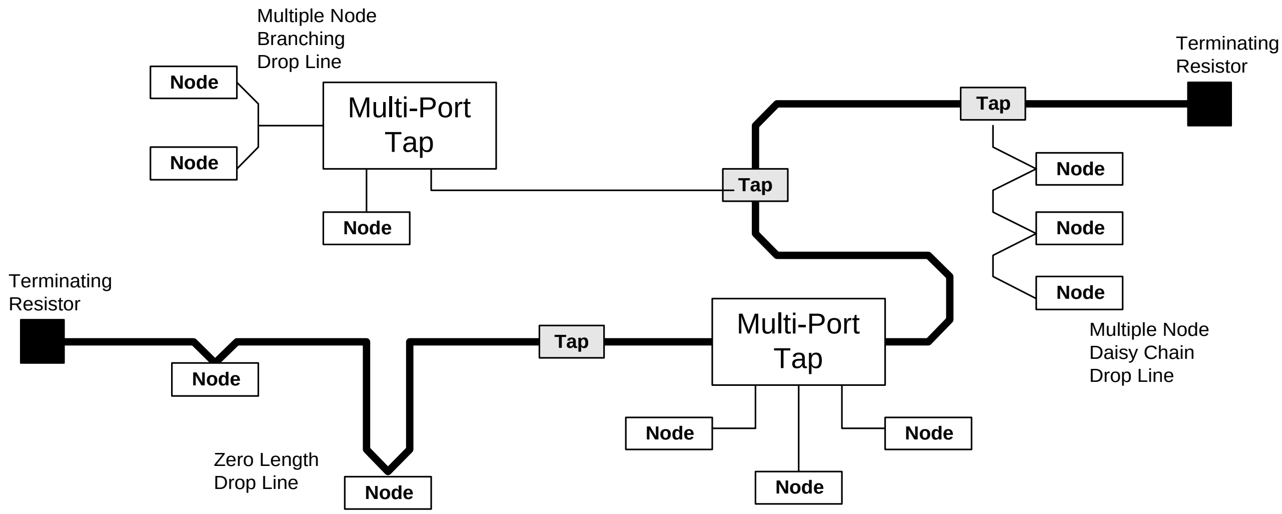

Figure 3. Typical DeviceNet Topology.

Network Length

In a DeviceNet network, end-to-end network (and point-to-point) distance varies with network transmission speed (baud rate). You may use a combination of thick and thin cable to construct trunk lines.

Line Length with Thin or Thick Cable

For trunk lines constructed of only one type of cable (either thick OR thin), refer to Table 1. Remember that "network length" includes the combined length of trunk line cable and drop line cable between the points.

Table 1. DeviceNet Network Length

DeviceNet Network Length		
Speed (Baud Rate)	**Maximum Length Allowed (Thick Trunk Length)**	**Maximum Length Allowed (Thin Trunk Length)**
125 Kbps	1, 640 ft. (500m)	328 ft (100m)
250 Kbps	820 ft (250 m)	328 ft (100m)
500 Kbps	328 ft. (100m)	328 ft (100m)

Maximum Drop Length 20 ft (6m) (Drop line length is the longest cable distance measured from the tap on the trunk line to each of the transceivers of the nodes on the drop line).

Cumulative Drop Length 512 ft (156 m) at 125 Kpbs; 256 ft (78m) at 250 Kbps; or 128 ft (39m) at 500 Kbps

Data Packets: 0-8 bytes

Bus Topology: Linear (trunkline/dropline) with power and signal on the same network cable.

Bus Addressing: Peer-to-Peer with Multi-Cast (one-to-many) or Multi-Master and Master/Slave special case; polled or change-of-state (exception-based)

System Features: Removal and replacement of devices from the network under power.

Line Length with both Thick and Thin Cables

When using a combination of thin and thick cable in a DeviceNet network, calculate the maximum cable distance according to Figure 4 and the following formulae:

At 125 Kbps: $L_{thick} + 5.0 * L_{thin} = 500$

At 250 Kbps: $L_{thick} + 2.5 * L_{thin} = 250$

At 500 Kbps: $L_{thick} + L_{thin} = 100$

(L_{thick} is length of thick cable and L_{thin} is length of thin cable)

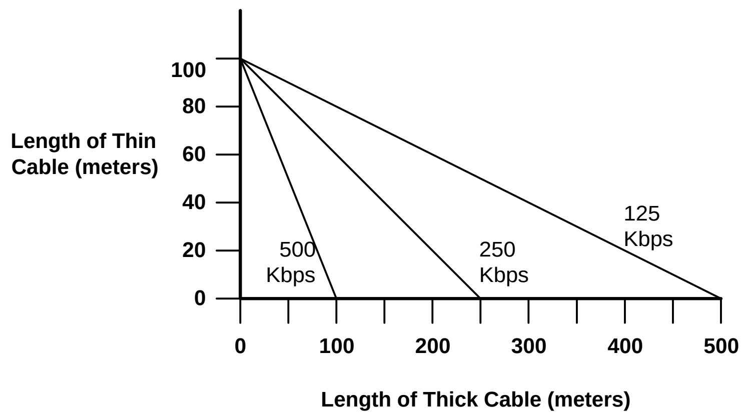

Figure 4. Combined Thin and Thick Cable Length Determination

Thick Cable Specifications

Thick cable consists of two shielded pairs twisted on a common axis with a drain wire in the center. An overall braid shield covers the shield pairs. Thick cable is typically used for trunk lines.

The thick cable specified for DeviceNet network connections consists of:

- One (1) twisted signal pair (#18): blue/white
- One (1) twisted power pair (#15): black/red
- Separate aluminized Mylar shields around power pair and signal pair
- Overall foil/braid shield with drain wire (#18): bare

Thin Cable Specifications

Thinner and more flexible than than Thick Cable, use Thin Cable for drop lines or for shorter distance trunk lines.

The thin cable specified for DeviceNet network connections consists of:

- One twisted signal pair (#24): blue/white
- One twisted power pair (#22): black/red
- Separate aluminized Mylar shields around power pair and signal pair
- Overall foil/braid shield with drain wire (#22): bare

Terminating Resistor Specifications

You must install a terminating resistor at the farthest ends of a trunk line (and only two per network). These terminating resistors must be 121 ohm, 1% Metal Film, 1/4 Watt resistors.

NOTE: DO NOT install terminating resistors at the end of drop lines.

DeviceNet Connector

Your Smart Trac DeviceNet card ships with one female DeviceNet connector. It mates with a male connector mounted on the card. The pinout of DeviceNet connectors is described in Table 2.

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Installing the Smart Trac DeviceNet Card

Unpacking

Electrostatic Sensitive Discharge (ESD) Procedures

WARNING - ESD

Keep electronic circuit boards in Electrostatic Sensitive Discharge (ESD) protective bags when not being handled. Use proper ESD procedures (including an ESD wrist strap) when handling circuit boards. Failure to comply may result in damage to equipment.

When working with an electrostatic sensitive discharge (ESD) device, you should be grounded at all times. The easiest and most common way to provide this ground is to use an approved ESD wrist strap. The strap is secured to your wrist with a wire attached to the strap and clipped or taped to the chassis of the unit being worked on. Any static is dissipated through the wire to ground, greatly reducing the possibility of damage to the device.

It is a good idea to touch the chassis with your finger before handling any electrostatic sensitive device. Any static electricity will be discharged to chassis ground and will not be transferred to the device.

Always store devices (cards, other electronic components) in ESD protective bags when not being handled.

Unpacking Procedure

Remove the protective shipping and packing material from the card. Ensure contact wedges and other shipping devices have been removed.

Installing the Smart Trac DeviceNet Card

The Smart Trac DeviceNet Card is PC/104 compatible, so it may be positioned on the very top of the Smart Trac card stack.

NOTE: If replacing or adding a Smart Trac DeviceNet card to an existing Smart Trac card stack, see "Appendix C – Removing the Smart Trac Card Stack" before continuing.

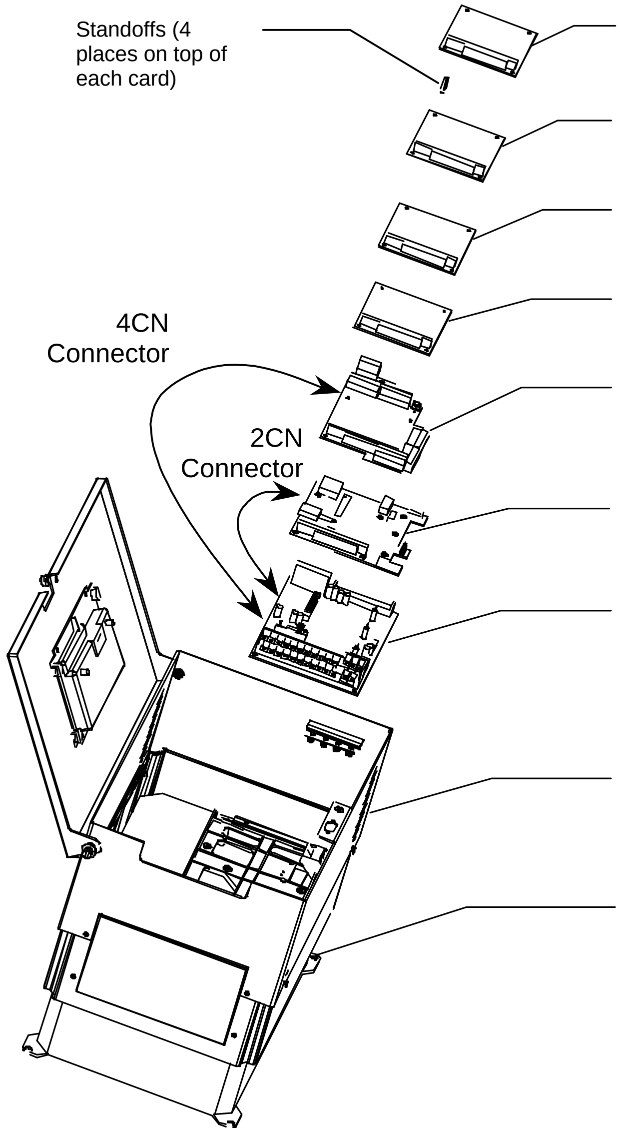


Figure 5. Smart Trac DeviceNet Card Stack Position

1. To install the DeviceNet card, orient the pins on the card with the female pin connector on the card below it (normally the Ethernet card). Gently but firmly push the Smart Trac DeviceNet card onto the card below it. Make sure connecting pins are in alignment before pushing the two boards tightly together. Secure the card using four (4) metal standoffs.
2. Replace all other cards, securing each with four (4) metal standoffs and the reverse of pertinent steps in "Appendix C – Removing the Smart Trac Card Stack".

Connecting the Smart Trac DeviceNet Card to a DeviceNet Network

1. Connect a DeviceNet cable to the 5-pin connector at J2. The connector conforms to the standard DeviceNet pinout (see Table 2). A DeviceNet Master (the Smart Trac AC1) is typically at one end of the trunk line, installed with a terminating resistor.

NOTE: Typically, a Master DeviceNet unit installed at one end of the trunk line and NOT on a drop cable.

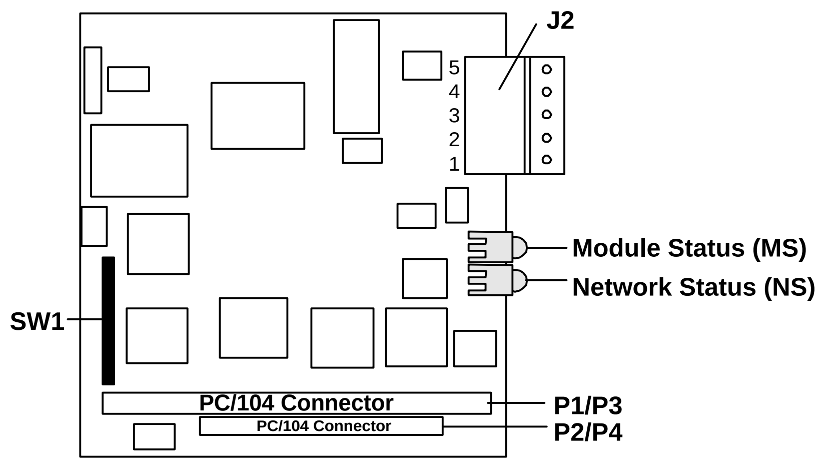


Figure 6. Smart Trac DeviceNet Card layout.

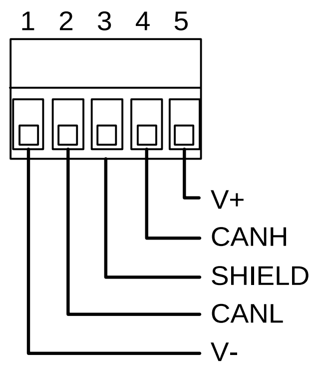
CAUTION

Ensure all strands of wire go into connector. Bent strands may cause shorts to the adjacent terminal. Failure to comply may result in damage to the DeviceNet card or Smart Trac electronics.

2. If your Smart Trac AC1 is at the end of DeviceNet network, connect a 120-ohm resistor from pin 2 to pin 4 of the 5-pin connector at J2. Connector pinouts are described in Table 2.

Table 2. DeviceNet connector pinout

Smart Trac DeviceNet Card 5-pin Connector



DeviceNet Color Code
Red
White
Bare
Blue
Black

Pin	DeviceNet Color Code	Purpose	Description
1	Black	V-	Network negative 24 VDC power supply terminal. Connect to external 11-25 VDC power supply if network cable does not have power supply conductors.
2	Blue	CANL	A CAN communication bus terminal (one of a pair) that carries the encoded serial data from one node to another. The signal pair is based on the Controller Area Network Specification from Bosch. Connect shielded twisted pair cable here.
3	Bare	Shield	Network cable shield terminal. Connect directly to earth ground at only one point in the network, by the power supply connection.
4	White	CANH	A CAN communication bus terminal (one of a pair) that carries the encoded serial data from one node to another. The signal pair is based on the Controller Area Network Specification from Bosch. Connect shielded twisted pair cable here.
5	Red	V+	Network positive 24 VDC power supply terminal. Connect to external 11-25 VDC power supply if network cable does not have power supply conductors.

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Configuring the Smart Trac DeviceNet Card

Configuration

You configure the Smart Trac DeviceNet card by either accepting default values or changing them to suit your unique situation. The values chosen at installation of the Smart Trac DeviceNet driver must match those set on the card.

Default Settings

The Smart Trac DeviceNet card is shipped from the factory already configured for the typical installation. The default values are:

- **Interrupt:** "7" The physical IRQ implements up to 8 logical interrupts, determined by the application program.
- **Base I/O Address (Switch SW1):** 0x250 (positions 2 and 4 set to logic "1", the other positions set to "0." Positions 1-6 of this switch determine the base I/O address. This default setting causes the card to use the eight I/O addresses 0x250 through 0x257.
- **Memory Address:** 0xC8000.

Be sure to set each device's MAC ID correctly to avoid addressing conflicts. Many simple devices are DIP switch configurable. However, more sophisticated devices are configured online via the network. Such devices require a DeviceNet management utility to be properly configured. It is recommended that you use an ODVA-approved software package to configure your device.

Non-Default Settings

Interrupt

The interrupt may be set to either 5 or 7, with 7 the default and preferred as the "standard" configuration for Smart Trac components. Using interrupt 7 assures you that there will be no conflicts with other basic components. Interrupt 5 should be reserved for only unusual situations.

Base I/O Address

In unusual situations, you may use several other Base I/O Addresses. If an option must be considered, record the settings of all other cards to be placed in the Smart Trac card stack. You must maintain unique addresses and interrupts for all cards in the stack. The recommended optional addresses and corresponding switch setting (SW1) are listed below:

I/O Address	SW1 Setting						Comment
	1	2	3	4	5	6	
0x250	**0**	**1**	**0**	**1**	**0**	**0**	**Default**
0x258	1	1	0	1	0	0	Recommended as option
0x260	0	0	1	1	0	0	Recommended as option
0x268	1	0	1	1	0	0	Recommended as option
0x650	0	0	1	1	0	1	Recommended as option
0x658	1	0	1	1	0	1	Recommended as option
0x660	0	0	1	1	0	1	Recommended as option
0x668	1	0	1	1	0	1	Recommended as option

Testing Card Installation

Testing the Network

Once installed, check the on-board indicator lights. Normally, both LEDs should be illuminated green and steady (not flashing), indicating the program is loaded and running, it is an active participant in network activities, and that polled connections are established with slaves.

General Test Parameters

- To properly test your DeviceNet network, perform all of the following steps below in sequence, since some tests require that previous tests were successful:

NOTE: Do not perform these tests while the system is operating. There must not be any communications activity.

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1. Ensure all devices are installed.

Network Termination & Signal Wires

2. Check the resistance from CANH to CANL at each device
   - If the value is > 60 ohms there could be a break in one of the signal wires or missing network terminator(s)
   - If the value is < 50 ohms look for; a short between the network wires, extra terminating resistor(s), faulty node transceiver(s) or unpowered nodes

Shield

3. Power-up all power supplies. Connect a DC ammeter (16 amps max) from DC common to the shield at the opposite end of the network from the power supply. There should be no significant current flow. This test can also be performed at the end of each drop if practical.
   - If there is no current, the shield is broken or the network is improperly grounded
   - If the power supply is in the middle of the network, do this test at each end

Grounding

4. Break the shield at a few points in the network and insert a DC ammeter
   - If there is current flow, the shield is connected to DC common or ground in more than one place (ground loop)

Network Power - Minimum supply voltage

5. Measure the supply voltage at each device. It should be > 11Vdc.
   - If not, check for faulty or loose connectors and verify power system design calculations by measuring current flow in each section of cable with an ammeter

Network Power - Common Mode Voltage

NOTE: Shield must be continuous and have no current flow in it (tested previously)

6. Measure and record the voltage between the shield and DC common at each device. The maximum difference should be < 5V between any two devices.

MAC ID/ Baud Rate Settings

7. Check the Network Status LED (see "On-board Indicator Lights." The LED should be steady green on all devices, or flashing green if polled connections are not established.
   - Solid RED indicates a communication fault (possibly incorrect baud rate) or a duplicate MAC ID (station address)
8. Use a network configuration tool to perform a "network who" to verify that all stations are connected and capable of communicating

On-board Indicator Lights

Two LED indicator lights on the Smart Trac DeviceNet card provide system-related information:

- *Module Status (MS)* LED: A two-color LED indicates whether or not the application program loaded properly. When GREEN, it indicates that the application program is loaded and running. When RED, it indicates the application program has not loaded, an error occurred during the load, or a fatal runtime error occurred.

Table 3. Interpretation of the Module Status Indicator

Module Status (MS) Indicator LED		
LED State	**Device State**	**Description**
OFF	No power	Power is not being supplied to device.
Flashing GREEN	In Standby	Needs commissioning due to missing, incomplete, or incorrect configuration parameters.
Solid GREEN	Operational	Operating in normal condition.
Flashing RED	Minor Fault	Recoverable fault active.
Solid RED	Unrecoverable Fault	Unrecoverable fault active.
Flash rate for LED is approximately 1 flash per second: ON for approximately 0.5 second, then OFF for approximately 0.5 second.		

- *Network Status (NS)* LED: A two-color LED indicates network communications status. When solid GREEN, it indicates that it is online and connected to other devices. When flashing GREEN, it indicates it is online but has not established a network I/O connection. When solid RED, it indicates that it has not established a network I/O connection, possibly because a duplicate MAC ID was detected, a bus-off conditions exists, or a communications failure. When flashing RED, the connection has timed out.

Table 4. Interpretation of the Network Status Indicator.

Network Status (NS) Indicator LED		
LED State	**Device State**	**Description**
OFF	Off-line or not powered up	Off-line: Device has not completed the duplicated MAC ID (node address) check. Device may not be powered. Check Module Status LED.
Flashing GREEN	On-line and NOT connected	On-line, but has no connections in established state: Device passed the duplicate MAC ID (node address) check, but has no established connections to other nodes.
Solid GREEN	On-line and connected	On-line and has connections in established state.
Flashing RED	Connection Time-Out	One or more of the I/O Connections are in the Timed-out state. The Smart Trac AC1 has probably stopped polling slave devices.
Solid RED	Critical Link Failure	Failed communication device. An error has been detected that has rendered the device incapable of communicating on the network. A duplicate MAC ID (node address) error was detected. A bus-off condition exists.
Flash rate for LED is approximately 1 flash per second: ON for approximately 0.5 second, then OFF for approximately 0.5 second.		

Module and Network Status LEDs at Power-Up

At power-up, the LEDs are tested using the following sequence:

1. Module Status LED on GREEN for 0.25 second.
2. Module Status LED on RED for 0.25 second.
3. Module Status LED on GREEN for 0.25 second.
4. Network Status LED on GREEN for 0.25 second.
5. Network Status LED on RED for 0.25 second.

NOTE: The above power-up sequence only occurs if a valid user program is loaded in the Smart Trac CPU Card.

Troubleshooting Your Smart Trac DeviceNet Card

Status and Error Messages

When installed, the Smart Trac DeviceNet driver automatically creates a set of global variables that provides status and error information on the CAN bus. Symbolic information is appended to the end of the card name to create each global variable. Deleting the card name in the dialog disables the creation of these variables.

These global variables may be assigned symbol names and used in function blocks, application programs and/or the fault manager. If read by the fault manager, they may be programmed to annunciate and/or to be displayed on the Digital Operator as they occur.

Table 5. Status and Error Message Global Variables

Status and Error Message Global Variables			
Global Variable (format is <Card Name>_Variable	**Type**	**Source**	**Action**
<Card Name>_CAN_A	BOOL	CAN Bus Status Word, Bit 3 (A)	Set when network activity detected (messages received or transmitted).
<Card Name>_CAN_ACK	WORD	CAN ack counter at offset 0034h	Incremented when transmit message aborted due to lack of acknowledgment from other stations. The CAN TX counter is decremented to compensate for a message not actually transmitted.
<Card Name>_CAN_BO	BOOL	CAN Bus Status Word, Bit 2 (BO).	Set when excessive number of communication errors is detected and CAN chip automatically goes off-line. Cleared when CAN interface is re-initialized. BO indicates a serious communication fault such as incorrect baud rate or physical layer error (short, open etc).

Status and Error Message Global Variables			
Global Variable (format is <Card Name>_Variable	**Type**	**Source**	**Action**
<Card Name>_CAN_BP	BOOL	CAN Bus Status Word, Bit 9 (BP)	Indicates presence or absence of network power. BP bit is clear if the physical bus interface is not powered.
<Card Name>_CAN_BW	BOOL	CAN Bus Status Word, Bit 1 (BW	Set when abnormal number of communication errors detected and CAN chip stops transmitting error frames. Cleared when error count returns to normal levels or CAN interface re-initialized. BW indicates potentially serious communication fault such as out-of-tolerance baud rate or physical layer error (electrical noise, signal attenuation, intermittent connections etc.).
<Card Name>_CAN_ER	BOOL	CAN Bus Status Word, Bit 8 (ER).	Set each time a CAN communication error is detected. An excessive number of errors indicates a faulty physical media component (cable, connector etc.) or excessive noise from external sources (check cable routing and shield connection).
<Card Name>_CAN_ERROR	WORD	CAN error counter at offset 0038h	The CAN communication error counter is incremented when a CAN frame error is detected
<Card Name>_CAN_LOST	WORD	CAN LOST counter at offset 003Ah.	The CAN lost messages counter is incremented when a CAN message is received before the previous message is placed into the receive queue.
<Card Name>_CAN_ML	BOOL	CAN Bus Status Word, Bit 7 (ML)	ML is set when a message is received from the bus while the previous message is still in the receive buffer. ML indicates a lower layer application error (in the kernel interrupt handler). Report this condition to your MagneTek Application Engineer.
<Card Name>_CAN_O1	BOOL	CAN Bus Status Word, Bit 12 (O1)	O1 is set when the scanner is online at 125 Kbaud.
<Card Name>_CAN_O2	BOOL	CAN Bus Status Word, Bit 13 (O2)	O2 is set when the scanner is online at 250 Kbaud
<Card Name>_CAN_O5	BOOL	CAN Bus Status Word, Bit 14 (O5).	O5 is set when the scanner is online at 500 Kbaud.

Status and Error Message Global Variables			
Global Variable (format is <Card Name>_Variable	**Type**	**Source**	**Action**
<Card Name>_CAN_OL	BOOL	CAN Bus Status Word, Bit 0 (OL)	Set when CAN interface initialized and ready to communicate.
<Card Name>_CAN_OR	WORD	CAN overrun counter at offset 003Ch	CAN receive queue overrun counter is incremented when a CAN message is lost due to a full receive queue.
<Card Name>_CAN_RO	BOOL	CAN Bus Status Word, Bit 6 (RO).	Set when messages received from bus faster than application can process them. RO indicates an upper layer application error (in the application module). Report this condition to your MagneTek Application Engineer.
<Card Name>_CAN_RX	WORD	CAN RX counter at offset 0036h	CAN receive counter is incremented when messages are received. Messages that fail the receive filter still increment the CAN RX counter.
<Card Name>_CAN_SA	BOOL	CAN Bus Status Word, Bit 15 (SA)	SA is set when the scanner is active
<Card Name>_CAN_TA	BOOL	CAN Bus Status Word, Bit 4 (TA).	TA set when a pending transmission is not acknowledged within 25-50ms. TA indicates that no other nodes are present (or on-line) on the network
<Card Name>_CAN_TO	BOOL	CAN Bus Status Word, Bit 5 (TO).	Set when a pending transmission is incomplete within 25-50ms. TO indicates excessive message traffic at a higher priority than the aborted message.
<Card Name>_CAN_TX	WORD	CAN TX counter at offset 0032h.	The CAN transmit counter is incremented when messages are submitted to the CAN controller

Troubleshooting DeviceNet Network Problems

Use the following general guidelines to troubleshoot your DeviceNet network:

1. Disconnect parts of the network and watch where the fault goes. This method does not work well for problems such as excessive common mode voltage, ground loops, electrical interference and signal distortion because disconnecting part of the network frequently solves the problem.
2. If the network was previously operating, determine what has changed.
3. Record symptoms in detail. Keep good notes about your network and its problems to properly define the problem.

- Look for patterns in the symptoms. Do intermittent problems occur when other un-related equipment is in use?
- Do some nodes communicate correctly? What is the difference between the functioning nodes and the others (proximity to the power supply, to the terminator, to the scanner)?. Is the device improperly shielded or tied to ground at each device instead of at ends?

Table 6. Hardware Configuration Troubleshooting.

Troubleshooting Hardware Configuration		
Symptom	**Probable Cause**	**Corrective Action**
Devices will not communicate	Baud rate not same for all devices	Check that baud rate is set correctly for each device on the network.
	MAC IDs not unique for each device on network.	Check MAC Ids for all devices on the network.
Faulty devices	Opens or shorts in the network wiring	Check for faulty connectors or cable.
	Incorrect Baud Rates on some devices	Check that baud rate is set correctly for each device on the network.
	Electrical interference	Check for incorrect grounding or broken shield.
	Signal distortion & attenuation	Check for improper termination such as a failure to adhere to topology guidelines, or faulty connectors or loose terminal blocks.
Missing terminators	Excessive common mode voltage	Check for excess current or cable length. Check for faulty connectors.
	Low power supply voltage	Check for excess current or cable length Check for faulty connectors Check that power supply is correctly sized for number of devices in network
	Excessive signal propagation delay	Check for excess cable length.

Appendix A – Technical Support

Technical Support

Should you need technical assistance with installation or troubleshooting of your Smart Trac AC1, you can phone our Help Desk at either (800)-541-0939 or (414)-782-0200. Alternatively, you may copy the *Problem Report* form, found on the next page, and fax it to us at (414)-782-3418.

References

CAN (Controller Area Network)	Contact CAN in Automation (CiA), the international users and manufacturers group, a non-profit trade association that develops and supports various CAN-based protocols including DeviceNet. http://www.can-cia.de
DeviceNet	Contact the Open *DeviceNet* Vendor Association, Inc. at: http://www.odva.org
MagneTek Drives and Systems	For more information about MagneTek drives and systems, training programs and contacts, visit: http://www.magnetekdrives.com
PC/104 Specification, Version 2.1	PC/104 Consortium. An overview and the specification may be obtained at the web site address: http://www.controlled.com/pc104/index.html

Problem Report

Name:

Address:

City: State: Zip

Serial Number: Smart Trac DeviceNet Card

Occurrence: ☐ Frequently ☐ Intermittantly ☐ Rarely

Nature of Problem:

Conditions when problem occurs:

Appendix B – Replaceable Parts

Replaceable Parts Listing

Description	MagneTek Part Number	Qty
Smart Trac DeviceNet Network Interface option kit	46S03643-0070	1
Technical Manual – Smart Trac DeviceNet Card	TM 3554-0070	1
Standoff, 4.5mm, Hex, Stl, CL ZINC, 15mm, M/F, M3, M3	05P00618-0006	4 each DeviceNet assy
Card Extraction Tool	(Parvus Corporation P/N PRV-0760A-01)	Option
Hardware Tools Kit for Smart Trac AC1	TBD	Option

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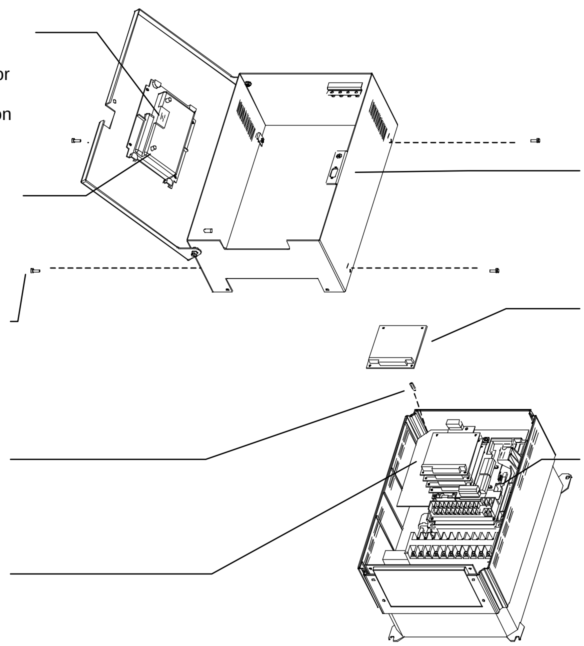
Appendix C – Removing the Smart Trac Card Stack

General Procedures

1. Power off the Smart Trac AC1. Disconnect it and tag "Out of Service".
2. Do one of the following:
   - Open the cover to the Smart Trac AC1 by rotating the spring-loaded, captive screw counterclockwise. Use a large screwdriver if necessary to free the slotted screw.

   OR

   - Loosen the screws holding down the cover.
3. Disconnect the 12-pin wiring harness from connector J4 at the digital operator.
4. Using the Phillips head screwdriver, remove the ground strap from the left inside and the ground strap from the top inside of the Smart Trac AC1 adapter ring.
5. Disconnect the 9-pin RS-232 cable at connector J5 on the Smart Trac CPU card.



6. Using a 4.5mm hex head driver, remove four standoffs from the topmost card.
7. Using the PC/104 extraction tool, remove the topmost card from the stack.

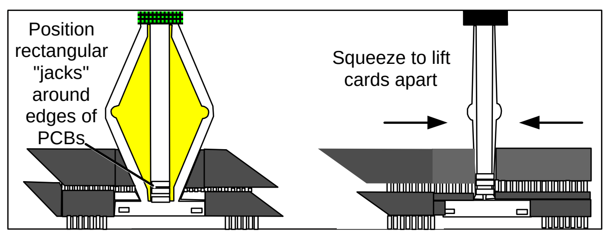


Figure 7. Using the PC/104 Extraction Tool.

8. Repeat step 8 above until all PC/104 cards have been removed.
9. *To remove the Smart Trac PG card*:
   - Disconnect the 4CN connector on the PG card.
   - Using a tubular extraction tool or pliers, squeeze the plastic, spring-loaded retainer built-in to the long plastic standoff located at the top of the PG card, just above connector J6.
   - Using a PC/104 extraction tool, remove the card.

NOTE: The Smart Trac PG card requires unique handling. Wedge the extracting tool between the PG card and the CPU card. The area between the terminal strip on the CPU card and the serial numbered edge of the PG card can be lifted first, then the opposite side (nearest TB1) on the PG card). Alternate sides until the card is free of the CPU card.

10. *To remove the Smart Trac CPU card*:

- Disconnect the card at the 2CN connector on the CPU card.
- The CPU card is secured with three plastic standoffs with spring-loaded clips on the end. Squeeze the top of the standoffs (the clips) with the special cylindrical removal tool, your fingers or needle-nosed pliers and lift the CPU card from the Smart Trac Inverter Control Card.

You have removed the entire card stack. The inverter card, considered part of the drive, is in clear view.

Glossary of Terms

Bit Strobed I/O
A type of message between Master and Slave devices on a DeviceNet network. A Bit-Strobe Command message provides 1-bit of data to each Slave. It is sent by the Master in a specified time interval. A Bit-Strobe Response message contains the Slave's response to a Bit-Strobe command by providing up to 8 bits of data back to the Master.

commissioning
The act of configuring a new DeviceNet network, such as setting baud rate, MAC ID, and device attributes for all connected nodes on a network.

Controller Area Network
A type of network (CAN) originally developed for the auto industry. It was later found useful for many other industrial applications. CAN's communication protocol is used in DeviceNet because it provides high noise immunity and high temperature operation. Because it uses a serial bus, it reduces signal wiring complexity and cost while providing high speed digital control for optimum performance.

data link layer
The second lowest layer in the OSI seven-layer model. It splits data into frames for sending on the physical layer and receives acknowledgement frames. It performs error checking and re-transmits frames not received correctly. The data link layer is split into an upper sublayer, Logical Link Control (LLC), and a lower sublayer, Media Access Control (MAC).

explicit messaging
Messages between a Master device and a specific Slave device on a DeviceNet network. Explicit Request messages, sent by the Master whenever a desired service is required, may read data from the Slave, write data to the Slave, and/or reset the Slave. Explicit Response messages are sent by a Slave back to the Master after receiving an Explicit Request message.

MAC ID
Acronym for Media Access Control Identifier. The identifier or address for the lower sublayer of the data link layer of the OSI networking model. The MAC is the interface between a node's Logical Link Control and the network's physical layer.

open network standard
An established standard for networking devices that does not require vendors to purchase hardware, software, or licensing rights to connect devices to a system.

OSI
Acronym for Open Systems Interconnect, a model used to describe a network. The system describes a network in terms of seven layers. Each layer provides a set of functions to the layer above, and relies on the functions of the layer below. Each layer communicates with its peer layer on another node by sending messages back and forth. OSI was developed by the International Standards Organization (ISO) in 1978. The model was mandated for use by the U.S. Government until 1995.

physical layer

The lowest layer in the OSI seven-layer model. It concerns electrical and mechanical connections and MAC. It is used by the data link layer. Example physical layer protocols are CSMA/CD, token ring and bus

Polled I/O

Communications messages, 8 bits at a time, used to send commands from Master to Slave at specified time intervals and provide Slave response to the Master.

protocol

A set of formal rules describing how to transmit data, especially across a network. At a low level, a protocol defines the electrical and physical standards to be observed, bit- and byte-ordering and the transmission and error detection and correction of the bit stream. At higher levels, protocols describe data formats, including the syntax of messages, handshaking (terminal-to-computer dialogue), character sets and the sequence of messages, among other related structures.

topology

The way in which devices on a network are physically connected: star, bus, ring or mesh. The topology may define transmission media, adapters, and physical design of the network.

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SMART TRAC DeviceNet Card

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