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DELTA TAU DATA SYSTEMS

SMCC-PC

P/N 602164 - 101

PRELIMINARY

INTERFACE CONTROL DOCUMENT

AND

USER'S MANUAL ADDENDUM

FOR

SMCC-PC

USE SMCC MANUAL (DOC. #602090-362) FOR DETAILED PROGRAMMING INFORMATION

SEPTEMBER 6, 1989

Document Number 602164-361

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USER'S MANUAL

FOR

SMCC - PC P/N 602164-101

1.0 INTRODUCTION

The purpose of this document is to describe the SMCC-PC Board, and to define the content, format, sequence, and timing of the data transfers required between the IBM PC, XT, AT host and the SMCC-PC. Also, to describe the data transfer protocols to be used and assign programmable values for SMCC-PC address space, interrupt registers, and interrupt masks. The SMCC-PC hardware is also described, together with all required I/O connections. For a complete description of motion commands and normal operations and programming, please refer to the SMCC Manual.

The two-axis Smart Motion Control Card (SMCC-PC) provides all communications between the host and the servo amplifier via the PC bus backplane. Otherwise, the SMCC-PC has precisely and exactly the same programming and operational characteristics as the standard SMCC with parabolic option. Please refer to the SMCC literature and manual for specifications and description of operational capabilities.

Even though the SMCC-PC operates on the PC bus, the RS232 communications channel has been retained and may be used as an alternative to the PC bus, for standalone operation. The parallel port has been eliminated and is replaced by the PC bus. Selection of PC vs. RS232 is done by means of DIP switch selection. All I/O functions to the amplifier and machine are provided on the J2/P2 connector. Additionally, connectors for the manual control panel, bus expansion, and RS232 are provided on the SMCC-PC.

Up to 16 SMCC-PC cards may be controlled by a single host computer; each card is assigned a separate memory space. Interrupts are generated on one or two of four interrupt lines and may be controlled by masking and/or selecting one or two actions for two separate interrupt sources.

The SMCC-PC offers only two optional features: that of increasing on-board memory size from 8K to 32K in order to allow storage of 5630 program steps instead of 1760, and that of adding the analog input conditioniong module in order to allow analog signals in the range of +/-10V instead of just 0 to +5V to be used as inputs.

The SMCC-PC without the above options, has 8K of buffer memory for storing in RAM and saving in permanent memory up to 1760 program steps, and is equipped with the parabolic path generator capability which offers many powerful features such as: automa-

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tic 3-point cubic smoothing of input data, 1/T encoder count measurement for smooth low velocity control, data gathering and storage at servo rates for analyzing actual servo performance of position, velocity and following error, programmable logic control (PLC) and many more.

The command set for the SMCC-PC is identical to the SMCC equipped with parabolic, and consists of four types:

1) Non-Buffer (on-line) commands which are received and immediately executed.

2) Buffer commands which are received and stored in the program buffer for later execution with the step or run commands. Standard buffer size is 1760 steps where each command takes up one step, except simultaneous X and Y commands which occupy two steps. Buffer commands may also be immediately executed by placing the SMCC in the MDI mode: i02 set to one.

   Also, the buffer size may be optionally expanded to 5630 program steps. Buffer data may be continuously executed while more data is being sent to SMCC, thus allowing an infinitely long program to be executed without stopping motion.

3) Servo and other parameters (i Parameters) which are used to personalize the SMCC-PC to the particular application. These parameters, once determined, may be permanently saved and stored in the non-volatile memory. These are referred to as i Parameters. i Parameters 00 to 63 may also be made part of the buffer commands by using "I" instead of "i."

4) PLC (Programmable Logic Control) instructions, which are stored in a special section of the program buffer, are active at all times and can be used to perform conditional I/O and motion checks, as well as, mathematical operations on position, velocity, following error and various input port values. Cycle time is two to five milliseconds and the format is: IF/THEN/ELSE/AND/AND IF/THEN IF/ELSE IF.

The data communications format can be handled in several different ways:

1) ASCII data which can be transmitted to and received from the SMCC-PC either using the RS232 port (300 to 38400 baud) or the PC bus. The SMCC-PC may be used as a standalone card, if power is supplied (+5V) and only RS232 is used.

2) DMA mode binary data, with parabolic and standard data format, selected by i63 (parabolic mode select) where i631 is position only mode, two bytes of data sent, and i630 is parabolic position and velocity mode, four bytes of data sent. The DMA mode is packet oriented and allows very rapid (approximately four microseconds per character) bidirectional data transfer. This mode may be used via RS232 or the PC

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bus, even though when used with RS232, the speed advantage is lost. The DMA mode is entered simply by sending a (02 H) character before sending data. See SMCC-Parabolic for detailed description.

An additional feature of DMA mode is that it can be used either in MDI mode, where data is received and executed, or in normal buffer mode, where data is stored in the buffer and then executed with the "R" (RUN) command or the "S" (STEP) commands.

3) Both in ASCII and DMA (binary) modes, it is possible to execute motion data immediately upon transmission to SMCC-PC, instead of placing it in the buffer, by invoking the MDI mode (parameter i02 set to 1.) The SMCC-PC then simply executes the data immediately upon reception of the move command. Conversely, setting i02 to 0 (normal, non MDI mode) places all data in the card's buffer first for later sequential execution. Data stored in the buffer can be permanently "saved" in Earom by using the save "s" command. The save function also saves all i parameters, subroutines, P variables, C and M function assignments, and PLC programs.

2.0 OPERATION

To operate the SMCC-PC simply plug the card in a PC, XT, or AT and use the P2 connector to make all necessary connections to the amplifier and motor encoder.

The SMCC V3.6 software diskette is highly recommended as the vehicle for getting started with writing programs and gaining familiarity with the SMCC-PC. It also offers a "servo tuning" procedure which is helpful in optimizing the servo parameters. Operation of the SMCC-PC is identical, in all respects, with the SMCC equipped with parabolic option; and when using SMCC V3.6, it is simply a matter of selecting the "PC" port instead of RS232 or parallel for communicating with the SMCC-PC. Separate "drivers," written in "C," are provided in software for use with system programs designed to drive the SMCC-PC in the user's environment.

Two DIP, eight position switches, SW1 and SW2, are provided for selecting the individual addresses and operating mode of each SMCC-PC installed on the bus. Up to 16 cards may be used for a total of 32 axes of control. When more than one card is used, it is necessary to daisy-chain the cards to each other by using the (J3) RS232 connector in order to provide the synchronization clock between all cards thus making them able to provide synchronized and interpolated motion between any number of axes.

Refer to Drawing 602180 for explanation of SW1's settings for the card address selection, A0 to /Af, and PC bus versus RS232 operation.

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SW2 is used to place the SMCC-PC at one of 256 suitable I/O addresses within the user's PC environment so that operation of the SMCC-PC does not interfere with the normal functions of the PC A complete address map is provided for selection purposes.

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TWO-AXIS, PCbus-COMPATIBLE SMART MOTION CONTROL CARD (SMCC-PC)

The SMCC-PC (Smart Motion Control Card) is a closed-loop digital controller that is completely compatible with IBM PC/XT/AT* and compatible systems. Its programming and functional capabilities are the same as Delta Tau Data Systems' standard SMCC with a parabolic option.

SMCC-PC Features:

- May be used with IBM PC/XT/AT, or compatible, systems
- Supports hardware interrupt selection
- Allows masked interrupts
- Switch-selectable starting address locator with 256 separate addresses
- Operates either on PCbus or standalone via RS-232C port
- 8-bit IBM PCbus compatible

Common SMCC Features:

- Controls any size amplifier/motor: DC, DC Brushless, AC Induction, Stepper
- Background PLC for I/O function control
- Parabolic path generator with 3-point smoother and "S" curve acceleration
- Sine, trapezoid, 6-step commutation
- Unmatched price/performance
- Precise synchronization, circular, linear interpolation for up to 32 axes (16 cards)
- Selectable 1/T period encoder measurement
- Ruggedized for noisy and harsh industrial environments
- Electromechanical & Hydraulic systems
- Motion data capture and plot capability

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SMCC FEATURES:

- Controls two axes of DC brush motors or self- commutating amplifiers; one axis when using internal commutation
- Easy-to-use, powerful, BASIC-like, English programming language with editing
- Allows motion programming changes "on the fly"
- Installation diagnostics aid verification of system integrity
- Daisy-chaining synchronizes 2 to 32 axes for precision linear, circular, elliptical, or parabolic interpolation - easily expandable
- Background PLC (programmable logic controller) executes I/O and control functions independent of motion commands
- Parabolic path generator provides accurate, smooth, complex contouring with three-point cubic smoothing function. Features zero acceleration change at boundaries.
- On-board trace feature verifies velocity, following error, position accuracy and other variables at servo cycle rates, and provides tabular and graphic data
- 16-bit custom μC with pipelining/DMA supports 300 μsec per axis servo update time
- DMA communication mode enables binary data transfer to/from card
- 1/T period measurement of encoder and 1 MHz count rate provide superior low speed and stiffer "tachless" servo performance
- Proportional, differential and integral gains with independent velocity and acceleration feedforward terms
- RS-232C serial communications port
- Can operate completely standalone

When used standalone, the differences between the SMCC-PC and a standard or parabolic SMCC are:

a) Only RS-232C (300 to 38,400 baud) is available for communications. A parallel port is not available on the SMCC-PC because the internal parallel port is used for the PC bus only and cannot be used for communications or thumbwheel inputs.

b) The SMCC-PC provides four general purpose inputs and five outputs, compared with seven inputs and five outputs for the SMCC.

c) All machine/amplifier/encoder connections are available on J2/P2 and are nearly identical to the SMCC.

d) The JOPTO connector on the SMCC (used for flat cable connection to commercial opto-isolated drivers) is not available on the SMCC-PC.

e) J DISP connectors used for the standard SMCC's displays are not available on the SMCC-PC.

f) Handwheel connectors used to connect the HEDS-7501 encoder to the standard SMCC, are not available on the SMCC-PC. Instead, all the SMCC-PC's encoder connections are made to its J2 connector.

All other characteristics of the SMCC-PC are identical to the standard SMCC equipped with the parabolic option. Refer to the standard SMCC manual and brochure for a description of all specifications, start-up instructions, commands, programming, operating modes and I/O operations. Characteristics that are specific to the SMCC-PC, such as communications on the PCbus and actual physical connections to machine, amplifier and motor, are described in the SMCC-PC manual.

Host PC to SMCC-PC communications use the PCbus. DIP switch settings on the SMCC-PC (from 0 to 1020, decimal) allow up to 256 I/O address locations to be selected on the PCbus. The SMCC-PC occupies four I/O address locations (8-bit registers) used for data, status and command transfers.

The SMCC-PC also supports interrupts that are jumper selectable and maskable. These can be generated on data transmission and reception, and task completion, such as Buffer Full or In Position.

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OPTIONS (OPT)

1) Parallel Input/Output:

- An external parallel port is not available on the SMCC-PC because the internal parallel port is used for the PC bus only and cannot be used for communications or thumbwheel inputs.

2) Permanent Program Storage (Standard):

- Standard 512 x 8 bit EAROM stores parameter and less than 10 program lines. Subroutines and labels cannot be stored.
- 8K X 8 bit EAROM for 1,790 program lines, subroutines and labels.

3) Analog Input Conditioning:

- Accepts 10V analog inputs and provides level-shifted outputs (0 to +5V) to 2 of the 4 on-board 8-bit A/D converters.
- Standard SMCC accepts only 0 to +5 V analog inputs on all 4 A/D channels.

4) Parabolic Path Generator (Standard):

- Parabolic Path Generation: All points defined by position, velocity and time to make the move. Third-order algorithms provide smooth, continuous path and interpolated motion control. "S" curve acceleration is provided.
- DMA Communication: RS-232C and parallel ports transmit/receive binary data.
- Data Trace and Storage: Analyzes servo performance at servo rate; provides position, following error and velocity, I/O ports and other registers. May also be stored and plotted.
- 1/T (Period) Measurement of Encoder Pulses allows higher usable servo gains and provides greatly improved low velocity operation and stiffer servo.
- "Dead band" zone/torque control/altered destination on trigger features
- Independently-adjustable velocity and acceleration feedforward terms

5) Expanded Program Memory:

Provides 32K byte RAM to store up to 5,630 program steps instead of the standard 1,790 program steps.

ACCESSORIES (ACC)

) +5V power supplies (standalone only)
) ±15V power supply for ACC 14, 15 and opto-isolation (standalone nly)
) 10 ft. flat cable terminated at one end with 26-pin connector and S-232C, DB25, at the other end
) Additional instruction manual
) (Not Applicable)
) Handwheel encoder HEDS-7501 with 6-in. cable
) (Not Applicable)
) Terminal block, plug-in (Vertical) or (Horizontal)
) IBM PC executive software diskette (SMCC), use with RS-232C
0) (Not Applicable)
1) Ruggedized control panel, membrane alphanumeric keypad/display
2) (Not Applicable)
2A) (Not Applicable)
2B) (Not Applicable)
3) (Not Applicable)
4) Combination of: resolver input; DAC output; 46 extra I/O; ADC input
5) Resolver-to-digital converter, single or multi-speed; 10, 12, 14, or 16 bits/revolution
6) Control panel with switches, display and handwheel encoder for use as manual control and diagnostics
7) SMCCAD software for converting CAD drawings to SMCC motion commands
8) (Not Applicable)

QUALITY ASSURANCE

Prior to leaving the factory, the SMCC-PC has undergone numerous tests that consist of:

A. A 100% test including calibration that is performed by a Delta Tau DT-2048 ATE (Automatic Test Equipment).

B. After high temperature, extended burn-in, the card is again given a 100% retest on the ATE.

C. With complete assurance that the SMCC-PC is free of manufacturing defects and faulty components, a final test is run that consists of operating the SMCC-PC with servo motors and amplifiers.

Ordering Information: To order desired SMCC-PC configuration, specify OPTion and ACC. For example, P/N 602164-100 PT 3, 5-ACC 3, 8H, 12A specifies an SMCC-PC with analog input conditioning, expanded memory options, RS-232C flat able, horizontal terminal block, and 40-digit X 2-line LCD position display accessories.

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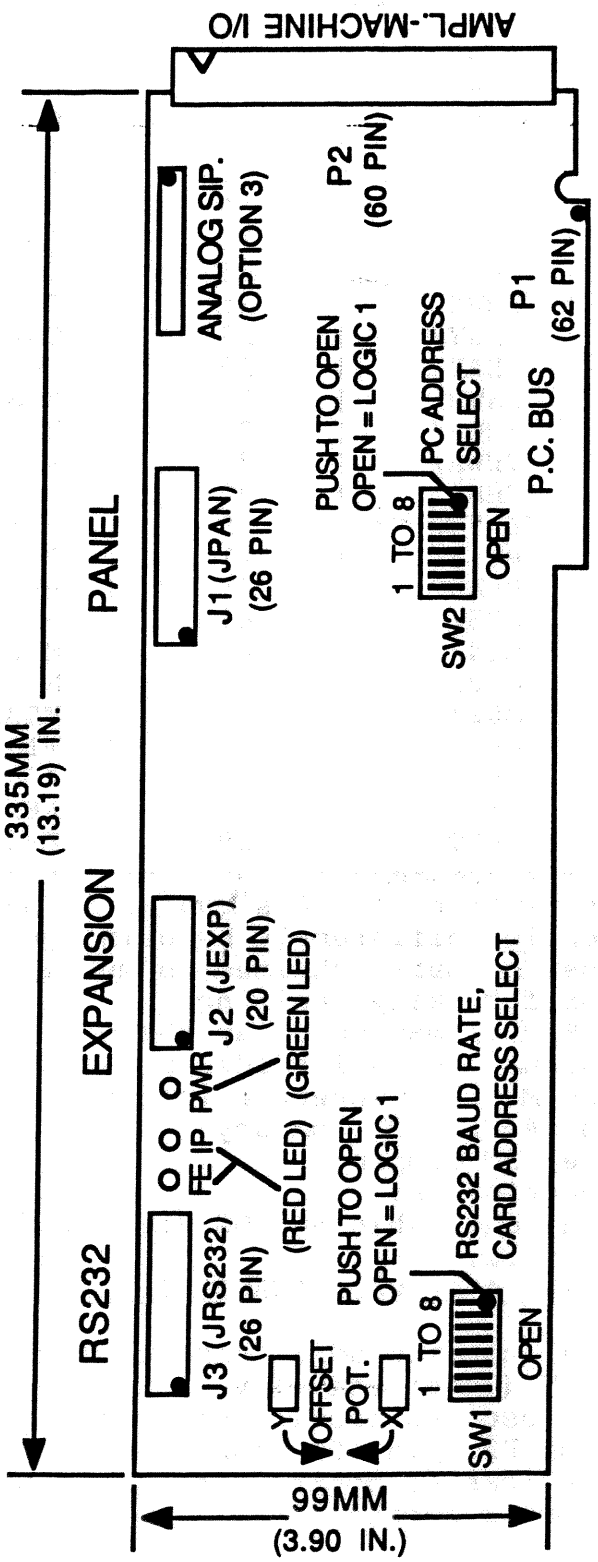
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SMCC-PC OUTLINE AND CONNECTOR PLACEMENT

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SMCC-PC
J2/P2 Pin Assignments

PIN "A" NUMBER EVEN	ROW EVEN MNEMONIC	PIN "C" NUMBER ODD	ROW ODD MNEMONIC
2	ANA3	1	ANA2
4	CUR 1/SIGNY	3	CUR0/SIGNX
6	YPLL	5	XPLL
8	YMIL	7	XMIL
10	+ 5V (5)	9	+ 5V (5)
12	GND	11	GND
14	MI4/	13	MI3/
16	YUFL/	15	XUFL/
18	YHFL/	17	XHFL/
20	CHCY/	19	CHCX/
22	CHCY	21	CHCX
24	CHBY/	23	CHBX/
26	CHBY	25	CHBX
28	CHAY/	27	CHAX/
30	CHAY	29	CHAX
32	YHWB	31	XHWB
34	YHWB/	33	XHWB/
36	YHWA/	35	XHWA/
38	YHWA	37	XHWA
40	HWY DIS/	39	HWX DIS/
42	PHA3/	41	PHA1/
44	PHA3	43	PHA1
46	M05/	45	-15A (6)
48	M04/	47	MI2/
50	M03/	49	MI1/
52	M02/	51	FERROR/(3)
54	M01/	53	+15 A (6)
56	IPOS (3)	55	AGND
58	SYNC/(2)	57	AENA
60	INIT/(2)	59	FAULT/(3)

1) See individual description of I/O signals, in SMCC manual. Pins 3,4 may be config. differently by using jumpers on SMCC-PC.
2) SYNC/ and INIT/ must be daisy chained on multiple card systems. Use RS232 connector for daisy chaining.
3) IPOS, FERROR/ and FAULT/ may be daisy chained to provide a wire-ored common signal for all cards, or used independently.
4) Part Number for the Mating Connector is:
   3334-7600 or P/N 3334-6600 3M Company
   3365/60 (Flat Cable) 3M Company
5) Power Supply consumption is:
   a) -12V,+/-5% 50 mA, only when ANALOG SIP (Option 3) is used, otherwise it is zero.
   b) +12V,+/-5%, 50 mA, only when ANALOG SIP is used, otherwise it is zero.
   c) +5V,+/-5%, 850mA, not including encoder current requirements.
6) If desired, the +12V (50mA) and -12V (25 mA) power supplies of the PC bus could be used to provide power to the opto-isolated output of SMCC-PC on P2, pin 45 (-15A) and P2 pin 53 (+15A). This will result in loss of optical isolation between SMCC-PC and the amplifier/power section.

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J2/P2 Pin Assignments

PIN NO.	EVEN ROW MNEMONIC
2	ANA3
4	CUR1/SIGNY (1)
6	YPLL
8	YMIL
10	+5v (5)
12	GND
14	MI4/
16	YUFL/
18	YHFL/
20	CHCY/
22	CHCY
24	CHBY/
26	CHBY
28	CHAY/
30	CHAY
32	YHWB
34	YHWB/
36	YHWA/
38	YHWA
40	HWY DIS/
42	PHA3/
44	PHA3
46	M05/
48	M04/
50	M03/
52	M02/
54	M01/
56	IPOS (3)
58	SYNC/ (2)
60	INIT/ (2)

J2/P2 Pin Assignments

PIN NO.	ODD ROW MNEMONIC
1	ANA2
3	CUR0/SIGNX (1)
5	XPLL
7	XMIL
9	+5v (5)
11	GND
13	MI3/
15	XUFL/
17	XHFL/
19	CHCX/
21	CHCX
23	CHBX/
25	CHBX
27	CHAX/
29	CHAX
31	XHWB
33	XHWB/
35	XHWA/
37	XHWA
39	HWX DIS/
41	PHA1/
43	PHA1
45	-15A (6)
47	MI2/
49	MI1/
51	FERROR/ (3)
53	+15A (6)
55	AGND
57	AENA
59	FAULT/ (3)

Notes:

1) See individual description of all I/O signals in the SMCC manual. Pins 3 and 4 of P2 have a dual function, selected by jumpers on the SMCC-PC.

2) SYNC/ and INIT/ must be dasiy-chained on multiple card systems.

Use the RS-232C connector for daisy chaining.

3) IPOS, FERROR/ and FAULT/ may be daisy-chained to provide a wire-ORed common signal for all cards, or may be used independently.

4) Part numbers for mating connectors are:

P2: 3M 7660-5002 (Header)

J2: 3M 3505-8160 (Flat Cable)

5) Power supply consumption is:

a) -12V, ±5% 50 mA, only when ANALOG SIP (is used, otherwise it is zero.

b) +12V, ±5%, 50 mA, only when ANALOG SIP is used, otherwise it is zero.

c) +5V, ±5%, 850 mA, not including encoder current requirements.

6) If desired, the +12V (50 mA) and -12V (25 mA) power supplies of the PCbus could be used to provide power to the opto-isolated output of SMCC-PC on P2, pin 45 (-15A) and P2, pin 53 (+15A). This will result in loss of optical isolation between SMCC-PC and the amplifier/power section.

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****

SMCC - PC CONNECTOR LISTING

****

P2, "EVEN" ROW - Description of I/O Functions

PIN	SYMBOL	FUNCTION	DESCRIPTION	NOTES
2	ANA3	INPUT	ANALOG INPUT 3 }	Could be used as analog speed command. Use 0 to +5V for 0 to full scale.
4	CUR1	INPUT	CURRENT 1 FEEDBACK	Current limiting
6	YPLL	INPUT	Y AXIS + LIMIT SW.	Low enables the move.
8	YMIL	INPUT	Y AXIS - LIMIT SW.	Low enables the move.
10	+ 5V	I or O	+5VDC POWER SUPPLY	Could be used as input to card or output to encoders.
12	GND	I or O	+5VDC RETURN	Logic GND
14	MI4/	INPUT	"M" FUNCTION INPUT#4	Low True
16	YUFL/	INPUT	Y AXIS USER FLAG	(Programmable polarity)
18	YHFL/	INPUT	Y AXIS HOME FLAG	(Programmable polarity)
20	CHCY/	INPUT	ENCODER "C" CH. NEG.	Y axis (Do not GND if not used)
22	CHCY	INPUT	ENCODER "C" CH. POS.	Y axis
24	CHBY/	INPUT	ENCODER "B" CH. NEG.	Y AXIS (Do not GND if not used)
26	CHBY	INPUT	ENCODER "B" CH. POS.	Y AXIS
28	CHAY/	INPUT	ENCODER "A" CH. NEG.	Y AXIS (Do not GND if not used)
30	CHAY	INPUT	ENCODER "A" CH. POS.	Y AXIS
32	YHWB	INPUT	HANDWHEEL "B" CH.POS.	Y AXIS
34	YHWB/	INPUT	HANDWHEEL "B" CH. NEG.	Y AXIS (Do not GND if not used)
36	YHWA/	INPUT	HANDWHEEL "A" CH. NEG.	Y AXIS (Do not GND if not used)
38	YHWA	INPUT	HANDWHEEL "A" CH. POS.	Y AXIS
40	HWYDIS/	INPUT	HANDWHEEL DISABLE	Y AXIS (Low to Disable)
*42	PHA3/	OUTPUT	PHASE 3 COMMAND NEG.}	Analog
44	PHA3	OUTPUT	PHASE 3 COMMAND POS.}	Differential Signal Out "Y" Axis
46	M05/	OUTPUT	"M" FUNCTION OUTPUT #5	Open Collector Low True
48	M04/	OUTPUT	"M" FUNCTION OUTPUT #4	Open Collector Low True

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PIN	SYMBOL	FUNCTION	DESCRIPTION	NOTES
50	M03/	OUTPUT	"M" FUNCTION OUTPUT #3	Open Collector Low True
52	M02/	OUTPUT	"M" FUNCTION OUTPUT #2	Open Collector Low True
54	M01/	OUTPUT	"M" FUNCTION OUTPUT #1	Open Collector Low True
56	IPOS	OUTPUT	IN POSITION SIGNAL	
58	SYNC/	I/O	SYNCHRONIZATION CLOCK	From an "A0" card to all others
60	INIT/	INPUT	Resets SMCC-PC	Low is a "RESET" will not RESET master "PC-CPU"

*NOTE: If PHA3/ is not needed for Servo Amplifier, do not tie to Amp-common (AGND).

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P2, "ODD" ROW - Description of I/O Functions

PIN	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	ANA2	INPUT	ANALOG INPUT 2 }	Could be used as analog speed command. Use 0 to +5V for 0 to full scale.
3	CUR0	INPUT	CURRENT 0 FEEDBACK	Current Limiting
5	XPLL	INPUT	X AXIS + LIMIT SW.	Low Enables the move.
7	XMIL	INPUT	X AXIS - LIMIT SW.	Low Enables the move.
9	+ 5V	I or O	+5VDC POWER SUPPLY	Could be used as input to card or output to encoders.
11	GND	I or 0	+5VDC RETURN	Logic End.
13	MI3/	INPUT	"M" FUNCTION INPUT #3	
15	XUFL/	INPUT	X AXIS USER FLAG	(Programmable Polarity)
17	XHFL/	INPUT	X AXIS HOME FLAG	(Programmable Polarity)
19	CHCX/	INPUT	ENCODER "C" CH. NEG.	X Axis (Do Not GND If not used)
21	CHCX	INPUT	ENCODER "C" CH. POS.	X Axis
23	CHBX/	INPUT	ENCODER "B" CH. NEG.	X Axis (Do Not GND If not used)
25	CHBX	INPUT	ENCODER "B" CH. POS.	X Axis
27	CHAX/	INPUT	ENCODER "A" CH. NEG.	X Axis (Do Not GND If not used)
29	CHAY	INPUT	ENCODER "A" CH. POS.	X Axis
31	XHWB	INPUT	HANDWHEEL "B" CH.POS.	X Axis
33	XHWB/	INPUT	HANDWHEEL "B" CH. NEG.	X Axis (Do Not GND If not used)
35	XHWA/	INPUT	HANDWHEEL "A" CH. NEG.	X Axis (Do Not GND If not used)
37	XHWA	INPUT	HANDWHEEL "A" CH. POS.	X Axis
39	HWXDIS/	INPUT	HANDWHEEL DISABLE	X Axis (Low to Disable)
*41	PHA1/	OUTPUT	PHASE 1 COMMAND NEG.}	Analog
43	PHA1	OUTPUT	PHASE 1 COMMAND POS.}	Differential Signal out "X" Axis
45	-15A	INPUT	ANALOG -15V SUPPLY	Provided by Amplifier or separate power supply.

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PIN	SYMBOL	FUNCTION	DESCRIPTION	NOTES
47	MI2/	INPUT	"M" FUNCTION INPUT#2	Low True
49	MI1/	INPUT	"M" FUNCTION INPUT#1	Low True
51	FERROR/	OUTPUT	FOLLOWING ERROR	Open Collector Low True
53	+15A	INPUT	ANALOG +15V SUPPLY	Provided by amplifier or separated power supply.
55	AGND	INPUT	ANALOG GND	
57	AENA	OUTPUT	SERVO AMP ENABLE	(Programmable Polarity)
59	FAULT/	INPUT	SERVO AMP FAULT LIMIT	Low = Amplifier Fault

*NOTES

1) If PHA1/ is not needed for Servo Amplifier, do not tie to Amp-Common (AGND), leave open. Grounding PHA1/ causes SMCC's output to malfunction.

2) If the P2 connector will be extended via flat cable to a terminal strip, and a single-ended encoder is being used, keep length of flat cable to less than 24" or add capacitors (0.10 uf) on the terminal strip from the unused encoder inputs (usually the "NOT" inputs) to GND. This prevents noise pickup on the unused encoder lines. DO NOT GND unused differential inputs directly since the encoder will stop functioning. Even when using a differential encoder, it is best to keep the length of the flat cable below 60".

3) A connector fan-out strip is available for allowing the user to connect the machine/amplifier signals to the SMCC-PC via terminal strips. The required hardware is:

   a) Mating connector to the P2 connector; two each required. P/N 3334-7600 or 3334-6600 (3M Company) to be crimped at both ends of flat cable.

   b) 60 Conductor flat cable, length not to exceed 24" if possible. (See Note 2) P/N 3365/60 (3M Company)

   c) 60 Position terminal block with flat cable connector mate. P/N 2281607 from "Phoenix Contact Company" in Harrisburg, Pennsylvania, (717) 944-1300.

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4) The same type of connectors, cables, and terminal strips as in 3) above may be used for the 26 pin JPAN (control panel) and RS232 connectors.

   a) Mating connector, two each required. P/N 3399-7600 or 3399-6600 (3M Company) to be crimped at both ends of flat cable.

   b) 26 Conductor flat cable, length not to exceed 24" if possible. (See Note 2) P/N 3365/26 (3M Company)

   c) 26 Position terminal block with flat cable connector mate. P/N 2281568 from "Phoenix Contact Company" in Harrisburg, Pennsylvania (717) 944-1300.

5) Delta Tau's ACC-8R (Accessory 8R) may also be used for expanding the SMCC-PC's P2 connector. In addition to terminal strips, it optionally provides several additional functions such as:

   a) Third phase generation for current amplifiers requiring all three phases instead of two phases for all commutation.

   b) Amplifier "fault" polarity inversion

   c) V to F converter for driving stepper motors

   d) Two small amplifiers for driving hydraulic servo valves or 60 watt DC motors.

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J1 PANEL Connector (26 Pin Header)

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	PL5V	Output	+5V power	For remote panel
2	GRND	Common	SMCC-PC common	
3	YJMI/	Input	Jog Y axis in -dir	Low is "Jog Y-"
4	XJMI/	"	Jog X axis in -dir	Low is "Jog X-"
5	YJPL/	"	Jog Y axis in -dir	Low is "Jog Y-"
6	XJPL/	"	Jog X axis in -dir	Low is "Jog X-"
7	PREJ/	"	Ret. to prejog pos.	Low is "Return"
8	STRT/	"	Start program run	Low is "Start"
9	STEP/	"	Step through program	Low is "Step"
10	STOP/	"	Stop program run	Low is "Stop"
11	HOME/	"	Go Home command	Low is "Go Home"
12	HOLD/	"	Hold motion	Low is "Hold"
13	HWYD/	"	Handwh. Y disable	Low disables
14	HWXD/	"	" X "	" "
15	INIT/	"	Resets SMCC-PC	Low is a "Reset"
16	ENAX	Input	X Handwh encoder A ch.	5V TTL sq. pulse
17	IPLD/	Output	In Position Ind.	Low lights LED
18	BFLD/	"	Buffer Full ind.	" " "
19	ERLD/	"	Error indicator	" " "
20	EPLD/	"	End of program ind.	" " "
21	ITLD/	"	Current limit ind.	Low lights LED
22	ENBX	Output	Y Handwh encoder B ch.	5V TTL Sq. pulse
23	FILD/	Output	Following Error 1	" " "
24	F2LD/	"	" " 2	" " "
25	PL5V	"	+5V power	For remote panel
26	GRND	Common	SMCC-PC common	

This connector provides access to all the "Control Panel" functions of the SMCC-PC. Accessory 16 (ACC-16) may directly be plugged-in to J1 (panel) to provide a complete operator's control panel for manual function inputs, such as X and Y jog +/-, Step, Run, Hold, Abort, Return to prejog, etc... ACC-16 also provides a 40 x 2 LCD display which cannot be used with this version of SMCC since the J4 (display) connection is not provided. An A/B Quadrature encoder for handwheel operation is also provided on the ACC-16.

NOTE: Mating Connector Part Number is P/N 4004-26-00-P3 H&T Co.
Alternate Part Number is P/N 3399-7600 3M Co.
or P/N 3399-6600 3M Co.

Flat Cable Part Number is P/N 3365/26 3M Co.

Terminal Block Fan-Out is P/N 2281586 Phoenix Contact Co.

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J2 Expansion Connector (20 Pin Header)

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	-15V	Output	-15V power	For expansion card
2	M Reset	"	Reset	High is "True"
3	+15V	"	+15V power	For expansion card
4	IOWR/	"	Write DATA	Low is "True"
5	GRND	"	SMCC-PC common	
6	MD3	Bidirect	Adress DATA3	
7	GRND	Common	SMCC-PC common	
8	MD2	Bidirect	Adress DATA2	
9	+5V	Output	+5V power	For expansion card
10	MD4	Bidirect	Adress DATA4	
11	+5V	Output	+5V power	For expansion card
12	MD1	Bidirect	Adress DATA1	
13	IORD/	Output	Read DATA	Low is "True"
14	MD5	Bidirect	Adress DATA5	
15	DISPCS/	Output	Display Chip Select	Low is "True"
16	MDO	Bidirect	Adress DATA0	
17	MALE	Output	Buffered ALE	High is "True"
18	MD6	Bidirect	Adress DATA6	
19	MMCS	Output	Exp. Board Chip Sel.	High is "True"
20	MD7	Bidirect	Adress DATA7	

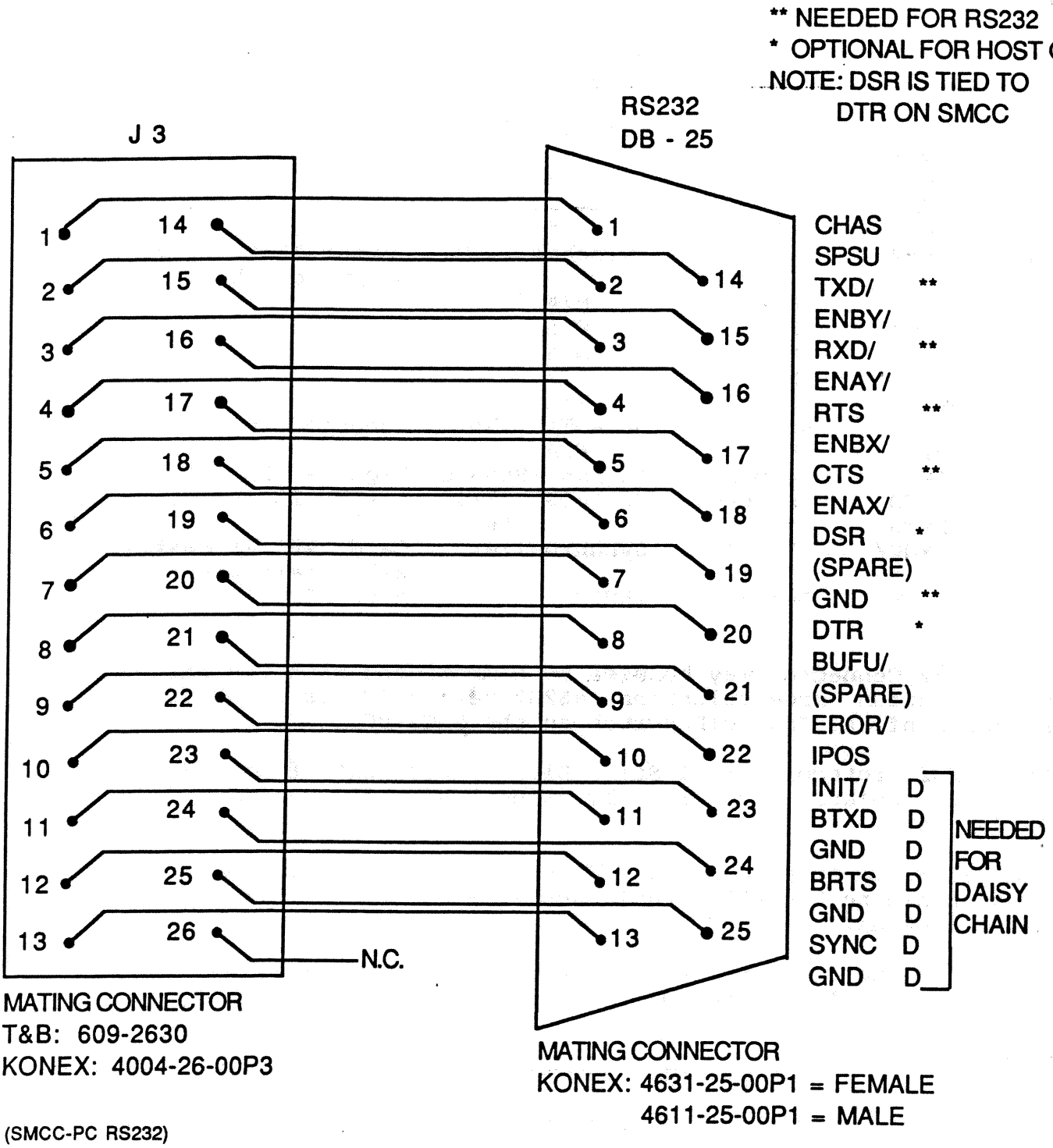
This connector provides a means to expand the I/O capability of the SMCC-PC by connecting accessory 14 (ACC-14) to the SMCC-PC Card. ACC-14 provides up to 48 digital I/O lines and via ISBx connectors, allows the use of a great variety of devices such as A/D, D/A converters, speech generators and most importantly, the use of R/D converters for handling single or double (geared) resolvers for positioning.

NOTE: Mating Connector Part Number is P/N 4004-20-00-P3 H&T Co.
Alternate Part Number is P/N 3421-7600 3M Co.
or P/N 3421-6600 3M Co.

Flat Cable Part Number is P/N 3365/20 3M Co.

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SMCC-PC
RS232 I/O CONNECTOR
(FLAT CABLE)



MATING CONNECTOR
T&B: 609-2630
KONEX: 4004-26-00P3

MATING CONNECTOR
KONEX: 4631-25-00P1 = FEMALE
4611-25-00P1 = MALE

(SMCC-PC RS232)

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J3 RS-232 CONNECTOR (26 Pin Header)

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	N/C	N/A	N/A	
2	TXD/	RS-232	Transmit Data	From Terminal to SMCC-PC
3	RXD/	"	Receive Data	From SMCC-PC to Terminal
4	RTS	"	Ready to Send	From Terminal PC to SMCC-PC
5	CTS	"	Clear to Send	From SMCC-PC to Terminal
6	DSR	"	Data Set Ready	Jumpered to "DTR" on SMCC-PC
7	GND	Common	"RS-232" GND	
8	BF/	Output	Buffer Full	TTL, Low "True"
9	EROR/	"	Error(SMCC-PC)	" " "
10	INIT/	Input	Resets SMCC-PC	Low is a "Reset"
11	GND	Common	SMCC-VME PC	
12	GND	"	" " "	
13	GND	"	" " "	
14	SP5V	Output	Switched +5VDC	Jumper "E3" For 5VDC Output on this Pin
15	N/C	N/A	N/A	
16	N/C	N/A	N/A	
17	N/C	N/A	N/A	
18	N/C	N/A	N/A	
19	N/C	N/A	N/A	
20	DTR	RS-232	Data Ter. Ready	Jumpered to "DSR" on SMCC-PC
21	N/C	N/A	N/A	
22	IPOS	Output	In Pos.(Bussed)	High is "In Position"
23	BTXD	In/Output	Buffered "TXD"	For RS-232 Daisychain
24	BRTS	" "	" "RTS"	" "
25	SYNC/	" "	Synchronizer	Card "A0" is master all others are slave
26	PL5V	Output	+5VDC	Power Supply Out

The RS232 Connector may be used to communicate with the SMCC-PC. Communication mode selection, RS232 versus PC, is accomplished by means of the "SW" DIP switch on the SMCC-PC.

The RS232 Protocol is: 1 Start Bit, 1 Stop Bit, 8 Data Bits, No Parity. Select Baud rate by using "SW" DIP switch, 300 to 38,400 Baud.

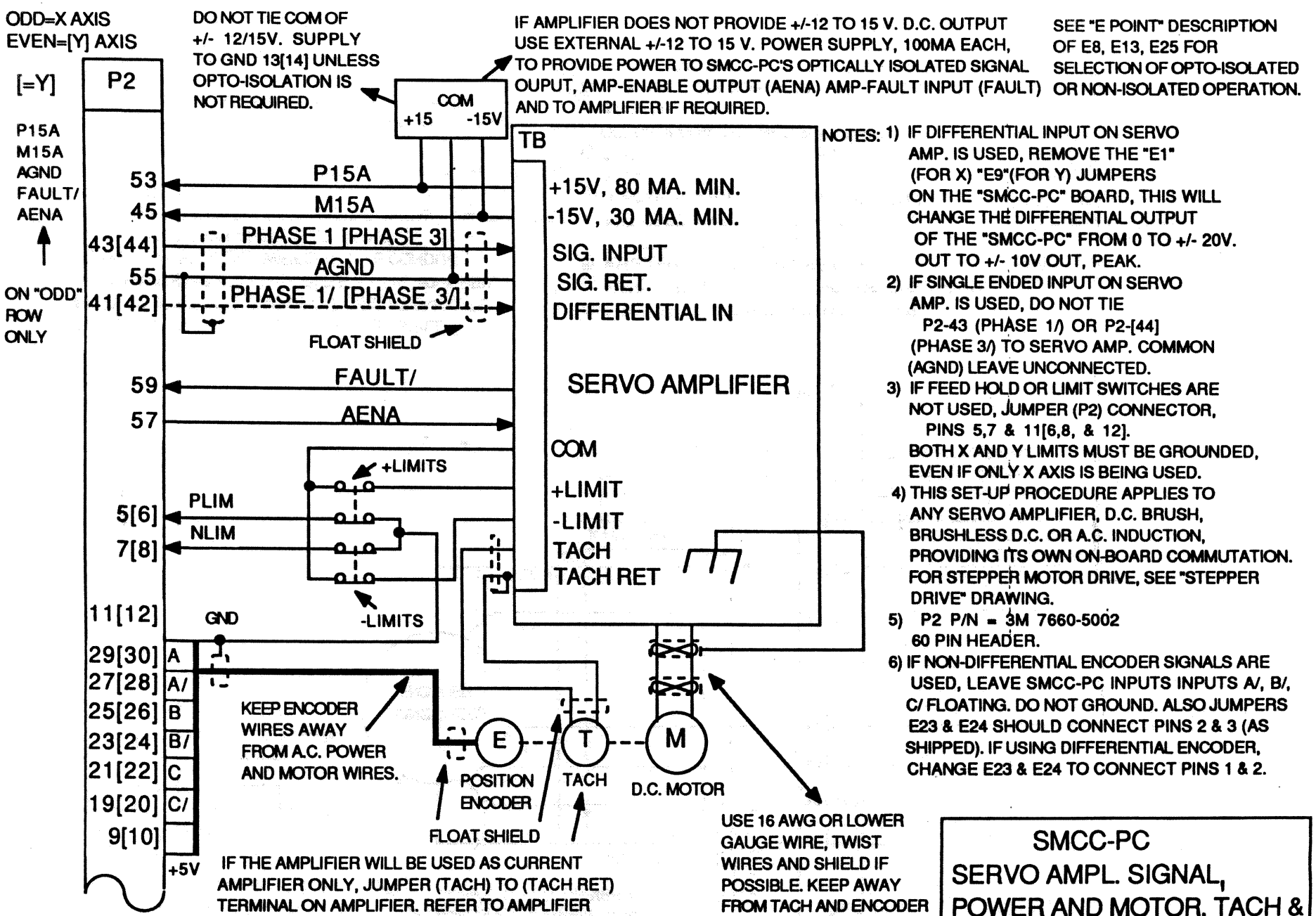
When RS232 is selected, the SMCC-PC may be used stand alone, and daisy chaining the RS232 cable achieves automatic synchronization between cards.

NOTE: Mating Connector Part Number is P/N 4004-26-00-P3 H&T Co.
Alternate Part Number is P/N 3399-7600 3M Co.
or P/N 3399-6600 3M Co.

Flat Cable Part Number is P/N 3365/26 3M Co.

Terminal Blank Fan-Out is P/N 228156 Phoenix Contact Co.

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NOTES:

1) IF DIFFERENTIAL INPUT ON SERVO AMP. IS USED, REMOVE THE "E1" (FOR X) "E9"(FOR Y) JUMPERS ON THE "SMCC-PC" BOARD, THIS WILL CHANGE THE DIFFERENTIAL OUTPUT OF THE "SMCC-PC" FROM 0 TO +/- 20V. OUT TO +/- 10V OUT, PEAK.
2) IF SINGLE ENDED INPUT ON SERVO AMP. IS USED, DO NOT TIE P2-43 (PHASE 1/) OR P2-[44] (PHASE 3/) TO SERVO AMP. COMMON (AGND) LEAVE UNCONNECTED.
3) IF FEED HOLD OR LIMIT SWITCHES ARE NOT USED, JUMPER (P2) CONNECTOR, PINS 5,7 & 11[6,8, & 12]. BOTH X AND Y LIMITS MUST BE GROUNDED, EVEN IF ONLY X AXIS IS BEING USED.
4) THIS SET-UP PROCEDURE APPLIES TO ANY SERVO AMPLIFIER, D.C. BRUSH, BRUSHLESS D.C. OR A.C. INDUCTION, PROVIDING ITS OWN ON-BOARD COMMUTATION. FOR STEPPER MOTOR DRIVE, SEE "STEPPER DRIVE" DRAWING.
5) P2 P/N = 3M 7660-5002 60 PIN HEADER.
6) IF NON-DIFFERENTIAL ENCODER SIGNALS ARE USED, LEAVE SMCC-PC INPUTS INPUTS A/, B/, C/ FLOATING. DO NOT GROUND. ALSO JUMPERS E23 & E24 SHOULD CONNECT PINS 2 & 3 (AS SHIPPED). IF USING DIFFERENTIAL ENCODER, CHANGE E23 & E24 TO CONNECT PINS 1 & 2.

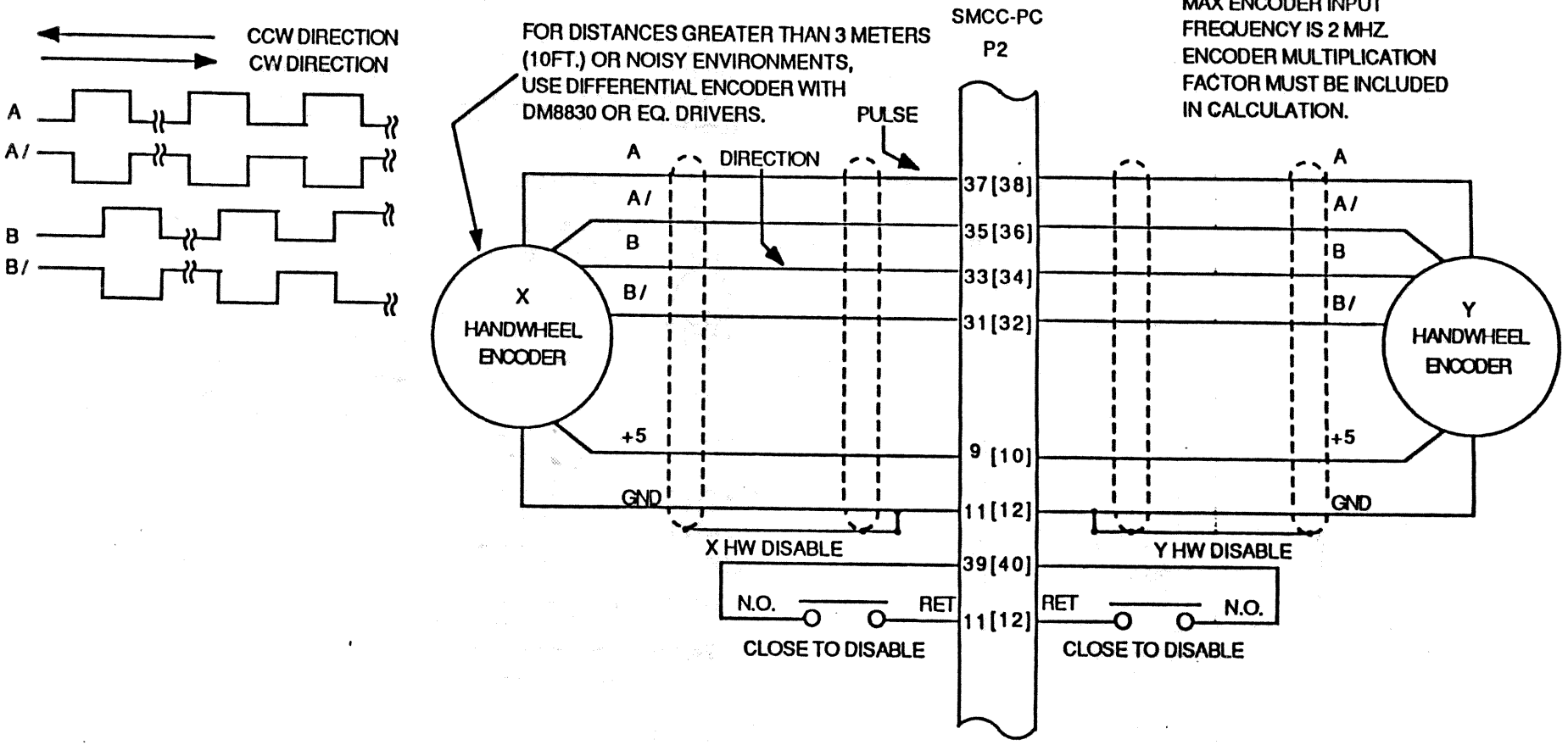
SMCC-PC SERVO AMPL. SIGNAL, POWER AND MOTOR, TACH & ENCODER INPUT/OUTPUT CONNECTIONS

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SEE I29 FOR X, [I49] FOR Y HANDWHEEL ENCODER MULTIPLICATION FACTORS AND DIRECTION CONTROL.

ODD = X AXIS
EVEN = Y AXIS [=Y]

NOTE:
MAX ENCODER INPUT FREQUENCY IS 2 MHZ. ENCODER MULTIPLICATION FACTOR MUST BE INCLUDED IN CALCULATION.



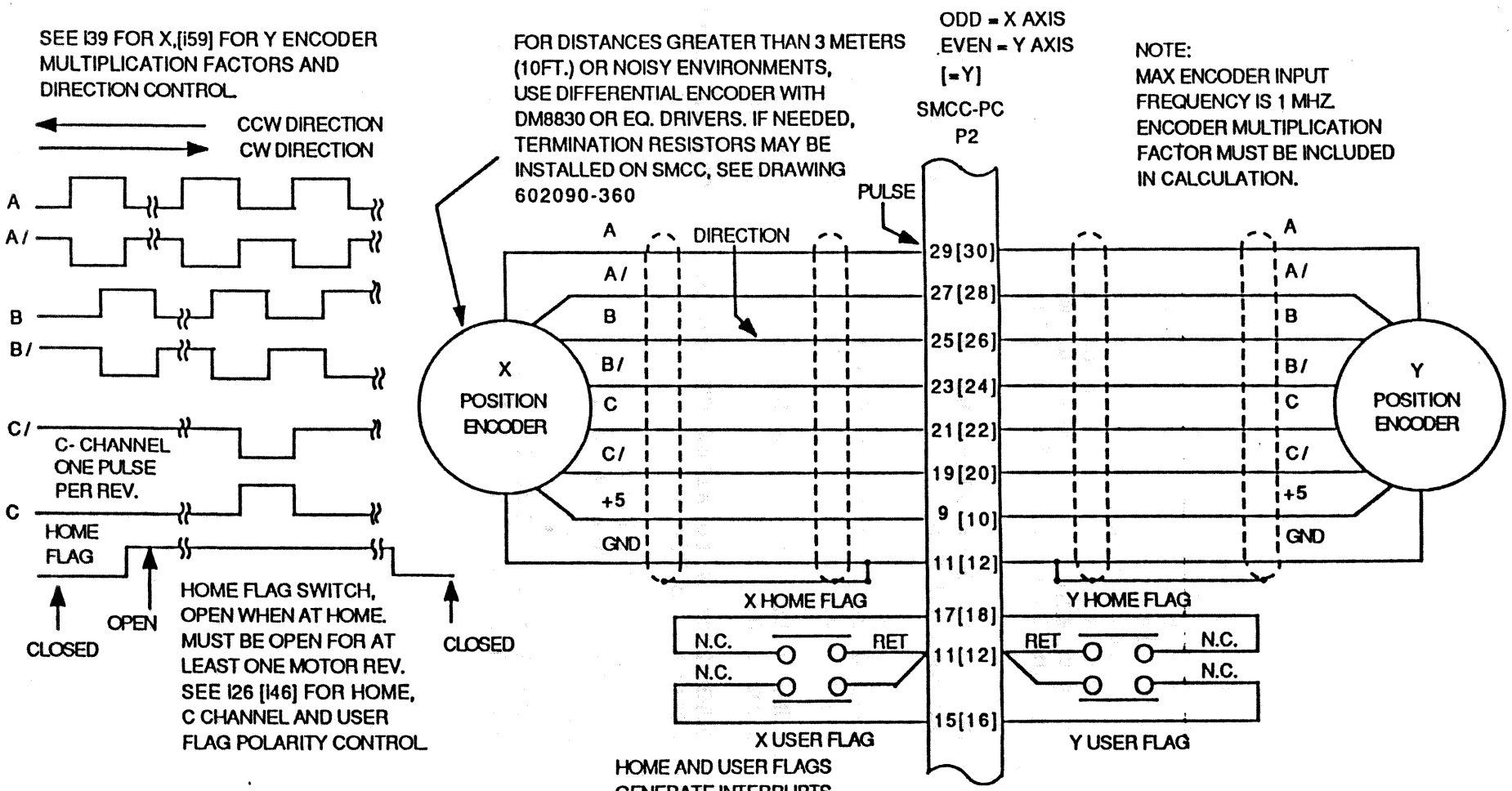
1) ENCODER LEADS "MUST BE" SHIELDED. SHIELD MUST BE INSULATED AND GROUNDED AT SMCC-PC ONLY. HAVE SHIELD AT ENCODER END UNGROUNDED. DO NOT RUN ENCODER WIRES IN SAME CONDUIT AS A.C. POWER OR AMPL. OUTPUT WIRES.
2) JUMP E22 PIN 1 TO PIN 2 FOR DIFFERENTIAL X HANDWHEEL ENCODER INPUT
   JUMP E14 PIN 1 TO PIN 2 FOR DIFFERENTIAL Y HANDWHEEL ENCODER INPUT
3) FOR SINGLE ENDED OPERATION, USE A,B, AND C INPUTS ONLY, LEAVE A/, B/, AND C/ OPEN, DO NOT TIE TO GND.
   JUMP E22 PIN 2 TO PIN 3 FOR "X"
   JUMP E14 PIN 2 TO PIN 3 FOR "Y"
4) HANDWHEEL SCALE FACTOR I27, [I47]
   HANDWHEEL MODE CONTROL I28, [I48] AND I16
5) WHEN ENCODER IS A PULSE AND DIRECTION DEVICE, P2-37/P2-38 ARE USED AS PULSE INPUT, AND P2-33/P2-34 ARE USED AS DIRECTION. HI= +DIRECTION.
6) FOR INFORMATION ABOUT HANDWHEEL OPERATING MODES REFER TO SMCC MANUAL.
7) P2 P/N = 3M 7660-5002
   60 PIN HEADER.

SMCC-PC

TYPICAL HANDWHEEL ENCODER CONNECTIONS DIFFERENTIAL DRIVER OR OPEN COLLECTOR OUTPUT A/B QUADRATURE

(HANDWHEEL ENC. SMCC-PC)

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HOME AND USER FLAGS GENERATE INTERRUPTS AND ARE USED TO CAPTURE POSITIONS ON THE FLY.

1) ENCODER LEADS "MUST BE" SHIELDED. SHIELD MUST BE INSULATED AND GROUNDED AT SMCC-PC ONLY. HAVE SHIELD AT ENCODER END UNGROUNDED. DO NOT RUN ENCODER WIRES IN SAME CONDUIT AS A.C. POWER OR AMPL. OUTPUT WIRES.
2) JUMP E24 PIN 1 TO PIN 2 FOR DIFFERENTIAL X ENCODER INPUT
   JUMP E23 PIN 1 TO PIN 2 FOR DIFFERENTIAL Y ENCODER INPUT
3) FOR SINGLE ENDED OPERATION, USE A,B, AND C INPUTS ONLY, LEAVE A/, B/, AND C/ OPEN, DO NOT TIE TO GND.
   JUMP E24 PIN 2 TO PIN 3 FOR "X"
   JUMP E23 PIN 2 TO PIN 3 FOR "Y"
4) SEE I24, I25 FOR X AND [I44][I45] FOR Y HOMING FUNCTION CONTROL
5) FOR ABSOLUTE POSITION ENCODER, OR RESOLVER, ACC 14 MUST BE INSTALLED.
6) REFER TO SMCC MANUAL FOR MORE DETAILS
7) WHEN ENCODER IS A PULSE AND DIRECTION DEVICE, P2-29/ P2-30 ARE USED AS PULSE INPUT, AND P2-25/ P2-26 ARE USED AS DIRECTION. HI= +DIRECTION:
8) P2 P/N = 3M 7660-5002 60 PIN HEADER.

SMCC-PC

TYPICAL POSITION ENCODER CONNECTIONS DIFFERENTIAL DRIVER OR OPEN COLLECTOR OUTPUT A/B QUADRATURE

(POSITION ENC. SMCC-PC)

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****

SMCC-PC E POINTS, TEST POINTS AND ADDRESS SELECTIONS
(HARDWARE CONFIGURATION)

****

E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E1	*1 *2	B3	JUMP Pin 1 to Pin 2 to increase gain of phase 1 output. No short is +/- 5 volts out, short is +/- 10 volts out. See E9 also. Normally used at +/- 10 volts out for single-ended output and +/- 5 volts out when output is used differentially.	Jumper installed +/- 10 volts out
E2	1 2 * * * * 3 4	D3	JUMP 1 to 2 to allow RTS to be output, J3 Pin 5	1-2 Jumper installed
			JUMP 3 to 4 to allow CTS to be input, J3 Pin 4	3-4 Jumper installed
			JUMP 1 to 3 to allow RTS to be input, J3 Pin 5	RTS is output
			JUMP 2 to 4 to allow CTS to be output, J3 Pin 4	CTS is input
			Use E2 in conjunction with E4 for proper configuration.	
E3	*1 *2	D3	JUMP Pin 1 to Pin 2 to allow +5 volts to go to J3 Pin 14	No Jumper installed

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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E4	1 2 * * * * 3 4	D4	JUMP 1 to 2 to allow RXD/ as output J3 Pin 3	1-2 Jumper installed
			JUMP 3 to 4 to allow TXD/ as input J3 Pin 2	3-4 Jumper installed
			JUMP 1 to 3 to allow RXD/ as input J3 Pin 3	RXD/ is output
			JUMP 2 to 4 to allow TXD/ as output J3 Pin 2	TXD/ is input
			E2 and E4 are used to, in effect swap pins 2 & 3 and 4 & 5 on a standard RS232 connector to accommodate various host configurations as Data Set or Data Terminal.	
E5	1 2 * *	B7	JUMP Pin 1 to Pin 2. With jumper installed, EA/ (Pin 51) of CPU is grounded, which causes the CPU to use external memory only. Otherwise, EA/ (Pin 51) is pulled up to +5 volts. CPU then uses internal and external memory.	No Jumper installed
E6	2 1 * *	C8	Same as E7, but for Y axis.	1-2 Jumper installed (Y encoder not 1/T)
E7	2 1 * *	C8	JUMP Pin 1 to Pin 2 to obtain normal X encoder operation. Remove Jumper for digital tach (1/T). X encoder operation.	1-2 Jumper installed (X encoder not 1/T)
E8	*2 *1	All	JUMP Pin 1 to Pin 2 to allow -14 VA to come from P1 (Ties amplifier and SMCC-PC power supply together. Defeats OPTO coupling).	No jumper installed
			Note that if E8 is changed, E13 and E25 must also be changed.	

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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E9	1 2 * *	C3	JUMP Pin 1 to Pin 2 to increase gain of Phase 3 (See E1)	Jumper installed +/-10 volts out
E10	* * * 1 2 3	D5	JUMP Pin 2 to Pin 3 to allow U16 (Pin 26) SRAM and U16A (Pin 26) EAROM to input +5 volts for 8KX8 parts.	2-3 Jumper installed card is configured for 8KX8 part
E11	* * * 1 2 3	D1	When short removed from 1&2 and placed on 2 and 3, provides X axis unipolar analog error output, with direction bit on SIGNX (P2-3) (See E15 for Y axis.)	1-2 Jumper installed
E12	* * * 1 2 3	D9	JUMP Pin 1 to Pin 2 to allow AMPENA/signal (low true) JUMP Pin 2 to Pin 3 to allow AMPENA/signal (high true)	1-2 Jumper installed
E13	*1 *2	D9	JUMP Pin 1 to Pin 2 to allow analog GND to come from P1 (Ties amplifier and SMCC-PC GND together. Defeats OPTO coupling.) Note that if E13 is changed, E8 and E25 must also be changed.	No Jumper installed
E14	*1 *2 *3	C12	Same as E22, but for Y handwheel.	2-3 Jumper installed (Y-HW Enc Non-diff.)
E15	* * * 3 2 1	C1	When short removed from 1-2 and placed on 2-3, provides Y axis unipolar error output with direction bit on SIGNY (P2-4) (See E11 for X axis).	1-2 Jumper installed

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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E16	*1 *2	D11	Jumper Pin 1 to Pin 2 to tie X handwheel and Y handwheel together for input from a front panel at J3-22 for Chan. B. (Same as E19 for Chan. A.) Note: Both E16 and E19 must be changed for proper operation.	No jumper installed
E17	* * * 3 2 1	A7	JUMP Pin 2 to Pin 3 to allow phasing without hall effects. JUMP Pin 1 to 2 to phase with hall effects.	2-3 Jumper installed
E18	*1 *2	D12	X axis, selects the ANALOG SIP/ Polarity. I2T polarity selector open = positive input shorted = negative input	No Jumper installed positive polarity
E19	2 1 * *	D11	Jumper Pin 1 to Pin 2 to tie X handwheel and Y handwheel together for input from a front panel at J3-16 for Chan. A. (Same as E16 for Channel B)	No Jumper installed
E20	*1 *2	D12	Y axis, selects the ANALOG SIP Polarity. I2T polarity selector open = positive input shorted = negative input	No Jumper installed positive polarity
E21	* * 2 1	A8	Used to allow the soft following error (i10), as well as the hard following error (i00), to control output FERROR/ on P2 Pin 51. Installing E21 causes either (i00) OR (i10) to output FERROR/; not installing E21 causes only (i00) to output FERROR/.	No Jumper installed

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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E22	*1 *2 *3	C12	JUMP Pin 1 to Pin 2 to obtain differential X handwheel input mode. JUMP Pin 2 to Pin 3 to obtain non-differential X handwheel input mode; this will bias X HW negative inputs to 1/2 VCC = 2.5V	2-3 Jumper installed (X HW Enc Non-diff.)
E23	*3 *2 *1	D9	JUMP Pin 1 to Pin 2 to obtain differential Y position encoder input mode. (See E24)	2-3 Jumper installed (Y encoder Non-Diff.)
E24	*1 *2 *3	B12	JUMP Pin 1 to Pin 2 to obtain differential X position encoder input mode. JUMP Pin 2 to Pin 3 to obtain non-differential X encoder input mode; this will bias X encoder negative inputs To 1/2 VCC = 2.5 V. (See E23)	2-3 Jumper installed (X encoder Non-diff.)
E25	*1 *2	D5	JUMP Pin 1 to Pin 2 to allow +14 VA to come from P1 (Ties amplifier and SMCC-PC power supply together. Defeats OPTO-coupling). Note that if E25 is changed, E8 and E13 must also be changed.	No Jumper installed
E26-39			NOT USED	
TP1		D2	INIT/ RESET INPUT TP, LOW = RESET CONDITION HIGH= NON-RESET CONDITION	
TP2		C4	PHASE 1 TP = X AXIS COMMAND SIGNAL or X AXIS PHASE 1 SIGNAL	
TP3		C4	PHASE 3 TP = Y AXIS COMMAND SIGNAL or X AXIS PHASE 3 SIGNAL	
TP4		C6	XENCB TP (X ENCODER CHANNEL B T.P.)	

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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
TP5		C7	YENCB TP (Y ENCODER CHANNEL A T.P.)	
TP6		C7	XENCC TP (X ENCODER CHANNEL C T.P.)	
TP7		C7	XENCA TP (X ENCODER CHANNEL A T.P.)	
TP8		C7	P3/	
TP9		C8	P2/	
TP10		A7	YENCA TP (Y ENCODER CHANNEL A T.P.)	
TP11		A7	YENCC TP (Y ENCODER CHANNEL C T.P.)	
TP12		A3	WATCH DOG TIMER (Low = OK)	
TP13			12 MHz clock	

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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E40 E41 E42 E43 E44	3 2 1 * * *	A12 A10 A10 A11 A11	JUMP Pin 1 to 2 to allow SMCC-PC interrupt to originate from choice of INT. 0: "Buffer Full" INT. 1: "Write Ready Handshake" INT. 2: "Read Ready Handshake" INT. 3: "In Position Status" JUMP Pin 2 to 3 to allow SMCC-PC interrupt to originate from choice of INT. 0: "In Position Status" INT. 1: "Error" or "Buffer Full" INT. 2: "Write Ready Handshake" INT. 3: "Read Ready Handshake" Use E40 for "IRQ2, P1-B4" Use E41 for "IRQ3, P1-B25" Use E42 for "IRQ4, P1-B24" Use E43 for "IRQ5, P1-B23" Use E44 for "IRQ7, P1-B21"	No Jumper installed
E45	1 2 3 * * *	A8	JUMP Pin 1 to 2 to allow INT. 1: Interrupt to originate from "Error" JUMP Pin 2 to 3 to allow INT. 1: Interrupt to originate from "Buffer Full"	2-3 Jumper installed
E46	*3 *2 *1	B9	JUMP Pin 1 to 2 to allow SMCC-PC to power up in normal way; PC hardware reset will not reset SMCC-PC, also needed for standalone operation. JUMP Pin 2 to 3 to allow SMCC-PC to power up in the reset condition and will require the PC software to enable the SMCC-PC.	2-3 Jumper installed
E47	*1 *2 *3	D13	JUMP Pin 1 to 2 to allow the "CUR0" input to enter the SMCC-PC on P2 Pin 5. JUMP Pin 2 to 3 to allow the "SIGNX" output to exit the SMCC-PC on P2 Pin 5.	2-3 Jumper installed

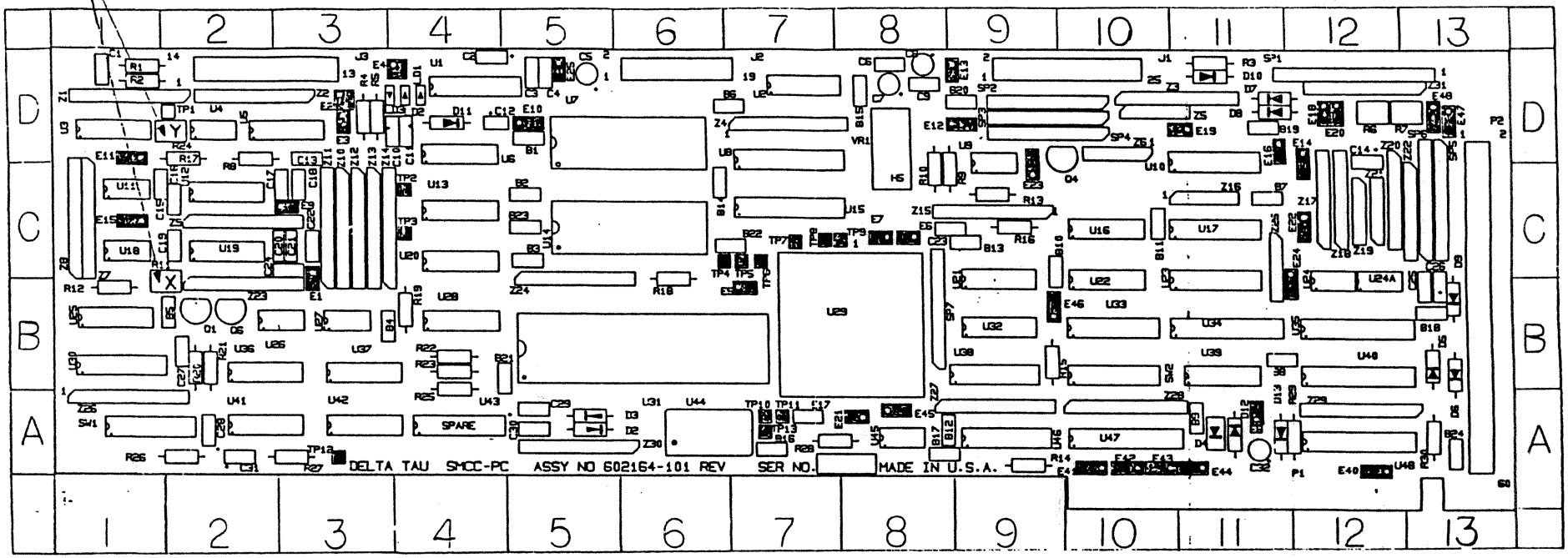
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E POINT	PHYSICAL LAYOUT	LOC.	DESCRIPTION	DEFAULT
E48	*1 *2 *3	D13	JUMP Pin 1 to 2 to allow the "CUR1" input to enter the SMCC-PC on P2 Pin 4. JUMP Pin 2 to 3 to allow the "SIGNY" output to exit the SMCC-PC on P2 Pin 4.	2-3 Jumper installed

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REVISIONS			
REV.	DESCRIPTION	DATE	APPROV

OUTPUT OFFSET ADJUST



CARD ADDRESS	SW1	SW2	SW3	SW4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

BAUD	SW6	SW7	SW8
9600	0	0	0
4800	1	0	0
2400	0	1	0
1200	1	1	0
P.C. BUS	0	0	1
300	1	0	1
38400	0	1	1
19200	1	1	1

FUNCTION	SW5
SAVE ENABLE	0
SAVE DISABLE	1

ITEM	E POINT	LOCATION	ITEM	E POINT	LOCATION
1.	E1	B3	19.	E19	D11
2.	E2	D3	20.	E20	D12
3.	E3	D3	21.	E21	A8
4.	E4	D4	22.	E22	C12
5.	E5	B7	23.	E23	D9
6.	E6	C8	24.	E24	B12
7.	E7	C8	25.	E25	D5
8.	E8	A11		E26-E39	
9.	E9	C3		NOT USED	
10.	E10	D5	26.	E40	A12
11.	E11	D1	27.	E41	A10
12.	E12	D9	28.	E42	A10
13.	E13	D9	29.	E43	A10
14.	E14	C12	30.	E44	A11
15.	E15	C1	31.	E45	A8
16.	E16	D11	32.	E46	B9
17.	E17	A7	33.	E47	D13
18.	E18	D12	34.	E48	D13

ITEM	T-POINT	LOCATION	ITEM	T-POINT	LOCATION	ITEM	T-POINT	LOCATION
1.	TP1	D2	7.	TP7	C7	13.	TP13	A7
2.	TP2	C4	8.	TP8	C7			
3.	TP3	C4	9.	TP9	C8			
4.	TP4	C6	10.	TP10	A7			
5.	TP5	C7	11.	TP11	A7			
6.	TP6	C7	12.	TP12	A3			

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

.. DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Anahid	5-2-89
CHECKED	
ISSUED	

DELTA TAU DATA SYSTEMS

SMCC PC E-POINTS AND TEST POINTS

SIZE B | FSCM NO. | DWG. NO. 602180

SCALE | SHEET 1 OF

BISHOP GRAPHICS/ACCUPRESS

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SMCC-PC BASE ADDRESSING

HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR	
000 HEX	ON	ON	ON	ON	ON	ON	ON	ON	0 DEC	*
004 HEX	ON	ON	ON	ON	ON	ON	ON	OFF	4 DEC	*
008 HEX	ON	ON	ON	ON	ON	ON	OFF	ON	8 DEC	*
00C HEX	ON	ON	ON	ON	ON	ON	OFF	OFF	12 DEC	*
010 HEX	ON	ON	ON	ON	ON	OFF	ON	ON	16 DEC	*
014 HEX	ON	ON	ON	ON	ON	OFF	ON	OFF	20 DEC	
018 HEX	ON	ON	ON	ON	ON	OFF	OFF	ON	24 DEC	
01C HEX	ON	ON	ON	ON	ON	OFF	OFF	OFF	28 DEC	
020 HEX	ON	ON	ON	ON	OFF	ON	ON	ON	32 DEC	*
024 HEX	ON	ON	ON	ON	OFF	ON	ON	OFF	36 DEC	
028 HEX	ON	ON	ON	ON	OFF	ON	OFF	ON	40 DEC	
02C HEX	ON	ON	ON	ON	OFF	ON	OFF	OFF	44 DEC	
030 HEX	ON	ON	ON	ON	OFF	OFF	ON	ON	48 DEC	
034 HEX	ON	ON	ON	ON	OFF	OFF	ON	OFF	52 DEC	
038 HEX	ON	ON	ON	ON	OFF	OFF	OFF	ON	56 DEC	
03C HEX	ON	ON	ON	ON	OFF	OFF	OFF	OFF	60 DEC	
040 HEX	ON	ON	ON	OFF	ON	ON	ON	ON	64 DEC	*
044 HEX	ON	ON	ON	OFF	ON	ON	ON	OFF	68 DEC	
048 HEX	ON	ON	ON	OFF	ON	ON	OFF	ON	72 DEC	
04C HEX	ON	ON	ON	OFF	ON	ON	OFF	OFF	76 DEC	
050 HEX	ON	ON	ON	OFF	ON	OFF	ON	ON	80 DEC	
054 HEX	ON	ON	ON	OFF	ON	OFF	ON	OFF	84 DEC	
058 HEX	ON	ON	ON	OFF	ON	OFF	OFF	ON	88 DEC	
05C HEX	ON	ON	ON	OFF	ON	OFF	OFF	OFF	92 DEC	
060 HEX	ON	ON	ON	OFF	OFF	ON	ON	ON	96 DEC	*
064 HEX	ON	ON	ON	OFF	OFF	ON	ON	OFF	100 DEC	
068 HEX	ON	ON	ON	OFF	OFF	ON	OFF	ON	104 DEC	
06C HEX	ON	ON	ON	OFF	OFF	ON	OFF	OFF	108 DEC	
070 HEX	ON	ON	ON	OFF	OFF	OFF	ON	ON	112 DEC	
074 HEX	ON	ON	ON	OFF	OFF	OFF	ON	OFF	116 DEC	
078 HEX	ON	ON	ON	OFF	OFF	OFF	OFF	ON	120 DEC	
07C HEX	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	124 DEC	

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR	
080 HEX	ON	ON	OFF	ON	ON	ON	ON	ON	128 DEC	*
084 HEX	ON	ON	OFF	ON	ON	ON	ON	OFF	132 DEC	
088 HEX	ON	ON	OFF	ON	ON	ON	OFF	ON	136 DEC	
08C HEX	ON	ON	OFF	ON	ON	ON	OFF	OFF	140 DEC	
090 HEX	ON	ON	OFF	ON	ON	OFF	ON	ON	144 DEC	
094 HEX	ON	ON	OFF	ON	ON	OFF	ON	OFF	148 DEC	
098 HEX	ON	ON	OFF	ON	ON	OFF	OFF	ON	152 DEC	
09C HEX	ON	ON	OFF	ON	ON	OFF	OFF	OFF	156 DEC	
0A0 HEX	ON	ON	OFF	ON	OFF	ON	ON	ON	160 DEC	*
0A4 HEX	ON	ON	OFF	ON	OFF	ON	ON	OFF	164 DEC	*
0A8 HEX	ON	ON	OFF	ON	OFF	ON	OFF	ON	168 DEC	*
0AC HEX	ON	ON	OFF	ON	OFF	ON	OFF	OFF	172 DEC	*
0B0 HEX	ON	ON	OFF	ON	OFF	OFF	ON	ON	176 DEC	
0B4 HEX	ON	ON	OFF	ON	OFF	OFF	ON	OFF	180 DEC	
0B8 HEX	ON	ON	OFF	ON	OFF	OFF	OFF	ON	184 DEC	
0BC HEX	ON	ON	OFF	ON	OFF	OFF	OFF	OFF	188 DEC	
OC0 HEX	ON	ON	OFF	OFF	ON	ON	ON	ON	192 DEC	
OC4 HEX	ON	ON	OFF	OFF	ON	ON	ON	OFF	196 DEC	
0C8 HEX	ON	ON	OFF	OFF	ON	ON	OFF	ON	200 DEC	
0CC HEX	ON	ON	OFF	OFF	ON	ON	OFF	OFF	204 DEC	
0D0 HEX	ON	ON	OFF	OFF	ON	OFF	ON	ON	208 DEC	
0D4 HEX	ON	ON	OFF	OFF	ON	OFF	ON	OFF	212 DEC	
0D8 HEX	ON	ON	OFF	OFF	ON	OFF	OFF	ON	216 DEC	
0DC HEX	ON	ON	OFF	OFF	ON	OFF	OFF	OFF	220 DEC	
0E0 HEX	ON	ON	OFF	OFF	OFF	ON	ON	ON	224 DEC	
0E4 HEX	ON	ON	OFF	OFF	OFF	ON	ON	OFF	228 DEC	
0E8 HEX	ON	ON	OFF	OFF	OFF	ON	OFF	ON	232 DEC	
0EC HEX	ON	ON	OFF	OFF	OFF	ON	OFF	OFF	236 DEC	
OF0 HEX	ON	ON	OFF	OFF	OFF	OFF	ON	ON	240 DEC	
0F4 HEX	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	244 DEC	
0F8 HEX	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	248 DEC	
OFC HEX	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	252 DEC	

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR
100 HEX	ON	OFF	ON	ON	ON	ON	ON	ON	256 DEC
104 HEX	ON	OFF	ON	ON	ON	ON	ON	OFF	260 DEC
108 HEX	ON	OFF	ON	ON	ON	ON	OFF	ON	264 DEC
10C HEX	ON	OFF	ON	ON	ON	ON	OFF	OFF	268 DEC
110 HEX	ON	OFF	ON	ON	ON	OFF	ON	ON	272 DEC
114 HEX	ON	OFF	ON	ON	ON	OFF	ON	OFF	276 DEC
118 HEX	ON	OFF	ON	ON	ON	OFF	OFF	ON	280 DEC
11C HEX	ON	OFF	ON	ON	ON	OFF	OFF	OFF	284 DEC
120 HEX	ON	OFF	ON	ON	OFF	ON	ON	ON	288 DEC
124 HEX	ON	OFF	ON	ON	OFF	ON	ON	OFF	292 DEC
128 HEX	ON	OFF	ON	ON	OFF	ON	OFF	ON	296 DEC
12C HEX	ON	OFF	ON	ON	OFF	ON	OFF	OFF	300 DEC
130 HEX	ON	OFF	ON	ON	OFF	OFF	ON	ON	304 DEC
134 HEX	ON	OFF	ON	ON	OFF	OFF	ON	OFF	308 DEC
138 HEX	ON	OFF	ON	ON	OFF	OFF	OFF	ON	312 DEC
13C HEX	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	316 DEC
140 HEX	ON	OFF	ON	OFF	ON	ON	ON	ON	320 DEC
144 HEX	ON	OFF	ON	OFF	ON	ON	ON	OFF	324 DEC
148 HEX	ON	OFF	ON	OFF	ON	ON	OFF	ON	328 DEC
14C HEX	ON	OFF	ON	OFF	ON	ON	OFF	OFF	332 DEC
150 HEX	ON	OFF	ON	OFF	ON	OFF	ON	ON	336 DEC
154 HEX	ON	OFF	ON	OFF	ON	OFF	ON	OFF	340 DEC
158 HEX	ON	OFF	ON	OFF	ON	OFF	OFF	ON	344 DEC
15C HEX	ON	OFF	ON	OFF	ON	OFF	OFF	OFF	348 DEC
160 HEX	ON	OFF	ON	OFF	OFF	ON	ON	ON	352 DEC
164 HEX	ON	OFF	ON	OFF	OFF	ON	ON	OFF	356 DEC
168 HEX	ON	OFF	ON	OFF	OFF	ON	OFF	ON	360 DEC
16C HEX	ON	OFF	ON	OFF	OFF	ON	OFF	OFF	364 DEC
170 HEX	ON	OFF	ON	OFF	OFF	OFF	ON	ON	368 DEC
174 HEX	ON	OFF	ON	OFF	OFF	OFF	ON	OFF	372 DEC
178 HEX	ON	OFF	ON	OFF	OFF	OFF	OFF	ON	376 DEC
17C HEX	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	380 DEC

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR
180 HEX	ON	OFF	OFF	ON	ON	ON	ON	ON	384 DEC
184 HEX	ON	OFF	OFF	ON	ON	ON	ON	OFF	388 DEC
188 HEX	ON	OFF	OFF	ON	ON	ON	OFF	ON	392 DEC
18C HEX	ON	OFF	OFF	ON	ON	ON	OFF	OFF	396 DEC
190 HEX	ON	OFF	OFF	ON	ON	OFF	ON	ON	400 DEC
194 HEX	ON	OFF	OFF	ON	ON	OFF	ON	OFF	404 DEC
198 HEX	ON	OFF	OFF	ON	ON	OFF	OFF	ON	408 DEC
19C HEX	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	412 DEC
1A0 HEX	ON	OFF	OFF	ON	OFF	ON	ON	ON	416 DEC
1A4 HEX	ON	OFF	OFF	ON	OFF	ON	ON	OFF	420 DEC
1A8 HEX	ON	OFF	OFF	ON	OFF	ON	OFF	ON	424 DEC
1AC HEX	ON	OFF	OFF	ON	OFF	ON	OFF	OFF	428 DEC
1B0 HEX	ON	OFF	OFF	ON	OFF	OFF	ON	ON	432 DEC
1B4 HEX	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	436 DEC
1B8 HEX	ON	OFF	OFF	ON	OFF	OFF	OFF	ON	440 DEC
1BC HEX	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	444 DEC
1C0 HEX	ON	OFF	OFF	OFF	ON	ON	ON	ON	448 DEC
1C4 HEX	ON	OFF	OFF	OFF	ON	ON	ON	OFF	452 DEC
1C8 HEX	ON	OFF	OFF	OFF	ON	ON	OFF	ON	456 DEC
1CC HEX	ON	OFF	OFF	OFF	ON	ON	OFF	OFF	460 DEC
1D0 HEX	ON	OFF	OFF	OFF	ON	OFF	ON	ON	464 DEC
1D4 HEX	ON	OFF	OFF	OFF	ON	OFF	ON	OFF	468 DEC
1D8 HEX	ON	OFF	OFF	OFF	ON	OFF	OFF	ON	472 DEC
1DC HEX	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF	476 DEC
1E0 HEX	ON	OFF	OFF	OFF	OFF	ON	ON	ON	480 DEC
1E4 HEX	ON	OFF	OFF	OFF	OFF	ON	ON	OFF	484 DEC
1E8 HEX	ON	OFF	OFF	OFF	OFF	ON	OFF	ON	488 DEC
1EC HEX	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF	492 DEC
1F0 HEX	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	496 DEC
1F4 HEX	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	500 DEC
1F8 HEX	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	504 DEC
1FC HEX	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	508 DEC

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR
200 HEX	OFF	ON	ON	ON	ON	ON	ON	ON	512 DEC *
204 HEX	OFF	ON	ON	ON	ON	ON	ON	OFF	516 DEC *
208 HEX	OFF	ON	ON	ON	ON	ON	OFF	ON	520 DEC *
20C HEX	OFF	ON	ON	ON	ON	ON	OFF	OFF	524 DEC *
210 HEX	OFF	ON	ON	ON	ON	OFF	ON	ON	528 DEC *
214 HEX	OFF	ON	ON	ON	ON	OFF	ON	OFF	532 DEC *
218 HEX	OFF	ON	ON	ON	ON	OFF	OFF	ON	536 DEC
21C HEX	OFF	ON	ON	ON	ON	OFF	OFF	OFF	540 DEC
220 HEX	OFF	ON	ON	ON	OFF	ON	ON	ON	544 DEC
224 HEX	OFF	ON	ON	ON	OFF	ON	ON	OFF	548 DEC
228 HEX	OFF	ON	ON	ON	OFF	ON	OFF	ON	552 DEC
22C HEX	OFF	ON	ON	ON	OFF	ON	OFF	OFF	556 DEC
230 HEX	OFF	ON	ON	ON	OFF	OFF	ON	ON	560 DEC
234 HEX	OFF	ON	ON	ON	OFF	OFF	ON	OFF	564 DEC
238 HEX	OFF	ON	ON	ON	OFF	OFF	OFF	ON	568 DEC
23C HEX	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	572 DEC
240 HEX	OFF	ON	ON	OFF	ON	ON	ON	ON	576 DEC
244 HEX	OFF	ON	ON	OFF	ON	ON	ON	OFF	580 DEC
248 HEX	OFF	ON	ON	OFF	ON	ON	OFF	ON	584 DEC
24C HEX	OFF	ON	ON	OFF	ON	ON	OFF	OFF	588 DEC
250 HEX	OFF	ON	ON	OFF	ON	OFF	ON	ON	592 DEC
254 HEX	OFF	ON	ON	OFF	ON	OFF	ON	OFF	596 DEC
258 HEX	OFF	ON	ON	OFF	ON	OFF	OFF	ON	600 DEC
25C HEX	OFF	ON	ON	OFF	ON	OFF	OFF	OFF	604 DEC
260 HEX	OFF	ON	ON	OFF	OFF	ON	ON	ON	608 DEC
264 HEX	OFF	ON	ON	OFF	OFF	ON	ON	OFF	612 DEC
268 HEX	OFF	ON	ON	OFF	OFF	ON	OFF	ON	616 DEC
26C HEX	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	620 DEC
270 HEX	OFF	ON	ON	OFF	OFF	OFF	ON	ON	624 DEC
274 HEX	OFF	ON	ON	OFF	OFF	OFF	ON	OFF	628 DEC
278 HEX	OFF	ON	ON	OFF	OFF	OFF	OFF	ON	632 DEC
27C HEX	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	636 DEC

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR	
280 HEX	OFF	ON	OFF	ON	ON	ON	ON	ON	640 DEC	
284 HEX	OFF	ON	OFF	ON	ON	ON	ON	OFF	644 DEC	
288 HEX	OFF	ON	OFF	ON	ON	ON	OFF	ON	648 DEC	
28C HEX	OFF	ON	OFF	ON	ON	ON	OFF	OFF	652 DEC	
290 HEX	OFF	ON	OFF	ON	ON	OFF	ON	ON	656 DEC	
294 HEX	OFF	ON	OFF	ON	ON	OFF	ON	OFF	660 DEC	
298 HEX	OFF	ON	OFF	ON	ON	OFF	OFF	ON	664 DEC	
29C HEX	OFF	ON	OFF	ON	ON	OFF	OFF	OFF	668 DEC	
2A0 HEX	OFF	ON	OFF	ON	OFF	ON	ON	ON	672 DEC	
2A4 HEX	OFF	ON	OFF	ON	OFF	ON	ON	OFF	676 DEC	
2A8 HEX	OFF	ON	OFF	ON	OFF	ON	OFF	ON	680 DEC	
2AC HEX	OFF	ON	OFF	ON	OFF	ON	OFF	OFF	684 DEC	
2B0 HEX	OFF	ON	OFF	ON	OFF	OFF	ON	ON	688 DEC	
2B4 HEX	OFF	ON	OFF	ON	OFF	OFF	ON	OFF	692 DEC	
2B8 HEX	OFF	ON	OFF	ON	OFF	OFF	OFF	ON	696 DEC	
2BC HEX	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	700 DEC	
2C0 HEX	OFF	ON	OFF	OFF	ON	ON	ON	ON	704 DEC	
2C4 HEX	OFF	ON	OFF	OFF	ON	ON	ON	OFF	708 DEC	
2C8 HEX	OFF	ON	OFF	OFF	ON	ON	OFF	ON	712 DEC	
2CC HEX	OFF	ON	OFF	OFF	ON	ON	OFF	OFF	716 DEC	
2D0 HEX	OFF	ON	OFF	OFF	ON	OFF	ON	ON	720 DEC	
2D4 HEX	OFF	ON	OFF	OFF	ON	OFF	ON	OFF	724 DEC	
2D8 HEX	OFF	ON	OFF	OFF	ON	OFF	OFF	ON	728 DEC	
2DC HEX	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF	732 DEC	
2E0 HEX	OFF	ON	OFF	OFF	OFF	ON	ON	ON	736 DEC	
2E4 HEX	OFF	ON	OFF	OFF	OFF	ON	ON	OFF	740 DEC	
2E8 HEX	OFF	ON	OFF	OFF	OFF	ON	OFF	ON	744 DEC	
2EC HEX	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF	748 DEC	
2F0 HEX	OFF	ON	OFF	OFF	OFF	OFF	ON	ON	752 DEC	
2F4 HEX	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF	756 DEC	
2F8 HEX	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON	760 DEC	*
2FC HEX	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	764 DEC	*

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR	
300 HEX	OFF	OFF	ON	ON	ON	ON	ON	ON	768 DEC	*
304 HEX	OFF	OFF	ON	ON	ON	ON	ON	OFF	772 DEC	*
308 HEX	OFF	OFF	ON	ON	ON	ON	OFF	ON	776 DEC	*
30C HEX	OFF	OFF	ON	ON	ON	ON	OFF	OFF	780 DEC	*
310 HEX	OFF	OFF	ON	ON	ON	OFF	ON	ON	784 DEC	*
314 HEX	OFF	OFF	ON	ON	ON	OFF	ON	OFF	788 DEC	*
318 HEX	OFF	OFF	ON	ON	ON	OFF	OFF	ON	792 DEC	*
31C HEX	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	796 DEC	*
320 HEX	OFF	OFF	ON	ON	OFF	ON	ON	ON	800 DEC	*
324 HEX	OFF	OFF	ON	ON	OFF	ON	ON	OFF	804 DEC	*
328 HEX	OFF	OFF	ON	ON	OFF	ON	OFF	ON	808 DEC	*
32C HEX	OFF	OFF	ON	ON	OFF	ON	OFF	OFF	812 DEC	*
330 HEX	OFF	OFF	ON	ON	OFF	OFF	ON	ON	816 DEC	
334 HEX	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	820 DEC	
338 HEX	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	824 DEC	
33C HEX	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	828 DEC	
340 HEX	OFF	OFF	ON	OFF	ON	ON	ON	ON	832 DEC	
344 HEX	OFF	OFF	ON	OFF	ON	ON	ON	OFF	836 DEC	
348 HEX	OFF	OFF	ON	OFF	ON	ON	OFF	ON	840 DEC	
34C HEX	OFF	OFF	ON	OFF	ON	ON	OFF	OFF	844 DEC	
350 HEX	OFF	OFF	ON	OFF	ON	OFF	ON	ON	848 DEC	
354 HEX	OFF	OFF	ON	OFF	ON	OFF	ON	OFF	852 DEC	
358 HEX	OFF	OFF	ON	OFF	ON	OFF	OFF	ON	856 DEC	
35C HEX	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	860 DEC	
360 HEX	OFF	OFF	ON	OFF	OFF	ON	ON	ON	864 DEC	
364 HEX	OFF	OFF	ON	OFF	OFF	ON	ON	OFF	868 DEC	
368 HEX	OFF	OFF	ON	OFF	OFF	ON	OFF	ON	872 DEC	
36C HEX	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	876 DEC	
370 HEX	OFF	OFF	ON	OFF	OFF	OFF	ON	ON	880 DEC	
374 HEX	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	884 DEC	
378 HEX	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON	888 DEC	*
37C HEX	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	892 DEC	*

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HEX-ADDR	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	DEC-ADDR
380 HEX	OFF	OFF	OFF	ON	ON	ON	ON	ON	896 DEC *
384 HEX	OFF	OFF	OFF	ON	ON	ON	ON	OFF	900 DEC *
388 HEX	OFF	OFF	OFF	ON	ON	ON	OFF	ON	904 DEC *
38C HEX	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	908 DEC *
390 HEX	OFF	OFF	OFF	ON	ON	OFF	ON	ON	912 DEC *
394 HEX	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	916 DEC
398 HEX	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	920 DEC
39C HEX	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	924 DEC
3A0 HEX	OFF	OFF	OFF	ON	OFF	ON	ON	ON	928 DEC *
3A4 HEX	OFF	OFF	OFF	ON	OFF	ON	ON	OFF	932 DEC *
3A8 HEX	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	936 DEC *
3AC HEX	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF	940 DEC
3B0 HEX	OFF	OFF	OFF	ON	OFF	OFF	ON	ON	944 DEC *
3B4 HEX	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	948 DEC *
3B8 HEX	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	952 DEC *
3BC HEX	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	956 DEC *
3C0 HEX	OFF	OFF	OFF	OFF	ON	ON	ON	ON	960 DEC
3C4 HEX	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	964 DEC
3C8 HEX	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	968 DEC
3CC HEX	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	972 DEC
3D0 HEX	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	976 DEC *
3D4 HEX	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF	980 DEC *
3D8 HEX	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON	984 DEC *
3DC HEX	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	988 DEC *
3E0 HEX	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	992 DEC
3E4 HEX	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	996 DEC
3E8 HEX	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	1000 DEC***
3EC HEX	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	1004 DEC
3F0 HEX	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	1008 DEC *
3F4 HEX	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	1012 DEC *
3F8 HEX	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	1016 DEC *
3FC HEX	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1020 DEC *

*** NOTE: - Default Setting at Factory

OFF = Logic +, Push Switch to "Open" Side
ON = Logic 0, Push Switch to "Number" Side

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HOST PC I/O ADDRESS MAP

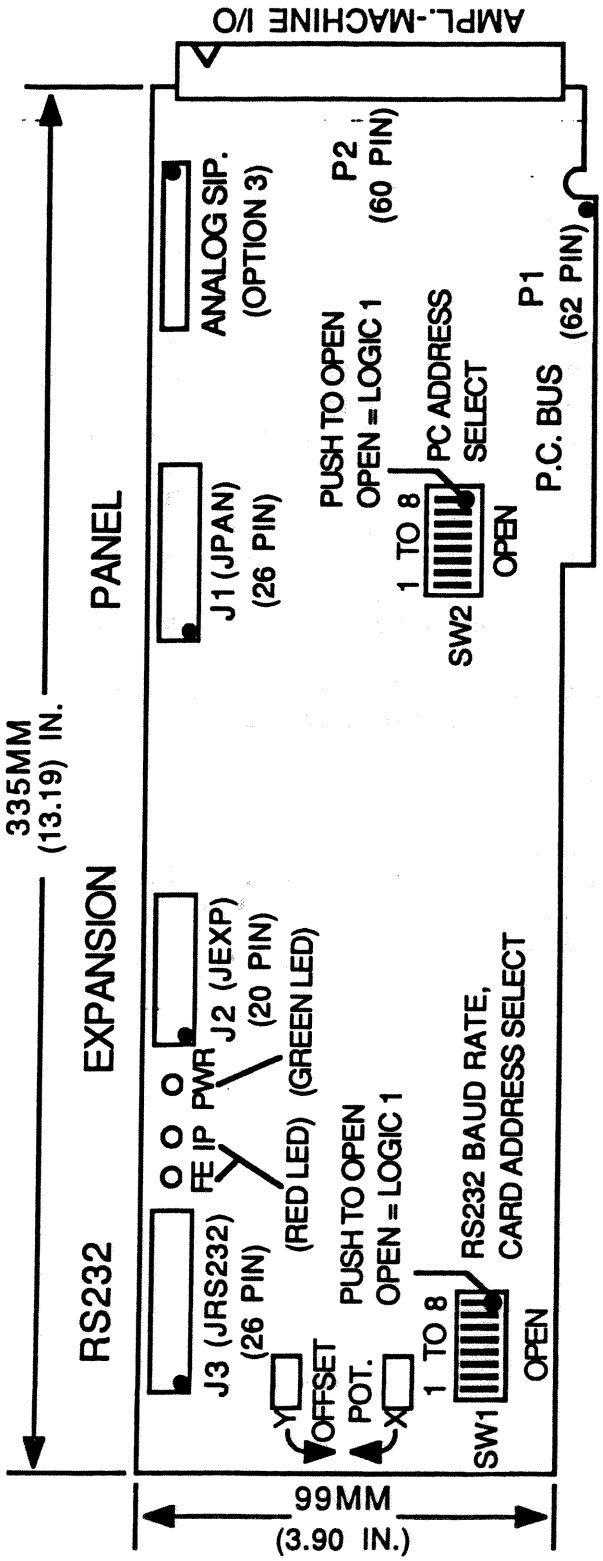
HEX RANGE	DEC RANGE	USAGE
000-00F	0-16	DMA Chip 8237A-5
020-021	32-33	Interrupt 8259A
040-043	64-67	Timer 8253-5
060-063	96-99	PPI 8255A-5
080-083	128-131	DMA Page Registers
0AX	16X	NMI Mask Register
200-20F	512-527	Game Control
210-217	528-535	Expansion Unit
2F8-2FF	760-767	Asynchronous Communications (Sec.)
300-31F	768-799	Prototype Card
320-32F	800-815	Fixed Disk
378-37F	888-895	Printer
380-38C	896-908	SDLC Communications
380-389	896-905	Binary Synchronous Communications (Sec.)
390-393	912-915	Cluster
3A0-3A9	928-937	Binary Synchronous Communications (Pri.)
3B0-3BF	944-959	IBM Monochrome Display/Printer
3D0-3DF	976-991	Color/Graphics
3F0-3F7	1000-1015	Diskette
3F8-3FF	1016-1023	Asynchronous Communications (Pri.)

*NOTE: It is highly recommended that the addresses marked with " * " not be used by "SMCC-PC." See above chart for possible contention with existing I/O. If a contention occurs, try a new unused address.

Contention is exhibited by:

1) Total Malfunction
2) Partial Function, Input O.K., Output bad or vice versa.
3) Intermittent operation

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SMCC-PC OUTLINE AND CONNECTOR PLACEMENT

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SMCC - PC I/O REGISTER MAP

	7	6	5	4	3	2	1	0	
READ/BIT WRITE DATA	D7	D6	D5	D4	D3	D2	D1	D0	SMCC-PC BASE ADDR +0
READ STATUS	LBF	WSL	IPOS	BRTS	LERR	RSL	FERR	BGLT	SMCC-PC BASE ADDR +1
READ CONTROL WRITE CONTROL	X	X	INT-SEL1	INT-SEL0	INT-ENA	SMC-ENA	X	X	SMCC-PC BASE ADDR +2
NOT USED	X	X	X	X	X	X	X	X	SMCC-PC BASE ADDR +3

BGLT; = i00 Following Error Fault = HIGH TRUE
FERR; = i10 Following Error Fault = HIGH TRUE
RSL; = Read Data From "SMCC" to "PC" Handshake Bit
0 = SMCC has Data
1 = SMCC has no Data

LERR; = COM. ERROR, DATA ERROR, FOL. ERROR = HIGH TRUE
BRTS; = Data Direction, HIGH = "PC" to "SMCC", LOW = "SMCC" to "PC"
IPOS; = IN POSITION = HIGH TRUE
WSL; = Write Data From "PC" to "SMCC" Handshake Bit
1 = SMCC is Ready
0 = SMCC is not Ready
LBF; = Buffer Full = HIGH TRUE

SMCENA
With E46-1 to 2 = "SMCC ENABLE", LOW="SMCC" Enable, HIGH="SMCC" Reset
With E46-2 to 3 = "SMCC ENABLE", LOW="SMCC" Reset, HIGH="SMCC" Enable
NOTE: With E46-2 to 3, SMCC-PC will power up in the "RESET" state and will require the "PC" software to enable it.

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INTENA; "SMCC-PC INTERRUPT ENABLE" LOW = DISABLE, HIGH = ENABLE

INTSEL0; "SMCC-PC INTERRUPT SELECT BIT 0"

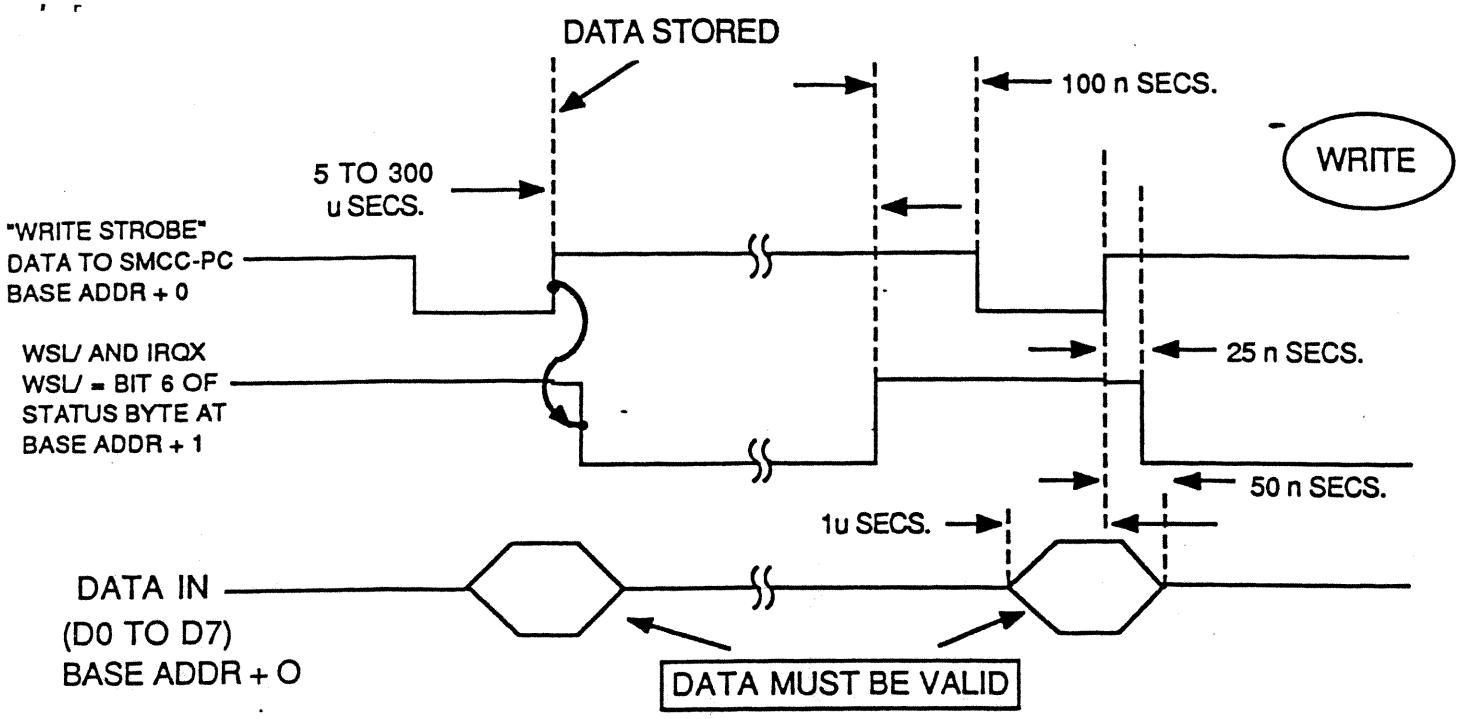
INTSEL1; "SMCC-PC INTERRUPT SELECT BIT 1"

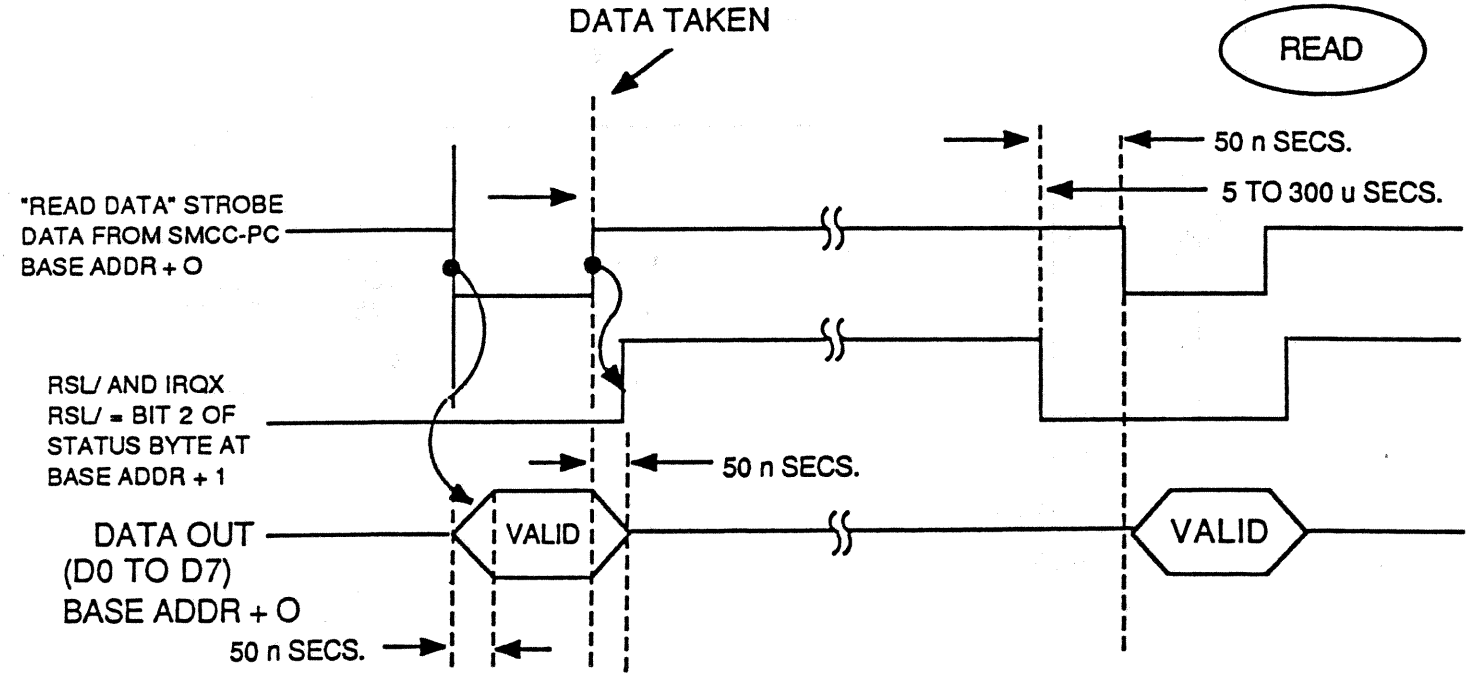
INTERRUPT CONTROL TABLE

INTSEL1	INTSEL0	INTENA	INTERRUPT CHANNEL-A (U38-PIN 7)	INTERRUPT CHANNEL-B (U38-PIN 9)
X	X	0	NO INTERRUPT	NO INTERRUPT
0	0	1	BUFFER FULL INT.	IN POSITION INT.
0	1	1	WRITE READY INT.	E45 1 TO 2 | ERROR INT.
				E45 2 TO 3 | BUFFER INT.
1	0	1	READ READY INT.	WRITE READY INT.
1	1	1	IN POSITION INT.	READ READY INT.

X = DON'T CARE CONDITION

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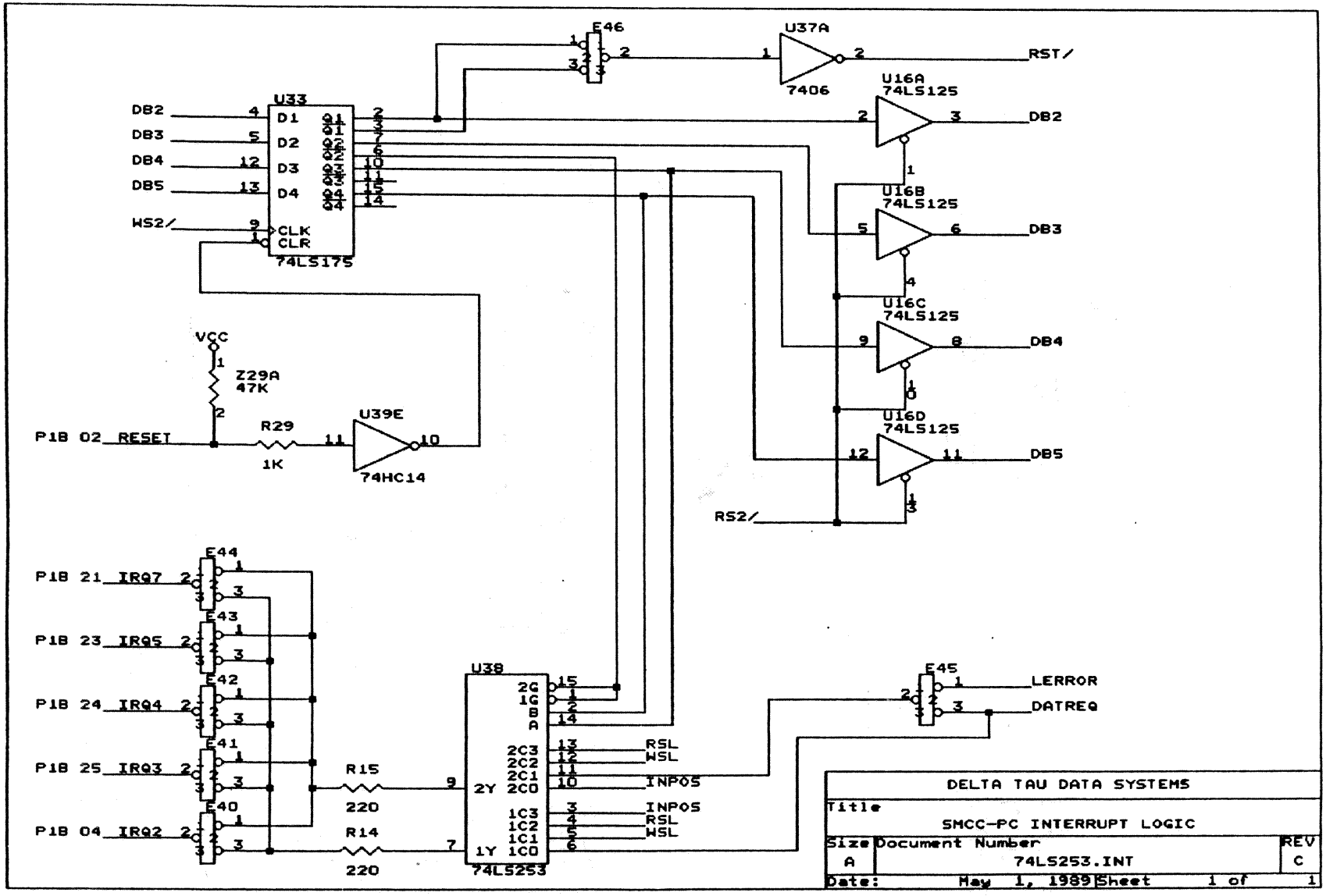


SMCC-PC INTERFACE BUSS TIMING DIAGRAM.

IRQX CAN BE A CHOICE OF ONE INTERRUPT LINE
i.e., IRQ2, IRQ3, IRQ6, OR IRQ7 CAN BE SELECTED

(SMCC-PC TIMING)

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COMMUNICATING WITH THE SMCC-PC CARD

The SMCC-PC motion control card talks to the IBM-PC over the PC's backplane bus, like any other expansion card. The bus has a ten-bit addressing scheme, so there are 1024 addresses on the bus. Each SMCC-PC card uses four consecutive addresses. The base address is set on the card by an 8-pin DIP switch, which defines the upper eight bits of the address -- the lowest two bits of the base address are zero.

The basic communication scheme for the card uses the base address (for the actual data) and the address one greater than the base address (for the handshaking). In this method, the CPU repeatedly polls the desired handshake bit until it is in the proper state, then reads or writes a character (byte) from or to the base address.

There should be an upper limit on the number of times the CPU will check the handshake bit to read or write a given character, so a problem with the card or the communications will not hang up the computer. Unfortunately, there is not a real-time clock on the IBM-PC of sufficient resolution to provide a definite time limit, regardless of the speed of the processor, so it is necessary to tailor the limit to the CPU speed. A limit of 10 times is probably good for a slow PC or PC/XT, 30-40 for an AT, depending on speed, and 50-70 for an 80386-based machine. Too low a limit will garble transmission by dropping characters (in either direction); a limit much higher than needed can slow down the program by tying it up too long waiting for a handshake bit that is not forthcoming (on reads).

To write a character to the card, the CPU should check the Write Ready/ bit (WSL/ -- bit 6 of BaseAddress+1). As long as this is 1, the card is not ready to accept a character. So the program should loop, reading a byte from that address, performing a bit-by-bit AND with 40H, until the AND produces a zero or the limit on number of times to check has been reached. Presuming a zero has been found, the CPU should write the desired character byte to the base address. Reaching the limit could mean one of several things. First, it could simply mean that the limit was set too low for that particular CPU, and the card could not reset the bit in time. Second, it could mean that the card was trying to talk, not listen, at the time. Finally, it could mean there is a problem with the card or the communications.

To read a character from the card, the CPU should check the Read Ready/ bit (RSL/ -- bit 2 of BaseAddress+1). As long as this is 1, the card is not ready to send a character. Therefore, the program should loop, reading a byte from that address, performing a bit-by-bit AND with 04H, until the AND produces a zero or the limit on the number of times to check has been reached. If a zero has been produced, the CPU should read the character byte from the base address. Since the card always sends a full line, this should be inside a larger loop that looks to see that the

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termination character has been read (usually CR -- 0DH). In the case of reading from the card, a timeout condition (exceeding the limit on number of checks) can be perfectly normal, in that the CPU will often check the card for data to read when there is none. This is where too high a limit on the number of times to check the handshake bit can slow down the program.

The following program, written in TurboC, illustrates the basic communications to the card over the PC-bus. The two routines that do the actual communication are "sendchar" (writing to the card) and "getline" (reading from the card).

The above description details communication with the card using a "polling" method, where the computer repeatedly checks the card to see when it is ready to communicate. It is also possible to talk with the card using an "interrupt" method, in which the card interrupts the host computer when it is ready to talk and/or listen. The SMCC-PC has a flexible interrupt configuration, and can be customized through a combination of hardware and software to provide the desired interrupts to the CPU. (See the interrupt table in the SMCC-PC I/O Register Map).

In the near future, we will provide an example program and more detailed instructions for using interrupt-based communications with the SMCC-PC card.

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```
/* Rudimentary port I/O program C.S. Wilson 2/3/89 */
/* Designed to make IBM PC act as terminal to SMCC-PC card */
#include <stdio.h>

    char        buf[128] ;    /* holds input string */
    int         combase ;     /* base address of the card */
    int         timeout ;     /* limits how long to look for handshake */

void set_up_interface () {
/* lets user define the interface to the SMCC-PC card */
    char    entry[16] ;
    int     i ;

    /* Base address is set by 8-pin DIP switch -- it is 10-bit value */
    /* with upper 8 bits defined by the DIP switch, low 2 bits are 0 */
    cprintf ("\r\n Enter base port address for card: ") ;
    gets (entry) ;
    sscanf (entry, "%d", &combase) ;
    /* Clock speed multiplier sets limit on how long to look for handshake */
    /* so read or write can occur.  Software looks seven times the number */
    /* entered for proper handshake before giving up.  The faster the CPU */
    /* the higher this value should be.  A 4-5 MHz PC can use 1; an 8-12  */
    /* MHz AT should use 3 or 4; and so on */
    cprintf ("\r\n Enter clock speed multiplier (1-9): ") ;
    while ((i = getch ()) < '1'  ||  i > '9') ;
    cprintf ("%c\r\n", i) ;
    timeout = 700 * (i - '0') ;
}


void sendchar (char outchar) {
/* sends a character to the SMCC-PC card */
    int     i ;

    i = 0 ;
    /* look for Write Ready bit (bit 6 of base address + 1) */
    while (i++ < timeout  &&  (inportb (combase + 1) & 64)) ;
    if (i < timeout)   /* found it, so send character */
        outportb (combase, outchar) ;
}


int getline (char *linebuf) {
/* looks for a line of character data from the SMCC-PC card */
    char    ic ;
    int     i, nc ;

    ic = 0 ;
    nc = 0 ;
    i = 0 ;
    while (i++ < timeout  &&  ic != 13  &&  nc < 127) {
        /* look for Read Ready bit (bit 2 of base address + 1) */
        if ((inportb (combase + 1) & 4) == 0)
        {   /* found it -- read a character and add on to string */
            ic = inportb (combase) ;
            linebuf [nc++] = ic ;
            i = 0 ;   /* reset counter */
        }
    }
    linebuf [nc] = 0 ;
    return (nc) ;
}
```


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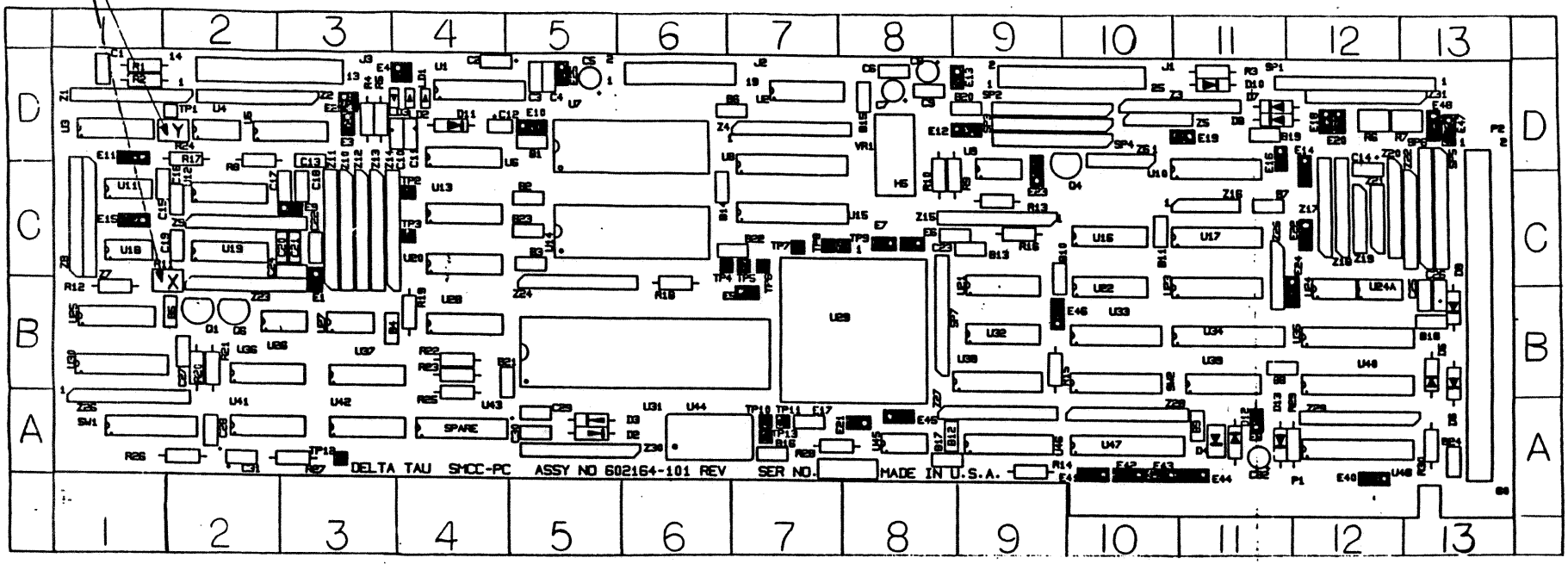
```
main () {
    int     done ;
    char    ic ;

    set_up_interface () ;
    cprintf ("\r\nNow acting as terminal to SMCC-PC card.\r\n") ;
    cprintf ("Hit <ESC> to exit.\r\n\n") ;
    done = 0 ;
    while (!done) {
        while (!kbhit()) {  /* no key hit, so look for line from card */
            getline (buf) ;
            cprintf (buf) ;
        }
        switch (ic = getch ()) {
            case 27 : done = 1 ; break ;  /* ESC exits */
            case 0 : /* swallow second part of special keys */
                getch () ; break ;
            default : sendchar (ic) ;
                if (ic == 13) putch (10) ;
                putch (ic) ;
                break ;
        }
    }
}
```

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REV.	DESCRIPTION	DATE	APPROVED

OUTPUT OFFSET ADJUST



CARD ADDRESS	SW1	SW2	SW3	SW4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

BAUD	SW6	SW7	SW8
9600	0	0	0
4800	1	0	0
2400	0	1	0
1200	1	1	0
P.C. BUS	0	0	1
300	1	0	1
38400	0	1	1
19200	1	1	1

FUNCTION	SW5
SAVE ENABLE	0
SAVE DISABLE	1

ITEM	E POINT	LOCATION	ITEM	E POINT	LOCATION
1.	E1	B3	19.	E19	D11
2.	E2	D3	20.	E20	D12
3.	E3	D3	21.	E21	A8
4.	E4	D4	22.	E22	C12
5.	E5	B7	23.	E23	D9
6.	E6	C8	24.	E24	B12
7.	E7	C8	25.	E25	D5
8.	E8	A11		E26-E39	
9.	E9	C3		NOT USED	
10.	E10	D5	26.	E40	A12
11.	E11	D1	27.	E41	A10
12.	E12	D9	28.	E42	A10
13.	E13	D9	29.	E43	A10
14.	E14	C12	30.	E44	A11
15.	E15	C1	31.	E45	A8
16.	E16	D11	32.	E46	B9
17.	E17	A7	33.	E47	D13
18.	E18	D12	34.	E48	D13

ITEM	T-POINT	LOCATION	ITEM	T-POINT	LOCATION	ITEM	T-POINT	LOCATION
1.	TP1	D2	7.	TP7	C7	13.	TP13	A7
2.	TP2	C4	8.	TP8	C7			
3.	TP3	C4	9.	TP9	C8			
4.	TP4	C6	10.	TP10	A7			
5.	TP5	C7	11.	TP11	A7			
6.	TP6	C7	12.	TP12	A3			

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

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CONTRACT NO.

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ISSUED	

DELTA TAU DATA SYSTEMS

SMCC PC E-POINTS AND TEST POINTS

SIZE	FSCM NO.	DWG. NO.	REV.
B		602180	B

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