APPLYING VXI TECHNOLOGY TO DC POWER SUPPLY PROGRAMMING RESISTORS

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Abstract – The legacy F-16 Analog Tester utilized resistor programmable DC power supplies for application of programmable stimulus. Resistor programmable power supplies, although still available in today’s market, are becoming a rarity. The F-16 Analog Test Station Sustainment (FATSS) team decided up front to eliminate reliance on the availability of such devices, and engineer a means to convert the existing resistances to an analog voltage, more compatible with modern power supply programming options.

INTRODUCTION

Many older test systems are equipped with resistor-programmable power supplies, while current technology is geared toward either analog (5 to 10 VDC) or digital (GPIB) programming. The engineer or team of engineers tasked with the replacement of resistor programmable power supplies is faced with an interesting challenge.

In the refurbishment of the Honeywell 2600 Analog Depot Automatic Test Set (ADATS), this challenge was one of many confronting the F-16 Analog Test Station Sustainment (FATSS) team. We set out from the beginning to find a way to incorporate the current technology, readily available from multiple vendors, into the existing legacy hardware and software. This software uses fixed and sometimes programmable resistances (incorporated within the interface hardware) to control voltage and current levels.

This paper will discuss the challenges of the task, the methods investigated, the input and assistance offered by power supply vendors, the path taken towards implementation, and finally, the progress of the chosen solution through hardware source selection, software driver development, prototype construction, and integration of the hardware and software into the refurbished Automatic Test Equipment (ATE).

Refurbishment Proof of Concept

On March 9, 1994, after many months of discussion among ourselves (the F-16 Analog Software Engineering Section), we set aside some man-hours and begged and borrowed some VXI equipment, and took up the task of running our simplest Test Program Set (TPS) on a VXI based system. The operating system was Windows 3.11, using National Instruments LabView version 3.1.1. The sole programmable DC power supply used in the effort was a spare Hewlett Packard 6274B, now no longer produced or supported by HP.

In October 1997, TISAD received funding from our customer, the F-16 Analog Depot Repair Branch (LARP), to perform a refurbishment of the aging ADATS. At this time, a team of 10 engineers was assembled, and one of the first tasks was Hardware Source Selection. In order for competent choices to be made for our eleven DC power supplies, a decision as to the method of remote programming would have to be made immediately.

THE SEARCH FOR AN ANSWER

The Legacy ADATS DC Power

The legacy ADATS contains eleven programmable DC power supplies, manufactured by various vendors, and each model of power supply currently in our ADATS has at some time in the remote to recent past...
been declared obsolete, thus unsupportable, by the
manufacturer.

The obsolescence of our power supplies has been a
matter of concern since even before the proof-of-concept
was constructed, this due to our concerns about replacing power supplies on the aging legacy
equipment. In the original ADATS design, the DC
power supplies rely on a fixed or variable linear
resistance physically located within the Interface Test
Adapter (ITA).

With no ITA present, or with an ITA not utilising a
particular power supply, the open circuit presented to
the resistor programming terminals of the power
supply results in an over-maximum voltage condition
on each unused power supply (the design circumvents
the over-voltage trip protection by wiring a diode in
parallel with the programming terminals, which allows
a minimal current flow between the terminals).

Sustainment Design Considerations

For the refurbishment, it is desirable to keep our
power supplies at zero potential when not in use, both
for personnel safety and equipment protection.

Taking into account all that we wanted to accomplish
with the refurbishment of the DC power supplies, we
decided that the best solution would be to use
equipment that could read the ITA programming
resistors and create a proportionate DC programming
voltage to the respective power supply.

Our informal searches for suitable replacements led
us to the conclusion that in order to absolutely ensure
procurement of and support for our programmable DC
power supplies in the future, we would have to find a
way to incorporate external DC voltage control of the
power supplies in our refurbishment effort.

Investigation of Options

The first bug in the soup for our solution was the fact
that the programming resistance could be changed
during the execution of a TPS, perhaps by changing a
value on the decade resistance unit. This means that
in order to implement our solution, we must be able
to continually monitor the ITA programming
resistances and immediately change the programming
voltage in response to a resistance change.

So, it appears that the ingredients for success include:
a means of reading a resistance, a means for
translating the resistance into a proportionate voltage,
and the ability to do so virtually instantaneously.

Knowing about Data Acquisition (DAQ) systems, we
hit the books and found that the HP E1419A seemed
to meet our requirements.

Capability of the HP E1419A Data
Acquisition Module

The HP E1419A is a configurable C-size VXI
multifunction measurement and control module. The
unit can have its Signal Conditioning Plug-on (SCP)
modules programmed at initialization, and the HP
E1419 will continually monitor the SCP's.

We configured out HP E1419A with model 1505
constant current sources and model 1501
programmable voltage sources. The 1505 modules
output a constant 488uA into the ITA programming
resistors, and the resultant voltage drop is read. The
voltage drop is then inserted into a specific equation
that determines the amount of DC control voltage to
be output by the 1501 SCP's into the analog control
inputs of the station DC power supplies.

The module operates independantly of VXI command
and control signals once programmed, so control of
the power supplies is moved out of the station
computer operating system (and the National
Instruments Test Executive) and thus is not
susceptable to demands on the station CPU, and does
not load the CPU with tasks that could interfere with
the operation of the test exec.

For operator and equipment safety, the algorithms
programmed into the E14919A will set the DC control
voltage to zero when the programming resistance
increases past +20% of the maximum allowed value.
Until the +20% point is reached (between 100% and
120%), the controller will output the maximum control
voltage (usually 10V).