Physical Interfaces for the APHID Spectrometer

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1 Document purpose and table of contents.

This document describes the physical interfaces (timing, microwave, data link, electrical, and mechanical) interfaces between the APHID spectrometer module, its signal processor, and external synchronization signals as of the date above.

Acronyms:

TBC	To be confirmed
TBD	To be defined

2 Brief system description

The APHID spectrometer consists of two parts:

1. The spectrometer module itself, containing a 16-lag correlator board and microwave signal processing components. This module should be mounted close to the WVR front end. Its power requirements and physical size are described below.
2. The digital signal processing and interface module. Its principal interface with the external system is a serial line, but it is also capable of directly reading hardware synchronization signals. These cards may be mounted remotely to both the module and host computer consistent with RS-232 line length standards; it may be most convenient to mount near electronics which provide hardware synchronization signals.

3 Timing and synchronization

3.1 Basic timing

All of APHID's integration times are multiples of its basic correlator readout time of 11.52 ms (86.81 Hz). The internal signal processor accumulates data during the integration and then transmits the result. This data transmission at the end of an integration cycle requires four additional readout times. A two second integration cycle time, for instance, would fit within

$$\mathrm{int}\left(\frac{2\,\mathrm{s}}{11.52\,\mathrm{ms}}\right) - 4 = 169$$

cycles for an actual integration time of 1.981 s, or a 97% duty cycle. A 320 ms readout rate would require 23 cycles, and would have a 83% duty cycle.

3.2 Timing setup and synchronization

The integration time is set in the command from the host computer that initiates the readout cycle. There are three standard modes: continuous internally triggered, continuous externally triggered, and single integrations.

3.2.1 Continuous internally triggered

This is a loop of readouts. On receipt of the command from the host, the spectrometer integrates for the desired number of cycles, transmits the data, begins the next integration, and so on. Integrations begin within 30 ms (TBC) of the request from the host computer. The loop is halted by the receipt of any character from the host computer.

3.2.2 Continuous externally triggered

This is a loop of readouts. On receipt of the command from the host, the spectrometer waits for a pulse edge on an external signal, then integrates for the desired number of cycles, transmits the data, waits for a pulse edge, begins the next integration, and so on. Integrations begin within 12 ms (TBC) of the trigger pulse edge (sec. 5.2) that arrives a minimum of 30 ms (TBC) of the request from the host computer. The signal processor will ignore any pulses during the integration, but triggers on the first pulse after the integration is complete. To allow resynchronization the integration loop time must therefore be a minimum of 25 ms (TBC) shorter than the time between triggering pulses to insure proper triggering. The loop is halted by the receipt of any character from the host computer.

3.2.3 Single integration readout

This mode is most useful for bandpass calibration and similar total power measurements. A single integration for a desired number of cycles begins within 30 ms (TBC) of the request from the host computer. The signal processor returns an attention signal (single byte character) at the end of the integration. A second request returns the accumulated data.

4 Microwave interface to spectrometer module

4.1 Input band

0.5 to 4 GHz nominal.

4.2 Input power level

–55 dBm (TBC).

4.3 Signal dynamic range

Signal dynamic range from nominal input power is minus 0 dBm, plus 3 dBm. Larger signal swings require compensation by external input attenuation.

4.4 Band flatness

±1.5 dB from nominal slope across 0.5 to 4 GHz of:

1. Maximum rolloff with increasing frequency of 0 dB.
2. Maximum rollup (preferred) with increasing frequency of 6 dB.

4.5 Mechanical

SMA female.

5 Data links

5.1 Spectrometer module to signal processor

40-connector 28-gauge flat ribbon cable, IDC socket ends.

5.2 Signal processor to external synchronization signals

Trigger on the rising edge of a TTL-compatible pulse with minimum width 50 ms.

5.3 Signal processor to host computer

RS-232 serial link, 19.2 kBd, 8 bits, one stop bit, no parity.

5.4 Host computer to calibration microwave synthesizer

A computer-controlled microwave synthesizer with a IEE-488 (GPIB) interface is necessary for occasional spectrometer calibration. The preferred interface is a GPIB card within the host computer. If necessary, the interface could be a second serial link with a serial-GPIB converter.

6 Electrical power

6.1 Spectrometer module

Power supplies:

+5 VDC @ 0.5 A (analog and digital for correlator board)
–5 VDC @ 0.5 A (analog for correlator board)
+15 VDC @ 1.5 A (microwave amplifiers)
+28 VDC @ 1 A (microwave switches)

Grounds

Analog
Digital
Microwave amplifiers and switches

Input is 9-pin female submin-D connector on correlator module.
Note: it may be desirable to supply ±5 VDC analog to correlator boards with a DC-DC converter at correlator module; power requirement would then be somewhat more +15 VDC and +5 VDC digital (TBD).

6.2 Signal processor module

+5 VDC @ 0.8 A, digital circuit stability and noise levels.

7 Mechanical

7.1 Spectrometer module

Figure 1 is a mechanical overview drawing of the spectrometer module. The basic dimensions of the current module are 13.8” long by 4.5” wide by 2.35” high, although the height is likely to increase by approximately 2” to include additional electronics. Mounting is through the “ears” on the baseplate (Figure 2), which is also the thermal contact for cooling the module. The external interface circuit card is 4.8 by 4 inches; its dimensions and mounting hole locations are shown in Figure 3.

7.2 Signal processor module

The card has Eurocard standard 3U size (100 x 160 mm) with a 64-pin DIN connector for all signals. Interface to other signals (e.g. ribbon cable to spectrometer module, synchronization signals, serial interface connection) is through a small (1.75 by 4.0 inch) circuit board that plugs into the DIN connector at right angles to the processor card. Dimensions and mounting hole locations are shown in Figure 3.

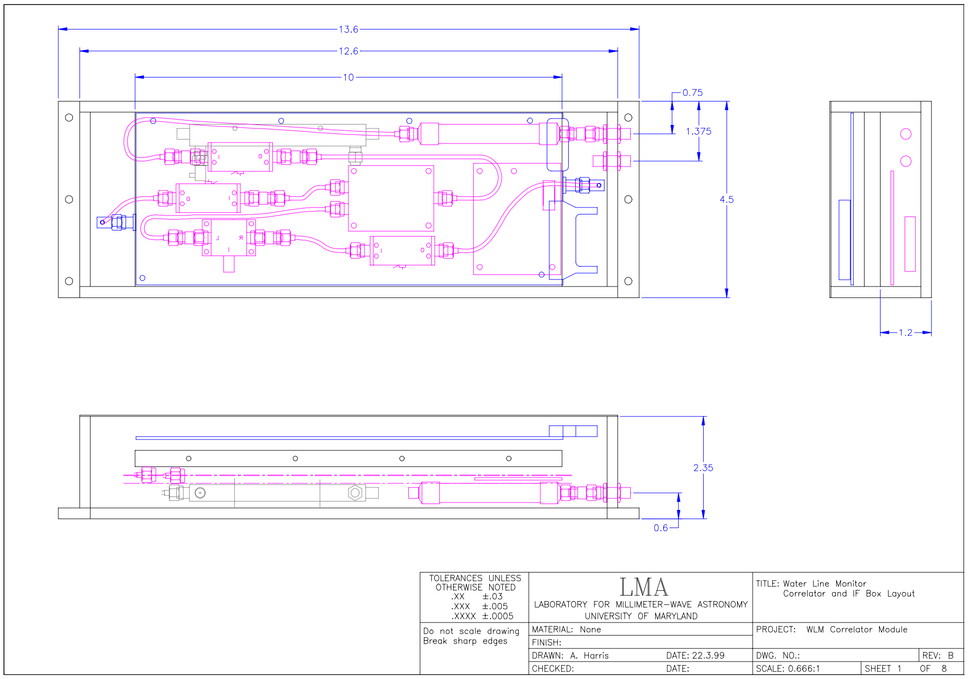

Figure 1: Mechanical drawing of spectrometer module. The height of the "production" models will likely increase by ~2 inches.

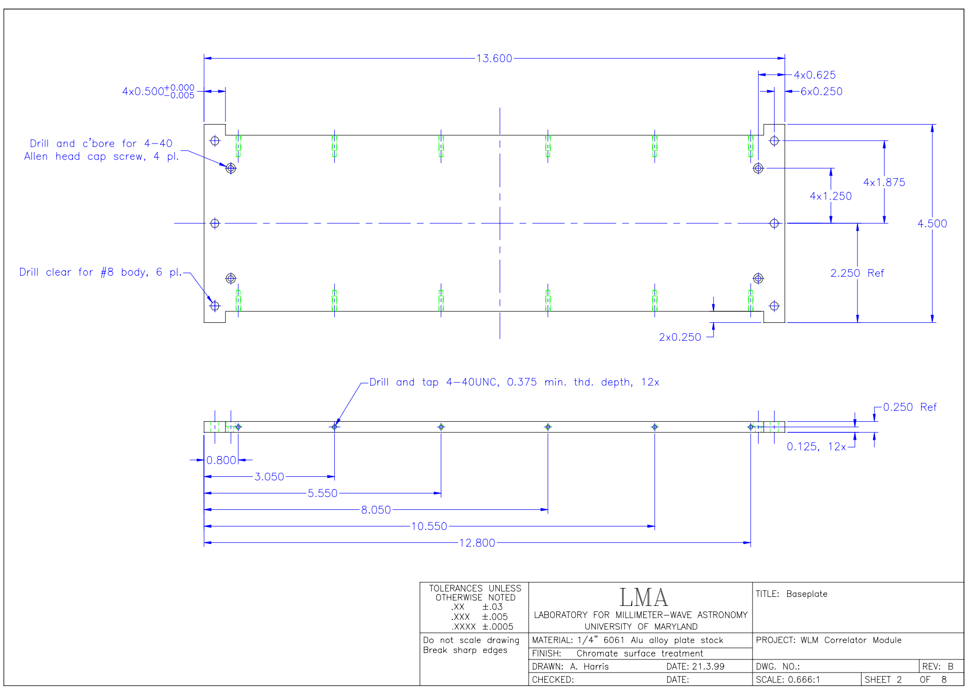

Figure 2: APHID baseplate with mounting hole dimensions. Mounting is with up to six #8 body screws through holes in baseplate. Baseplate also carries thermal flow from module.

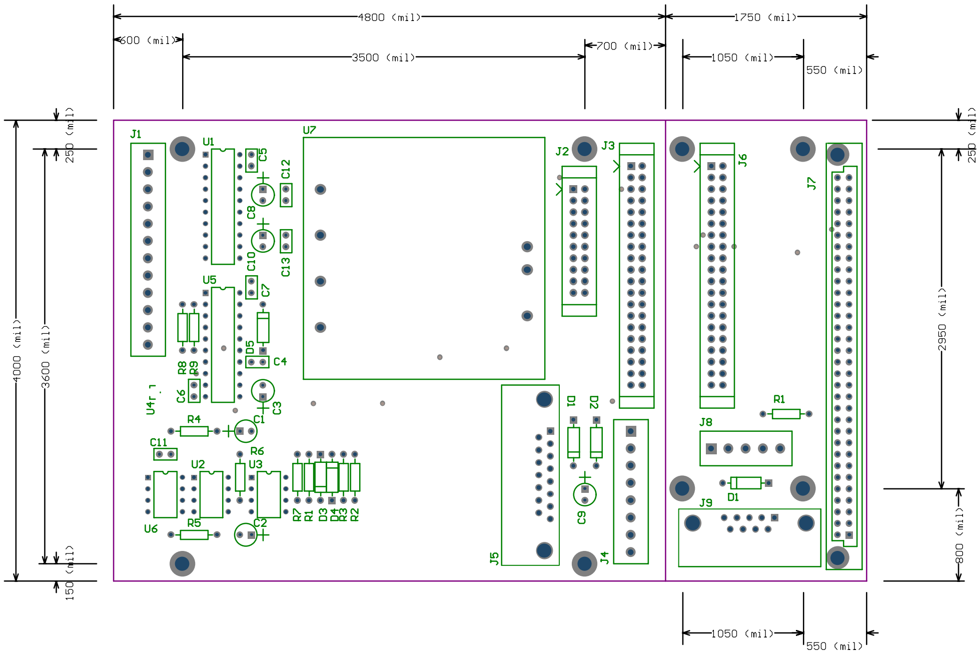

Figure 3: Mechanical layout of APHID-microcontroller interface boards. The boards are cut apart before assembly: the APHID-end is to the left, microcontroller-end to the right.