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SERVICE INSTRUCTIONS
ADDER/SUBTRACTOR MODULE
MODEL 380F

SD380F
Issue: 4
Date: 4/90

GENERAL

Model 380F Adder/Subtractor Modules accept 2 or 3 input signals (1-5V dc) and provides a process current output proportional to the sum and/or difference of these inputs. Up to 10 of these modules can be mounted in a Series 380 enclosure resulting in substantial space savings as well as providing flexibility for interconnection with other modules.

It provides a process current output of either 4-20mA or 10-50mA. Inputs can be either added or subtracted by means of a field changeable jumper on the circuit board. Wide span and zero adjustments are provided for each input. The following formula describes the input/output relationship which can be achieved with the 380F.

$$I_o = \frac{G_o}{R_o}\left[G_A\ (V_A - b_A) \pm G_B\ (V_B - b_B) \pm G_C\ (V_C - b_C)\right] \pm K_o$$

I_o = output process current (referred to common)

G_o = adjustable span; 0.2 to 2.0

G_A = 1.0 with trim adjustment

G_B = adjustable span; 0.2 to 2.0

G_C = adjustable span; 0.2 to 2.0

V_A = (input A); 1-5V dc (referred to common)

V_B = (input B); 1-5V dc (referred to common)

V_C = (input C); 1-5V dc (referred to common)

b_A = adjustable zero; 0-2V dc

b_B = adjustable zero; 0-2V dc

b_C = adjustable zero; 0-5V dc

K_o = output zero; 0-20mA or 0-50mA depending on output range

R_o = voltage to current transfer constant

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Process current inputs are handled with the use of precision resistors that are placed across the enclosure input terminals. This permits removal of the module without breaking the input current loop.

SPECIFICATIONS

Input:
(V_A, V_B, V_C) 1-5V dc, 5 meg ohm min. input impedance

Note 1: Zero based inputs can also be handled.

Note 2: The negative input lead is common to the cage DC power supply.

Note 3: For process current inputs, refer to enclosure Service Instructions, SD3801.

Note 4: All computations must have a zero or plus result, minus results do not show in the output.

Input Zero Range:
b_A; 0-2V dc
b_B; 0-2V dc
b_C; 0-5V dc

Output Zero Range (K_O):
0-20mA or 0-50mA depending on output range

Span Range (G_O, G_A, G_B, G_C):
G_O, G_B, G_C; 0.2 to 2.0 continuously adjustable
G_A; 1.0 with trim adjustment

Voltage to Current Transfer Constant (R_O):
For 4-20mA output range, R_O = 250 Ohms
For 10-50mA output range, R_O = 100 Ohms

Output (I_O):
4-20mA into 0-900 Ohms (0-700 Ohms for 24V dc powered cages)
10-50mA into 0-360 Ohms (0-280 Ohms for 24V dc powered cages)

NOTE: The negative output lead is common with the cage DC power supply.

Load Effect:
The output current will change less than 0.1% as load resistance is changed over entire range.

Current Limiting:
The output current will limit at approx. 150% full scale when the input is overdriven.

Accuracy:
±0.25% of output span.

Repeatability:
±0.15% of output span; test limit, ±0.1% typical.

Temp. Effect:
±0.008%/°F max. over the ambient temperature range (test condition: A + B + C = output, 1-5V dc inputs, 4-20 mA outputs.)

Response Time:
150ms to read 98% of output span - typical.

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INSTALLATION

Using the card cage enclosure instructions as a reference (Service Instructions, SD3801), set the keys as follows:

Left Key: V (vertical)
Right Key: V (vertical)

If the adder/subtractor module is factory calibrated, insert the module into the proper slot in the card cage enclosure. If it is not factory calibrated, refer to the CALIBRATION section of this instruction. The module accepts 1-5V dc input signals, if current input signals are to be used, refer to the card cage enclosure instructions, SD3801, for details on input signal conditioning resistors.

CALIBRATION

PREPARATION

Determine which output range is required in your application, 4-20 or 10-50mA. A jumper wire located on the foil side of the circuit board determines the output range.

Output 4-20mA: J1 out
Output 10-50mA: J1 in

The following is a list of formulas, expressed in simplified form, that can be performed by this unit. They are shown here so that they can be grouped. Reference is made to these groups in the adjustment procedure.

Equations - Group I

A. $I_o = A + B + C$
B. $I_o = A + B$ (Input C - not used)

Equations - Group II

D. $I_o = A + B - C$
E. $I_o = A - B + C$
F. $I_o = A - B$ (Input C - not used)

Equations - Group III

H. $I_o = A - B - C$

Place the B and C, Plus/Minus plugs, located on the component side of the PC board as follows:

Eqn's - Group I: Place both the B and C plugs to the plus (+) position.

Eqn's - Group II: Place the B and C plugs as required in your computation, if an input will not be used, place the plug for that input into the plus (+) position.

Eqn's - Group III: Place both the B and C plugs to the minus (-) position.

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Connect the transmitter as shown in the connection diagram. Your input sources must be adjustable over the entire input range of your unit, and settable to an accuracy of 0.1% or better. Load the transmitter within the limitations listed under OUTPUT in the SPECIFICATIONS section of this instruction. The output current must be measured to 0.1% accuracy or better for proper results.

ADJUSTMENT PROCEDURE

When calibrating a particular input, the other inputs can be set at any input level (0 to 5V) or left open.

Input - A

1. Connect a voltmeter (20KΩ/V or greater input impedance) to TP-A and TP-COM, located on the front of the card. Set input A to 1.000V and adjust the 22-turn pot. marked IN: A-ZERO until the meter reads 0.00V to within ±4mV (0.1% of input span).

2. Set Input A to 5.000V and adjust the 22-turn pot. marked IN: A-SPAN until the meter reads:

   Eqn's - Groups I & II - 4.000V to within ±4mV (0.1% of input span)

   Eqn's - Group III - 2.000V to within ±4mV (0.1% of input span)

Input - B

NOTE: If Input B is not used in your application, follow procedure as outlined in UNUSED INPUTS. If it is an active input, proceed with the following procedure.

1. Connect the voltmeter to TP-B and TP-COM located on the front of the card.

2. Set Input B to the minimum value in your application and adjust the 22-turn pot. marked IN: B-ZERO until the meter reads 0.00V to within 0.1% of your input span.

3. Input B can be modified by a gain factor from 0.2 to 2.0. To determine the maximum output at TP-B multiply your input span by the gain factor in your application. Set Input B to the maximum value in your application and adjust the 22-turn pot. marked IN: B-SPAN until the meter reads the voltage determined above (the voltage at TP-B, after calibration, can range from 0-8.0V).

Input - C

NOTE: If Input C is not used in your application, follow procedure as outlined in UNUSED INPUTS. If it is an active input, proceed with the following procedure.

1. Connect the voltmeter to TP-C and TP-COM located on the front of the card.

2. Set Input C to the minimum value in your application and adjust the 22-turn pot. marked IN: C-ZERO until the meter reads 0.00V to within 0.1% of your input span.

3. Input C can be modified by a gain factor from 0.2 to 2.0. To determine the maximum output at TP-C multiply your input span by the gain factor in your application. Set Input C to the Maximum value in your application and adjust the 22-turn pot. marked IN: C-SPAN until the meter reads the voltage determined above (the voltage at TP-C, after calibration, can range from 0-8.0V).

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Unused Inputs

1. Input B - not used: Install a jumper wire between Terminal 2 and Terminal 9 on the connection barrier strip.

2. Input C - not used: Install a jumper wire between Terminal 7 and Terminal 9 on the connection barrier strip.

3. Connect the voltmeter to TP-B or TP-C as required, located on the front of card.

4. Adjust the Zero pot. for the required input until the meter at the test point reads 0.00V.

5. Adjustment for this unused input is now complete. (NOTE: The span pot. does not have to be adjusted.)

Output

1. Determine which output range is required in your application, 4-20 or 10-50mA. A jumper wire located on the foil side of the circuit board determines the output range.

   Output 4-20mA: J1 out
   Output 10-50mA: J1 in

2. Set all active inputs to their minimum value in your application and adjust the 22-turn pot. marked OUT-ZERO to give the minimum output current required in your application.

3. Set all inputs, which are positive (+) in your computation, to their maximum value. Set all inputs, which are negative (-) in your computation, to their minimum value.

4. Adjust the potentiometer marked OUT-SPAN to give the maximum output current required in your application.

5. Repeat steps 2, 3 and 4 as required.

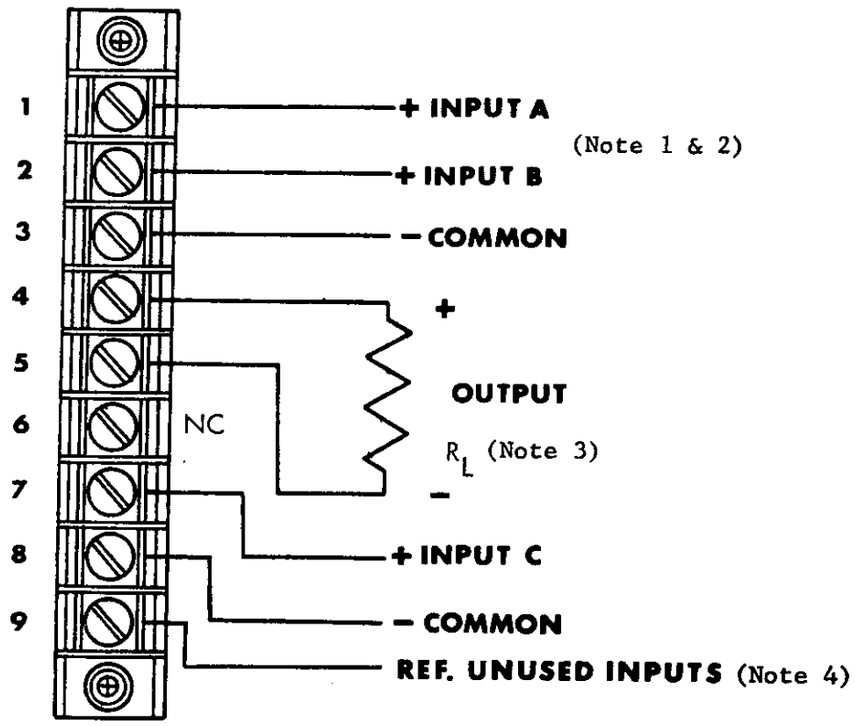
MAINTENANCE

These instruments are solid state and require no maintenance on a regular basis, except for annual cleaning, blowing out dirt, and verifying calibration. If the adder/subtractor module is not operating properly, remove it and give it a full bench check-out. Most problems are in field wiring or peripheral circuitry. If the problem is traced to the unit itself, conventional electronic troubleshooting methods suffice.

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CONNECTION DIAGRAM

Terminal strips on Series 380
rack enclosures



Notes:

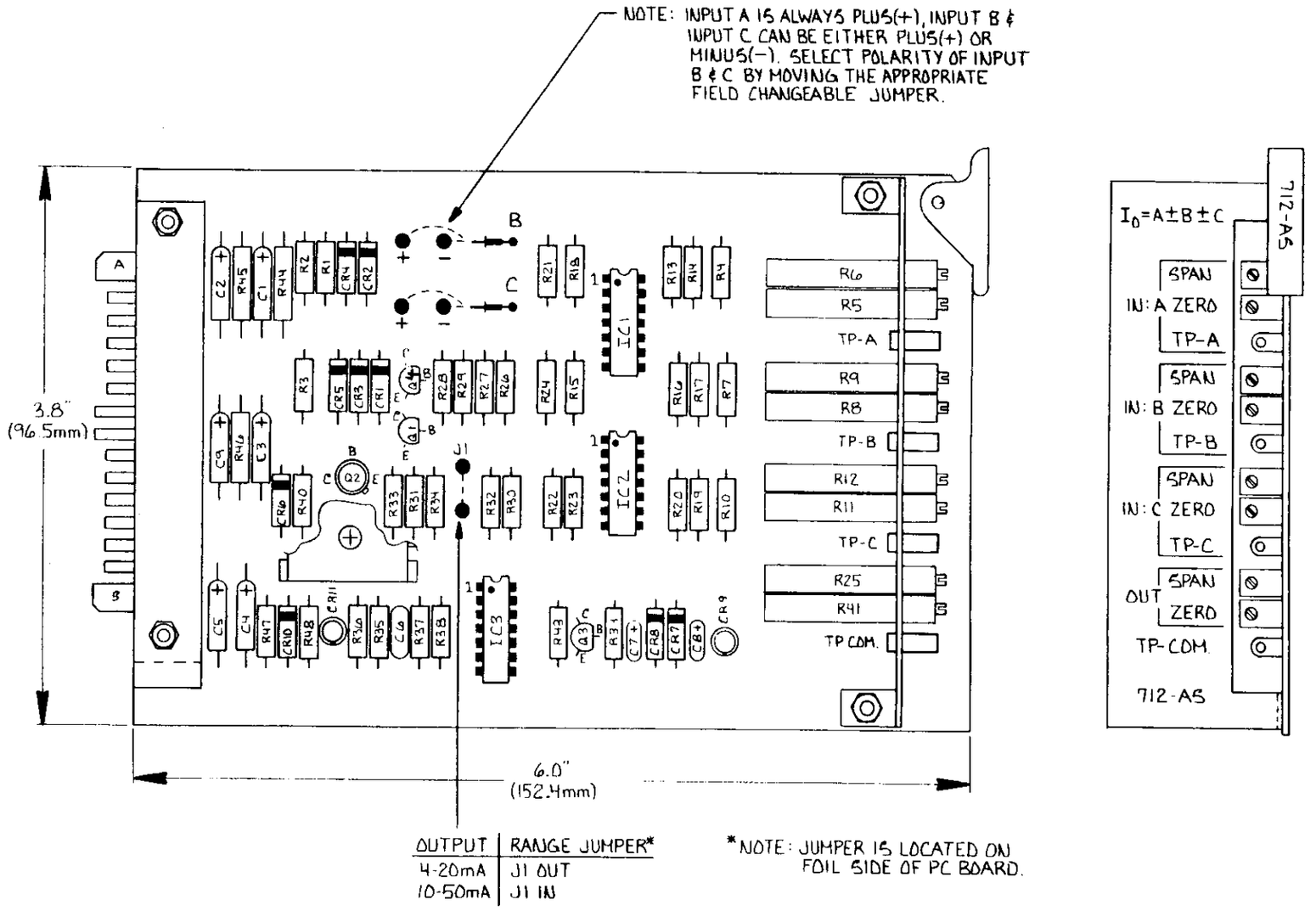
1. 1-5V dc signals are standard inputs. For process current inputs, refer to Service Instruction, SD3801 for proper input conditioning resistors.

2. The negative input terminal is common with the cage DC power supply.

3. See output specifications for load limits.

4. Reference 5V nominal

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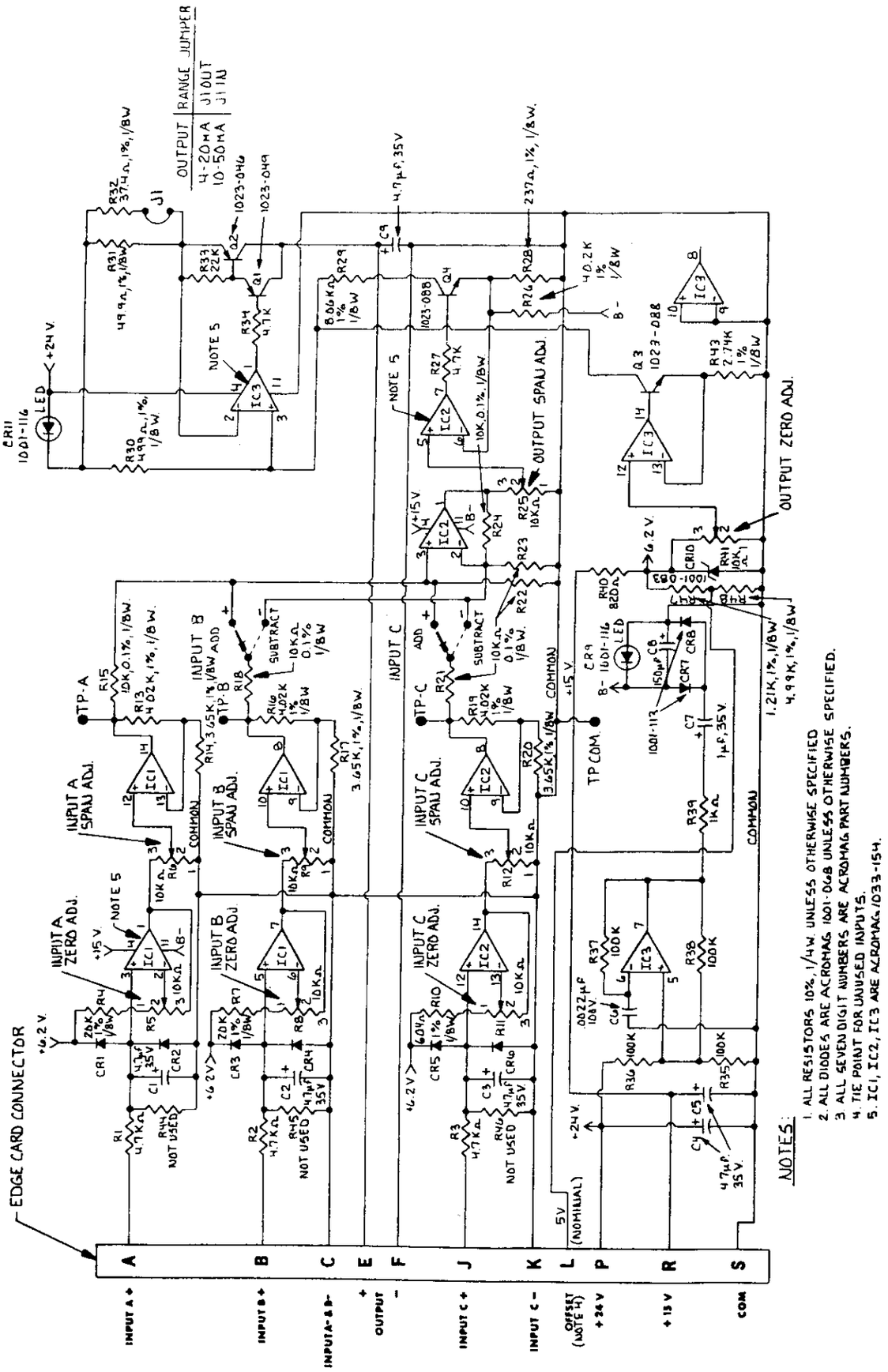
OUTPUT	RANGE JUMPER*
4-20mA	J1 OUT
10-50mA	J1 IN

*NOTE: JUMPER IS LOCATED ON FOIL SIDE OF PC BOARD.

REF. 4500-062B

SD380F

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