Symmetricom™

9611

Switching and Distribution Unit

Revision G

User's Guide

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9611
SWITCHING AND DISTRIBUTION UNIT

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CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION

The 9611 Switching and Distribution Unit (SDU) is a multipurpose instrument. While the primary purpose is selection and distribution of two signals, the unit may alternately be configured to distribute up to seven different signals or to monitor up to fourteen. This is accomplished by using architecture composed of two switching channels and twelve channels, which may be used as either inputs or outputs each with access to all the others.

Each of the channels will accommodate either logic or analog signals over the frequency range from DC to 10 MHz. All channels are monitored for loss of level or activity, with reporting both via local, and an RS-232 or RS-422 link, which may also be used for parameter set-up. All outputs are independently jumper selectable for analog or digital, either RS-232, open collector or low impedance (or optionally RS-485/RS-422 differential).

1.1 SPECIFICATIONS

1.1.1 AC POWER

- 85-264 VAC.
- 47-440 Hz.
- Less than 50VA.

1.2 SIGNAL INPUTS

- 0-6 Vp-p
- DC-10 MHz.
- Input impedance selectable 50 Ω or 1K Ω.
- Two channels, A and B, are dedicated as inputs and may be fail-safe configured. Twelve channels may be used as either inputs or outputs.
- Inputs may be analog or digital, around ground or positive.

1.3 ANALOG SIGNAL OUTPUTS

- 0-6 Vp-p (6 Vp-p unloaded or 3Vp-p matched into 50/600 Ω).
- DC-10 MHz.

Output Impedance Selectable

- Less than 10 Ω.
- 50 Ω.
- 600 Ω.

Note: If differential outputs are provided, output is via RS-485/RS-422 compatible drivers.

Gain

The 9611 SDU is designed to distribute signals with an overall gain of 1:1. Any internal amplification is only provided to compensate for termination.

If the input is on Input A or B and output on Channels 1 – 12, the maximum gain is x4. However, if the input signal has a source impedance of 50Ω, Input A or B should be terminated with 50Ω by internal jumper selection. This effectively cuts the input signal by ½, so the input amplifier stage needs to be adjusted for x2 to compensate. If the signal out (from the 9611) is input to a device with an input impedance of 50 Ω, the 9611 needs to be configured (by an internal jumper) to provide a source impedance of 50 Ω. This effectively cuts the output signal by ½, so the output amplifier stage needs to be adjusted (by an internal jumper) for x2 to compensate. Hence, there is only a 1:1 gain, input to output. The same is true for an output source impedance of 600 Ω input to a device with an input impedance of 600 Ω.

The same scenario as above occurs if the input is on one channel and the output is on another channel. The only difference is that the input amplifier is automatically configured for a gain of x2 when 50 Ω input impedance is selected (i.e. no jumper required).

Distortion

Total harmonic at 10M~, 3 Vp-p into 50 Ω.

- Less than 0.5%.
- Spurs less than 60 dBc above 1Khz.

Phase Noise (-dBVrms/√Hz)

At 10Mhz, 3 Vp-p into 50 Ω when using channel A or B as input.

- Less than 102 at 1 Hz.
- Less than 125 at 10 Hz.
- Less than 140 at 100 Hz.
- Less than 145 at 1 Khz.
- Less than 150 at 10 Khz.
- Less than 150 at 100 Khz.
- Spurs less than -120 dB at 1 Khz.

Crosstalk

- Channel B into channel A, at 10Mhz less than 40 dB.

Reverse Isolation

- Channel one through twelve to other channels one through twelve at 10Mhz, less than 60 dB.
- Short circuit (to ground) protected.

1.4 DIGITAL SIGNAL OUTPUTS

- RS-232 (bipolar) or open collector (50V, 200mA).
- Short circuit (to ground) protected.

1.5 CONTROL INPUTS/OUTPUTS

1.5.1 FORCE B

This is an input to J4, the daisy chain connector. It is a normally high TTL/CMOS compatible line which, if pulled to ground, forces Channel B to be selected, overriding any selection made by the front panel or remote I/O.

1.5.2 REMOTE I/O

J5 provides for serial control of the SDU. It includes an RS-232 and an RS-422 serial port. Only one of these may be used, selected by the user's cable wiring and a jumper. These ports are electrically compliant with their respective specification. Electrical handshaking is not supported; software handshaking is provided by the communication protocol. Loss thresholds and activity time-out for each channel can be independently programmed. Threshold range is 0.1 volt to 2.5 volts peak. Activity time-out range is 300 nanoseconds to 25,300 seconds.

1.5.3 DAISY CHAIN

This unit provides the capability to control up to thirty-two SDU's from one serial port. Each SDU must be assigned a unique address using internal switches (See Chapter Four – Installation – Switches). J4 from an upstream (closer to the PC) unit is pin to pin cabled to J5 of the next unit in the daisy chain. This connector also includes the alarm bus, which is a relay closure to ground *or* tied between all SDU's.

1.6 CONTROLS

- Push-button switches (A, Auto, and B) on the front panel may be used to select Channel A, Channel B, or auto-transfer for the on-line signal.
- A push-button (Reset) is provided to permit local reset of an alarm condition and can also be used to silence the audible alarm. See Chapter Three – Operation.
- A toggle switch (located in rear panel cutout J1) is used to control power to the unit.

1.7 INDICATORS

- A green LED (Power) on the front panel is used to signify application of power to the SDU.
- A red/green LED (Alarm) on the front panel is used to signify presence/absence of an alarm condition. The alarm will blink orange/red or orange/green (depending on the alarm condition) if the audible alarm has previously been silenced. See Chapter Three – Operation.
- Three amber LED's on the front panel, above the A, Auto, and B pushbuttons, are used to signify which of the operating modes (A, B, or Auto) has been selected.
- Two red/green LED's on the front panel, adjacent to the A and B pushbuttons, are used to indicate the status (alarmed/normal) of channels A and B.
- Twelve red/green LED's on the front panel are used to indicate the status (alarmed/normal) of Channels One through Twelve.

1.8 CONNECTORS

- All connectors are located on the rear panel of the SDU.
- J1, the power input connector, is an IEC three pin male.
- J2 and J3, Channel A and B input connectors and Channels One through Twelve input or output connections are provided by BNCs.

  Note: If optional differential outputs are provided, Channels One through Twelve are provided by concentric twinax/triax connectors, Trompeter P/N CBBJR79A. The suggested mating connector is Trompeter P/N PL75-9 or PL75C-213 (crimp type). The suggested twinax cable is Trompeter P/N TWC-78-2 (or equivalent) that @500MHz has a loss of 16dB per 100 feet.

- J5, a nine pin miniature "D" connector is provided for the remote control serial interface.
- J4, a nine pin miniature "D" connector is provided for the daisy chain interface.
- A ground stud is furnished to provide earth ground to the chassis.

Table One

Connector Pin	J5 Signal	Connector Pin	J4 Signal
1	RXD422-	1	DT422-
2	RXD (232)	2	Not Used
3	TXD (232)	3	Not Used
4	TX422+	4	DR422+
5	GND	5	GND
6	RXD422+	6	DT422+
7	TX422-	7	DR422-
8	Not Used	8	FORCBN
9	ALARM*	9	ALARM*

* ALARM signal is ground true.

1.9 ENVIRONMENT

- **Temperature**
  0^o-50^oC operating, -40^o to +70^oC storage.

- **Humidity**
  10% to 90%, non-condensing operating, 5% to 95%, non-condensing storage.

- **Altitude**
  0-25,000 feet operating, 0-40,000 feet storage.

1.10 SIZE AND CONFIGURATION

- **Chassis**
  1¾" H, 19" W, 13" D.

- **Mounting**
  Standard nineteen inch equipment cabinet.

CHAPTER TWO
INSTALLATION

2.0 INSTALLATION

2.1 INTRODUCTION

This section provides an installation procedure for the 9611 Switching and Distribution Unit.

2.2 INSTALLATION PROCEDURE

Upon receiving the 9611, make a thorough inspection of the instrument and its accessories. Any damage or loss of equipment should be reported immediately to the responsible carrier. If no damage is found, install the unit as outlined in the following steps.

- Before shipping, the unit was configured for its anticipated use.

- If no configuration was specified, the default configuration is:

    1. Inputs A and B, 50 Ω termination, analog signal output, logic threshold at 2.5 Volts

    2. Outputs one through twelve; selected signal output, 50 Ω output impedance, output gain of two, logic threshold at 5 Volts, analog signal output.

All channel loss thresholds, 0.5V peak.

A & B channel timeouts, ten milliseconds times 150 (1.5 seconds).

All other channel timeouts, ten milliseconds times 153 (1.53 seconds).

- Unit address, 00.

- Baud rate, 4,800.

- Default configuration: 8 bits, no parity, and 1 stop bit.

- Master/slave-232/422, master-232.

***Note:* If the user wishes to make any changes, this can most conveniently be done before installation.**

- Remove the screws securing the top cover. Remove the top cover.

Jumpers

Refer to Chapter Three – Operation and Figure 2b for jumper installation guidance.

Switches

See Figure 2a for switch selection guidance. Switches one through five are used for address selection. Off switches (left position) determine the address; figure 2a shows zero selected.

Note: **The address number must be selected, because this number is used when issuing the I/O commands listed in Appendix A.**

- Switches six and seven select the baud rate for serial communication.

Table One

BD0	BD1	BAUD
0	0	4,800
1	0	9,600
0	1	19,200
1	1	38,400 (Both switches off.)

- Switches eight and nine select the parity for serial communication.

Table Two

PAR0	PAR1	PARITY
0	0	None.
1	0	Even.
0	1	Odd.
1	1	None. (Both switches off.)

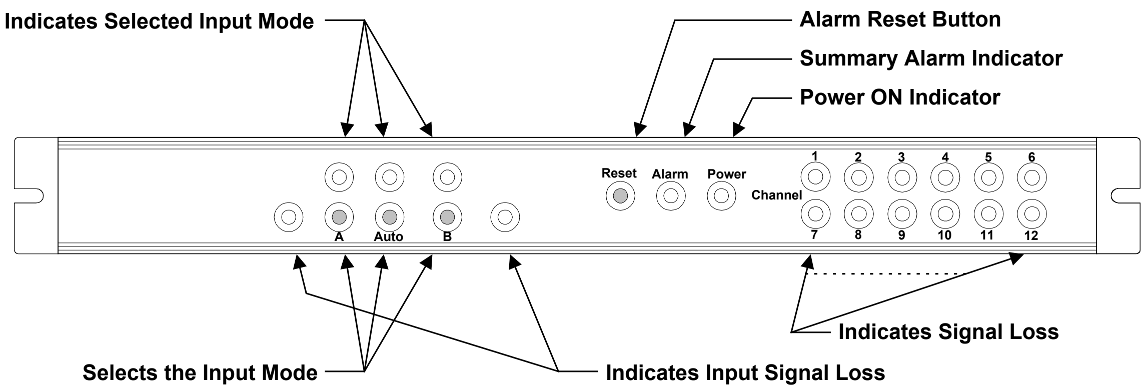
- If using the daisy chain capability, be sure the new unit has a unique address.
- Replace the top cover. Replace the screws securing the top cover.
- Connect the primary power source to the power-input connector on the rear panel of the unit.
- Make appropriate connections to the unit's input and output connectors.
- If desired, thresholds and repetition rates for alarm detection can be modified by use of an appropriate serial communication program and a PC.
- The unit is now ready for application of power and operation.

CHAPTER THREE
OPERATION

3.0 OPERATION

Front Panel Controls and Indicators
This section describes operation of the manual controls on the front panel of the 9611 Switching and Distribution Unit (SDU).

Figure 1
Controls and Indicators



The power indicator is a green LED that indicates that AC power is applied and turned on.

The 9611 will process two signal inputs (A and B) and will automatically switch from A (primary) to B (secondary) in the event that A fails. There are three pushbuttons (A, Auto, and B) that allow the input mode to be selected. Pressing A or B will force the selected input to be sent to all channels that are jumpered to use the "Selected Input." Pressing Auto will activate the automatic switchover mode. A yellow LED above one of the three pushbuttons will be turned on to indicate the selected mode. To the left of the A button and to the right of the B button are LED indicators that are green if the signal is present and active, and red if the signal has failed.

Each of the twelve channels can be programmed by jumpers to function either as an input channel or as an output channel. In either case, the twelve LED's numbered one through twelve are either green to indicate that the channel signal is present and active, or red to indicate that the channel signal has failed.

When any alarm (A, B or 1-12) is set, the Alarm indicator turns from green (normal) to red (alarm) and the audible alarm is activated. Once the failure is remedied, pressing the Reset button deactivates all alarm indicators, returning them to the normal green color.

NOTE: When the unit is powered down in an alarm condition. Then re-powered with the condition fixed, the alarm is still reported. This is normal operation. The unit will "remember" status at power down and report it when the power is restored.

While maintenance is in progress, the audible alarm can be silenced by one of two methods:

<u>Method One:</u> Issue a control (Clear Alarm) via the serial Master I/O port (see Appendix A).

<u>Method Two:</u> Hold down the front panel Reset push button for approximately three seconds or until the Alarm indicator starts to blink. In this mode (without the audible alarm), if the alarm blinks orange and then red, the alarm condition still exists. If the alarm blinks orange and then green, there is not an alarm condition. To turn on the audible alarm in this mode, hold down the Reset push button until the Alarm indicator stops blinking. Cycling primary power will always re-enable the alarm.

When the failure of Channel A input has caused an automatic switch over to Channel B, after the failure has been remedied, press the Reset button to clear the alarm condition.

Please refer to Appendix A for remote operation via the serial Master I/O port.

Internal Jumpers and Switches

When the top cover of the 9611 is removed the operator is faced with a bewildering array of jumper pins. Please do not let this be discouraging. It is really not as complicated as it would seem at first glance. Please refer to Figure 2a and Figure 2b for the following discussion.

P3 – Used to select either RS-232 or RS-422 signal levels for the serial Master I/O port (J5). This jumper is defaulted (factory selected) to RS-232.

The "daisy chain" port (J4) is used to interconnect multiple 9611 units. If two or more 9611's are used, connect the computer to J5 of the first unit. Next, connect J4 of the first unit to J5 of the second unit, and so on until all units are connected. Up to thirty-two 9611's can be interconnected in this way and controlled via a single serial port on the computer.

Jumpers P4, P5, P6, P7, P8, and P9 are used to configure the automatically switched inputs (A and B). Figure 2a illustrates these jumpers and indicates the default settings that are shipped from the factory.

P4 – Used to configure Input B to accept either an analog or digital input. Factory default is the analog input.

P5 – Used to configure Input A to accept either an analog or digital input. Factory default is the analog input.

P6 - Used to select the slice level for the logic level converter on the B input.

P7 - Used to select the slice level for the logic level converter on the A input.

NOTE: Each input is routed to an input of a voltage comparator (the logic level converter). The other input of this voltage comparator is connected to a DC reference (either ground or a voltage derived from a DAC-digital to analog covverter). When the input crosses over this DC reference (the "slice" level), the comparator changes output states. Selecting ground reference uses ground as the signal threshold and triggers the comparator as the input signal crosses zero volts (ground) thereby creating a square wave when the input is sinusoidal. These jumpers are defaulted to the DAC reference providing a quieter system in the case where analog signals are being used. Selecting DAC reference uses a voltage that is programmed to a digital-to-analog converter via the serial master I/O port rather than ground. Use the DAC reference for digital inputs. DAC 13 is the reference for Input A and DAC 14 is for Input B.

DAC 15 and DAC 16 set the threshold levels for the loss time-out circuitry. This is the time period between when the input is lost and the actual alarm is activated. This amount of time can be selected (programmed) via the RS-232 (or RS-485) I/O – See Appendix A.

P8 and P9 - Are used to select the input impedance of the A and B signal inputs. Either 50Ω or 1KΩ can be selected. The default (factory) setting is 50Ω.

R34 – Channel Input B has a gain of 2, however this potentiometer can be used to optimize the signal level in this channel.

R37 – Channel Input A has a gain of 2, however this potentiometer can be used to optimize the signal level in this channel.

P001 and P002 - Associated with input/output Channel 1, thus P601 and P602 are associated with I/O Channel 7. The programming of all twelve channels is identical, so a discussion of jumpers for Channel 1 follows. Refer to Figure 2b.

The twelve input/output channels can be individually jumpered for use as either an input channel or an output channel. If the channel is an output, then a jumper is placed to select the source of its signal. If the channel is used as an input, then it is necessary to select the signal mode (either analog or digital) and the signal slicer level (either ground or +1.4V). Disable the slicer when a channel is used for output.

P001 has twenty-five locations for jumpers, but normally only two or three jumpers are required. If the channel is being used as an input, then the top two jumpers select either the analog or digital signal mode, and the bottom jumper is ON to use ground as the slicer reference or OFF to use +1.4V as a reference. If the channel is used as an output, install a jumper in the next to last position to disable the slicer.

The third jumper from the top chooses the selected input from the A and B inputs. If the channel is being used as input, then these jumpers (one and two) should not be installed. If there is input only on the A input, then this jumper will select that signal. The fifth jumper from the top chooses the B input, regardless of the automatic selection.

The jumpers marked “Channel 1” through “Channel 12” are used if you are using one of the twelve numbered channels as input. For example, if Channel 4 is used as a signal input, and you wish to select it as an output via this channel, then you would place a jumper on “Channel 4.”

Jumpers labeled Spare, E_x, E_y, -12V, +12V, GND and +5V are provided for future designs. They have no function in this product.

<u>Example:</u>

Scenario: You have two 10MHz sine wave 50· sources and you wish to distribute them to three users and provide dual redundancy (i.e. if one 10MHz source is lost, automatically switch to the other source). Refer to Drawing 22226, sheets 4 and 6-8.

On the back of the 9611, connect one of the two 10MHz inputs to Input A J2 and the other to Input B J3. The three outputs can be connected to Input/Output Channels 1, 2, and 3.

Install the following internal jumpers:

P9 1 and 2	Selects 50· input impedance for Input A.
P8 1 and 2	Selects 50· input impedance for Input B.
P5 3 and 4	Selects the analog signal from Input A to be routed through.
P4 3 and 4	Selects the analog signal from Input B to be routed through.
P7 and P6	(Don’t care).

For jumper locations P001, P101, and P201, install <u>only</u> the following jumpers:
P001 5 to 6 P101 5 to 6 P201 5 to 6

For jumper locations P002, P102, and P202, install <u>only</u> the following jumpers:
P002 7 to 8 P102 7 to 8 P202 7 to 8 (for 50· output impedance)

Program DAC 1 (Channel 1), DAC 2 (Channel 2), and DAC 3 (Channel 3) for the appropriate DC values to detect loss of output signal.

Adjust R37 (Input A) and R34 (Input B) for the appropriate output at Channel 1, 2, or 3 when terminated into 50·.

Figure 2a
Switch and Jumper Settings

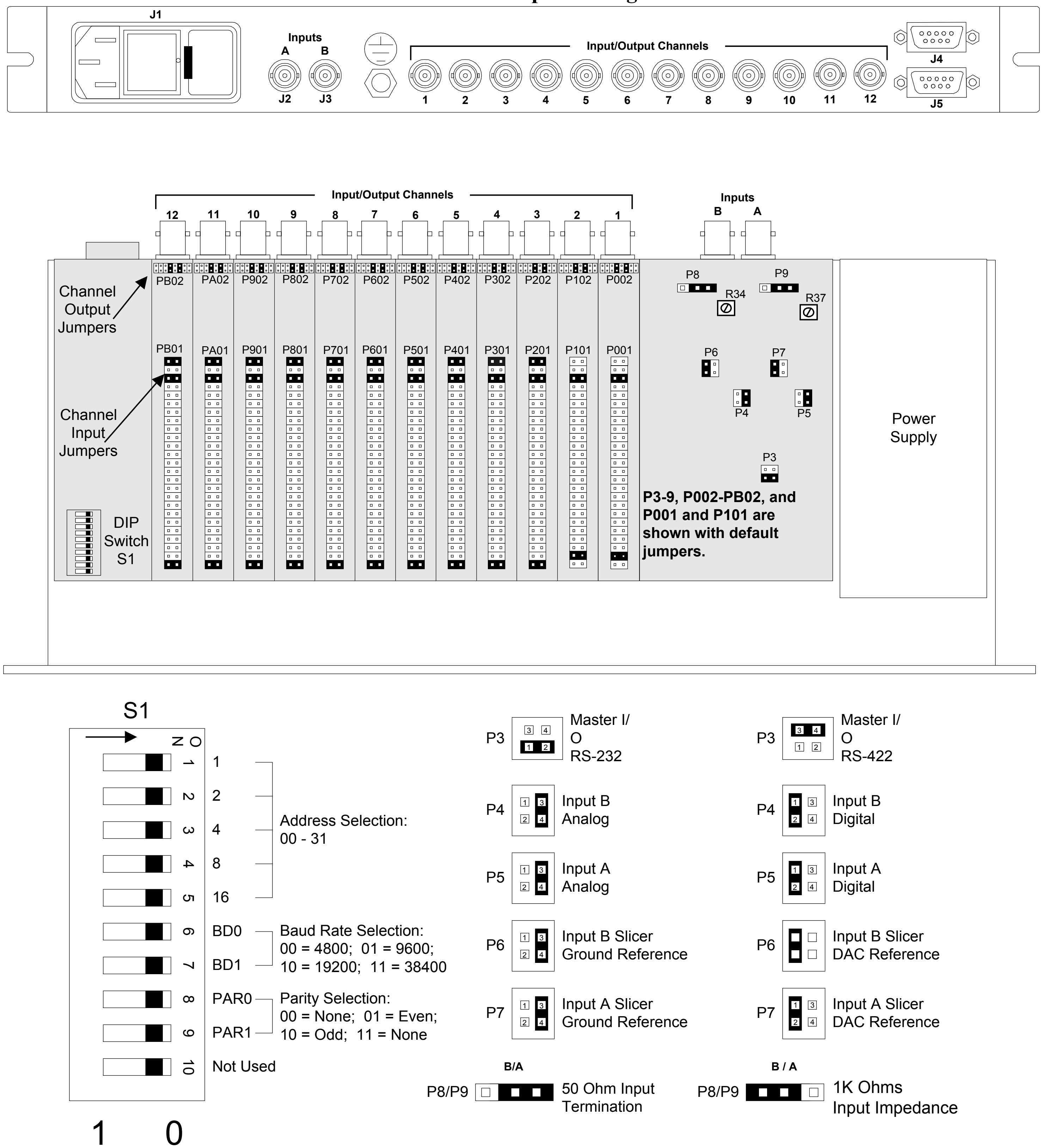
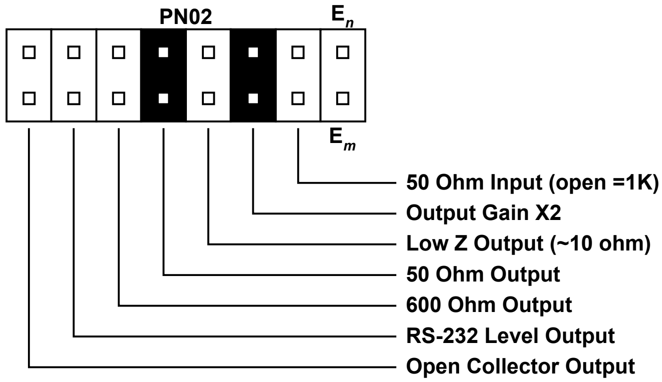
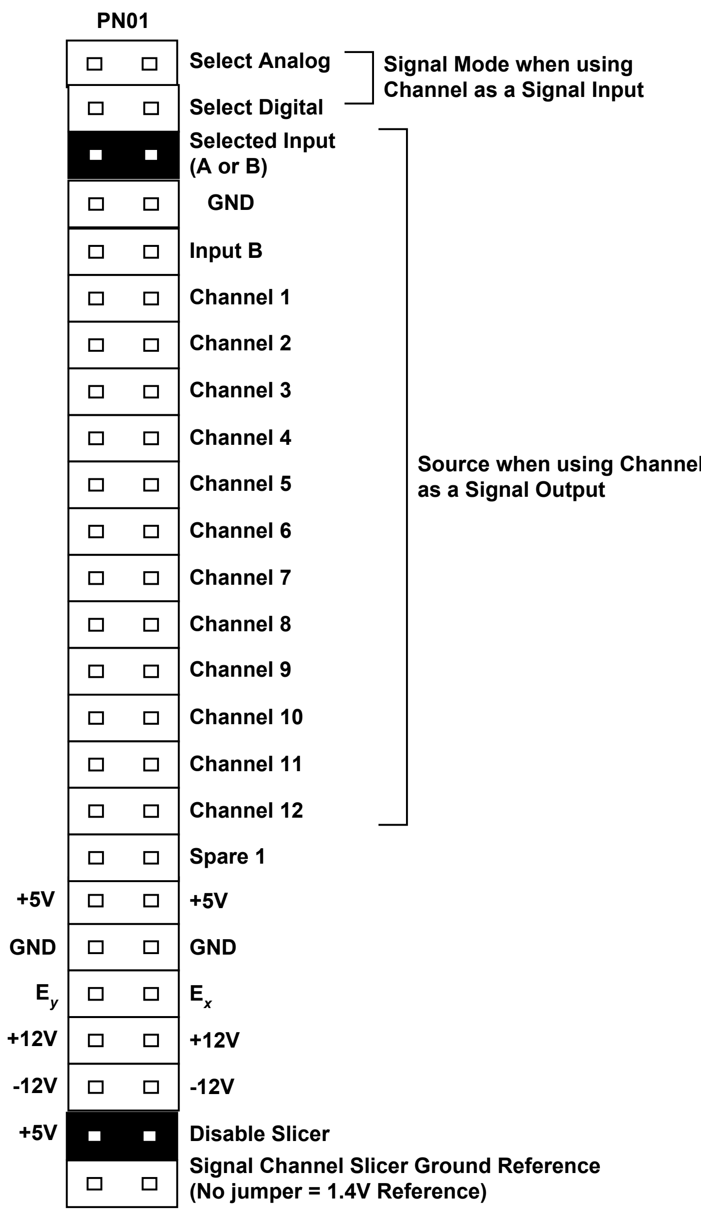


Figure 2b
Switch and Jumper Settings





PN02 configures the input/output signal type for the channel. Starting on the right end (viewed from the rear of the unit) of the jumper row, the following explains each jumper.

Open Collector Output is selected only when the channel is used as a digital output channel. The output circuit swings between ground and a positive voltage that is furnished externally through a load resistor. Any voltage up to 50 V in series with a resistor with a value that will limit current to 200 mA can be used.

RS-232 Level Output is selected only when the channel is used as a digital output channel. The output circuit swings between –12V and +12V (RS-232 signal levels).

600 Ω Output is suitable for either analog or digital outputs. This setting is usually selected for compatibility with telephone lines with a characteristic 600 Ω impedance.

50 Ω Output is suitable for either analog or digital outputs. This setting is usually selected for high frequency signals that must be matched to a 50 Ω load to minimize signal distortion.

Low Z Output (<10 Ω) is suitable for either analog or digital outputs. This setting is usually selected for low to medium frequency signals that may have to drive a long cable length, be connected in parallel to multiple loads, or that otherwise may be connected to a low resistance load.

Output Gain X2 doubles the gain of the output buffer amplifier, which is normally set to unity gain. This jumper is used in cases where output impedance matching halves the gain.

NOTE: No output jumpers should be installed when the channel is used as an input.

3.1 THEORY OF OPERATION

The following Theory of Operation discusses an input into Input A, and Channel 1 used as an output from Input A, and then as an input to another channel. And specifically, how all of this pertains to the operation. Reference Schematic Drawing 22226, Sheets 4 and 6 of 17, in Chapter Five.

The purpose of the 9611 SDU is to distribute signals on a 1:1 basis, i.e. not to be used as a signal amplifier. Any internal amplification is provided only to insure that the output signal amplitude matches that of the input.

Signal Input on Input A and Output on Channel 1:

The purpose of operational amplifier (op amp) U12 (connected to Input A BNC J2) is to provide the same signal amplitude out of it as what was on the input BNC. It has a nominal gain of x2 which can be adjusted from 0 to x2 by potentiometer (pot) R37. Clockwise rotation of this pot increases the gain.

If the source impedance of the signal connected to J2 is 50 ohms, install jumper P9 (pins 1&2) for proper impedance matching. The result of this reduces the input amplitude by ½, so the input amplifier has to be changed by x2 to compensate.

The output of U12 (ANA-A) is connected to the input of two voltage comparators (1/2 each of U10). The purpose of the first comparator (U10 pins 6,5, and 2) is to convert an analog input signal to a logic level output (LOG-A). The other input to this comparator is connected to jumper block P7. If the input signal analog, around ground, and you want to convert it to a digital output, connect P7 pins 3 and 4 (ground). If the input is a sine wave and the output (from the 9611) is intended to be a sine wave, connect P7 pins 1 and 2 (DAC13). Adjust the DAC input to maximum (see Appendix A – "ST" peak threshold setting). This hopefully will prevent the comparator from switching and putting the digital switching noise in the analog output. If the input is digital, connect P7 pins 1 and 2 (DAC13) and adjust the DAC input to ½ of the maximum digital amplitude.

The second voltage comparator (U10 pins 11, 12, and 15) is used for loss detection. It compares the input signal to the voltage level DAC15. This loss threshold can be adjusted (see Appendix A – "PT" peak level threshold). If the input amplitude drops below the DAC15 voltage level, the output of the comparator (ITTLA) stops toggling which activates the alarm circuitry.

The output of the input amplifier (ANA-A) and the output of the voltage comparator (LOG-A) both go to jumper block P5. If the desired output is an analog signal (and the input to the 9611 is a sine wave), jumper P5 pins 3&4. If the desired output is a digital, rectangular wave, jumper P5 pins 1&2.

The output of the P5 jumper block (SIGA) goes to a 2:1 multiplexer U8. The output of this multiplexer that selects between SIGA and the signal from Input B goes through a buffer (U19) and becomes the signal SIGSEL. This becomes one of 15 inputs to jumper block P001 (Schematic 22226 Sheet 6 of 17). The output of this jumper block (P001) becomes the input to buffer/amplifier U002. The signal then goes through jumper block P002 and is then output on Channel 1 BNC J001(or twinax connector J001 if optional, differential outputs have been provided).

Where the jumpers are installed in P002 and whether op amp U002 is configured as a buffer (gain 1:1) or an amplifier (gain 2:1) depends on what is the desired signal output impedance on J001. If the desired output impedance is 50 ohms, jumper P002 pins 7&8. If the desired output impedance is 600 ohms, jumper P002 pins 5&6. In either of these two cases, configure op amp U002 as a amplifier (gain 2:1) by connecting jumper P002 pins 11&12. This assumes that the output signal (J001) is connected to equipment having an input impedance of 50 or 600 ohms. The output signal amplitude would be reduced by ½, hence the need to amplify it by x2 first.

If the desired output impedance is 0 ohms, jumper P002 pins 9&10 and don't connect (remove) P002 pins 11&12. This will make the output amplifier (U002) a buffer with a gain of 1:1.

The output signal is monitored for loss (or reduction in amplitude). The output signal on J001 goes through input amplifier U003 and the output of this amplifier (ANA1) goes to the input of voltage comparator U001 (pins 11, 12, and 15). The output of this comparator (ITTL1) goes to alarm circuitry for notification of loss of output signal. It compares the input signal to the voltage level DAC1. This loss threshold can be adjusted (see Appendix A – "PT" peak level threshold).

Signal Input on Channel 1 and Output on Channel 2:

Input amplifier U003 can be configured as a buffer (gain of 1:1) or an amplifier (gain 2:1) using jumper block P002 pins 13&14. If the source impedance of the signal connected to J001 is 50 ohms, install jumper P002 (pins 13&14) for proper impedance matching. The result of this reduces the input amplitude by ½, so the input amplifier (U003) will automatically be configured as a gain of x2 to compensate. If the source impedance of the input signal isn't 50 ohms, remove jumper P002 (pins 13&14) and the input amplifier (U003) will automatically be configured as a buffer with a gain of x1.

The output of U003 (ANA1) is connected to the input of two voltage comparators (1/2 each of U001). The purpose of the first comparator (U001 pins 6,5, and 2) is to convert an analog input signal to a logic level output (LOG1). The other input to this comparator is connected to jumper block P001. If the input signal is analog, around ground, and you want to convert it to a digital output, connect P001 pins 49&50 (ground). If the input is a sine wave and the output (from the 9611) is intended to be a sine wave, connect P001 pins 47&48 (+5V). This will prevent the comparator from switching and putting the digital switching noise in the analog output. If the input is digital (TTL levels), don't connect either jumper P001 pins 47&48 nor P001 pins 49&50. The comparator will use the 1.4V as its comparison input.

The second voltage comparator (U001 pins 11, 12, and 15) is used for loss detection. It compares the input signal to the voltage level DAC1. This loss threshold can be adjusted (see Appendix A – "PT" peak level threshold). If the input amplitude drops below the DAC1 voltage level, the output of the comparator (ITTL1) stops toggling which activates the alarm circuitry.

The output of the input amplifier (ANA1) and the output of the voltage comparator (LOG1) both go to jumper block P001. If the desired output is an analog signal (and the input to the 9611 is a sine wave), jumper P001 pins 1&2. If the desired output is a digital, rectangular wave, jumper P001 pins 3&4.

The output of the P001 jumper block (SIG1) becomes one of 16 inputs to jumper block P101 (Schematic 22226 Sheet 7 of 17). The output of this jumper block (P101) becomes the input to buffer/amplifier U102. The signal then goes through jumper block P102 and is then output on Channel 2 BNC J002 (or twinax connector J001 if optional, differential outputs have been provided).

Where the jumpers are installed in P102 and whether op amp U102 is configured as a buffer (gain 1:1) or an amplifier (gain 2:1) depends on what is the desired signal output impedance on J002. If the desired output impedance is 50 ohms, jumper P102 pins 7&8. If the desired output impedance is 600 ohms, jumper P102 pins 5&6. In either of these two cases, configure op amp U102 as a amplifier (gain 2:1) by connecting jumper P102 pins 11&12. This assumes that the output signal (J002) is connected to equipment having an input impedance of 50 or 600 ohms. The output signal amplitude would be reduced by ½, hence the need to amplify it by x2 first.

If the desired output impedance is 0 ohms, jumper P102 pins 9&10 and don't connect (remove) P102 pins 11&12. This will make the output amplifier (U102) a buffer with a gain of 1:1.

The output signal is monitored for loss (or reduction in amplitude). The output signal on J002 goes through input amplifier U103 and the output of this amplifier (ANA2) goes to the input of voltage comparator U101 (pins 11, 12, and 15). The output of this comparator (ITTL2) goes to alarm circuitry for notification of loss of output signal. It compares the input signal to the voltage level DAC2. This loss threshold can be adjusted (see Appendix A – "PT" peak level threshold).

APPENDIX A

COMMUNICATION PROTOCOL

A.0 GENERAL

Communication with the 9611 may be either RS-232 or RS-485 (or RS-422). All communication in either direction is ASCII characters. There are two types of commands; controls settings and requests for status. All command strings begin with the dollar sign ($ = HEX "24") followed by a two character address (A#) (from 00 to 31), then the command and ending with carriage return (CR = HEX "0D") and line feed (LF = HEX "0A"). The command itself is a letter that may be followed by more characters, depending upon the type of command that is being generated.

A.1 COMMANDS

There are eighteen commands; ten controls and eight requests for information.

Command Description	Command Character
Enable Audio Alarm	"A"
Clear Alarm	"C"
Select Input	"I"
Setup Channel	"H"
Save Data	"S"
Request Unit Status	"T"
Request Firmware Version	"V"
Request Serial Number	"N"
Password Protect	"P"
Keypad	"K"

NOTE: In the following descriptions, command strings are shown with commas separating the fields within the command. These commas are provided in this document for purposes of clarity only. The actual commands and responses do not include commas. Upper case characters must be used.

In the following examples, the unit's address (A#) is assumed to be 00.

A.1.1 ENABLE AUDIO ALARM

$,A#,A,N,CR,LF

Enables the audio alarm. The alarm will sound at any time that any signal fault is being indicated on the front panel.

Example: $, 00, A, N, CR, LF
(HEX 24), 00, (HEX 41), (HEX 4E), (HEX 0D), (HEX 0A)

$,A#,A,F,CR,LF

Disables the audio alarm. The visual alarm indicators on the front panel will continue to indicate an alarm. Upon cycling of primary power, the alarm is automatically enabled.

Example: $, 00, A, F, CR, LF
(HEX 24), 00, (HEX 41), (HEX 46), (HEX 0D), (HEX 0A)

A.1.2 CLEAR ALARM

$,A#,C,CR,LF

Clears both the visual and audio alarm. If the alarm condition persists, the alarm will be reasserted. If the audio alarm has been disabled by a previous command, only the visual alarm will be reasserted.

Example: $, 00, C, CR, LF
(HEX 24), 00, (HEX 43), (HEX 0D), (HEX 0A)

A.1.3 SELECT INPUT

$,A#,I,U,CR,LF

Select the Auto mode in which input A is the primary input and B is the secondary input. Switching to B will occur automatically if A should fail.

Example: $, 00, I, U, CR, LF
(HEX 24), 00, (HEX 49), (HEX 55), (HEX 0D), (HEX 0A)

$,A#,I,A,CR,LF

Force selection of Input A. Failure of the signal input to A will not cause an automatic switchover.

Example: $, 00, I, A, CR, LF
(HEX 24), 00, (HEX 49), (HEX 41), (HEX 0D), (HEX 0A)

$,A#,I,B,CR,LF

Force selection of Input B.

Example: $, 00, I, B, CR, LF
(HEX 24), 00, (HEX 49), (HEX 42), (HEX 0D), (HEX 0A)

A.1.4 SETUP CHANNEL

The Setup Channel always has four parts, and optionally five parts.

$,A#,H,CH,…

The “CH” field is the channel number being controlled. Channels A and B are “0A” and “0B” respectively. The twelve Input/Output channels are “01” through “12.”

$,A#,H,CH,PT…

“PT” is the peak DC level threshold for the activity detector that analyzes the signal input to or output from the channel. This peak DC level is produced by a DAC (Digital to Analog Converter) referenced in previous chapters. There is an individual DAC for each channel as shown in Table A1 below and on Schematic 22226 in Chapter Five. The value is a two-digit number from 01 to 25, representing 0.1 V to 2.5 V. The channel signal must cross this voltage threshold to trigger the activity detector. Otherwise, a signal loss is reported.

Table A1

CHANNEL	DAC NO.
Input A	DAC 15
Input B	DAC 16
1	DAC 1
2	DAC 2
3	DAC 3
4	DAC 4
5	DAC 5
6	DAC 6
7	DAC 7
8	DAC 8
9	DAC 9
10	DAC 10
11	DAC 11
12	DAC 12

$,A#,H,CH,PT,T…

"T" is the base time that is multiplied by the multiplier (below). The product of the base time and the multiplier is the time period that represents the loss of a signal if no activity is detected over this period. The base time is a one digit number representing one-hundred nanoseconds through one-hundred seconds. The definition is Base Time = $1X10^{-(7+T)}$ seconds.

0 = 100 nanoseconds	5 = 10 milliseconds
1 = 1 microsecond	6 = 100 milliseconds
2 = 10 microseconds	7 = 1 second
3 = 100 microseconds	8 = 10 seconds
4 = 1 millisecond	9 = 100 seconds

$,A#,H,CH,PT,T,M…

"M" is a three digit ASCII numeric string that is the multiplier of the base time (above). The value is in the range of 0 to 253. Any base time may be multiplied by any multiplier value to produce a time period for the activity detector.

NOTE: For best accuracy, the multiplier (M) should be as high as possible. For example, if a time period of 13 milliseconds is desired, use T=3 (100 microseconds) and M=130 rather than T=4 (1 milliseconds) and M=13.

NOTE: A multiplier value of zero will disable the channel. All unused channels must be disabled by setting their multipliers to zero. An unused channel that is not disabled may report a false signal failure.

$,A#,H,CH,PT,T,M,ST…

"ST" is a slicing threshold setting for Channel A (0A) or Channel B (0B) if the jumper has not be used to select a ground level for threshold slicing. This is applicable when the optional analog-to-digital conversion feature has been selected. This DC slicing level is produced by a DAC (Digital to Analog Converter) referenced in previous chapters. There is an individual DAC for each channel as shown in Table A2 below and on Schematic 22226 in Chapter Five. It is a two-digit number in the range from 01 to 25, representing a threshold voltage value of from 0.1 V to 2.5 volts. This command only applies to Input Channels A and B, so if this portion of the command string is included in a command to one of the twelve Input/Output Channels, it will merely be ignored.

Table A2

CHANNEL	DAC NO.
Input A	DAC 13
Input B	DAC 14

A.1.5 SAVE DATA

$,A#,S,CR,LF

Saves all setup decisions made up to this point. If power is shut down without executing the Save Data command, all setup decisions will be lost.

A.1.6 REQUEST UNIT STATUS

$,A#,S,CR,LF

This command requests a report of failed signal channels or power supply voltages. Only failures will be reported. A status reply of "$,A#,CR,LF" would indicate that there are no signal failures. A status reply of "$,A#,05,09,CR,LF" indicates that channels 5 and 9 have failed. All channel numbers are represented by two characters. "0A" and "0B" for the two switched inputs and "01" through "12" for the twelve input/output channels. Power supply voltages are reported as: V = +5 V, P = +12 V, R = -12 V.

A.1 7 REQUEST FOR FIRMWARE VERSION

$,A#,V,CR,LF

The unit returns a message in the format, "$,A#,V,DT1238W,CR,LF." "DT1238" is the part number of the firmware chip and "W" is the revision level.

A.1.8 REQUEST FOR SERIAL NUMBER

$,A#,N,CR,LF

A typical reply to this request would be "$,A#,1234,CR,LF" for a serial number of 1234.

A.1.9 REQUEST FOR SETUP DATA

$,A#,H,CH,CR,LF

A.1.10 REQUEST ON-LINE (A/B) STATUS

$,A#,I,?,CR,LF

A.1.11 DISABLE KEYPAD

$,A#,K,F,CR,LF

Upon cycling of primary power, the keypad is automatically enabled.

A.1.12 Password Protect

$,A#,P,N,(four digit password),CR,LF

Upon cycling of primary power, the password protection is automatically disabled, and the password is set to 0000. When Password protection is on, SELECT INPUT, SET-UP CHANNEL, SAVE DATA, and KEYPAD commands are disabled

Note: **For additional command and status examples see the following:**

A.1.13 9611 Software Commands

Get Firmware Version:

PC $, A#, V, CR, LF
9611 $, A#, V, D, T, 1, 2, 3, 8, D, CR, LF

Get Serial Number:

PC $, A#, N, CR, LF
9611 $, A#, < 16 digits>, CR, LF

Clear Alarm:

PC $, A#, C, CR, LF
9611 $, A#, C, CR, LF

Buzzer On:

PC $, A#, A, N, CR, LF
9611 $, A#, A, N, CR, LF

Buzzer Off:

PC $, A#, A, F , CR, LF
9611 $, A#, A, F , CR, LF

Get Buzzer:

PC $, A#, A, ?, CR, LF
9611 $, A#, A, N, CR, LF (Buzzer On)
9611 $, A#, A, F, CR, LF (Buzzer Off)

Select Input:

PC $, A#, I, {U, A, B}, CR, LF
9611 $, A#, I, {U, A, B}, CR, LF
9611 $, A#, I, D, E, N, I, E, D, CR, LF (Password Active)

U = Auto, A= Force to Channel A, B=Force to Channel B

Get Select Input:

PC $, A#, I, ?, CR, LF
9611 $, A#, I, {U, A, B}, CR, LF

9611 $,A#,I ,U, A, CR, LF

U = Auto, A= Force to Channel A, B=Force to Channel B

Set-Up Channel:

PC $, A#, H, {0A, 0B, 01-12}, {01-25}, {0-9}, {000-253}, {01-25} CR, LF
9611 $, A#, H, {0A, 0B, 01-12}, {01-25}, {0-9}, {000-253}, {01-25} CR, LF
9611 $, A#, H, D, E, N, I, E, D, CR, LF (Password Active)

Channel = {0A, 0B, 01-12}
Voltage = {01-25}
Base = {0-9}
Multiplier = {000-253}
Voltage = {01-25} Used only for channels A and B

Get Channel Setup:

PC $, A#, H, ?,{0A, 0B, 01-12}, CR, LF
9611 $, A#, H, {0A, 0B, 01-12}, {01-25}, {0-9}, {000-253}, {01-25} CR, LF

Get Status:

PC $, A#, T, CR, LF
9611 $, A#, {List of Failed Channels}, {P,V,R}, CR, LF

Save Data:

PC $, A#, S, CR, LF
9611 $, A#, S, CR, LF
9611 $, A#, S, D, E, N, I, E, D, CR, LF (Password Active)

Password Protect On:

PC $, A#, P, N, (current 4 digit password), CR, LF
9611 $, A#, O, K, CR, LF
9611 $, A#, P, N, D, E, N, I, E, D, CR, LF (Incorrect Password)

Password Protect Off:

PC $, A#, P, F, (current 4 digit password), CR, LF
9611 $, A#, O, K, CR, LF
9611 $, A#, P, F, D, E, N, I, E, D, CR, LF (Incorrect Password)

Get Password Protect:

PC $, A#, P, ?, CR, LF
9611 $, A#, P, N, CR, LF (Password Active)
9611 $, A#, P, F, CR, LF (Password Inactive)

Change Password;

PC $, A#, P, C, (current 4 digit password), (new 4 digit password), CR, LF
9611 $, A#, P, C, O, K, CR, LF

9611 $, A#, P, C, D, E, N, I, E, D, CR, LF (Incorrect Password)

Keypad Disable:

PC $, A#, K, F, CR, LF
9611 $, A#, K, F, CR, LF
9611 $, A#, K, F, D, E, N, I, E, D, CR, LF (Password Active)

Keypad Enable:

PC $, A#, K, N, CR, LF
9611 $, A#, K, N, CR, LF
9611 $, A#, K, O, D, E, N, I, E, D, CR, LF (Password Active)

Get Keypad Status:

PC $, A#, K, ?, CR, LF
9611 $, A#, K, N, CR, LF (keypad operational)
9611 $, A#, K, F, CR, LF (keypad disabled)

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