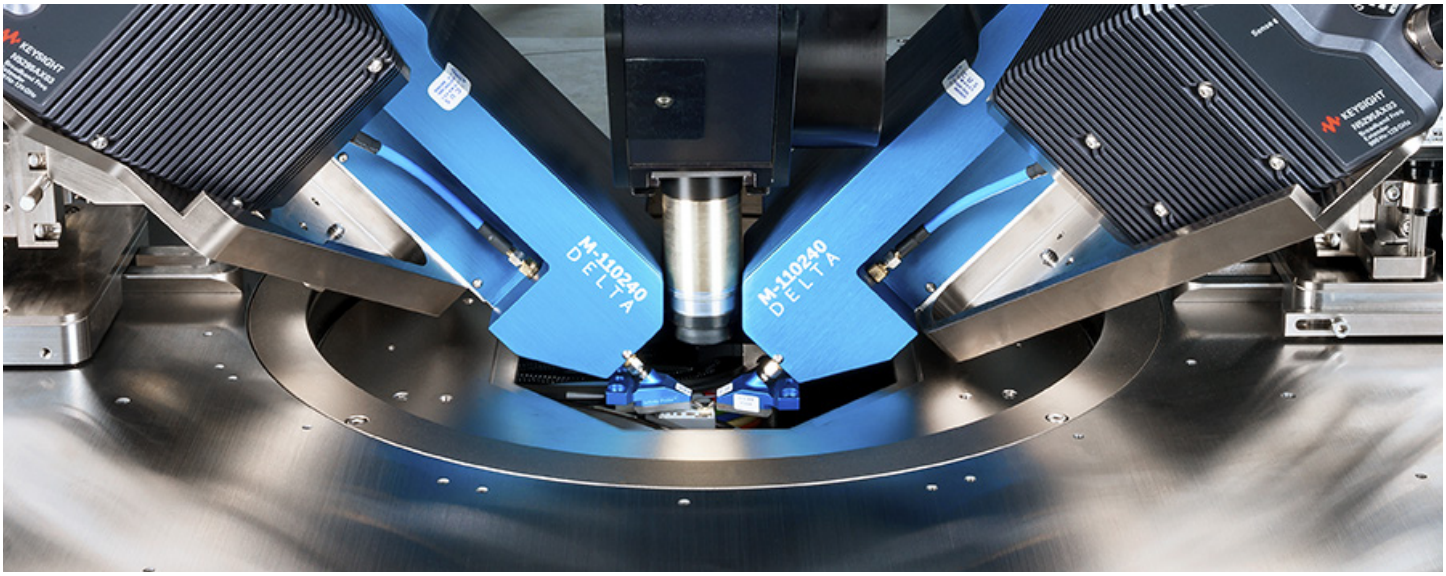
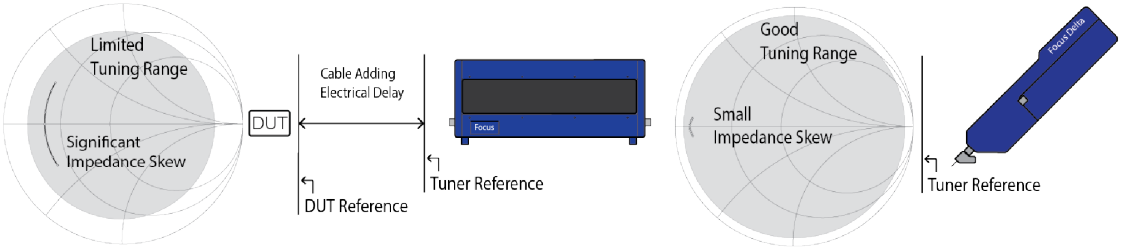
FOCUS MICROWAVES

DELTA for On-Wafer Measurements

1.8-120GHz Coaxial Tuners | Fundamental & Harmonic

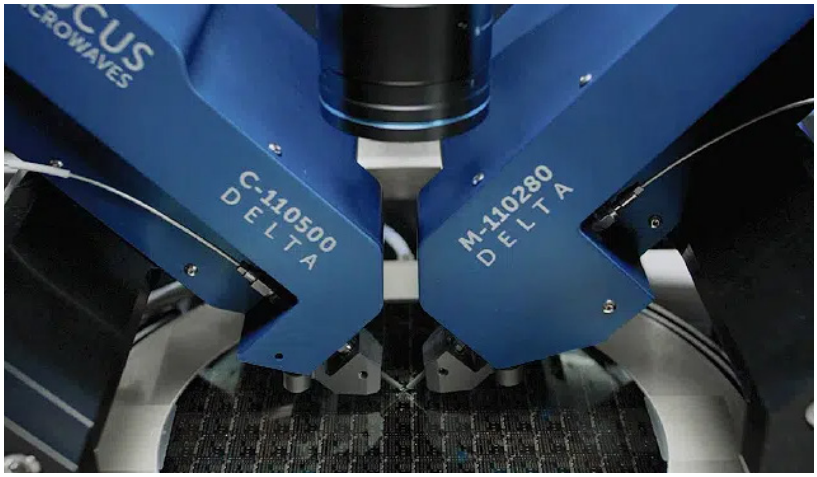


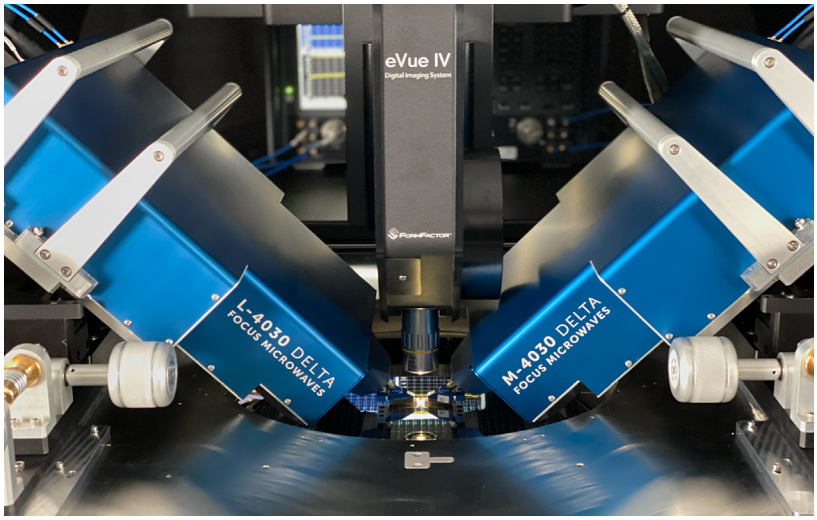
Introduction | Delta Tuners for On-Wafer Measurements



Focus Microwaves' DELTA series of electro-mechanical tuners is designed specifically for high frequency on wafer measurements. The tuner's low profile allows it to be placed within the wafer perimeter and allows for a direct connection between the probe tip and the tuner, eliminating all possible insertion loss between the DUT and the tuner. This revolutionary new tuner design enables the engineer to achieve optimum tuning range, with a tuner whose footprint and weight has been dramatically reduced.

As recent wireless bands like 5G are being deployed and new ones are being defined such as Wi-Fi 6 (or 802.11ax) more is being expected from the measurement systems: Broader frequency coverage, better tuning range, and uncompromised harmonic capability. Focus Microwaves introduces yet another industry first with its Low Frequency Delta Tuners (LFD) that start as low as 1.8GHz and cover up to 40GHz. Designers and test engineers now need to cover broader frequency ranges with the same device technology. Leveraging the industry unique
DELTA tuner technology, the LFD tuners can connect directly to the RF probe, making them ideal for on wafer measurements. This direct probe connection is key in minimizing any loss between the tuner and the device under test, not only for fundamental tuning but also for high VSWR harmonic tuning required for high efficiency.





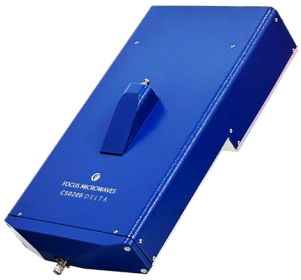
Focus Delta Tuners: 2 US Patents

120GHz Delta | 24-120GHz F0, 2F0, 3F0

The 120GHz Delta tuners are a pioneering achievement by Focus Microwaves. Unmatched in the industry, and in collaboration with Keysight 120GHz PNA-X with M4 extension heads, these tuners allow for harmonic tuning of 3F0 for fundamental frequencies at FR2 (24 to 39GHz). First released in 2019 and improved every year since, the 120GHz Delta tuners have fast become one of Focus's most important and sought after

High Frequency Delta | 2-50GHz F0

The High Frequency Delta tuners used for fundamental tuning are available in 6 model variations, with 40, 50 and 67GHz versions. The unique 2-50GHz model (C5020B) is ideal for Noise parameter extraction up to 50GHz. In combination with Focus's 50GHz noise modules, the end-user can perform noise parameter extraction on a DUT uninterrupted from 2-50GHz.

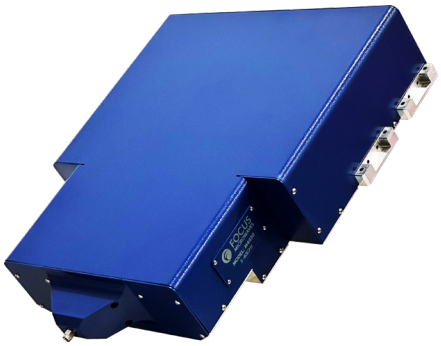


High Frequency Delta | 5-67GHz F0, 2F0, 3F0

The harmonic models of High Frequency Delta tuners come in L(2F0) and M(3F0) versions, with a total of 12 models covering 40, 50 and 67GHz. The newest addition to the Delta lineup in the B series is a 5-67GHz harmonic tuner (in 2F0 and 3F0 versions) allowing for industry leading ultra-wideband measurements.

Low Frequency Delta | 1.8-40GHz F0, 2F0, 3F0

The Low Frequency Delta tuner series comes in several models ranging from 1.8-30GHz, 2-36GHz and 3-40GHz bandwidths, each in fundamental and harmonic versions. A unique 0.7-26GHz model also exists in the fundamental version. These tuners offer great tuning range for both RF and mmWave bands. They provide high VSWR fundamental tuning as well as three frequency tuning for sub 6GHz applications; the wideband tuning probes also cover up to 40GHz making it very useful for engineers wanting to cover both FR1 and FR2 bands.



Integrations | Delta Tuners for On-Wafer Measurements

Integration with FormFactor |

The ramp-up of 5G mm-Wave technologies comes with substantial enhancements in connectivity, revolutionizing smart cities, the internet of things, vehicle to everything (V2X), and more. One of the fundamental requirements of such 5G devices is to maximize their performance by optimizing power and/or efficiency of the contained amplifiers and transistors. This is done by measuring the performance characteristics of the device under test at different impedances that are systematically changed using load-pull tuners.

The new Cascade SUMMIT200 advanced 200mm probe system, is essential for collecting high accuracy measurement data on single or volume wafers; as fast as possible.

FormFactor has partnered up with Focus Microwaves to deliver a fully integrated solution for accurate on-wafer mm-Wave load-pull measurements using Focus high performance DELTA tuners.

Integration with MPI |

TS150-AIT and TS200-THZ probe systems expand MPI one-of-a-kind system solutions for emerging THz applications such as high-speed 5G communication, satellites, non-invasive spectroscopy, security and surveillance, medical and health care equipment, and short range automotive radar by adding active impedance tuner integrations on the same probe stations. These two systems are the industry's first explicitly designed 150 mm and 200 mm probe systems providing accurate tests for the combination of requirements for mm-wave, THz, and automated impedance tuner applications with best possible measurement directivity.

MPI has partnered up with Focus Microwaves to deliver a fully integrated solution for accurate on-wafer mm-Wave load-pull measurements using Focus high performance DELTA tuners.

Focus | Delta Tuners for On-Wafer Measurements | Models & Specifications

Model	*f*0, 2*f*0, 3*f*0	Frequency	VSWR	Connector type
C2607	*f*0	0.7 - 26 GHz	≥ 10:1 (typ. 15:1)	3.5 mm
C3018	*f*0	1.8 - 30 GHz	≥ 10:1 (typ. 15:1)	3.5 mm
C3620	*f*0	2.0 - 36 GHz	≥ 10:1 (typ. 15:1)	2.92 mm
C4030	*f*0	3.0 - 40 GHz	≥ 10:1 (typ. 15:1)	2.92 mm
C4060B	*f*0	6 - 40 GHz	≥ 10:1	2.92 mm
C4080B	*f*0	8 - 40 GHz	≥ 10:1	2.92 mm
C5020B	*f*0	2 - 50 GHz	≥ 10:1	2.4 mm
C5060B	*f*0	6 - 50 GHz	≥ 10:1 (typ. 15:1)	2.4 mm
C5080B	*f*0	8 - 50 GHz	≥ 10:1 (typ. 15:1)	2.4 mm
C6750B	*f*0	5 - 67 GHz	≥ 6:1	1.85 mm
C67100B	*f*0	10 - 67 GHz	≥ 10:1 (typ. 15:1)	1.85 mm
C110240	*f*0	24 - 110 GHz	≥ 8:1	1 mm
C110500	*f*0	50 - 110 GHz	≥ 10:1 (typ. 12:1)	1 mm
C120270	*f*0	27 - 120 GHz	≥ 6.5:1	1 mm
L3018	*f*0, 2*f*0	1.8 - 30 GHz	10:1 - 50:1	2.92 mm
L3620	*f*0, 2*f*0	2 - 36 GHz	10:1 - 50:1	2.92 mm
L4030	*f*0, 2*f*0	3 - 40 GHz	10:1 - 50:1	2.92 mm
L4060B	*f*0, 2*f*0	6 - 40 GHz	10:1 - 50:1	2.92 mm
L4080B	*f*0, 2*f*0	8 - 40 GHz	10:1 - 50:1	2.92 mm
L5060B	*f*0, 2*f*0	6 - 50 GHz	7:1 - 50:1	2.4 mm
L5080B	*f*0, 2*f*0	8 - 50 GHz	10:1	2.4 mm
L6750B	*f*0, 2*f*0	5 - 67 GHz	6:1 - 50:1	1.85 mm
L67100B	*f*0, 2*f*0	10 - 67 GHz	10:1-50:1	1.85 mm
L110240	*f*0, 2*f*0	24 - 110 GHz	6:1 - 30:1	1 mm
L120270	*f*0, 2*f*0	27 - 120 GHz	6:1 - 30:1	1 mm
M3018	*f*0, 2*f*0, 3*f*0	1.8 - 30 GHz	10:1 - 50:1	3.5 mm
M3620	*f*0, 2*f*0, 3*f*0	2 - 36 GHz	10:1 - 50:1	2.92 mm
M4030	*f*0, 2*f*0, 3*f*0	3 - 40 GHz	10:1 - 50:1	2.92 mm
M4060B	*f*0, 2*f*0, 3*f*0	6 - 40 GHz	10:1 - 50:1	2.92 mm
M4080B	*f*0, 2*f*0, 3*f*0	8 - 40 GHz	10:1 - 50:1	2.92 mm
M5060B	*f*0, 2*f*0, 3*f*0	6 - 50 GHz	7:1 - 50:1	2.4 mm
M5080B	*f*0, 2*f*0, 3*f*0	8 - 50 GHz	10:1 - 50:1	2.4 mm
M6750B	*f*0, 2*f*0, 3*f*0	5 - 67 GHz	6:1 - 50:1	1.85 mm
M67100B	*f*0, 2*f*0, 3*f*0	10 - 67 GHz	10:1 - 50:1	1.85 mm
M110240	*f*0, 2*f*0, 3*f*0	24 - 110 GHz	6:1 - 30:1	1 mm
M120270	*f*0, 2*f*0, 3*f*0	27 - 120 GHz	6:1 - 30:1	1 mm