Multiplier Module

Instruction Manual
MUL270-000

CAROTRON

Driven by Excellence

D.C. DRIVES, A.C. INVERTERS,
SOLID STATE STARTERS, SYSTEM INTERFACE
CIRCUITS AND ENGINEERED SYSTEMS

Table of Contents

List of Figures

1 General Description

Model MUL270-000 is designed for industrial applications where the multiplication of DC voltage signals is required. The module has two voltage inputs (X & Y). Each voltage input has an associated Teach terminal that can be used to calibrate the minimum and maximum input levels. In its most basic setup, the module multiplies INPUT X by INPUT Y:

$$Output = InputX \times InputY$$

A calibrated 100% signal on Input X and on Input Y would nominally produce a full-scale output signal. The multi-turn GAIN and BIAS potentiometers can be used to set the maximum and minimum output levels. Typical output levels are 0-10V, 0-20mA, or 4-20mA.

Input Y also has a TRIM RANGE potentiometer that can be used to limit the minimum range of INPUT Y. This functionality is typically used in the dancer trim and torque takeup/letoff applications. An internal jumper allows selection of a voltage or current output. Onboard EEPROM is used to backup and retain the calibration values during a power loss.

2 Specifications

2.1 Electrical

D.C. Power Input

- 24 VDC ±10%, 60mA max, internally fused

+15VDC Reference Output

- 20mA max

X & Y Inputs

- Range: 0-10VDC
- Input Impedance: 10^{12} Ω

Potentiometers

- Turns: 15

Temperature Range

- 0-55º C

Signal Output

- **Voltage Output**
  Selected by position V on J2. This circuit allows the output to source a voltage level of up to +10 VDC into a minimum resistance of 600 Ohms. If resistance is too low, output linearity may be affected.
- **Current Output**
  Selected by position I on J2. This circuit allows the output to source a regulated current up to 20mA into a maximum resistance of 500 Ohms. Using the BIAS pot, the output can source a 4 to 20mA signal.

2.2 Physical

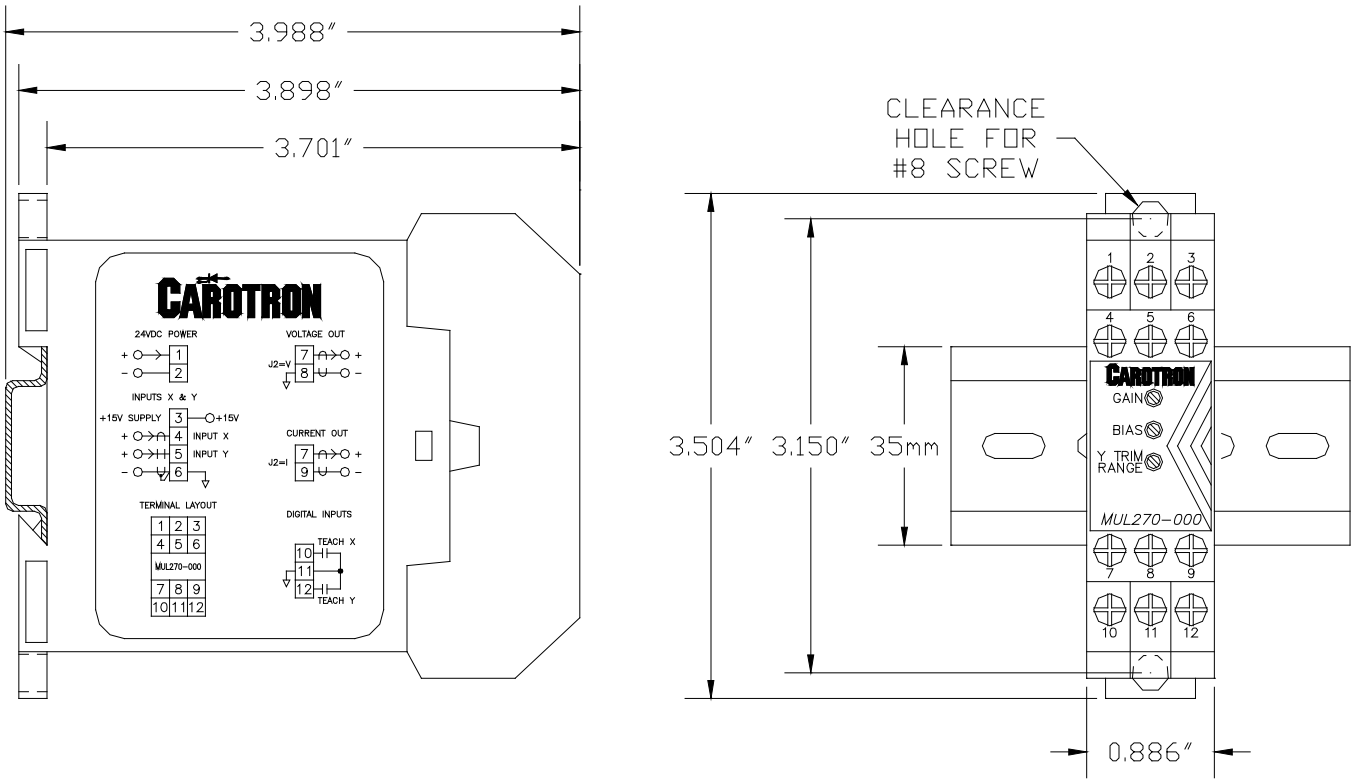


Figure 1: Physical Dimensions

3 Installation

3.1 Wiring Guidelines

To prevent electrical interference and to minimize start-up problems, adhere to the following guidelines:

Use fully insulated and shielded cable for all signal wiring. The shield should be connected to circuit common at one end only. The other end of the shield should be clipped and insulated to prevent the possibility of accidental grounding.

Signal level wiring such as listed above should be routed separately from high level power wiring (such as the A.C. line, motor, operator control, and relay control wiring). When these two types of wire must cross, they should cross at right angles to each other.

Any relay, contactor, starter, solenoid or other electro-mechanical device located in close proximity to or on the same line supply as the MUL270-000 should have a transient suppression device such as an MOV or R-C snubber connected in parallel with its coil. The suppressor should have short leads and be connected as close to the coil as possible.

3.2 Signal Connections

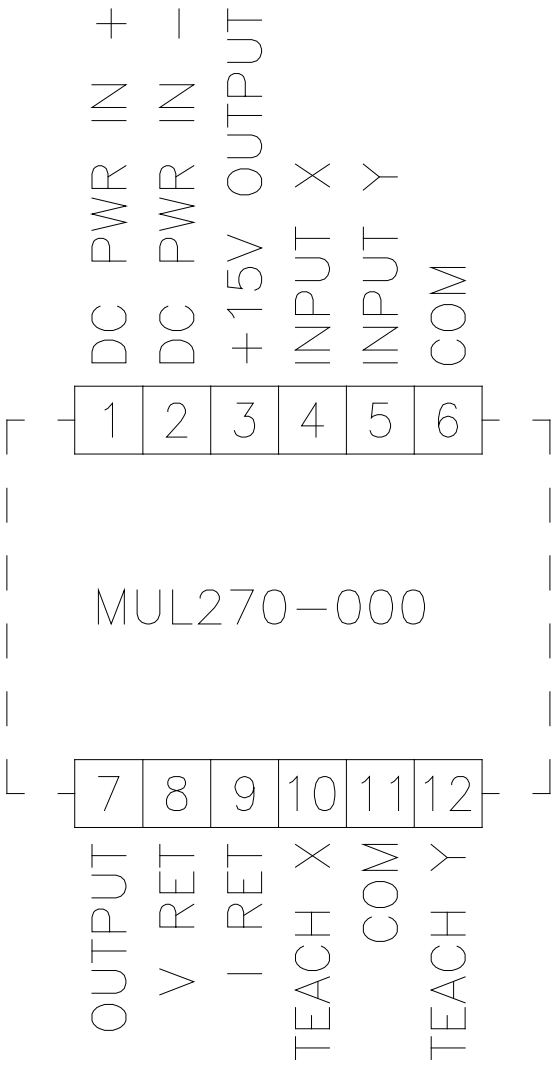


Figure 2: General Connections

4 Description of Features & Adjustments

JUMPER J2
Selects the Output Mode between Voltage or Current. Position V on J2 selects the Voltage Mode and the output is sourced from terminals 7 & 8. Position I on J2 selects the Current Mode and the output is sourced on terminals 7 & 9.

GAIN Potentiometer
Sets the maximum output level at terminal 7. With full-scale signals applied to INPUT X and INPUT Y, adjust this potentiometer to set the maximum output level.

BIAS Potentiometer
Sets the minimum output level at terminal 7. With the minimum signals applied to INPUT X and INPUT Y, adjust this potentiometer to set the minimum output level.

INPUT Y TRIM RANGE Potentiometer
Sets the minimum trim range of the terminal 5 input. The maximum range of INPUT Y is always 100%. The minimum range of INPUT Y can be adjusted from 0% to 100% via this potentiometer. When the TRIM RANGE is set fully counter clockwise, INPUT Y has full range of 0 to 100%. Thus, INPUT Y can scale the output entirely to minimum. Clockwise rotation of this potentiometer increases the minimum range of INPUT Y. Setting this pot at mid-position would define an input range of 50-100% for INPUT Y. Thus, a minimum input level on INPUT Y would only scale the output down to 50% of INPUT X instead of 0%.

TEACH INPUTS
The INPUT X and INPUT Y terminals can accept a nominal 0 to 10VDC input signal. Each input has an associated TEACH terminal that can be used to calibrate that input to the actual minimum and maximum signal levels. Thus, an input signal with a range less than 10V (1V to 9V for example) can be calibrated to reflect a 0 to 100% input. In addition, the order in which the voltage levels are taught can be used to invert the slope of the input. Thus the 1-9V input can reflect a 0-100% or a 100-0% signal.

Apply the signal level to the input terminal that corresponds to 0%. Teach this level by connecting the associated Teach input to circuit common (terminal 11). Next, apply to the input terminal the signal level that corresponds to 100%. Teach this level by disconnecting the Teach input from circuit common. If an error is made during the teach process, simply repeat the procedure.

5 Adjustment Procedure

WARNING! DURING CALIBRATION, THE MUL270-000 MODULE WILL PRODUCE AN OUTPUT. PLEASE DISCONNECT ANY EQUIPMENT FROM THE MODULE THAT COULD BE DAMAGED OR CAUSE INJURY DURING THIS PROCESS.

Proceed to Section 5.1, 5.2, or 5.3 depending upon the type of application.

5.1 Generic Trim Potentiometer

Many times, it may be desirable to use an electronic sensor instead of an actual potentiometer. In cases where the clockwise terminal of the potentiometer is connected to a fixed supply voltage, the electronic sensor can easily be substituted.

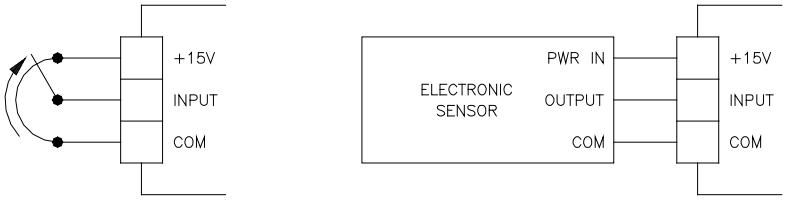


Figure 3: Valid Pot Replacement

However, an electronic sensor cannot be substituted when a trim function is desired and the clockwise terminal of the potentiometer is connected to a variable supply. This is because the electronic sensor cannot perform the multiply (or ratio) function that a potentiometer inherently can. In addition, the electronic sensor requires a fixed supply voltage.

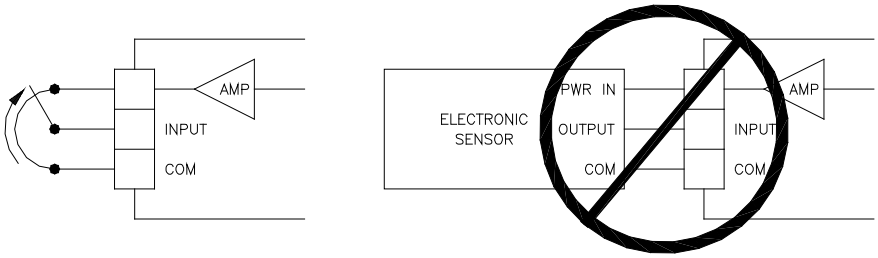


Figure 4: Invalid Trim Pot Replacement

In these cases, the MUL270-000 multiplier module can be used to perform the multiplication function.

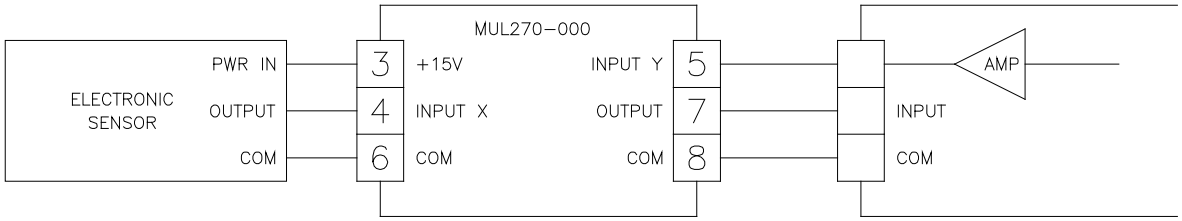


Figure 5: MUL270-000 Trim Pot Replacement Example

Step 1: Select Output Type

1. Select the type of output desired using Jumper J2. If a Voltage output is desired, select V on J2 and use output terminals 7 (OUTPUT) and 8 (VOLTAGE RETURN). If a Current output is desired, select I on J2 and use output terminals 7 (OUTPUT) and 9 (CURRENT RETURN).

Step 2: Connections

1. Make connections per drawing C13810 on page 16. Initially, there should be no connection on the Teach inputs on terminals 10 & 12.

Step 3: Teach Inputs

1. Apply the 0% signal level to Input X on terminal 4. Connect the Teach X input (terminal 10) to circuit common (terminal 11). Apply the 100% signal level to Input X. Disconnect the Teach X input from circuit common.
2. Apply the 0% signal level to Input Y on terminal 5. Connect the Teach Y input (terminal 12) to circuit common (terminal 11). Apply the 100% signal level to Input Y. Disconnect the Teach Y input from circuit common.

Step 4: Scale Output

1. Initially set the GAIN and Y TRIM RANGE potentiometers fully counter clockwise
2. With the 0% voltage level applied to either the X or the Y input, adjust the BIAS potentiometer until the minimum desired output level is achieved on terminal 7 (typically 0V, 0mA, or 4mA).
3. With the 100% voltage levels applied to BOTH the X and Y inputs, adjust the GAIN potentiometer until the maximum desired output level is achieved on terminal 7 (typically 10V or 20mA).

Step 5: Input Y Trim Range Scaling

1. The output should now reflect the multiplication of the X and Y inputs. As would be expected, a 0% signal on INPUT Y would scale the output to zero. In some cases, it may be desirable to limit the full scaling capability of the Y input. In these cases, a 0% signal on INPUT Y would not scale the output entirely to minimum.
2. Apply the maximum signal level to INPUT X (terminal 4) and apply the 0% voltage signal level to INPUT Y (terminal 5). Adjust the Y TRIM RANGE potentiometer clockwise until the desired output is achieved on terminal 7.

5.2 Dancer Trim

In a surface speed follower application, a follower drive tracks the speed of a lead drive. A dancer sensor is used as a trim to slightly increase or decrease the follower drive speed. Consider the example where it is desired for the dancer to provide ±10% speed correction to the follower roll. Each of the inputs would be calibrated using their respective Teach inputs. If we choose a module output level of 9V as the speed match, then 9.9V would provide 10% overspeed on the follower. With both input signals at 100%, adjust the output Gain to get 9.9V. Raise the dancer to the extreme top position so it provides 0% signal. With the Y TRIM RANGE potentiometer at minimum, the dancer has full trim capability and can slow the follower to a stop. The Y TRIM RANGE potentiometer can then be adjusted clockwise until the output reaches 8.1V (10% underspeed).

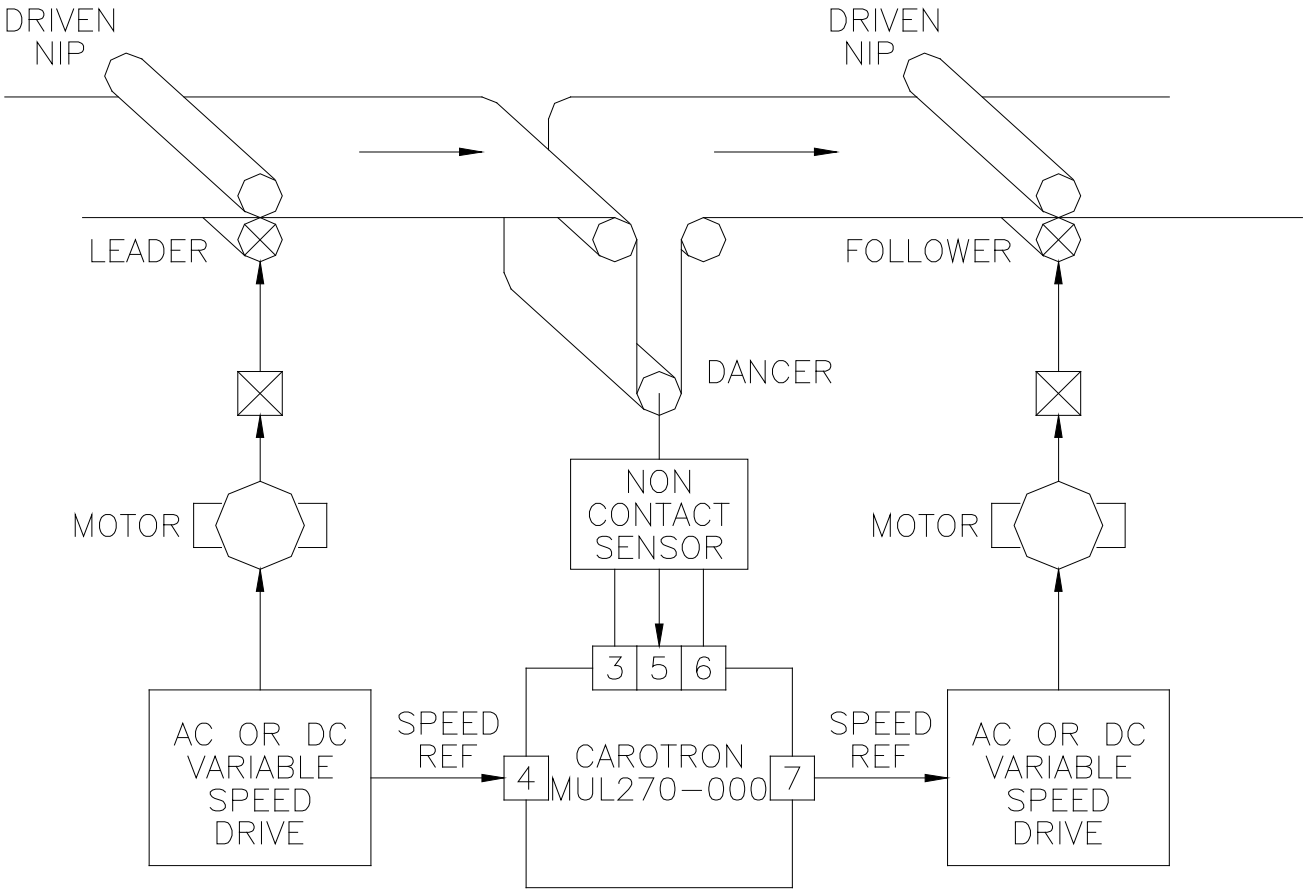


Figure 6: MUL270-000 Dancer Trim Example

Step 1: Select Output Type

1. Select the type of output desired using Jumper J2. If a Voltage output is desired, select V on J2 and use output terminals 7 (OUTPUT) and 8 (VOLTAGE RETURN). If a Current output is desired, select I on J2 and use output terminals 7 (OUTPUT) and 9 (CURRENT RETURN).

Step 2: Initial Settings & Connections

1. Make connections per drawing C13810 on page 16. Initially, there should be no contact closure on the Teach inputs on terminals 10 & 12.
2. Set all potentiometers fully counter-clockwise.

Step 3: Teach Inputs

1. Apply the minimum Line Speed signal to Input X on terminal 4. Connect the Teach X input (terminal 10) to circuit common (terminal 11). Run line at 100% to apply the maximum signal to Input X. Disconnect the Teach X input from circuit common. Use a hand tachometer to measure the surface speed of the line (i.e. Ft/min[fpm], Ft/sec[fps], m/min[mpm], etc…).
2. Manually move the dancer to the extreme travel position that would call for the follower drive to slow down. Connect the Teach Y input (terminal 12) to circuit common (terminal 11). Manually move the dancer to the other extreme position that should cause the follower drive to speed up. Disconnect the Teach Y input from circuit common.

Step 4: Scale Output

1. With the 0% level applied to either the X or the Y inputs, adjust the BIAS potentiometer until the minimum desired output level is achieved on terminal 7 (typically 0V, 0mA, or 4mA).
2. With 100% Line Speed signal applied to INPUT X, and the dancer in the extreme “speed up” position, adjust the GAIN potentiometer clockwise until the maximum desired output level is achieved on terminal 7 (typically 10V or 20mA). Use the hand tachometer to measure the surface speed of the follower drive and compare to the value measured in Step 3.1 above. Adjust the follower drive’s max speed setting until the desired amount of overspeed is achieved (typically +10%).
3. Move the dancer to the extreme “slow down” position. Use the hand tachometer to measure the surface speed of the follower drive, adjust the Y TRIM RANGE potentiometer clockwise until the desired level of underspeed is achieved (typically –10%).

5.3 Torque Takeup/Letoff

In a simple torque controlled center takeup (winder) or center letoff (unwinder), the required torque (to maintain constant tension) can be calculated by multiplying the tension by the roll radius. Thus, a signal from a tension potentiometer can be multiplied by a voltage signal from a radius (or diameter) measuring device to generate the reference for a torque regulator or a torque controlling clutch or brake. The radius or diameter sensor could consist of a rider roll and potentiometer, a laser, or a sonic sensor. The desired tension would be set initially with the Tension potentiometer. As the roll size increases on a takeup, the torque is increased proportionally to maintain constant tension. On a letoff, braking torque would be decreased with roll depletion to maintain constant tension. Note that this arrangement provides only diameter compensation. Some applications may require inertia and friction compensation.

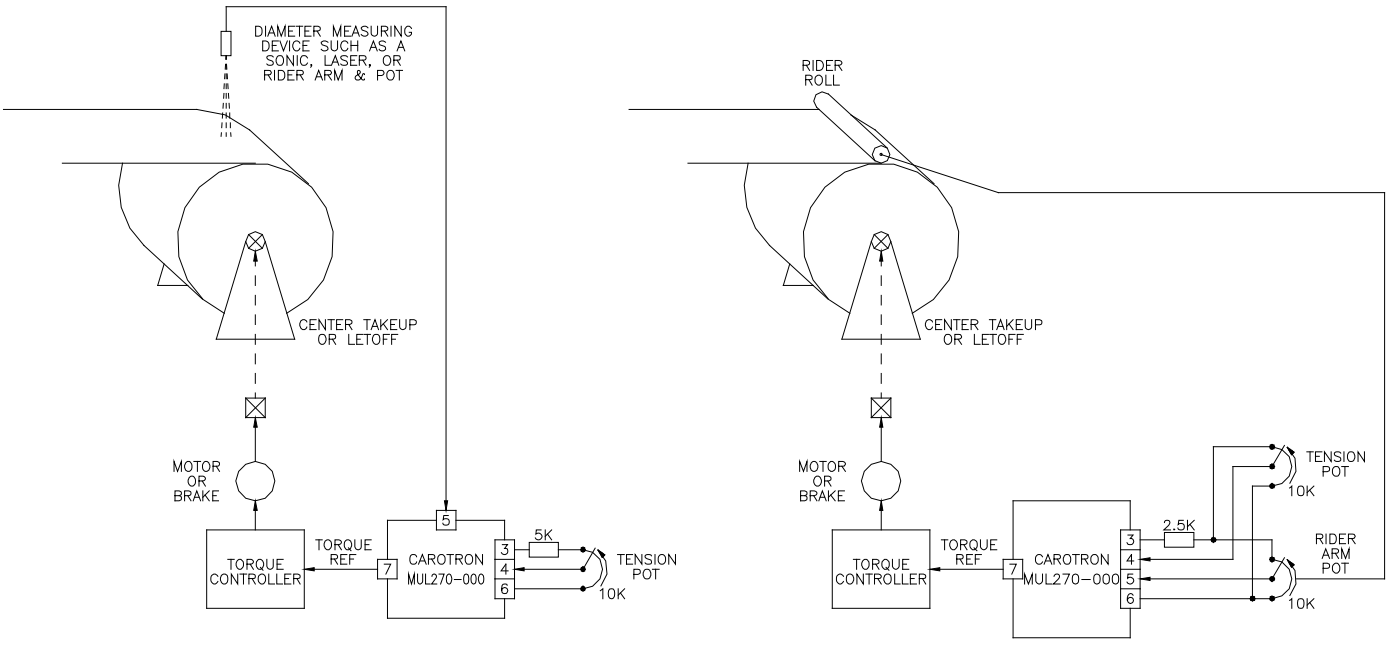


Figure 7: MUL270-000 Torque Takeup/Letoff Examples

The MUL270-000 provides a nominal +15VDC supply for external sensors on terminal 3. If a potentiometer is connected as an input (as shown above), a dropping resistor in series with the clockwise terminal may be required to reduce the input voltage to a maximum of 10VDC. The dropping resistor value depends upon the quantity and value of each potentiometer. Please refer to C13810 on page 16 for information on sizing the dropping resistor.

In this application, a signal proportional to roll diameter (or radius) is required. When the minimum and maximum signal levels are taught (see the Teach function), the MUL270-000 module assumes the Zero Diameter and Max Diameter levels are used (points A and C). Note that point A is the ‘zero’ diameter level which would correspond to the center axis of the roll. With this type of signal, the normal operating range would be between points B and C (since the diameter should never fall below core). During the teach process, the Zero Diameter point (center of roll axis) must be measured or simulated. Often, it is easier to calibrate the diameter signal by teaching the Core and Max Diameter levels (points B to C).

However, this introduces an error because the module assumes the Zero Diameter point has been taught. The Y TRIM RANGE potentiometer can be used to rescale the signal so that the minimum input is treated as the Core level instead of the Zero level.

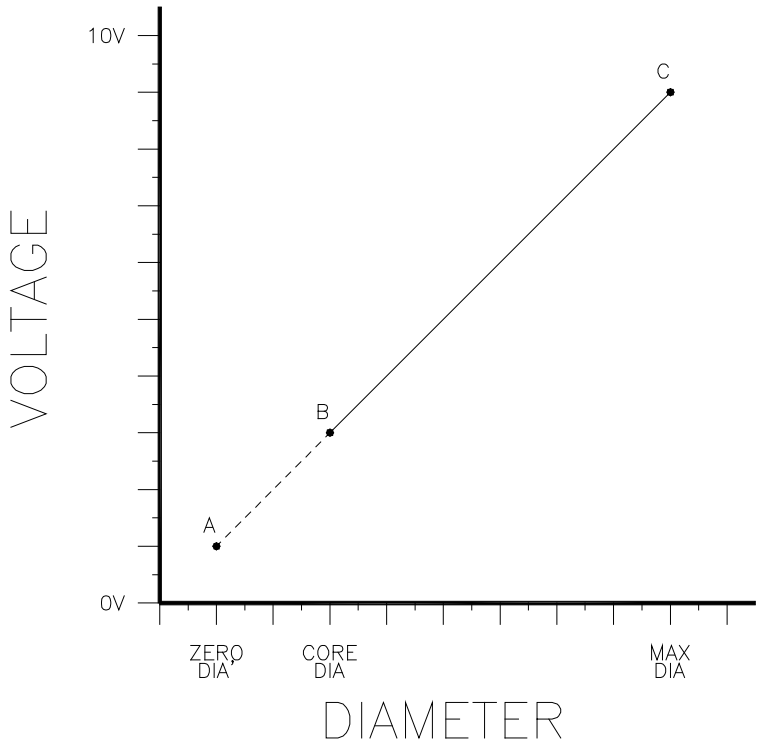


Figure 8: Diameter Input Scaling

Step 1: Select Output Type

1. Select the type of output desired using Jumper J2. If a Voltage output is desired, select V on J2 and use output terminals 7 (OUTPUT) and 8 (VOLTAGE RETURN). If a Current output is desired, select I on J2 and use output terminals 7 (OUTPUT) and 9 (CURRENT RETURN).

Step 2: Initial Connections & Settings

1. Make connections per drawing C13810 on page 16. Initially, there should be no contact closure on the Teach inputs on terminals 10 & 12.
2. Set all potentiometers fully counter-clockwise.

Step 3: Teach Inputs

1. Apply the minimum Tension Demand signal level to Input X on terminal 4. Connect the Teach X input (terminal 10) to circuit common (terminal 11). Apply the maximum Tension Demand signal level to Input X. Disconnect the Teach X input from circuit common.
2. Apply the Zero Diameter or Core Diameter signal level to Input Y on terminal 5. Connect the Teach Y input (terminal 12) to circuit common (terminal 11). Apply the Max Diameter signal level to Input Y. Disconnect the Teach Y input from circuit common.

Step 4: Scale Output

1. With the minimum Tension Demand voltage level applied, adjust the BIAS potentiometer until the minimum desired output level is achieved on terminal 7 (typically 0V, 0mA,or 4mA).
2. With the maximum Tension Demand applied to INPUT X and the Max Diameter signal applied to INPUT Y, adjust the GAIN potentiometer until the maximum desired output level is achieved on terminal 7 (typically 10V or 20mA).

Step 5: Input Y Trim Range Scaling

1. If the Zero Diameter level was taught in Step 3.2 above, calibration is complete.
2. If the Core Diameter level was taught in Step 3.2 above, determine the Build Ratio by dividing the maximum roll diameter by the minimum roll (empty core) diameter. If multiple sizes are used, calculate with the smallest core and the largest maximum diameter. For example, a maximum diameter of 32" and a core diameter of 4" will yield a Build Ratio of 8.
3. Using the minimum and maximum output values set in Step 4 above, calculate the nominal output level for core diameter.

$$CoreDiameterLevel = \frac{(MaxOutput - MinOutput)}{BuildRatio} + MinOutput$$

For example, a nominal 0 to 10V output with a Build Ratio of 8 would yield:

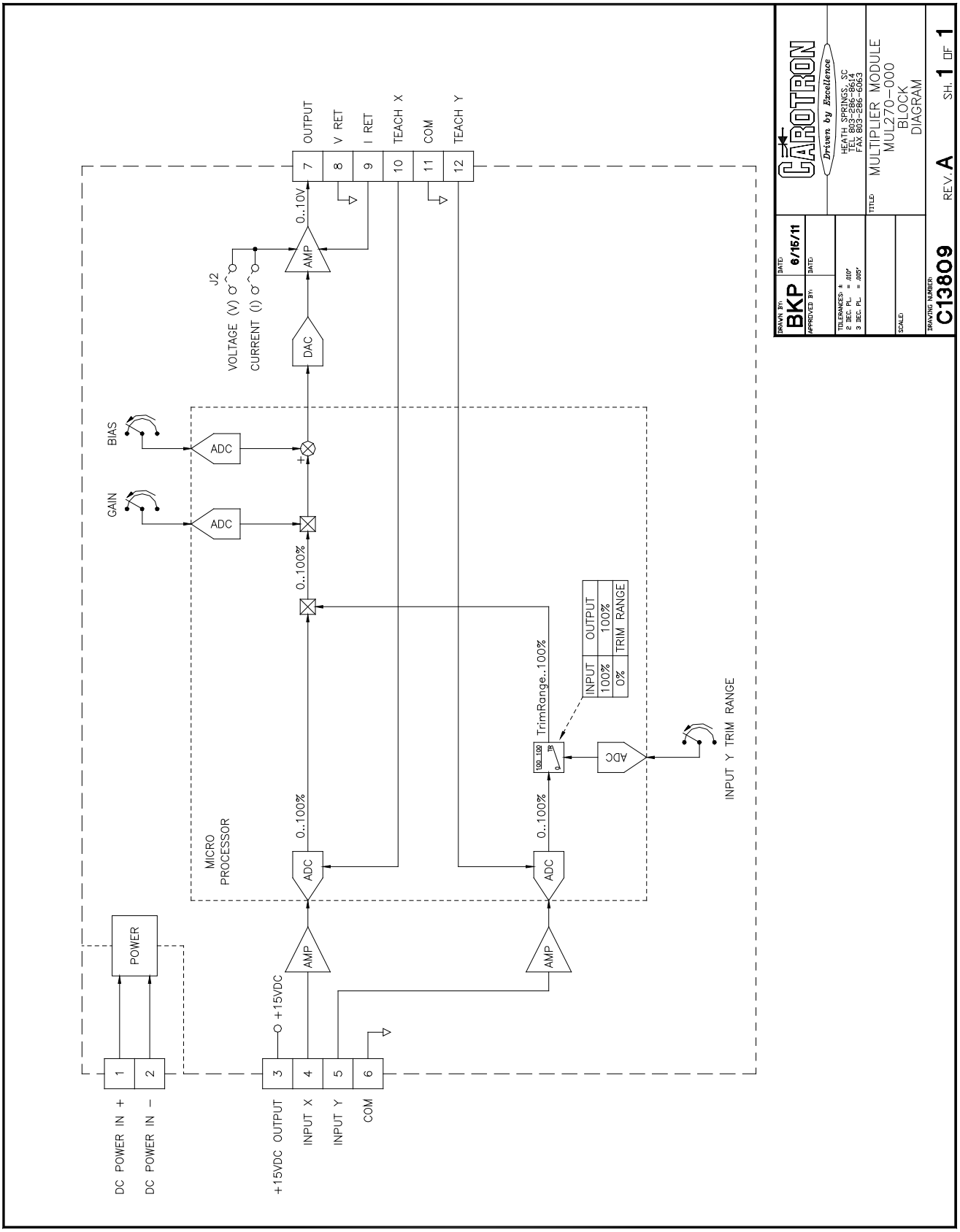
$$CoreDiameterLevel = \frac{(10V - 0V)}{8} + 0V = 1.25V$$

or a nominal 4 to 20mA output with a Build Ratio of 8 would yield:

$$CoreDiameterLevel = \frac{(20mA - 4mA)}{8} + 4mA = 6mA$$

4. With the maximum Tension Demand signal applied to INPUT X and the Core Diameter level applied to INPUT Y, adjust the Y MIN RANGE potentiometer clockwise until the output on terminal 7 equals the CoreDiameterLevel value calculated above.

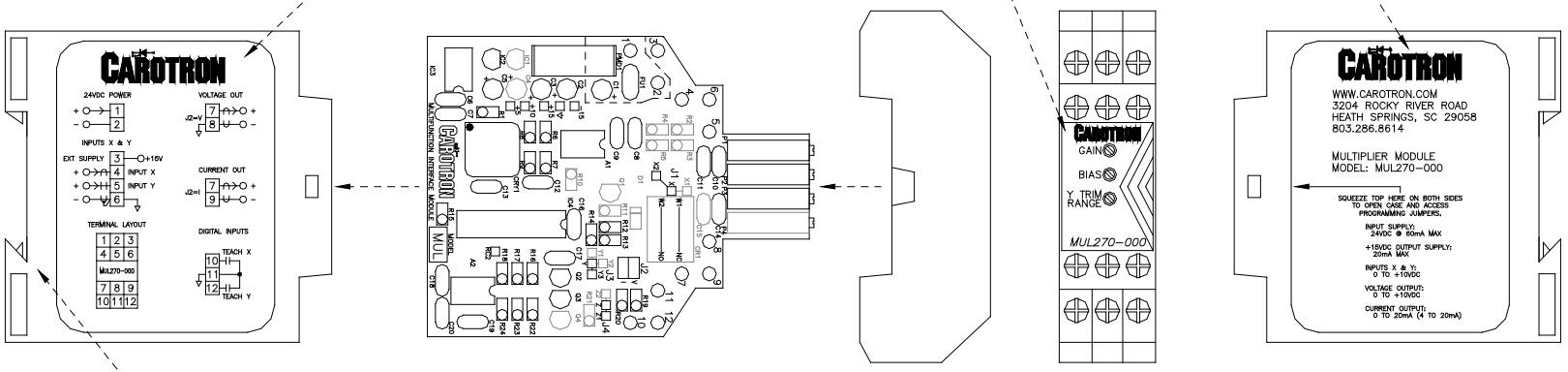
6 Prints


DC POWER IN +
DC POWER IN –
+15VDC OUTPUT
INPUT X
INPUT Y
COM
POWER
AMP
+15VDC
MICRO PROCESSOR
ADC
0..100%
BIAS
GAIN
DAC
0..10V
J2
VOLTAGE (V)
CURRENT (I)
OUTPUT
V RET
I RET
TEACH X
COM
TEACH Y
TrimRange..100%
INPUT 100% 0%
OUTPUT 100% TRIM RANGE
INPUT Y TRIM RANGE
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
DRAWN BY: BKP
DATE: 6/16/11
APPROVED BY:
DATE:
TOLERANCES: 2 DEC. PL. = .010" 3 DEC. PL. = .005"
SCALE:
TITLE: MULTIPLIER MODULE MUL270-000 BLOCK DIAGRAM
DRAWING NUMBER: C13809
REV. A
SH. 1 OF 1

APPLY TOP LABEL. ENSURE POTENTIOMETER HOLES LINE UP.

APPLY MODEL NUM LABEL TO RIGHT SIDE

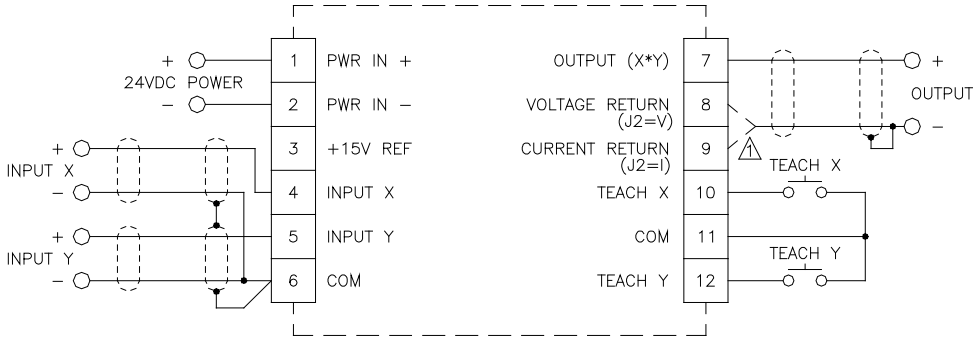
APPLY CONNECTION LABEL TO LEFT SIDE



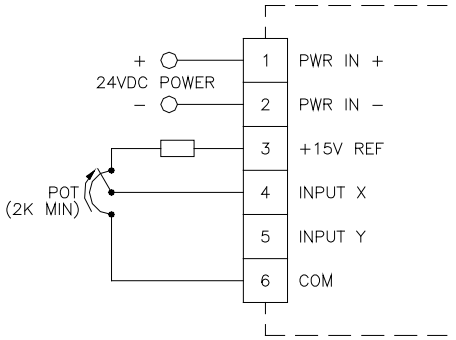
NOTE ORIENTATION OF ENCLOSURE BASE

DRAWN BY: BKP	DATE: 6/14/11	CAROTRON Driven by Excellence	
APPROVED BY:	DATE:	HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063	
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"		TITLE: MUL270-000 MULTIPLIER MODULE ASSEMBLY	
SCALE:			
DRAWING NUMBER: C13793	REV. A	SH. 1 OF 1	

GENERAL CONNECTIONS

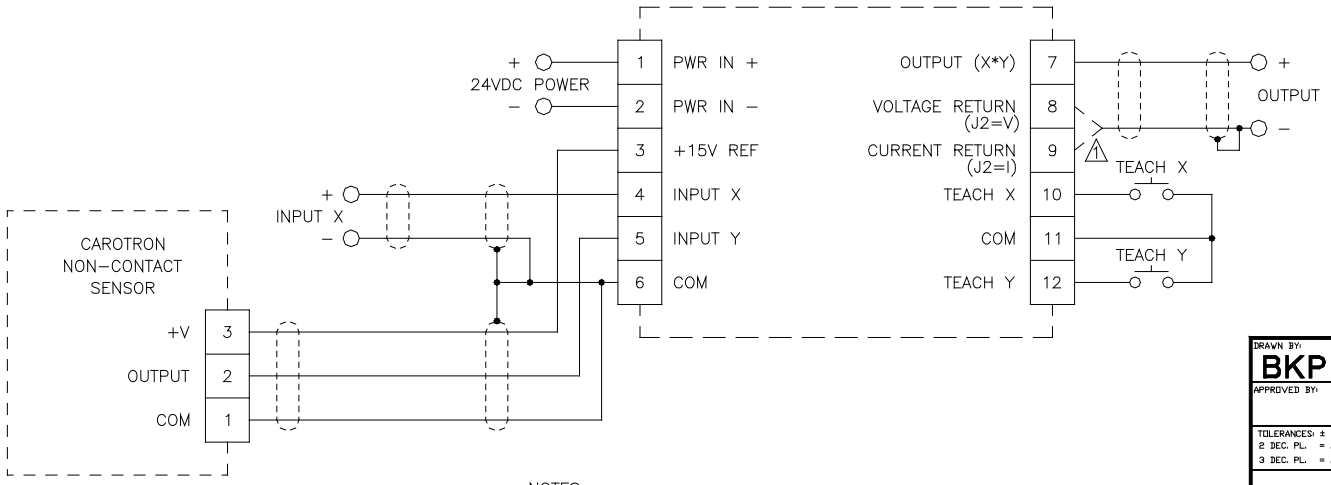


POT CONNECTIONS



THE +15V OUTPUT IS INTENDED TO SUPPLY POWER TO EXTERNAL SENSORS. IF A POTENTIOMETER IS USED, A DROPPING RESISTOR IS REQUIRED TO PREVENT OVERVOLTAGING THE INPUTS. IF ONE POTENTIOMETER IS USED, THE DROPPING RESISTOR SHOULD BE 1/2 THE POTENTIOMETER VALUE. IF TWO EQUAL VALUE POTENTIOMETERS ARE USED, THE DROPPING RESISTOR SHOULD BE 1/4 OF THE POTOTENTIOMETER VALUE.

EXAMPLE CONNECTIONS TO CAROTRON NCD0x–000



NOTES:

1. FOR A VOLTAGE OUTPUT, SET J2=V AND CONNECT THE NEGATIVE OUTPUT WIRE TO TERMINAL 8. FOR A CURRENT OUTPUT, SET J2=I AND CONNECT THE NEGATIVE OUTPUT WIRE TO TERMINAL 9.

DRAWN BY: BKP	DATE: 6/13/2011
APPROVED BY:	DATE:
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"	CAROTRON Driven by Excellence
	HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
SCALE:	TITLE: MUL270–000 GENERAL CONNECTIONS
DRAWING NUMBER: C13810	REV. A SH. 1 OF 1

7 Standard Terms & Conditions of Sale

1. General
The Standard Terms and Conditions of Sale of Carotron, Inc. (hereinafter called "Company") are set forth as follows in order to give the Company and the Purchaser a clear understanding thereof. No additional or different terms and conditions of sale by the Company shall be binding upon the Company unless they are expressly consented to by the Company in writing. The acceptance by the Company of any order of the Purchaser is expressly conditioned upon the Purchaser's agreement to said Standard Terms and Conditions. The acceptance or acknowledgement, written, oral, by conduct or otherwise, by the Company of the Purchaser's order shall not constitute written consent by the Company to addition to or change in said Standard Terms and Conditions.

2. Prices
Prices, discounts, allowances, services and commissions are subject to change without notice. Prices shown on any Company published price list and other published literature issued by the Company are not offers to sell and are subject to express confirmation by written quotation and acknowledgement. All orders of the Purchaser are subject to acceptance, which shall not be effective unless made in writing by an authorized Company representative at its office in Heath Springs, S.C. The Company may refuse to accept any order for any reason whatsoever without incurring any liability to the Purchaser. The Company reserves the right to correct clerical and stenographic errors at any time.

3. Shipping dates
Quotation of a shipping date by the Company is based on conditions at the date upon which the quotation is made. Any such shipping date is subject to change occasioned by agreements entered into previous to the Company's acceptance of the Purchaser's order, governmental priorities, strikes, riots, fires, the elements, explosion, war, embargoes, epidemics, quarantines, acts of God, labor troubles, delays of vendors or of transportation, inability to obtain raw materials, containers or transportation or manufacturing facilities or any other cause beyond the reasonable control of the Company. In no event shall the Company be liable for consequential damages for failure to meet any shipping date resulting from any of the above causes or any other cause.

In the event of any delay in the Purchaser's accepting shipment of products or parts in accordance with scheduled shipping dates, which delay has been requested by the Purchaser, or any such delay which has been caused by lack of shipping instructions, the Company shall store all products and parts involved at the Purchaser's risk and expense and shall invoice the Purchaser for the full contract price of such products and parts on the date scheduled for shipment or on the date on which the same is ready for delivery, whichever occurs later.

4. Warranty
The Company warrants to the Purchaser that products manufactured or parts repaired by the Company, will be free, under normal use and maintenance, from defects in material and workmanship for a period of one (1) year after the shipment date from the Company's factory to the Purchaser. The Company makes no warranty concerning products manufactured by other parties.

As the Purchaser's sole and exclusive remedy under said warranty in regard to such products and parts, including but not limited to remedy for consequential damages, the Company will at its option, repair or replace without charge any product manufactured or part repaired by it, which is found to the Company's satisfaction to be so defective; provided, however, that (a) the product or part involved is returned to the Company at the location designated by the Company, transportation charges prepaid by the Purchaser; or (b) at the Company's option the product or part will be repaired or replaced in the Purchaser's plant; and also provided that Cc) the Company is notified of the defect within one (1) year after the shipment date from the Company's factory of the product or part so involved.

The Company warrants to the Purchaser that any system engineered by it and started up under the supervision of an authorized Company representative will, if properly installed, operated and maintained, perform in compliance with such system's written specifications for a period of one (1) year from the date of shipment of such system.

As the Purchaser's sole and exclusive remedy under said warrant in regard to such systems, including but not limited to remedy for consequential damages, the Company will, at its option, cause, without charges any such system to so perform, which system is found to the Company's satisfaction to have failed to so perform, or refund to the Purchaser the purchase price paid by the Purchaser to the Company in regard thereto; provided, however, that (a) Company and its representatives are permitted to inspect and work upon the system involved during reasonable hours, and (b) the Company is notified of the failure within one (1) year after date of shipment of the system so involved.

The warranties hereunder of the Company specifically exclude and do not apply to the following:

a. Products and parts damaged or abused in shipment without fault of the Company.
b. Defects and failures due to operation, either intentional or otherwise, (l) above or beyond rated capacities, (2) in connection with equipment not recommended by the Company, or (3) in an otherwise improper manner.
c. Defects and failures due to misapplication, abuse, improper installation or abnormal conditions of temperature, humidity, abrasives, dirt or corrosive matter.
d. Products, parts and systems which have been in any way tampered with or altered by any party other than an authorized Company representative.
e. Products, parts and systems designed by the Purchaser.
f. Any party other than the Purchaser.

The Company makes no other warranties or representation, expressed or implied, of merchantability and of fitness for a particular purpose, in regard to products manufactured, parts repaired and systems engineered by it.

5. Terms of payment
Standard terms of payment are net thirty (30) days from date of the Company invoice. For invoice purposed, delivery shall be deemed to be complete at the time the products, parts and systems are shipped from the Company and shall not be conditioned upon the start up thereof. Amounts past due are subject to a service charge of 1.5% per month or fraction thereof.

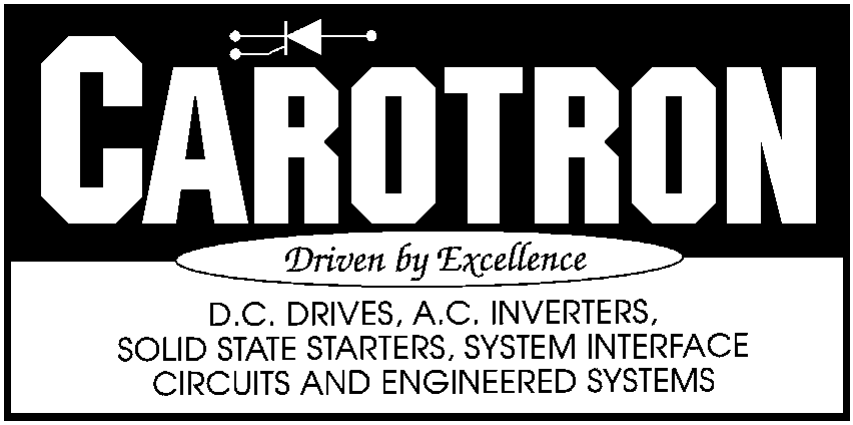
6. Order cancellation
Any cancellation by the Purchaser of any order or contract between the Company and the Purchaser must be made in writing and receive written approval of an authorized Company representative at its office in Heath Springs, S.C. In the event of any cancellation of an order by either party, the Purchaser shall pay to the Company the reasonable costs, expenses, damages and loss of profit of the Company incurred there by, including but not limited to engineering expenses and expenses caused by commitments to the suppliers of the Company's subcontractors, as determined by the Company.

7. Changes
The Purchaser may, from time to time, but only with the written consent of an authorized Company representative, make a change in specifications to products, parts or systems covered by a purchase order accepted by the company. In the event of any such changes, the Company shall be entitled to revise its price and delivery schedule under such order.

8. Returned material
If the Purchaser desires to return any product or part, written authorization thereof must first be obtained from the Company which will advise the Purchaser of the credit to be allowed and restocking charges to be paid in regard to such return. No product or part shall be returned to the Company without a "RETURNTAG" attached thereon which has been issued by the Company.

9. Packing
Published prices and quotations include the Company's standard packing for domestic shipment. Additional expenses for special packing or overseas shipments shall be paid by the Purchaser. If the Purchaser does not specify packing or accepts parts unpacked, no allowance will be made to the Purchaser in lieu of packing.

10. Standard transportation policy
Unless expressly provided in writing to the contrary, products, parts and systems are sold f.o.b. first point of shipment. Partial shipments shall be permitted, and the Company may invoice each shipment separately. Claims for non-delivery of products, parts and systems, and for damages thereto must be filed with the carrier by the Purchaser. The Company's responsibility therefor shall cease when the carrier signs for and accepts the shipment.



3204 Rocky River Road
Heath Springs, SC 29058
Phone: 803.286.8614
Fax: 803.286.6063
Email: saleserv@carotron.com
Web: www.carotron.com

MAN1059-0B
Issued 07-13-2011