

How to Keep Computer and Digital Signals out of your Radio Telescope: Interference Suppression Begins at Home

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The high sensitivity of modern radio telescopes derives from low-noise receivers supplemented by clever signal processing algorithms, inevitably carried out with computers and digital-signal processing equipment. The march of technology brings these influences into conflict. As digital signal processing proliferates and operates at higher speeds it generates ever more spurious signals which are picked up by increasingly sensitive front ends.

This talk describes techniques and policies developed at the Dominion Radio Astrophysical Observatory for suppressing interference from digital equipment. Every device that enters the Observatory buildings is tested. The test equipment consists of a broadband antenna with pre-amplifier, feeding onto a spectrum analyzer. One antenna/amplifier pair covers 50 to 1000 MHz and another covers 1000 to 2000 MHz. Amplifier gains and spectrum analyzer setting are standardized. Testing is on a go/no-go basis. If emissions exceed the level in the middle of the screen, the device must be shielded. If emissions are below this level, the device can be used without shielding. The pass/fail level has been calculated by estimating (and measuring) the tolerable level of an interfering signal continuously present, given the particular telescopes in use at the Observatory.

Modern personal computers fail the test, almost without exception, and must be shielded. We have developed a standard enclosure based on a box fabricated from sheet aluminum. All peripheral interconnection lines and power lines are filtered. A similar enclosure is used for laser printers. This computer enclosure costs about Can\$1000. It is much cheaper than the additional cost of a Tempest specified computer because we do not attempt to shield frequencies below 100 MHz. At frequencies up to 3 GHz the enclosure delivers a shielding effectiveness of about 50 dB. We have been forced to modify the design as computer clocks have climbed past 400 MHz.

There are some costs, other than the purely financial. It is generally advisable to build the computer enclosure considerably larger than the computer to avoid overheating. This uses office space, and we may be shortening the life of the computer slightly by raising its operating temperature. Some computer enclosures need extra fans, which make noise. It is generally not necessary to shield computer monitors. Digital LED displays cannot be shielded and are not permitted.

To shield large digital systems, it is worth buying commercial enclosures, either shielded individual racks or shielded rooms. There is no cost advantage in attempting to build such devices on your own.