Multiplier and Divider Card

Instruction Manual

Model D11005-000

c UL US

CAROTRON

Driven by Excellence

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

Table of Contents

1 General Description

The model D11005-000 Multiplier and Divider Card is designed for applications where the multiplication or division of DC voltage signals is required. The D11005-000 has two isolated input channels which are isolated from each other and also isolated from the output. Each input signal is conditioned by scaling circuits which can be modified via on board multiturn OFFSET, GAIN and BIAS Potentiometers. The calculated output can also be modified by additional OFFSET, GAIN and BIAS Potentiometers.

Depluggable terminal strips are provided for connecting a TRIM Potentiometer, 2 Auxiliary Inputs, Summing Input and Meter Output. A single turn TRIM RANGE adjustment is provided to limit the range of the external TRIM Potentiometer. A METER RANGE adjustment is provided to limit the range of the meter output. The output circuit can be configured to source either a voltage or a current. Typical output ranges are -10 to +10 VDC, 0 to 20 mADC, or 4 to 20 mADC.

2 Specifications

A.C. Input:

115 VAC ± 10%, 50/60 Hz, internally fused at 0.3 AMPS

Isolation Voltage:

2400V peak at 1 second or 1500 VRMS

Linearity:

± 0.5% of 10 VDC span

Signal Inputs:

Inputs A and B can each be connected to a potentiometer or an external voltage input.

a.) Potentiometer Input (Inputs A & B):
+15 VDC is provided to source a 2K to 10K OHM potentiometer. The 25 VDC input range should be selected for this type of input.

b.) Voltage Input (Inputs A & B):
7 selectable ranges with 100K to 10M OHM input impedance

Input Range	Input Impedance
-100 mVDC to +100 mVDC	100K
-1 VDC to +1 VDC	1M
-2.5 VDC to +2.5 VDC	100K
-10 VDC to +10 VDC	10M
-25 VDC to +25 VDC	1M
-100 VDC to +100 VDC	10M
-250 VDC to +250 VDC	10M

NOTE: Negative input voltages cannot be used at Input A when the D11005-000 is used in the Divide Mode of Operation.

c.) Auxiliary Input A:
Accepts a fixed or variable signal (-10 VDC to + 10 VDC) to be trimmed by P1, SUM TRIM, and summed with the Input A scaled signal. Isolation is maintained between the Auxiliary Input A, Input B signals and the Output.

d.) Auxiliary Input B:
Accepts a fixed or variable signal (-10 VDC to +10 VDC) to be trimmed by P5, SUM TRIM, and summed with the Input B scaled signal. Isolation is maintained between Auxiliary Input B, Input A signals and the Output.

e.) Summing Input:
This input allows a fixed or variable signal (-10 VDC to +10 VDC) to be summed directly with the calculated output and the BIAS pot signal. The polarity may be inverted by selecting (-) on J7. Isolation is not maintained between the summing input and the output.

Output Types:

a.) Voltage Output:
Selected by position V on Jumper J7. ±10 VDC can be sourced into a minimum resistance of 500 OHMS.

b.) Current Output:
Selected by position I on Jumper J7. A regulated current up to 20 mAmps can be sourced into a maximum resistance of 500 OHMS. Using the Bias Potentiometer, the output can source a 4-20 mAmp signal.

c.) Meter Output:
This output can be used to source a ± 10 VDC voltage level to a meter with a minimum 2K OHM internal resistance. Within the ± 10VDC limit, its range can be set by the Meter Range Potentiometer from 0 to 2 times the full voltage span of the main output at TB4-11.

d.) Trim Potentiometer:
Allows connection of an external 10K ohm potentiometer to trim the output. The Trim pot range may be as wide as 0-100% or limited from 80 to 100% as controlled by the P12, Trim Range pot.

3 Description of Jumpers, Switches & Potentiometers

J1: Selects between the three multiplier ranges, 0.01, 0.1 or 1.0 for Input A

J2: Selects between the three voltage input range maximums, 10V, 100V or 250V for Input A

Note: The actual voltage range for Input A is determined by multiplying the value selected at J2 times the value selected at J1.

J3: Along with J6, S1 and S2 sets operating mode to either Multiply or Divide. In DIVIDE position it prevents division by a negative number.

J4: Selects between the three multiplier ranges, 0.01, 0.1 or 1.0 for Input B

J5: Selects between the three voltage input range maximums, 10V, 100V or 250V for Input B.

Note: The actual voltage range for Input B is determined by multiplying the value selected at J5.

J6: Along with J3, S1 and S2 sets operating mode to either Multiply or Divide. In DIVIDE position it reduces the gain to give a Scaled Input A ,numerator, signal < 1 volt.

J7: Selects between Voltage or Current Output mode. Position V selects Voltage output TB4-11 and TB4-12. Position I selects Current output from TB4-11 and TB4-13.

J8: Selects the function of Addition (+) or Subtraction (-) to be performed by a positive Summing Input.

J9: Selects either Positive, Negative or Bi-Polar Output Signals. Position POS on J9 will only allow the positive portion of the output to be used. Position NEG will only allow the negative portion of the output to be used. Position of BI-POL will allow all of a bi-polar output signal to be used.

S1 & S2: Along with J3 and J6 sets the operating mode to either Multiply or Divide. They control the calculator function IC.

P1 - Sum Trim (Input A): This potentiometer controls the percentage affect of signal applied to TB2-6 (Aux Input A) has on Scaled A.

P2 - Offset (Input A): Used to null out input A signals to 0.0 VDC with minimum reference input.

P3 - Gain (Input A): Used to set the maximum Scaled A reference to the Multiplier and Divider Circuit with maximum reference input and 0.0 VDC Aux. Input A signal.

P4 - Bias (Input A): Used to set the desired reference to the Multiplier/Divider Circuit with minimum reference input and minimum Aux. Input A.

P5 - Sum Trim (Input (B): This potentiometer controls the percentage affect a signal applied to TB2-10 (Aux Input B) has on Scaled B.

P6 - Offset (Input B): Used to null out Input B signals to 0.0 VDC with minimum reference input.

P7 - Gain (Input B): Used to set the maximum Scaled B reference to the Multiplier and Divider Circuit with maximum reference input and 0.0 VDC Aux.Input B signal.

P8 - Bias (Input B): Used to set the desired reference to the Multiplier/Divider Circuit with minimum reference input and minimum Aux. Input B.

P9 - Gain (Output): Used to set the maximum output level with maximum Scaled A & B signals in Multiply Mode or with A minimum and B maximum in Divide Mode.

P10 -Offset (Output): Used to null out the final amplifier stages to 0.0 VDC with the following conditions:
1.) minimum Scaled A & B signals in the Multiply Mode
2.) minimum Scaled B and maximum Scaled A inputs in the Divide Mode.

P11 -Bias (Output): Used to set the desired output level with the following condi-tions:
1.) minimum Scaled A & B signals in the Multiply mode
2.) minimum Scaled B and maximum Scaled A input in the Divide Mode.

P12 -Trim Range: Used to set the minimum percentage level given by the Trim Potentiometer - does not affect the maximum output level. Using a 10K Trim Potentiometer, the trim range can be set as wide as 0 to 100% or as narrow as 80 to 100%.

P13 - Meter Range: Used to set the meter output from 0 to approximately 2 times the normal output voltage range.

4 Formulas

Note that output is calculated from the scaled A and B voltage inputs, not the actual input voltage level.

4.1 Multiplication Formulas

A) $$\frac{\text{Scaled Input A X Scaled Input B}}{\text{10 VDC}} = \text{Output}$$

NOTE: The scaled Input A and Input B voltages should not exceed 10 VDC.

Example:
Scaled Input A = 10 VDC
Scaled Input B = 10 VDC

$$\frac{\text{10 VDC X 10 VDC}}{\text{10 VDC}} = \text{10 VDC}$$

B) $$\frac{\text{(Scaled Input A + Scaled Aux Input A) X (Scaled Input B + Scaled Aux Input B)}}{\text{10 VDC}} = \text{Output}$$

NOTE: The sum of each scaled Input Signal and the Aux Input Signal should not exceed 10 VDC.

Example:
Scaled Input A = 5V Scaled Aux Input A = 5V
Scaled Input B = 5V Scaled Aux Input B = 5V

$$\frac{\text{(5 VDC + 5 VDC) X (5 VDC + 5 VDC)}}{\text{10V}} = \text{10 VDC}$$

4.2 Division Formulas

A) $$\frac{\text{Scaled Input B}}{\text{Scaled Input A}} \text{ X 10 VDC} = \text{Output}$$

NOTE: Scaled Input B should not exceed 1.0 VDC and Scaled Input A should not exceed 10.0 VDC.

Example:
Scaled Input A = 5 VDC
Scaled Input B = 1 VDC

$$\frac{\text{1 VDC}}{\text{5 VDC}} \text{ X 10 VDC = 2 VDC}$$

B) $\dfrac{\text{Scaled Input B + Aux B}}{\text{Scaled Input A + Aux Input A}}$ X 10 VDC = Output

NOTE: The sum of scaled Input B and scaled Aux Input B should not exceed 1.0 VDC and the sum of scaled Input A and scaled Auxiliary Input A should not exceed 10.0 VDC.

Example:

Scaled Input A = 5VDC   Scaled Aux Input A = 5VDC
Scaled Input B = 0.5VDC   Scaled Aux Input B = 0.5VDC

$$\frac{(0.5 \text{ VDC} + 0.5 \text{ VDC})}{5 \text{ VDC} + 5 \text{ VDC}} \times 10 \text{ VDC} = 1.0 \text{ VDC}$$

Where the calculation produces an output voltage that is low but greater than 1 volt, the P9 GAIN pot can be used to amplify the output up to 2.5 times. The level of gain set should keep the maximum output close to 10 volts to prevent calculation error or saturation.

EXCEPTION FOR VERY LOW CALCULATED OUTPUTS: In the Divide mode the "B" signal or numerator is normally pre-divided by 10 when J6 is placed in the DIVIDE position. This helps range the maximum Scaled B signal to 1 VDC and compensates for the inherent "times 10" characteristic of the multiplier/divider chip, IC5, and produces normally calculated outputs up to 10 VDC.

In applications where the Scaled A, denominator, voltage will never go lower than the Scaled-B-times-10 level, the calculated output will always remain less than or equal to 1 VDC. In this case the J6 jumper can be left in the MULTIPLY position to give an additional gain of 10 and the resultant higher output level.

An example of this appears in the next Section 5.2

NOTE: This method should not be used where Scaled A signal goes below the Scaled B X 10 level or the calculator output section will become saturated and give an incorrect output level.

5 Application Examples

5.1 Multiply Mode Examples

Voltage controlled pot: An adjustable voltage from a pot or other source can be controlled by the level of a second voltage signal.

For example, we know that in a simple center winder/unwinder torque control the motor torque equals the required pulling force or tension on the web times the radius of the material roll. A Tension pot signal then could be multiplied by the voltage signal from a radius measuring device to generate the reference for a torque regulator or torque controlling clutch or brake. On a winder the desired tension would be set initially with a new core started. Then as roll size increases, the torque is increased proportionately to maintain constant tension. On the unwinder or let-off, 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.

Another example uses a Carotron motor control that makes the output of its velocity loop available for special applications. The application is a turret type center winder where a web of material is transferred from a full roll to a new core without stopping. The new core is initially velocity controlled to slightly greater than line speed. Then the newly started material slows the core to an exact speed match and causes a shift into torque limited operation by saturating the velocity loop. The level of torque limiting is set by a "smart" circuit such as the Carotron CTCW (Constant Tension Center wind) board that generates a total torque reference based on roll diameter, friction, inertia and other parameters. The saturated velocity loop, now a constant voltage, is multiplied by the torque reference to give constant tension during roll build.

5.2 Divide Mode Examples

A problem encountered in center driven winder and unwind applications is the nonlinear relationship between the diameter of a roll and the motor speed required to maintain constant surface speed of the roll during diameter increase or decrease. A plot of this relationship shows a hyperbolic curve - refer to Figure 1.

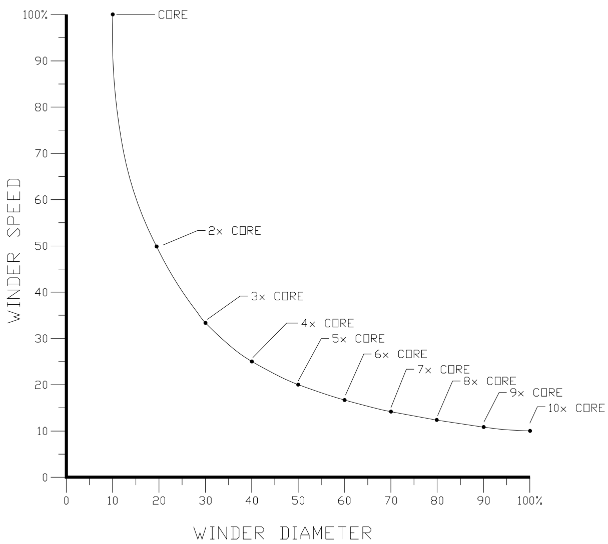


Figure 1

With inputs proportional to line speed and roll radius, the required Winder or Unwinder Motor Speed can be calculated. The rate of material pay-out from a center driven unwinder would be held constant during roll diameter decrease. The line speed signal could come from a tachometer on the line drive or mounted on the machine to sense speed. The radius signal could come from an ultrasonic measuring unit like the SONICTRAC® or from a mechanical measuring device such as a rider arm and pot. The scaled line speed is divided by the scaled radius signal to generate the center drive speed reference. Depending on required system response, a dancer or other device may be required for limited transient compensation between the center winder/unwinder and other driven parts of a line. In some applications the winder/unwinder may be controlling the speed of the line. In this case the line speed signal could come from a SPEED pot connected to the + 15 VDC supply at terminal 7.

Winder Roll Diameter is calculated by dividing the scaled line speed by the scaled winder speed. The diameter signal could be used to control braking torque on an unwind application or to control motoring torque for a winder.

6 Initial Programming/ Presets and Adjustment Procedures

At this point application specifics such as input signal types and levels, trim pot use, output signal type and the required calculation formula should already be known. If not, refer to Sections 4.0 and 5.0 for information on these subjects.

6.1 Multiply Mode Programming/ Presets

a.) Place J3, J6, S1 & S2 in the MULTIPLY position.

b.) Connect the Voltage Input signal leads (Input A & Input B) in accordance with connection diagram C11030 in Section 7.0.

c.) If used, zero any Summing Input signal at terminals 14 & 15. Rotate the Sum Trim Potentiometers (P1 & P5) full counter-clockwise.

d.) If used, adjust the external Trim Potentiometer to full clockwise rotation. The controlling range of the external Trim Pot can be preset by referring to the following table and setting the P12 Trim Range pot.

Trim Range Potentiometer Setting	10K Trim Potentiometer Adjustment Range
0% Clockwise	0 - 100%
25% Clockwise	55 - 100%
50% Clockwise	71 - 100%
100% Clockwise	83 - 100%

NOTE: If an external Trim Potentiometer is not used, Jumper terminal 18 to 19.

e.) NOTE: The Multiplier/Divider card is shipped from the factory with Input A and Input B calibrated for 10 VDC input signals. Step (e.) here and the calibration steps in both the Multiply Mode and Divide Mode adjustment procedures are necessary only for maximum inputs other than 10 VDC.

Referring to the following table, place J1 and J2 jumper positions according to the expected input voltage range at Input A.

Select the lowest input range which is greater than or equal to the input voltage.

Place J4 and J5 according to the input voltage range expected at Input B.

J1/J4 Selection	J2/J5 Selection	Input Voltage Range
X0 . 01	10	+100 mVDC
X0 . 1	10	+ 1 VDC
X0 . 01	250	+ 2.5 VDC
X1 . 0	10	+ 10 VDC
X0 . 1	250	+ 25 VDC
X1 . 0	100	+ 100 VDC
X1 . 0	250	+ 250 VDC

f.) Select the type of output desired using the Jumper J7. If a voltage output is desired, select V on J7 and use output terminals 11 (output) and 12 (Voltage Return). If a current output is desired, select I on J7 and use output terminals 11 (Output) and 13 (Current Return).

g.) If used, determine the polarity of any Summing Input signal connected to Terminal 14. Place J8 in the (+) position to add a positive summing signal to the calculated output or in the (-) position to subtract a positive signal. J8's position doesn't matter if no summing signal is connected.

h.) Select the desired output polarity at J9. The POS position will only allow the positive portion of the calculated output to be used. Position NEG will only allow the negative portion of the signal to be used. The Bi-POL position will allow the D11005-000 to source both positive and negative signals.

NOTE: The position of J9 does not affect the polarity of an output caused from a Summing Input signal.

6.2 Multiply Mode Adjustment Procedure -Aux Inputs Not Used

Use steps a.) and b.) for calibration of Input A signals.

a.) Turn the Gain Potentiometer (P3) full clockwise (approximately 15 turns). With input A at minimum, adjust the Offset Potentiometer (P2) for 0.0 VDC between TP1 & Terminal 5. Turn the Gain Potentiometer (P3) full counter clockwise.

b.) Monitor TP2 with respect to Terminal 15 or 17. With Input A still at minimum, adjust the Bias Potentiometer (P4) for zero volts. Apply full voltage at Input A and adjust the Gain Potentiometer (P3) for the maximum desired voltage at TP2 (typically 10.0 VDC).

NOTE: The Input A multiplier voltage at TP2 and Input B multiplier at TP4 may be adjusted to some percentage of maximum when summed with an Auxiliary Input signal. See Section 6.3 when using Auxiliary Inputs.

Use steps c.) and d.) for calibration of Input B signals.

c.) Turn the Gain Potentiometer (P7) full clockwise (approximately 15 turns). With Input B at minimum, adjust the Offset Potentiometer (P6) for 0.0 VDC between TP3 & Terminal 9. Turn the Gain Potentiometer (P7) full counter-clockwise.

d.) Monitor TP4 with respect to Terminal 15 or 17. With Input B still at minimum, adjust the Bias Potentiometer (P8) for zero volts. Apply full voltage at Input B and adjust the Gain Potentiometer (P7) for the maximum desired voltage at TP4 (typically 10.0 VDC).

Use steps e.) and f.) for calibration of the multiplier output section.

e.) Turn the output circuit Gain Potentiometer (P9) fully clockwise (approximately 15 turns). With both Input A and Input B at minimum, adjust the output circuit Offset Potentiometer (P10) for 0.0 VDC between Terminal 18 and common at terminal 15 or 17. Turn the Gain Potentiometer (P9) fully counter clockwise.

f.) With both Input A and Input B still at minimum, adjust the Bias (P11) Potentiometer for the minimum output level desired. Voltage output at Terminals 11 and 12 is usually set to zero and if used, current output at Terminals 11 and 13 is set for the minimum mA level required. Apply full reference input voltage to both Inputs A and B. Adjust the Gain Potentiometer (P9) for the maximum desired output.

g.) The unit is now calibrated for operation. The output may now be trimmed by the Trim Potentiometer or an external signal may be summed using the Summing Input at Terminal 14. Use Jumper J8 to select (+) or (-) for adding or subtracting a positive input signal.

6.3 Multiply Mode Adjustment Procedure -Using Aux Inputs

This procedure is used only when Input A or Input B is to be modified by summing additional input through Auxiliary Inputs A or B. Each Input and corresponding Auxiliary Input is calibrated to give a total multiplier signal at TP2 or TP4 with the percentage affect of each signal determined by the customer.

a.) Connect the Aux Reference Input Signals (Aux Input A & Aux Input B) in accordance with connection diagram C11030 in Section 7.0.

NOTE: The Aux Inputs should Not exceed +10 VDC.

The following steps calibrate the total summed "A" and "B" multiplier signal levels. The percentage affect of each the Input and Auxiliary Input must first be decided. The total will equal 100% or 10 VDC at TP2 and/or TP4. Each percentage is multiplied X 10 VDC to determine the corresponding voltage level.

EXAMPLE:

The "A" multiplier will be derived by summing signals from a tachometer and a manual pot. The tachometer will provide 90% and the pot (at maximum) will provide 10% of the total signal.

90% of 10 VDC = .9 X 10 VDC = 9 VDC scaled "A" TP2 signal

10% of 10 VDC = .1 X 10 VDC = 1 VDC scaled "A" TP2 signal

The tachometer would connect to the A Input to take advantage of its programmable scaling and the pot would use the Aux Input A circuit.

Calibrate the total "A" multiplier as follows:

b.) Adjust the Input A signal to zero. Apply the Full Aux Input A voltage, and monitor TP2 with respect to Terminal 15 or 17. Adjust the Sum Trim Potentiometer (P1) to the pre-determined scaled "A" signal level for the Aux Input signal. Reduce the Aux Input A to zero volts.

c.) Turn the Gain Potentiometer (P3) full clockwise (approximately 15 turns). With Input A at minimum, adjust the Offset Potentiometer (P2) for 0.0 VDC between TP1 & Terminal 5. Turn the Gain Potentiometer (P3) full counter clockwise.

d.) Monitor TP2 with respect to Terminal 15 or 17. With Input A still at minimum, adjust the Bias Potentiometer (P4) for zero volts. Apply full voltage at Input A and adjust the Gain Potentiometer (P3) for the predetermined Scaled A level for the Input A signal. This level added to the signal caused by the maximum Aux Input A should not exceed a total of 10 volts.

Calibrate the total "B" multiplier as follows:

e.) Adjust the Input B signal to zero. Apply the Full Aux Input B voltage, and monitor TP4 with respect to Terminal 15 or 17. Adjust the Sum Trim Potentiometer (P5) to the pre-determined scaled "B" signal level for the Aux Input signal. Reduce the Aux Input B to zero volts.

f.) Turn the Gain Potentiometer (P7) full clockwise (approximately 15 turns). With Input B at minimum, adjust the Offset Potentiometer (P6) for 0.0 VDC between TP3 & Terminal 9. Turn the Gain Potentiometer (P7) full counter clockwise.

g.) Monitor TP4 with respect to Terminal 15 or 17. With Input B still at minimum, adjust the Bias Potentiometer (P8) for zero volts. Apply full voltage at Input B and adjust the Gain Potentiometer (P7) for the predetermined Scaled B level for the Input B signal. This level added to the signal caused by the maximum Aux Input B should not exceed a total of 10 volts.

Use steps h.) and i.) for calibration of the output section.

h.) Turn the output circuit Gain Potentiometer (P9) full clockwise (approximately 15 turns). With both Input A and Input B and Aux Input A and Aux Input B at minimum, adjust the output circuit Offset Potentiometer (P10) for 0.0 VDC between Terminal 18 and common at terminal 15 or 17. Turn the Gain Potentiometer (P9) fully counter clockwise.

i.) With all inputs still at minimum, adjust the Bias (P11) Potentiometer for the minimum output level desired. Voltage output at Terminals 11 and 12 is usually set to zero and if used, current output at Terminals 11 and 13 is set for the minimum mA level required. Apply full voltage to all inputs. Adjust the Gain Potentiometer (P9) for the maximum desired output.

j.) The unit is now calibrated for operation. The output may now be trimmed by the Trim Potentiometer or an external signal may be summed using the Summing Input at Terminal 14. Use Jumper J8 to select (+) or (-) for adding or subtracting a positive input signal.

6.4 Divide Mode Programming/ Presets

At this point the application specifics and the required calculation formula should already be known. If not, refer to Sections 4.0 and 5.0 for information on these subjects.

Remember, the calculated output is based on the total Scaled A and B signal levels.

a.) Place J3, J6, S1 & S2 in the DIVIDE position.

b.) Connect the Voltage Reference Input signals (Input A & Input B) in accordance with connection diagram C11030 in Section 7.

c.) If used, zero any Summing Input signal at terminals 14 & 15. Rotate the Sum Trim Potentiometers (P1 & P5) full counter-clockwise.

d.) If used, adjust the external Trim Potentiometer to full clockwise rotation. The controlling range of the external Trim Potentiometer can can be preset by referring to the following table and setting the P12 Trim Range pot.

Trim Range Potentiometer Setting	10KTrim Potentiometer Adjustment Range
0% Clockwise	0 - 100%
25% Clockwise	55 - 100%
50% Clockwise	71 - 100%
100% Clockwise	83 - 100%

NOTE: If a Trim Potentiometer is not used, Jumper terminal 18 to 19.

e.) Referring to the following table, place J1 and J2 jumper positions according to the expected input voltage range at Input A.

Select the lowest input range which is greater than or equal to the input voltage.

Place J4 and J5 according to the input voltage range expected at Input B.

J1/J4 Selection	J2/J5 Selection	Input Voltage Range
X0 . 01	10	+100 mVDC
X0 . 1	10	+ 1 VDC
X0 . 01	250	+ 2.5 VDC
X1 . 0	10	+ 10 VDC
X0 . 1	250	+ 25 VDC
X1 . 0	100	+ 100 VDC
X1 . 0	250	+ 250 VDC

f.) Select the type of output desired using Jumper J7. If a voltage output is desired, select V on J7 and use output terminals 11 (Output) and 12 (Voltage Return). If a current output is desired, select I on J7 and use output terminals 11 (Output) and 13 (Current Return).

g.) If used, determine the polarity of any Summing Input signal connected to Terminal 14. Place J8 in the (+) position to add a positive summing signal to the calculated output or in the (-) position to subtract a positive signal. J8’s position doesn’t matter if no summing signal is connected.

h.) Select the desired output polarity at J9. The POS position will only allow the positive portion of the calculated output to be used. Position NEG will only allow the negative portion of the signal to be used. The BI-POL position will allow the D11005-000 to source both positive and negative signals.

NOTE: The position of J9 does not affect the polarity of an output caused from a Summing Input Signal.

6.5 Divide Mode Adjustment Procedure - -Aux Inputs Not Used

NOTE: Since Input A is the denominator and division by zero is undefined, the Scaled A signal should not be allowed to reach zero volts during normal operation. This would not normally happen when the Input A is a diameter signal - since there are no zero diameter rolls.

When calculating diameter by using center drive motor speed as the denominator, the speed signal must appear at the same time as the line speed, numerator, signal to prevent miscalculation. When this is a problem, the P4 BIAS pot can be adjusted to give a minimum Scaled A signal although doing so will introduce a small error in the output.

Use steps a.) and b.) for calibration of Input A signals.

NOTE: Use alternate "b)" step if INPUT is a diameter signal.

a.) Turn the Gain Potentiometer (P3) full clockwise (approximately 15 turns). With Input A at minimum, adjust the Offset Potentiometer (P2) for 0.0 VDC between TP1 & Terminal 5. Turn the Gain Potentiometer (P3) full counter clockwise.

b.) Monitor TP2 with respect to Terminal 15 or 17. With Input A still at minimum. adjust the Bias Potentiometer (P4) for zero volts or to a minimum level as discussed in the note above. Apply full voltage at Input A and adjust the Gain Potentiometer (P3) for the maximum desired voltage at TP2 (typically 10.0 VDC).

b.) Alternate setup for a diameter signal.
Monitor TP2 with respect to Terminal 15 or 17. With the minimum (core) diameter signal applied, adjust the P3, GAIN, pot for 1.0 VDC. As rolls are wound, multiples of the core diameter should give the the same multiple times this 1.0 VDC.

Example: Set P3 for 1.0 VDC at core. A roll three times the core diameter should give 3.0 VDC. A roll 10 times core diameter will give 10.0 VDC.

Use steps c.) and d.) for calibration of Input B signals.

c.) Turn the Gain Potentiometer (P7) full clockwise (approximately 15 turns). With Input B at minimum, adjust the Offset Potentiometer (P6) for 0.0 VDC between TP3 & Terminal 9. Turn the Gain Potentiometer (P7) full counter-clockwise.

d. Monitor TP4 with respect to Terminal 15 or 17. With Input B still at minimum, adjust the Bias Potentiometer (P8) for zero volts. Apply full voltage at Input B and adjust the Gain Potentiometer (P7) for the maximum desired voltage at TP4 (typically 1.0 VDC).

Use steps e.) and f.) for calibration of the output section.

e.) Turn the output circuit Gain Potentiometer (P9) fully clockwise (approximately 15 turns). With Input B at minimum, adjust the output circuit Offset Potentiometer (P10) for 0.0 VDC between Terminal 18 and common at terminal 15 or 17. Turn the Gain Potentiometer (P9) fully counter clockwise.

f.) With Input B still at minimum, adjust the Bias (P11) Potentiometer for the minimum output level desired. Voltage output at Terminals 11 and 12 is usually set to zero and if used, current output at Terminals 11 and 13 is set for the minimum mA level required. Apply full reference input voltage to Input B and normal minimum Input A voltage - refer to the Note at the beginning of section 6.5. Adjust the Gain Potentiometer (P9) for the maximum desired output.

g.) The unit is now calibrated for operation. The output may now be trimmed by the Trim Potentiometer or an external signal may be summed using the Summing Input at Terminal 14. Use Jumper J8 to select (+) or
(-) for adding or subtracting a positive input signal.

6.6 Divide Mode Adjustment Procedure -Using Aux Inputs

This procedure is to be used when either Input A or Input B is to be modified by summing additional input through Auxiliary Input A or B. Each Input and corresponding Auxiliary Input is calibrated to give a total signal at TP2 or TP4 with the percentage affect of each signal determined by the customer.

NOTE: Since Scaled Input A is the denominator and division by zero is undefined, the Scaled A signal should not be allowed to reach zero volts during normal operation. This would not normally happen when the Input A is a diameter signal - since there are no zero diameter rolls. When calculating diameter by using center drive motor speed as the denominator, the speed signal must appear at the same time as the line speed, numerator, signal to prevent miscalculation. When this is a problem, the P4 BIAS pot can be adjusted to give a minimum Scaled A signal although doing so will introduce a small error in the output.

a.) Connect the Aux Reference Input Signals (Aux Input A & Aux Input B) in accordance with connection diagram C11030 in Section 7.0.

NOTE: The Aux Inputs should not exceed ±10 VDC.

The following steps calibrate the total summed "A" and "B" Scaled signal levels. The percentage affect of each Input and Auxiliary Input must first be decided. The total will equal 100% or 10 VDC at TP2 and 1.0 volts at TP4. Each percentage is multiplied by the appropriate full scale voltage to determine the corresponding voltage level.

EXAMPLE:

The "A", denominator, scaled total will be derived by summing signals from a tachometer and a manual pot. The tachometer will provide 90% and the pot (at maximum) will provide 10% of the total signal.

90% of 10 VDC = .9 X 10 VDC = 9 VDC scaled "A" TP2 signal

10% of 10 VDC = .1 X 10 VDC = 1 VDC scaled "A" TP2 signal

The tachometer would connect to the A Input to take advantage of its programmable scaling and the pot would use the Aux Input A circuit.

Calibrate the total Scaled A Input as follows:

b.) Adjust the Input A signal to zero. Apply the Full Aux Input A voltage, and monitor TP2 with respect to Terminal 15 or 17. Adjust the Sum Trim Potentiometer (P1) to the predetermined scaled "A" signal level for the Aux Input signal. Reduce the Aux Input A to zero volts.

c.) Turn the Gain Potentiometer (P3) full clockwise (approximately 15 turns). With Input A at zero, adjust the Offset Potentiometer (P2) for 0.0 VDC between TP1 and Terminal 5. Turn the Gain Potentiometer (P3) full counter-clockwise.

d.) Monitor TP2 with respect to Terminal 15 or 17. With Input A still at minimum, adjust the Bias Potentiometer (P4) for zero volts. Apply full voltage at Input A and adjust the Gain Potentiometer (P3) for the predetermined Scaled A level for the Input A signal. This level added to the signal caused by the maximum Aux Input should not exceed a total of 10 volts.

Calibrate the total Scaled B signal as follows:

e.) Adjust the Input B signal to zero. Apply the Full Aux Input B voltage, and monitor TP4 with respect to terminal 15 or 17. Adjust the Sum Trim Potentiometer (P5) to the predetermined scaled "B" signal level for the Aux Input signal. Reduce the Aux Input B to zero volts.

f.) Turn the Gain Potentiometer (P7) full clockwise (approximately 15 turns). With Input B at minimum, adjust the Offset potentiometer (P6) for 0.0 VDC between TP3 and Terminal 9. Turn the Gain Potentiometer (P7) full counter clockwise.

g.) Monitor TP4 with respect to Terminal 15 or 17. With Input B still at minimum, adjust the Bias Potentiometer (P8) for zero volts. Apply full voltage at input B and adjust the Gain Potentiometer (P7) for the predetermined Scaled B level for the Input B signal. This level added to the signal caused by the maximum Aux Input B should not exceed a total of 1.0 volt.

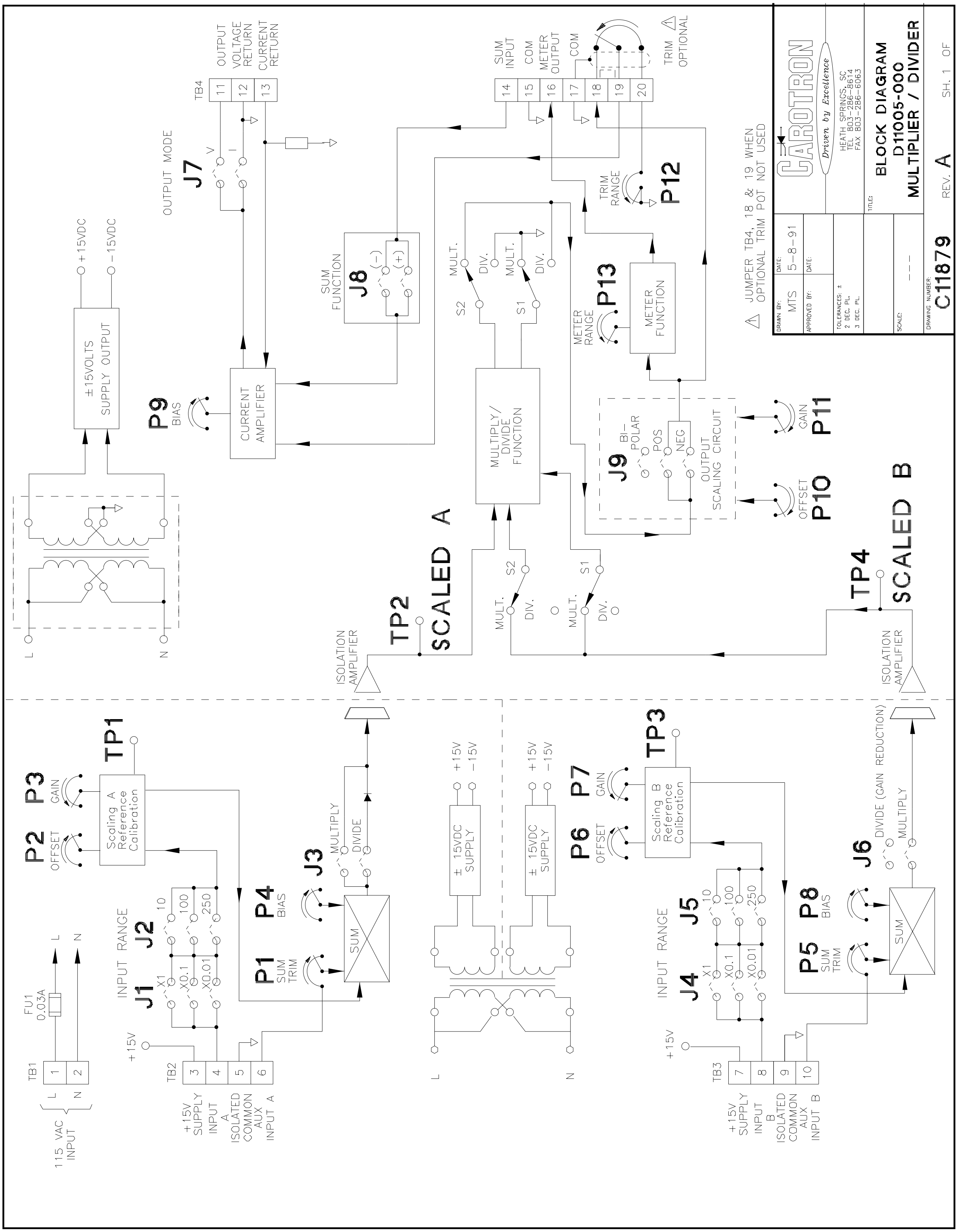
Use steps h.) and i.) for calibration of the output section.

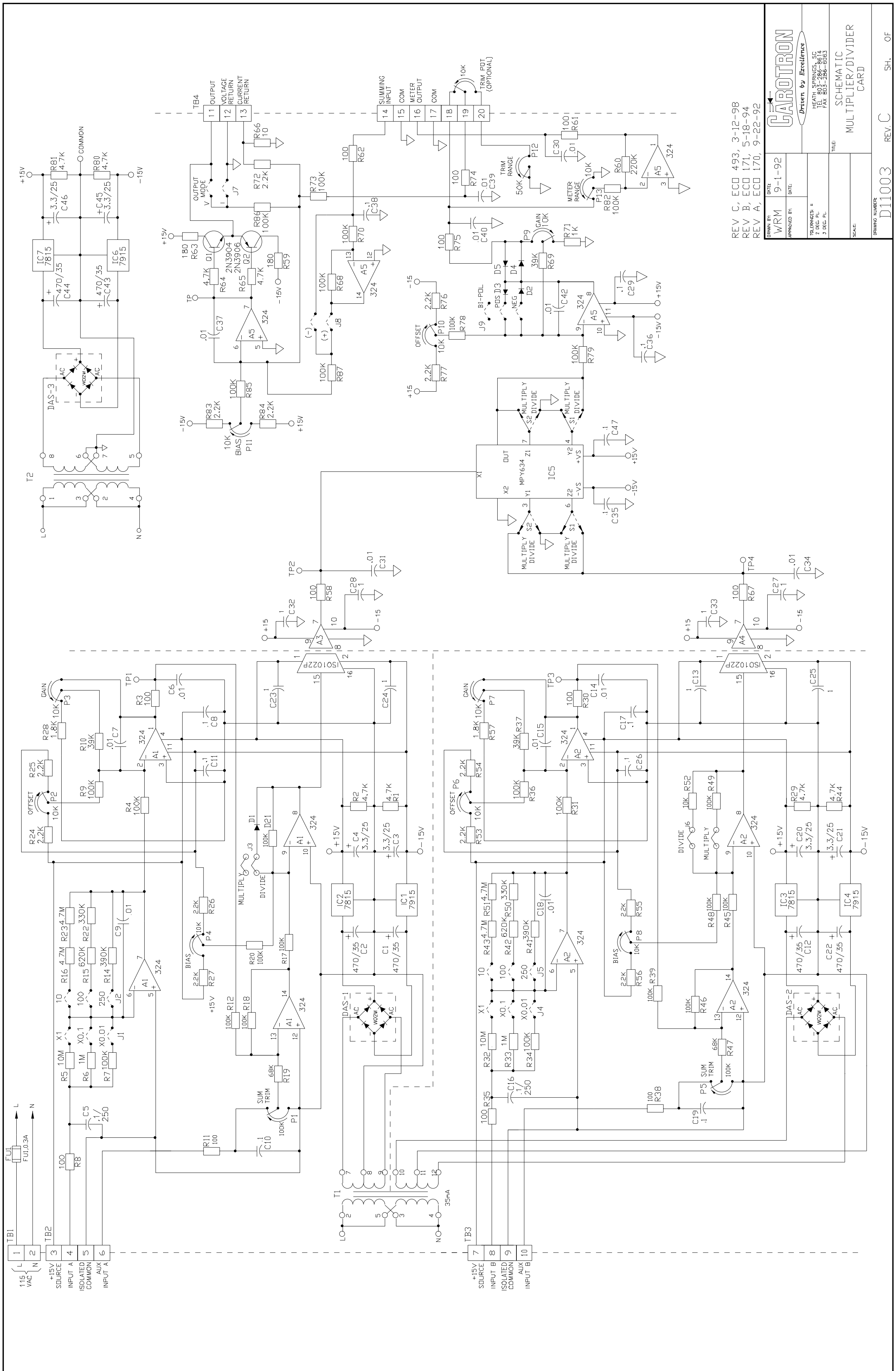
h.) Turn the output circuit Gain Potentiometer (P9) full clockwise (approximately 15 turns). With both Input A and Input B and Aux Input A and Aux Input B at minimum, adjust the output circuit Offset Potentiometer (P10) for 0.0 VDC between Terminal 18 and common at terminal 15 or 17. Turn the Gain Potentiometer (P9) fully counter clockwise.

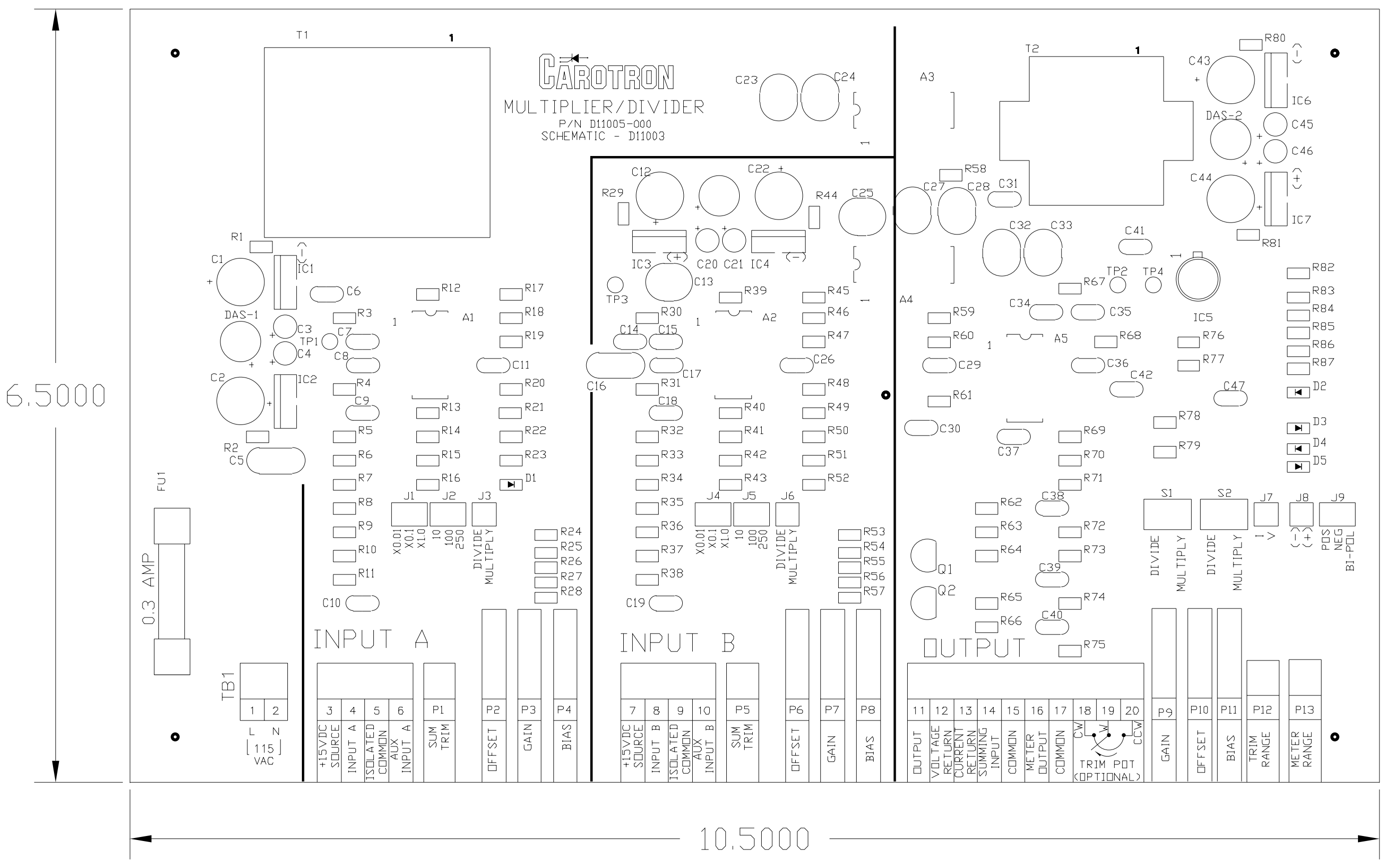
i.) With all inputs still at minimum, adjust the Bias (P11) Potentiometer for the minimum output level desired. Voltage output at Terminals 11 and 12 is usually set to zero and if used, current output at Terminals 11 and 13 is set for the minimum mA level required. Apply full voltage to all inputs. Adjust the Gain Potentiometer (P9) for the maximum desired output.

j.) The unit is now calibrated for operation. The output may now be trimmed by the Trim Potentiometer or an external signal may be summed using the Summing Input at Terminal 14. Use Jumper J8 to select (+) or
(-) for adding or subtracting a positive input signal.

7 Prints


CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
BLOCK DIAGRAM
D11005-000
MULTIPLIER / DIVIDER
DRAWN BY: MTS
DATE: 5-8-91
DRAWING NUMBER: C11879
REV. A
SH. 1 OF
JUMPER TB4, 18 & 19 WHEN OPTIONAL TRIM POT NOT USED
115 VAC INPUT
FU1 0.03A
INPUT RANGE
J1
J2
J3
J4
J5
J6
J7
J8
J9
P1 SUM TRIM
P2 OFFSET
P3 GAIN
P4 BIAS
P5 SUM TRIM
P6 OFFSET
P7 GAIN
P8 BIAS
P9 BIAS
P10 OFFSET
P11 GAIN
P12
P13
TP1
TP2
TP3
TP4
Scaling A Reference Calibration
Scaling B Reference Calibration
ISOLATION AMPLIFIER
SCALED A
SCALED B
MULTIPLY/ DIVIDE FUNCTION
CURRENT AMPLIFIER
METER FUNCTION
OUTPUT SCALING CIRCUIT
±15VOLTS SUPPLY OUTPUT
SUM FUNCTION
OUTPUT MODE
+15V SUPPLY
INPUT A
INPUT B
ISOLATED COMMON
AUX INPUT A
AUX INPUT B
OUTPUT
VOLTAGE RETURN
CURRENT RETURN
SUM INPUT
COM
METER OUTPUT
TRIM OPTIONAL
TRIM RANGE
METER RANGE


REV C, ECO 493, 3-12-98
REV B, ECO 171, 5-18-94
REV A, ECO 170, 9-22-92
CAROTRON
Driven by Excellence
SCHEMATIC
MULTIPLIER/DIVIDER
CARD
WRM
9-1-92
D11003
REV. C



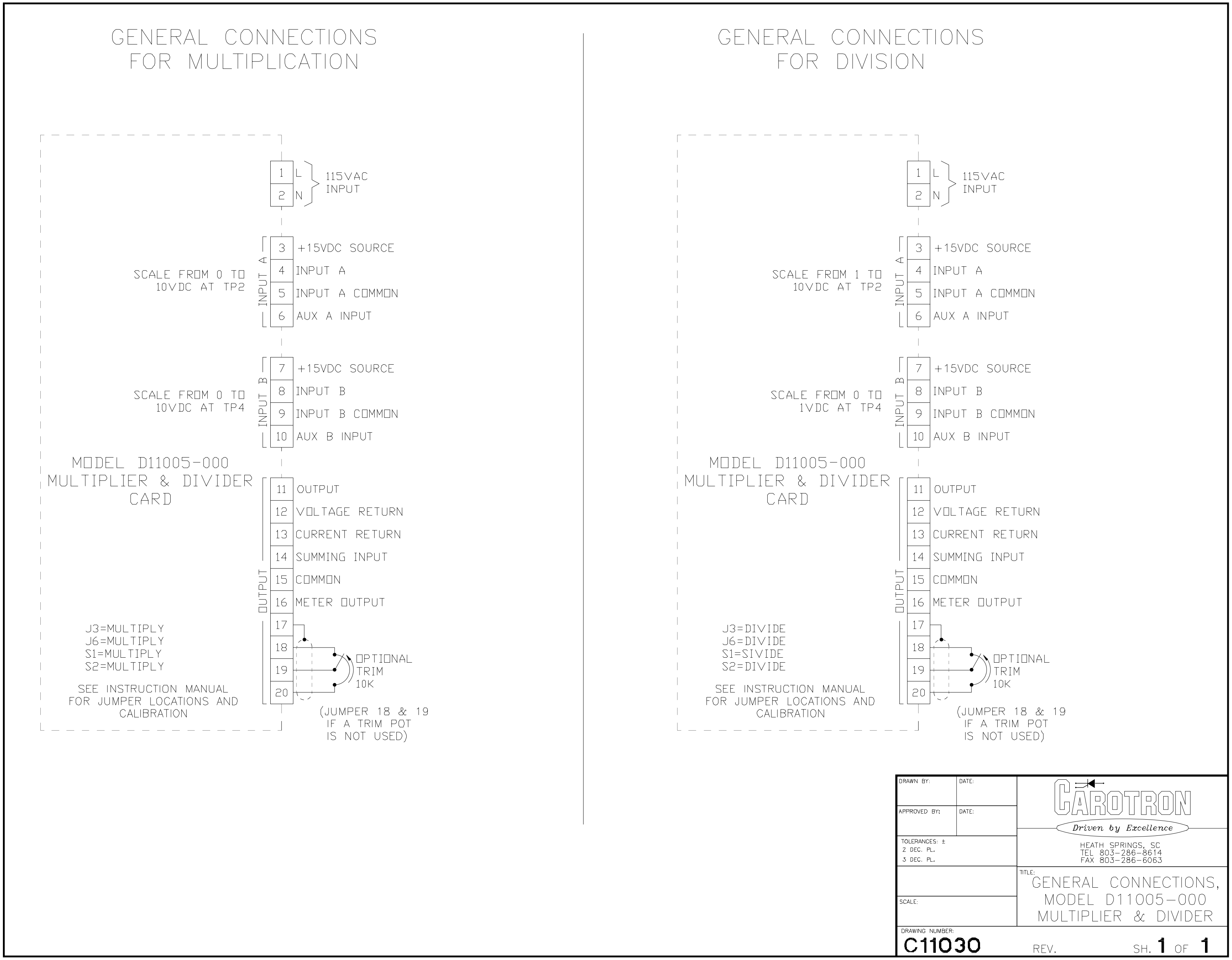
NOTES;
1. REF. SCHEMATIC D11003
2. REF. B.O.M. A11005

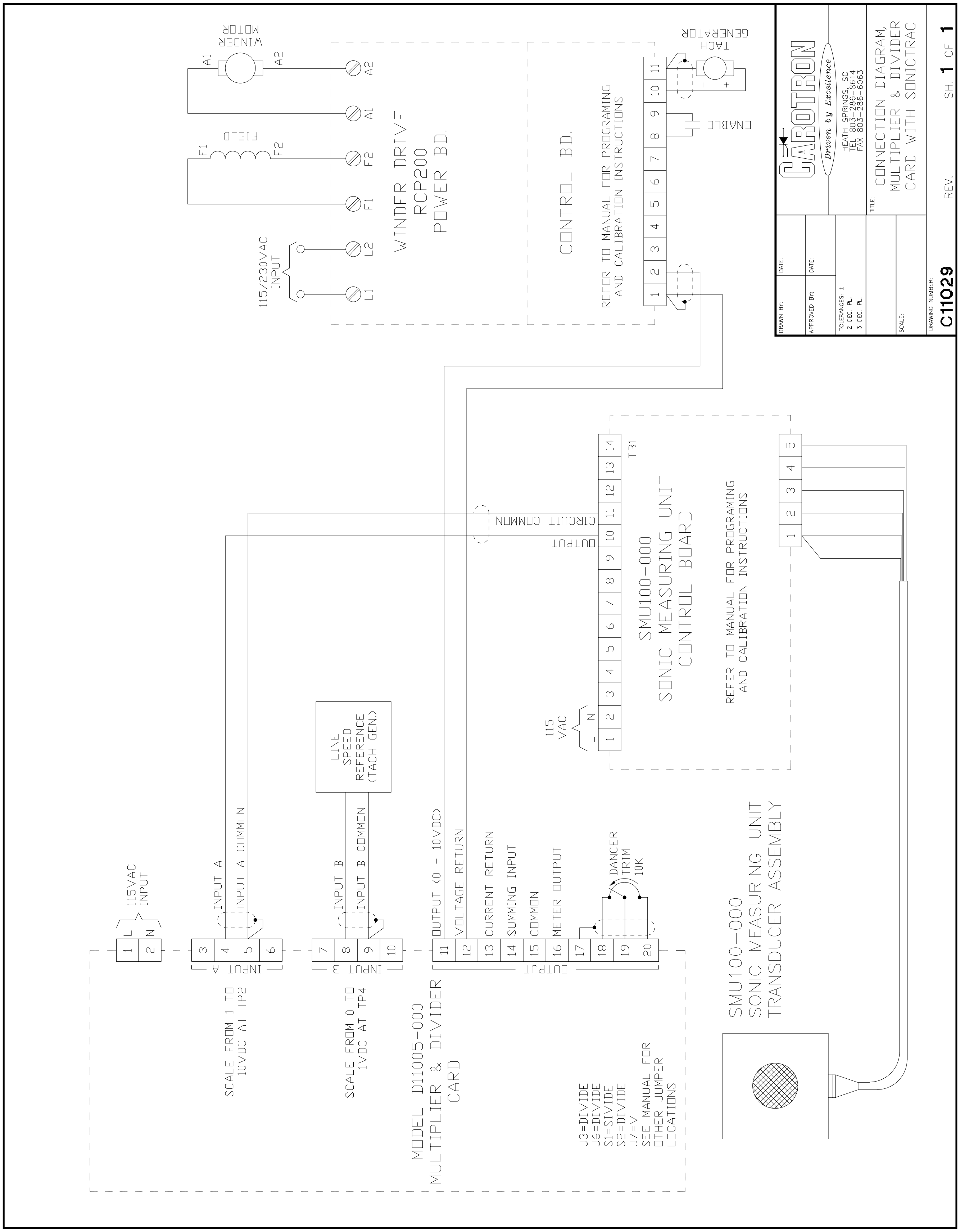
REV. B, ECO 171, 5-18-94

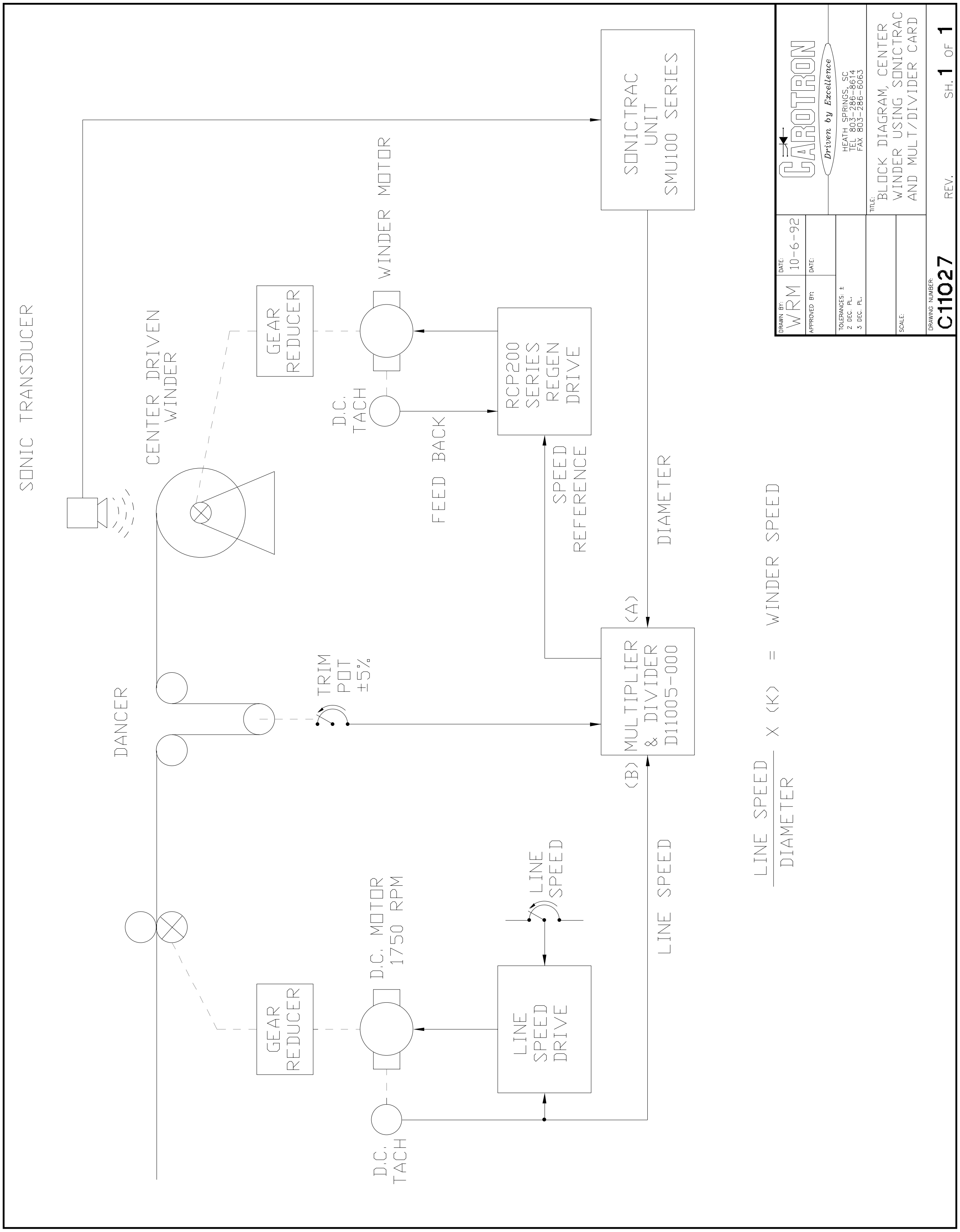
DRAWN BY: HJH	DATE: 9-2-92
APPROVED BY:	DATE:
TOLERANCES: ± 2 DEC. PL. 3 DEC. PL.	
SCALE: 2=1	
DRAWING NUMBER: D11005	REV. B SH. 1 OF 1

CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063

TITLE: ASSEMBLY MULTIPLIER/DIVIDER CARD


GENERAL CONNECTIONS
FOR MULTIPLICATION
1 L
2 N
115VAC
INPUT
INPUT A
3 +15VDC SOURCE
4 INPUT A
5 INPUT A COMMON
6 AUX A INPUT
SCALE FROM 0 TO
10VDC AT TP2
INPUT B
7 +15VDC SOURCE
8 INPUT B
9 INPUT B COMMON
10 AUX B INPUT
SCALE FROM 0 TO
10VDC AT TP4
MODEL D11005-000
MULTIPLIER & DIVIDER
CARD
OUTPUT
11 OUTPUT
12 VOLTAGE RETURN
13 CURRENT RETURN
14 SUMMING INPUT
15 COMMON
16 METER OUTPUT
17
18
19
20
OPTIONAL
TRIM
10K
(JUMPER 18 & 19
IF A TRIM POT
IS NOT USED)
J3=MULTIPLY
J6=MULTIPLY
S1=MULTIPLY
S2=MULTIPLY
SEE INSTRUCTION MANUAL
FOR JUMPER LOCATIONS AND
CALIBRATION
GENERAL CONNECTIONS
FOR DIVISION
1 L
2 N
115VAC
INPUT
INPUT A
3 +15VDC SOURCE
4 INPUT A
5 INPUT A COMMON
6 AUX A INPUT
SCALE FROM 1 TO
10VDC AT TP2
INPUT B
7 +15VDC SOURCE
8 INPUT B
9 INPUT B COMMON
10 AUX B INPUT
SCALE FROM 0 TO
1VDC AT TP4
MODEL D11005-000
MULTIPLIER & DIVIDER
CARD
OUTPUT
11 OUTPUT
12 VOLTAGE RETURN
13 CURRENT RETURN
14 SUMMING INPUT
15 COMMON
16 METER OUTPUT
17
18
19
20
OPTIONAL
TRIM
10K
(JUMPER 18 & 19
IF A TRIM POT
IS NOT USED)
J3=DIVIDE
J6=DIVIDE
S1=SIVIDE
S2=DIVIDE
SEE INSTRUCTION MANUAL
FOR JUMPER LOCATIONS AND
CALIBRATION
DRAWN BY:
DATE:
APPROVED BY:
DATE:
TOLERANCES: ±
2 DEC. PL.
3 DEC. PL.
SCALE:
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
TITLE:
GENERAL CONNECTIONS,
MODEL D11005-000
MULTIPLIER & DIVIDER
DRAWING NUMBER:
C11030
REV.
SH. 1 OF 1


WINDER MOTOR
A1
A2
FIELD
F1
F2
115/230VAC INPUT
L1
L2
F1
F2
A1
A2
WINDER DRIVE RCP200 POWER BD.
CONTROL BD.
REFER TO MANUAL FOR PROGRAMING AND CALIBRATION INSTRUCTIONS
1 2 3 4 5 6 7 8 9 10 11
ENABLE
TACH GENERATOR
CIRCUIT COMMON
OUTPUT
TB1
1 2 3 4 5 6 7 8 9 10 11 12 13 14
115 VAC
L N
SMU100-000 SONIC MEASURING UNIT CONTROL BOARD
REFER TO MANUAL FOR PROGRAMING AND CALIBRATION INSTRUCTIONS
1 2 3 4 5
LINE SPEED REFERENCE (TACH GEN.)
115VAC INPUT
L N
INPUT A
INPUT A COMMON
INPUT B
INPUT B COMMON
OUTPUT (0 - 10VDC)
VOLTAGE RETURN
CURRENT RETURN
SUMMING INPUT
COMMON
METER OUTPUT
DANCER TRIM 10K
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
INPUT A
INPUT B
OUTPUT
SCALE FROM 1 TO 10VDC AT TP2
SCALE FROM 0 TO 1VDC AT TP4
MODEL D11005-000 MULTIPLIER & DIVIDER CARD
J3=DIVIDE
J6=DIVIDE
S1=SIVIDE
S2=DIVIDE
J7=V
SEE MANUAL FOR OTHER JUMPER LOCATIONS
SMU100-000 SONIC MEASURING UNIT TRANSDUCER ASSEMBLY
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
DRAWN BY:
DATE:
APPROVED BY:
DATE:
TOLERANCES: ±
2 DEC. PL.
3 DEC. PL.
TITLE:
CONNECTION DIAGRAM, MULTIPLIER & DIVIDER CARD WITH SONICTRAC
SCALE:
DRAWING NUMBER:
C11029
REV.
SH. 1 OF 1


SONIC TRANSDUCER
CENTER DRIVEN WINDER
GEAR REDUCER
WINDER MOTOR
D.C. TACH
RCP200 SERIES REGEN DRIVE
FEED BACK
SPEED REFERENCE
DIAMETER
SONICTRAC UNIT SMU100 SERIES
DANCER
TRIM POT ±5%
(A)
MULTIPLIER & DIVIDER D11005-000
(B)
LINE SPEED
LINE SPEED / DIAMETER X (K) = WINDER SPEED
D.C. MOTOR 1750 RPM
GEAR REDUCER
LINE SPEED DRIVE
LINE SPEED
D.C. TACH
DRAWN BY: WRM
DATE: 10-6-92
APPROVED BY:
DATE:
TOLERANCES: ±
2 DEC. PL.
3 DEC. PL.
SCALE:
DRAWING NUMBER: C11027
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
TITLE: BLOCK DIAGRAM, CENTER WINDER USING SONICTRAC AND MULT/DIVIDER CARD
REV.
SH. 1 OF 1

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 (c) 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, (1) 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 Çompany. 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 "RETURN TAG" 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.

CAROTRON

Driven by Excellence

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

3204 Rocky River Road
Heath Springs, SC 29058
Phone: (803) 286-8614
FAX: (803) 286-6063

MAN 1023-0C
Issued 2-99