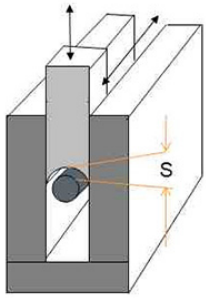
How does a Slide Screw Tuner (frequency > 100 MHz) work?

Focus Microwaves' electro-mechanical slide screw tuners have been used in the RF industry in prototype form since 1985 and as final products since 1989. Over the years, we have worked and reworked our tuners, making them the most universal, user-friendly and reliable tuners on the market. Focus tuners have been designed following a simple and robust principle: they consist of two precise hardened and grounded parallel shafts accurately guiding a carriage controlled by a center lead screw with trapezoidal thread. The carriage slides on Teflon-coated bearings that reduce friction and eliminate noise. An extremely precise stainless steel vertical axis with a 1.5 to 3µm resolution per motor step is located inside each carriage and is used to control the vertical position of each probe. Backlash within the carriage is eliminated by using spring-loaded horizontal and vertical movements.



RF Probe positioning inside a tuner slabline

Timing belts are used to transfer movement from the horizontal and vertical motors thereby reducing vibration. By adjusting the pitch of the lead screw and the size of the timing pulley on the horizontal motor we are able to fine tune the step resolution from 3 to 50µm, so the same gear can be used from 200MHz to 110GHz. 100MHz and new 200MHz tuners (models iCCMT-101, -201, -301 and -302) use a bigger step size and a belt drive instead of the lead screw, allowing for a tenfold increase in tuning speed while maintaining the same accuracy.
The design and quality of RF probes is very important for electro-mechanical tuners. Focus manufactures two types of probes: probes that make ground contact with the slabline walls and contactless probes. Long term testing has shown little difference between the two probe types. Probes are manufactured out of Aluminum, Brass or Bronze, depending on the frequency range and application. Our probes (slugs) operate between 100 MHz and 67GHz in coaxial tuners and up to 110GHz in waveguide (Ka, Q, V and W-band) tuners. Wear of contacting probes is negligible. Tuners using this technology have been in operation for more than 20 years.

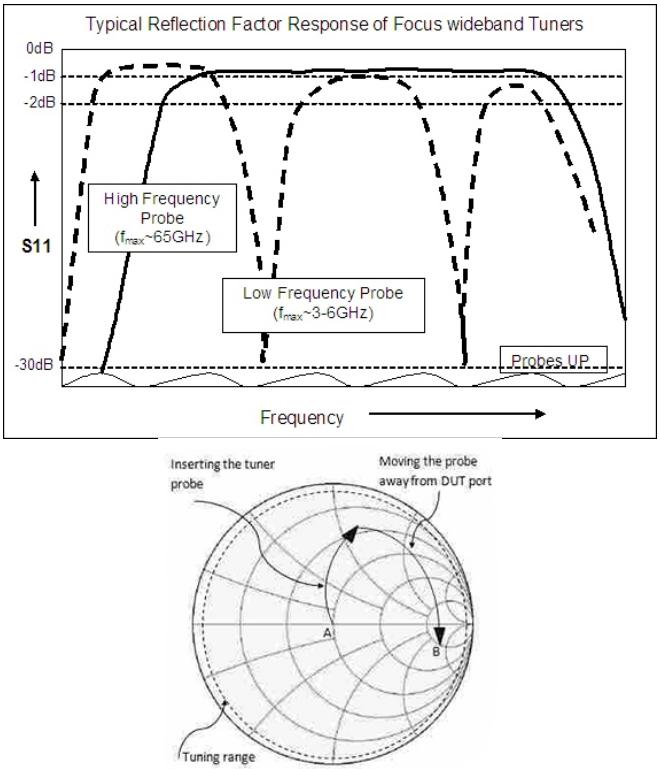
The slabline is positioned in such a way as to compensate for insertion loss when the probe moves away from the test port, thus providing perfect tuning circles.

Focus has been developping simplified tuner control mechanisms since 1990, thereby eliminating bulky and outdated external controllers. Starting with a bulky external controller (abandoned in 1992) we followed with an ISA card, a PCI card, the USB control to finish with a LAN (TCP/IP) control using our new integrated iTuner microprocessor.

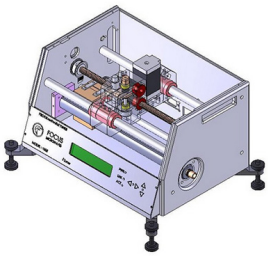
Focus characterizes its tuners for repeatability and tuning accuracy. Repeatability is the RF error resulting when the probe is placed in the same set of positions several times. Tuning accuracy is the RF error when the probe is positioned such as to synthesize a set of user defined (interpolated) impedances.

Before shipment Focus tuners undergo a rigorous burn-in and QA process over 24 hours and repeatability is tested before and after at several frequencies inside the band.

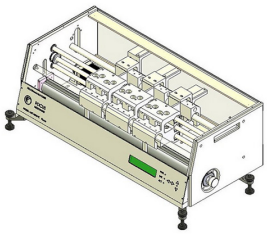
Reliability of Focus tuners is excellent. Units manufactured as early as 1990 are still in faultless operation and are being upgraded by Focus to iTuners.



Tuning mechanism of a single probe tuner (models CCMT and MRT)



Internal mechanics and assembly of iCCMT-608 (0.8-6GHz, single probe, two motors)



Internal mechanics and assembly of iMPT-1818-TC (1.8-18GHz with Twin Carriages, six probes, nine motors)