$25.00

BALDOR®
MOTORS AND DRIVES

SUM Series

Installation & Operating Manual

7/96 MN1219

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Section 1
General Information

Introduction

The Baldor SUM Positioning Servo uses pulse width modulation (PWM) technology. Each control can drive one or two DC motors with built-in 2-axis positioning capability. DC motors must have encoder feedback. The control is an integrated package of the UM-2 Servo control and the SMCC (Smart Motion Control Card). A SUM drive has the following features:

- High Frequency “Inaudible” Switching (20kHz)
- Power Up to 30 A peak, 150 V DC
- Various protective features (Amplifier fault, Following error, Positional Limit etc.)
- Fault Status Indicators
- Direct 1 or 2-axis Co-ordinated Position Control
- Programmed motion including multiple I/O capability
- Communication to the host computer (RS-232)
- Multi-axis (up to 32 axes) coordinated moves by using daisy chained SMCC’s (Smart Motion Control Card’s).

A SUM4 package shipped from the factory includes the following items.

1. One SUM4 Chassis with Servo Control Card installed.
2. One SMCC with options 1, 2, 3 and 4.
3. One 10 foot RS-232 Cable for Host Communication.
4. “MONITOR” software program disk.
5. The following manuals:

   Smart Motion Control Card, MN1209

   UM Series DC Servo Control, MN1213

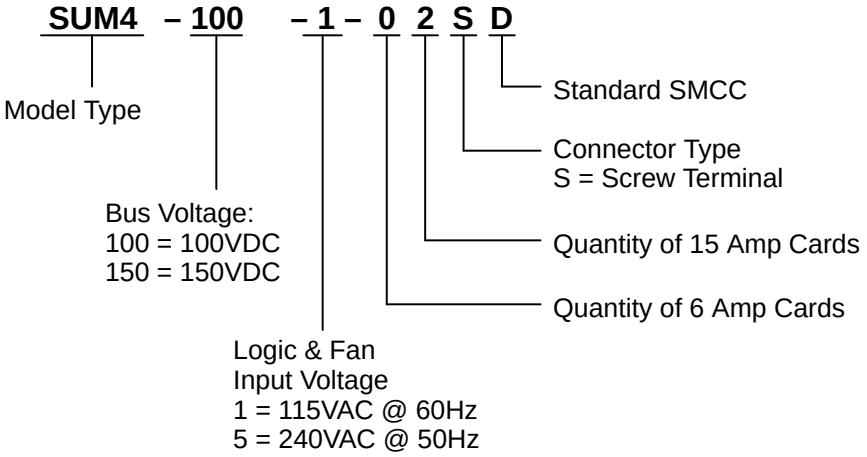
   SUM Series manual, MN1219

This manual contains a general overview and installation/startup information for the SUM positioning servo control. Refer to MN1213 for further information on control hardware and chassis information. For software and hardware information on SMCC, see MN1209.

Model Information

The SUM4 Positioning Servo control is specified by the model number as shown in Figure 1-1.

Figure 1-1 Model Number Description



Note: 6 Amp Card: 6A continuous, 15A peak, 100VDC bus voltage.
15Amp Card: 15A continuous, 30A peak, 100VDC or 150VDC bus voltage.

Section 2
Receiving & Installation

Receiving & Inspection

The control is thoroughly tested at the factory and carefully packaged for shipment. When you receive your control, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your control.
2. Verify that the part number of the control you received is the same as the part number listed on your purchase order.
3. If the control is to be stored for several weeks before use, be sure that it is stored in a location that confirms to published storage specifications. (Refer to the specifications in the SMCC manual MN1209).

Physical Installation

The location of the control is important. It should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these can reduce the operating life and degrade performance of the control.

Several other factors should be carefully evaluated when selecting a location for installation:

1. The following is a list of tools you may need:
   A. 8″ long Philips screw driver
   B. Standard and small blade screw drivers
   C. Wire strippers, wire cutters
   D. Soldering iron
2. Unpack the control and verify that all components are present.
3. When a mounting location is selected, mount the control securely inside an enclosure (NEMA 12 is preferred). Use the four 0.28” mounting holes provided. (See Figure 2-1.)
   A. For effective cooling and maintenance, the control should be mounted on a smooth, non-flammable vertical surface.
   B. At least two inches clearance must be provided on all sides for air flow.
4. Select and mount an isolation transformer in the enclosure. The SUM control requires an external isolation transformer to provide an isolated source of AC power. Use the following information to select a transformer:

Input Voltage:	Same as power line voltage.
Output Voltage:	70V RMS for 100 VDC bus. 105V RMS for 150 VDC bus.
KVA Rating:	Sum total of the KVAs of all axes.

   Example: For SUM4–100 control with two UM3015 control cards, 15A x 100V x 2 = 3000 VA = 3KVA.

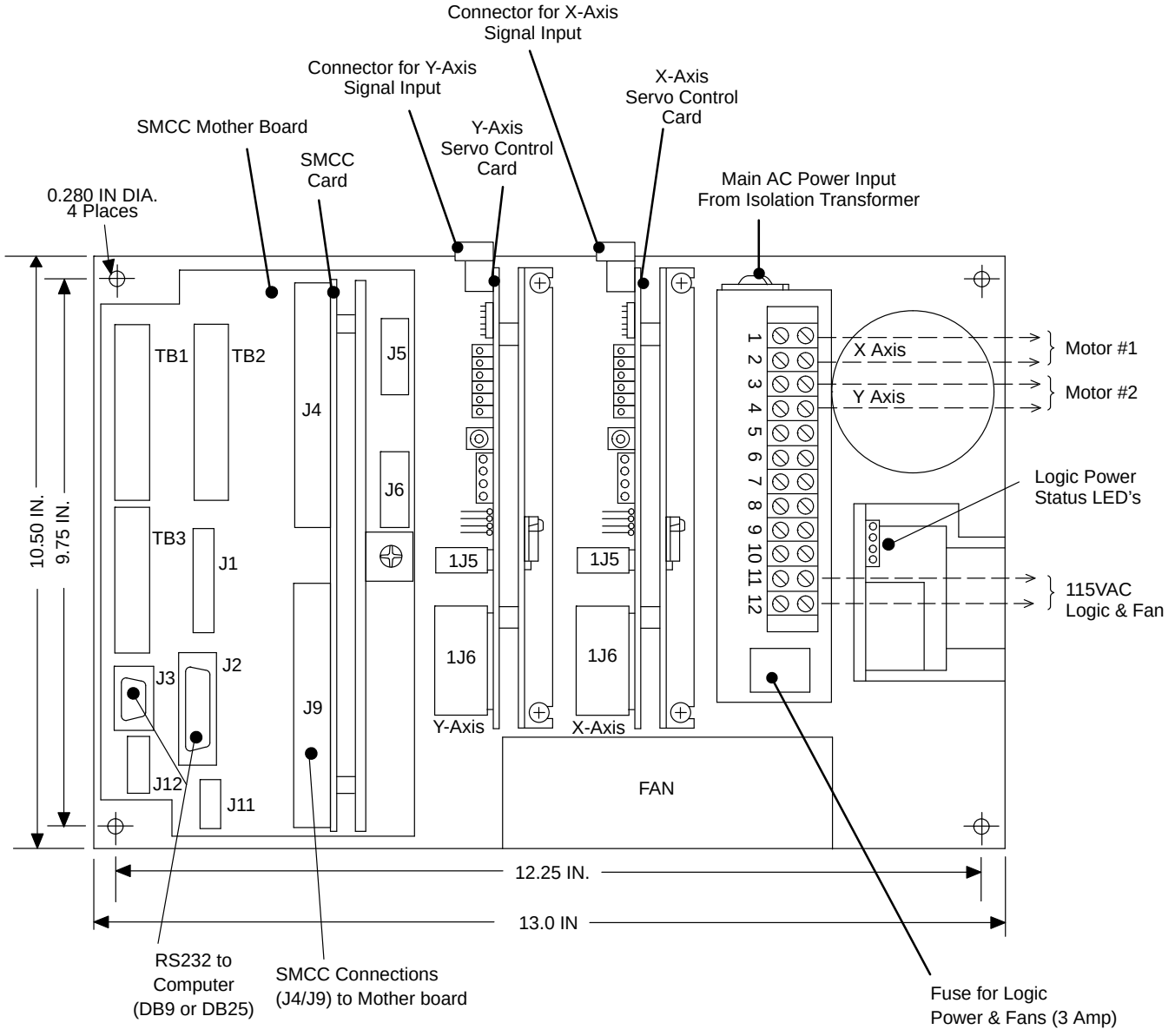
   Transformers with slightly lower ratings may be used if the KVA requirement of the application is less. Baldor transformers include:

ET–015–100–1123T	Single phase 1.5 KVA, 115/230V input.
ET–030–100–1123T	Single phase 3.0 KVA, 115/230V input.

   Refer to the UM Series Servo Control, MN1213 manual for details.
5. Four screws are located at the locations of the 2 servo cards. Loosen but do not remove these four screws.
6. If the Y-Axis Control Card is already installed, proceed to step 8. Install the Y-Axis Control Card at the location shown in Figure 2-1. Tighten the 2 screws that secure the card to the chassis.

7. Connect the Y-Axis power connectors to 1J6 (11 Pin) and 1J5 (3 Pin) of the Y-Axis card.
8. If the X-Axis Control Card is already installed, proceed to step 10. Install the X-Axis Control Card at the location shown in Figure 2-1. Tighten the 2 screws that secure the card to the chassis.
9. Connect the X-Axis power connectors to 1J6 (11 Pin) and 1J5 (3 Pin) of the X-Axis card.
10. Install the SMCC Card by inserting it into connectors J4 and J9. The SMCC must fit securely with the solder side of the SMCC card facing the UM control cards. Fasten the SMCC to the mother board using the captive screw provided.

Figure 2-1 Installation Diagram.



Electrical Installation

Interconnection wiring is required between the motor control, AC power source, motor, host control and any operator interface stations. Use connectors that are of appropriate size for wire gauge being used. Connectors are to be installed using crimp tool specified by the manufacturer of the connector.

AC Main Circuit

1. Refer to MN1213 Section 2.5 and perform the Power Wiring and Grounding procedures.
2. Refer to MN1213 Section 2.6 and perform the Power Wiring, Signal Input Wiring and other wiring procedures that apply to your installation.

   Limit Switch inputs may be connected either to the control card or to SMCC. Limit switches inhibit over travel. For the SUM4 drive, it is recommended that limit switches are connected to the SMCC, not to the control card. Normally Closed type limit switches may be connected between a ground line and XMIL, XPLL, YMIL, YPLL. Refer to manual MN1209 for connection of the limit switches to the SMCC card.

Note: All unused SMCC Limit SW Inputs (XMIL, XPLL, YMIL, YPLL) must be grounded to enable any move from the SMCC.

Wiring and Configuration

1. The Motor and Encoder cable is available from Baldor. If you are going to make your own cable, determine the cable lengths required for your motor and encoder cables. It is recommended that an 8 conductor #20–24 AWG, shielded, twisted pair cable that has an overall shield be used for the encoder signals for noise immunity.
2. Connect the X encoder cable to TB1. The connections are shown in Figure 2-2.
   A. **Differential encoder** connections are shown in Figure 2-2.
   For example, X-Axis encoder output has A and $\overline{A}$, B and $\overline{B}$, C and $\overline{C}$. Connect the encoder wires as indicated. Jumper E42 on the SMCC card must be across pins 1-2 position. Jumper E50 on the SMCC card must be across pins 1-2 position.

   B. **Single ended encoders** can be identified by their output signals.
   For example, if the encoder output has A (no $\overline{A}$), B (no $\overline{B}$), C (no $\overline{C}$). Differential output encoders are recommended for best noise immunity. If only single ended encoders are available, connect the encoder outputs to A, B and C (CHAX, CHBX and CHCX respectively of Figure 2-2). Jumper E42 on the SMCC card must be across pins 2-3 position. Jumper E50 on the SMCC card must be across pins 2-3 position.
3. Connect the Y encoder cable to TB2. The connections are shown in Figure 2-2.
   A. **DIfferential encoder** connections are shown in Figure 2-2.
   For example, channel A encoder output has A and $\overline{A}$, B and $\overline{B}$, C and $\overline{C}$. Connect the encoder wires as indicated. Jumper E42 on the X-Axis card must be across pins 1-2 position. Jumper E50 on the Y-Axis card must be across pins 1-2 position.

B. **Single ended encoders** can be identified by their output signals. For example, channel A encoder output has A (no $\overline{A}$), B (no $\overline{B}$), C (no $\overline{C}$). Differential output encoders are recommended for best noise immunity. If only single ended encoders are available, connect the encoder outputs to A, B and C (CHAX, CHBX and CHCX respectively of Figure 2-2). Jumper E42 on the X-Axis card must be across pins 2-3 position. Jumper E50 on the Y-Axis card must be across pins 2-3 position.

4. Connect the X input cable from J5 (of the SMCC motherboard) to the X-Axis control card.
5. Connect the Y input cable from J6 (of the SMCC motherboard) to the Y-Axis control card.
6. The control card is operated in the Current Mode. Verify control card jumper P6 is across pins 1-2. In this configuration, position control is performed digitally by the SMCC. A tach (tach-generator) signal can be used as a velocity feedback to stabilize the system (Parabolic version only), however it is not necessary in most applications.
7. Encoder signals connected to the SMCC mother board (TB1 and TB2) are used for velocity feedback as well as position feedback. Adjust pots on the SMCC Card as follows.

   A pot: rotate fully counter clockwise (not used)

   S pot: rotate fully clockwise

   T pot: rotate fully counter clockwise (tach input not used)

   C pot: rotate fully clockwise, and then rotate 7 turns (15 turn pot) counter clockwise (limit peak current to half)
8. Host computer communication must be established for testing, tuning and programming purposes. Connect an RS–232 cable to the host computer serial port. Connect the other end to the mother board J2 (DB25) or J3 (DB9) port. Be sure that SMCC DIP switches are configured as card address A0, and 9600 Baud rate. This setup will simplify startup procedures.
9. For IBM or compatible PC computer, Baldor distributes the “Monitor” software program – a communication program dedicated to SMCC operation. It features full screen editor, menu driven i–parameter setup procedure, file upload/download, etc.

Note: Operation of the SMCC does not require the “Monitor” software program. Obtain a communication (terminal emulation) program that works on your computer. Configure communication parameters to 9600 Baud, Half Duplex, 1–stop bit, 8–data bits, No–parity. Baud rate may be changed by configuring SMCC DIP switches. Refer to MN1209 Section 3 for communication setup.

Figure 2-2 Simplified Wiring Diagram

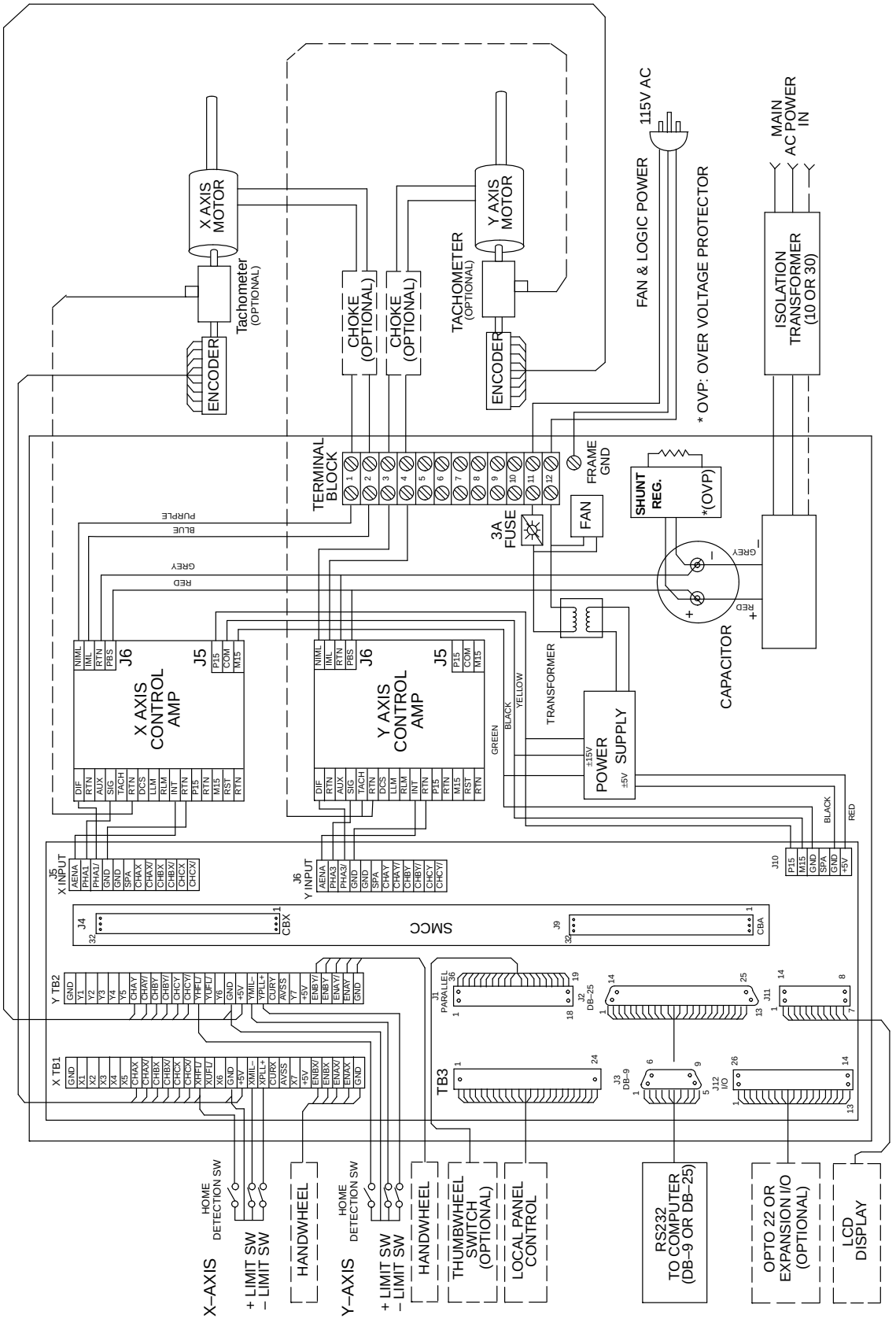
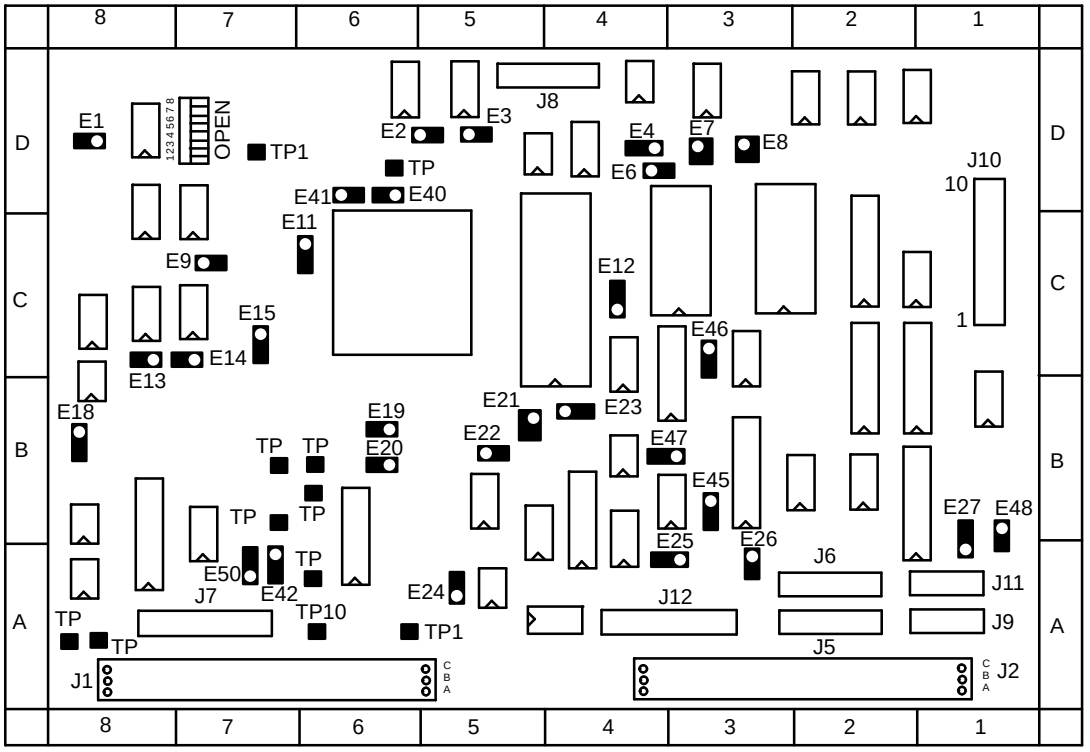


Figure 2-3 SMCC Card Jumper locations.



Indicates Pin 1

	E	LOC.	CONFIG.
E1	D8	2 1	±5V. (±10V)
E2	D6	[1 2]	SERVO AO
E3	D5	1 2	SYNC AO
E4	D4	3 2 1	NO RESOLVER
E6	D4	1 2	
E7	D3	[1 2] [3 4]	RS–232
E8	D3	[1 2] [3 4]	RS–232
E9	C7	1 2	+/–5V. (+/–10V)
E11	C7	1 2 3	EXTERNAL +15V
E12	C4	2 1	8 KHZ
E13	C8	[1 2] 3	
* E14	C7	[3 2] 1	AENA (AENA/)
E15	C7	[1 2]	EXTERNAL +15V
E18	B8	[1 2] 3	
E19	B6	1 2	
E20	B6	1 2	
E21	B5	4 1 [5 2] 6 3	

	E	LOC.	CONFIG.
E22	B5	1 2	
E23	B4	1 [2 3]	
E24	A5	[1 2]	
E25	A4	[1 2] 3	
E26	A3	1 2	SP5V
E27	B1	3 2 1	
E40	D6	[1 2]	
E41	D6	[1 2]	
E42	A7	[1 2] 3	DIFFERENTIAL X–ENCODER
E45	B3	1 [2 3]	
E46	C3	1 [2 3]	
E47	B4	1 2	
E48	B1	1 2	
E50	A7	3 [2 1]	DIFFERENTIAL Y–ENCODER

* E14: FOR TSD CONNECTION ONLY - JUMPER 1-2

Refer to SMCC manual MN1209 for configuration details.

Section 3
Programming and Operation

Setup SMCC Parameters

This section contains procedures to check and tune each axis. Refer to the SMCC manual MN1209 for additional details regarding the following procedure.

⚠ **Caution: DO NOT apply bus power until instructed to do so. Only logic & fan power is required for these steps. This allows the control to be checked without having power applied to the motor.**

1. Apply 115V AC (Fan & Logic Power) to the drive (Terminal Block #11 and #12). Do not apply bus power (Main AC Power In).
2. Turn on the host computer and run the Monitor program. Press Function Key F9 and configure the program to the correct baud rate (9600 Baud), communications port (COM1: or COM2:), and type of monitor.
   Press F2 to check the SMCC, response should be

   ```
   *** Communication Established, Go Ahead.
   ```

   If communications cannot be established, refer to MN1209.
3. When communications is established, the SMCC i–parameters may by set. Refer to the SMCC manual MN1209. Parameters are factory set as shown in Table 3-1. Examine all values to make sure that these parameters are correct for your application. Since one or two axis DC motors are to be used with SUM–4, verify the following two parameters and change if necessary.

   `i13 0`; indicating that DC motors are used.

   `i15 0;` (for two axis operation), `1` (for X axis only)
4. While slowly rotating motor shaft clockwise CW (as seen from the load side), check position by issuing a “p” command. The computer will display two columns of numbers. The left number is the “X” axis encoder count position; the right number is the the “Y” axis count position. You should observe position increasing. If position is decreasing as shaft turns in the CW direction, encoder A and B channels are reversed. If position is not changing at all while you rotate shaft, verify connections.
5. Turn the power off. Familiarize yourself with other SMCC commands such as jog (j, J), kill (k), quit (q), torque input (O) etc. Be prepared to use “k” command any time the motor rotates at an uncontrollable speed.

Basic Move and Tuning

This procedure may be performed one axis at a time. Perform the following steps for the X-Axis then repeat the procedure for the Y-Axis. Commands for the Y-Axis are enclosed in braces “[ ]”. When starting X-Axis testing, unplug J6 connector of the Y-Axis amplifier. The control card located closer to the DC bus power supply side is the X-Axis (axis 1).

1. Turn both control and BUS power ON. Issue “O20” [“OY20”] command and verify the shaft rotates clockwise. Issue “O–20” [“OY–20”] command and verify the shaft rotation reverses. This verifies correct motor and encoder connections. If load is connected to the shaft, it may be necessary to use a higher value like “O50”[“OY50”], which means 50/255 of the maximum peak current will drive the motor. Issue “k” command to shut off the motor power.
2. Now, issue “O0” [“OY0”] command and verify that the shaft is not drifting. Adjust B (balance) pot on the amplifier to null out the offset.
3. Issue “q” command and verify that the shaft is locked. Adjust servo tuning parameters (i20,i21 [i40, i41]) to get desired stiffness. Adjust your amplifier S pots and C pots if necessary. Fully clockwise S pot position results in approximately 6A/V (UM3015), or 3A/V (UM1506) amplifier gain. Reduce the gain by turning the S pot counterclockwise if motor current will be considerably lower than rated amplifier current during most of the duty cycle time.
4. Fully clockwise C pot position allows maximum peak current to flow, while fully counterclockwise C pot position allows 10% of the peak current to flow. Adjust C pot to limit peak current to your desired level. This should be less than the demagnetization current of the motor.
5. Re–adjust servo tuning parameters (i20,i21 [i40,i41]). You may use on–line data capture capability to plot servo data (See Alt F2 function) to tune the system. Set other tuning parameters (i30,i23,i22) as well. Issue job commands and check following errors and acceleration time. Change speeds and acceleration time as desire.
6. Turn control and BUS power OFF.
7. Plug in J6 of the Y-Axis control.
8. Unplug J6 of the X-Axis control.
9. Repeat steps 1 to 6, and do the same procedure for Y-Axis.
10. Plug in J6 of the X-Axis control.
11. Turn both control and BUS power ON.

Special Connections (Optional) SMCC motherboard has several other connectors to provide operator control and handshaking with other equipments. Several typical examples include the following:

1. LCD Display Unit
   Baldor supplies a 2 x 40 LCD display and cable that fits into the 14 pin connector J11 on the motherboard. Many industry models (1x24, 1x40, 2 x 24, 2x40, etc.) also fit with appropriate cabling. SMCC has to be configured (refer to i18) properly.
2. Thumbwheel Switch Input – See SMCC manual.
3. Handwheel Input – Position offset, or speed override.
4. Local panel interface (direct logic control of operation and status monitoring)
5. General purpose machine I/O to handshake with other machines or processes.
6. Alternative communication methods (Parallel interface, daisy-chain, DMA, etc.).

A complete listing of connector pinouts and interface circuit drawings (DWG. 1–10) can be found in Appendix B.

Table 3-1 Factory Settings I–Parameters (Parabolic)

Name	Factory Setting		Comments (*: application dependent)
i00	15000		Following Error Fault Limit.
i01	100		In–Position Band.
i02	0		MDI mode OFF.
i03	1		“Line Feed” Handshake ON.
i04	64		Home feedrate i04/256 * i06.
i05	487		Servo time, critical, do not change.
i06	60000	*	Maximum reference speed in count per sec.
i07	65498		Servo constant, critical, do not change.
i08	1000	*	Acceleration/deceleration time (mSec).
i09	1		Integration enabled only when stopped.
i10	1000		Following Error Indication Band.
i11	1		Set Deceleration Mode (i08) or %Slew).
i12	40		Move Calc time, critical, do not change.
i13	0		Select DC motors.
i14	0		Disable analog input ANA2 and ANA3.
i15	0	*	Y axis enabled (1 disables Y axis).
i16	0		Set Handwheel mode (Default).,
i17	30000		Velocity Display Time base.
i18	3	*	Select a 2x40 LCD display.
i19	0	*	Set Highest card address.
i20[i40]	500	*	Proportional gain, can not be 0.
i21[i41]	40	*	Differential gain.
i22[i42]	0	*	Velocity Feedforward gain.
i23[i43]	0	*	Integral Gain.
i24[i44]	0		Home Direction (Negative).
i25[i45]	0		Home Offset.
i26[i46]	0		Home flag and User flay control.
i27[i47]	4096		Handwheel Scale Factor.
i28[i48]	3		Handwheel mode disable. (assume i16+o)
i29[i49]	0		Handwheel Input Logic.
i30[i50]	0	*	Acceleration Feedforward Gain.
i31[i51]	64		Jog Feedrate.
i32[i52]	255		Set Normal PWM limit.
i33[i53]	64		Set Protective PWM limit.
i34[i54]	0		Backlash Compensation.
i35[i55]	–1		Software positive limit. no limit.
i36[i56]	–1		Software negative limit. no limit.
i37[i57]	0		Set Position Rollover Range.
i38[i58]	1:1.0		Position Display Scale.
i39[i59]	3		Position encoder control bits.
i60[i60]	0		Deadband X [Y] axis.
i62	0		Disable PLC
i63 – i81	0		Default parameters i63 – i81 are all zeros.

Appendix A
Motherboard Connectors

RS-232 Interface (J2, J3)

There is one 25-pin (J2), and one 9-pin (J3) RS-232 connector on the motherboard. The signals at each pin are defined in the following table. These connectors are configured for null modem operation so that a straight thru serial cable can be used for communication. Do not use a null modem with these connectors.

To daisy-chain multiple SMCC's the 25-pin connector (J2) must be used. For daisy-chain, all pins marked as "Daisy-Chain" below must be used. All other signals are optional as required by the host computer.

Pin # (J2)	Pin # (J3)	NAME	FUNCTION
1	1	CHAS	RS-232, Chassis, Not tied to Common.
2	3	TXD/	RS-232, Transmit Data.
3	2	RXD/	RS-232, Receive Data.
4	7	RETS	RS-232, Request To Send.
5	8	CLTS	RS-232, Clear To Send.
6	6	DASR	RS-232, Data Set Ready.
7	5	GND	RS-232, Ground.
8		BUFU/	Program Buffer Full.
9		EROR/	Output, Error (Fault or Communication Error).
10		INIT/	Daisy-Chain, Input, SMCC Reset.
11		GND	Ground.
12		GND	Ground.
13		GND	Ground.
14		SP5V	Output, +5 VDC SUPPLY, Can be deactivated by E26.
15		ENBY/	Do Not Connect.
16		ENAY/	Do Not Connect.
17		ENBX/	Do Not Connect.
18		ENAX/	Do Not Connect.
19		SPARE	Do Not Connect.
20	4	DATR	RS-232, Data Terminal Ready.
21		SPARE	Do Not Connect.
22		IPOS	Output, In position Indicator. Positive Logic.
23		ETXD	Daisy-Chain, TTL level, Buffered TXD.
24		BRTS	Daisy-Chain, TTL level, Buffered RTS.
25		SYNC/	Daisy-Chain, Multiple-card Sync Clock.

X[Y] Axis Interface (TB1, [TB2]) TB1 [TB2] are “press type” terminal blocks X-axis [Y-axis] connections. To reduce noise, shielded cable is highly recommended for encoder connections. Shield must be grounded at the drive side, and open at the other end. Either differential or single ended encoder types may be used. Depending on the encoder type, jumpers on the SMCC board must be configured properly. Factory setting is for differential encoder type. See DWG 2, 4, 5, and 8 in Appendix B for interface circuits and jumpers. Note that logic on XHFL/ and YHFL/ are software controllable (see SMCC manual, i26 [i46] parameters).

PIN#	X-NAME	Y-NAME	FUNCTION
1	GND	GND	Ground.
2	X1	Y1	Reserved, Do Not Use.
3	X2	Y2	Reserved, Do Not Use
4	X3	Y3	Reserved, Do Not Use.
5	X4	Y4	Reserved, Do Not Use.
6	X5	Y5	Reserved, Do Not Use.
7	CHAX	CHAY	Input, Encoder A channel Positive.
8	CHAX/	CHAY/	Input, Encoder A channel Negative.
9	CHBX	CHBY	Input, Encoder B channel Positive.
10	CHBX/	CHBY/	Input, Encoder B channel Negative.
11	CHCX	CHCY	Input, Encoder C channel Positive.
12	CHCX/	CHCY/	Input, Encoder C channel Negative.
13	XHFL/	YHFL/	Input, Home Flag, Programmable Parity.
14	XUFL/	YUFL/	Input, User Flag.
15	X6	Y6	Reserved, Do Not Use.
16	GND	GND	Ground.
17	+5V	+5V	Output, +5V DC Power Supply.
18	XMIL	YMIL	Input, Neg. Limit switch. Low enables Move.
19	XPLL	YPLL	Input, Pos. Limit switch. Low enables Move.
20	CURX	CURY	Current Input for Overload (I2T) fault.
21	AVSS	AVSS	Analog Ground.
22	X7	Y7	ANA2 for X7; ANA3 for Y7.
23	+5V	+5V	Output, +5V DC Power Supply.
24	ENBX/	ENBY/	Input, Handwheel Encoder channel B Negative.
25	ENBX	ENBY	Input, Handwheel Encoder channel B Positive.
26	ENAX/	ENAY/	Input, Handwheel Encoder channel A Negative.
27	ENAX	ENAY	Input, Handwheel Encoder channel A Positive.
28	GND	GND	Ground.

Local Panel Interface (TB3)

For local panel control, switch inputs for operational commands, and LED indicator output connections are provided. Refer to DWG. 3 in Appendix B for input and output connections. for INIT/ circuit, refer to DWG. 6. Equivalent software commands are shown in braces {}.

PIN#	NAME	FUNCTION
1	XJMI/	Input, Jog X axis in negative direction. {j}.
2	YJMI/	Input, Jog Y axis in negative direction. {jY}.
3	XJPL/	Input, Jog X axis in positive direction. {J}.
4	YJPL/	Input, Jog Y axis in positive direction. {JY}.
5	STRT/	Input, Start program run. {R}.
6	PREJ/	Input, Return to Prejog position {=}.
7	STOP/	Input, Stop program run. {q}.
8	STEP/	Input, Single step program sequentially. {S}.
9	HOLD/	Input, Hold program run temporarily. {H}.
10	HOME/	Input, Go to HOME position. {h}.
11	HWXD/	Input, X Handwheel Disable.
12	HWYD/	Input, Y Handwheel Disable.
13	GND	Ground.
14	GND	Ground.
15	INIT/	Input, Resets SMCC, Low to Reset.
16	BFLD/	Output, Buffer Full indicator.
17	IPLD/	Output, In-Position indicator.
18	EPLD/	Output, Not used.
19	ERLD/	Output, Error (amplifier fault) indicator.
20	ITLD/	Output, Overload (I2T protection) Indicator.
21	F2LD/	Output, Following error fault indicator.
22	F1LD/	Output, Following error warning indicator.
23	PL5V	Output, +5V DC Power Supply.
24	GND	Ground.

Machine Expansion I/O Interface (J12) The machine expansion connector provides the following functions:

1. Seven general purpose TTL inputs (MAI1/ - MAI7/) and five general purpose open collector outputs (MAO1/ - MAO5/). Refer to DWG. 4 in Appendix B for interface circuits.

Note: The input logic circuits of MAI5/ - MAI7/ are different from MAI1/ - MAI4/.

2. Limit Switch and Home Detect Inputs. The limit switch inputs must be normally closed type. All limit switch inputs must be grounded if it is not used to enable a move in that direction. Home detect inputs are programmable. In Parabolic SMCC, XUFG/ and YUFG/ establishes the trigger signal in the “GO Until” and “Wait Until” moves. See SMCC manual, i26[i46], WUT, Xd^d command). Refer to DWG. 4 in Appendix B.
3. Handwheel Encoder interface for both X axis and Y axis. See DWG. 5 in Appendix B for interface circuits.
4. In-Position indicator and Following Error indicator. Refer to DWG 3 in Appendix B.

PIN#	NAME	FUNCTION
1	MAI7/	Input, Machine input 7. Logic internally inverted.
2	MAI6/	Input, Machine input 6. Logic internally inverted.
3	MAI5/	Input, Machine input 5. Logic internally inverted.
4	MAI4/	Input, Machine input 4.
5	MAI3/	Input, Machine input 3.
6	MAI2/	Input, Machine input 2.
7	MAI1/	Input, Machine input 1.
8	MAO5/	Output, Machine output 5. Open collector, 200mA Max.
9	MAO4/	Output, Machine output 4. Open collector, 200mA Max.
10	MAO3/	Output, Machine output 3. Open collector, 200mA Max.
11	MAO2/	Output, Machine output 2. Open collector, 200mA Max.
12	MAO1/	Output, Machine output 1. Open collector, 60mA Max.
13	+5V	+5VDC.
14	GND	Ground. (All pins 14 to 26 are grounds)

LCD Display Interface (J11) The LCD display interface may be used to drive various types of displays. The i18 parameter determines the type of the display that SMCC will write to (see SMCC manual, i18 parameter). Refer to DWG. 7 in Appendix B for interface circuits.

PIN#	NAME	FUNCTION
1	PL5V	+5VDC.
2	RSTR	Output, Read Strobe.
3	EX	Output, X Display Select.
4	DAB1	Display DATA Output 1, 5V TTL.
5	DAB3	Display DATA Output 3, 5V TTL.
6	DAB5	Display DATA Output 5, 5V TTL.
7	DAB7	Display DATA Output 7, 5V TTL.
8	DAB6	Display DATA Output 6, 5V TTL.
9	DAB4	Display DATA Output 4, 5V TTL.
10	DAB2	Display DATA Output 2, 5V TTL.
11	DAB0	Display DATA Output 0, 5V TTL.
12	RDWR	Output, Read/Write. E27 selects function.
13	CONT	Output, Contrast Adjust. 0 to 5 VDC.
14	GND	Ground.

Control (Amplifier) and Encoder Interface (J5, J6)

These signals are to be connected to the X and Y axis circuits and encoder circuit of the control. Encoder connections may be made at axis interface (TB1, TB2) terminal blocks. Refer to DWG. 2 and DWG. 8 of Appendix B for interface circuits.

PIN#	X-NAME (J5)	Y-NAME (J6)	FUNCTION
1	AENA	AENA	Output, Amplifier Enable. High true.
2	PHA1	PHA3	Output, X-axis Command Signal (Positive).
3	PHA1/	PHA3/	Output, X-axis Command Signal (Negative).
4	GND	GND	Common Ground.
5	GND	GND	Common Ground.
6	SPA	SPA	Spare.
7	CHAX	CHAY	Input, Encoder A channel Positive.
8	CHAX/	CHAY/	Input, Encoder A channel Negative.
9	CHBX	CHBY	Input, Encoder B channel Positive.
10	CHBX/	CHBY/	Input, Encoder B channel Negative.
11	CHCX	CHCY	Input, Encoder C channel Positive.
12	CHCX/	CHCY/	Input, Encoder C channel Negative.

Parallel Interface (J1)

Parallel interface may by used as a thumbwheel switch interface or for parallel communication (as opposed to serial). Up to 8 thumbwheel switches can be connected in parallel to data lines 0 to 7. SEL0 - SEL7 are used to select each thumbwheel switch. Refer to DWG. 10 of Appendix B for interface circuits.

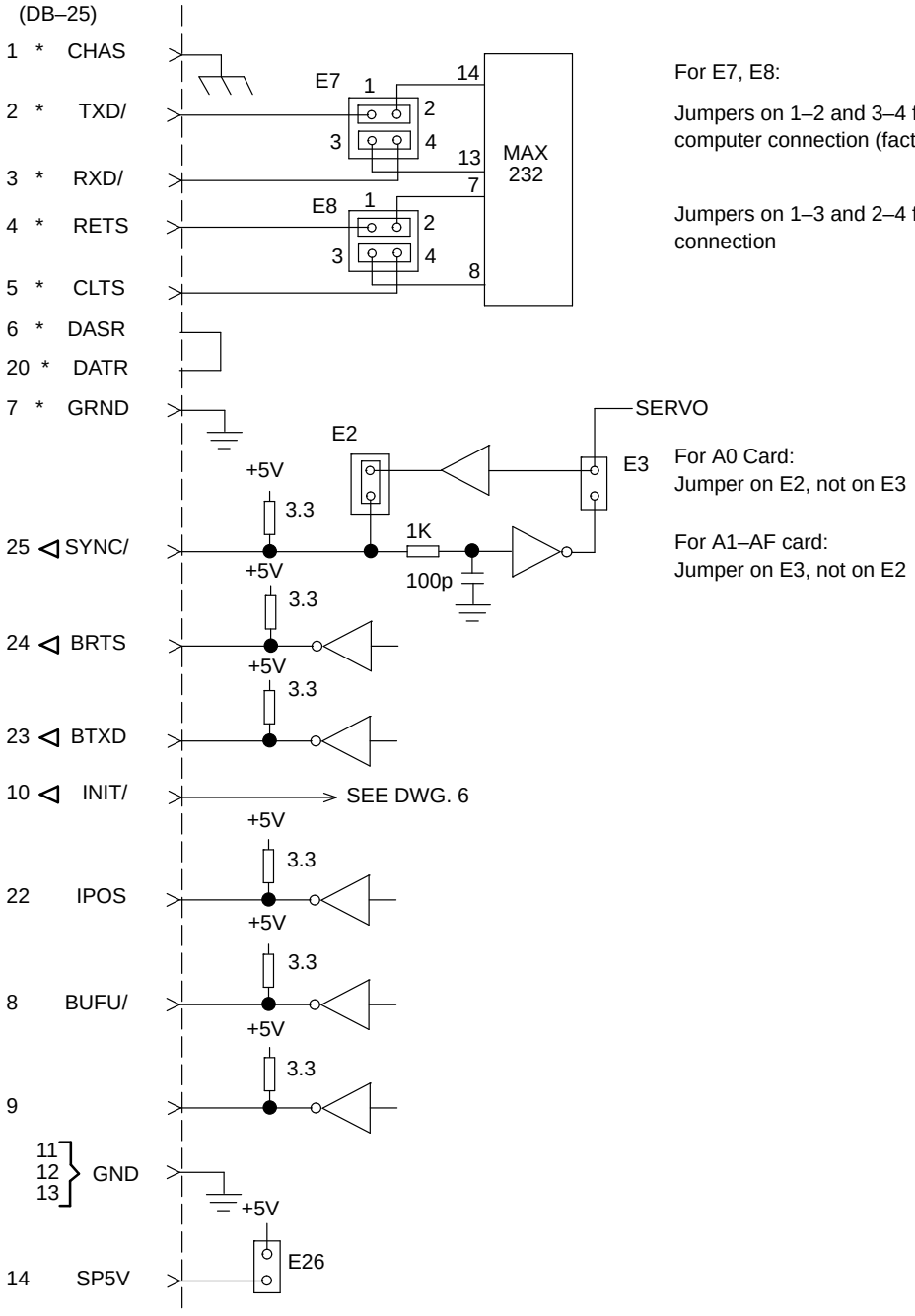
PIN#	NAME	FUNCTION
1	STRB/	Input, Strobe Signal.
2	DAT0	Bidirectional, Parallel interface DATA 0.
3	DAT1	Bidirectional, Parallel interface DATA 1.
4	DAT2	Bidirectional, Parallel interface DATA 2.
5	DAT3	Bidirectional, Parallel interface DATA 3.
6	DAT4	Bidirectional, Parallel interface DATA 4.
7	DAT5	Bidirectional, Parallel interface DATA 5.
8	DAT6	Bidirectional, Parallel interface DATA 6.
9	DAT7	Bidirectional, Parallel interface DATA 7.
10	ACKN/	Output, Acknowledge Signal.
11	BUFU	Output, Program Buffer Full.
12	IPOS/	Output, In-Position.
13	SP5V	+5 VDC (Jumper E26 configures).
14	GND	Ground.
15	BUFU/	Output, Program Buffer Full.
16	GND	Ground.
17	CHAS	Chassis ground, Not tied to Common.
18	IPOS	Output, In-Position.
19	SYNC/	Output(A0)/Input(other) Synchronization Clock.
20	HSB/	Input, Read Strobe. Active Low.
21	RDY/	Output, Ready. Active Low.
22	GND	Ground.
23	EROR/	Output, ERROR (Fault or Communication Error).
24	INIT/	Input, Reset SMCC, Active Low.
25	GRND	Ground.
26	GND	Ground.
27	GND	Ground.
28	SEL7	Output, DATA7. Scanner for thumbwheel switches.
29	SEL6	Output, DATA6. Scanner for thumbwheel switches.
30	SEL5	Output, DATA5. Scanner for thumbwheel switches.
31	SEL4	Output, DATA4. Scanner for thumbwheel switches.
32	SEL3	Output, DATA3. Scanner for thumbwheel switches.
33	SEL2	Output, DATA2. Scanner for thumbwheel switches.
34	SEL1	Output, DATA1. Scanner for thumbwheel switches.
35	SEL0	Output, DATA0. Scanner for thumbwheel switches.
36	GND	Ground.

Power Supply Connection (J10) Power Connections are pre-wired at the factory.

PIN#	NAME	FUNCTION
1	+15V	+15 VDC Power Input.
2	-15V	-15 VDC Power Input.
3	AGND	Analog Ground.
4	SPA	Spare, No Connection.
5	GND	Digital Ground.
6	+5V	+5 VDC Power Input.

Appendix B
Interface Circuits

Drawing 1 – Serial Communication Interface

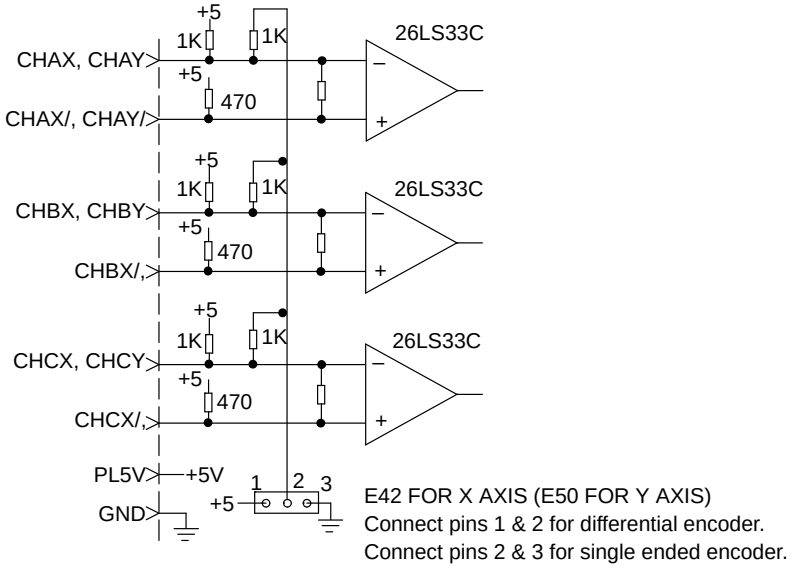


Notes:

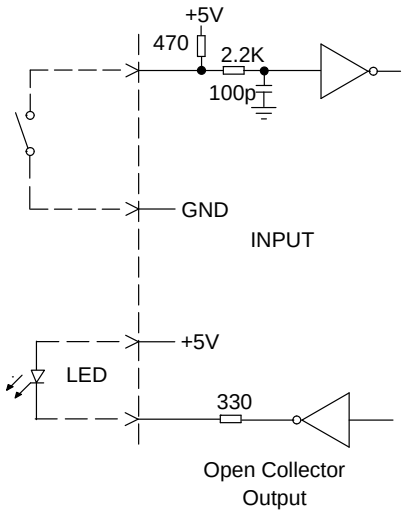
1. Connect only the lines marked * for normal RS–232 operation from computer to one SMCC.
2. For daisy-chain operation, signals marked ◁ as well as * must be connected in parallel.

Connection of all other signals is optional.

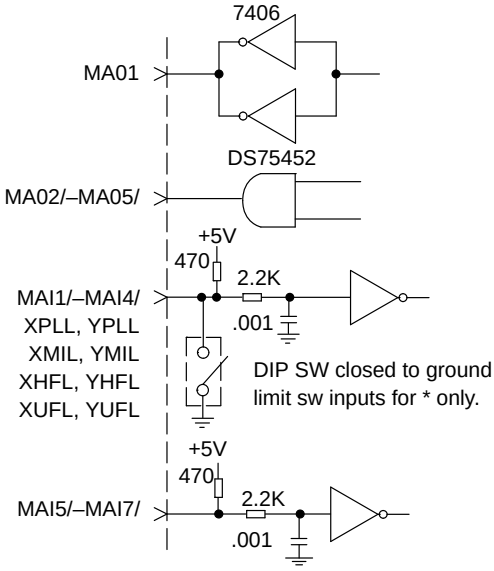
Drawings 2, 3, 4, 5



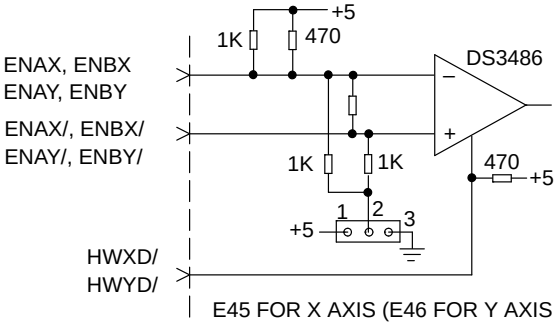
Drawing 2 - Encoder Interface



Drawing 3 - Local Panel Interface

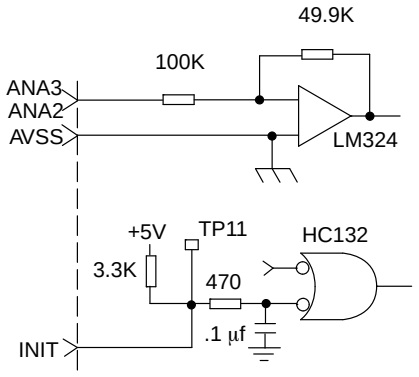


Drawing 4 - Machine I/O Interface
(Not Opto Isolated)

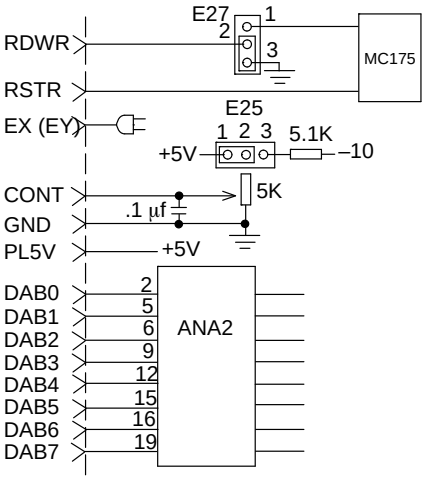


Drawing 5 - Handwheel Encoder Interface

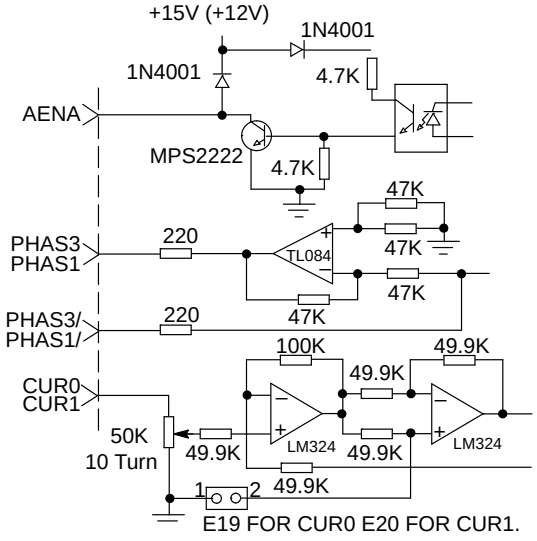
Drawing 6, 7, 8, 9



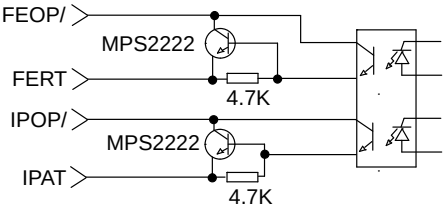
Drawing 6 - Analog Command & Reset Circuit



Drawing 7 - LCD Display Interface

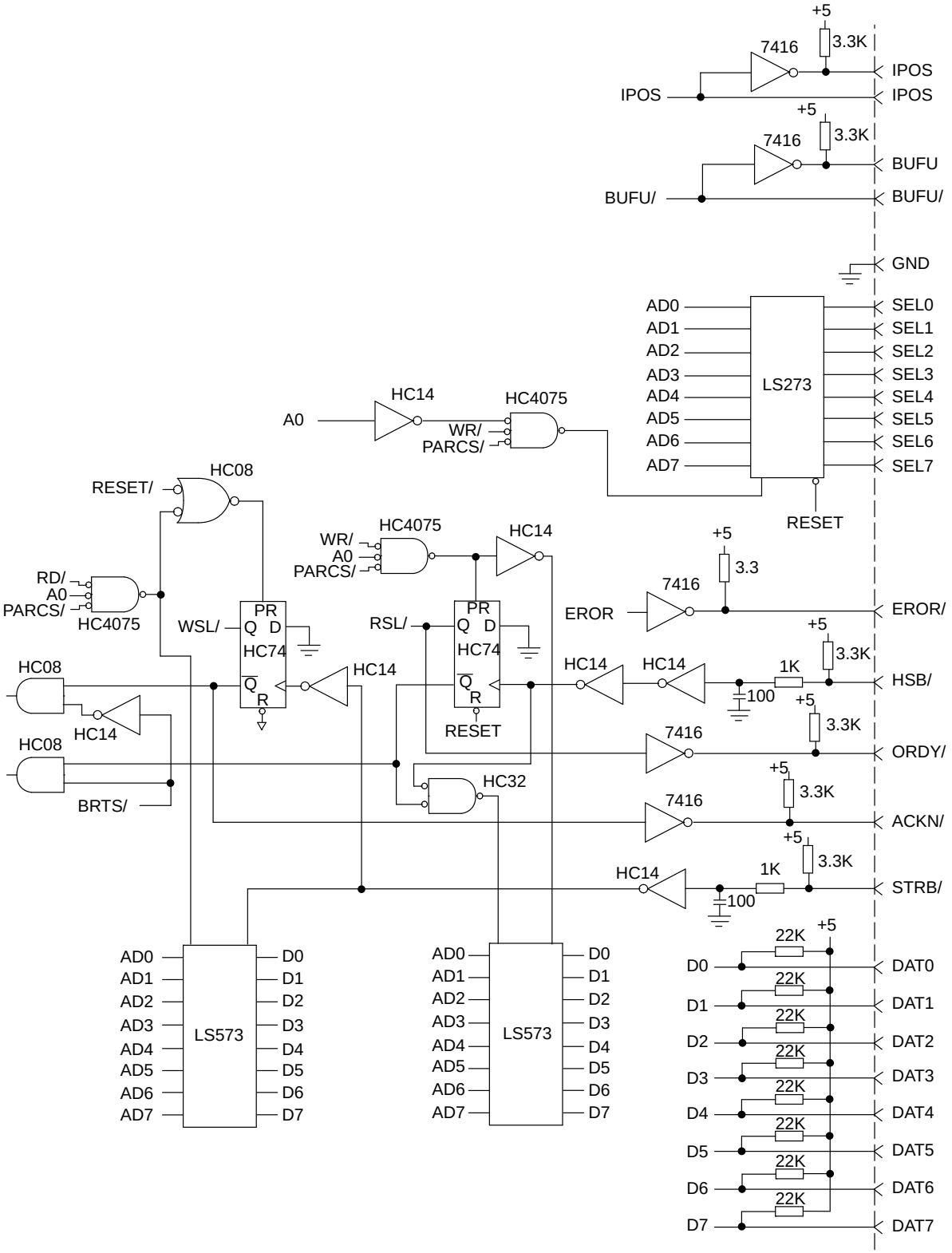


Drawing 8 - Control (Amplifier) Interface



Drawing 9 - Opto Isolated Error Output

Drawing 10 – Parallel Interface



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