Testing a Phillips 7186 16-Channel Time-to-Digital Converter

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Abstract

A Phillips 7186 16-Channel Time-to Digital-Converter has been modified and is being tested during times when the MLRS station is not actively gathering ranging data. The Phillips 7186 has the potential of becoming a critical component in the Time-of-flight timing system. Eventually the Phillips 7186 will be used in a test satellite pass. If the data quality is improved using the Phillips 7186 it will replace the Ortec TD811 8 channel Time Digitizer.

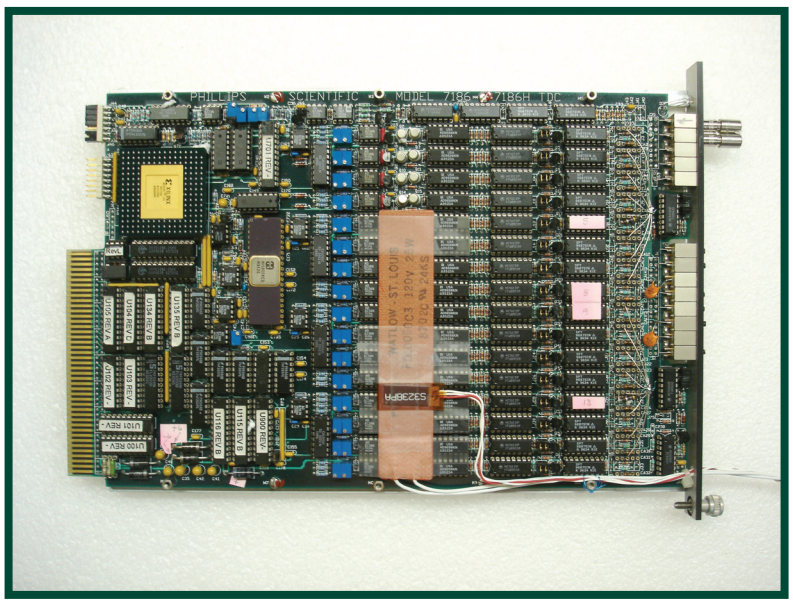
Motivation

The Phillips 7186 was given to MLRS as a gift from the Next Generation SLR, Greenbelt, Maryland (NGSLR) project. NGSLR had hoped to use the Phillips 7186, but it did not meet the project's needs. The similarity between the Ortec TD811, in use at MLRS, and the Phillips offered the possibility of improving the MLRS data, without additional cost to our station.

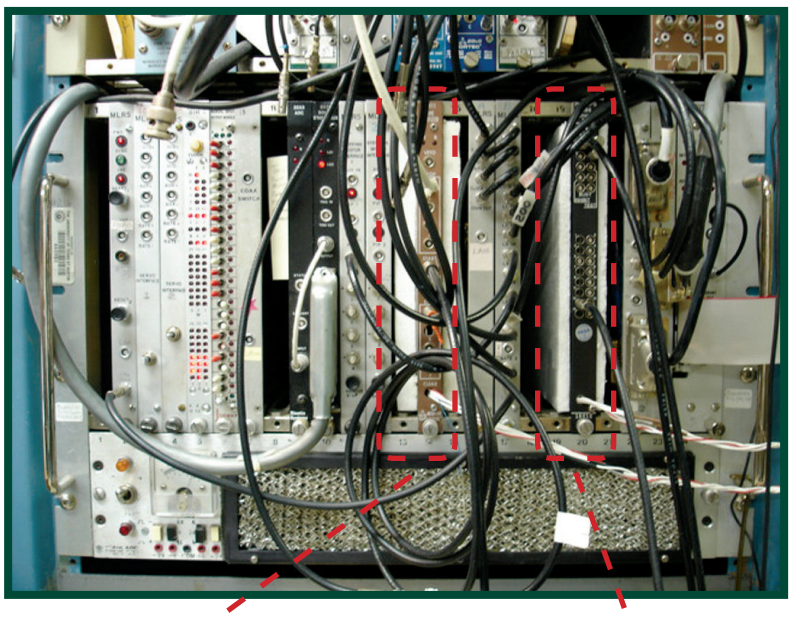
Both the Ortec TD811 and the Philllips 7186 digitize the time between zero and 100 nanoseconds. The Ortec TD811 gives 50 picoseconds per count where the Phillips 7186 is about 25 picoseconds per count, thus offering better time resolution. Our hope is that the 16 channel Phillips 7186 will produce better data rms than the 8 channel Ortec TD811.

Technical Challenges

Both the Ortec and the Phillips are Computer Automated Measurement And Control (CAMAC) units, which can be plugged into individual crates, that are controlled by slave units. However, a lot has to be done to consider using the Phillips 7186.



The Phillips 7186 unit



In the rack:

Ortec TD811 Phillips 7186

Before testing on a satellite pass we need to accomplish the following tasks:

Hardware

- ➤ The unit needs to be:
  - Configured for Common Start
  - Configured for 100 nanoseconds range
- ➤ The unit needs to be modified to allow inputs:
  - Channel 1 - Channel 8 bridging
  - Channel 9 - Channel 16 bridging

➤ All gains need to be reduced for a maximum range of a few nanosec more than 100 nanosec

➤ Heater and Resistance Temperature Detector need to be installed

➤ Need to discover

- Best operating temperature
  - Best percent applied heat
  - Best load resistor in series with heater
- Discover best operating parameters for the temperature micro-controller.

Software

- Create a special ranging program that will accept 16 instead of 8 channels using slightly different CAMAC commands.
- Create a special slope determining program to determine the individual slopes of the 16 channels.
- Modify several diagnostic programs for use in testing the Phillips 7186.
- Brain-storm to figure out why weird results were being produced.
- Review satellite data for accuracy and low rms.
- Tasks not yet accomplished

If the Phillips 7186 produces lower rms values and we decide to install it for all ranging, many more modifications have to be implemented to integrate the Phillips into the "production" system.

Summary

The 16 channels of the Phillips 7186 must be calibrated at a choosen temperature and satellite ranging must be done at the same. The temperature sensor, which is almost a point source sensor, is placed directly on top of the most temperature-sensitive elements in the Phillips 7186. Maintaining a constant temperature is necessary, but not sufficient, since there will always be a temperature gradient (the unit is over 6 inches high). Thus the controller will only keep one spot at the specified temperature, which does not keep the gradient from changes. If the room heats up, the gradient change will cause the rms to grow.

One way to establish a constant thermal gradient within, is to visually monitor the percent heat being delivered to the unit by the temperature controller. The crew changes the temperature of the equipment van room manually to keep the percent heat delivered to within a few single digit units of percent heat. This procedure has worked well with the TD811 for many years. We have learned that when the percent heat is off by more than four units of percent for the TD811, our range data is not usable.

Until the Phillips 7186 demonstrates sufficient thermal stability, that is, stays in a narrow range of percent heat delivered, ranging to a satellite is meaningless. So...

Stay Tuned!