

Using Frequency Converters with the MRI System

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Terms:

CCU: Compact Up-Converter (VDI-737 CC)

CCD: Compact Down-Converter (VDI-737 CC)

AWG: M8195A - Arbitrary Waveform Generator

PSG: E8257D - Analog Signal Generator (x2)

DSO: DSOV254A - Digital Storage Oscilloscope

Important notes about operating the frequency converters:

- **Wear a grounding strap when handling.** The IF input of the CCU unit (and the rest of the devices to a lesser extent) are extremely ESD sensitive.
- **Disable AWG and PSG outputs before connecting to input of CCU/CCD.** Applying input signal to the devices in the wrong order or while they are powered off can result in irreparable damage.

Tips on calculating appropriate power output values

- See the datasheet for the particular CCU/CCD units you are using. The maximum allowable input power value varies by device. The limit also differs for the LO and IF ports.
- Remember to account for loss caused by the cables you are using. This should be listed on the cable spec-sheet, or it can be easily measured using the VNA or DSO.
- The cable loss varies by frequency. Make sure you calculate the correct loss for the frequency a particular cable will see.
- To calculate correct signal amplitude for the AWG, remember to convert AWG output voltage to RMS. The following formula can be used:

$$\text{Amplitude (mV)} = 10^{\left(\frac{\text{Desired CCU IF power (dBm)} + \text{Cable loss (dBm)} + 50}{20}\right)}$$

- Make sure you do not overload the RF input of the CCD (this isn't likely to be a concern if the THz signal is not being amplified).

Startup Procedure

Start with all cables disconnected.

1. Calculate desired frequency/power output for PSG.
 - see *Tips on calculating appropriate power output values*.
2. Disable the outputs of the PSGs.
3. Calculate desired power output for AWG.
 - Tip: set maximum amplitude in *Output* tab and then adjust output level by increasing FIR Scale value from 0 in the *FIR Filter* tab.
4. Disable the outputs of the AWG (uncheck 'Enabled' for each available channel in the *Output* tab).
5. Double check that the outputs for each device are disabled.
 - On the PSGs, the on-screen icon will say "RF OFF" when output is disabled.
 - On the AWG, the physical LED below each channel port will be off when output is disabled.
 - When in doubt, shut the signal sources off. Once you have made all the connections, they should boot up in a safe state.
6. Make sure the CCU/CCD are powered off (unplugged).
7. Connect Devices (see document on *Proper use of high frequency coaxial cables*)
 - a. PSG output to CCU/CCD LO inputs.
 - b. AWG output to CCU IF input.
 - c. CCD IF output to DSO input.
8. Connect power to the CCU/CCD.
9. Verify that PSG and AWG output levels are within the safe operating range.
10. Enable PSG outputs.
11. Enable AWG outputs.

Shutdown Procedure

It is important that you turn off and disconnect devices in the correct order to avoid damaging equipment.

1. Disable AWG output.
2. Disable PSG output.
3. Disconnect CCU/CCD power supplies.
4. Power off AWG, PSG, DSO.
5. Replace the dust covers and/or protective tape on the CCU and CCD outputs.
6. Disconnect cables if system is to be stored.