Some Specific Measurement Instructions

Sweep Device (Resonance) Measurements

The phrase “Sweep Devices” is used to describe measurement devices that, by themselves, make a measurement over some range. For instance, a network or spectrum analyzer measures over a frequency range, and an oscilloscope measures over a time range. As of this writing, support for sweep devices is pretty limiited. Only the Agilent 4194, 4195, 4294 and ancient HP 3562 are supported at all. And with those the only parameter that can be controlled from the script is the ac level (referred to as SWEEPAC). And the frequency range being measured is assumed to be constant during the execution of any one script. Besides the SWEEPAC, three commands are used (both MEASURES):
MEASURE SWEEPFREQS and
MEASURE SWEEP
MONITOR SWEEP

At some point in the script after the SET SWEEPDEVICE command and before any other measurements using the sweep device are made, MEASURE SWEEPFREQS should be in the script. This causes GADD to read the frequency range from the device. Once read, these are assumed to apply for the rest of the script.

Then, in the body of the script, the MEASURE SWEEP command (like others, SWEEP0 through SWEEP9 can be used, but any one of them can only be used once) will trigger the device, wait for a sweep to complete, then record the output. All settings other than the ac level must be made by hand. If triggering the device is not desired MONITOR can be used instead. It will simply retrieve the data from the machine which is already present on the sweep device.

The following script measures (whatever was set on the 4194, over whatever frequency range was set) as a function of ac field.

```
SET SWEEPDEVICE=HP4194
MEAS SWEEPFREQS
SWEEP SWEEPAC, START=.1, STOP=1, STEP=.1
  MEAS SWEEP
ENDSWEEP
```

Of course, this can be combined with any other GADD commands to control any of the other devices such as temperature chambers.

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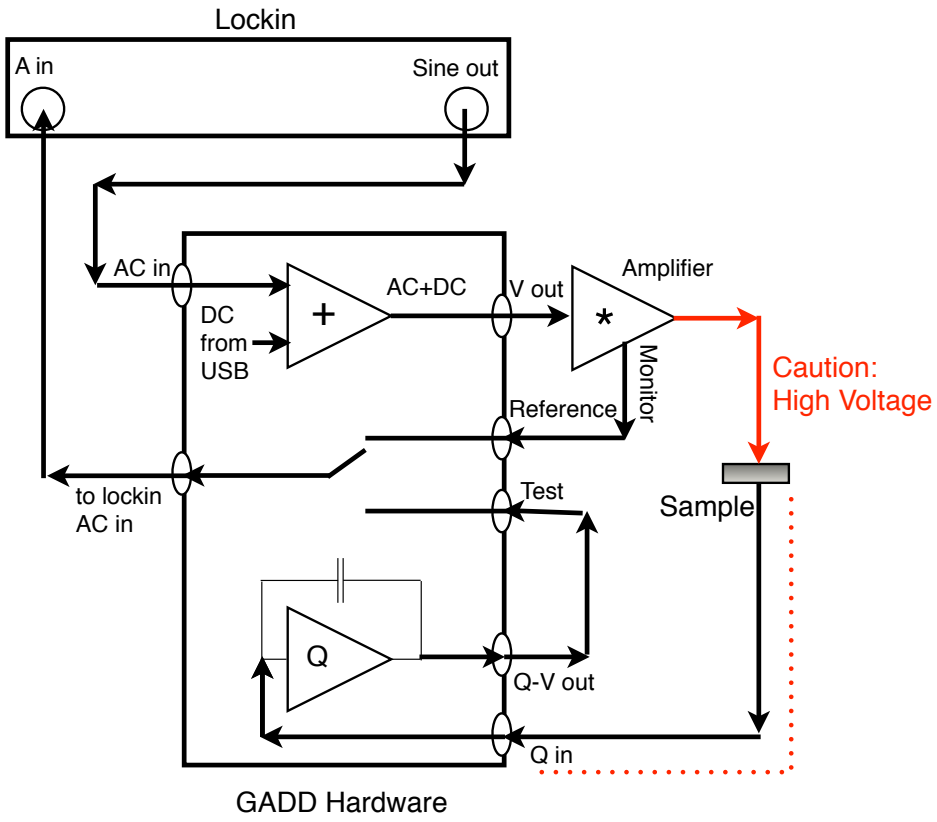
GADD Hardware for Permittivity Measurements

The GADD hardware converts charge to voltage for measurement either by lockin (AC) or instantaneously (for PE and Preisach using built-in USB interface). It can use almost any amplifier or driver as long as the amplifier is provided with a voltage monitor. Connections are normally made with coaxial cables with two exceptions:

1. Voltage limits and safety precautions must be observed when high voltage is used.
2. For low charge measurements a low noise, low leakage cable should be used between the sample low and the system input.

Connections are made according to the following diagram:



GADD Hardware

For simplicity, the following are not shown on diagram:

1. The GADD hardware has an external power supply. It should be plugged into the mains power and connected to the back of the unit. A power light is visible on the unit. If the light is not illuminated power is not on and the unit will not function. Occasionally spikes or other transients may turn off the power supply, unplugging and plugging in again is the corrective action.

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2. The unit should be connected by USB to the PC being used. When the USB is connected and functioning a flashing light, typically located next to the USB plug, is activated. If the indicator is not flashing the USB has not been recognized by the computer and the system will not function. Rebooting and checking NI's Measurement and Automation Explorer are the usual corrective actions.
3. For optional low frequency synchronization there is a connection from the lockin TTL sync out to a similarly labelled input on the GADD unit.
4. Switches may be available on the GADD unit to make some connections, such as from the Q->V out to the test input, or the low voltage driver monitor to the reference input. The switch can be used in place of a cable, or a cable can be connected as shown in the diagram above.

Scripting

The command for measuring permittivity using the GADD hardware is MEASURE EPSILON (optionally 0-9, as usual) and for PE is MEASURE PE. The following settings apply:
(units are SI base & RMS unless otherwise noted)

AC AC signal level
DC DC bias
FREQUENCY frequency of the permittivity measurement
PEAK the peak voltage of the PE measurement
HARMONIC the harmonic of the permittivity measurement
AMPLIFIER the name of an amplifier in the GADD_CONFIG.ini file
TAU sets the lockin time constant
SETTLING the number of time constants GADD waits to allow the lockin to settle before taking a measurement. 15 is required for full accuracy, 3 can be used for a fast survey
TIMECONSTANTTRACKING (ON/OFF) When on causes GADD to adjust the time constant such that tau is always at least equal to the period. This is required to meet the published specifications of the SRS lockins, although often not necessary. When off the time constant remains fixed and the system waits for a measurement to settle one period plus the normal settling time. Experience suggests that this is normally adequate and enormously faster at low frequency.
RESERVE Sets the dynamic reserve of the lockin
DCFILTER Adds a resistor in parallel with the charge collector capacitor. The resistor is adjusted at each frequency such that Zcref/Zr ~= DCFILTER, with 0 setting no resistor. For use with leaky samples.
RANGEFLOOR
RANGEROOF Sets the scale factor (0. to 1.) to be used the criterion to uprange or downrange the lockin when GADD is making ac and permittivity measurements
QRANGE Sets a specific reference capacitor (0-5). GADD always autoranges when making measurements so this would normally be used as part of a test of the system.
ZEROSYNC Causes GADD to synchronize charge zeroing with the ac signal zerocrossing. Useful below ~100Hz.