Sorensen

Instruction Manual for

Internal Analog Programming (APG) Interface (Option M5A)

TM-6HM5-ASN
Rev. A

Internal Analog Programming (APG) Interface

(Option M5A)

INSTRUCTION MANUAL

Release 5.0 (93/11/19)

TM-6HM5-ASN

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M5A Analog Programming and Readback Card Schematic XS-6HM5-A

SECTION 1. FEATURES and SPECIFICATIONS

1.1 Description

The Analog Programming (APG) Interface is an internal option card for analog programming of XT and HPD Series DC power supplies with a 0-10Vdc programming source or a 0-10kΩ resistance. A 25-pin female DSUB connector on the unit's rear panel enables connections to the card.

1.2 Features

- Programming output voltage and/or current limit using a 0-10Vdc programming source or a 0-10kΩ resistance. Externally adjustable offset and range.
- Fixed programming of output voltage and/or current limit using an available 10V reference (10mA max source)
- 0-10V readback of output voltage and current with externally adjustable offset and range
- Status signals for programming mode, operating mode, OVP (over voltage protection) flag, and output fail flag
- Adjustable OVP with reset and flag
- TTL shutdown with selectable positive or negative logic
- Tracking for multiple supplies of the same output

1.3 Specifications

Remote Analog Programming: 0-10Vdc for 0-100% of rated voltage or current ±0.1%
0-10kΩ for 0-100% of rated voltage or current ±0.1%

OVP Trip Range: 3V to full output + 10%

Remote ON/OFF: 2 to 25Vdc high. <0.8Vdc low. User-selectable logic.

Tracking Accuracy: ±1%

SECTION 2. OPERATION

2.1 Introduction

Configure, operate, adjust, and calibrate the analog programming interface installed in your XT or HPD DC power supply as indicated in this section. You will find the main programming option switch and connector on the unit's rear panel. Calibrate through the top and at the rear of the unit. Adjust OVP right at the front panel. Finally, front panel LEDs indicate when V or I programming is selected (PGM), when TTL shutdown has occurred (S/D), and when the supply exceeds the voltage trip point OVP).

2.2 Configuration

2.2.1 Front Panel LEDs and OVP Adjust

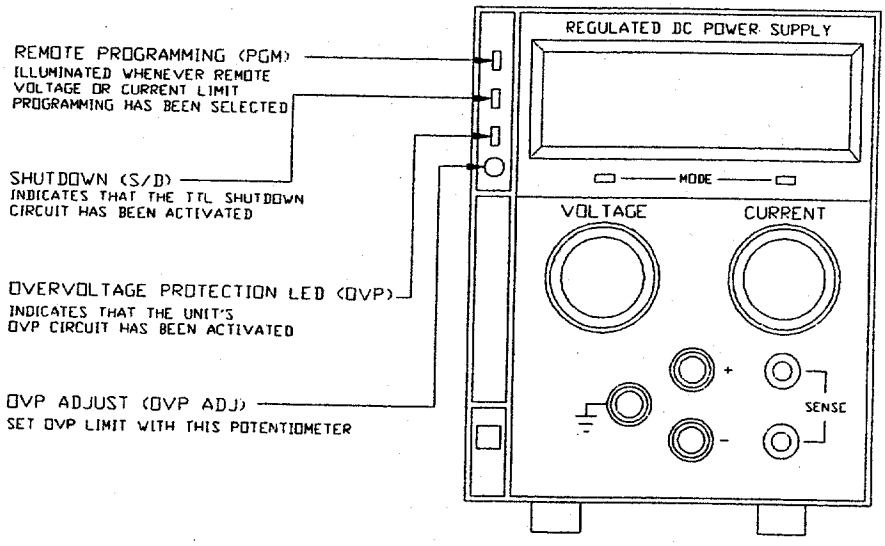


Figure 2.2-1 XT or HPD Series Front Panel with APG Interface Installed

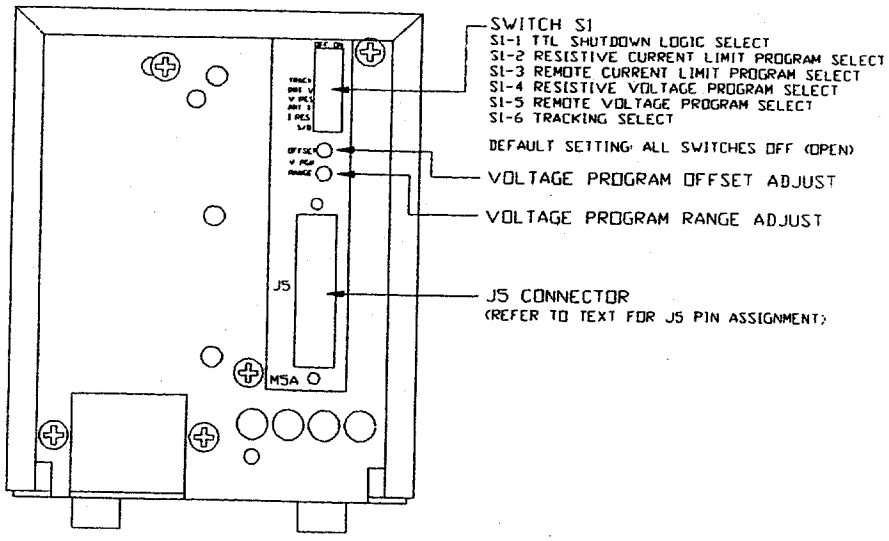


Figure 2.2-2 XT or HPD Series Rear Panel with APG Interface Installed

2.2 Configuration (continued)

2.2.2 Rear Panel Switch S1 Default Settings

S1-1 TTL Shutdown Logic Select (OPEN=negative logic, CLOSED=positive logic)
S1-2 Resistive Current Program Select
S1-3 Remote Current Program Select
S1-4 Resistive Voltage Program Select
S1-5 Remote Voltage Program Select
S1-6 Tracking Select

Default: Local control (all switches OPEN).

2.2.3 Rear Panel J5 Connector

Make analog interface connections via the rear panel 25-pin female DSUB connector designated J5. To provide the lowest noise performance, we recommend you use shielded-twisted pair wiring for making connections from external circuits to the J5 connector. Use the shortest leads possible. Ground the shield to pin 6 (auxiliary ground) on the J5 connector or to the chassis via one of the J5 connector screws.

Note: In order to maintain isolation of power supply output, any programming source must also be an isolated source.

J5 Connector Pin Assignments

OVER VOLTAGE PROTECTION FLAG 1
TTL SHUTDOWN RETURN 2
NOT USED 3
PROGRAM RETURN 4
PROGRAM RETURN 5
AUXILIARY GROUND 6
REMOTE VOLTAGE PROGRAM SELECT* 7
REMOTE CURRENT PROGRAM SELECT* 8
VOLTAGE/CURRENT LIMIT MODE INDICATOR 9
+ OUT 10
+ OUT 11
RTN 12
RTN 13
14 ..... NOT USED
15 ..... TTL SHUTDOWN
16 ..... CURRENT LIMIT PROGRAM
17 ..... VOLTAGE PROGRAM
18 ..... CURRENT READBACK
19 ..... VOLTAGE READBACK
20 ..... +10V REFERENCE OUT (10mA Max)
21 ..... OUTPUT FAIL FLAG*
22 ..... + SNS
23 ..... + OUT
24 ..... RTN
25 ..... RTN SNS

* Negative Logic: LOW = ACTIVE

2.2 Configuration (continued)

2.2.4 Calibration Adjustment

You can access most calibration potentiometers through the top of the unit (**Figure 2.2-3**). The exceptions are Voltage Program OFFSET and RANGE which are on the unit's rear panel. See **Figure 2.2-2 XT or HPD Series Rear Panel with APG Interface Installed**.

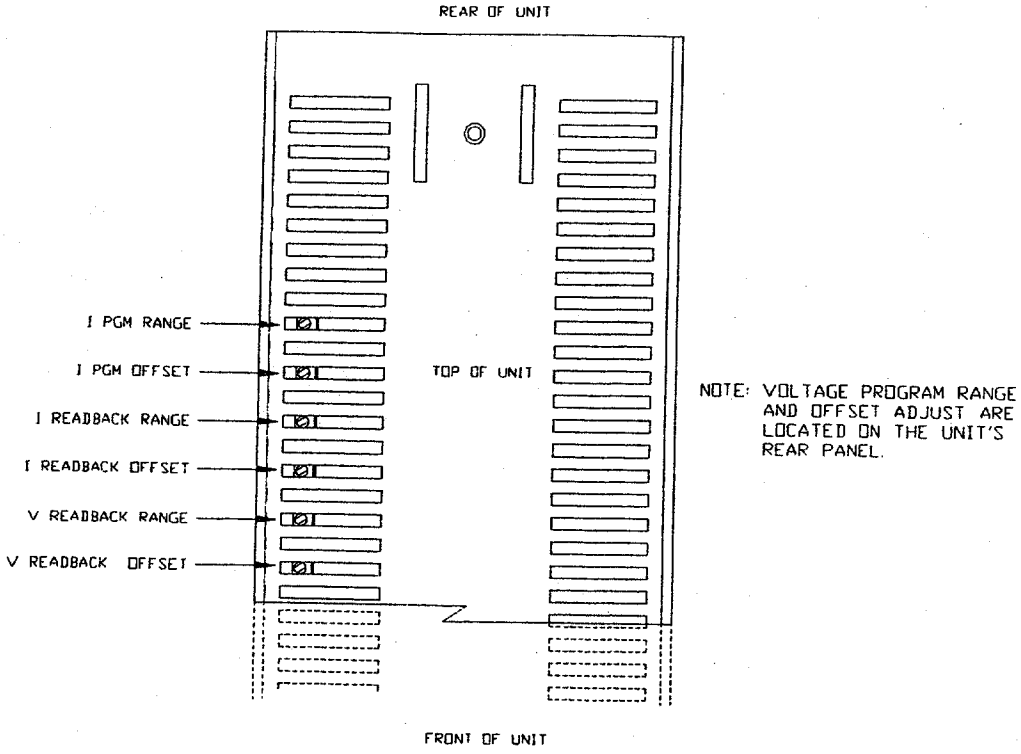


Figure 2.2-3 APG Interface (M5A) Calibration Adjustment Locations

SECTION 2. OPERATION (continued)

2.3 Remote Programming

Remote programming allows control of the power supply's output voltage and/or current limit to shift from local operation at the front panel voltage and current controls to external analog input sources. As you vary the programming source, the power supply's output varies proportionally over its output range.

When you select remote voltage programming, the voltage control knob on the front panel will not work. The same situation applies when you select remote current programming: the remote option overrides the current control knob on the front panel.

CAUTION

The programming signal return is internally referenced to the return sense (RTN SNS) potential of the power supply. Therefore, you may connect the remote programming source return to the power supply circuit at ONLY ONE of the following nodes:

- APG Interface J5 connector pins 4 or 5 (program return), OR
- power supply output return when remote sense not used, OR
- power supply return sense (RTN SNS) when remote sense is connected.

If you do not observe this restriction, the power supply may operate erratically, or, fuse F1 on the APG Interface PCB assembly may blow.

In order to maintain isolation of power supply output, use a programming source which is also an isolated source.

2.3.1 Programming Output Voltage with a 0-10Vdc Voltage Source

- Select remote voltage programming by moving the rear panel switch S1-5 (remote voltage program select) to the ON (closed) position.

  Or, connect J5 pin 7 (remote voltage program select) to J5 pin 6 (auxiliary ground). As these two control functions are wired in parallel, they function as a logic OR.

- Connect the voltage source between pin 17 (voltage program) and either pin 4 or pin 5 (program return).

- Vary the external voltage from 0-10Vdc to cause the power supply output to vary from 0-100% of rated output voltage. You may set the power supply's output current limit using another source or the front panel current limit control.

Note: Access the zero offset adjustment through the rear panel hole labelled OFFSET. Access the full scale calibration adjustment through the rear panel hole labelled RANGE. See **Figure 2.2-2**.

2.3 Remote Programming (continued)

2.3.2 Programming Output Voltage with a 0-10k Resistance

- Select remote voltage programming by moving the rear panel switch S1-5 (remote voltage program select) to the ON (closed) position.

  Or, connect J5 pin 7 (remote voltage program select) to J5 pin 6 (auxiliary ground). As these two control functions are wired in parallel, they function as a logic OR.

- Set rear panel switch S1-4 (resistive voltage program select) to the ON (closed) position.

- Connect a variable resistor between pin 17 (voltage program) and either pin 4 or pin 5 (program return).

- Adjust the resistance from 0-10kΩ to vary the power supply output from 0-100% of rated output voltage. You may set the power supply's output current limit using another source or the front panel current limit control.

2.3.3 Programming Output Current with a 0-10 Vdc Voltage Source

- Select remote current limit programming by moving the rear panel switch S1-3 (remote current program select) to the ON (closed) position.

  Or, connect J5 pin 8 (remote current program select) to J5 pin 6 (auxiliary ground). As these two control functions are wired in parallel, they function as a logic OR.

- Connect the voltage source between J5 pin 16 (current program, positive) and either pin 4 or pin 5 (program return).

- Vary the external voltage from 0-10Vdc to cause the power supply current limit to vary from 0-100% of rated output. You may set the power supply's output voltage using another source or the front panel voltage control.

Access the zero offset adjustment and full range scale adjustment through top cover slots as shown in **Figure 2.2-3**.

2.3.4 Programming Output Current with a 0-10k Resistance

- Select remote current programming by external resistance by moving the rear panel switch S1-3 (remote current program select) to the ON (closed) position.

  Or, connect J5 pin 8 (remote current program select) to J5 pin 6 (auxiliary ground). As these two control functions are wired in parallel, they function as a logic OR.

- Set rear panel switch S1-2 (resistive current program select) to the ON (closed) position.

- Connect a variable resistance between J5 pin 16 and either pin 4 or pin 5 (program return).

- Adjust the resistance from 0-10kΩ to vary the power supply current limit from 0-100% of rated output. You may set the power supply's output voltage using another source or the front panel voltage control.

2.3 Remote Programming (continued)

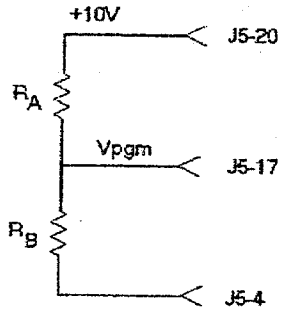
2.3.5 Programming with a Fixed +10V Reference

The APG Interface J5 connector provides a +10V reference output at pin 20 for applications which require a fixed output voltage and/or current limit. The current from this output must be less than 10mA.

To program output voltage:

- Connect resistor A between J5 connector pin 20 (+10V reference out) and pin 17 (voltage program).
- Connect resistor B between pin 17 (voltage program) and either pin 4 or 5 (program return).

To program current limit, follow the procedure used to set up for programming output voltage, substituting pin 16 (current program) for pin 17.



$$V_O = \frac{V_{OMAX} R_B}{R_A + R_B}$$

Where V_O = programmed output of power supply

V_{OMAX} = rated maximum output of power supply

$R_A + R_B \geq 1k$

Figure 2.3-1 Programming with a Fixed +10V Reference

2.4 Readback and Status Indicators

2.4.1 Voltage and Current Readback

Voltage Readback

- Connect a meter between J5 connector pin 19 (voltage readback) and either pin 4 or 5 (program return).

  Range: 0-10V = 0-100% full rated voltage output of power supply

Current Readback

- Connect a meter between J5 connector pin 18 (current readback) and either pin 4 or 5 (program return).

  Range: 0-10V = 0-100% full rated current output of power supply

Note: The voltage and current readback signals have adjustable offset and range. These adjustments are accessible from the top of the power supply (see **Figure 2.2-3**). The adjustments are independent of other power supply calibrations or adjustments such that M5A readback can be zero and range calibrated without affecting other power supply parameters.

2.4 Readback and Status Indicators (continued)

2.4.2 Operating Mode Status

- Connect voltmeter between J5 connector pin 9 (voltage/current limit mode indicator) and pin 6 (auxiliary ground).

  Voltage Mode: active low open collector

  Current Mode: high impedance open collector

2.4.3 Remote Programming Status

Remote programming status is available via J5 connector pins 7 (remote voltage program select) and 8 (remote current program select). Reference to J5 connector at either pin 4 or 5 (program return).

J5-7 LOW = Remote Voltage Program, HIGH=Local Front Panel Control

J5-8 LOW = Remote Current Program, HIGH=Local Front Panel Control

2.4.4 Output Fail Flag

The Output Fail Flag (J5 connector pin 21) signal is HIGH (open collector) when any one of the following conditions is true:

- AC input to the power supply is below operating limits.
- Over voltage protection is activated.
- TTL shutdown is active.
- Sense line protect circuit is active (excessive load line drop or load line(s) not connected or fuse(s) in power supply blown).

2.5 Overvoltage Protection (OVP)

The OVP circuit is designed to protect the load in the event of a remote programming error, incorrect voltage control adjustment, or power supply failure. The protection circuit monitors the output and reduces the output voltage and current to zero whenever a preset voltage limit is exceeded. A red LED on the front panel indicates when the OVP circuit has been activated. Set the OVP trip level at the front panel.

2.5.1 OVP Flag

When the OVP has been activated, a signal of nominal +10V through 10k will be present at pin J5-1. When no OVP condition exists, this signal will be 0V.

2.5 Overvoltage Protection (OVP) (continued)

2.5.2 Setting the OVP Trip Level

1. Turn the power supply OFF.
2. Insert a small, flat-bladed screwdriver through the OVP ADJ (OVP Adjust) hole in the front panel to turn the adjusting screw fully clockwise (one-turn screw).
3. Turn the unit ON and set the output to the desired trip voltage.
4. Slowly turn the adjusting screw counterclockwise until the red OVP indicator lamp lights.
5. Turn the POWER switch to OFF.
6. Turn the voltage control knob to minimum.
7. Turn the POWER switch back ON and increase the voltage to check that the power supply shuts off the output at the set voltage. Reference to J5 connector pin 6 (auxiliary ground).
8. Reset the OVP circuit after activation by removing the overvoltage condition and powering the unit OFF and back ON, or, by momentarily activating the TTL remote shut down circuit. See **Section 2.6** for information about shut down circuit operation.

2.6 TTL Shutdown

TTL Shutdown allows the output of the power supply to be disabled by a logic level signal. This input is optically isolated from the power supply output and will withstand a highpot test potential of 600Vac minimum. When TTL shutdown is activated, the front panel LED comes on.

- Connect the signal source between J5 connector pins 15 (TTL shutdown/positive) and 2 (TTL shutdown return/negative).
- Set rear panel switch S1-1 (TTL shutdown) to ON (closed) to obtain positive logic (high signal enables output). The factory-set default is switch OPEN for negative logic (high signal disables power supply output).

Switch SW1-1 Setting	TTL Signal Level	Output Condition
OPEN (Negative logic)	HIGH LOW	OFF ON
CLOSED (Positive logic)	HIGH LOW	ON OFF

Notes: Minimum activation signal required: 2V at 500μA
Maximum activation signal allowed : 25Vdc

SECTION 2. OPERATION (continued)

2.7 Tracking

For tracking +/- outputs, use the following set-up:

- Set slave unit rear panel switch S1-5 (remote voltage program select) and switch S1-6 (tracking select) to ON (closed).
- Connect master return (J5 connector pins 12, 13, or 24) to slave +OUT (J5 connector pins 10, 11, or 23).
- Connect master +OUT (J5 connector pins 10, 11, or 23) to slave voltage program input (J5 connector pin 17).

Notes:

1. Master/slave power supplies must have the same output ratings.

2. Set switch S2 on the slave unit's APG Interface PCB to the correct model number (factory preset). This requires that you remove the power supply cover.

3. Slave tracking can be calibrated by adjusting the unit's offset and range potentiometers. See **Section 2.2.4 Calibration Adjustment**

4. As the slave is referenced to the master's output, the noise and ripple on the slave may increase. In addition, if the master's output decreases due to current limit acting, the output voltage of the slave will follow.

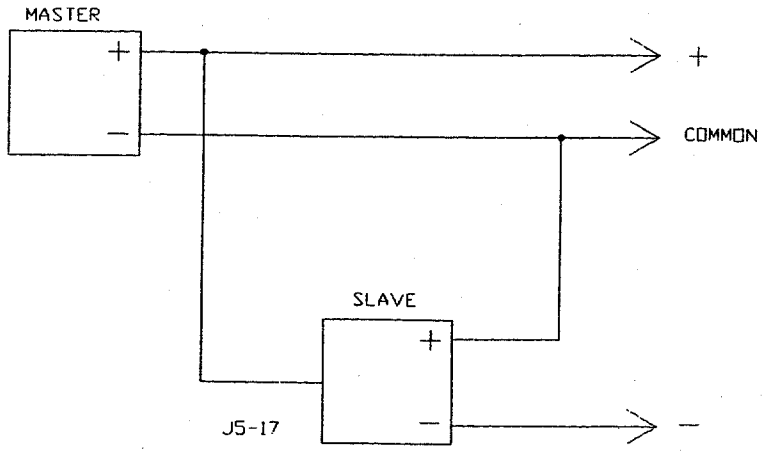


Figure 2.7-1 Master/Slave Tracking Configuration

SECTION 3. MAINTENANCE

3.1 Introduction

This section includes basic servicing and servicing safety notes, replacement parts lists, and the APG Interface schematic.

3.2 Periodic Service

No routine servicing of the APG Interface is required except for periodic cleaning. A vacuum or low pressure compressed air may be used to remove dust from in and around components on the printed circuit boards.

3.3 Servicing Precautions

Always disconnect power and discharge circuits before replacing components. Repairs must be made by experienced technical personnel only.

Use proper static control techniques to avoid damage to power supply front panel display drivers and other static-sensitive parts. Be sure to isolate the power supply from the input line with an isolation transformer when using grounded test equipment, such as an oscilloscope, in the primary circuit.

3.4 Replacement Parts

This section provides replacement parts lists for the APG Interface (Option M5A). Do not use substitute parts without first checking with the manufacturer's service department regarding their compatibility.

Note: When ordering replacement parts, please include the power supply model number and serial number in addition to the APG Interface part number and description.

3.4.1 APG Interface Common Parts

Circuit Designation	Description	Part #
C1, 20	10µF 25V Tantalum 20% 5.0mm	CJ-100F-25
C2, 3, 4, 5, 8, 10, 11, C13, 14, 16, 18, 24, 25, C26, 26B	0.1µF 50V X7R 10% 5.0mm Ceramic Radial Capacitor	CB-104F-06
C6, 9, 12, 15, 17, 19	1nF 100V X7R 10% 5.0mm Ceramic Radial Cap	CB-102F-16
C7	220pF 100V X7R 10% 5.0mm Ceramic Radial Cap	CB-221F-16
C23	2.2nF 100V X7R 10% 5.0mm Ceramic Radial Cap	CB-222F-16
C26A	10nF 100V X7R 10% 5.0mm Ceramic Radial Cap	CB-103F-16
CR1, 3, 10, 11, 19C, CR19D	1N4005 R D035 75V 300mA	CR-4005
CR2	1N4735A Zener D041 6.2V 1W	CR-4735-A
CR4, 5, 6, 7, 8, 9, 12, CR13, 14, 15, 16, 17, CR18, 19, 19A,19B, CR20, 22, 23	1N4148 UR D035 75V 300mA	CR-4148

Continued on next page.

3.4.1 APG Interface Common Parts (continued)

Circuit Designation	Description	Part #
F1	1/8A 125V Picofuse	F1-0012-F2
F2	7A Fast 125V 3AG	F1-0700-F
Mount J5 DSub to Subplate	DSub F/M Screwlock Assembly #4-40	MA-440D-FS
	25-pin Male DSub Connector Cable	MC-2500-D
J1, 2, 3, 4	#22 x 9, 3.5" Flat Cable Assembly	WA-0922-07
J5 Mount on PCB	25 pin Female R/A PCB Mount DSub	MC-2501-D
For F2	Fuseclip, 3AG Tin-Plate Brass PC Mount	MC-3001-FC
For F1	Socket, 0.25" Component Lead, 0.052 Mounting Hole	MC-5315-MS
For Mounting PCB Assy to Heatsink of Power Supply	Nylon Grommet #6 Screw 0.25" Square Hole	MI-4026-00
For Mounting Q10	#6 - 32 x 1/4" Kep Nut	MN-632K-08
For Shield Plate installation on PCB	1/4 x 1/4" Standoff, Snap-In	MR-618P-04
For Mounting Q10 and Subplate to Power Supply	#6 - 32 x 5/16" Philips Pan Zinc	MS-6P00-05
For Mounting PCB Assembly to Heatsink of Power Supply	#6 x 3/8" PPM Type A Zinc	MS-6P09-06
Bare PC Board Rev. -	M5A Analog Interface Card for XT/HPD	PC-M05A
Q1,2,9	XX2907A PB 60V .5mA 400mV TO92	QN-2907-A
Q7,8	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q10 Mount on PCB	2N6404 S 600V 16A TO 92	QJ-6404
R1,2	Trimpot 50k "P" 20 or 25 Turn 10% Rectangular	RC-5002-P9
R21,22,27,28,32,33		
R3,5,6,16,22A,38, R41,42,49,54	47.5k 1/4W 1% MF	R-4752-41
R4,7,37	2.49k 1/4W 1% MF	R-2491-41
R8,18,44-46,50,53	10k 1/4W 1% MF	R-1002-41
R9,23	5.23k 1/4W 1% MF	R-5231-41
R10,24	12.1k 1/4W 1% MF	R-1212-41
R11,26,27A,35,39,40	301k 1/4W 1% MF	R-3013-41
R12,25	1.20M 1/4W 1%	R-1204-41
R13	1.10M 1/4W 1%	R-1104-41
R14	121k 1/4W 1% MF	R-1213-41
R15	82.5k 1/4W 1% MF	R-8252-41
R17	20k 1/4W 1% MF	R-2002-41
R19,58	4.99k 1/4W 1% MF	R-4991-41
R20	Empty Position	R-EMPT
R27B,31A,52	100Ω 1/4W 1% MF	R-1000-41
R29	110k 1/4W 1% MF	R-1103-41
R30	100k 1/4W 1% MF	R-1003-41
R31,36	150k 1/4W 1% MF	R-1503-41

Continued on next page.

3.4.1 APG Interface Common Parts (continued)

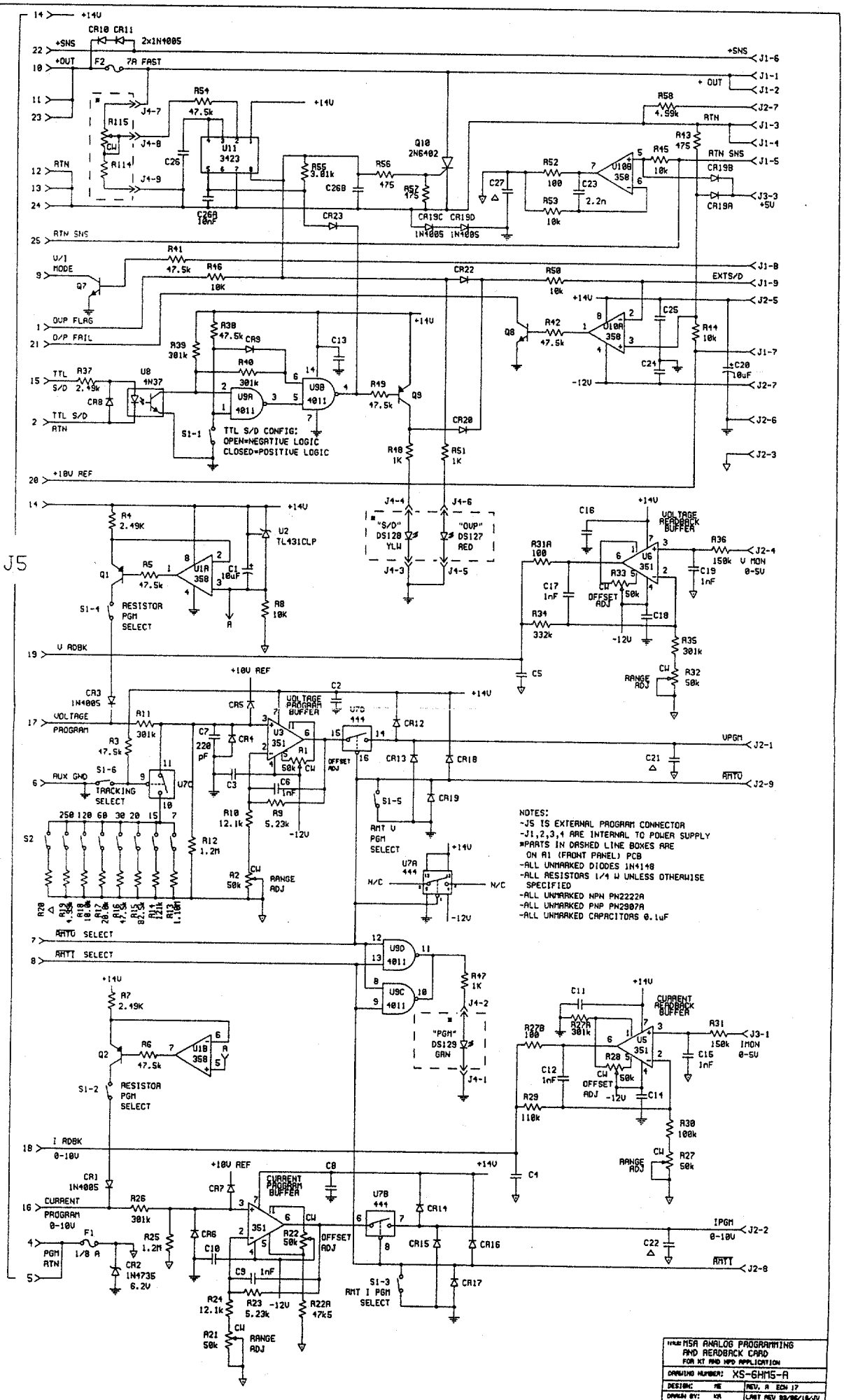
Circuit Designation	Description	Part #
R34	332k 1/4W 1% MF	R-3323-41
R43,56,57	475Ω 1/4W 1% MF	R-4750-41
R47,48,51	1k 1/4W 1% MF	R-1001-41
R55	3.01k 1/4W 1% MF	R-3011-41
Subplate mount to PCB	Subplate: M5A PLTD ST with Black Ink	SM-6HM5
Mount on PCB	M5A Shield Plate	SM-6HM5-SP
S1 and S2	8PST 5V 0.1A Piano Dip Switch	SW-8156-KA3
U1,10	8 pin DIP LM358 Dual Op Amp	UA-0358-N
U2	TL431CLP Adj Shunt Reg TO92	UR-0431-CP
U3,4,5,6	351 OP Amp, JFET Input	UA-0351-N
U7	16 pin MIL DG444 Quad SPST Analog SW	UI-D444-N
U8	6 pin DIP 4N37 Optocoupler	UP-4N37
U9	14 pin DIP 4011B Quad 2 Input NAND	UC-4011-BN
U11	8 pin DIP3423 OVP Control	US-3423-P

3.4.2 APG Interface Differential Parts for XT Series

Circuit Designation	Description	Part #
C21,22	Empty Position	C-EMPT
C27	0.1µF 50V X7R 10% 5.0mm Ceramic Radial Cap	CB-104F-06
	XT M5A Rear Output Wiring Assembly	WA-XT00-M5A

3.4.3 APG Interface Differential Parts for HPD Series

Circuit Designation	Description	Part #
C21,22,27	10µF 25V Tantalum 20% 2.5mm	CJ-100D-25
	HPD M5A Option Output Wiring Assembly	WA-3000-M5A



THIS INFORMATION IS SUBMITTED IN CONFIDENCE. THE INFORMATION CONVEYED BY THIS DOCUMENT IS NOT TO BE DISCLOSED TO ANY THIRD PARTY

TITLE: MSA ANALOG PROGRAMMING AND READBACK CARD FOR KT AND HPD APPLICATION	
DRAWING NUMBER: XS-6HMS-A	
DESIGN: ME	REV. A ECN 17
DRAWN BY: KR	LAST REV 89/06/16/JV
CHECKED:	RELEASE DATE:
APPROVED:	

K6HMSA.SCH