

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

a.i.tek
instruments

TACHTROL® 3
Instruction Manual



AI-TEK INSTRUMENTS, LLC

152 Knotter Drive
P.O. Box 748
Cheshire, CT USA 06410-0748
www.aitekinstruments.com

Phone: 1-800-643-0643

13010-D 7/04
Printed in U.S.A.

TABLE OF CONTENTS

1.0 FOREWORD 1

2.0 INTRODUCTION 1

2.1 MATHEMATICAL FUNCTIONS 1

2.1.1 Single Channel Operation 1
2.1.2 Dual Channel Operation 1
2.1.3 Bi-DIrectIonal Operation 1

2.2 OUTPUTS 2

3.0 THEORY OF OPERATION 2

4.0 HOW TO OPERATE THE TACHTROL®3 TACHOMETER 4

4.1 FINDING THE SCALING FACTORS 4

4.1.1 Finding the Scaling Factor For Common Applications 4
Single Channel and Bi-DIrectIonal 4
Dual Channel 6
4.1.2 Finding The Scaling Factor For Other Applications 6

4.2 SELECTING THE MATHEMATICAL FUNCTIONS 6

4.3 DEFINING THE BEHAVIOR OF THE OUTPUTS 7

4.3.1 Display 7
AutorangIng 7
4.3.2 Analog Output 7
Zero Scale 7
FullScole 8
4.3.3 SetpoInts 8
Setpoint Types 8
Setpoint Behavior 8
LatchIng/Auto Reset 9
4.3.4 Sample Set-Ups 10
Single Channel Operations 10
Dual Channel Operation 11

4.4 ENTERING THE CONSTANTS 13

4.4.1 Control Features 13
4.4.2 Turning On The Power 14
4.4.3 Entering The Scaling Factors 14
4.4.4 Entering The Function Constant 15
4.4.5 Entering Constants Which Define Output Behavior 15
Display Output 15
Analog Output 16
Setpoint 1 Output 16
Setpoint 2 Output 17

4.5 STORING THE CONSTANTS 18

4.6 SELECTING THE INPUT OPTIONS 18

5.0 HOW TO INSTALL THE TACHTROL®3 TACHOMETER 18

5.1 MOUNTING THE INSTRUMENT 18
5.2 PANEL MOUNTING DIMENSIONS 18

6.0 HOW TO INSTALL THE SPEED SENSOR (S) 20

6.1 MOUNTING THE SPEED SENSOR (S) 20
6.2 SETTING THE CLEARANCE 20
6.3 TYPICAL WIRING CONNECTIONS FOR AI-TEK SENSORS 20

6.3.1 Passive Sensors 21
6.3.2 Active Sensors 22
6.3.3 BI-Directional Sensors 22

7.0 APPENDIX: TIME MODE OPERATION 23

SPECIFICATIONS 23

INSTALLATION AND WIRING PRACTICES FOR ELECTRONIC INSTRUMENTATION & CONTROL 25

WARRANTY 27

1.0 FOREWORD

The following manual is written for users of the TACHTROL® 3 tachometer manufactured by AI-Tek Instruments. The manual provides easy to follow, step by step instructions for setting up and installing the instrument. Some knowledge of algebra is helpful but not necessary.

2.0 INTRODUCTION

The TACHTROL® 3 tachometer is an applications oriented, single or dual channel computing tachometer which uses the period mode of frequency measurement (time per event).

Used as a single channel tachometer, the TACHTROL® 3 tachometer measures the rate of industrial events, such as the rate at which liquid is passing through a pump, or the rate at which bottles are passing along a conveyor belt. The tachometer displays these rates in engineering units such as FPS (feet per second), GPH (gallons per hour), RPM (revolutions per minute), and other rates.*

Used as a dual channel tachometer, the TACHTROL® 3 tachometer can read two unrelated speeds or can compute six mathematical functions from the input signal frequencies of two related speeds.

In addition, the TACHTROL® 3 tachometer may be used as a bi-directional tachometer to measure speed with direction indication (from an AI-Tek bi-directional sensor).

2.1 MATHEMATICAL FUNCTIONS

2.1.1 Single Channel Operation. Used as a single channel instrument, the TACHTROL® 3 tachometer can compute Speed A or Speed B.

2.1.2 Dual Channel Operation. Used as a dual channel instrument, the TACHTROL® 3 tachometer can compute unrelated Speed A and Speed B. When Speed A and Speed B are related, the TACHTROL® 3 can compute the following mathematical functions.

A - B	(Difference)	$\frac{A-B}{A} \times 100$ (% Slip)
A/B	(Ratio)	
B/A	(Inverse Ratio)	$\frac{B-A}{A} \times 100$ (% Elongation)
$\frac{A+B}{2}$	(Average)	

2.1.3 Bi-Directional Operation. Used as a bi-directional instrument, the TACHTROL® 3 tachometer can compute +A, -A (opposite direction).

***Note:** Like most conventional tachometers, the TACHTROL® 3 tachometer comes from the factory ready to read RPM from a single, 60 pulse per revolution gear.

2.2 OUTPUTS

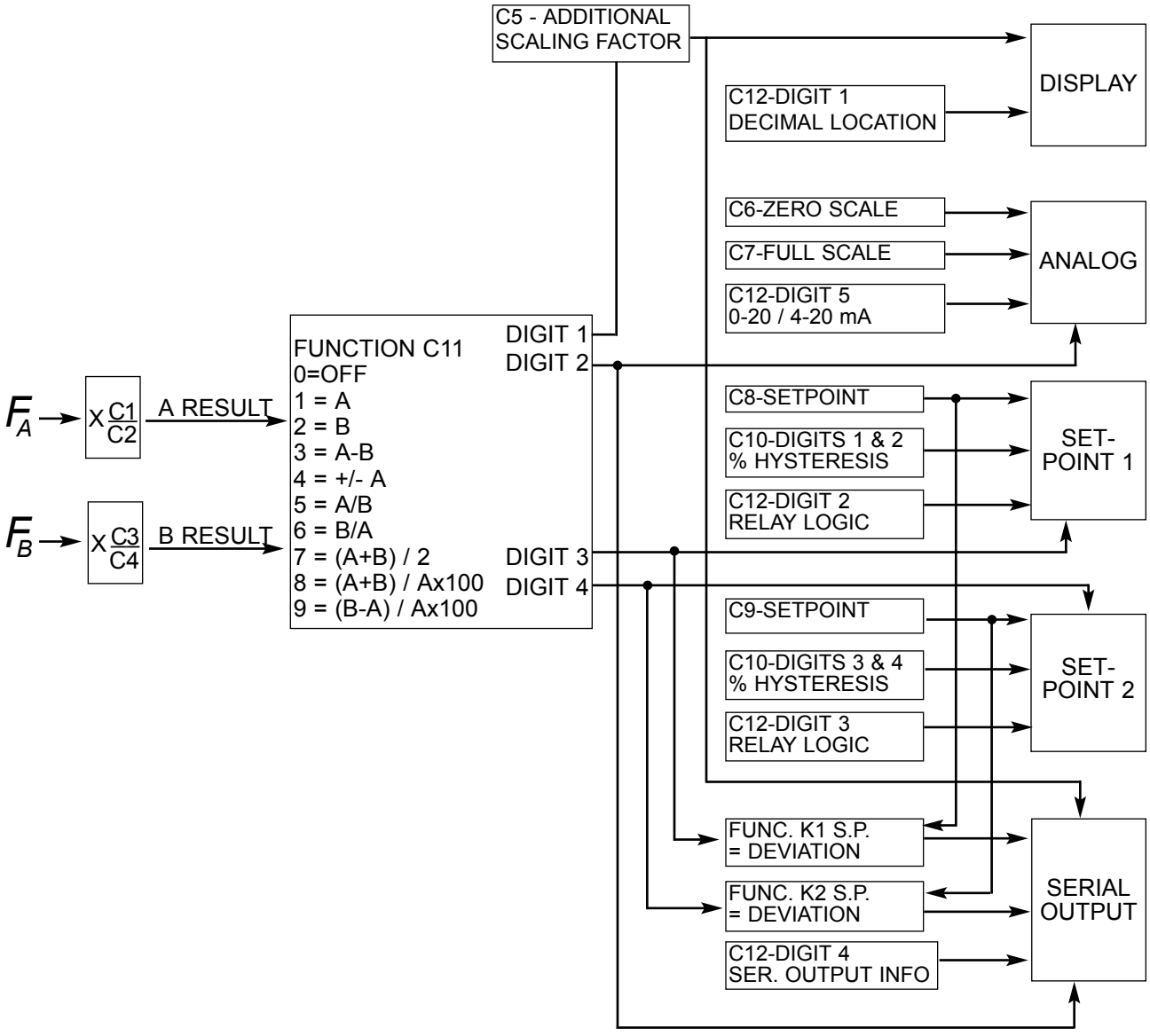
Any of the mathematical functions may be assigned independently to:

- An L.E.D. Display which updates every 0.5 seconds.
- An optional output (a current source): either 4 to 20mA or 0 to 20mA.
- 1 or 2 optional Relay Setpoints (2 form C contacts) whlch can be used to trlgger external events such as alarms. All forms of relay logic can be selected and adjusted In the field.

3.0 THEORY OF OPERATION

Speed sensors (transducers such as AI-Tek series 70085, H or BH) are placed near ferrous metal targets such as gears. The sensors generate repeating electrical pulses (input signal frequencies) whose repetition rates are proportional to the rates of the event. The TACHTROL®3 tachometer measures these rates in the number of pulses per second. The tachometer's microcomputer allows you to scale the input signal frequencies to appropriate display values, select and route the mathematical functions to the outputs, and define the behavior of each output. Figure 1 illustrates the flow of data in the TACHTROL®3 tachometer.

Figure 1, Data Flow Diagram

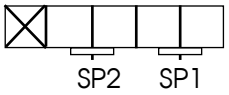


Once you have selected a function for and determined the behavior of each output, you set up the instrument by entering twelve 4 1/2 digit, signed numbers (called constants) on the thumbwheel and pushbutton switches on the control panel located behind the Door. These constants are held in the TACHTROL®3 tachometer's electrically alterable, read only memory (EAROM) and can be individually displayed and altered by a method similar to the setting of a digital watch. You then mount the instrument, install the speed sensor(s), connect the sensor(s) and the power wiring, and you are ready to operate. The following chart describes the purpose of each constant (C_1 thru C_{12}) and lists the standard constants which are preset in the instrument.

Constant	**Purpose**	**Std. Constants**
C_1 and C_2	scale (normalize) the input signal frequency from channel A.	1.000
C_3 and C_4	scale (normalize) the input signal frequency from channel B.	1.000
C_5	provides an additional method of scaling. When C_5 is set to standard constant. Display shows the computed function of channel A or channel B. However, C_5 can be altered to convert one engineering unit to another for Display purposes only. For example, C5 can be used to configure the instrument so that RPM is being computed and FPS Is being displayed. This Is Illustrated by the following equation. $A_{rpm} \times C_5 = D_{fpm}$ where A = scaled Input signal frequency D = display value	1.000
C_6	sets the Analog Output Zero Scale by determining at which value of the analog function (C_{11}) the analog output delivers 0 or 4mA to the load.	0.000
C_7	sets the Analog Output Full Scale by determining at which value of the analog function (C_{11}) the analog output delivers 20mA to the load.	2000

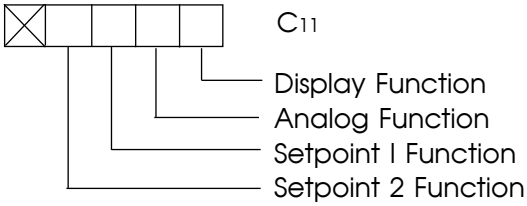
Note: You can make the Zero Scale larger than the Full Scale to compute Inverse functions.

C_8	determines at which value of the selected function (C_{11}) setpoint one relay K1 changes to the alarm state.	1000
C_9	determines at which value of the selected function (C_{11}) setpoint two relay K2 changes to the alarm state.	1000
C_{10} (Hysteresis Constant)	determines the independent reset point for both relays. The Hysteresis (dead band) may be specified in 1% steps from 00 to 99% of the setpoint value.	0505



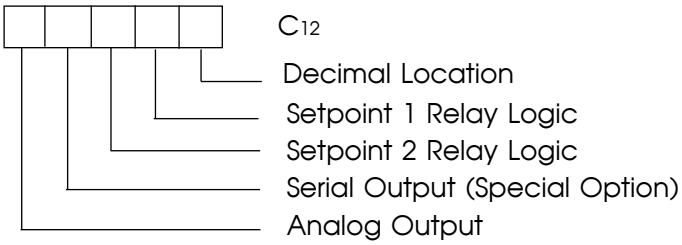
C_{10}

C_{11} (Function Constant)	determines which functions are sent to the four outputs. The calculated values of A and B (such as difference, ratio, and average) may be assigned independently to any of the four outputs.	1121



Note: Any unused outputs should be set to zero (OFF) for faster response.

C_{12} (Output Constant)	determines the specific properties of the four outputs, such as analog zero scale current, reporting method, display decimal location (autoranging). and relay logic.	14017



4.0 HOW TO OPERATE THE TACHTROL® 3 TACHOMETER

This section provides you with instructions for:
1. Finding the Scaling Factors.
2. Selecting the Mathematical Functions
3. Defining the Behavior of the Outputs
4. Entering the Constants
5. Storing the Constants
6. Selecting the Input Options

4.1 FINDING THE SCALING FACTORS (C_1 THRU C_4)

If you are using the TACHTROL®3 tachometer as a single channel Instrument to measure RPM and are using a 60 tooth gear. skip this section and proceed to section 4.2 Selecting The Mathematical Functions.

4.1.1 Finding the Scaling Factor for Common Applications:

This section provides you with formulas and examples for finding the scaling factor for revolutions per minute (RPM). gallons per minute (GPM), feet per minute (FPM). Inches per minute (IPM). yards per minute (YPM). Inches per second (IPS) and feet per second (FPS). For other applications, see Section B.

1. Single Channel and BI-Directional:

   A. Find the number of pulses per revolution (ppr) produced by the gear or target being monitored by the speed sensor.

   B. Calculate the scaling factor by applying the number of ppr to the appropriate formula for the engineering units you are displaying.

For **RPM** the formula for finding the scaling factor Is:

$$\frac{60}{PPR} = \text{Scaling Factor}$$

Suppose you have a 72 ppr gear. The formula reads:

$$\text{Scaling Factor} = \frac{60}{72} = \frac{5}{6}$$

For **GPM** the formula for finding the scaling factor is:

$$\frac{60}{PPG} = \text{Scaling Factor}$$

where PPG = Pulses Per Gallon

Suppose you have a gear operating at 140 PPG. The formula reads:

$$\text{Scaling Factor} = \frac{60}{140} = \frac{3}{7}$$

For **FPM** the formula for finding the scaling factor Is:

$$\frac{60 \times \pi \times D'}{PPR} = \text{Scaling Factor}$$

Suppose you are monitoring the speed of a moving conveyor belt. To calculate the scaling factor, you would need to know the diameter (In feet) of the roller to which the gear is attached and the thickness of the belt (multiplied by 2). If the diameter of the roller is 1 ft. 10 Inches and the thickness of the belt Is 1inch (x2). and the gear is 48 ppr. then the formula reads:

$$\text{Sealing Factor} = \frac{60 \times 3.1416^* \times 2'}{48} = \frac{7.8512}{1}$$

* π always = 3.1416

You can improve the accuracy of the scaling factor by manipulating the fraction in a way that uses the full 4 1/2 digits that can be entered on the Display. In this example the two 4 1/2 digit scaling factors are used to scale the channel with 5 digits of accuracy.

$$\frac{7.8512}{1} = \frac{7.8512}{1} \times \frac{10000}{10000} = \frac{78512}{10000} \div \frac{4}{4} = \frac{19628}{2500}$$

For **IPM; YPM; IPS;** and **FPS** the formulas for finding the scaling factor are:

$$\text{IPM: } \frac{60 \times \pi \times D''}{PPR} = SF \qquad \text{YPM: } \frac{60 \times \pi \times D'}{PPR \times 3} = SF$$

$$\text{IPS: } \frac{\pi \times D''}{PPR} = SF \qquad \text{FPS: } \frac{\pi \times D'}{PPR} = SF$$

Where

D′ = diameter in feet
D″ = diameter in inches
SF = scaling factor

Note: In some applications the shaft's speed you want to read may not be accessible. You may need to mount the gear and sensor on a shaft whose speed is proportional to but not the same as the one you want to read. In such cases, you will need to determine the ratio of speeds. For example, if the shaft to which you have mounted the gear and sensor makes three rotations for every single rotation of the shaft you want to read, then you must divide the scaling factor by 3.

2. Dual Channel

A. Find the number of pulses per revolution (PPR) produced by the gears or targets being monitored by the speed sensors.

B. Calculate the scaling factors by applying the number of PPR's to the appropriate formula for the engineering units you are displaying.

For RPM the formula for finding the scaling factor is:

$$\frac{60}{\text{PPR}} = \text{Scaling Factor}$$

Suppose you are using Channel A to measure RPM from a 48 tooth gear and Channel B to measure RPM from a 90 tooth gear. The formulas read:

$$\text{Channel A: Scaling Factor} = \frac{60}{48} = \frac{5}{4}$$

$$\text{Channel A: Scaling Factor} = \frac{60}{90} = \frac{6}{9}$$

The formulas for GPM; FPM; IPM; IPS; and FPS are given in the previous section for single channel instruments. Please be sure to read the note at the end of that section.

4.1.2 Other Applications for Scaling to Other Engineering Units

The general formula is:

$$\text{Scaling Factor} = \frac{\text{Display Value}}{\text{Input Signal Frequency}}$$

To solve this problem:

1. Pick a display value within the range of your operation.

2. Calculate the Input signal frequency produced by the speed sensor at the display value you've picked.

   Frequency is simply the number of electrical "pulses" produced by the sensor in one second. All AI-Tek sensors produce 1 pulse each time a gear or target tooth passes in front of the sensor. You will need to calculate how many pulses per second are created by the sensor when your machinery is operating at the display value you've picked.

3. Divide the display value by the input signal frequency.

4.2 SELECTING THE MATHEMATICAL FUNCTIONS (C_{11})

Select the mathematical functions from the menu below. You select and route a mathematical function to an output by placing the number to the left of the function in a digit of the Function Constant (C_{11}). For a complete explanation of how to enter the functions see Section 4.4.

MENU

Function C_{11}

0 = OFF

1 = A

2 = B

3 = A-B

4 = ±A

5 = A/B

6 = B/A

7 = $\frac{A+B}{2}$

8 = $\frac{A-B}{A}$ x 100

9 = $\frac{B-A}{A}$ x 100

The mathematical functions which can be computed in each mode of operation are listed in Section **2.1**.

Note: A + B can be computed by using a negative scaling factor for the B channel.

Note: With bi-directional operation, when a bidirectional sensor is connected to the instrument, Speed A can be computed from one frequency input (TTL input A) and direction can be computed from TTL input B. High (+5V) indicates a positive direction. Only single speed functions (Speed A) are useful when connected in this operation mode. In addition, channel B can be connected to any type of limit switches when using Function 4 (±A).

Note: With dual channel operation, when ratio and elongation functions are selected (Functions 5, 6 and 9), the ratio of zero over zero, by definition is unity (1).

4.3 DEFINING THE BEHAVIOR OF THE OUTPUTS

4.3.1 Display

You can program the Display to show the computed function of channel A and/or channel B, and you can configure the instrument to compute in one unit of measurement and to display another by altering constant C_5. (See page 3.)

Autoranging

Autoranging refers to the movement of the decimal among the 4 1/2 digits on the Display. You can limit the movement of the decimal point, and thereby determine the smallest value the Display will show.

4.3.2 Analog Output

Zero Scale

You can determine at which value of the analog function the analog output delivers 0 or 4 milllamps to the load.

Full Scale

You can determine at which value of the analog function the analog output delivers 20 milllamps to the load.

Note: The 0-20mA can be converted to a 0 to 5vdc or 0 to 10vdc signal by placing a resistor across the input of the receiving instrument whose parallel combination with the input resistance of the receiver is 250 ohms or 500 ohms respectively.

4.3.3 Setpoints

Relay setpolnts are used to trigger events. In some applications, they are used to trigger the adding of ingredients at specified stages of a process. In other applications, they are used to trigger alarm conditions. For Instance, they are used to trigger an alarm condition when the speed of a machine drops below or rises above its normal range of operation. The following discussion will focus on the latter type of application.

Setpoint Types

There are two types of setpoints: underspeed and overspeed. Underspeed relays trigger events when frequency drops below the setpolnt.

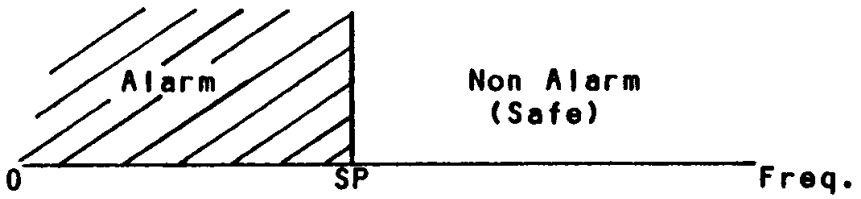


FIGURE 2. UNDERSPEED SETPOINT

Overspeed relays trigger events when the frequency rises above the setpolnt.

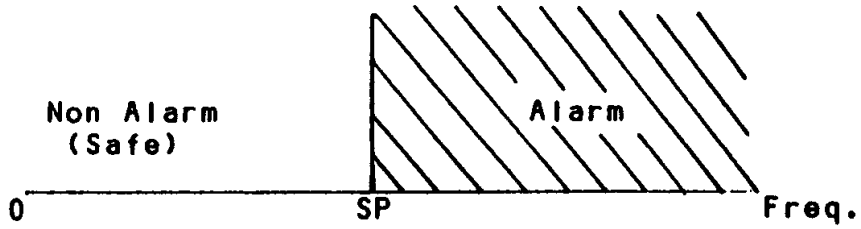


FIGURE 3. OVERSPEED SETPOINT

Setpoint Behavior

Relay setpoints may be configured to either energize or de-energize above and below the setpoint value. Thus, for each relay setpoint you must decide what type you want and how you want the relay to behave. Overspeed relays which energize above the setpoint and underspeed relays which energize below the setpoint are called Non-Failsafe. Ovespeed relays which de-energize above the setpoint and underspeed relays which de-energize below the setpoint are called Failsafe. Failsafe provides you with a warning in the event that a power failure occurs which the machine is operating within the Non-Alarm (Safe) area of operation.

Latchlng/Auto Reset

You can configure the relays as either Latching or Auto Reset. Latching relays remain in an alarm condition and must be reset manually by using the pushbutton located behind the instrument's Display door*. Failsafe Auto Reset relays automatically energize when the machine returns to its Non-Alarm state of operation. You can program the relay to automatically reset at setpoint or you can program it to reset with a Hysteresis (a dead band). That is, you can program it to reset within a specified range of the setpoint. Hysteresis prevents "chatter" (the clicking on and off of the relay) as frequency hovers around the setpoint value. Hysteresis is specified as a percentage of the setpoint value. The position of hysteresis above or below the setpoint is determined by the relay type. Overspeed relays have hysteresis below the setpoint. Underspeed relays have hysteresis above the setpoint.
Figure 4 shows an overspeed relay with hysteresis below setpolnt.

*Loss of instrument power will cause a latching relay to reset in the absence of an alarm condition.

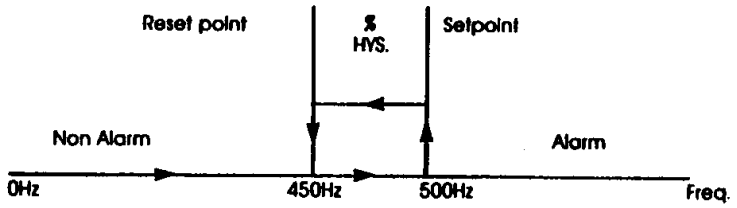
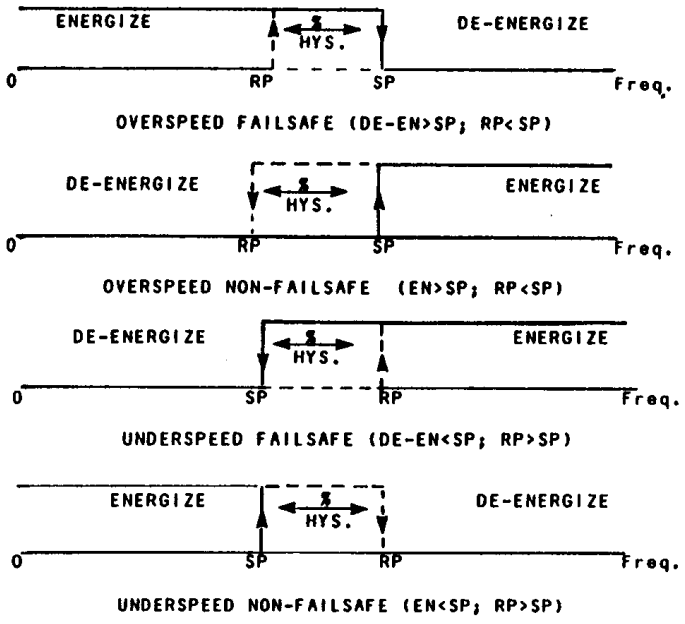


FIGURE 4. OVERSPEED RELAY WITH HYSTERESIS BELOW SETPOINT

Figure 5 illustrates the behavior of the setpoint relays.

FIGURE 5. SETPOINT RELAY BEHAVIOR

En = energize	RP = resetpoint	> = above
DE - EN = de-energize	HYS. = hysteresis	< = below



Use Table 1 to select the behavior and type of relay setpoint. The numbers in the table denote the numbers placed in the second digit of Constant C_{12} for setpoint 1 and the third digit of Constant C_{12} for setpoint 2.

SETPOINT TYPE

SETPOINT BEHAVIOR	Overspeed hysteresis below setpoint	Underspeed hysteresis above setpoint
Auto Reset Failsafe	de-energize above setpoint 0	de-energize below setpoint 1
Auto Reset Non-Failsafe	energize above setpoint 2	energize below setpoint 3
Latching Failsafe	de-energize above setpoint 4	de-energize below setpoint 5
Latching Non-Failsafe	energize above ssetpoint 6	energize below setpoint 7

TABLE 1. RELAY SETPOINT BEHAVIOR AND TYPE

4.3.4 Sample Set-ups

Single Channel Operation

Suppose you are measuring the rate at which paper is passing along a bed roll, the diameter of the roller plus twice the thickness of the conveyor belt is equal to 36 inches. The sensor is reading from a 24 tooth gear.

You want the tachometer to;

1. Compute Speed A in RPM

$$SF = \frac{C_1}{C_2,} = \frac{60}{PPR} = \frac{60}{24} = \frac{10}{4}$$

$C_1 = 10.000$

(C_3 and C_4 are not adjusted)

$C_2 = 4.000$

(C_3 and C_4 are not adjusted)

2. Send Computed Function (Speed A) to All Outputs

Speed A = 1 on Function Chart

C_{11} = | X | 1 | 1 | 1 | 1 | x - denotes unused digit

3. Have Display Show FPM with Autoranging to Two Decimals, right only

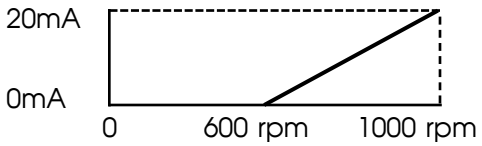
A x C_5 = Display value: RPM x FPR = FPM

FPR = Diameter x π = 36 x 3.1416 = I I3.0973 in. Converted to Feet = 9.425 where FPR = feet per revolution

C_5 = 9.425

C12 = | | X | | | 6 |

4. Have the Analog Output Drive an Auxiliary 0-20mA meter with a range of 600 to IOOOrpm.

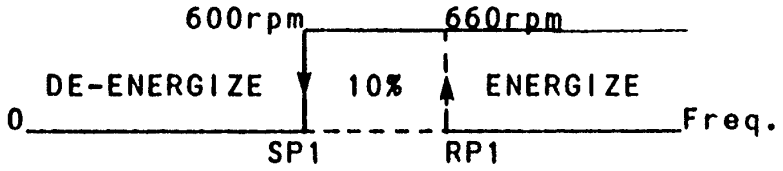


C_6 = 600

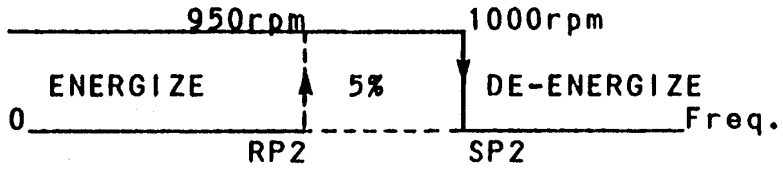
C_7 = 1000

C12 = | 1 | X | | | 6 |

5. Go to an Alarm Condition when the speed drops below 600rpm and automatically come out of Alarm when it returns to 660rpm (Underspeed Failsafe)



6. Go to an Alarm condition when the speed rises above IOOOrpm and automatically come out of Alarm when it returns to 950rpm (Overspeed Failsafe)



C_8 = 600

C_9 = 1000

C_{10} = | X | 0 | 5 | 1 | 0 |

C_{12} = | 1 | X | 0 | 1 | 6 |

- autoranging to two decimals, right only
- underspeed failsafe
- overspeed failsafe
- analog output is 0 - 20 mA

Dual Channel Operation

Suppose you are using the tachometer as an elongation monitor in a paper mill. Elongation is the change in length of the paper at the outgoing roller. The diameter of the roller plus twice the thickness of the belt at each end of the process is 36 inches. The sensors are reading from 48 tooth gears.

The shaft driving the incoming roller is turning at 1000 rpm, and the shaft driving the outgoing roller is turning at 1250 rpm.

You want the tachometer to:

1. Compute Speed A (Incoming roller) and Speed B (out-going roller) in FPM.

$$SF\ fpm = \frac{60 \times \pi \times D'}{PPR} = \frac{60 \times 3.1416 \times 3'}{48} = \frac{565.4880}{48}$$

$C_1 = 565.5$

$C_2 = 48.00$

$C_3 = 565.5$

$C_4 = 48.00$

2. Send the percentage of elongation to Display, ratio to Setpoints I and 2, and Speed B only to Analog Output.

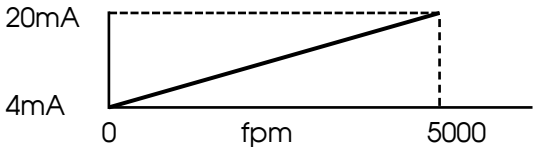
C_{11} = | x | 5 | 5 | 2 | 9 |

3. Have Display show FPM with autoranging fixed to one decimal place.

C_5 =1000

C_{12} = | | X | | | 1 |

4. Have the Analog Output drive an auxiliary 4 - 20mA recorded which has a range of 0 to 5000fpm.



$C_6 = 0000$

$C_7 = 5000$

C_{12} = | | X | | | 1 | — blank

5. Use the setpoints for web break detection, with Setpoint 1 going to alarm if the ratio is less than 0.5, and Setpoint 2 going to alarm if the ratio is less than 1.0. Relays are latching.

$C_8 = 0.500$

$C_9 = 1.000$

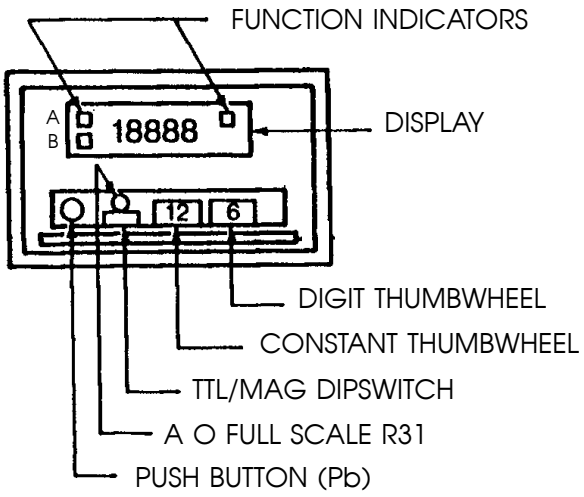
C_{10} = | x | 0 | 0 | 0 | 0 | (no hysteresis)

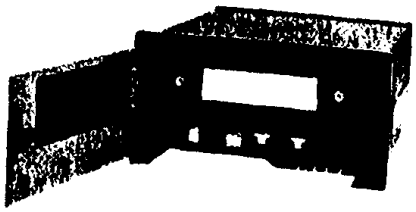
C_{12} = | | x | 5 | 5 | 1 |

- 1 — autoranging fixed to one decimal place
- 5 — latching relay
- 5 — latching relay
- x — analog output is 4 - 20mA

4.4 ENTERING THE CONSTANTS

The Control Panel Is located behind the door of the Display. To gain access to the panel, slide the latch on the Display door to the left.





4.4.1 Control Features

Constant Thumbwheel (CTW): When the CTW is set to "0", the instrument runs at its configured mode. When it is set to a number other than "0", the instrument stops operating as a rate monitor, all outputs freeze at their current values, and the Display shows the constant selected by the CTW. For example, to look at the value for setpoint one, set CTW to 8. Constant 8 (C_8) will appear on the Display. In like manner all constants may be viewed. After reviewing the constants, return CTW and DTW to zero. The Display will show Pb". This means "push the button Pb." By pushing the button, you instruct the instrument to return to normal operation.

Digit Thumbwheel (DTW): The constant being displayed can be altered by using the DTW and the Pb. When the DTW is set to "O", pushing and holding the Pb locates the decimal. When the DTW is set to a Display digit, pushing and holding the Pb changes the number in the digit.

Push Button (Pb): TTL/MAG Dipswitches: Four possible settings program the instrument for the type of sensor being used.

A.O. Full Scale R31 is factory set and normally will not require calibration. It may be adjusted by inputting signals to the instrument that force the output beyond the analog output full scale and by adjusting R31 to 20 millllamps using an accurate current meter.

Display: The Display has 4 1/2 digits. The digit to the far left is referred to as a 1/2 digit because only a blank (zero) or a one (1) can be entered on it. Any two channel calculation may result in a negative quantity. Any value too large for the Display will cause the Display to flash its largest value (19999).

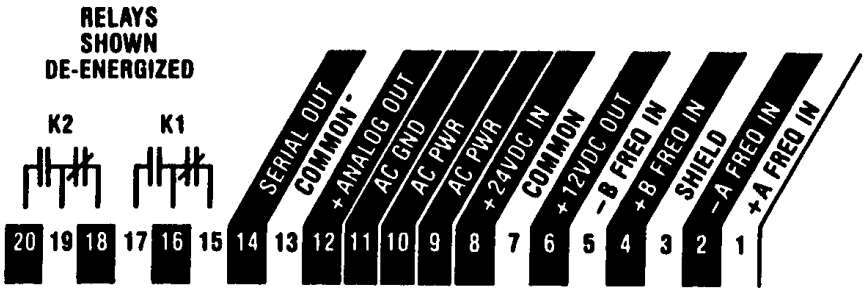
Alternate Display Mode: While in the run mode (CTW and DTW = 0), you may use the DTW to vlew quantities A and B. To view A. set DTW to 1. To view B. set DTW to 2. To view the quantity originally selected for the Display, set DTW to zero. This does not affect the operation of the instrument. The values displayed under A and B using this feature will always be full autoranging regardless of the setting of digit 1 of the constant C_{12}.

Function Indicators: These indicator lamps show the channel displayed.

4.4.2 Turning On The Power

1. Place the tachometer on the flat surface.

2. Attach the AC power cord to rear terminal lead 9,10, and 11.



3. Plug the unit into an AC outlet.

4.4.3 Entering The Scaling Factors For Frequency A and B (C_1 thru C_4)

Note: If you have a 60 tooth gear. then frequency is equal to RPM and the constants are equal to 1 (the standard constant).

1. Use two 4 1/2 digit numbers in the form of a fraction to enter each of the scaling factors.

2. For Frequency A, enter the numerator in C_1 and the denominator in C_2. For Frequency B, enter the numerator in C_3 and the denominator in C_4. If you are using the TACHTROL® 3 tachometer as a single channel instrument, do not adjust the settings for C_3 and C_4.

SAMPLE SCALING FACTOR

$C_1 = \frac{19628}{2500}$,

To enter C_1:

1. Turn CTW to 1

2. DTW is already set at 0. Push and hold the Pb until the decimal disappears.

3. Turn DTW to 1. Push and hold Pb until 8 appears on Display Digit 1.

4. Turn DTW to 2. Push and hold Pb until 2 appears on Display Digit 2.

5. Turn DTW to 3. Push and hold Pb until 6 appears on Display Digit 3.

6. Turn DTW to 4. Push and hold Pb until 9 appears on Display Digit 4.

7. Turn DTW to 5. Push and hold Pb until a 1 appears on Display Digit 5.

To enter C_2:

1. Turn CTW to 2 and then use DTW and Pb to enter the decimal and the number for each digit in the same manner as you did for C_1.

4.4.4 Entering The Function Constant (C_{11})

1. Turn CTW to 11.

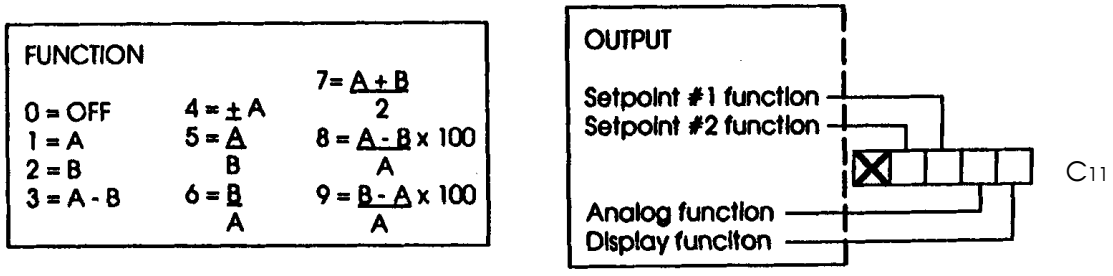
2. Turn DTW to 1 and enter the number of the function you have selected to send to Display by pushing and holding the Pb until the number appears in the first Display digit.

3. Turn DTW to 2 and enter the number of the function you have selected to send to analog output by pushing and holding the Pb until the number appears in the second Display digit.

4. Turn DTW to 3 enter the number of the function you have selected to send to setpoint 1 by pushing and holding the Pb until the number appears in the third Display digit.

5. Turn DTW to 4 enter the number of the function you have selected to send to setpoint 2 by pushing and holding the Pb until the number appears in the fourth Display digit.

Select the number of the function from the table on the left for each output.



Note: Set any unused output to "0" (off) for faster response.

4.4.5 Entering The Constants Which Define The Behavior Of The Outputs(C_{12})

Display Output

1. Constant

   A. Turn CTW to 5.

   B. Enter the constant by using the DTW and Pb in the same manner as you did for C_1 thru C_4

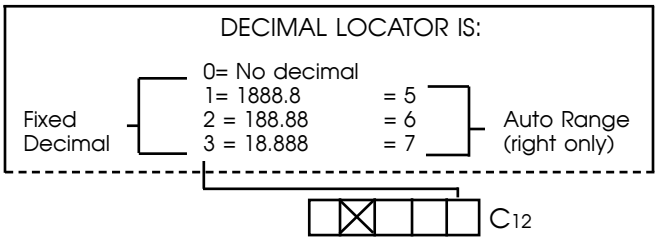
2. Autoranging

   A. Turn CTW to 12.

   B. Turn DTW to 1.

C. Use chart below to select the location of the decimal.

D. Push and hold Pb until the number from the chart appears in the first Display digit.



Analog Output

1. Zero Scale Constant

   A. Turn CTW to 6.

   B. Enter the constant by using DTW and Pb in the same manner as you did for C_1 thru C_5.

2. Full Scale Constant

   A. Turn CTW to 7.

   B. Enter constant by using the DTW and Pb in the same manner as you did for C_1 thru C_6.

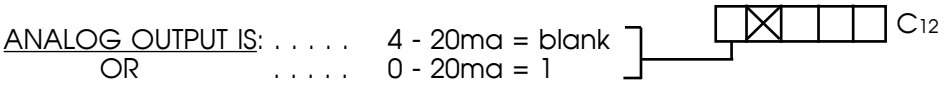
3. Zero Scale Current

   A. Turn CTW to 12.

   B. Turn DTW to 5.

   C. Select the zero scale current from chart (0 or 4ma).

   D. Push and hold Pb until the number representing the zero you've selected appears in the fifth Display digit.



Setpoint 1 Output

1. Setpoint Constant

   A. Turn CTW to 8.

   B. Enter constant by using DTW and Pb in the same manner as you did for C_1 thru C_7.

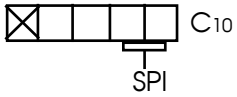
2. Hysteresis For Setpoint 1

   A. Turn CTW to 10.

   B. Enter the value of the hysteresis (given in percents) as a two digit number. (i.e. 5% as 05).

C. Turn DTW to 1. Push and hold Pb until the value of the first digit appears in the first Display digit.

D. Turn DTW to 2. Push and hold Pb until the value of the second digit appears in the second Display digit.



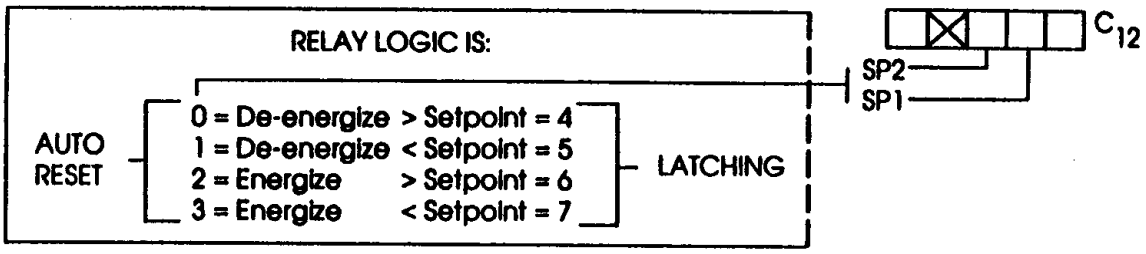
3. Relay Logic

A. Turn CTW to 12.

B. Turn DTW to 2.

C. Select the Relay Logic from the chart below.

D. Push and hold the Pb until the number representing the logic you've selected appears in the second Display digit.



Setpoint 2 Output

1. Setpoint Constant

A. Turn CTW to 9.

B. enter the constant using the DTW and Pb in the same manner as you did for C1 thru C8.

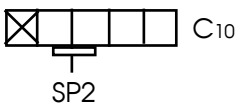
2. Hysteresis for Setpoint 2

A. Turn CTW to 10.

B. Enter the value of the hysteresis (given in percent) as a two digit number.

C. Turn DTW to 3. Push and hold Pb until the value of the first digit appears in the third Display digit.

D. Turn DTW to 4. Push and hold Pb until the value of the second digit appears in the fourth Display digit.



4.5 STORING THE CONSTANTS

Once you have entered the constants, to store them in the TACHTROL® 3 tachometer's memory and return to normal operation, turn the CTW and the DTW both to zero and push the Pb.

4.6 SELECTING THE INPUT OPTIONS

The two dip switches located between the CTW and the Pb are used to program the instrument for the type of sensor being used. The front switch is for channel B, the rear one for channel A. For TTL inputs set the switch to "ON" and for AC signals such as passive magnetic sensors, set the switch to "OFF". When using TTL inputs, it is also necessary to connect the negative input on the terminal block to the common terminal with a wire number as shown In the wiring diagram.

Note: A passive sensor may be used with one channel and an active sensor with the other.

Note: Both active and passive inputs present a 2000 ohm load to the sensors.

Now that you have finished entering the constants and input options, the instrument is ready to operate. Proceed to installation.

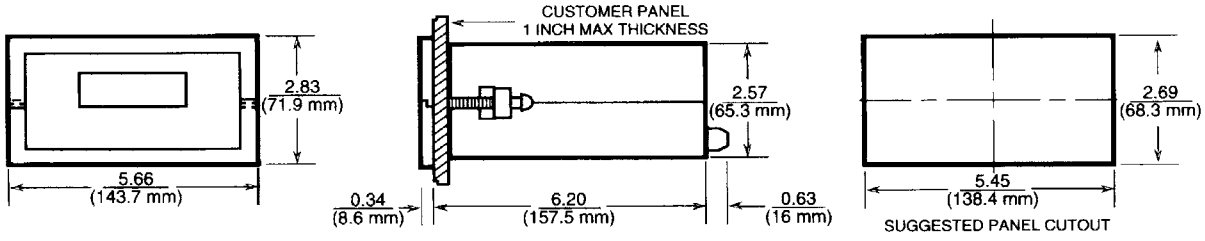
5.0 HOW TO INSTALL THE TACHTROL® 3

5.1 MOUTING THE INSTRUMENT

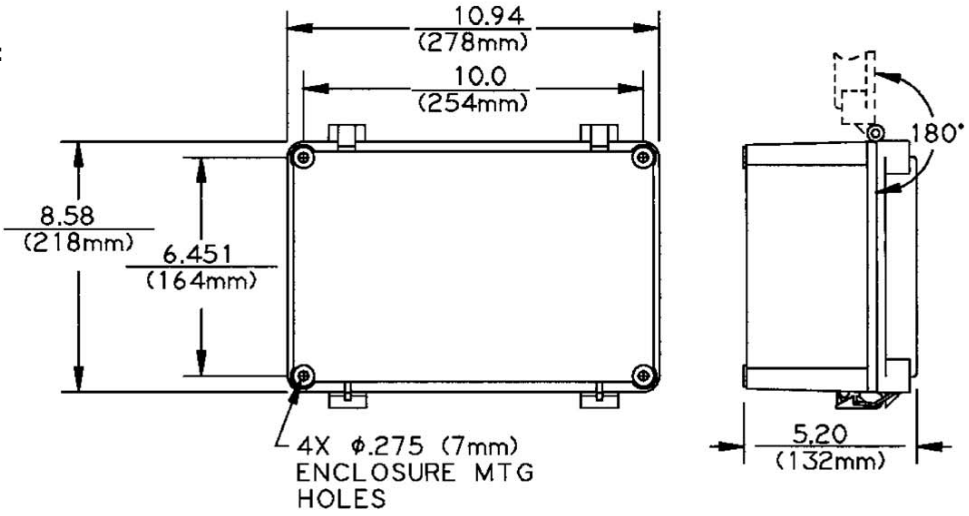
Mounting the instrument onto panels ranging in thickness from 1/l6 inch to 1 Inch. Install a splash proof gasket between the panel and the bezel. Make sure all cuts are made precisely.

5.2 PANEL MOUNTING DIMENSIONS

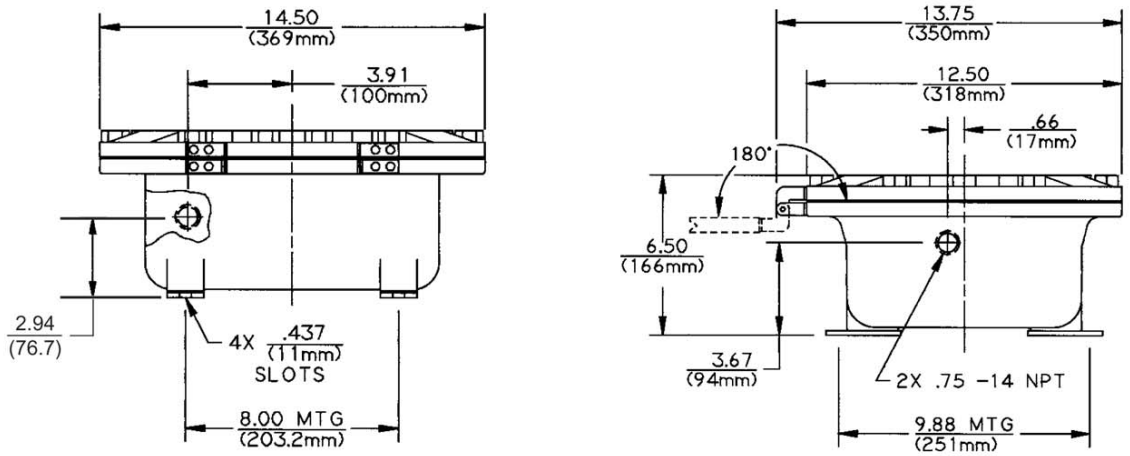
1. Panel Mount (Standard):



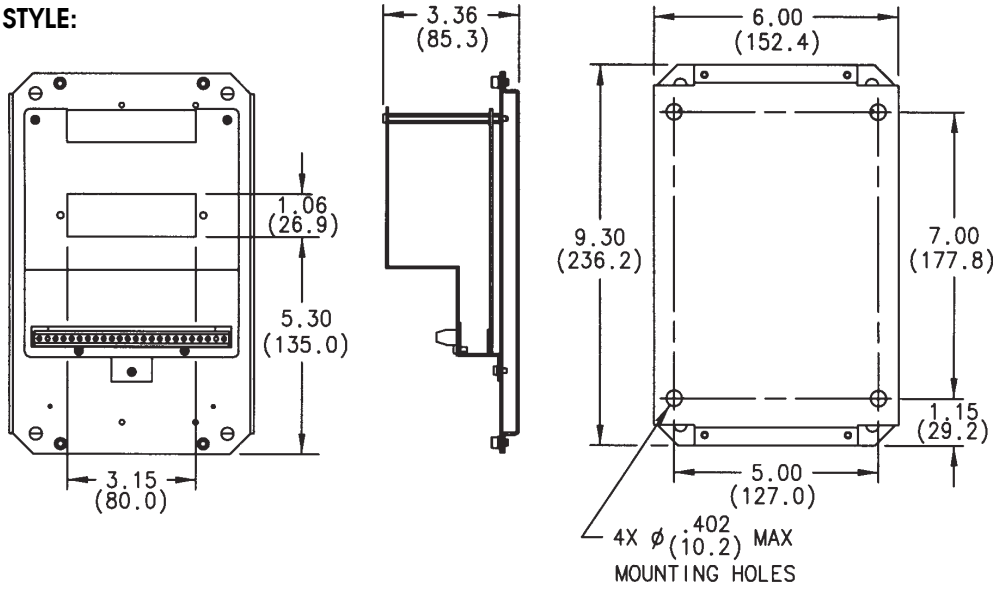
2. NEMA 4X:



3. X STYLE:



4. LESS ENCLOSURE STYLE:



T77310-01 & -02

6.0 HOW TO INSTALL THE SPEED SENSOR

6.1 MOUNTING THE SPEED SENSOR:

In most applications, Passive (not powered) speed sensors will be used. Low speed applications (typically below 100 RPM) will require an Active (powered) or Zero Velocity speed sensor.

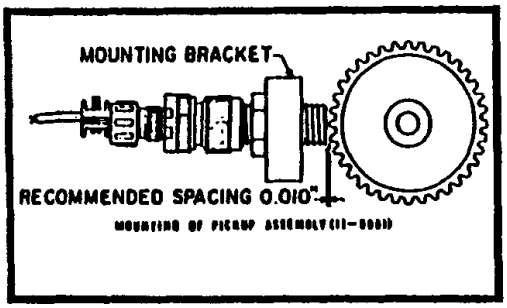
The mounting for both types of sensors should be able to accommodate several threads and heavy enough to prevent excessive vibration. The mounting material should be non-magnetic. The normal vibration of the machine in operation will not affect the accuracy of the display reading. However, relative motion between the sensor and the gear can cause incorrect readings.

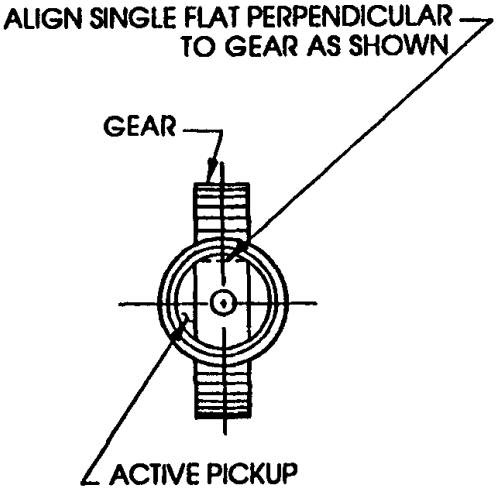
6.2 SETTING THE CLEARANCE:

If you are using an AI-Tek Speed Sensor, use a feeler gauge to set the clearance. For Passive Sensors a clearance of .005 to.030 inches is recommended. For Active Sensors a clearance of .010 to .060 inches is recommended. Increasing the clearance beyond these values causes the amplitude of Passive Sensors to decrease and may cause Active Sensors to cease operation.

CAUTION: AT NO TIME IN ITS REVOLUTION SHOULD THE GEAR TOUCH THE SENSOR OR DAMAGE MAY OCCUR. When you have set the clearance, check the setting to see that a complete revolution of the gear does not in any way contact the sensor.

Proper orientation of Active Sensors is also required. Flats on the housing must be in the same plane as the gear. See diagram below:





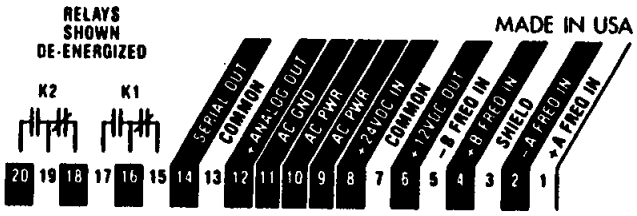
If you are using another manufacturer's speed sensor, consult the manufacturer's recommended installation procedures.

6.3 TYPICAL WIRING CONNECTIONS FOR AI-TEK SENSORS

Signal leads between the sensors and the instrument should be shielded, twisted pairs with insulation over the shielding. This will provide effective noise shielding and is recommended for all pickup, analog output, and serial data cables. Nevertheless, care should be taken to run signal leads away from noise sources such as switching and power lines carrying large currents. Shields should be connected at the TACHTROL® 3 end only. The shields at the sensor end should be trimmed and taped so there is no contact with the conduit or other grounds. Make sure you connect terminal 11 to an earth ground.

Standard AI-Tek sensors are designed to operate with gears of 8 or 20 pitch, and new designs should incorporate these. For applications using other pitch gears or other irregular discontinuities consult the AI-Tek Industrial Products Catalog.

The pulse signal for channel A enters the instrument through terminals 1 (freq. +) and 2 (freq. -). The pulse signal for channel B enters the instrument through terminals 4 (freq. +) and 5 (freq. -).



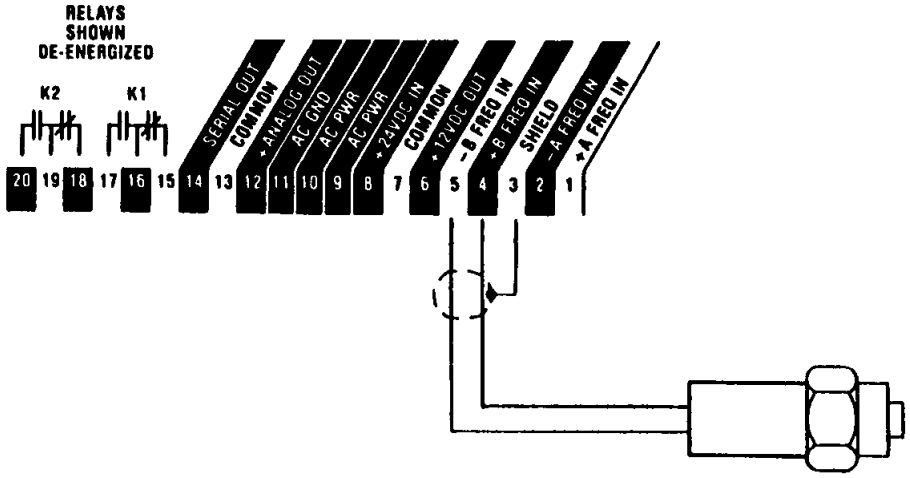
WIRING LIST	
TERMINAL NO.	SIGNAL NAME
1	+ A FREQ. IN
2	- A FREQ. IN NOTE 1
3	SHIELD
4	+ B FREQ. IN
5	- B FREQ. IN NOTE 1
6	+ 12 V.D.C. OUT
7	COMMON
8	+ 24 V.D.C. IN
9	AC. POWER
10	AC. POWER
11	AC. GROUND
12	+ ANALOG OUT
13	COMMON
14	SERIAL OUT
15	K-1 CLOSED CONTACT #2
16	K-1 COMMON #2
17	K-1 OPEN CONTACT #2
18	K-2 CLOSED CONTACT #2
19	K-2 COMMON #2
20	K-2 OPEN CONTACT #2

NOTES: 1. TO CONFIGURE AN INPUT FOR TTL OPERATION THERE MUST BE A JUMPER FROM THE APPROPRIATE - FREQUENCY IN TERMINAL TO TERMINAL 7 (COMMON).

#2. RELAYS (K-1 AND K-2) ARE SHOWN DE-ENERGIZED.

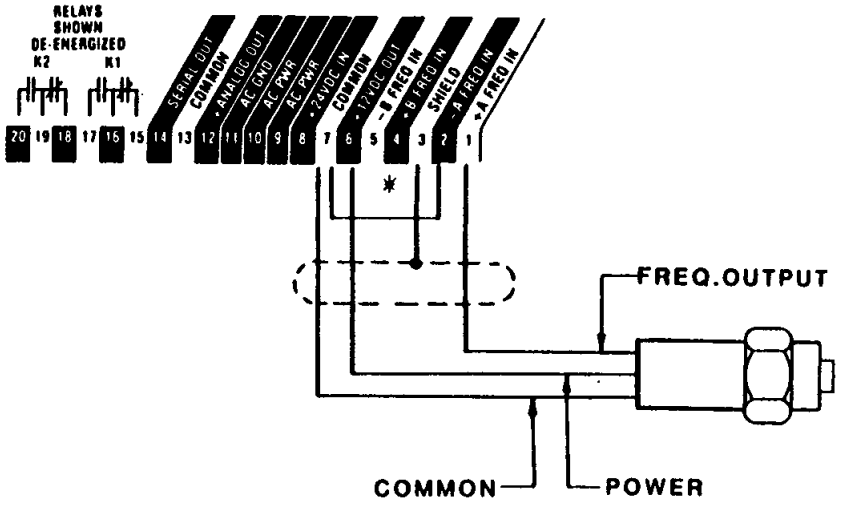
6.3.1 Passive Sensors

The figure below illustrates the use of a Passive Sensor connected to channel B producing an AC signal.
Refer to the AI-Tek Instruments Products Catalog for information.



6.3.2 Active Sensors

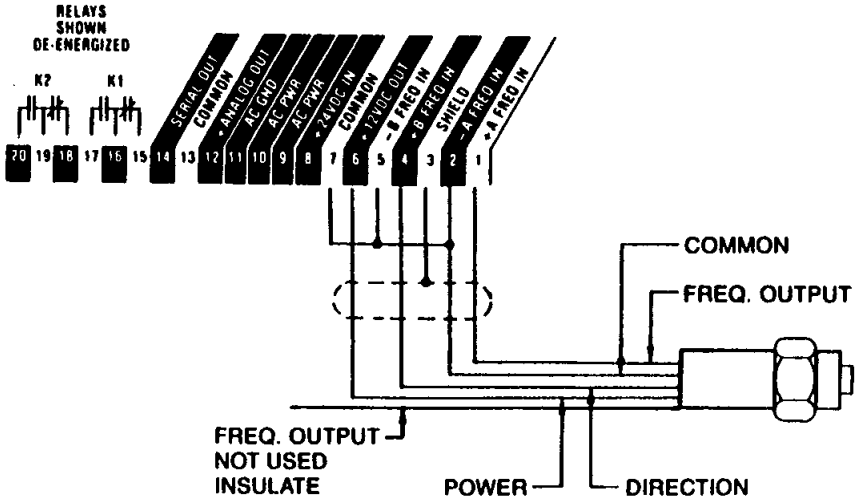
The figure below illustrates the use of an Active Sensor connected to channel A producing TTL pulses. Note that the jumper between terminals 2 and 7 references one side of the frequency output to circuit common. Other TTL sensors should be wired the same way.



***Note:** connect 2 and 7 with jumper

6.3.3 Bi-Directional Sensors:

These sensors have basically the same wiring as Active Sensors. When set up for bi-directional operation, The TACHTROL® 3 tachometer "reads" the B input to determine direction. You can choose which direction is considered minus (-) direction by orienting the sensor. Rotate the sensor through 180 to reverse the operation of the minus (-) sign. See Signal input Specs.



***Note:** connect 2, 5, and 7 with jumper

7.0 APPENDIX: TIME MODE OPERATION

The TACHTROL® 3 tachometer can be configured to display the time between pulses in micro seconds by setting the denominator of each scaling factor (C_2 and C_4) to zero. The scaled input frequency is now as follows:

$$A = \frac{C1}{fA \times 10^{-6}} \qquad OR \qquad C1 = A \times 10^{-6} \times fA$$

$$B = \frac{C3}{fB \times 10^{-6}} \qquad OR \qquad C3 = B \times 10^{-6} \times fB$$

Example:

$C_1 = 1.000$
$C_2 = 0.000$

fA = 2000hz

$$A = \frac{1.000}{2000} \times 10^{6} = 500$$

The resulting number in micro seconds can be used with all the functions and outputs in the TACHTROL® 3 tachometer.

SPECIFICATIONS

INPUT SIGNAL:
Frequency: 2 Hz to 30K Hz

Passive Pickup (Sine wave): 200 mV to 25 VRMS standard, 2K ohm impedance, common mode rejection: 40 db, balanced input, sensitivity measured at I KHz.

Active Pickup (TTL): duty cycle 20 to 80%; DC pickup power, 12 VDC @ 100 mA (will power two (2) zero velocity pickups or one (1) bi-directional pickup).

Bi-Directional Pickup: One (1) frequency input (TTL input A) and the direction input (TTL input B) from a Bi-Directional pickup. (High (+5v) indicates positive direction, and only single speed functions (Speed A) are useful when connected in this operation mode.

POWER SUPPLY:
120 VAC± 10%. 50-60 Hz.
24 VDC (23-30 VDC), standard (750 ohm analog load)
(20-30 VDC with 600 ohm analog output load)
240 VAC± 10% 50-60 Hz.
15 watts maximum

TEMPERATURE:
Operating: 0 to 50° C (ambient)
Storage: -40° to + 80° C

HUMIDITY:
90% relative and non-condensing

VIBRATION:
Designed to meet MIL 810C. method 514.2. Procedure VIII, Fig. 514.2-6, curve V (l.5g's 10-200 Hz)

SHOCK:
Designed to meet MIL 810C, method 516.2. Procedure 1. Fig. 516.2-2 for ground equipment (30g's half sine)

NOISE:
Designed to operate in high noise environments (400 V line spikes, and RF immunity to high power UHF portable transmitters In close proximity).

DISPLAYS:
4 1/2 digit with minus sign & decimals (positive values indicated by no minus sign).
Bright .56" Red LED
Fixed or floating decimal (3 places)
Number range ± 0.000 to ± 19999
Three (3) LED function indicator lamps

OUTPUTS:

Analog 0-20mA or 4-20mA field selectable, output consists of 1000 .02mA steps. 750 ohm load maximum.
Span pot adjustable ±10%. Zero and full scale set into memory in engineering units.
0-10 VDC or 0-5 VDC obtained by installing a 500 ohm or 250 ohm precision, low temperature coefficient resistor across the driven load.

Relay Setpoints: 2 Relays standard
SPDT (form C) contact rating (resistive) 250 VAC 6 amp (1800 VA), 28 VDC 6 amp (170W). Selectable Relay Logic: Energize or de-energize above or below setpoint, auto-reset with hysteresis selectable 0-99% of SP In 1% steps, latching (reset by pushbutton behind front panel door).

Accuracy: (including temp. variations)
Digital ±.03% typical (±.05% max.) and ± 1 least significant digit
Analog ±.3% of range

Response Times: Display updated approx. every 1/2 sec. based on latest available input measurement(s).

Analog & Relay Outputs updated at a variable rate depending on the frequency. The typical & maximum response times are:

Above 100 Hz =100 milliseconds typical
200 milliseconds maximum
2 Hz to100 Hz = 2 cycles + 30 milliseconds typical
6 cycles + 30 milliseconds maximum
Below 2 Hz = Measurements considered zero.

For values computed from both signal inputs, a new computed value is updated each time either signal completes a measurement.

Range of Normalization (linear or inverse only)
Input frequencies A & B may be normalized by a number from .5000 x 10^{-7} to 2.000 x 10^{+7}.
Normalization is entered in the form: $\frac{+ -1XXXX}{+ -1XXXX}$
Additional display normalization range ±.001 to 19999.

Constant Storage:
Retained In EAROM and may each be altered 1000 or more times.

Electrical References:
Circuit Common is isolated from AC power, AC ground and case. DC power, analog output and serial output are referenced to circuit common. Passive inputs are balanced. Active pickup inputs are referenced to circuit common.

CAUTIONARY NOTE: Attempts to repair the TACHTROL® 3 in the field are NOT RECOMMENDED. Should a problem occur, call: Deca Systems, Inc.
Baton Rouge, LA
225-273-2770

FOR SCHEMATICS WRITE TO:

SCHEMATICS
AI-Tek Instruments
152 Knotter Drive
P.O. Box 748
Cheshire, CT 06410-0748

INSTALLATION AND WIRING PRACTICES FOR ELECTRONIC INSTRUMENTATION & CONTROL

The following practices should be followed in the installation of electronic indicating and control devices in industrial locations. Each installation will be different and generally more care should be exercised as installations become wires that transmit frequencies or pulse coded data.

The following practices should be observed:

1. Locate equipment away from sources of water, humidity, heat or dust, or provide a suitable enclosure to protect the equipment from these elements.
2. Locate equipment away from SCR's. triacs, buzzers, horns, heavy motors, welding equipment, contactors, heavy current relays or other electrical noise generating equipment.
3. Use a metal enclosure to protect the electronic components from radiated electrical noise or other magnetic influences. If the electronic equipment is removed from its original cabinet, it should only be installed in panels or cabinets with other low level electronic devices.
4. Conduits from low level signal and control wiring should be separate from wiring for switching and power wiring. Cabinet and panel wiring should be planned so the power and relay wiring is dressed to one side. and low level signals dressed to the other side. Wiring to barrier strips, connectors and relay contacts should be planned also for maximum separation.
5. Signal and control wiring should be at a minimum run in twisted pairs. Lines for magnetic pickups, pulse type outputs and other frequency devices should be run in separate 2 wire shielded cables.
6. The switching of balanced inputs (such as magnetic pickup inputs) should be accomplished by switching both inputs. The switching of just one input creates an unbalanced line and introduces additional electrical noise to low level signals.
7. The use of commutators or slip rings in transmitting low level signals is not recommended. Should this practice be absolutely necessary, care must be exercised that the point of contact be maintained and clean at all times.
8. Shield Connections for shielded cables should be connected so that no current flows in the shield. This is accomplished by connecting all of the shields in series. Care is exercised not to ground the shield at any point. The shield is then connected to the instrument (tachometer or other device) at the shield terminal. The case of the electronic instrument should be connected to earth ground. Some instruments will provide a connection terminal for this purpose.
9. Provide a power line that is noise free and free of power interruption. Normally this will be a buss for use by low power electronic devices. In some cases this may require constant voltage, isolation or noise filters.
10. DC power busses should operate within the limits provided in the instrument's specifications. Special care to isolate DC relay contact wiring should be taken. Most electronic instruments will not operate correctly on battery charger supplies unless the battery remains in the circuit. In some cases removal of the battery with the charger remaining on may damage the instrument.

TROUBLESHOOTING

Most troubles wll be avoided by following the above practices. In particularly severe cases electrical noise may be further reduced. As a general rule. electrical noise may be easily reduced at the source. The installation of snubber networks or commercially available noise suppressors across relay contact, relay coils and buzzers will usually be successful.

WARRANTY AND RETURN SHIPMENTS STATEMENT

The materials ordered and agreed to be furnished by Seller are warranted against defect of material or workmanship for a period of one (1) year from the date of shipment, or for their rated life whichever comes first). Seller's obligation under the warranty is limited to repair or replacement, in Seller's option, of the defective material at Seller's factory (point of shipment) and does not extend to equipment other than of Seller's manufacture. The warranty shall not apply to any product or part which has been subject to misuse, negligence, accident, or attempted or unauthorized repair or modification. All return shipments must be factory authorized prior to shipment, and shipment will be at Buyer's expense. The only statutory warranties applicable to the materials are warranties of title and that the materials will be merchantable and, if manufactured to Buyer's specifications, that the said items conform to such specifications. UNLESS EXPRESSLY STATED ON THE FACE HEREOF, NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE IS TO BE IMPLIED, NOR ARE ANY OTHER WARRANTIES TO BE IMPLIED FROM COURSE OF DEALING OR USAGE OF TRADE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THOSE STATED HEREIN. SELLER'S SOLE LIABILITY FOR DEFECTS OR BREACH OF WARRANTY SHALL BE REPLACEMENT OF THE MATERIALS INVOLVED, AND IN NO EVENT WILL THE SELLER BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES. FAILURE TO TEST, INSPECT AND MAKE CLAIMS FOR BREACH OF WARRANTY WITHIN REASONABLE PERIODS SHALL BE CONCLUSIVE EVIDENCE THAT THE MERCHANDISE SHIPPED SATISFACTORY IN ALL RESPECTS AND SUPPLIED IN ACCORDANCE WITH ORDERED SPECIFICATIONS.

LIMITATIONS OF LIABILITY: (a) SELLER WILL NOT UNDER ANY CIRCUMSTANCES, WHETHER AS A RESULT OF BREACH OF CONTRACT, BREACH OF WARRANTY, TORT OR OTHERWISE BE LIABLE FOR CONSEQUENTIAL. INCIDENTAL. SPECIAL. OR EXEMPLARY DAMAGES including, but not limited to, loss of profits or revenues, loss of use of or damage to any associated equipment, cost of capital, cost of substitute products, facilities or services, downtime costs, or claims of Buyer's customers, (b) SELLER'S LIABILITY ON ANY CLAIM OF ANY KIND FOR ANY LOSS OR DAMAGE ARISING OUT OF, RESULTING FROM, OR CONCERNING ANY ASPECT OF THIS AGREEMENT OR FROM THE PRODUCTS OR SERVICES FURNISHED HEREUNDER SHALL NOT EXCEED THE PRICE OF THE SPECIFIC ORDER OR SHIPMENT WHICH GIVES RISE TO THE CLAIM.

NOTICE REGARDING DAMAGE

These units were carefully packed in compliance with carrier regulations and thoroughly inspected before leaving our plant. Responsibility for their safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss or damage sustained in transit must, therefore, be made upon the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents may be damaged in transit due to rough handling even though the package may not show external damage. When damage is discovered upon unpacking, make a request for inspection by the carrier's agent. Then file a claim with the carrier since such damage is the carrier's responsibility.

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt and signed by the carrier's agent. Failure to properly describe evidence of loss or damage may result in the carrier refusing to honor a claim.

We definitely are not responsible for any damage incurred while merchandise is in transit. The transportation company will settle promptly all claims as they are insured and their rates cover this cost. Any correspondence in regard to loss or damage must be accompanied by a copy of the carrier's report.

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP