
Technical Manual

SMART TRAC™ AC1



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Warranty

Standard products manufactured by MagneTek are warranted to be free from defects in workmanship and material for a period of one year from date of shipment and any products which are defective in workmanship or material will be repaired or replaced, at MagneTek's option, at no charge to the Buyer. Final determination as to whether a product is actually defective rests with MagneTek. The obligation of MagneTek hereunder shall be limited solely to repair or replace, at MagneTek's discretion, products that fall within the foregoing limitations, and shall be conditioned upon receipt by MagneTek of written notice of any alleged defects or deficiency promptly after discovery and within the warranty period, and in the case of components or units purchased by MagneTek, the obligations of MagneTek shall not exceed the settlement that MagneTek is able to obtain from the supplier thereof. No products shall be returned to MagneTek without its prior consent. Products which MagneTek consents to have returned shall be shipped prepaid f.o.b. MagneTek's factory. MagneTek cannot assume responsibility or accept invoices for unauthorized repairs to its components, even though defective. The life of the products of MagneTek depends, to a large extent, upon the usage thereof, and MAGNETEK MAKES NO WARRANTY AS TO FITNESS OF ITS PRODUCTS FOR THE SPECIFIC APPLICATIONS BY THE BUYER NOR AS TO PERIOD OF SERVICE UNLESS MAGNETEK SPECIFICALLY AGREES OTHERWISE IN WRITING AFTER THE PROPOSED USAGE HAS BEEN MADE KNOWN TO IT.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE AND BUYER HEREBY WAIVES ANY AND ALL CLAIMS THEREFORE.

Limitation of Liability

IN NO EVENT SHALL MAGNETEK BE LIABLE FOR LOSS OF PROFIT, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL DAMAGES WHETHER ARISING OUT OF WARRANTY, BREACH OF CONTRACT OR TORT.

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Important Safety and Warranty Information

This Chapter will enable you to:

- Be aware of warnings, cautions and notes as they appear in the documentation.*
- Learn about important 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 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.

**WARNING**

Verify that the rated voltage of the Smart Trac AC1 matches the voltage of the incoming power.

Always ground the Smart Trac AC1 using ground terminal G. See the detailed instructions provided in the *Smart Trac Technical Manual*.

Wiring must be performed only by qualified personnel.

Do not perform a "HIPOT" or withstand voltage test on any part of the Smart Trac AC1. The AC1 uses semi-conductors and is vulnerable to high voltage.

Never connect the main circuit output terminals T1, T2 and T3 to the AC main circuit power supply.

All parameters have been factory set to values commonly used. Do not change their settings without good reason.

Failure to comply with this warning may result in damage to the Smart Trac AC1 and connected equipment along with personal injury and/or death.

**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. Failure to comply may result in damage to equipment and/or personal injury.

**CAUTION**

All parameters have been factory set to values commonly used. Do not change their settings without a full understanding of their impact on Smart Trac AC1 and machine operation. Failure to comply may result in damage to equipment and/or personal injury.

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Smart Trac AC1

This Chapter will enable you to:

- Describe the capabilities of the Smart Trac AC1*
- Become familiar with the ratings and specifications of the Smart Trac AC1*

Overview

General Capabilities

The Smart Trac AC1 is a high performance, programmable AC motor drive that eliminates the need for an external PLC or PC to control a machine or process. Utilizing the Windows® environment, *Smart Trac Workstation™* software allows the Smart Trac AC1 to be programmed efficiently and easily. Each Smart Trac AC1 can be programmed to fulfill a specific function and purpose using any of the five IEC-61131-3 programming languages. IEC-61131-3 programming languages include Relay Ladder Logic (RLL), Structured Text (ST), Sequential Function Charts (SFC), Function Blocks (FB) or Instruction Lists (IL). Commonly used function blocks may be obtained from MagneTek's *Program Library*. Consult your local MagneTek representative for details.

Smart Trac AC1 offers many means of communications with other control devices using either the built-in RS-232 port or any of the optional add-on communication cards. A MagneTek ARCNET card may be used to communicate with MicroTrac® LAN systems, providing backward compatibility with existing MagneTek systems. In addition, the Smart Trac AC1 system supports off-the-shelf Ethernet, DeviceNet, Profibus, SDS, Interbus-S, Fiber Optic and local I/O cards conforming to PC/104 specifications for form and fit.

The Smart Trac AC1 provides a sine-coded and pulse width modulated three-phase output with adjustable voltage and frequency. This provides for complete speed and/or torque control of any conventional squirrel cage induction motor. Automatic stall prevention and voltage boost prevents nuisance tripping during load or line side transient conditions. The Smart Trac AC1 will not induce any voltage line notching distortion back to the utility line and will maintain a displacement power factor of not less than 0.98 throughout its speed range.

Specifications

Table 1. Smart Trac AC1 Specifications

Characteristic	Specification
Ratings:	0.75 to 100 HP at 230 VAC 1.0 to 1600 HP at 460 VAC 2.0 to 200 HP at 600 VAC
Amperes	3.2 to 1,600 amps, depending on model
Input Power – 208/230V Class	Voltage: 3 Phase 200/208/220/230 VAC +10%, -15% Frequency: 50/60 Hz \pm 5%
Output Power-208/230V Class	Voltage: 0-230V (proportional to input voltage) Frequency: 0-400 Hz (V/Hz pattern selectable)
Input Power – 380/415/460V Class	Voltage: 3 Phase 380/400/415/440/460 VAC +10%, -15% Frequency: 50/60 Hz \pm 5%
Output Power– 380/415/460V Class	Voltage: 0-460V (proportional to input voltage) Frequency: 0-400 Hz (V/Hz pattern selectable)
Input Power – 575 / 600 V Class	Voltage: 3 Phase 500/ 575/ 600 VAC \pm 10% Frequency: 50/60 Hz \pm 5%
Output Power– 575 / 600 V Class	Voltage: 0-575V (proportional to input voltage) Frequency: 0-400 Hz (V/Hz pattern selectable)
Overload Capacity	150% for 1 minute
Enclosure Types	NEMA 1 Protected Chassis, NEMA 4 , or NEMA 12
Ambient Operating Temp.	0°C to 40° C
Storage Temperature	-20° C to 60° C
Humidity	95% RH non-condensing
Vibration	1G<20Hz, 0.2G 20 to 50 Hz
Location	Indoor, protected from corrosive gases and dust
Elevation	3300 ft (1000 M) or less

Assembling a Smart Trac AC1

This Chapter will enable you to:

- Understand what is contained within your Smart Trac AC1*
- Learn how to assemble your Smart Trac AC1 from the components you received.*
- Recognize each of the Option cards in your Smart Trac AC1*

The Contents of Your Shipment

Because Smart Trac AC1s are shipped to your specifications, there is wide variation in the types and numbers of component parts shipped to you. While some of your components may already be assembled, the assembly procedures in this chapter assume that you've received the following components :

- Smart Trac AC1 Chassis, Drive and Inverter Card (assembled)
- Cover and Adapter Ring
- Smart Trac CPU Card
- Smart Trac Option Cards (as specified for your configuration)

Assembly Procedure


Use the following procedure for first time installation of your Smart Trac AC1 only!

WARNING - ESD



The Smart Trac AC1 electronics are electrostatic sensitive devices. Follow Electrostatic Discharge (ESD) procedures when handling to protect components. Failure to follow ESD procedures may result in damage to the Smart Trac AC1 or its components.

1. Ensure wiring harness at connector 7CN, located at the top of the Smart Trac Inverter card, is connected to the 7CN connector on the primary power supply printed circuit board (1PCB). The power supply board is either a Power PCB (units B034 or less) or a Gate Drive PCB (A064 or higher number).

2. Ensure ground strap E, located at bottom of inverter card, is connected to the Smart Trac case ground terminal (indicated by the printed ground symbol ).

NOTE: The case ground terminals are the two screw terminals in the lower left of smaller cases, or placed one on the lower left and one on the lower right sides of larger cases. You can use either or both terminals to connect ground straps, depending on the length of the strap or your preference.

***NOTE:** Standoffs used between the Smart Trac CPU and Inverter cards are shorter than other standoffs used between all other cards.*

3. Connect and tighten all electrical leads to terminal blocks on the Smart Trac Inverter card to their proper termination, as shown on the specific connection diagram for your Smart Trac AC1 installation.
4. Remove the Smart Trac CPU card (marked "ST") from its anti-static bag.
5. Familiarize yourself with the location of the 2CN connector on the Inverter card. The female half of the black 2CN connector is located on the Smart Trac Inverter card. The male half is located on the Smart Trac CPU card.
6. While rotating the Smart Trac CPU card about 45 degrees from its base position, set the Smart Trac CPU card locking plate into the plastic locking tab on the Inverter card. Align the holes in the locking plate with the special, short black plastic standoffs. The metal locking plate should be oriented so the standoff screw hole is on the left and the plate is below the plane of the black plastic standoffs. Rotate the card downward to lock in place.
7. Insert four metal standoffs through four outside holes in the Smart Trac Inverter card and screw into the four standoffs on the underside of the card. Tighten standoffs with fingers (torque to about 10 in-lbs).
8. Locate the three plastic standoffs and spring-loaded clips that secure the Smart Trac CPU card to the Smart Trac Inverter card through holes in the card.
9. Orient the Smart Trac CPU card with the PC/104 connector at the bottom. The MagneTek logo, printed on the card, should be at the top. Slip the Smart Trac CPU card under the wiring harness connector (the harness is connected to 1CN on the inverter card). Rotate slightly upward from the left.
10. Align the male and female halves of the 2CN connector and, being careful not to bend the pins of the 2CN connector, press the Smart Trac CPU card firmly into place on the Smart Trac Inverter card (1PCB). You should see and hear the plastic standoffs and spring-loaded clips snap into place.
11. Install four metal standoffs through four outside holes in the Smart Trac CPU card and screw into the four standoffs on the underside of the card. One standoff may be a different color than the other three. This standoff is inserted through the CPU card and into the threaded hole in the metal locking plate. Tighten standoffs with fingers (torque to about 10 in-lbs).
12. If you purchased the Smart Trac PG card option, install it as follows. Otherwise, proceed immediately to step 12.

***NOTE:** Depending on the drive and case size, make encoder connections before installing the Smart Trac PG Card.*

- a. Locate two block pin positions on the female PC/104 connector. Using a pin or other sharp object, carefully remove two black plugs from the two blocked pin positions.
 - b. Orient the Smart Trac PG card so that the PC/104 connector and the J2 connector (on the solder side of the card) align with the PC/104 connector on the Smart Trac CPU card and the 4CN connector on the Inverter Control card. The standoff hole above J6 must slip over the plastic standoff. 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.
 - c. 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. Tighten metal standoffs with fingers (torque to about 10 lb-ft).
13. Position the Adapter Ring over the drive chassis, aligning two tabs on the right side of the ring with slots in the chassis.
 14. Secure the Adapter Ring to the chassis using two or four Phillips head screws, depending on drive case size.
 15. Connect the 9-pin RS-232 cable at connector J5 on the Smart Trac CPU card.
 16. If your unit includes a Smart Trac PG card, connect the ground strap from J11 on the Smart Trac PG card, to the left inside and top inside of the Adapter Ring.
 17. Connect the 12-pin wiring harness from the Digital Operator to connector J4 on the Smart Trac PS card.
 18. Install other option cards per instructions included with each card. See "Option Cards" below for general information.
 19. Close the cover and tighten the screws or single captive screw to secure the cover.
 20. Your Smart Trac AC1 should not be assembled and ready for connection to a 110V power supply.

Option Cards

The Smart Trac Inverter Control Card is the first card of the stack. It is the card on which all others are stacked. The Smart Trac CPU card is mounted on top of the Smart Trac Inverter and communicates with it via the connector labeled 2CN.

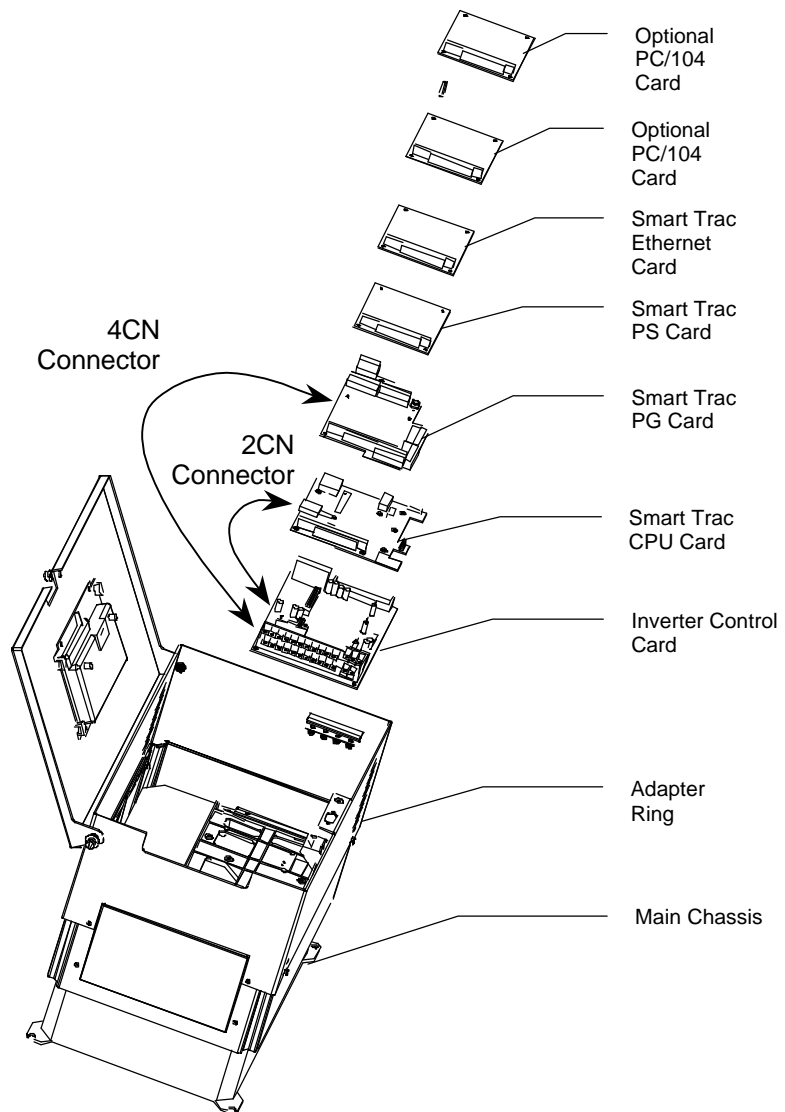


Figure 1. Smart Trac card assembly showing option cards.

Smart Trac PG Card

The Smart Trac PG (Pulse Generator) card is installed on top of the Smart Trac CPU card. It communicates with the Smart Trac Inverter control card via connector 4CN and the Smart Trac CPU card's PC/104 connector. The Smart Trac PG card accumulates pulses (A, B and Z) from both master and follower encoders. It has two analog inputs and can accept two proximity switches. It includes its own +5V power supply rated at 50 ma. This 50 ma power is typically ample for applications requiring a load cell.

Smart Trac PS Card

The Smart Trac PS (Power Supply) card is connected to the Smart Trac PG card via the PC/104 connector and supplies all the voltages and power to support the Smart Trac CPU, Smart Trac PG, and all other option cards. If the Smart Trac PG card is not installed, the Smart Trac PS connects to the Smart Trac CPU.

Smart Trac Ethernet Card

The Smart Trac Ethernet Card is a PC/104 compliant card included in all Smart Trac AC1s, providing quick program downloads and uploads and fast, reliable networking capabilities.

Optional PC-104 Compliant Cards

Several additional PC/104 compliant option cards may be stacked on top of the Smart Trac PG card. Optional cards might include local I/O, ARCNET, Genius, DeviceNet, Profibus or fiber optic cards for communications and/or additional system I/O. The Smart Trac ARCNET card allows the Smart Trac AC1 to communicate with MagneTek Micro Trac drives, making it fully backward compatible with MagneTek's earlier drive systems. DeviceNet, Profibus and Fiber Optic cards will support master/slave and peer-to-peer communications. See the documentation on the individual option cards for further information

Smart Trac AC1 Installation

This Chapter will enable you to:

- Prepare your Smart Trac AC1 for installation*
- Determine a physical location for your Smart Trac AC1.*
- Make required electrical connections.*
- Recommend the proper grounding and shielding for your Smart Trac AC1.*
- Run adequate conduit for the wiring to and from your Smart Trac AC1.*
- Audit your Smart Trac AC1 system using the Pre-power checklist.*
- Become familiar with the Digital Operator*
- Start your Smart Trac AC1 for the first time.*
- Connect one or more vector-controlled motors.*
- Perform an integrated Smart Trac AC1 and motor test.*

Installing Your Smart Trac AC1



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) 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.

Storage

If the Smart Trac AC-1 will be stored for a while after receipt, keep the Smart Trac AC1 in its original packaging material. Store the Smart Trac AC1 in a controlled environment that meets the following:

- temperature range within -20°C to 60°C
- humidity of less than 95% (no condensation)

Unpacking

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

Contents Checklist

You should have received the following with your Smart Trac AC1:

- Smart Trac AC1
- Option card(s) and accessories, if purchased, and option card technical manuals
- Smart Trac Technical Manual
- Applicable Smart Trac AC-1 Bulletins and Application Notes

Locating Your Smart Trac AC1

To achieve proper performance and normal operating life, your Smart Trac AC1 must be installed in an area where it is protected:

- Excessive heat, direct sunlight, rain or moisture.
- Corrosive gases or liquids.
- Vibration, airborne dust or metallic particles.

Consider the following when planning the installation and installing your Smart Trac AC1:

- Always lift your Smart Trac AC1 by its base, **never** by the front cover.
- Install the Smart Trac AC1 on a flat, non-flammable vertical surface (wall or panel) using mounting screws specified (See "Smart Trac AC1 Dimensions" for screw specifications).
- Provide a **minimum** 4.7" (26.1cm) clearance above and below the Smart Trac AC1. This allows for proper air circulation over the heat sink fins.
- Provide a **minimum** 1.2" (3.05cm) clearance on each side of the Smart Trac AC1.
- Mount your Smart Trac AC1 in a freestanding floor-mount cabinet. Sufficient clearance must be obtained to permit the door to be opened.
- Add a fan or cooling device as necessary to ensure air entering the Smart Trac AC1 is below 113° F. (45° C) for protected chassis or below 104° F. (40° C) for NEMA 1. See "[Table 1. Smart Trac AC1 Specifications](#)".

Making Electrical Connections

Complete wire interconnections per information [Table 2 and Table 3](#), [Table 4](#) or [Table 5](#), depending on the voltage of your Smart Trac AC1. Always adhere to the following:



WARNING

Wiring should be performed only by qualified personnel. Disconnect all power to Smart Trac AC1. Do not remove the front cover while input power is ON.

Never connect the main circuit output terminals T1, T2 and T3 to the AC main circuit power supply.

Failure to comply with this warning may result in damage to the Smart Trac AC1 and connected equipment along with personal injury and/or death.

- Use 600V vinyl-sheathed wire or equivalent.
- Determine wire size to consider voltage drop of leads.
- Wire size must be suitable for NEC Class I Circuits.
- Use UL approved closed loop connectors or CSA certified ring connectors sized for the selected wire gauge. Install connectors using only the connector manufacturer's recommended crimp tool. See [Table 2](#).
- Motor lead length should **not** exceed 164 feet (50 meters). Motor wiring should be run in a separate conduit from the power wiring. If lead length must exceed this distance, reduce the carrier frequency and consult the motor manufacturer for proper installation procedures.
- **Never** connect AC main power to drive output terminals T1(U), T2(V), T3(W).

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- **Never** allow wire leads to contact metal surfaces. Short-circuit may result.
- **Never** connect power factor correction capacitors or noise filters to Smart Trac AC1 output.

Table 2. Terminal screws, connectors and clamping torque by wire size

Wire Size (AWG)	Wire Size (mm ²)	Terminal Screw	Closed-Loop Connector	Clamping Torque Steel, lb-in	Clamping Torque Steel, N-m	Clamping Torque Copper, lb-in	Clamping Torque Copper, lb-in
20	0.50	M3.5	1.25-3.5	7.8	0.9	7.0	0.8
18	0.75	M4	1.25-4	13.0	1.5	10.4	1.2
16	1.25	M4	1.25-4	13.0	1.5	10.4	1.2
14	2	M4	2-4	13.0	1.5	10.4	1.2
		M5	2-5	26.1	20.9	3.1	2.4
12	3.5	M4	3.5-4	13.0	1.5	10.4	1.2
		M5	3.5-5	26.1	20.9	3.1	2.4
10	5.5	M4	5.5-4	13.0	1.5	10.4	1.2
		M5	5.5-5	26.1	20.9	3.1	2.4
8	8	M5	8-5	26.1	20.9	3.1	2.4
		M6	8-6	40.9	34.8	4.8	4.1
6	14	M6	14-6	40.9	34.8	4.8	4.1
4	22	M8	22-8	100.0	82.6	11.7	10.7
2	38	M8	38-8	100.0	82.6	11.7	10.7
		M10	38-10	182.6	156.5	21.4	18.4
1/0	60	M10	60-10	182.6	156.5	21.4	18.4
3/0	80	M10	80-10	182.6	156.5	21.4	18.4
4/0	100	M10	100-10	182.6	156.5	21.4	18.4
		M12	100-12	313.0	191.3	36.7	23.1
MCM300	150	M12	150-12	313.0	191.3	36.7	23.1
MCM400	200	M12	200-12	313.0	191.3	36.7	23.1
MCM650	325	M12	325-12	313.0	191.3	36.7	23.1
		M16	325-16	313.0	191.3	36.7	23.1

Table 3. Wire Sizing for Main Circuit, 230 Volt

Wire Sizing for Main Circuit, 230 Volt				
Smart Trac AC1 Model No.	Terminal Symbol	Terminal Screw	Wire Size (AWG)	Wire Size (mm ²)
STAC*A003	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W), GND	M4	14-10	2-5.5
STAC*A006	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W), GND	M4	14-10	2-5.5
STAC*A008	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	14-10	2-5.5
	GND	M4	12-10	3.5-5.5
STAC*A011	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W), GND	M4	12-10	3.5-5.5
STAC*A017	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W), GND	M4	10	5.5
STAC*A025, STAC*A033	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M5	8	8
	GND	M5	10-8	5.5-8
STAC*A049	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M6	4	22
	GND	M6	8	8
STAC*A064	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M8	3	30
	GND	M6	8	8
STAC*A080	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M8	3	30
	GND	M8	6	14
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*A130	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	4/0	100
	GND	M8	4	22
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*A160	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	1/0 XP	60 X 2P
	GND	M8	4	22
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*A224	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	1/0 XP	60 X 2P
	GND	M8	3	30
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*A300	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M12	4/0 X 2P	100 X 2P
	GND	M8	1	50
	1(r), 2(s)	M4	20-10	0.5-5.5

Table 4. Wire Sizing for Main Circuit, 460 Volt

Wire Sizing for Main Circuit, 460 Volt				
Smart Trac AC1 Model No.	Terminal Symbol	Terminal Screw	Wire Size (AWG)	Wire Size (mm ²)
STAC*B001	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W), GND	M4	14-10	2-5.5
STAC*B003, STAC*B004, STAC*B008	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	14-10	2-5.5
	GND	M4	12-10	3.5-5.5
STAC*B011, STAC*B014	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W), GND	M4	12-10	3.5-5.5
STAC*B021	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	8-6	8-14
	GND	M4	8-6	8-14
STAC*B027, STAC*B034	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M5	8-6	8-14
	GND	M6	8	8
STAC*B041	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M6	6	14
	GND	M8	8	8
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*B052	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M6	4	22
	GND	M8	8	8
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*B065	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M8	4	22
	GND	M8	8	8
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*B080	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M8	3	30
	GND	M8	6	14
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*B096	L1(R), L2(S), L3(T), □, □1, □2, □3, T1(U), T2(V), T3(W)	M8	1	50
	GND	M8	6	14
	1(r), 2(s)	M4	20-10	0.5-5.5
STAC*B128	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	4/0	100
	GND	M8	4	22
	1(r), 2 200 (s200), 2 400 (s400)	M4	20-10	0.5-5.5
STAC*B165	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	1/0	60 x 2P
	GND	M8	4	22

Wire Sizing for Main Circuit, 460 Volt				
Smart Trac AC1 Model No.	Terminal Symbol	Terminal Screw	Wire Size (AWG)	Wire Size (mm²)
	1(r), 2 200 (s200), 2 400 (s400)	M4	20-10	0.5-5.5
STAC*B224	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	1/0 x 2P	60 x 2P
	GND	M8	3	30
	1(r), 2 200 (s200), 2 400 (s400)	M4	20-10	0.5-5.5
STAC*B302	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M10	1/0 x 2P	60 x 2P
	GND	M8	3	30
	1(r), 2 200 (s200), 2 400 (s400)	M4	20-10	0.5-5.5
STAC*B302	L1(R), L2(S), L3(T), □, □3, T1(U), T2(V), T3(W)	M12	4/0 x 2P	100 x 2P
	GND	M8	1	50
	1(r), 2 200 (s200), 2 400 (s400)	M4	20-10	0.5-5.5
STAC*B450, STAC*B605	L1(R), L2(S), L3(T), □, □1, □3, T1(U), T2(V), T3(W)	M16	MCM65 0 x 2P	325 x 2P
	GND	M8	1/0	60
	1(r), 2 20 0 (s200), 2 400 (s400)	M4	20-10	0.5-5.5

Table 5. Wire Sizing for Main Circuit 600V (575V).

Wire Sizing for Main Circuit, 600 Volt				
Smart Trac AC1 Model No.	Terminal Symbol	Terminal Screw	Wire Size (AWG)	Wire Size (mm ²)
STAC*C003, STAC*C004	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	14-10	2-5.5
	GND		12-10	3.5-5.5
STAC*C006	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	14-10	2-5.5
	GND		12-10	3.5-5.5
STAC*C010	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	12-10	3.5-5.5
	GND			
STAC*C012	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M4	10	5.5
	GND		12-10	3.5-5.5
STAC*C017	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W),	M5	10-6	5.5-14
	GND	M6		
STAC*C022	L1(R), L2(S), L3(T), □, □1, □2, B1, B2, T1(U), T2(V), T3(W)	M5	8-6	8-14
	GND	M6	10-6	5.5-14
STAC*C027, STAC*C032	L1(R), L2(S), L3(T), □, □1, B1, B2, T1(U), T2(V), T3(W)	M6	8-6	8-14
	GND	Ä	10-6	5.5-14
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C041	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M8	6-1/0	14-50
	GND	*	8-2	8-30
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C052	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M8	4-1/0	22-50
	GND	*	8-2	8-30
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C062	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M8	3-1/0	30-50
	GND	*	8-2	8-30
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C077	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M8	2-1/0	30-50
	GND	*	6-2	22-30
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C099	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M8	2/0-1/0	50-60

Wire Sizing for Main Circuit, 600 Volt				
Smart Trac AC1 Model No.	Terminal Symbol	Terminal Screw	Wire Size (AWG)	Wire Size (mm ²)
	GND	*	4-2	22-30
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C130	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M10	3/0=300	80-150
	GND	*	4-2/0	22-60
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C172	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M12	300-400	150-200
	GND	*	4-2/0	22-60
	1(r), 2(s)	M4	14-10	2-5.5
STAC*C200	L1(R), L2(S), L3(T), □, □1, T1(U), T2(V), T3(W)	M12	350-400	180-200
	GND	*	3-2/0	30-60
	1(r), 2 (s)	M4	14-10	2-5.5

* Indicates terminal uses a pressure lug.

Smart Trac Grounding

Your Smart Trac AC1 must be solidly grounded using main circuit ground terminal GND. Refer to the latest edition of the *National Electrical Code (NEC)*, Article 250, *Grounding*, for proper grounding methods, especially ground rod requirements. Select lead size suitable for size of terminal screw. Make the length as short as possible.

Never ground the Smart Trac AC1 with the same common as welding machines, motors, or other large-current electrical equipment. Where several Smart Trac AC1s are used, ground each directly or daisy chain each to the machine ground bar or ground rod. **Refer to Figure 2. Do not form a loop with the ground leads.**

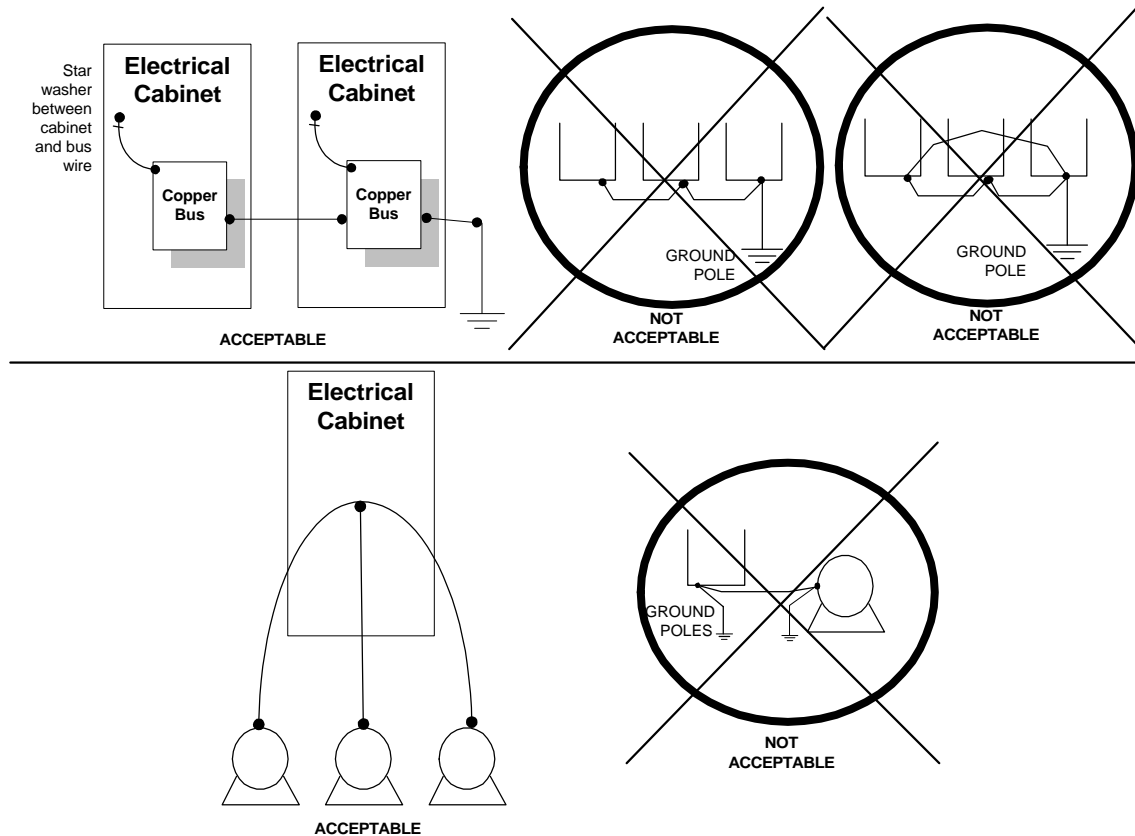


Figure 2. Grounding of Three Smart Trac AC1s (top) and Grounding of Smart Trac AC1 with Vector Controlled Motor (VCM) (bottom)

Connecting Auxiliary Input and Output Power Option Devices

Proper wiring practices and relative locations within the electrical path, from line to load, are shown in . Your application may use some or all of the devices shown. Disregard items depicted which do not match those in your Smart Trac AC1 configuration.

WARNING

Disconnect all power to Smart Trac AC1. Do not remove the front cover while input power is ON. Failure to comply may result in personal injury or death.

Connecting the Control Circuit

Mount all power option devices as close to the Smart Trac AC1 as possible. Keep electrical connections as short as possible. For Models with base designations of STAC-A003 through STAC-A064, STACWA003 through STACWA064, STAC-B001 through STAC-B034, and STACWB001 through STACWB034, an input or DC reactor should be used.

Basic control circuit (signal) terminations on the Smart Trac AC1 are shown in the "Simplified Customer Connection Diagram." The use of these terminals, however, is dependent on the needs of the application program. Terminal numbers and their function are listed in the table "Terminal Definitions of the Inverter Control Card."

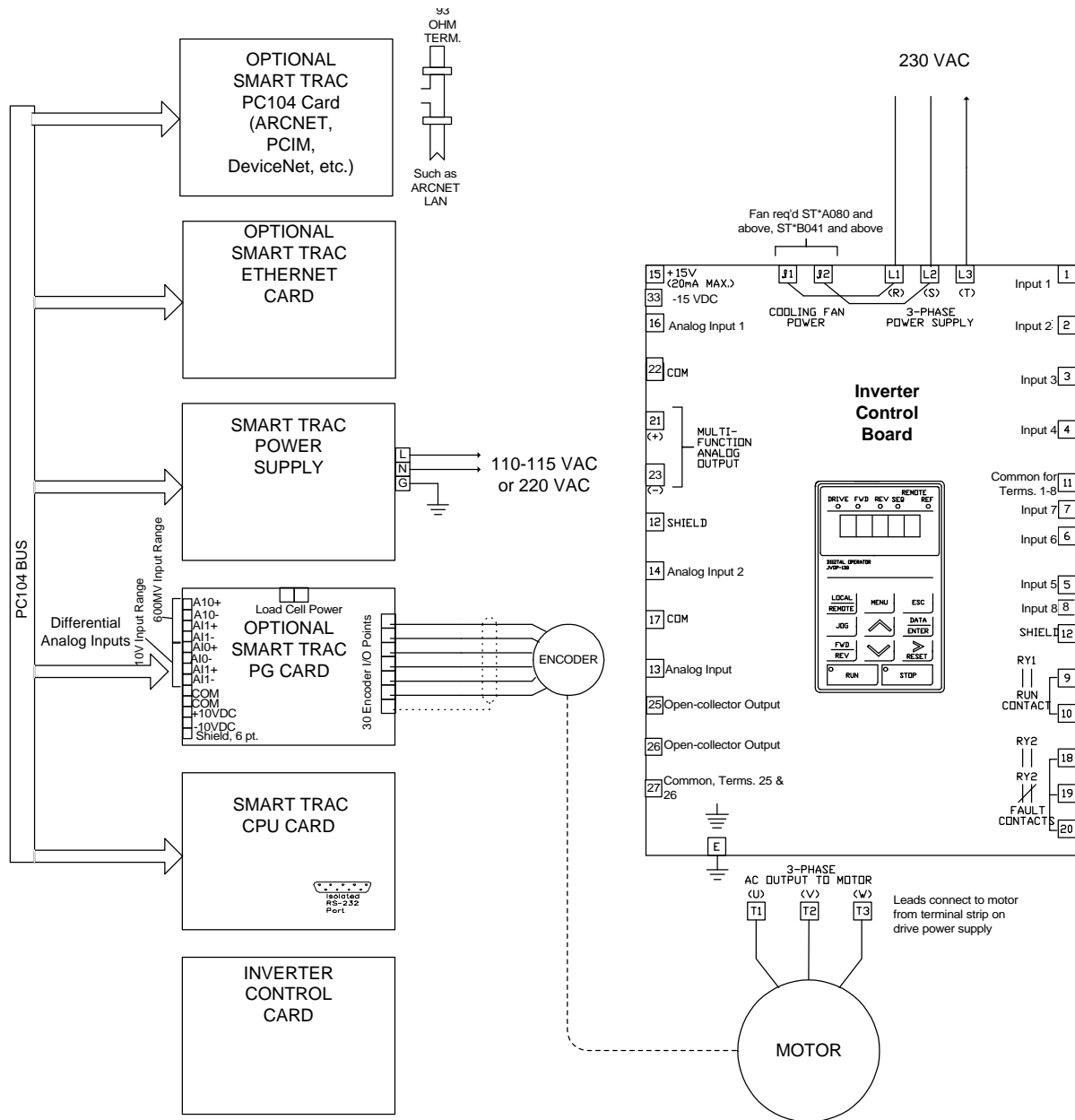


Figure 3. Simplified Customer Connection Diagram

Terminal Definitions of the Inverter Control Card

Term No.	Function	Term No.	Function
1*	Multifunction Logic Input 1	23	Multifunction Analog Output 2, 0 to +11 V; 2mA maximum
2*	Multifunction Logic Input 2	25	Open-collector Output: +48 V, 50 mA maximum
3*	Multifunction Logic Input 3	26	Open-collector Output
4*	Multifunction Logic Input 4	27	Multifunction Open Collector Common
5*	Multifunction Logic Input 5	33	-15 VDC Control power supply for frequency settings: 20 mA max
6*	Multifunction Logic Input 6	POWER CONNECTIONS	
7*	Multifunction Logic Input 7	L	1-phase power 90-264 V, to Smart Trac PS
8*	Multifunction Logic Input 8	N	1-phase power 90-264 V, to Smart Trac PS
9, 10	Multifunction contact output (N.O.) One of 18 functions available by setting of parameter H2-01. Contact capacity: 250 VAC at 1A or less; or 30 VDC at 1A or less	L1	3-phase power 230 V/460 V
11	COM, sequence control input common for terminals 1 -6, 0 V	L2	3-phase power 230 V/460 V
12	Shield sheath of signal leads	L3	3-phase power 230 V/460 V
13	Typically Speed Reference, but is multifunction analog input: 0 V to +10V (20K ohms), -10 V to +10V (20K ohms), Can be changed to manual by setting of parameter H3-01.	T1	Motor
14	Analog Input 2, 4-20mA (250 ohms)	T2	Motor
15	+15 VDC	T3	Motor
16	Analog Input 1	B1	Dynamic Braking (option)
17	Multifunction Analog Input Common, 0 V for terminals 13 thru 16, and 33	B2	Dynamic Braking (option)
18	Fault Contact-OPEN, capacity: 250 VAC at 1A or less or 30 VDC at 1A or less	+1	DC Reactor (option)
19	Fault Contact-OPEN, capacity: 250 VAC at 1A; or less or 30 VDC at 1A or less	+2	DC Reactor (option)
20	Fault Contact-OPEN, capacity: 250 VAC at 1A; or less or 30 VDC at 1A or less	9-pin D connector	Isolated RS-232
21	Multifunction Analog Output 1, 0 to +11 V; 2mA maximum	* NOTE: Terminals 1-8 source +24 VDC (8MA max), Low=True (ON) when connected to terminal 11	
22	Multifunction Analog Output Common for terminals 21 and 23, 0 to +11V; 2mA max.		

Table 6. Terminal Definitions of the Inverter Control Card

Connections

Make connections according to the "Simplified Customer Connection Diagram" with the following notes:

Lead Length:

Do not exceed 164 feet (50 meters).

Wire Sizes:

Consider voltage drop when determining size. Consult "Table 3. Wire Sizing for Main Circuit, 230 Volt" on page 6, "Table 4. Wire Sizing for Main Circuit, 460 Volt" on page 7, "Table 5. Wire Sizing for Main Circuit 600V (575V)." on page 9.

NOTE: Signal and Control Leads require twisted-pair shielded wire (20-16 AWG [0.5 – 1.25mm²]). Shield sheath terminal 12 requires twisted shielded or twisted-pair shielded wire (20-14 AWG [0.5 – 2.0mm²]).

Signal Leads:

- Multifunction Logic Inputs to Terminals 1 thru 8 and 11.
- Multifunction Analog Inputs to Terminals 12 thru 17, 33.
- Multifunction Analog Outputs to Terminals 21 thru 23.
- Multifunction Open-collector Outputs to Terminals 25 thru 27.

Control Leads:

- Multifunction Contacts to Terminals 9 and 10.
- Fault Contacts to Terminals 18, 19 and 20.

Power Leads:

- Single Phase Power 90-264 V to Terminals L and N.
- Three Phase Power 230V/460V to Terminals L1, L2 and L3.
- Motor (Output) to Terminals T1, T2 and T3.

Terminating Shielded Cable

Terminate woven metallic shielded cables at only one end, typically at the power supply end, as shown "[Figure 4. Shielded Termination](#)" on page 16. When using foil type shields, terminate the drain wire in a similar manner.

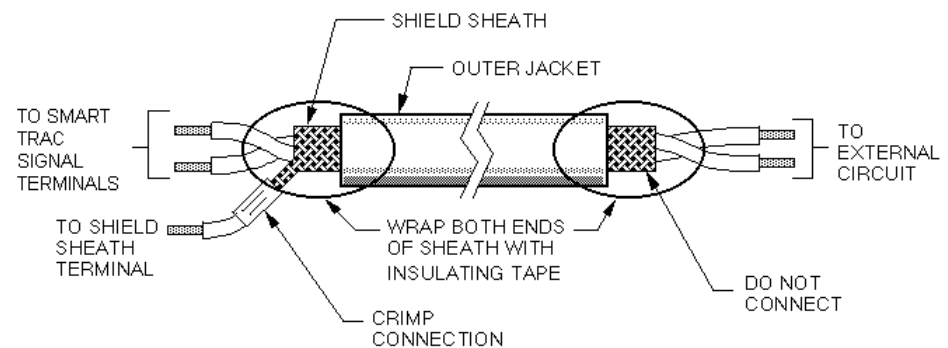


Figure 4. Shielded Termination

Connecting Optional Cards

The Optional Smart Trac PG (Pulse Generator) card, Arcnet card and other cards are described in separate, specific manuals. See the specific manual for appropriate connection information.

Pre-Power Checklist

- Verify wires are properly connected and no erroneous grounds exist.
- Ensure all debris is removed from the Smart Trac enclosure and there are no loose wire clippings.
- Verify cooling fans are free of debris and rotate freely.
- Verify all electrical and mechanical connections for the Smart Trac AC1 are present and tighten, as necessary
- Verify and test source power is correct for the drive installed.

Booting and Power-Up Self-Test

Immediately after power-up of the Smart Trac AC1, the validity of the operating system is checked. The Smart Trac AC1 BIOS (Basic Input Output System) performs a self-test to determine the integrity of RAM, flash memory, system timers and interrupts, among other checks. Any detected faults appear on the Smart Trac AC1 digital operator.

Next, the system loads any installed drivers. It checks the validity of the user program before starting its execution.

Once drivers are installed and the user program is validated, the system performs according to the user program, responding with diagnostics and error handling as necessary.

NOTE: If communication with the Smart Trac processor and its card stack is not established within 7 seconds of power up or within 2 seconds of no data transfers, it will shut down. The LEDs on the digital operator will flash, indicating this lack of communications.

The Boot Menu

CAUTION



Do not change the Boot Menu without understanding the implications of your actions or unless instructed to do so by a MagneTek engineer. The menu does not typically require any changes. Items which may be changed are: setting the system clock; TCP/IP address; or checking the firmware version. Failure to comply may result in damage to your Smart Trac AC1 or other equipment.

Several functions are available by pressing the **MENU** key within the first 2 seconds of the boot. [Figure 5. The Smart Trac AC1 Boot Process.](#) shows the boot menu and the functions available.

You may scroll through the menu selections using the Up and Down arrow keys on the Digital Operator. Pressing **ENTER** while at any one of the menu selections causes the submenu to display. Some submenus contain entries you may scroll through using the Up and Down arrow keys. You may change values of these entries using procedures for those submenus.

*To return to the previous menu level, press **ESC**.*

To stop the boot menu from displaying and resume starting the Operating System, press ESC until a first level menu appears. Scroll using the up and down arrow keys until the message appears "Start System?". Press ENTER and the Operating System should resume loading.

NOTE: The message "Starting OS" can be used as output at the J5 (serial) connector if desired. The message is sent after the initial 2 second timeout as indicated in the "Smart Trac AC1 Boot Process" flow chart.

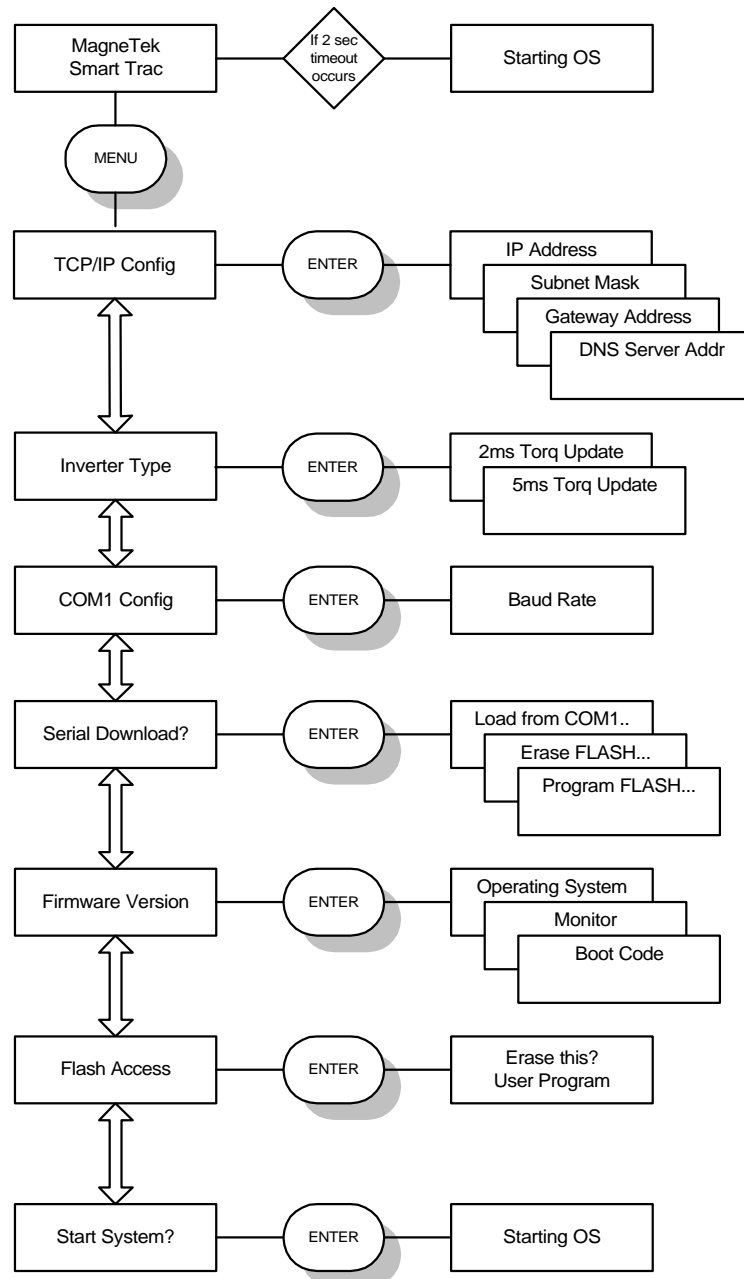


Figure 5. The Smart Trac AC1 Boot Process.

TCP/IP Address

Refer to "Addresses and subnet mask" for information on setting the TCP/IP address through the Boot Menu.

Inverter Type

This function changes the Torque Update parameter from 2 milliseconds to 5 milliseconds. Do not change this function without the approval of an application engineer.

COM1 Config

Using this function enables you to change the baud rate of the RS-232 communications port located on display panel. Normally, this port is only used to download operating system, monitor and boot programs. It should not normally be changed.

SMART TRAC AC1

Serial Download?

This function allows loading data through the RS-232 port, erasing flash ROM, or programming Flash ROM. Do not enter this function without the direction or approval of an application engineer.

Firmware Version

Use this function to check the Operating System, Monitor and Boot Code program versions stored in your Smart Trac AC1.

Flash Access

This function allows erasing of a user program. Do not enter this function without the direction or approval of an application engineer.

Start System?

You must always exit the boot menu through this function. Pressing **ENTER** starts the operating system for your Smart Trac AC1.

Setting the System Time

All events occurring in your Smart Trac AC1 are time-stamped with the system date and time.

To set the system clock:

1. Load Smart Trac Workstation.
2. Right click a node.
3. Click the **Set Date/Time** selection. The **Set Date/Time** dialog box appears indicating the system date and time.
4. Enter a new date in the format DD/MM/YY and time in the format hh:mm:ss AM/PM. The dialog box indicates the new date and time.
5. Click **OK** to continue.

Connecting the Vector Controlled Motor

Most MagneTek Vector Controlled Motors (VCMs) may be configured for either 380V/460V or 190V/230V operation. VMB motors may be configured for 190V or 230V, 380V or 460V. VMC motors may be configured for 230V or 460V. Your application will determine which configuration to use:

For best control of torque or speed linearity and response

To control torque or speed when 150% peak torque is required at a base speed of 90-100%, with 100% torque at 0 RPM, use a low voltage winding – 190V or 380 V motor tap selection mon VMB motor.

For control in speed mode or use with standard motor voltage ratings

Use a high voltage winding, 230V or 460V, when:

- replacing an existing 460V/230V NEMA design B motor with encoder feedback.
- for speed control when torque limit adjustment is required.
- in high starting torque situations.

Tune Your Smart Trac AC1

Your Smart Trac AC1 does not typically require tuning. Tuning of your Smart Trac AC1 should be done either by a qualified MagneTek Field Service Engineer or according to recommended procedures.

Power On and Preliminary Checks

1. Verify that the tachometer and motor are rotating properly before proceeding. Refer to the table "Flux Vector Control Tachometer and Motor Rotation Check."
2. Make sure that the motor is disconnected from the load. To assure safety, disconnect the coupling or belt which connects the motor with the machine so that motor operation is isolated before testing operations begin.
3. Power down the Smart Trac AC1. Do not proceed until the CHARGE light goes OFF.
4. Remove the Digital Operator from the Display Panel and carefully disconnect the ribbon cable or wiring harness (attached to the Digital Operator) from its normal location at connector J4 on the CPU card.
5. Disconnect power leads to the Smart Trac CPU at locations L and N.
6. Connect the Digital Operator to connector 1CN on the Smart Trac Inverter control card PCB.



WARNING

Make sure the motor is disconnected from the load before proceeding. Failure to comply may result in personal injury or death.

7. Power up the Smart Trac AC1.



WARNING



Any motor connected to the Smart Trac AC1 will move when auto-tuning is executed. Take proper precautions. Failure to comply may result in personal injury or death.



CAUTION

Motor should be disconnected from its load before executing the auto-tuning routine. Failure to comply may result in damage to the Smart Trac AC1 and/or other equipment.




NOTE: If the motor cannot be disconnected from the load, or if Auto-Tuning fails, motor parameters should be entered manually.

8. Enter the motor nameplate values needed to perform Auto-Tuning.
9. Press , then  three (3) times. The Smart Trac Main Menu - Auto-Tuning will appear.


**** Main Menu ****
Auto-Tuning

10. Press  twice. The message "Rated Voltage" appears.

Rated Voltage
400.0 VAC


11. Set the correct Nameplate voltage of the motor, using the  and  keys to scroll and the  key to move one decimal point to the right.

Rated Voltage
460.0 VAC


12. Press  to store the value in memory. The message "Entry Accepted" will appear briefly, followed by a return to the previous "Rated Voltage" message.

Entry Accepted

Rated Voltage
400.0 VAC

13. Enter the current and the rest of the parameters following a similar procedure to that of the motor nameplate voltage.
14. When all of the parameters are entered, execute Auto-Tuning:
15. Press the . The message "Tuning Ready?" will appear.

Tuning Ready?
Press RUN key

16. Press . The drive will first output current to the motor, then run the motor at a high speed. During tuning, the following message will appear.

Tune proceeding
XX Hz X.XX A

- If no problems are encountered., the following message will appear:

Tune Successful

- If a problem occurs during Auto-Tuning execution, the "Tune Aborted" message appears with a reason listed. See "Auto-Tuning Faults and Corrective Actions".

Tune Aborted
"Reason"



















17. If successful, record the settings for parameters E2-01 to E2-09. You use the **Programming Menu** (see "Checking Motor Parameters").
18. Remove power from the Smart Trac AC1. Wait until the **CHARGE** light goes out.













19. Disconnect the ribbon cable or wiring harness attached to the Digital Operator from connector PCB 1CN.
20. Connect the Digital Operator to its normal location on connector J4 on the Smart Trac CPU card.
21. Power up the drive.
22. Load parameters as follows:









Table 7. Motor Setup Parameters

Parameter	Description	Numeric Parameter Number	Displayed Description
E2-01	Motor rated current	48	RATED MOTOR AMPS
E2-02	Motor rated slip	47	MOTOR RATED SLIP
E2-03	Motor no-load current	49	MTR NO LOAD AMPS
E2-04	Number of motor poles	50	MOTOR POLES
E2-05	Motor line-to-line resistance	51	MTR TERM RES.
E2-06	Motor leakage inductance	52	MTR LEAKAGE IND.
E2-07	Motor iron core saturation coefficient 1	53	MTR SAT COEF 1
E2-08	Motor iron core saturation coefficient 2	54	MTR SAT COEF 2
E2-09	Motor mechanical loss	55	MTR MECH LOSS















Tachometer and Motor Rotation Check













Flux Vector Control Tachometer and Motor Rotation Check		
Description	Key Sequence	Digital Operator Display
Apply input power to the drive.		
Set the control method of the drive to Flux Vector (A1-02 to 3) or to other control method.	Press  , then 	** Main Menu ** Initialize
	Press  , then  twice	Control Method Open Loop Vector
	Press  , then set drive to Flux Vector using:  	A1-02= 3 Flux Vector
	Write values to memory by pressing 	Entry Accepted briefly, then Control Method Flux-Vector
Set parameter access level to Advanced. This allows all parameters to be viewed and modified.	Press  , then 	** Main Menu ** Initialize
	Press  , then 	Access Level Quick Start
	Press  , then set drive to Advanced using:  	A1-01= 4 Advanced Level
	Write value to memory by pressing: 	** Main Menu ** Initialize
Set PG Pulses/Rev to the correct value. (NOTE: For a MagneTek vector motor, the correct value is 1024.)	Press  , then  twice.	** Main Menu ** Programming


Flux Vector Control Tachometer and Motor Rotation Check		
Description	Key Sequence	Digital Operator Display
	Press  , then  4 times	Group F Options
	Press  3 times	PG Pulses/Rev 01024
	Set the correct PPR, using:   	** Main Menu ** Initialize
	Write value to memory by pressing: 	Entry Accepted briefly, then PG Pulses/Rev F1-01= 1024
Display motor speed	Press  , then  , then 	Function U1 Monitor
	Press  , then  4 times	Motor Speed U1-05= 0.00 Hz
<p>Rotate the motor shaft counter-clockwise by hand (as viewed from the load end of the motor).</p> <p>As the shaft is turned counter-clockwise, a low positive speed should be indicated</p> <p>As the shaft is turned clockwise, a low negative speed should be indicated.</p> <p>If the speed doesn't change when the motor shaft is rotated, check encoder wiring and connections. The pulses from the encoder can also be checked.</p> <p>If the polarity is wrong, switch channels on the input to the PG card.</p>		Motor Speed U1-05- 2.38 Hz Motor Speed U1-05=- 1.47 Hz

Flux Vector Control Tachometer and Motor Rotation Check		
Description	Key Sequence	Digital Operator Display
<p>Check the motor rotation using the JOG function.</p> <p>NOTE: The frequency reference from this operation comes from D1-09 and is factory set to 6 Hz.</p>	<p>Press , then </p>	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Frequency Ref U1-01=0.00 Hz </div>
	<p>If either or both of the SEQ and REF lights are ON,</p> <p>press </p>	
	<p> WARNING The next key-press will cause the motor to move: take appropriate precautions.</p>	
<p>The motor should ramp up to speed, and rotation should be counter-clockwise if the FWD light is ON. Rotation should be clockwise if the REV light is ON. If the motor does not accelerate smoothly or oscillates, reverse any two motor leads, then repeat the motor rotation check.</p>	<p>Press and hold </p>	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Frequency Ref U1-01- 6.00 Hz </div> <p>RUN light will illuminate</p>
	<p>Release </p>	
<p>Run the Auto-Tuning routine:</p>	<p> WARNING</p> <p>The motor will move when auto-tuning is executed! Take proper precautions!</p> <p> CAUTION</p> <p>The motor should be disconnected from the load before executing auto-tuning.</p>	
<p>NOTE: If the motor cannot be disconnected from the load, or if Auto-Tuning fails, motor parameters should be entered manually. (See manual procedures in this chapter).</p> <p>Go to step 8 of the Auto-Tuning procedure (above).</p>		

Recording Settings Using the Programming Menu

Recording Settings Using the Programming Menu		
Description	Key Sequence	Digital Operator Display
Get to ** Main Menu ** Programming	Press  , then  twice	** Main Menu ** Initialize
	Press  , then  3 times	Group E Motor
Enter the motor rated full load amps (E2-01). This value can be obtained from the motor nameplate (motor full load amps).	Press  twice	Motor Rated FLA 001.00 A
	Set Full Load Amps (FLA) using:   	Motor Rated FLA 001.20 A
	Write value to memory by pressing 	Entry Accepted briefly, then Motor Rated FLA E2-01= 1.20 A
Enter the motor rated slip (E2-02). This value can be calculated using the following formula: E2-02= $((N_s - N_r) / N_s) * 60 * .7$ N _r =nameplate rated speed N _s =synchronous speed $N_s = f_r * 120 / \# \text{ of motor poles}$	Press  , then 	Motor Rated Slip 02.90 Hz
	Set motor rated slip using:   	Motor Rated Slip 1.08 Hz

Recording Settings Using the Programming Menu		
Description	Key Sequence	Digital Operator Display
	Write value to memory by pressing 	Entry Accepted briefly, then Motor Rated Slip E2-02= 1.08 Hz
Enter the motor no-load current (E2-03). This value can sometimes be obtained from the motor nameplate. If it is unavailable, use the following formula to calculate it: 1-5 HP: $I_{NLA}=I_{FLA} * .50$ 5-15 HP: $I_{NLA}=I_{FLA} * .40$ >15 HP: $I_{NLA}=I_{FLA} * .30$	Press  , then 	No-Load Current 000.60 A
	Set motor no load current using: :   	No-Load Current 000.32 A
	Write value to memory by pressing 	Entry Accepted briefly, then No-Load Current E2-03= 0.32 A
Enter number of motor poles (E2-04). (Assuming an f_R of 50 or 60 Hz) <u>Motor RPM # Poles</u> 2400-3600 2 1300-1800 4 900-1200 6 660-900 8 NOTE: This step is not required for Open Loop Vector Control method (A1-02=0).	Press  , then 	Entry Accepted briefly, then Number of Poles 04
	Set number of motor poles using: :   	Number of Poles 04

Recording Settings Using the Programming Menu		
Description	Key Sequence	Digital Operator Display
	Write value to memory by pressing 	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 5px;">Entry Accepted</div> briefly, then <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-top: 5px;">Number of Poles E2-04= 4</div>
Parameters E2-05 to E2-09: (see table)		

Auto-Tuning Faults and Corrective Actions

Auto-Tuning Faults and Corrective Actions		
Digital Operator Display	Description	Corrective Action
Tune aborted-Data Invalid	Motor data is not correct.	Check the motor data entered. Check the drive and motor capacities.
Tune aborted-Resistance	Line-to-line resistance not within tolerance.	Check the motor data entered. Check the motor wiring.
Tune aborted-No-Load Current	No-load current (magnetizing current) not within tolerance.	
Tune aborted-Sat Coef 1	Iron core saturation coefficient 1 not within tolerance.	
Tune aborted-Sat Coef 2	Iron core saturation coefficient 2 not within tolerance.	
Tune aborted-Rated slip	Rated slip not within tolerance.	Increase acceleration time (parameter C1-01). Increase torque limit values (parameter L7_01, -02) if they are reduced from factory settings.
Tune aborted-Accelerate	Motor did not accelerate in the specified time.	
Tune aborted-PG Direction	Encoder phasing opposite that of motor phasing.	Swap two motor leads. OR Swap channels on the input to the PG card

Auto-Tuning Faults and Corrective Actions		
Digital Operator Display	Description	Corrective Action
Tune aborted-Motor Speed	Torque reference exceeded 100% during auto-tuning.	Uncouple motor from load. Increase acceleration time (C1-01). Check input data, especially the encoder PPR (parameter F1-01).
Tune aborted-Over Load (Displayed after completion of tuning)	Torque reference exceeded 20% during auto-tuning	Uncouple motor from load. Increase acceleration time (C1-01) Check input data, especially the encoder PPR (F1-01).
Tune aborted-Minor Fault: XXX	A minor drive fault occurred.	Check for specific minor Power Conversion Unit fault indicated by "XXX." (See "Smart Trac Fault Codes Technical Manual.")
Tune aborted-PG Circuit	PG cable wires are disconnected.	Pulse generator is disconnected from the PG card. Check PG wiring.

Networking the Smart Trac AC1

Types of Networks for Your Smart Trac AC1

Several methods exist to network your Smart Trac AC1: Arcnet, Ethernet, Profibus, DeviceNet, and others. The methods you choose depend on whether you will have a "self-contained " network or you will interface to an enterprise-wide LAN. Below are a few guidelines to help you choose which method or combination is right for your application. More than one type of network card may be stacked in the Smart Trac AC1.

PC-based Operation

A typical use of Ethernet involves the addition of an Ethernet card in the stack to provide a fast, reliable, PC-based interface to the Smart Trac AC1. As an alternative to a serial RS-232 connection, an Ethernet card may be used for high speed monitoring, program uploading and downloading, and running diagnostics. A TCP/IP address is assigned to the ethernet card, as is true of all ethernet cards running the TCP/IP protocol. However, any valid and unique TCP/IP address may be assigned, if the device will not interface to a corporate network.

Self-Contained, Control Networks

Most industrial drive networks are self-contained, communicating with each other to control sections of a specific machine. They do not necessarily interface with the Internet or a corporate local area network (LAN). ARCNET, Profibus, DeviceNet, Modbus and Ethernet may be used in self-contained networks. Ethernet would provide for PC-based operation of Smart Trac AC1s attached to the network.

ARCNET

Arcnet, or Attached Resource Computer Network, was developed by Datapoint Corporation. A relatively simple, inexpensive and reliable LAN, it uses token passing in a star or bus topology to transmit data at up to 2.5 Mbps. Many PLCs are networked using this networking method. Choose Arcnet if your application requires multiple Smart Trac AC1s to be coordinated.

RG-62 coaxial cable should be used to connect devices in an Arcnet network. Up to 255 nodes may be configured using UTP or coaxial cable and hubs.

- The IRQ, I/O port address and node ID of each arcnet node must be set manually. Because of the way Arcnet initializes stations when the LAN is first activated, it is important to locate devices with sequential physical addresses located close to one another.

- Maximum segment lengths are: with a star network and coaxial cable - 2,000 feet; with a bus network and coaxial cable – 1,000 feet; with UTP cable – 400 feet; with fiber-optic cable – 11,500 feet.

Each end of the network cable must be terminated with a 93 ohm plug, available from MagneTek (see "Replaceable Parts List"). For further details about Arcnet, reference *ARCNET Local Area Network Standard, ATA/ANSI 878.1*, ARCNET Trade Association, 1992.

Profibus - DP

Profibus – DP (Decentralized Periphery) provides open, standard, inter-operable and fully transparent networking between field devices (i.e. Smart Trac AC1s) and the controlling computers, PLCs and/or DCSs. It supports network speeds of 9600 bps to 12 Mbps over shielded, twisted 2-wire line. Data may be transferred in 1 byte to 244 byte messages at distances up to 1200 meters. It permits a maximum of 125 nodes.

DeviceNet

DeviceNet is a simple, economical, networking solution to connect industrial devices (i.e. limit switches, smart motor controllers, operator interfaces, and variable frequency drives). Programmable controllers and computers may also be networked using DeviceNet.

It supports network speeds of 125Kpbs, 250 Kbps and 500 Kbps. DeviceNet cabling consists of a 5-wire cable containing a twisted pair for data communications, a second twisted pair for network 24 VDC power, and a shield. It permits a maximum of 64 nodes. Speed is slow, but throughput is high.

Modbus

Modbus is an industrial communications network that operates via RS-232, RS-485 or RS-722 that utilizes the PLC or PC as Master and a Smart Trac AC1 as Slave. It is an open network and often uses serial port communications at speeds of 9600 bps to 19,200 bps. Using RS-232, it serves as a point to point (2-device) network. Using RS-485, it permits a maximum of 31 Smart Trac AC1 nodes.

Using Ethernet for PC-based Operation

The most common use of ethernet cards with Smart Trac AC1 will be to permit a faster, PC-based connection for monitoring the drive, program uploading to the drive, downloading from the drive, and running diagnostics.

Ethernet generally transmits data at 10 Mbps to 100 Mbps. It was developed by Intel, Digital (now Compaq), and Xerox as an "open" network standard, meaning it can network computers using several operating system platforms. Most types of Ethernet cards, compliant with the PC/104 footprint and Ethernet standard 802.3, may be installed in your Smart Trac AC1 to provide the interface for PC-based operation. Check with your MagneTek representative for a list of Ethernet cards supported by MagneTek. Each Smart Trac is supplied with one Ethernet card.

To set up an ethernet network, you will need the following:

- a laptop and/or desktop computer on which to run Smart Trac Workstation.
- ethernet cabling to connect the various devices on the network.
- one or more Smart Trac AC1s.
- a hub, if connecting more than two devices on the network.

A typical PC-based network for operation of Smart Trac AC1s is depicted in Figure 6.

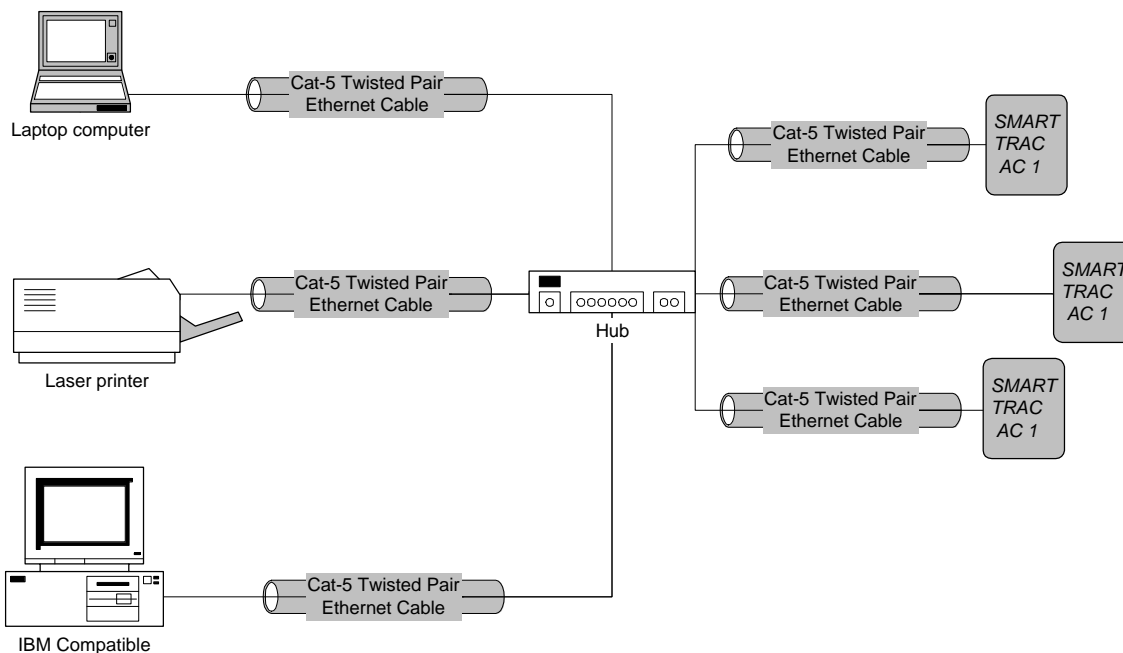


Figure 6. A typical local area network used for PC-based operation of Smart Trac AC1s.

Ethernet Hub

An ethernet hub is required if connecting more than two devices (more than one Smart Trac AC1 and one computer). If only connecting a single Smart Trac with a single computer, you need only a special "crossover" or "uplink" Ethernet cable. (Contact your MagneTek representative for cable information).

Ethernet cabling

Two Ethernet cabling standards are commonly used with Smart Trac AC1 systems, each intended for different purposes:

- 10Base-T (Twisted-pair Ethernet) – The most widely used ethernet cabling, it supports network speeds of 100Mbps. Uses 22- or 26-AWG UTP cabling to transmit baseband signals on maximum 100-meter segments. RJ-45 jacks connect separate cables between device and hub. Each device must be at least 2 feet apart and no more than 328 feet from the hub. Bridges or routers may be used to accommodate a larger network. There is no limit on network length. It permits a maximum of 1,024 segments and 1,024 nodes. See IEEE standard 802.3i.
- 10Base-2 (Thin Ethernet) – Supports network speeds of 10Mbps. Uses RG-58 coaxial cable with "T"-shaped connectors to transmit baseband signals on 200-meter segments. Total network length can be 925 meters. One end of each linear bus cable must be terminated using a 50 ohm resistor. Transceivers reside on the NIC at each connection of the trunk cable to a device, simplifying connections. The cable, thinner than 10Base-5, is more flexible for easier handling. See IEEE standard 802.3a.

Ethernet Network Architecture

Linear Bus using 10Base-T

BNC, or "T"-shaped connectors are used to connect network devices to a coaxial trunk cable in a linear bus topology. The bus is tied to ground, often at a wall plate. The other end of the trunk cable (bus) must be terminated with a 50-ohm resistor. Without termination, broadcast signals bounce back across the network, causing contention. This, combined with the fact that each device on a linear bus must wait its turn to broadcast information across the network, results in decreased performance compared with a star topology, for example. Also, a linear bus network is more difficult to troubleshoot because all devices are on a single trunk cable.

A linear bus network is easy to install. All devices on the network connect to a trunk cable. It does not require the use of equipment to amplify or regenerate the signal, but can use devices to amplify the signal. They are generally inexpensive and can be expanded easily.

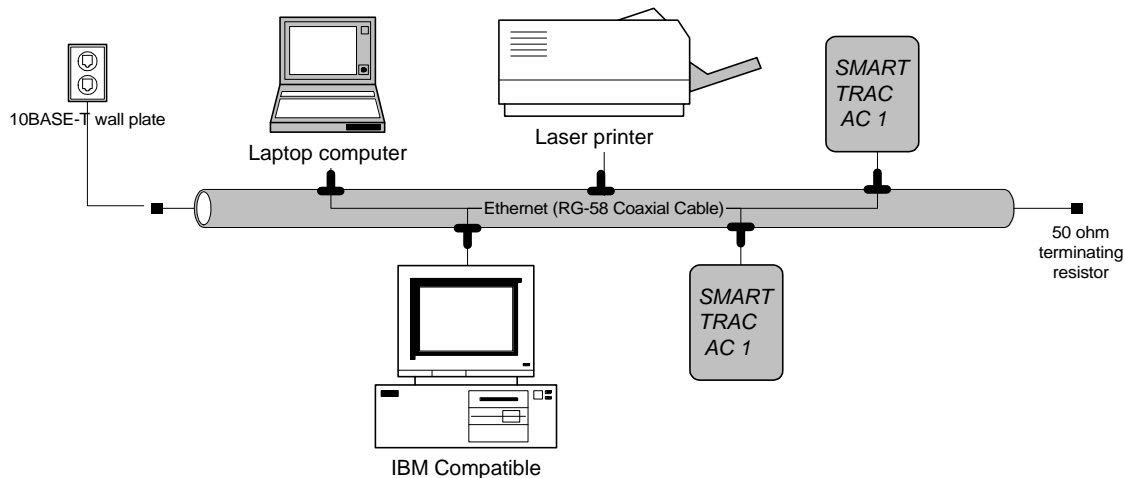


Figure 7. A Linear Bus topology using 10Base-T

Star network using 10Base-2 or 10Base-T

A star network topology connects two or more device clusters, or *stars*, together using hubs. Either 10Base-2 or 10Base-T may be used in a star topology. A separate cable connects each device to a "hub." A hub can be *active* (connects to an external power source, amplifies the signal, and extends the length of the network) or *passive* (requires no external power source).

A star network allows one part of the network to be down without experiencing total system downtime. If a cable fails in a star configuration, it usually affects only one device or those in one star. If a hub fails, it takes down the devices in a star but not usually the entire network.

It is easier to troubleshoot a star network than a linear bus network. A problem can be quickly isolated to a device in one star, then a particular address or cable within that star. While it can be more expensive to implement because more cable may be needed, a star network is easily expanded.

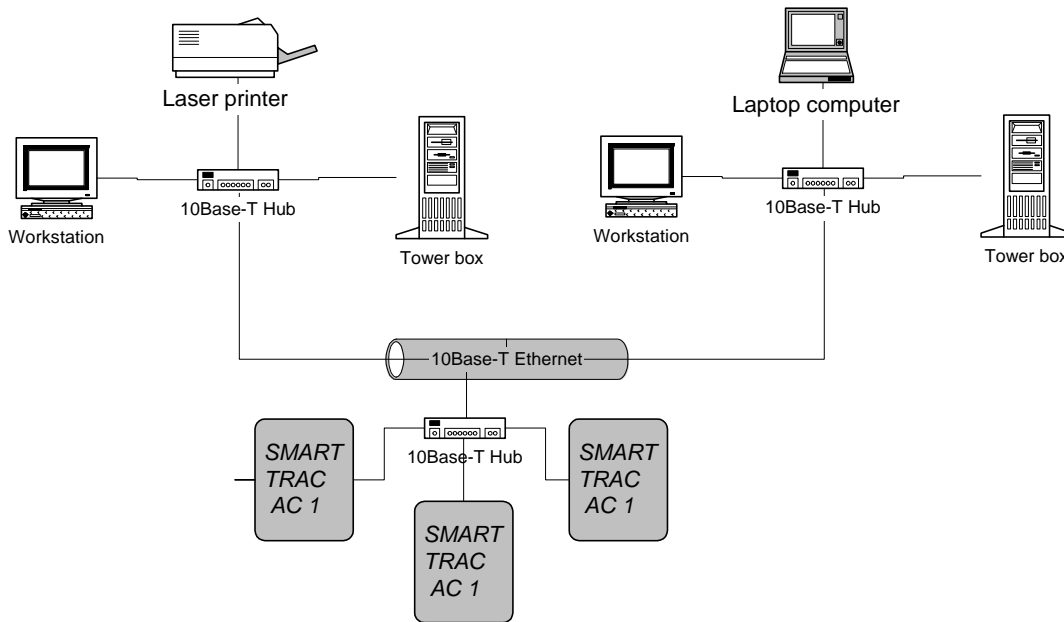


Figure 8. A Star topology using 10Base-T.

Ethernet Network Configuration

Depending on whether you are networking for PC-based operation on a small LAN or an enterprise-wide LAN, you may need the assistance of your LAN Administrator to specify unique TCP/IP address, a subnet mask, and gateway addresses.

Addresses and subnet mask

All ethernet cards require a unique TCP/IP address. Every device (Smart Trac AC1, printer, computer, etc) connected to a TCP/IP network requires at least one IP address, unique within that network. This is true whether the device is part of a control network or not.

A TCP/IP address (i.e. "207.21.32.12") identifies the unique network ID and host ID of a computer or host using 32-bit numbers. Each component number of the TCP/IP address, separated by a decimal point, is referred to as an "octet". This is because it can be represented by an eight-digit binary number.

For discussion of subnet masks and gateway addresses, see "Configuration for an enterprise-wide LAN". However, you may not need to concern yourself with exactly what they are, viewing them only as values to be entered during configuration.

For typical applications, you may determine the subnet mask and gateway address as follows:

1. Select **Start, Settings, Control Panel**. The Control Panel dialog box appears, displaying the control icons.
2. Click the **Network** icon. The Network dialog box appears.
3. Click the **Protocols** tab.
4. In **Network** Protocols, select **TCP/IP Protocol**.
5. Click **Properties**, then read and record the subnet mask and gateway address of your computer. These same values will be entered into your

Smart Trac AC1s, the desktop PC running Smart Trac Workstation software and any other devices on your LAN.

NOTE: For most applications, you may set the subnet mask and gateway address as described. **The information in the balance of this chapter supplies details needed only in unusual situations.**

Configuration for PC-Based Operation

You configure each Smart Trac TCP/IP address on your network using the digital operator. You configure the TCP/IP address, on a PC running Smart Trac Workstation, in Windows NT.

Entering addresses and subnet mask

To enter the TCP/IP address, Subnet Mask, and Gateway Address into the Digital Operator:

1. Press **MENU** on the digital operator within 2 seconds of bootup. The message "TCP/IP Config" screen should appear.
2. Press **DATA/ENTER**. You are prompted with the message "IP Address" and below it 0.0.0.0. or another IP address.
3. Press **DATA/ENTER**. The first digit of the first octet will flash, indicating it is ready to accept new data. Enter the values of each octet, in succession, pressing the right arrow key (**>RESET**) to move one octet to the right if all three digits of an octet are not required entries.
4. Once all octets are entered, press **DATA/ENTER** to accept the new IP Address.
5. Press the **UP** arrow key to the message "Subnet Mask". Enter it as you did the IP Address in step 3.
6. In a similar manner, enter the desired Gateway Address and DNS Server Address, should they be required.

NOTE: For most networks, the default of no gateway address and no DNS Server address should be accepted.

7. Press **MENU** when completed.

Configuration for an enterprise-wide LAN

Smart Trac AC1s may be connected, in certain situations, to an enterprise-wide LAN. In such cases, your LAN Administrator will need to be involved to supply certain required addresses.

While you may be able to determine the TCP/IP address as described in "Using Ethernet for PC-based Operation", you may require the more detailed information below:

Obtaining TCP/IP addresses

The easiest way to obtain a TCP/IP address for your Smart Trac AC1 host or computer is to request one from your LAN Administrator. This is especially true if the device will be on an enterprise-wide LAN.

NOTE: If your internal network is to be used on a self-contained network and **not** connecting directly to the public internet or a larger enterprise-wide LAN, you may use any valid TCP/IP address except for certain reserved addresses (0.0.0.0, 127.0.0.1, 224.0.0.0 and 255.255.255.255). Most industrial devices fall into this category.

If on a private network (intranet) you may use any valid Class A, B, or C address, described below. Most other LANs fall into one of these address classes and are assigned by the corporation's LAN Administrator.

Any device that connects directly to the internet (not through a "proxy" server) must be assigned a network ID from the Internet Network Information Center (InterNIC at www.internic.com). Smart Trac AC1s do not fall into this category.

TCP/IP Address Classes

TCP/IP addresses are grouped into five classes, from Class A through Class E. The first octet of the IP address specifies its classification.

- Class A – First octet is between 1 and 126 (0 is not allowed, 127 is reserved as "loopback" address). Organizations with a very large number of hosts (networked devices) require a Class A address.
- Class B – First octet is between 128 and 191. Large organizations with as many as 65, 534 networked devices (workstations, printers, routers, etc) require at least a Class B address.
- Class C – First octet is between 192 and 223. A network with less than 255 networked devices may be assigned a Class C address.
- Class D – First octet is between 224 and 239. These addresses are for multicast groups, such as RealAudio and Microsoft NetShow.
- Class E – First octet is between 240 and 247. These addresses are reserved for experimental purposes.

TCP/IP Subnet Masks

A *Subnet Mask* defines the split between network and host (device) parts of the TCP/IP address. It identifies the network octets of the IP address with the number "255" or "252" and the host octets with the number "0". This defines the maximum number of different devices (hosts) allowed on the network. A subnet mask of 255.255.255.0, then, identifies the first three octets of the IP address as network parts and the last as a single host part. The use of "252" provides one or more bits of additional resolution for hosts.

Example: The address 200.20.16.5 with a subnet mask of 255.255.0.0 identifies a network with $(255*255)-2$ hosts, or 65,534 hosts (two is subtracted to allow for reserved numbers) on the network identified as "200.20".

Fortunately, Microsoft's Windows NT assigns a default subnet mask to an IP address. It can be changed if necessary. The defaults result in the following maximum number of networks and hosts allowed per TCP/IP address:

- Class A – 126 networks, 16,777,214 hosts (default subnet mask=255.0.0.0).
- Class B – 16,384 networks, 65,534 hosts (default subnet mask=255.255.0.0)
- Class C – 2,097,152 networks, 254 hosts (default subnet mask=255.255.255.0)

The Gateway Address

The Gateway Address provides the IP address to which packets of data should be sent to route them to their final destination, if on a large enterprise-wide LAN or the internet. While the Smart Trac AC1 allows you to change the gateway address to any required, *the default of no address will work in nearly all situations*. In enterprise-wide LANs the default may not be acceptable. Contact your LAN Administrator to determine the proper gateway address.

The DNS Server Address

The DNS Server is unavailable for changes. This accepts the default of no address. Selecting DNS Server will cause a "Not Available" message to be displayed on the digital operator.

Verifying Your TCP/IP Configuration

You can verify your TCP/IP configuration with two simple DOS commands: IPCONFIG and PING:

1. Click **START, PROGRAMS, COMMAND PROMPT**. A DOS window appears with the cursor at the default directory.

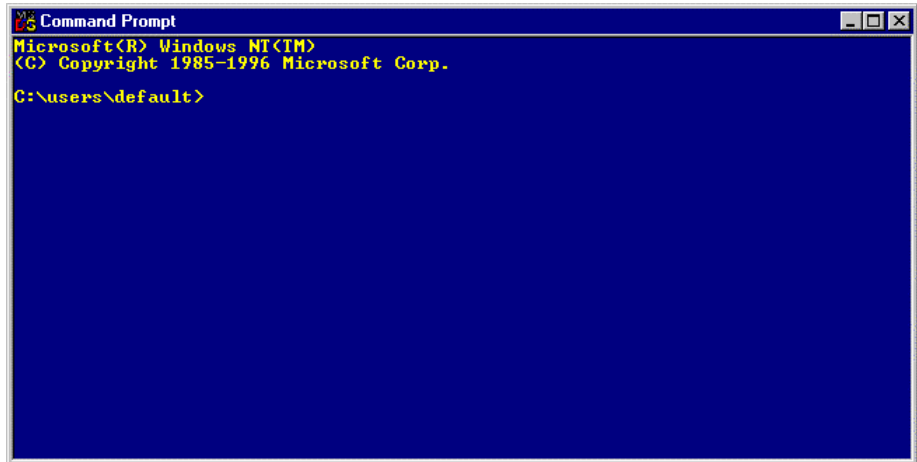


Figure 9. The Command Prompt from Windows NT

2. Type **IPCONFIG**. A listing should appear of the IP Address, subnet mask, and default gateway for all network adapters to which TCP/IP is bound on your computer.

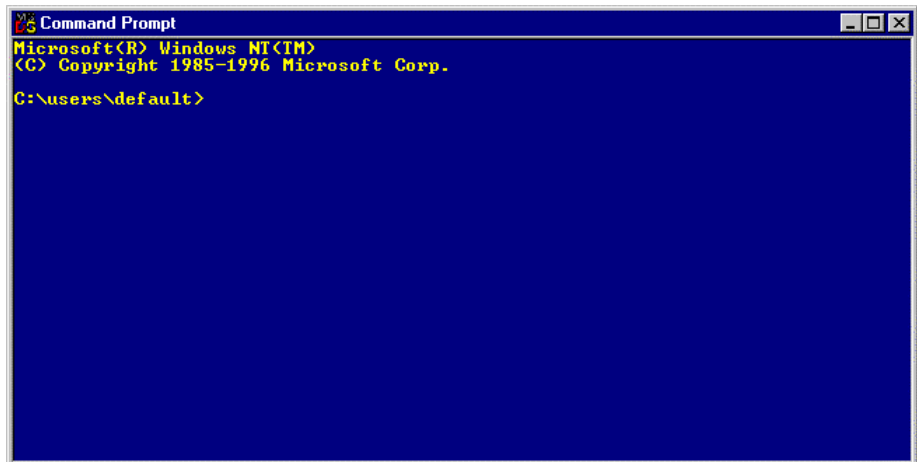
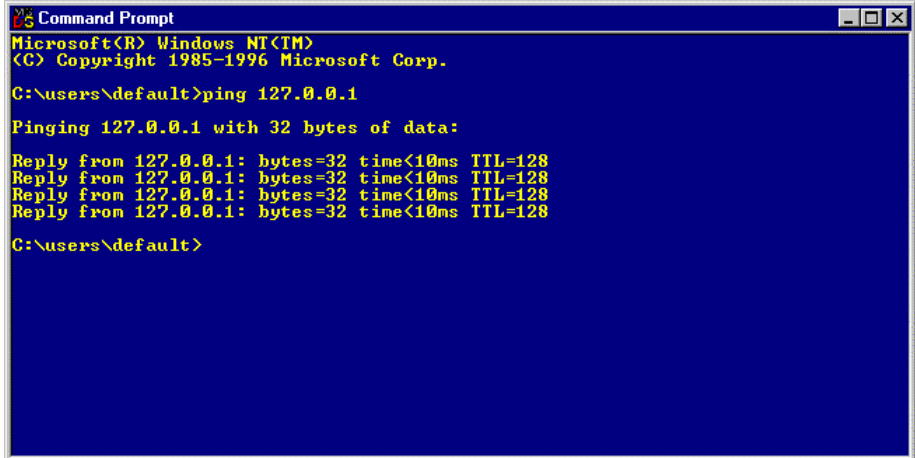


Figure 10. IPCONFIG results

3. Type **PING 127.0.0.1**. The PING utility, included in Windows NT, tests for proper TCP/IP configuration on your system with the special "loopback" address. You should get the results shown in the following screen. If not, the TCP/IP configuration is not correct and must be fixed before proceeding.



```
Command Prompt
Microsoft(R) Windows NT(TM)
(C) Copyright 1985-1996 Microsoft Corp.

C:\users\default>ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:

Reply from 127.0.0.1: bytes=32 time<10ms TTL=128
Reply from 127.0.0.1: bytes=32 time<10ms TTL=128
Reply from 127.0.0.1: bytes=32 time<10ms TTL=128
Reply from 127.0.0.1: bytes=32 time<10ms TTL=128

C:\users\default>
```

Figure 11. A successful PING of the computer you are using

4. Type **PING [Your IP Address]**. For example, type "PING 200.20.16.5" (substitute your computer's IP Address). Results similar to those in step 2 confirms that the IP address on your computer is configured correctly. You will also find out if duplicate addresses exist on your network.
5. Type **PING [Address of another networked computer]**. You should get results similar to those in step 2. This confirms the IP address of the chosen computer. You may test all other networked computers in the same way.
6. Type **PING [Address of the default network gateway]**. This step is necessary only if your system uses a gateway, to confirm your connection to the gateway.
7. Type **PING [Address of computer on other side of gateway]**. This step confirms that you can connect to remote computing resources. Again, it is only needed if your system uses a gateway and you need to access remote systems.

Troubleshooting Your Smart Trac AC1

This Chapter will enable you to:

- Understand the types of fault histories available with your Smart Trac AC1.
- Clear and Reset Faults.
- Troubleshoot motor symptoms and fault conditions.

Reporting of Faults and Errors

Fault Histories

Faults result from a failure of system hardware or firmware, or from a program failure. You may obtain fault information by reviewing information on the digital operator. See the publication "Smart Trac Digital Operator" for more information. The Smart Trac AC1 maintains two *fault histories*: Oldest Faults and Newest Faults. Each history lists up to twenty faults.

When a fault is detected by the Smart Trac AC1, it is considered *active* and is displayed on the Smart Trac AC1 digital operator.

Resetting Faults

You reset a fault by pushing the **>RESET** key on the digital operator while a fault is displayed on the digital operator. Once reset, another fault may appear on the digital operator and the process may be repeated.

A fault is considered *active* until it is reset. A queue of active faults is maintained by the Smart Trac AC1. The condition causing the fault must be determined and resolved. If all faults have been resolved and reset, and until a new fault is detected, the display will read "No Active Faults."

Clearing Faults

The digital operator displays the most recent fault detected by the Smart Trac AC1. If you are using the digital operator when a *priority fault* occurs, you may *clear* it. Clearing a fault means to acknowledge it and remove it from the display. It remains in the *active* fault list.

To clear a fault, simply press any key on the digital operator. The fault message is removed from the display and you are returned to your original position in the digital operator menu.

Troubleshooting Motor Symptoms

Each Smart Trac AC1 is programmed for your specific application. Because all faults are programmable, an Application Engineer has selected and programmed certain faults to be displayed as they occur. Some (Standard) faults are displayed by most typical systems. Reference tables in the appendices which list all faults by type of fault.

Should your AC1 malfunction, diagnose the problem using the general information in this chapter. Pay special attention to the following safety precautions:



WARNING

Always disconnect, lock out and tag "out of service" incoming single-phase or three-phase power before test equipment is connected or removed. Failure to comply with this warning may result in personal injury or death.



WARNING

Oscilloscope chassis may be at voltages potentially hazardous to life if not properly grounded. Use only a dual channel, electrically isolated oscilloscope (i.e., Tektronix 222P, THS 700) in the differential mode, with X100 probes, to measure high voltage waveforms. **Always connect oscilloscope chassis to earth ground.** Failure to comply with this warning may result in personal injury or death.



WARNING

High Voltages may be present when equipment is open and energized. Do not work alone. Failure to comply with this warning may result in personal injury or death.



CAUTION

Never disconnect or connect the wiring while the power is applied. Failure to comply with this warning may result in damage to equipment..

If the drive/motor will not operate

1. Check the red **CHARGE** light. When illuminated, it indicates that the DC bus is running. If not lit, check the circuit breaker and input power circuitry.
2. Check for rated incoming power to the drive (110 VAC, 240 VAC, 480 VAC or 600 VAC, depending on unit) across terminals L1(R), L2(S), L3(T). If not at rated voltage, check the circuit breaker and input power circuitry.
3. Check for loose wiring or connections.

4. Check power supply fuse (see "Replacing the Power Supply Fuse" in the "Smart Trac AC1 Maintenance" chapter).
5. Reference the Fault Listing (addendum) supplied with your Smart Trac AC1. Determine the meaning of any message displayed on the digital operator.
6. Contact your MagneTek representative or MagneTek Technical Support for further troubleshooting procedures or assistance with your Smart Trac AC1.

Troubleshooting For Fault Conditions

General troubleshooting information below applies to the conditions which typically result in a fault indication on the digital operator. Because faults are specific to each application, some or all of the faults may apply to your Smart Trac AC1. Reference the Fault tables in the **Appendices**.

Table 8. Troubleshooting Faults

Troubleshooting Fault Conditions		
Symptom	Probable Cause	Corrective Action
Overvoltage	AC supply voltage not set correctly.	Check input AC supply voltage. If not correct, decrease to proper voltage range.
Overvoltage condition occurs only during deceleration	Deceleration time set too low.	Deceleration parameters must be changed. Contact your MagneTek Engineer with this information.
Overvoltage occurs at times other than deceleration	Electrical noise.	Check for a source of electrical noise and remove the source as required. This might be eliminated or greatly reduced by use of a surge suppressor connected to relay and magnetic contactor coils, or through the addition of a line filter to remove noise on the input power line.
	Control signals to gate drive PCB are faulty.	Replace Control card.
Blown Fuse	Power supply fuse blown.	Check power supply fuse. (See "Replacing the Power Supply Fuse").
Overcurrent, but output current does not exceed 200% of rated output.	Machine jammed.	If overcurrent trip does not result from power being turned on, determine whether a machine is jammed. Clear the jam.

Troubleshooting Fault Conditions		
Symptom	Probable Cause	Corrective Action
	Motor failure.	Replace the motor.
	Improper load impedance.	Disconnect wiring from output terminals T1, T2, and T3. Check load impedance.
Overcurrent when power turned on.	Failed or bad power transistors.	Check power transistors and replace, as required. If the problem persists, contact your MagneTek representative with this information.
	Electrical noise.	Remove noise source by connecting a surge suppressor to relay and magnetic contactor coils and/or provide a line filter to remove noise on input power line.
	Faulty control card or gate drive PCB.	Replace faulty card.
Overload or overheated motor.	Load too large.	Decrease the load if necessary.
		If the problem persists or the load is within capacity, contact your MagneTek Engineer.
Undervoltage	Improper AC supply voltage.	Check input AC supply. Increase voltage to within the correct range, if necessary. Check wiring between main AC contactor and Smart Trac AC1. Correct as required for proper operation.
Heatsink Overtemp	Ambient temperature too high	Check ambient temperature. If 45 degrees Centigrade (113 degrees Fahrenheit) or greater, reduce ambient temperature.
	Dirty heat sink, reducing its effectiveness.	Inspect heat sink. If not clean, clean it.
	Fan not operating.	Check cooling fan. if included on your Smart Trac AC1. If not running, replace it.
	Erroneous fault indication due to noise.	Remove noise source by connecting a surge suppressor to relay and magnetic contactor coils, or providing a line filter to remove noise on the input power line.

Troubleshooting Fault Conditions		
Symptom	Probable Cause	Corrective Action
Control Function Error	False indication of error.	Turn off power. After red CHARGE light on the Smart Trac Control card goes out, turn power back on. If the error is no longer indicated, you may return your Smart Trac AC1 to normal operation,
External Fault	External fault signal present.	Check whether an external fault signal is present. This is normally a closed circuit between terminal 3 and 11 or an open circuit between terminal 11 and whichever terminal (4-8) is programmed for an external fault input.
	External fault in external circuit.	If the fault has, in fact, occurred in circuits outside the Smart Trac AC1, troubleshoot and correct.
Digital Operator not displaying any information	No input power at L1, L2 or L3.	Check input power at L1, L2, and L3. Troubleshoot as required.
	DC bus power supply malfunctioning	If input power is acceptable and within proper limits, check that the red CHARGE lamp is lit.
	DC bus power not charging.	Check DC bus power supply.

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Smart Trac AC1 Maintenance

This Chapter will enable you to:

- Do periodic maintenance to prevent Smart Trac AC1 problems.*
- Replace parts as needed to correct problems.*
- Order spare or replacement parts from MagneTek.*
- Repackage parts for return to MagneTek under Warranty.*

Preventive Maintenance



WARNING

Disconnect, lock out and tag "out of service" all incoming single-phase or three-phase line and control power. Do not touch circuit components until main circuit power has been turned OFF. Never perform preventive maintenance of the Smart Trac AC1 unless incoming three-phase and control power are disconnected and locked out. Hazardous voltages may exist in the Smart Trac AC1 circuits even with Smart Trac AC1 circuit breaker in OFF position. Failure to comply may result in personal injury or death.



WARNING - ESD

The Smart Trac AC1 electronics are electrostatic sensitive devices. Follow Electrostatic Discharge (ESD) procedures when handling to protect components. Failure to follow ESD procedures may result in damage to the Smart Trac AC1 or its components. Failure to comply may result in personal injury or death.

To properly maintain your Smart Trac AC1, you must ensure sufficient airflow around the Smart Trac AC1 to cool it and keep electrical connections tight.

At least *once every three months*:

1. Ground an ESD wrist strap to the Smart Trac AC1 housing and secure the other end to your wrist. Touch the Smart Trac AC1 housing to dissipate any static electricity.
2. Check and clean the Smart Trac AC1 within the housing. Remove any accumulated dust and dirt. If in a harsh environment with more dust and dirt, clean the Smart Trac AC1 more often.
3. Check that all mounting and electrical connections are tight. Tighten any loose connections and check for corrosion and frayed wires.

Corrective Maintenance


Replacing Parts

Tools Required

Removing and Replacing Smart Trac Cards (containing printed circuit boards)


Described below is a basic procedure applicable to removal of all base and option cards from the housing.

To properly separate cards without breaking connecting pins, you need a *4.5mm hex head driver, needle-nosed pliers, phillips screwdriver, a slotted screwdriver, and a PC/104 card extraction tool.*



WARNING

Disconnect, lock out and tag "out of service" all incoming single-phase or three-phase line and control power. Do not touch circuit components until main circuit power has been turned OFF. Never perform preventive maintenance of the Smart Trac AC1 unless incoming three-phase and control power are disconnected and locked out. Hazardous voltages may exist in the Smart Trac AC1 circuits even with Smart Trac AC1 circuit breaker in OFF position. Failure to comply may result in personal injury or death..



WARNING - ESD

The Smart Trac AC1 electronics are electrostatic sensitive devices. Follow Electrostatic Discharge (ESD) procedures when handling to protect components. Failure to follow ESD procedures may result in damage to the Smart Trac AC1 or its components. Failure to comply may result in personal injury or death.

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 a phillips screwdriver, remove the ground strap from the left inside and the ground strap from the top inside of the Smart Trac AC1 adapter ring.

Model numbers beginning with STACS-A080 and above, STACS-B041 and above, STACS-C027 and above or STACW- models with the same succeeding four digits do not require removal of the adapter ring.

TIP: Hold the lower standoff (next in stack) with pliers while turning standoff to be removed with hex head driver.

5. Disconnect the 9-pin RS-232 cable at connector J5 on the Smart Trac CPU card.
6. Using the phillips head screwdriver, remove two screws which secure the adapter ring to the main chassis. Press inward on the main chassis housing at the location of two tabs on the right side of the adapter ring and lift to free the tabs. Remove the door with the adapter ring.
7. Using the 4.5mm hex head driver and pliers, remove four standoffs from the topmost card.

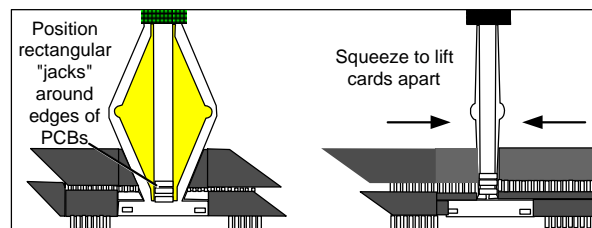


Figure 12. Using the PC/104 card extraction tool

8. Using the PC/104 card extraction tool, remove the topmost card from the others. Lift the card slightly on one side, then move to another side and lift the card slightly again. In this manner, work your way around the card to remove it without damaging connecting pins.

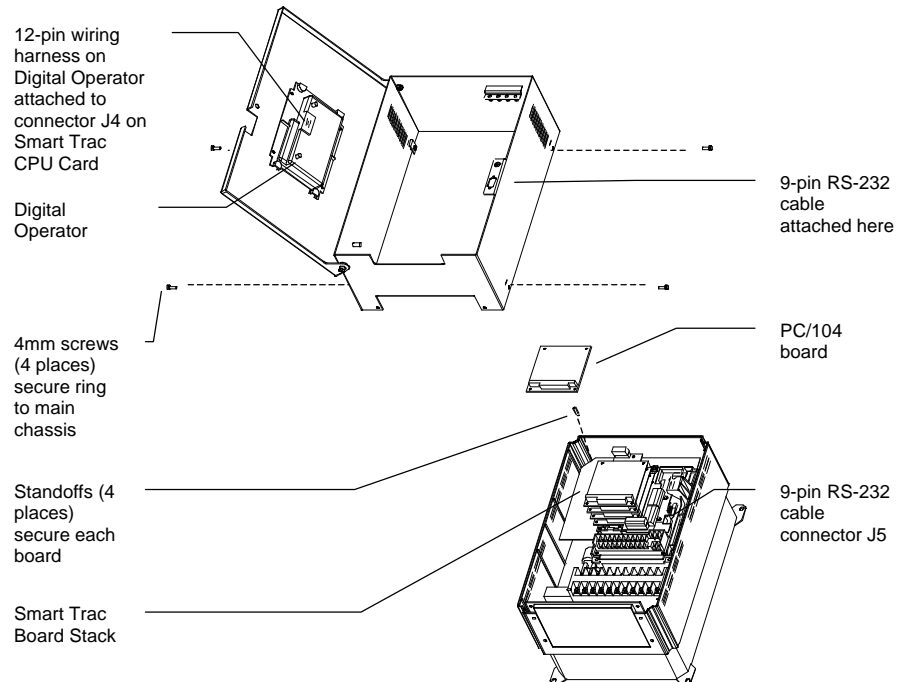


Figure 13. Removing the Smart Trac Card Stack

9. Continue removing all PC/104 cards, including option, Smart Trac Ethernet and Smart Trac PS cards, using steps 8 and 9.
10. *To remove the Smart Trac PG card:*
 - Disconnect the 4CN Connector cable on the PG card.
 - Remove the card.

NOTE: The 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.

11. *To remove the Smart Trac CPU card:*
 - Locate the black 2CN connector between the Smart Trac CPU card and the Inverter Control 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.
 - Remove the Smart Trac CPU card. Be very careful when lifting not to bend connecting pins at the 2CN connector.
12. *To remove the Smart Trac Inverter Control Card (1PCB):*
 - Disconnect the wiring harness at connector 7CN, located at the top of the card.

- Disconnect ground strap E, located at the bottom of the card.
 - Disconnect all electrical leads to the terminal blocks located at the bottom of the card.
 - Remove two phillips head screws located at the bottom of the card.
 - Finally, remove the card by pressing outward on two captive, plastic locking clips located at the top end of the board and lifting the card to free it.
13. Replace faulty cards and secure per the reverse of steps 1 through 11, taking care not to damage connecting pins. Align each card and its pins precisely with the next before pressing into position on the next card.
 14. Secure each PC/104 card by replacing and tightening four standoffs.
 15. Reconnect the 9-pin RS-232 cable at connector J5 and at connector on housing. Reconnect one end of the 12-pin wiring harness to connector J4 on Smart Trac CPU card and the other at back of Digital Operator.
 16. Secure the two ground straps to their proper locations inside the housing.
 17. Close the cover and secure with the captive screw located on the front of the Smart Trac AC1.

Replacing the Power Supply Fuse

Fuse- Smart Trac Power Supply

A fuse prevents overloading of the electrical circuits for your Smart Trac AC1. Located on the Smart Trac PS card, the fuse protects the circuits of all stacked cards. It is a 2-amp, 250-volt fast type fuse, designed to trip at 5.6 to 6.0 volts.

1. Remove all stacked PC/104 cards as described in "Replacing Parts."
2. Locate the 2A/250V fuse (near AC Input CN1). Using a fuse extracting tool, remove and replace the fuse.
3. Install all stacked PC/104 cards previously removed. Follow the reverse of procedures in "Replacing Parts."
4. Replace adapter ring and secure with two phillips head screws (right side of Smart Trac).
5. Secure ground straps to their proper locations inside the adapter ring.

Ordering Parts

Should a circuit card fail in your Smart Trac AC1, you may need to order parts. If the operation is critical to your operation, you may want to order spare parts.

To order parts for your Smart Trac AC1, contact your local MagneTek Representative or Authorized Distributor. For additional information, you may contact Smart Trac Technical Support at:

MagneTek, Inc.
16555 West Ryerson Rd.
New Berlin, WI 53151
(800) 541-0939
(262) 782-0200
FAX (262) 782-1283:

Replaceable Parts List

When ordering, refer to the part description and part number listed in [Table 9](#).

Table 9. Smart Trac AC1 Replaceable Parts List

Description	MagneTek Part Number	Qty
Smart Trac CPU Card option kit	46S03643-0010	1 req'd
Smart Trac PG Card	46S03643-0020	Option
Smart Trac Power Supply option kit	46S03643-0030	1 req'd
Smart Trac Inverter Card	05P00090-0535	1 req'd
Smart Trac Arcnet Network Interface (LAN) option kit	46S03643-0040	Option
Smart Trac DM6420 Multi I/O option kit	46S03643-0050	Option
Smart Trac Ethernet Network Interface option kit	46S03643-0060	1 req'd
Smart Trac DeviceNet Network Interface option kit	46S03643-0070	Option
Smart Trac PCIM (Genius) option kit	46S03643-0080	Option
Smart Trac PCIF Card	46S03554-0090	Option
Smart Trac Modbus RTU Card	46S03554-0100	Option
Card Extraction Tool	(Parvus Corporation P/N PRV-0760A-01)	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 6 foot	46S02995-0010	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 30 foot	46S02995-0020	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 20 foot	46S02995-0030	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 10 foot	46S02995-0040	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 14 foot	46S02995-0050	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 40 foot	46S02995-0070	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 50 foot	46S02995-0090	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 55 foot	46S02995-0100	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 80 foot	46S02995-0110	Option
Special Standoff for CPU card (qty 1), 4.5mm, Hex, STI, CL ZINC, 14mm, M/F, M3,M3	05P00618-0005	1
Standoff (used on all assemblies except Genius and qty 1 of CPU Card), 4.5mm, Hex, STI, CL ZINC, 15mm, M/F, M3,M3	05P00618-0006	4 ea. card

Return Authorization

You must obtain a return authorization before shipping a Smart Trac AC1 back to the factory for repairs or replacement. MagneTek will issue a Return Authorization number on receipt of an approved Purchase Order. The number

must appear, clearly legible, on the outside of the shipping container and on the customer packing list.

If MagneTek does not receive the item at the factory within 60 calendar days, the authorization to return shall expire and the request must be re-authorized.

If an item being returned is for credit or non-warranty repair, contact MagneTek's Repair Department for the Return Authorization number and form F0301603. Complete the form and return with the item. If not received within two (2) weeks, the return authorization will be canceled and any items received by MagneTek will be returned to you, freight collect.

In the event of a potential warranty failure, immediately contact the Product Service Center for technical and procedural guidance. If an item is subsequently returned under suspect warranty terms, the Product Service Center Return Authorization number and return instructions apply.

Repackaging



WARNING - ESD

The Smart Trac electronics are electrostatic sensitive devices. Follow Electrostatic Discharge (ESD) procedures when handling to protect components. Failure to follow ESD procedures may result in damage to the Smart Trac AC1 or its components. Failure to comply may result in personal injury or death.

Return your Smart Trac in its original packaging whenever possible. If the original packaging has been discarded, or if you have questions, contact your MagneTek representative.

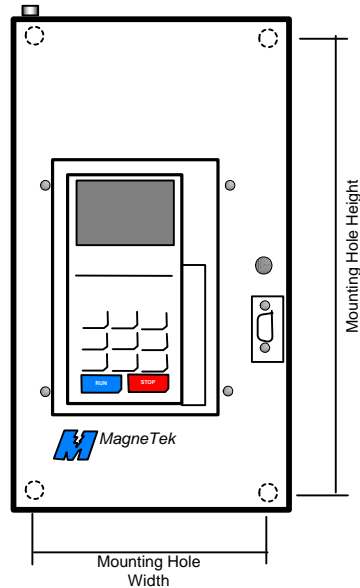
Appendix A – Dimensions

Smart Trac AC1 Dimensions

1. Drive overload capacity is 150% for one minute.
2. Nominal Horsepower is based on Standard NEMA B 4-pole motor design.
3. NEMA 1 enclosure is an available option for protected chassis ratings.
4. NEMA 4 and 12 enclosures are available options.
5. Dimensions for NEMA 1 w/o circuit breaker options.
6. Customer enclosure designs are available.

Input Volts	Continuous Output Amps ¹	Nominal HP ²	Height (Inch)	Height (mm)	Width (Inch)	Width (mm)	Depth (Inch)	Depth (mm)	Enclosure Type ^{3,4}
230V	3.2	3/4	12.3	302	6.75	171	10.74	260	NEMA 1
	6	1	12.30	302	6.75	171	10.74	260	
	8	2	12.30	302	6.75	171	10.74	260	
	11	3	12.30	302	6.75	171	11.53	260	
	17.5	5	12.30	302	6.75	171	11.53	260	
	25	7.5	13.00	322	8.50	211	12.40	305	
	33	10	13.00	322	8.50	211	12.40	305	
	49	15	16.20	402	10.30	261	12.80	325	
	64	20	16.20	402	10.30	261	12.80	325	
	80	25/30	24.02	610	12.99	330	14.30	359	
	130	40/50	26.57	675	16.73	425	16.98	432	Protected Chassis
	160	60	26.57	675	16.73	425	16.98	432	
	224	75	31.50	800	18.70	476	16.98	432	
300	100	36.42	925	22.64	575	18.95	482		
460V	1.8	1	11.89	302	6.75	171	10.23	260	NEMA 1
	3.4	2	11.89	302	6.75	171	10.23	260	
	4.8	3	12.30	302	6.75	171	10.74	260	
	8	5	12.30	302	6.75	171	10.74	260	
	11	7.5	12.30	302	6.75	171	10.74	260	
	14	10	13.00	322	8.50	211	12.40	305	
	21	15	13.00	322	8.50	211	12.40	305	
	27	20	16.20	402	10.50	262	13.20	325	
	34	25	16.20	402	10.50	262	13.20	325	
	41	30	24.02	610	12.99	330	14.30	359	
	52	40	24.02	610	12.99	330	14.30	359	
	65	50	30.91	785	12.99	330	14.30	359	Protected Chassis
	80	60	30.91	785	12.99	330	14.30	359	
	96	75	33.46	850	12.99	330	14.30	359	
	128	100	32.28	820	17.91	455	16.98	432	
	165	125	32.28	820	17.91	455	16.98	432	
	224	150	36.42	925	22.64	575	17.96	457	
	302	200/250	36.42	925	22.64	575	18.90	457	
	450	300/350	57.09	1450	37.40	950	20.33	517	
	605	400/500	62.99	1600	37.80	960	21.11	537	
400A	-	97.50	2477	31.50	900	32.20	818	NEMA 1 Dimensions for NEMA 1 without circuit breaker options.	
800A	-	97.50	2477	39.00	990	32.20	818		
1200A	-	97.50	2477	63.00	1600	32.20	818		
1600A	-	97.50	2477	71.00	1803	32.20	818		
400A	-	97.50	2477	31.50	900	32.20	818		
600V	800A	-	97.50	2477	39.00	990	32.20	818	NEMA 1 Dimensions for NEMA 1 without circuit breaker options.
	1200A	-	97.50	2477	63.00	1600	32.20	818	
	1600A	-	97.50	2477	71.00	1803	32.20	818	
	1600A	-	97.50	2477	71.00	1803	32.20	818	

Mounting Hardware and Hole Dimensions



Input Volts	Continuous Output Amps ¹	Nominal HP ²	Mounting Screws	Mounting Hole Height (in.)	Mounting Hole Width (in.)
2 3 0 V	3.2	3/4	#10	10.47	4.96
	6	1	#10	10.47	4.96
	8	2	#10	10.47	4.96
	11	3	#10	10.47	4.96
	17.5	5	#10	10.47	4.96
	25	7.5	1/4"	11.22	7.32
	33	10	1/4"	11.22	7.32
	49	15	1/4"	14.37	9.29
	64	20	1/4"	14.37	9.29
	80	25/30	1/4"	17.13	10.83
	130	40/50	1/4"	25.59	12.60
	160	60	1/4"	25.59	12.60
	224	75	3/8"	30.51	14.57
300	100	3/8"	35.24	17.52	
4 6 0 V	1.8	1	#10	10.47	4.96
	3.4	2	#10	10.47	4.96
	4.8	3	#10	10.47	4.96
	8	5	#10	10.47	4.96
	11	7.5	#10	10.47	4.96
	14	10	1/4"	11.22	7.32
	21	15	1/4"	11.22	7.32
	27	20	1/4"	14.37	9.29
	34	25	1/4"	14.37	9.29
	41	30	1/4"	17.13	10.83
	52	40	1/4"	17.13	10.83
	65	50	1/4"	24.02	10.83
	80	60	1/4"	24.02	10.83
	96	75	1/4"	24.02	10.83
	128	100	3/8"	31.30	13.78
	165	125	3/8"	31.30	13.78
	224	150	3/8"	35.24	17.52
	302	200/250	3/8"	35.24	17.52
450	300/350	3/8"-16	55.12	*	
605	400/500	3/8"-16	31.02	*	
400A	-				
800A	-				
1200A	-				
1600A	-				
6 0 0 V	400A	-			
	800A	-			
	1200A	-			
	1600A	-			

Appendix B – Detailed Specifications

AC1 Specifications

NOTE: The specifications listed in the table below may vary according to the parameters programmed into your Smart Trac AC1 and the option cards installed. Check the specifications supplied in the manual for each option card.

Detailed Specifications		
Specification Category	Description	Specification
Control Characteristics	Control Methods	V/f , V/f with PG feedback, open loop vector, or flux vector
	Frequency/Speed Control Range	100:1 (including at stall) (1000:1 possible with PG)
	Frequency Control Range	0.1 to 400 Hz
	Speed Control Accuracy	+/- 0.2% (+/- 0.02% with PG)
	Starting Torque	150%/1 Hz (150% / 0 RPM with PG)
	Output Frequency Resolution	0.01 Hz
	Auto Speed Reference Signal	+/- 10 VDC (20K ohms), or 4-20mA (250 ohms)
	Torque Limit	4 types available
	Braking Torque	Approximately 20%
Protective Functions	Motor Overload Protection	Electronic thermal overload relay
	Instantaneous Overcurrent	Motor coasts to a stop at approximately 200% rated current

Detailed Specifications		
Specification Category	Description	Specification
	Fuse Blown Protection	Motor coasts to a stop when fuse blows
	Overload	Motor coasts to a stop after 60 seconds at 150% of rated output
	Overvoltage	Motor coasts to a stop if Smart Trac AC1 DC bus voltage exceeds 400 VDC (230V unit), 800 VDC (460V unit), or 1050 VDC (600V unit).
	Undervoltage	Motor coasts to a stop if Smart Trac AC1 DC bus voltage exceeds 400 VDC (230V unit), 800 VDC (460V unit), or 1050 VDC (600V unit).
	Momentary Power Failure	Factory setting provides for motor to coast to a stop after momentary power failure of more than 15 ms. Can be reprogrammed to allow continuous operation (ride-through) during power failure of up to 2 seconds or longer.
	Heatsink Overheat	Thermistor
	Stall Prevention	Stall prevention at acceleration/deceleration and constant speed operation.
	Ground Fault	Provided by electrical circuit.
	Power Charge Indication	"CHARGE" lamp remains lit until bus voltage drops below 50 V.

Appendix C - Wiring, Grounding and Installation Practices for Noise Immunity

Wiring, Grounding and Installation Practices

When wiring, grounding and installing your Smart Trac AC1s, motors, operator controls and machine interfaces in environments with high amounts of electrical noise, the following practices will reduce effects due to electrical noise:

Wiring Requirements for Panel Design/Layout:

Panel design and layout must take into consideration all shop wiring and field installation requirements as well as panel layout requirements and standards.

Panel design should encourage good wiring practices in the field. For instance:

- Motor leads should always be wired to a separate terminal block
- Terminal for motor ground wire should always be supplied
- Only signals which should be routed together should be on the same terminal strip
- If cabinet is too cramped, shielded cabling may be required internally. This adds to the cost and should be reflected in the quoted price.

The following describes additional requirements and recommendations:

- Shielded motor power cables are recommended. In some applications they may be required in order to meet noise abatement requirements.
- Shielded motor feedback (tach/encoder) cables are required.
- Ground wire must be provided from the motor case to panel ground in addition to the required safety ground. A separate lug should be provided for this ground wire next to those for the motor leads.
- Ground AC control wiring (typically 115 VAC) neutral for relay signals, where codes permit. Route AC control wiring separately from power and separately from low voltage wiring.

- Low voltage signals such as analog inputs and outputs for speed or torque control, digital inputs and outputs, and 24 VDC used for control of the customers operating interface, should be run using shielded cable, containing twisted pair(s).
- All AC relay coils should have RC snubber devices attached.
- Verify shield drain wire connections do not form ground loops.
- Motor thermistor wires should not be routed with the Power wiring nor AC Control.
- Grounding wire sizing shall meet the minimum of equipment grounding of NEC Table 250-95.

Wire separation groups – STANDARD PRACTICE:

Wires must be separated into groups, as described below:

1. POWER AC WIRING 230/460/575 (usually heavy black wires). This is the main input power to the drive for driving the load. Group together:
 - Leads to DC Link filter inductor.
 - Leads to power line filter (05P00325-0023)
 - May include power to a step-down transformer (typically wired from the drive's power terminals) for use as input power for the controls.
 - 110 VAC wiring to the control power supply but not wiring going to relay circuitry.
2. POWER DRIVE OUTPUT WIRING (usually heavy black wires). Group:
 - Power wiring to the motor.
 - Also includes ground wire from drive to motor.
3. POWER DC BUS WIRING (separated from others)
4. POWER CONTROL 110 VAC. Group:
 - Wiring used for relay control logic.
 - Do NOT include 110 VAC wiring to the control power supply because noise from the relay/contactors coils and contacts can easily be coupled to the control power supply.
5. LOW VOLTAGE AC, DC. Group:
 - 24 vdc
 - Analog Inputs (shielded)
 - Analog Outputs(shielded)
 - Low voltage dc
 - 4 ~ 20 mA(shielded)
6. ENCODER SIGNALS. Group:
 - AC (shielded)
 - DC (shielded)
 - Digital (shielded)

7. COMMUNICATION WIRING

- ArcNet Coaxial Cables
- Ethernet Wiring
- Genius Wiring

**Wiring Requirements
for Shop Wiring**

Adhere to the following when wiring:

- AC control wiring (typically 115 VAC) for relay signals should be routed separately from power and separately from low voltage wiring.
- AC input power to the SmartTrac Power Supply shall be routed separate from AC Control wiring.
- Do not route input and output power wiring together internal to the drive/panel/cabinet.
- Serial communication may be included with the low voltage or routed separately.
- A minimum three-inch bend radius for coax cables should be maintained.
- Stripping off signal wire insulation for termination should not result in excessive exposed bare wire.
- Electrical safety and improved mechanical capabilities also require that the terminals crimp on to the insulation on the back half of the terminal. Approved crimpers will accomplish this automatically when used correctly.
- Shield terminations need to be as short as possible 2.5 inches maximum length. Smart Trac wiring paths will, when followed properly, allow this length to be less than 1 inch.
- Use heat shrink tubing over all bare shield drain wires.
- When a noise filter (model – 05P00325-0023) is installed it should be mounted near the drive to allow its existing wires to be connected to the terminals of the drive L1, L2, L3. Lead extensions are not allowed.
- Within the panel motor encoder leads, encoder power and encoder output signals wires shall be bundled alone not with power or ac control wiring.
- The drives are electrically connected to the drive panels by removing paint at the mounting locations, and using star washers on the mounting hardware. Alternately, RivNuts may be used to mount the drive to the panel.
- Drive panels are likewise electrically connected to the enclosures.

**Wiring Requirements
and
Recommendations
for Field Installation:**

Adhere to the following requirements and recommendations when installing your Smart Trac AC1:

- Steel conduit is recommended.
- Shielded motor power cables are recommended.
- Ground AC control wiring (typically 115 VAC) neutral for relay signals, where codes permit. Route this wiring separately from power and separately from low voltage wiring.

- Run separate steel conduit for power wiring to the drive input and the drive output to the motor. Do not route input and output power wiring together internal to the cabinet.
- Never coil excess cable, whether in temporary wiring or final installation wiring.
- Ground wire must be provided from the motor case to panel ground in addition to the required safety ground at the motor.
- Excess cable should not be coiled. This applies to temporary wiring and final installation. Wire length for a service loop is allowed for maintenance purposes.
- Low voltage signals such as analog inputs and outputs for speed or torque control, digital inputs and outputs, and 24 VDC used for control of the customer's operating interface, should be run using shielded cable, containing twisted pair(s).
- Shields are connected to the drive shield connection. On a panel, the shield is terminated to a terminal block. In the field, the external cable shield is terminated to the terminal block, while the other end is usually left unconnected.
- Serial communication may be included with the low voltage wiring, or routed in its own steel conduit.
- A minimum three-inch bend radius for coax cables should be maintained.
- Stripping off signal wire insulation for termination should not result in excessive exposed bare wire.
- Electrical safety and improved mechanical capabilities require that the terminals crimp on to the insulation on the back half of the terminal.
- AMP or Thomas & Betts crimping tools are recommended. Crimping tools must be used with the manufacturer recommended lugs, in accordance with the manufacturer's usage guidelines.
- The facility power ground should conform to the NEC, National Electric Code for power distribution.
- The chassis ground of the equipment and the conduit must be connected to facility ground without creating ground loops.
- If codes require grounding of the "Y" or "Star Point" of the distribution transformer, this should be connected directly to facility ground only.
- Motor Encoder leads, encoder power and encoder output signals, should be routed in their own steel conduit that does not contain power or ac control wiring.
- If necessary, the motor thermistor wiring may be included in the conduit with the motor encoder leads. When doing so, a ferrite bead is placed over the thermistor wires before they enter the conduit.
- Separate conduit runs are required for Input Power, Output Power (Motor), AC Control, and Low voltage.
- Dynamic Braking wires are dc Bus voltage and switched at a very high rate thus they need to be routed alone within their own conduit if conduit is indicated.

- Flex conduit could be used for the Motor leads (PWM signals).
- Multiple panels/cabinets maybe interconnected by bolting together with star washers on either side of the bolted connection. When this is done, the panels/cabinets form a 'unified ground plane', which can be grounded with a single wire to facility ground.
- Grounding Wire sizing shall meet the minimum of equipment grounding of NEC Table 250-95
- When using wire trays, each of the respective wire groups input power, output power, AC control, and low voltage need to be routed in their own respective harnesses, and separated with magnetic barriers.

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Appendix D - Application Parameters

Application Parameter Form

By filling in the form on the following pages, you will record the parameter settings specific to your application.

Appendix E – Installing System Software

Installing Boot, Monitor or Operating System Software and Recovery from CPU Failure

To install a software update or to recover from a failure of the Smart Trac CPU card, you may need to download Boot, Monitor or Operating System Software. This is called a "Kernel Download."

Kernel Download

Using the RS-232 Serial Port on the front of the Digital Operator, you may download the kernel software (in files with a .BIN extension). This may be necessary due to a failure of the CPU card, replacement of the CPU card or loss of the CPU battery.

To download the boot, monitor, or kernel software from the Windows NT main screen:

1. Click Start, Programs, Windows NT Explorer. The Explorer Window will appear.
2. Locate the path of the KernDownload program (i.e. a:\Kerndownload.exe) and double click it. The Kernel Download screen appears with three tabs: Download Operations, Communications Setup, and About.

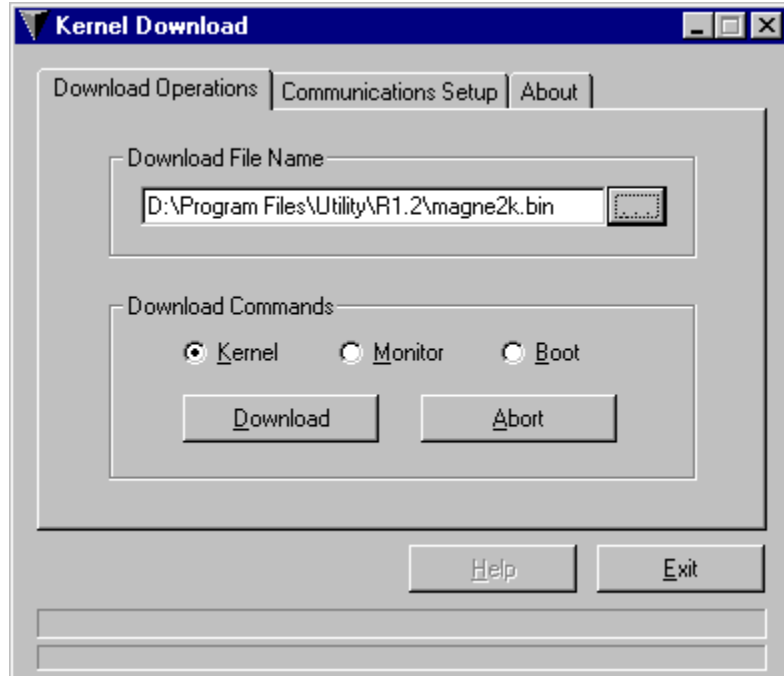


Figure 14. The Kernel Download – Download Operations dialog box.

2. Click **Communications Setup**. Verify that all serial communications settings match those of your PC. You should not typically need to change any settings from their defaults. The baud rate of the PC must match the baud rate set for the Smart Trac CPU board.

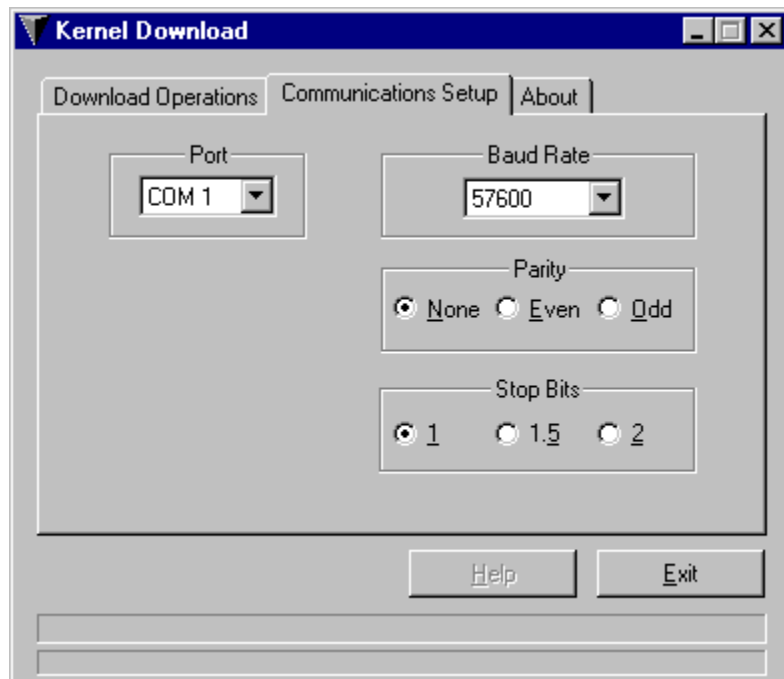


Figure 15. The Kernel Download – Communications Setup dialog box.

NOTE: To set the baud rate of the Smart Trac CPU card, power-up and within 2 seconds of bootup, press the MENU key on the Digital Operator. Using the up and down arrows, scroll to **COM1 Config**. Press the **ENTER** key. The **BAUD** rate entry appears. Enter the **BAUD** rate. (Pressing **>RESET** moves one digit to the right). Press **DATA/ENTER**.

3. Connect an RS-232, 9-pin straight through cable from your PC (laptop) to the RS-232 port located on the front of the Smart Trac **AC1**.
4. Click **Download Operations** tab. The Download Operations screen appears. You may change the **Download File Name**, if necessary, by clicking on the box with the three dots and browsing through to the complete path of the file. Normally, the correct path will already be displayed.

NOTE: Magne2k.bin is the Kernel firmware, Monitor.bin the monitor firmware, and Smrtbios.bin the Boot firmware.

5. Click one of the three Download Commands to select it: **Kernel**, **Monitor**, or **Boot**. Each is downloaded in a separate operation.
6. Click **Download**. A message appears in the rectangular area near the bottom of the Kernel Download window, indicating the download in progress and the remaining time to download. When complete, the message "Download successfully completed" appears.
7. Reboot your drive to recognize the new Kernel, Monitor and/or Boot software.

Appendix F – 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.*

Problem Report

Name:

Address:

City:

State:

Zip

Serial Number:

Hp:

230 460

Occurrence: Frequently Intermittantly Rarely

Nature of Problem:

Conditions when problem occurs:

Training



MagneTek holds Training Seminars at its Training Facility in New Berlin, WI. The facility includes training rooms with individual desktop computers and videoconferencing capabilities, a drive demonstration room displaying MagneTek's drives, and an on-site company lunchroom. **Mail or fax the form below to obtain information on scheduled dates of Training Seminars for the Smart Trac AC1.**

Should you have questions about training, or need information quickly, you may contact the Help Desk at (800) 541-0939 or (262) 782-0200.

Training Seminar Information Request

You may fax your request to MagneTek at (262) 782-3416, or mail to:

MagneTek
Ref: Training
16555 West Ryerson Road
New Berlin, WI 53151

<i>Last Name</i>	<i>First Name</i>	<i>Middle Initial</i>
<i>Title/Position</i>		
<i>Company Name</i>		
<i>Address</i>		
<i>Address</i>		
<i>City</i>	<i>State</i>	<i>ZIP</i>
<i>Telephone</i>	<i>Fax</i>	
<i>e-mail Address</i>		

References

The following publications may be of help to you. Some are referenced within this manual. Others are listed as important supporting information.

- | | |
|---|--|
| <i>ARCNET Local Area Network Standard: Token Bus (2.5 MBPS)</i> | ATA/ANSI 878.1, ARCNET Trade Association, 1992. Information about ARCNET and the standard may be obtained at the web site:

http://www.arcnet.com |
| 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 <i>DeviceNet</i> Vendor Association, Inc. at:

http://www.odva.org/ |
| Ethernet | For a good primer on ethernet, visit Charles Spurgeon's Ethernet Web Site at:

http://www.ots.utexas.edu/ethernet/ |
| <i>IEC-61131-3</i> | An international standard for software control of programmable logic controllers established by International Electrotechnical Commission (IEC). For more information, visit their web site at:

http://www.iec.ch/home-e.htm

For information about the standard, contact PLCopen. a vendor- and product-independent world-wide association that brings greater value to users of Programmable Controllers through the pursuit of the IEC 1131-3 open software development standard. Visit:

http://www.plcopen.org/ |
| <i>IEEE Standards 802.3, 802.3a, 802.3i</i> | Institute of Electrical and Electronics Engineers. Standards may be downloaded on a subscription basis from the web site:

http://www.standards.ieee.org/ |

MagneTek Drives and Systems

For more information about MagneTek drives and systems, training programs and contacts, visit:

<http://www.magnetekdrives.com/>

National Electrical Code

Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101. You may obtain copies of the NEC on various media at the web site:

<http://www.nfpa.org/>

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.htm>

Profibus

For more information about Profibus, contact PROFIBUS International, "an umbrella organisation for the expanding PROFIBUS 'User Groups' which now cover 20 countries in Europe, North and South America, Africa, and the Pacific Rim."

<http://www.profibus.com/>

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Appendix G – Replaceable Parts

Replaceable Parts Listing

(For option kits, see Replaceable Parts List)

Description	MagneTek Part Number	Qty
Smart Trac CPU Card option kit	46S03643-0010	1 req'd
Smart Trac PG Card	46S03643-0020	Option
Smart Trac Power Supply option kit	46S03643-0030	1 req'd
Smart Trac Inverter Card	05P00090-0535	1 req'd
Smart Trac Arcnet Network Interface (LAN) option kit	46S03643-0040	Option
Smart Trac DM6420 Multi I/O option kit	46S03643-0050	Option
Smart Trac Ethernet Network Interface option kit	46S03643-0060	1 req'd
Smart Trac DeviceNet Network Interface option kit	46S03643-0070	Option
Smart Trac PCIM (Genius) option kit	46S03643-0080	Option
Smart Trac PCIF Card	46S03554-0090	Option
Smart Trac Modbus RTU Card	46S03554-0100	Option
Card Extraction Tool	(Parvus Corporation P/N PRV-0760A-01)	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 6 foot	46S02995-0010	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 30 foot	46S02995-0020	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 20 foot	46S02995-0030	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 10 foot	46S02995-0040	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 14 foot	46S02995-0050	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 40 foot	46S02995-0070	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 50 foot	46S02995-0090	Option

SMART TRAC AC1

Description	MagneTek Part Number	Qty
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 55 foot	46S02995-0100	Option
Smart Trac LAN RG-62/u Coaxial Cable-Arcnet Cable Assy, 80 foot	46S02995-0110	Option
Special Standoff for CPU card (qty 1), 4.5mm, Hex, ST1, CL ZINC, 14mm, M/F, M3,M3	05P00618-0005	1
Standoff (used on all assemblies except Genius and qty 1 of CPU Card), 4.5mm, Hex, ST1, CL ZINC, 15mm, M/F, M3,M3	05P00618-0006	4 ea. card
Ethernet Crossover Cable	TBD	1 req'd
Ethernet Cable (various lengths)	TBD	1 req'd
PC/104 Extension Cable	TBD	Option
Smart Trac LAN BNC 93-ohm Terminator	05P00034-0586	Option
Connector, BNC Tee	05P00034-0540	Option
Hardware Tools Kit for Smart Trac AC1	TBD	Option

Glossary of Terms

Arcnet	Acronym for Attached Resource Computer Network, it is one of the oldest forms of networks. Created in 1977 by Datapoint Corporation, ARCNET uses token passing in combination with star/bus topology to transmit data at 2.5 Mbps (megabits per second). It is simple, inexpensive and reliable and is a good solution for small LANs. Cabling may include RG-62, 90-ohm or 93-ohm coaxial, UTP and fiber optic. It will support as many as 255 nodes.
BIOS	Abbreviation for Basic Input/Output System. The BIOS insulates application software from the hardware by providing primitive I/O services and by programming the hardware's interrupt handling.
Bridge	A device used to control network traffic. It splits a network segment, passing data through or rejecting it depending on the destination device's physical address
contiguous	Touching along a boundary or a point.
enterprise-wide LAN	used to describe a local area network that serves more than one purpose, may network devices physically separated by long distances, and possibly connected to the internet.
DeviceNet	A type of network simple and low-cost, designed to connect industrial devices as well as control devices. It supports up to 64 devices on a single network at data rates up to 500 kbaud.
DNS	Acronym for Domain Name Server. DNS is the internet naming scheme, which consists of a sequence of names, separated by dots, from the most specific to the most general (i.e. www.magnetek.com).
DPRAM I/O Driver	Acronym for Dual Port Random Access Memory I/O Driver. It allows programs written with the Smart Trac Workstation and downloaded to the Smart Trac AC1 to set and read parameters on the Smart Trac AC1 using the Smart Trac AC1's Dual Port RAM.
Ethernet	The most common type of network, ethernet is an open network standard (per Ethernet 802.3). It was developed by Intel, Digital and Xerox. It is relatively low-cost yet offers support for a variety of protocols and computer platforms. Several ethernet cabling standards exist including 10Base-5 (Thick), 10Base-2 (Thin), 10Base-T (twisted pair). All provide data transfer rates of 10 Mbps. Variations have been introduced for faster networking, including 10Base-FL (10 Mbps over fiber optic cable), Fast Ethernet (10Mbps or 100 Mbps), 100VG-AnyLAN (100Mbps) and Switched Ethernet.

faults	Abnormal conditions generally requiring corrective action. Major faults stop execution of the program. Minor faults do not stop execution but issues a warning, displayed as a fault on the digital operator.
flash memory	A type of memory that can be programmed while installed in a printed circuit board. It retains its contents even in the absence of power.
Function Block	One of three Program Control Unit types. A programming language element, typically represented by a graphical block, consisting of inputs, outputs, internal variables, and a set of operations. Function blocks are instantiated and can contain state information from one invocation of an instantiation to the next.
global symbols	Symbols defined for use among all Program Control Units associated with a node. Global symbols cannot be seen or accessed across the network.
hub	A connection device that receives a signal, then transmits it to the connected devices.
IEC-61131-3	Part 3 of the international standard on Programmable Controllers, which specifies Programming Languages, including Relay Ladder Logic (RLL), Structured Text (ST), Sequential Function Charts (SFC), Function Blocks (FB), and Instruction Lists (IL).
Instruction List	The IEC 61131-3 Instruction List language for programmable controllers. Alternatively, a program control unit developed using the Instruction List language.
LCD	Acronym for Liquid Crystal Display.
LED	Acronym for Light Emitting Diode.
local symbols	Symbols defined for use within a Program Control Unit. Its use is limited to the program control unit in which it is defined.
NIC	Acronym for Network Interface Card.
node ID	The unique address assigned to a point in an Arcnet network where service is provided, service is used, or communications channels are interconnected.
Operator Configurator	A selection box that permits setting of parameters and feedbacks. This determines the menu items and structure displayed to the user of the Smart Trac AC1.
PC/104	An embedded PC bus standard. The standard defines the mechanical size of a self-stacking bus. Also an IEEE draft standard, called the P996.1 Standard for Compact Embedded PC Modules, the PC/104 Specification, Version 2.1, July 1994, PC/104 Consortium.
Profibus	A networking method that provides open, standard, inter-operable and fully transparent networking between field devices and controlling computers, PLCs or DCSs.
Program Units	An entry on the Object Menu of the Control Manager. It is a storage bin for user programs which may consist of relay ladder logic, function blocks, sequential function charts, and/or structured text.
RAM	Acronym for Random Access Memory. This type of memory loses the state of its contents upon removal of power.
Relay Ladder Logic Retentive	An implementation of the IEC 61131-3 Ladder Diagram language. A symbol, stored in NVRAM, that remains unchanged after a power-down/power-up sequence.

router	A hardware and software connection between two or more networks that permits data traffic to be passed from one network to the other based on the intended destinations of the data.
self-contained network	Used to describe a small, single-purpose network, confined to a very limited physical area, such as a single industrial plant or mill and not connecting to any device outside of the area.
Sequential Function Charts	The IEC-61131-3 defined Sequential Function Chart language used for programmable controllers or a program control unit developed using Sequential Function Chart language.
Structured Text	The Structured Text language specified by IEC 61131-3 used in programmable controllers. It provides a structured programming environment similar to that of the computer programming language PASCAL.
Symbol	An entry on the Object Tree of Control Manager. It is a location where user-defined variables are created and stored.
Tasks	An entry on the Object Menu. It allows you to specify what programs to run and when to run them.
TCP/IP	Acronym for Transmission Control Protocol/Internet Protocol. It is a connection-oriented specification for the format and relative timing of information exchanged between communicating devices. TCP opens and maintains a connection between two communication hosts on a network.
TCP/IP Addresses	An addressing method used to specify the Network ID, for general location of the host, and the Host ID, which uniquely identifies an individual host after the network is located. It further defines segments on the network. This information is used to route information to its proper destination.
Watch Window	A feature that allows observation of a program as it runs. You can look at the value of I/O points, global symbols, and run-time symbols (i.e. fault and scan conditions). As the program runs, symbol values are displayed. You may set or force symbols to certain values using this window to aid in debugging a program.

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