
Technical Manual

SMART TRAC™ PG Card

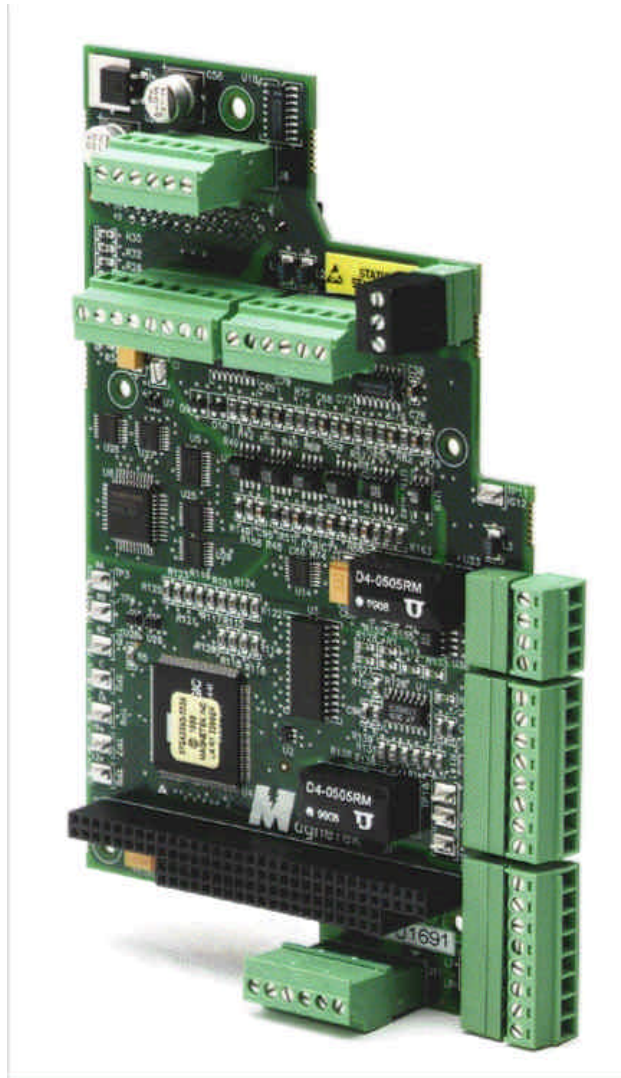


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Important Safety and Warranty Information

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 PG Card

General Capabilities

Closed-loop Control

A Smart Trac PG Card added to your Smart Trac AC1 provides closed loop flux vector control and closed loop speed control. With the card, 5 V to 12 V differential quadrature signals at a rate of up to 300 KHz with a 540 ohm input load may be input. Quadrature phasing of encoder inputs is 90 degrees +/- 22 degrees maximum at 300 kHz. Follower applications may use a second encoder input. A 12 VDC power supply rated at 200 mA supplies power to the encoder.

Position Control

The Smart Trac PG Card also provides position control. Start and stop signals control two 32-bit counters that can be used to measure the rotation of either start or stop signals. The Start and Stop signals can come from one of three sources: the marker pulse of either encoder; one of the two digital inputs (i.e., connected to proximity switches); or software command.

Digital Input

The two 12 VDC input signals can be used as general purpose inputs if not needed for position control.

Analog Input

Two analog input channels can accommodate either load cells or potentiometers. The input voltage range for each channel is ± 600 mV or ± 10 Volts, selectable.

The Smart Trac PG Card also supplies:

- an A/D converter with 12 bits of resolution.
- a +5VDC, 50 mA power supply.
- reference voltages of +10VDC and -10VDC, both rated at 10 mA.

Quick Start

1. Remove all Smart Trac cards except the Smart Trac Inverter and CPU cards per instructions in "Installing the Smart Trac PG Card."
2. Install the Smart Trac PG card as the second card of the card stack.
3. Make connections to the PG card terminal blocks per information contained in this manual and your situation.
4. Replace all other cards per the instructions in "Installing the Smart Trac PG Card."
5. Power up and test functionality of your Smart Trac AC1, including that of the Smart Trac PG card.

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Installing the Smart Trac PG Card

Unpacking

ElectroStatic Discharge (ESD) Procedures



WARNING - ESD

Keep electronic circuit boards in ElectroStatic 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 Discharge (ESD) sensitive 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 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 PG Card

The Smart Trac PG Card must be positioned above the Smart Trac CPU card on the Smart Trac AC1 card stack.

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

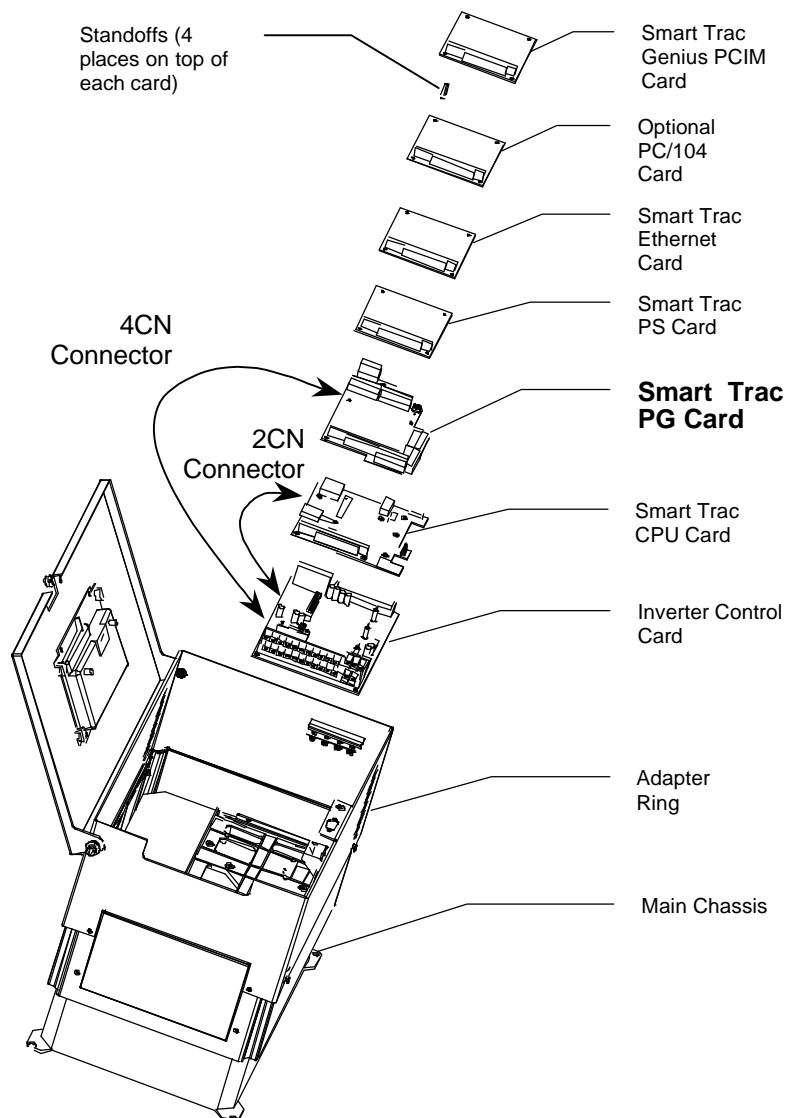


Figure 1. Smart Trac PG Card Stack Position

1. Power off the Smart Trac AC1. Disconnect it and tag it as "Out of Service". Perform this and all other steps required to remove all cards located in a stack position above the PG Card. See "Appendix D – Removing the Smart Trac Card Stack"
2. To replace the PG card, orient the PG card so that the PC/104 connector and the J2 connector align with the PC/104 connector on the Smart Trac CPU card and the 4CN connector on the Inverter Control board. Be careful to align the PC/104 connector pins with the receptacle on the Smart Trac CPU card so the pins don't bend when the card is pushed into place.
3. Gently but firmly push the Smart Trac PG card onto the Smart Trac CPU card. Make sure connecting pins are in alignment and J2 mates with 4CN before pushing the two boards tightly together. Secure the card using four (4) metal standoffs and one (1) plastic standoff.

4. Replace the Smart Trac PS or Ethernet card and other cards by reversing the procedures described in the Appendix "Removal of the Smart Trac Card Stack."

Using the Smart Trac PG Card

Basic Features

The Smart Trac PG card has:

- Two encoder inputs for closed loop flux vector control, closed loop speed control and position control.
- Digital inputs (if not needed for position control).
- Analog inputs to accommodate load cells or potentiometers.

Port Address

The Smart Trac PG card uses a port address of "1". Hardwired on the card, the address may be overridden if two Smart Trac PG cards must be used. Contact MagneTek for details.

Encoders

Connect encoders at Terminal Block J3 (feedback encoder input) or at Terminal Block J5 (follower encoder input). Only the feedback encoder Terminal Block J3 provides a 12 volt power supply for the encoder.

Channel 0 - feedback encoder

Use Channel 0 for the encoder of the motor connected to the Smart Trac AC1. It provides feedback to both the Smart Trac AC1 inverter control card and CPU. Terminal Block J3 provides these connections for differential A, B and Z inputs and a 12-volt @200ma power supply. A and B are used for speed and position control. Z is used for position start and stop only.

Channel 1 - follower encoder

Use Channel 1 for another feedback source. It only provides feedback for the Smart Trac CPU card. Terminal Block J5 provides connections for differential A, B and Z inputs.

Digital Inputs

Two +12 Volt digital inputs are located on Terminal Block J4 for proximity switch inputs (LI0 and LI1). Each of the digital inputs sinks 10mA and may be used for position start and stop, or as a general purpose input.

Analog Inputs

The Smart Trac PG card provides analog input differential pairs of 600mV and 10V at Terminals Blocks J9 (Analog Channel 0) and J10 (Analog Channel 1). Pins 1-2 of the terminal blocks are inputs for the 600 mV pair. Pins 3-4 of the terminal blocks are inputs for the 10V pair.

Testing Card Installation

Test Points

You may test the Smart Trac PG card at eleven test points. The test points and a description of each follows:

Smart Trac PG Card Test Points		
Test Point Designator	Description	Purpose
TP1	Analog Common	Test analog input signals
TP9	Analog Input 0	Test analog input signals
TP10	Analog Input 1	Test analog input signals
TP2	Digital Common	Test encoder test points
TP3	A pulse, encoder channel 0	Test pulse after Smart Trac PG card
TP4	B pulse, encoder channel 0	Test pulse after Smart Trac PG card
TP5	Z pulse, encoder channel 0	Test pulse after Smart Trac PG card
TP6	A pulse, encoder channel 1	Test pulse after Smart Trac PG card
TP7	B pulse, encoder channel 1	Test pulse after Smart Trac PG card
TP8	Z pulse, encoder channel 1	Test pulse after Smart Trac PG card
TP11	+5 V Isolated Common	Test pulses at input to Smart Trac PG card
TP12	Inverter Digital Common	Field Service use only

Checking Analog Input Signals

You may check analog inputs using a Digital Voltmeter or Multimeter between test points TP1 (common) and either TP9 (Analog Input 0) or TP10 (Analog Input 1). Values should be within a range of -10V to +10V.

Checking the Power Supply

You may check the +5V power supply by connecting a Digital Voltmeter or Digital Multimeter between J9-6 (5V power supply) and J9-7 (5V power supply return). It should read between 4.5 and 5.5 volts.

Checking Encoder Pulses

Using an oscilloscope, you can check encoder pulses after they have been processed by the Smart Trac PG card or at the motor.

Note: Measure all encoder pulses at the input with reference to +5V isolated common (TP11).



WARNING

Take proper precautions when making the following system checks. Hazardous voltages and amperage are present. The front door of the Smart Trac AC1 must be open and power applied to the unit while testing. Electrical shock or damage to the equipment may result if precautions are not taken while checking encoder pulses. Failure to comply may result in personal injury or death.

1. Remove power from L1, L2 and L3. Wait for the **CHARGE** light to go out.
2. Connect the common of the oscilloscope to TP2 (digital) to check encoder signals.

NOTE: You may want to remove the adapter ring from the drive for easier access to test points, especially when testing drives with smaller case sizes (1-4).

3. Connect one channel of the oscilloscope to TP3 if checking channel 0 or TP6 if checking channel 1. If using a two-channel oscilloscope, connect the second channel to TP4 if checking channel 0 or TP7 if checking channel 1.
4. Set the oscilloscope for 2V/div, 50ms/div, normal trigger, and rising edge trigger.
5. Apply power to the Smart Trac AC1, but **DO NOT** apply a **RUN** command.
6. Turn the motor shaft by hand. You should see pulses on both channels at a +5V level, 50% duty cycle. The pulses should be separated by 90 electrical degrees (half a pulse).
7. If one or both channels do not have the correct pulses present (i.e. missing pulses, incorrect duty cycle, improper voltage, etc.) check pulses at input to the Smart Trac PG card (next procedure).

Checking Pulses at Input to Smart Trac PG Card

NOTE: The following procedure describes checking feedback (channel 0) encoder pulses at terminal J3 and follower (channel 1) encoder pulses at terminal J5.

1. Remove power from L1, L2 and L3. Wait for the **CHARGE** light to go out.
2. Connect the common of the oscilloscope to TP11 (+5 V ISO Common).

NOTE: This procedure requires a two-channel oscilloscope to view the relationship between A+ and A- at the same time.

3. *To check A to /A:* Connect one channel of the oscilloscope to J3-1 if checking channel 0 A pulse or J5-1 if checking channel 1 A pulse. Connect the second channel to J3-2 (/A pulse) if checking channel 0 or J5-2 (/A pulse) if checking channel 1.
4. Set the oscilloscope for 5V/div, 50ms/div, normal trigger, and rising edge trigger.
5. Apply power to the Smart Trac AC1, but **DO NOT** apply a **RUN** command.
6. Turn the motor shaft by hand. You should see pulses on both channels and 50% duty cycle. The pulses should be separated by 180 electrical degrees (one the inverse of the other).
7. Disconnect the two oscilloscope channels. Reconnect them to terminals J3-3 or J5-3 (B pulse) and J3-4 or J5-4 (/B pulse).
8. *To check B to /B:* Turn the motor shaft by hand. You should see pulses on both channels and 50% duty cycle. Again, the pulses should be separated by 180 electrical degrees (one the inverse of the other).
9. *To check A to B, Channel 0:* Disconnect the two oscilloscope channels. Reconnect them to terminals J3-1 (Channel 0 A pulse) and J3-3 (channel 0 B pulse) Check the relationship between A and B. They should be 90 degrees out of phase.
10. *To check A to B, Channel 1:* Disconnect the two oscilloscope channels. Reconnect them to terminals J5-1 (Channel 1 A pulse) and J5-3 (channel 1 B pulse) Check the relationship between A and B. They should be 90 degrees out of phase.
11. If one or both channels do not have the correct pulses present (i.e. missing pulses, incorrect duty cycle, improper voltage, etc.), check pulses at the motor (next procedure).

Checking Pulses at a MagneTek VCM Motor

1. Remove power from L1, L2 and L3. Wait for the **CHARGE** light to go out.
2. Take apart the military-style, circular connector at the motor.
3. Connect the common of the oscilloscope to pin F of the circular connector.
4. Connect one channel of the scope to pin A of the circular connector. If the oscilloscope is two channel, connect the second channel to pin H.
5. Set the oscilloscope for 5V/div, 50ms/div, normal trigger, and rising edge trigger.
6. Apply power to the Smart Trac AC1, but **DO NOT** apply a **RUN** command.
7. Turn the motor shaft by hand. You should see pulses on both channels and 50% duty cycle. The pulses should be separated by 180 electrical degrees (one the inverse of the other).

If no pulse can be seen on any of the four connector pins (A, B, H or I), check the power supply between pins D and F. It should be at or near 12 VDC. If not, check the power supply at the Smart Trac PG card, between J3-7 and J3-8. If the power supply is not at or near 12VDC, check to make sure J2 is mated with 4CN on the inverter control board. If it is properly mated, replace the Smart Trac PG card.

Troubleshooting Your Smart Trac PG Card

Symptoms and Corrective Action

Many problems associated with the functioning of the Smart Trac PG card will be discovered when troubleshooting the Smart Trac AC1 and its option boards as an integrated unit. They are listed in the following table along with symptoms unique to the Smart Trac PG card.

Smart Trac PG Card Symptoms and Corrective Action		
Symptoms	Probable Cause	Corrective Action
Smart Trac PG Card not functioning	Control method set to Flux Vector or V/F w/PG but no PG card installed.	Install Smart Trac PG card.
	PG cable wires not installed.	Install cable wires.
No encoder pulses - Smart Trac PG card installed and good cable wires and connections.	Defective Smart Trac PG card	Check pulses per chapter "Testing Card Installation." Replace Smart Trac PG card as required.
Motor does not rotate	Improper connections from PG	Repair or replace connecting cables.
Motor does not rotate at set speed.	Out of tolerance or no PG output signal if Flux Vector or V/F w/PG control	Replace Smart Trac PG card
	PG power supply.	Replace power supply.

SMART TRAC PG Card

Smart Trac PG Card Symptoms and Corrective Action		
Symptoms	Probable Cause	Corrective Action
Motor hunting	Bad or no connections from inverter control board to PG card if Flux Vector or V/F w/PG control.	Check connections from Inverter Control board to PG. Repair or replace, as necessary.
Motor Overload fault indication	PG PCB may be faulty.	Replace Smart Trac PG card.
Heatsink Overtemp fault indication.	May be faulty or defective Smart Trac PG.	Replace Smart Trac PG

Appendix A – Specifications

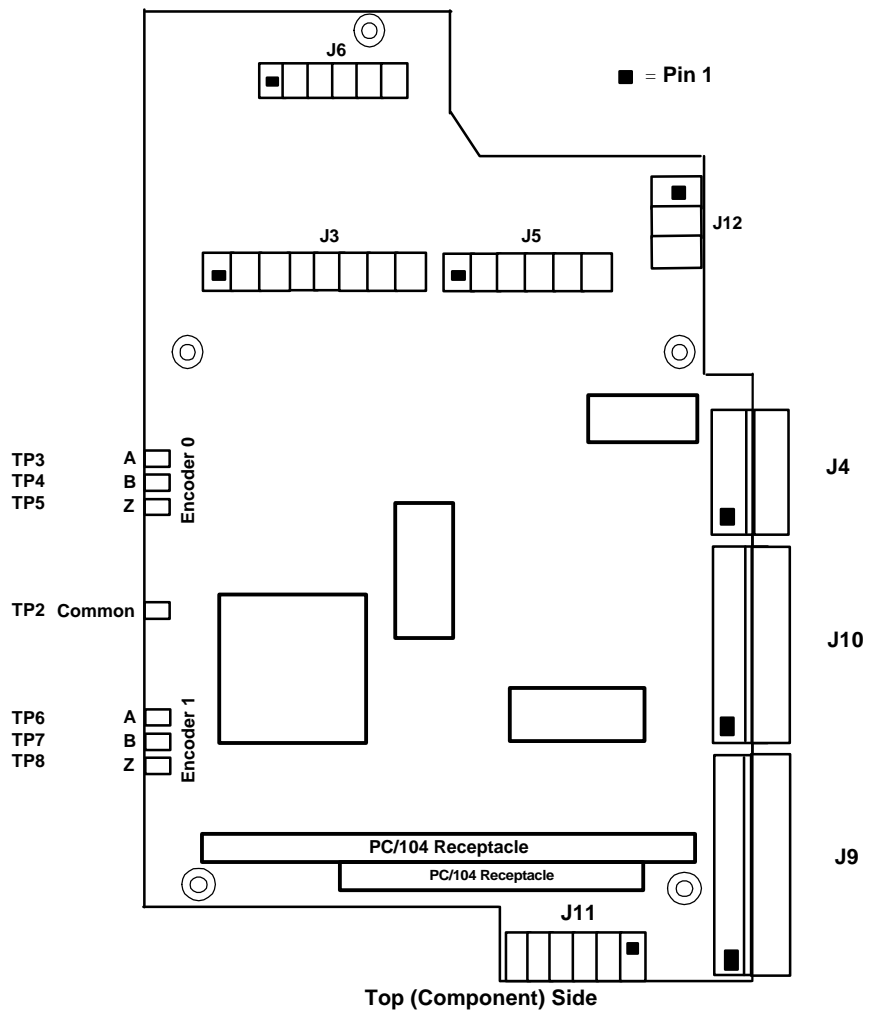
Smart Trac PG Card Specifications

Smart Trac PG Card Specifications		
Analog Inputs	Description	Two non-isolated differential inputs, simultaneously sampled
	Voltage	± 600 mVDC or ± 10 VDC
	Input Impedence	> 100,000 ohms
	Resolution	12 bits
Digital Inputs	Description	Two, opto-isolated
	Voltage	12 VDC internal pull-up provided
	Sink Current	10 mA
	Frequency	10KHz maximum
	Pulse Width	0.1 ms minimum
Feedback Encoder Input	Supply Voltage	12 VDC @ 200mA
	Maximum Frequency	300 kHz
	Input	Differential quadrature, opto-isolated (A, /A, B, /B) Optional differential index , opto-isolated (Z, /Z) 540 ohm input load on each pair 5 to 12 VDC differential input voltage Quadrature Phasing: 90 degrees +/- 22 degrees max. at 300 KHz.
Follower Encoder Input	Maximum Frequency	300 kHz

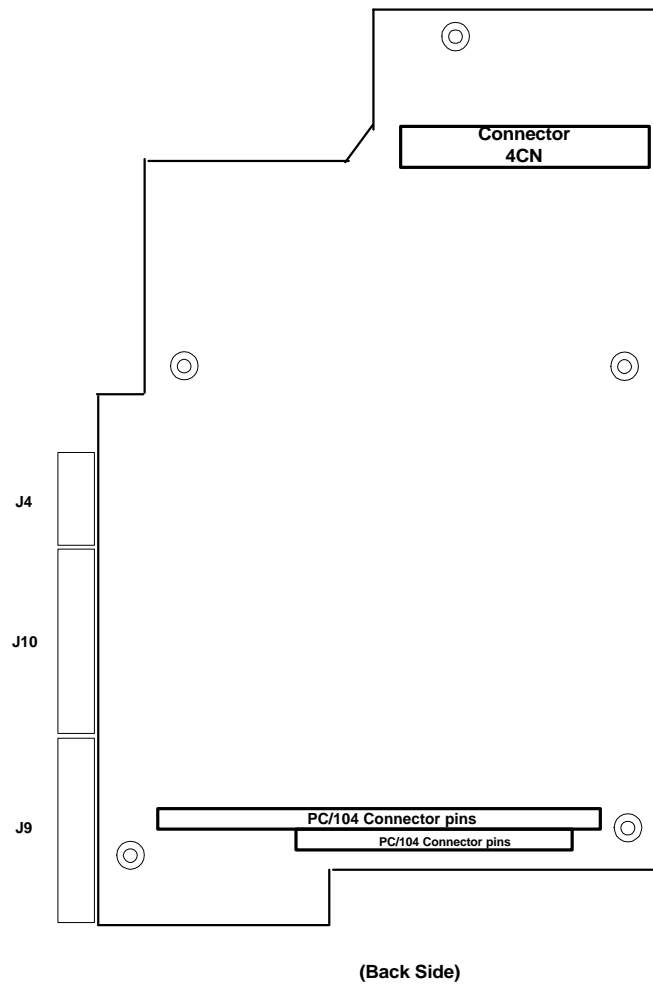
Smart Trac PG Card Specifications		
Follower Encoder Input	Input	Differential quadrature, opto-isolated (A, /A, B, /B) Optional differential index, opto-isolated (Z, /Z) 540 ohm input load on each pair 5 to 12 VDC differential input voltage. Quadrature Phasing: 90 degrees +/- 22 degrees max. at 300 KHz.
Encoder Monitor Output	Description	Quadrature plus index, opto-isolated (A, /A, B, /B, Z, /Z)
	Outputs	RS-422 differential
	Source	Software selectable
Reference Voltage Outputs		+ 10 VDC @ 10mA - 10 VDC @ 10mA
Isolated Power Supply Output		+ 5 VDC @ 50mA

Appendix B - Card Layout

Smart Trac PG Card – Component Side

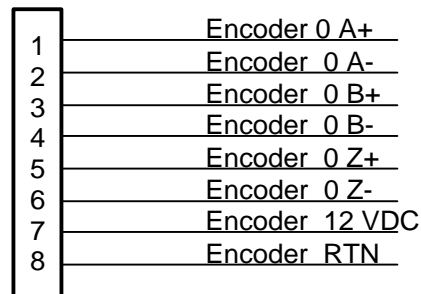


Smart Trac PG Card – Solder Side



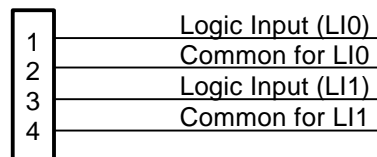
Appendix C - Connections

Feedback Encoder Input (J3)



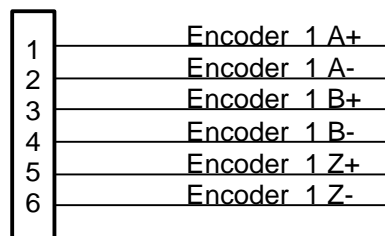
J3

Logic Input (J4)



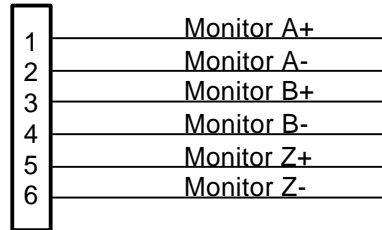
J4

Follower Encoder Input (J5)



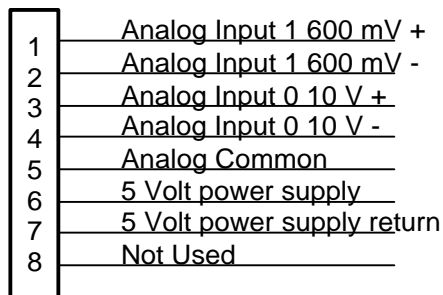
J5

Monitor Output (J6)



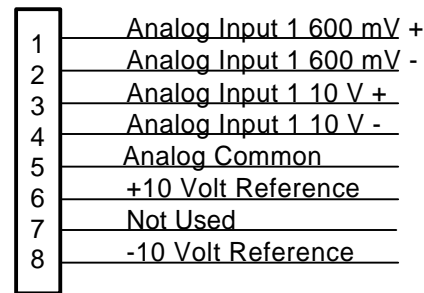
J6

Analog Channel 0 (J9)



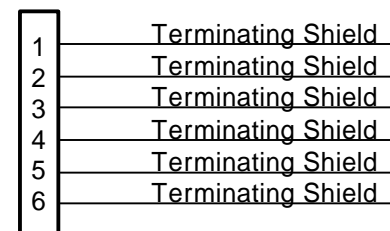
J9

Analog Channel 1 (J10)



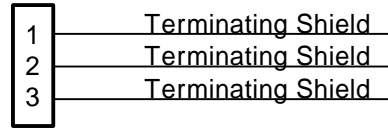
J10

Shield Termination (J11)



J11

Shield Termination (J12)



J12

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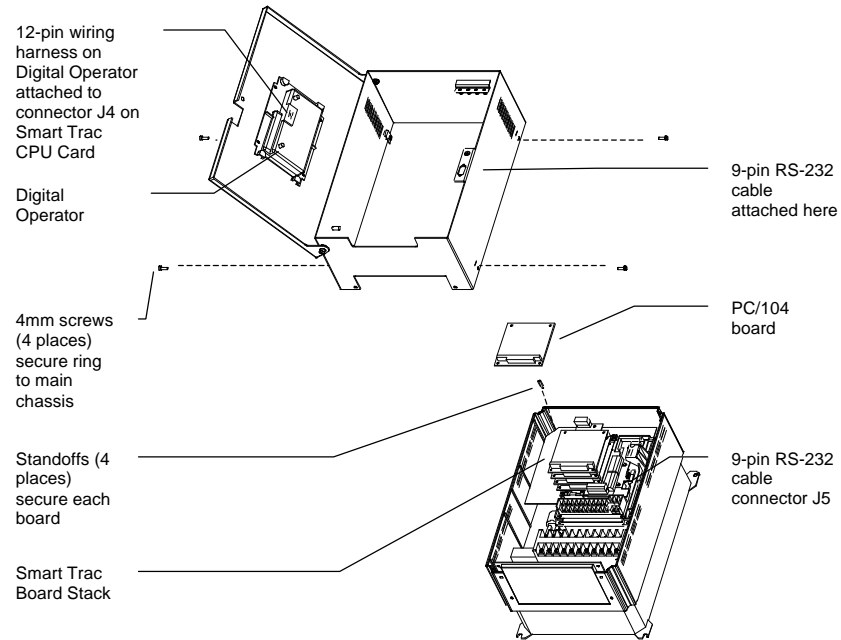
Appendix D – Removing the Smart Trac Card Stack

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.

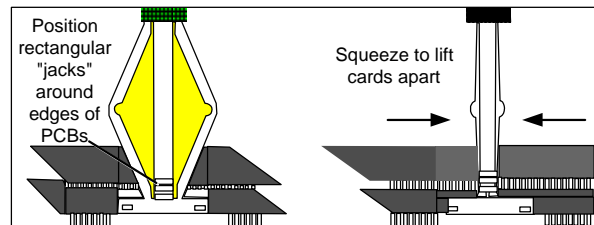


Figure 2. Using the PC/104 Extraction Tool.

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.

Appendix E – Technical Support

Getting Help

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 (262)-782-0200. Alternatively, you may copy the *Problem Report* form, found on the next page, and fax it to us at (262)-782-3418.

References

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 PG Card

Occurrence: Frequently Intermittantly Rarely

Nature of Problem:

Conditions when problem occurs:

Appendix F – Replaceable Parts Listing

Replaceable Parts Listing

Description	MagneTek Part Number	Qty
Smart Trac PG Card option kit	46S03643-0020	1
Technical Manual – Smart Trac PG Card	TM 3554-0020	1
Standoff, 4.5mm, Hex, Stl, CL ZINC, 16mm, M/F, M3, M3	05P00618-0006	4 each PG assy.
Card Extraction Tool	(Parvus Corporation P/N PRV-0760A-01)	1
Hardware Tools Kit for Smart Trac AC1	TBD	Option

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Glossary of Terms

encoder	A device that changes one digital code to another digital code.
Inverter	Inverter - A device that converts Direct Current (DC) to Alternating Current (AC).
marker pulse	Sometimes called an "index pulse," a marker pulse is an encoder output that pulses once each revolution of a rotating device. Position control often employs marker pulses to home or zero the position.
quadrature	An encoder output of two channels, one of which is 90 degrees out of phase with the other. The phase relationship changes depending on the direction of rotation.
sinks	Providing a current path to ground.

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