Zomega Terahertz

THz System & Component Catalog

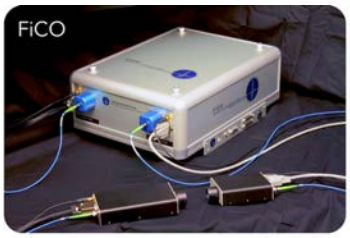
Introduction

Overview

Zomega Terahertz Corporation is a leading supplier of innovative solutions and components for the terahertz community. Since 2006, Zomega has been providing terahertz instruments and components to both universities and industry worldwide. As the pioneer of compact, highly-integrated, real-time terahertz systems, such as the Mini-Z™, Zomega has advanced the frontier of terahertz technology to make it more accessible, versatile, and reliable for both expert and non-expert users.

Systems

Zomega offers a broad selection of complete terahertz time-domain systems as standard products, backed by 1 year limited warranty and our commitment to deliver the terahertz instrumentation that you need to succeed.



Zomega's terahertz systems are available in a variety of form factors targeting different needs and application requirements from compact, portable systems like the Mini-Z to research oriented systems like the ZAP™ or Z3™. The FiCO™, Zomega's fiber-coupled system, provides the most flexibility and versatility, and it is suitable for OEM integration applications.

All systems come with pre-installed software and computer. Software is open-source and fully customizable via open source plugin architecture at no extra cost to you so that any analysis or functionality can be easily added.

Components for Research

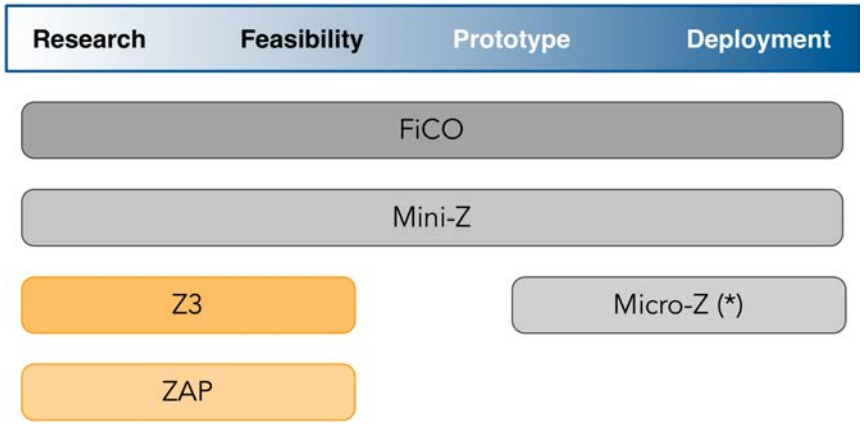
Beyond producing complete systems, Zomega aims to provide a complete set of specialty components and materials for terahertz research and development. This catalog highlights some of the most popular products. Please consult the online catalog for the most complete, up-to-date information!

Application Guideline

Each system has specific features that are best suited for certain applications. The table below provides a general guideline of systems versus most common applications. Zomega can even provide a handheld and battery operated system, the Micro-Z™, for applications that truly demand the ultimate portability. Contact us with your application or research requirements so we can provide the best possible system for you.

Application/System	FiCO	Mini-Z	Z3	ZAP
Spectroscopy (Bandwidth)	**4 THz**	3.5 THz	3.5 THz	**>10 THz**
Spectroscopy (Data rate)	**Fastest**	**Fastest**	Slow	Slow
NDE/Imaging	**Best**	**Best**	Good	Inquire
NDE/Tomography	**Best**	N/A	N/A	N/A
NDE/Thickness measurements	**Best**	Good	Good	Inquire
Medical/biological	**Best**	**Best**	Good	Inquire
Optical-Pump Terahertz-Probe	N/A	N/A	Good	**Best**
Low-temperature/cryogenics	**Best**	Inquire	Inquire	Good

An important factor when selecting a system is the level of familiarly of the user with the technology and the development stage of the application. For instance, both the FiCO and Mini-Z are highly-integrated, user-friendly systems that can cover all development stages from research to deployment. On the other hand, the Z3 and ZAP systems are designed for the research and feasibility stages for users that have some familiarity with optical and laser systems.



(*) Micro-Z is a handheld, battery operated system designed for very specific requirements. Please, inquire for more information.

The All-in-One Terahertz System

With independent fiber-coupled emitter and receiver heads, the FiCO Terahertz time-domain system offers the maximum flexibility in measurement geometry. The system can be quickly reconfigured in transmission, normal reflection or pitch-catch reflection geometries to accommodate a variety of measurement conditions and sample sizes. Waveform acquisition rates up to 500 Hz makes the FiCO ideal for high-speed spectroscopy and imaging for non-destructive testing applications. Robust hardware and open software architecture make FiCO the perfect choice for any stand-alone operation or OEM integration.

Typical applications

- Spectroscopic material characterization/ imaging
- Non-destructive evaluation/imaging
- Thickness measurements

Features

- Independent fiber-coupled emitter and receiver heads
- Fast waveform scanning rate up to 500 Hz
- Broad bandwidth or high sensitivity selectable with the flip of a switch
- Multiple applications and inspection geometries (transmission, normal and pitch-catch reflection)
- Easy operation and minimal maintenance
- Multiple lens options to accommodate a variety of imaging conditions
- Measurement point indicated by laser guide for precise alignment
- Customizable software

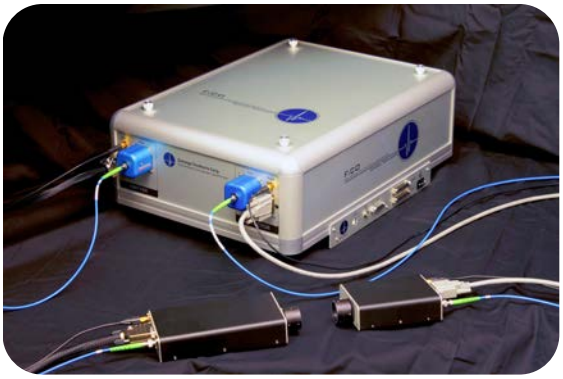


Figure 1. FiCO base, emitter, and receiver heads. External laser option not shown.

Figure 2. FiCO heads mounted on integrated imaging stage in pitch-catch geometry. Transmission and normal reflection geometries are also possible with this imaging stage.

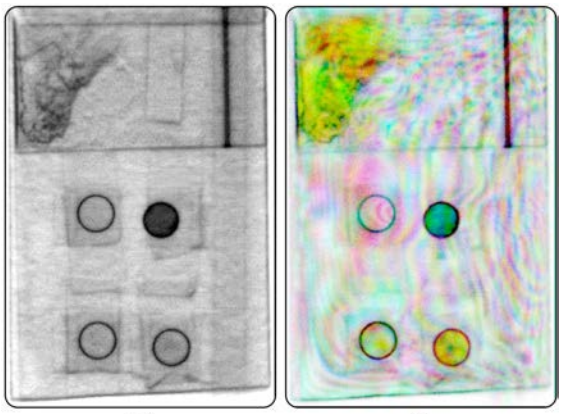


Figure 3. Amplitude (a) and false color (b) images of an envelope containing four pellets taped within a folded piece of paper inserted into an envelope along with a small ziploc bag containing alpha lactose powder.

Specifications (P/N 15-FCO-STDX-005)

Bandwidth	High sensitivity: 0.1 - 2 THz (peak @0.75 THz) Broad bandwidth: 0.1 - 4 THz (peak @0.75 THz)
Dynamic range	High sensitivity: >50 dB @500 Hz, >70 dB @1 Hz Broad bandwidth: >38 db @500 Hz, >58 dB @1 Hz
Frequency resolution	11 GHz
Waveform rate[1]	500 Hz
Geometry	Transmission, normal and pitch-catch reflection
Software	Terahertz Analysis and Control (TAC) software with plug-in architecture for custom application development
Size (LxWxH) / Weight	FICO base: 22" x 14" x 7" / 65 lb. Emitter module: 8" x 3.5" x 1.3" / 5 lb. Receiver module: 6" x 3.5" x 1.3" / 3 lb. Laser[2]: 12.5" x 9.25" x 5.5" / 23 lb.

1. Delay range is fixed at 100 ps.
2. Free space laser input option.

Common configurations

Imaging	Integrated high-speed imaging stage, 150 mm x 150 mm range. P/N 45-IMG-150M-001
ATR	Attenuated Total Reflection module for liquid and bio-tissue characterization. P/N 45-ATR-STDX-002
T2T	Angle of incidence sweep (normal, 15° - 80°) for reflectometry studies. P/N 45-T2T-STDX-003
Cryostat	Cryostat integration (closed cycle or continuous flow). Please inquire with your requirements. P/N 45-FCO-CRYO-004
Purge cell	Integration with purgeable chamber. Includes transmission and normal reflection modules. P/N 45-FCO-PURG-005

Mini-Z™

Systems

The Portable and Compact Terahertz Time-Domain Spectrometer

Overview

The Mini-Z is a state-of-the-art terahertz system for its integration level, compact form factor, unparalleled portability, and ease of operation. The Mini-Z can be transported in a small equipment case (notebook computer-size form) and perform measurements in both laboratory and industrial environments. The Mini-Z is ideal for spectroscopic and non-destructive inspection applications in transmission or normal-reflection and it is offered in two models: standard and the high-speed (HS). The standard model can operate up to 5 Hz with a variable time delay, whereas the HS operates at 500 Hz with a fixed delay of 100 ps.

Typical applications

- Spectroscopic material characterization/ imaging
- Non-destructive evaluation/imaging
- Thickness measurements

Features

- Compact and portable integrated terahertz system
- Waveform scanning rate up to 5 Hz (standard) or 500 Hz (HS model)
- Turn-key system, minimal adjustments and maintenance
- Broad bandwidth or high sensitivity selectable with the flip of a switch
- Quick and easy switching between reflection and transmission
- Vibration tolerant
- Operates in most indoor environments
- Customizable software
- Fiber-coupled pump laser

Figure 4. Mini-Z with the normal reflection module mounted. Mini-Z includes both transmission and reflection modules.

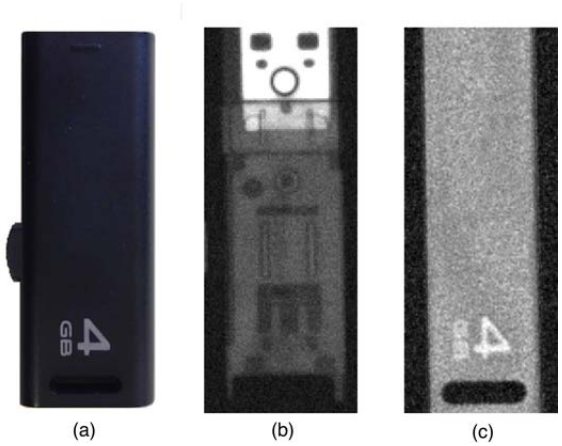


Figure 5. Imaging inspection of an USB stick. Time-domain data allow imaging different layers. (a) Picture of stick. (b) Terahertz amplitude image of internal structure. (c) THz amplitude of top surface.

Specifications

Model	Mini-Z P/N 15-MNZ-STDX-011	Mini-Z HS P/N 15-MNZ-HISP-012
Waveform rate[1]	0.1 - 5 Hz	500 Hz
Scan range	Adjustable - up to 300 ps	Fixed - 100 ps
Dynamic range	>70 dB @30 ps, 1 min >55 dB @30 ps, 1 sec	>70 dB, 1 min >55 dB, 1 sec >30 dB, 2 ms
Bandwidth	0.1 - 3.5 THz (peak @0.75 THz)	
Frequency resolution	<25 GHz	
Geometry[2]	Transmission and normal reflection	
Standoff distance	1 - 40 cm	
Software	Terahertz Analysis and Control (TAC) software with plug-in architecture for custom application development	
Size (LxWxH) / Weight[3]	10.75" x 6.75" x 3.375" / 6.4 lb.	

1. Scan rate in the standard Mini-Z depends of the delay stage speed and window size.
2. Transmission module (P/N 45-TRX-050M-007) and reflection module (P/N 45-NRX-025M-006) included.
3. Size and weight quoted for the THz system only. Does not include size of laser and computer.

Common configurations

Imaging	Integrated high speed imaging stage. Ranges available are 150 mm x 150 mm (P/N 45-IMG-150M-001) or 50 mm x 50 mm (P/N 45-IMG-050M-008).
ATR	Attenuated Total Reflection module for liquid and bio-tissue characterization. P/N 45-ATR-STDX-002
T2T	Angle of incidence sweep (normal, 15° - 80°) for reflectometry studies. P/N 45-T2T-STDX-003

Overview

The Z3 Terahertz Time Domain Spectrometer is a robust, powerful instrument packed with features and options that both meets your needs today and grows with your research needs in the future. The Z3 is widely compatible with femtosecond oscillators, fiber, and regenerative amplifier (RGA) laser systems in the market, configurable to accept pulse energies from the nJ to mJ range. The Z3 can be purchased as an accessory for an existing pump laser or as a complete system. The Z3 supports measurements in normal reflection and transmission. A baseline time delay adjustment allows the Z3 to also support reflection measurements up to 4" stand-off distance. Reflection measurements with variable angle of incidence can be performed as well. For optical-pump terahertz-probe (OPTP) applications, the Z3 supports a standard scanning range of over 1.3 ns.

Typical applications

- Spectroscopic material characterization
- Optical pump terahertz probe
- Non-destructive testing
- Thickness measurements

Features

- Broadband sensitivity up to 3.5 THz
- High dynamic range (>70 dB at peak)
- Transmission and reflection modes
- Compatible with many oscillator and fiber laser systems
- Quick nitrogen/dry air purge
- Open architecture and large sample chamber
- Long time delay of 1.3 ns or longer
- Customizable software

Figure 6. Picture of standard Z3 THz TDS. The pump beam enters (external laser not shown) in the rear of the spectrometer and the purgeable system has three ports on the front to send the terahertz beam as required by the application. Control of the Z3 is enabled by TAC software and the connector bus shown above.

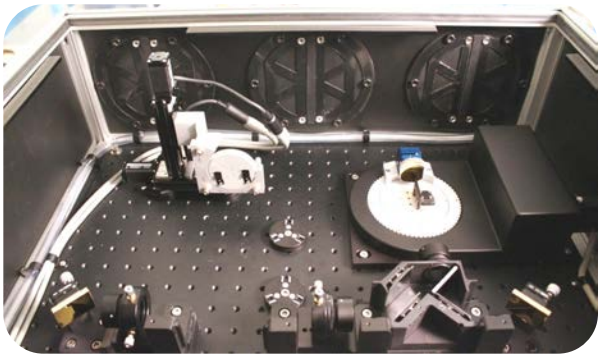


Figure 7. Z3 standard sample chamber with imaging (left) and T2T (right) modules.

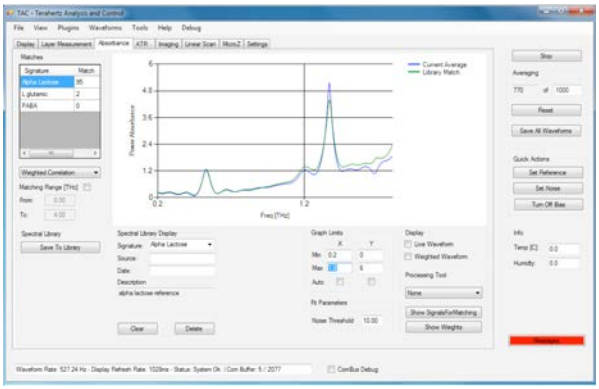


Figure 8. Screenshot of TAC software for absorbance measurements and compound library matching.

Demonstrated performance

Configuration	Z3-STANDARD	Z3-AMPLIFIER
Pump source (@780-820 nm)	Fiber laser or Ti:S oscillator	Fiber oscillator-amplifier, CW pumped RGA, or kHz pumped RGA
Pump energy	<10 nJ	100 uJ to 2 mJ
Emitter / Receiver	PCA / EO sampling	EO rectification / EO sampling
Bandwidth[1]	0.1 - 3.5 THz	
Frequency resolution	<5 GHz	
Time delay	1.3 ns (longer ranges upon request)	
Dynamic range[2]	>70 dB (peak @0.7 THz)	>60 dB (peak @0.7 THz)
Geometry	Transmission and reflection (modules included)	
Software	Terahertz Analysis and Control (TAC)	
Size (LxWxH) / Weight[3]	38" x 26" x 13" / <100 lb.	48" x 24" x 10" / <170 lb.

1. Pulse widths from 50 to 80 fs, pump power of 120 mW for Z3-STANDARD. Pulse widths <80 fs and pulse energy of 1 mJ for Z3-AMPLIFIER. Bandwidth up to 6 THz is possible with the extended bandwidth option.
2. Dynamic range quoted for the power spectrum from the FFT of the waveform. It can be substantially lower if laser noise is significant.
3. Size is quoted for the THz system only. Does not include the size of the laser, computer, TIC or external supporting optics. Other case sizes available.

Common configurations

OPTP	A 2-axis TIC and a second time delay stage allows adjusting the timing between the optical pump and the terahertz probe at the sample. This option can use an external laser or split a portion of the input beam as the optical pump.
ATR	Attenuated Total Reflection module for liquid and bio-tissue characterization. P/N 45-ATR-STDX-002
T2T	Angle of incidence sweep (normal, 15° - 80°) for reflectometry studies. P/N 45-T2T-STDX-003
Imaging	Integrated high speed imaging stage, range is 50 mm x 50 mm. P/N 45-IMG-050M-008
Gas cell	1 m path cavity for gas-phase measurements. Not compatible with other options. P/N 45-Z3X-GASX-010
Extended bandwidth	300 um GaP detector for bandwidth up to 6 THz. Sensitivity is reduced. P/N 45-Z3X-GAPX-012

ZAP™ - Zomega Air Photonics

Systems

Ultra-broadband, High Electric Field Terahertz Time-Domain Spectrometer

Overview

Terahertz Air Biased Coherent Detection (THz-ABCD) is a radical new technique that uses air-plasma to both generate and detect ultra-broadband terahertz radiation. With THz-ABCD it is possible to reach bandwidths in excess of 20 THz limited only by laser pulse duration with no phonon absorption or damage threshold because no solid material is involved in the generation or detection. THz-ABCD also generates high terahertz electric fields that enable non-linear spectroscopy.

The Zomega Air Photonics (ZAP) Terahertz Time Domain Spectrometer offers a convenient integrated package with a large sample chamber to accommodate a variety of experimental requirements, including optical-pump terahertz-probe (OPTP) and integration with cryostats for low temperature measurements. The ZAP requires an amplifier laser system (not included as standard).

Typical applications

- Spectroscopy material characterization
- Optical pump terahertz probe
- Non-linear spectroscopy

Features

- Ultra-broad bandwidth (>10 THz), gapless spectral coverage from mm-wave to FIR
- High THz electric field (>100 kV/cm), non-linear spectroscopy
- Higher SNR below 10 THz than cryo-cooled FTIR
- Room-temperature detector
- Large sample chamber
- Customizable software

Figure 9. ZAP system. External amplifier laser system not shown.

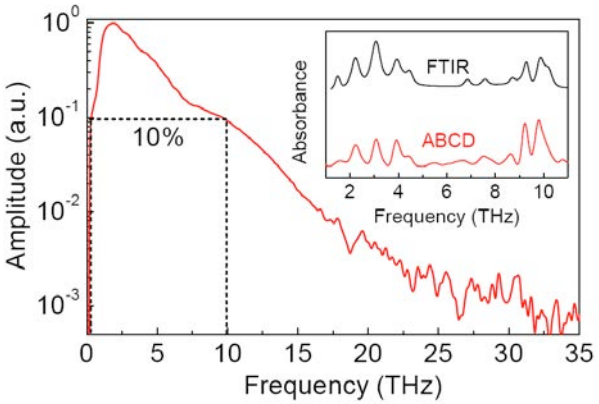


Figure 10. Typical ZAP spectrum. With a pump pulse duration of <35 fs, bandwidths of >20 THz are possible.

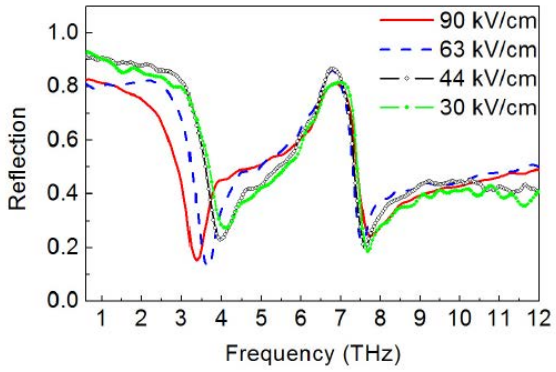


Figure 11. Reflectivity of InAs as a function of THz electric field showing a non-linear effect.

ZAP™ - Zomega Air Photonics

Ultra-broadband, High Electric Field Terahertz Time-Domain Spectrometer

Specifications (P/N 15-ZAP-STDX-002)

Bandwidth[1]	0.1 - 10 THz
Frequency resolution	<1 GHz
Dynamic range[2]	>60 dB (peak @3 THz)
Geometry[3]	Transmission and normal reflection
E-field strength	>100 kV/cm
Experimental chamber	24" x 10" x 6", purgeable
Emitter	Air-plasma generation
Detector	Heterodyne air-plasma detection
Software	Terahertz Analysis and Control (TAC) software with plug-in architecture for custom application development
Size (LxWxH) / Weight[4]	48" x 24" x 10" / 170 lb.

1. Bandwidth depends on pump laser width. For best results out to 10 THz, a pulse width of 80 fs or less is required.
2. Assumes a 2.5 W average power mode-locked Ti:Sapphire laser pump with a pulse width of <50 fs. Dynamic range is quoted for the electric field, and can be substantially lower if laser noise is a significant factor. Typical suitable repetition rates for this configuration are 1 to 5 kHz. Minimum pulse energy is 1 mJ.
3. Transmission and reflection modules included.
4. Size is quoted for the THz system only. Does not include the size of the laser, computer, TIC or external supporting optics.

Common configurations

Amplifier laser	Terahertz Air Photonics Spectrometer bundled with amplifier pump laser (3 mJ/pulse - 30 fs pulse) - complete system. P/N 45-ZAP-LASE-013
OPTP	A second time delay stage allows adjusting the timing between the optical pump and the terahertz probe at the sample. This option can use an external pump from an OPA, or to split a portion of the input beam as the optical pump beam. Please inquire with your requirements. P/N 45-ZAP-OPTP-014
Cryostat	Cryostat integration (closed cycle or continuous flow). Please inquire with your requirements. P/N 45-ZAP-CRYO-015

ZAP-APD

Zomega Air Photonics Detector

Overview

Terahertz Air Biased Coherent Detection (THz-ABCD) technique uses air plasma to generate and detect terahertz pulses. The ZAP-APD implements the detection side of the technique. This detector is capable to measure ultra-broadband and high electric field terahertz radiation from sources such as plasma or tilted-wavefront emitters with bandwidth only limited by the duration of the terahertz pulse. The ZAP-APD includes both the detector module and the HVM-5KV, which is used to bias the weak plasma inside the detector.

Figure 12. ZAP-APD picture showing the THz input window.

Features

- Convenient small-footprint integrated package
- Easy alignment and operation
- Room-temperature detector (no expensive cyrogenics)
- Ultra-broad bandwidth (>10 THz)
- Capable to measure high terahertz electric fields (>100 kV/cm)
- Higher SNR below 10 THz than cryo-cooled FTIR

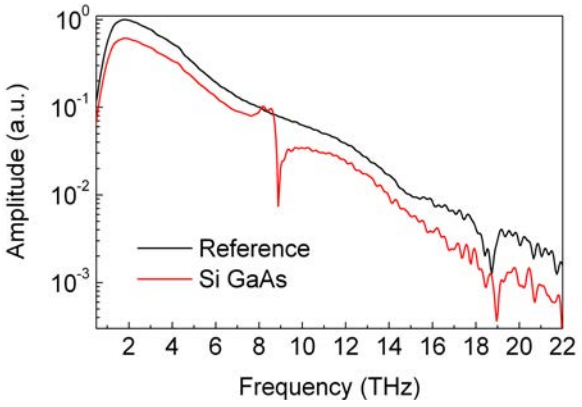


Figure 13. Spectrum of semi-insulating (Si) GaAs with air-plasma generation and detection showing phonon absorption around 9 THz.

Specifications

Bandwidth[1]	0.1 - 10 THz
Dynamic Range[2]	>60 dB at peak
THz Detector	Heterodyne air-plasma detection
Dimensions / Weight	8"x5"x3" / 3.6 lb.
P/N	25-APD-STDX-001

1. Bandwidth depends on pump laser pulse width. For best results out to 10 THz, a pulse width of 80 fs or less is required with air-plasma generation using 1 mJ/pulse.
2. Assumes a 2.5 W average power mode-locked Ti:Sapphire laser pump with a pulse width of <50 fs. Dynamic range is quoted for the electric field, and can be substantially lower if laser noise is a significant factor. Typically suitable repetition rates are 1 to 5 kHz. Minimum pulse energy is 1 mJ.

Related products:

HVM-5KV (included)
BBO crystals
Pierced OAP

HVM-5KV

High Voltage Modulator

Overview

The THz Air Biased Coherent Detection (THz-ABCD) mechanism provides an ultra-broadband, high dynamic range method for spectroscopy across the entire terahertz range. The HVM-5KV is specially designed with essential features to achieve the best results with THz-ABCD detection, including the use with the ZAP-APD detector module. the HVM-5KV utilizes a dual square wave output to generate a pseudo square wave to modulate the weak plasma inside the ZAP-APD at a frequency of one half the frequency of the repetition rate of the laser.

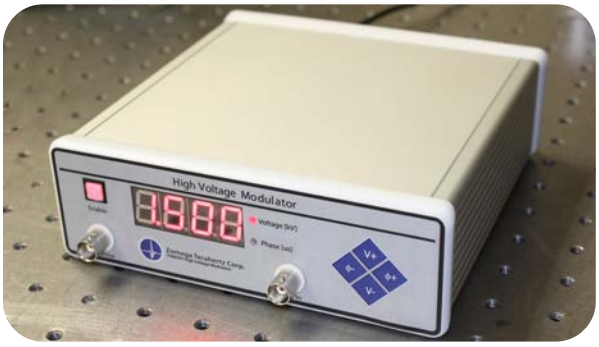


Figure 14. HVM-5KV front panel.

Features

- Designed for THz Air Biased Coherent Detection (THz-ABCD) technique
- Convenient small footprint integrated package
- Digital phase adjustment relative to input TTL
- Micro-controller stabilized voltage output
- Front panel voltage and phase control
- Easy operation
- Optimized for ZAP-APD
- Unipolar, bipolar, and DC output

Specifications

Output Voltage	100 V - 1.8 kV (single) 200 V - 3.6 kV (bipolar)
Modulation Frequency	500 Hz - 15 kHz
Output Waveform	Square wave
Reference Input	External 3 V -5 V TTL
Output Connection	Protected Banana Jacks
Dimensions / Weight	6.5”x6.25”x2.25” / 2 lb.
P/N	12-HVM-5KVS-004

Related products:

ZAP-APD

HVM-500

High Voltage Modulator

Overview

Pulsed terahertz generation using a photo-conductive antenna (PCA) often relies on an optical chopper to modulate the terahertz signal measured by a lock-in amplifier. However, electronic and laser noise below 2 kHz and unstable chopper modulation can limit the dynamic range of a terahertz system. The HVM-500 offers the flexibility to select a modulation frequency in a "quiet" part of your lab's electronic noise spectrum, and since it is frequency coupled to the TTL output of your lock-in, you can be sure to minimize the noise characteristics of your system. The HVM-500 is designed to work in terahertz time-domain spectrometers using either PCA or electro-optical (EO) detectors, and is also perfectly matched for EO detection using our auto-balanced detector ABL-100.

Features

- Antenna burn-out protection with user-programmable current limit and anti-surge/ slow power-up cycle
- Convenient small footprint integrated package
- Micro-controller stabilized voltage output
- Toggle up/down front panel voltage control
- Settings memory
- Unipolar and bipolar outputs available
- Optimized for PCAs
- USB control with user configurable output settings
- Opto-isolated TTL input

Figure 15. Button and display in the front allow setting and displaying output voltage.

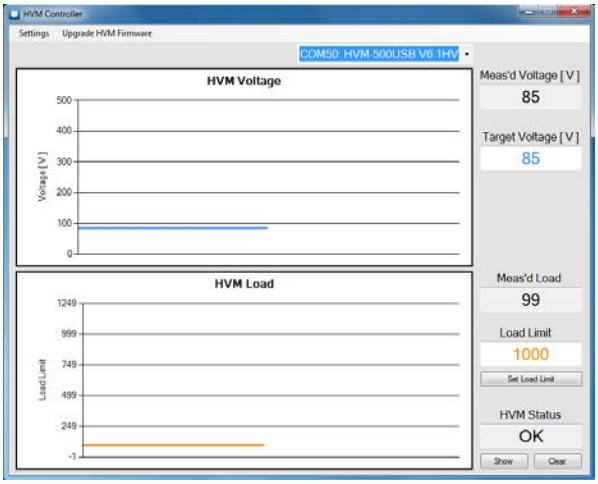


Figure 16. HVM-500 controller software.

Related products:

PCAs
ABL-100
EO crystals

Options

AC-coupled (Default)

This option provides a bipolar output with a peak to peak amplitude equal to a set value HV. This option is optimized to operate at high modulation frequencies between 1 to 100 kHz. Maximum set value HV is 500 V.

DC-coupled

The output in this option is unipolar between 0 V and a positive set value HV. This option is optimized to operate at low modulation frequencies starting at 10 Hz. Maximum set value HV is 500 V.

Pseudo-Square (PS)

In this option, two DC-coupled outputs are shifted 180° in time and subtracted across the connected load to generate a bipolar output with a peak to peak amplitude equal to 2HV. The operation in this option is also optimized for low modulation frequencies starting at 10 Hz. Maximum set value HV is 500 V.

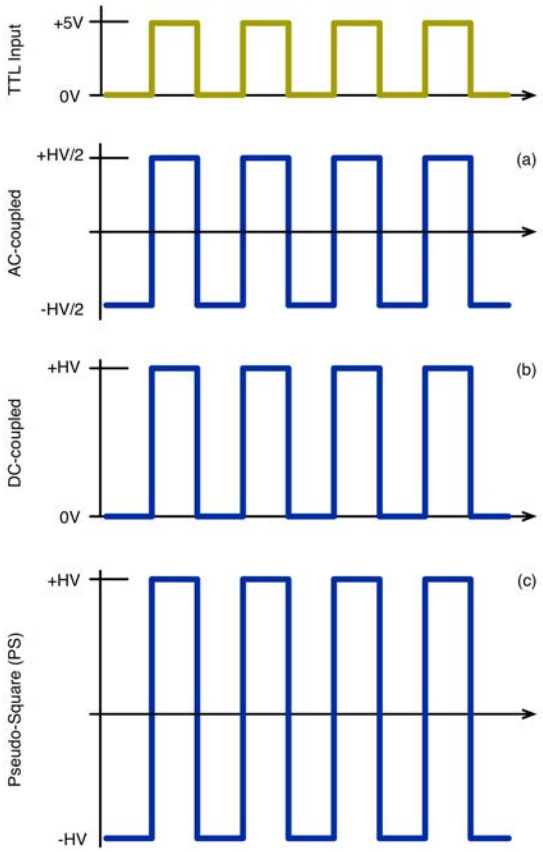


Figure 17. HVM outputs for the different options.

Specifications

Model	AC-coupled	DC-coupled	Pseudo-Square
P/N	12-HVM-500A-001	12-HVM-500D-002	12-HVM-500S-003
Modulation Frequency	1 kHz - 100 kHz	10 Hz- 100 kHz	10 Hz - 100 kHz
Output Voltage	50 - 500 Vpp		2 channels: 50 - 500 Vpp
Output Waveform	Square Wave		Pseudo-Square
Output Connector	BNC		3-pin-mini-DIN
Output Load (Max)	25 mA		
Reference Input	External 5V TTL		
Dimensions / Weight	6.5" x 3" x 2" / 1 lb.		

PCA

Components

Photo-Conductive Antenna Emitter

Overview

A photo-conductive antenna (PCA) generates terahertz waves via the temporal variation of the photo-current created by a femto-second laser pulse and the bias applied across the electrodes.

Features

- Broadband Terahertz emission (>4 THz)
- High dynamic range (>70 dB)
- Linear polarization perpendicular to bias direction
- Durable, stable and low-maintenance
- Si-GaAs or LT-GaAs available
- Efficient coupling with Si hemispheric lens
- High-repeatability mounting system
- Designed for operation at 780 - 800 nm
- Different gap sizes available, please inquire

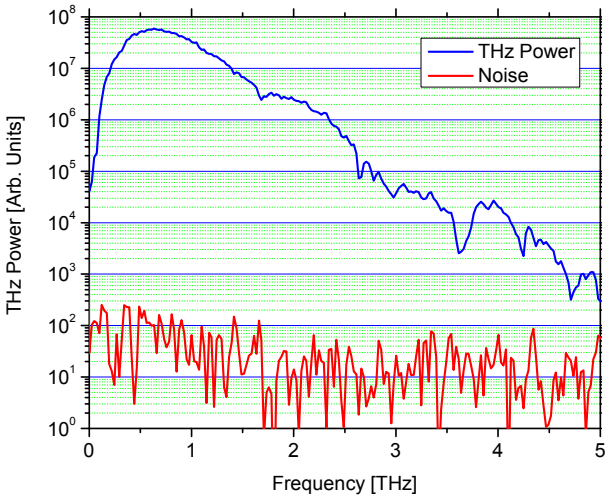


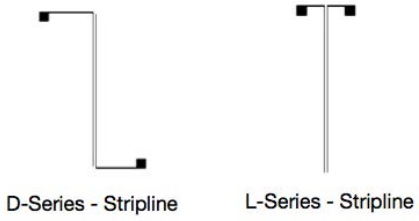
Figure 18. Stripline antenna (16-PCA-LTGA-002) measured with EO detection with 1 mm thick <110> ZnTe crystal. Pump beam is 780 nm, 100 fs, 10 mW average power at 50 MHz repetition rate.

Related products:

HVM-500
ABL-100
EO crystals

Specifications

P/N	Material	Gap Size	Vmax(1)	Pmax(2)
16-PCA-LTGA-001 (3)	LT GaAs	50 µm	150 V	50 mW
16-PCA-LTGA-002	LT GaAs	50 µm	150 V	50 mW
16-PCA-GAAS-003	SI-GaAs	250 µm	250 V	400 mW
16-PCA-GAAS-004	SI-GaAs	200 µm	200 V	300 mW
16-PCA-GAAS-005	SI-GaAs	150 µm	150 V	200 mW
16-PCA-GAAS-006	SI-GaAs	100 µm	100 V	100 mW
16-PCA-GAAS-007	SI-GaAs	80 µm	100 V	60 mW



1. Maximum bias amplitude for safe, long-term operation of antenna without degradation.
2. Maximum pump beam intensity recommended to prevent antenna damage, assuming 100 fs pulses and repetition rate from 20 to 100 MHz. Shorter pulse duration or lower repetition rates may require lower pump power.
3. Pre-aligned high-resistivity Silicon hemisphere lens.

ABL-100

Auto-Balanced Detector

Overview

The ABL-100 is an integrated balanced detection device with automatic tuning for hands-free and long-term stable operation, compensating drifts due to changes in humidity and temperature. Balanced detection is achieved when S and P polarizations of the probe beam are balanced to give zero net current in absence of terahertz. An electro-optic crystal breaks the balance when it senses the presence of a terahertz wave.

Figure 19. ABL-100 unit. EO crystal is not shown. EO crystal and focusing lens are not included.

Features

- Hands free, set and forget operation
- High sensitivity wide area photo-diodes
- Small footprint, integrated package
- Easy alignment and operation
- Anti-reflection coatings for all optics
- High-extinction ratio calcite Wollaston prism (<5 10^{-6})
- User selectable balance point

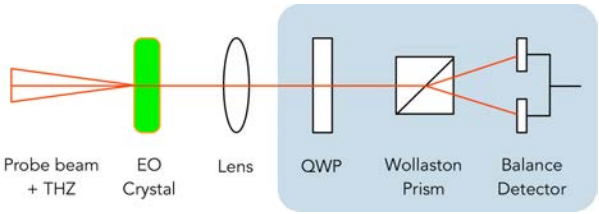


Figure 20. Typical EO sensing schematic. The Quarter Wave Plate (QWP) balances the detector in absence of terahertz radiation so that net current is zero. Terahertz illuminating the EO crystal will cause changes in its birefringence, breaking the balance between S and P polarizations. Shaded area indicates components included in ABL-100.

Specifications

Model[1]	ABL-100	ABL-100-1kHz	ABL-100-10Hz
P/N	15-ABL-STDX-006	15-ABL-1KHZ-007	15-ABL-10HZ-008
Modulation range	DC - 300 kHz	1 - 5 kHz	<100 Hz
Laser repetition rate	≥10 MHz	1 - 5 kHz	<100 Hz
Wavelength	740 - 860 nm		
Voltage/Current Mode Output (max)	±5 V / 1 µA		
Output Connector	SMA		
Dimensions / Weight	4.5" x 2" x 2.25" / 0.5 lb.		

1. EO crystal and focusing lens not included.

Terahertz Optics and Materials

Overview

Below is a list of standard optics and material components that we provide to serve the needs of the terahertz research community, including electro-optical (EO) crystals, TPX and high-density polyethylene (HDPE) lenses, and specialty optics such as the pierced off-axis parabolic (OAP) mirrors.

Category	P/N	Description
Crystals	10-EOD-ZNTE-004	ZnTe <110> EO crystal, **11x10x1 mm**, 2 sides polished, mounted
	10-EOD-ZNTE-005	ZnTe <110> EO crystal, **11x10x2 mm**, 2 sides polished, mounted
	10-EOD-ZNTE-006	ZnTe <110> EO crystal, **6x5x2 mm**, unmounted
	10-EOD-GAPX-007	GaP <110> EO crystal, **10x10x0.2 mm**, 2 sides polished, mounted
	10-EOD-GAPX-008	GaP <110> EO crystal, **10x10x0.3 mm**, 2 sides polished, mounted
	10-BBO-PART-009	BBO crystal, **6x6x0.1 mm**, mounted
	10-BBO-PART-002	BBO crystal, **7x7x0.3 mm**, mounted
HDPE Optics	10-LEN-HDPE-010	HDPE lens, **25.4 mm** diameter, **50 mm** focal length
	10-LEN-HDPE-011	HDPE lens, **25.4 mm** diameter, **100 mm** focal length
	10-LEN-HDPE-012	HDPE lens, **25.4 mm** diameter, **150 mm** focal length
	10-LEN-HDPE-013	HDPE lens, **25.4 mm** diameter, **200 mm** focal length
	10-LEN-HDPE-014	HDPE lens, **25.4 mm** diameter, **250 mm** focal length
	10-LEN-HDPE-015	HDPE lens, **25.4 mm** diameter, **300 mm** focal length
	10-LEN-HDPE-016	HDPE lens, **50.8 mm** diameter, **75 mm** focal length
	10-LEN-HDPE-017	HDPE lens, **50.8 mm** diameter, **100 mm** focal length
	10-LEN-HDPE-018	HDPE lens, **50.8 mm** diameter, **150 mm** focal length
	10-LEN-HDPE-019	HDPE lens, **50.8 mm** diameter, **200 mm** focal length
	10-LEN-HDPE-020	HDPE lens, **50.8 mm** diameter, **250 mm** focal length
	10-LEN-HDPE-021	HDPE lens, **50.8 mm** diameter, **300 mm** focal length
	10-LEN-HDPE-022	HDPE lens, **50.8 mm** diameter, **350 mm** focal length
	10-LEN-HDPE-023	HDPE lens, **50.8 mm** diameter, **400 mm** focal length
	10-LEN-HDPE-024	HDPE lens, **76.2 mm** diameter, **100 mm** focal length
	10-LEN-HDPE-025	HDPE lens, **76.2 mm** diameter, **150 mm** focal length
	10-LEN-HDPE-026	HDPE lens, **76.2 mm** diameter, **200 mm** focal length
	10-LEN-HDPE-027	HDPE lens, **76.2 mm** diameter, **250 mm** focal length
	10-LEN-HDPE-028	HDPE lens, **76.2 mm** diameter, **300 mm** focal length
	10-LEN-HDPE-029	HDPE lens, **76.2 mm** diameter, **350 mm** focal length
	10-LEN-HDPE-030	HDPE lens, **76.2 mm** diameter, **400 mm** focal length

Terahertz Optics and Materials

Please, inquire if you need a component that is not listed here, we may be able to help you. Check our online store at https://ssl.z-thz.com.

Category	P/N	Description
TPX Optics	10-LEN-TPXX-031	TPX lens, **25.4 mm** diameter, **25 mm** focal length
	10-LEN-TPXX-032	TPX lens, **25.4 mm** diameter, **50 mm** focal length
	10-LEN-TPXX-033	TPX lens, **25.4 mm** diameter, **100 mm** focal length
	10-LEN-TPXX-034	TPX lens, **50.8 mm** diameter, **50 mm** focal length
	10-LEN-TPXX-035	TPX lens, **50.8 mm** diameter, **100 mm** focal length
	10-WIN-TPXX-036	TPX window, **1.25"** diameter, **2 mm** thickness
High Resistivity Silicon	10-LEN-HRSI-010	HR Silicon ball lens, **10 mm** diameter, **4.45 mm** height
	10-WAF-HRSI-037	HR Silicon wafer, **100 mm** diameter, **3 mm** thickness
	10-WAF-HRSI-003	HR Silicon wafer, **50.8 mm** diameter, **2 mm** thickness
Specialty optics	10-OAP-STDX-004	Pierced OAP mirror, **50.8 mm** diameter 50.8 m, **2"** effective focal length, protected **Au**
	10-OAP-STDX-005	Pierced OAP mirror, **50.8 mm** diameter 50.8 m, **4"** effective focal length, protected **Au**
	10-OAP-STDX-006	Pierced OAP mirror, **50.8 mm** diameter 50.8 m, **6"** effective focal length, protected **Au**
	10-OAP-STDX-007	Pierced OAP mirror, **50.8 mm** diameter 50.8 m, **2"** effective focal length, protected **Al**
	10-OAP-STDX-008	Pierced OAP mirror, **50.8 mm** diameter 50.8 m, **4"** effective focal length, protected **Al**
	10-OAP-STDX-009	Pierced OAP mirror, **50.8 mm** diameter 50.8 m, **6"** effective focal length, protected **Al**

ZnTe | HDPE lens | TPX lens | HR Si wafers | HR Si lens | Pierced OAP

Options

Option	System	P/N	Description
Imaging	Mini-Z, FICO	45-IMG-150M-001	Integrated high-speed imaging stage, 150 mm x 150 mm range.
	Mini-Z, Z3	45-IMG-050M-008	Integrated high speed imaging stage, 50 mm x 50 mm range. Figure 24.
ATR	Mini-Z, Z3, FICO	45-ATR-STDX-002	Attenuated Total Reflection module for liquid and bio-tissue characterization. Figure 22.
		45-ATR-TEMP-012	ATR module with temperature control (room temperature to 100 °C).
T2T	Mini-Z, Z3, FICO	45-T2T-STDX-003	Angle of incidence sweep (normal, 15° - 80°) for reflectometry studies. Figure 21.
OPTP	Z3	45-Z3X-OPTP-009	A 2-axis TIC and a second time delay stage allows adjusting the timing between the pump pulse and the terahertz pulse at the sample. This option can be set up to either use an external laser or to split a portion of the input beam as the optical pump.
	ZAP	45-ZAP-OPTP-014	
Cryostat	FICO	45-FCO-CRYO-004	Cryostat integration (closed cycle or continuous flow). Please inquire with your requirements.
	ZAP	45-ZAP-CRYO-015	
Purge cell	FICO	45-FCO-PURG-005	Integration with purgeable chamber that allows removing the effects of water vapor. Includes transmission (part # 45-TRX-050M-007) and normal reflection (part # 45-NRX-025M-006) modules. Figure 23.
Gas cell	Z3	45-Z3X-GASX-010	1 m terahertz path cavity for gas-phase measurements that require a long path length. Standalone option, not compatible with any other option.
Extended bandwidth	Z3	45-Z3X-GAPX-012	300 um GaP detector that enables reaching a bandwidth up to 6 THz. Sensitivity is reduced.
Amplifier laser	ZAP	45-ZAP-LASE-013	THz Air Photonics Spectrometer bundled with amplifier pump laser (3 mJ/pulse - 30 fs pulse) - complete system.

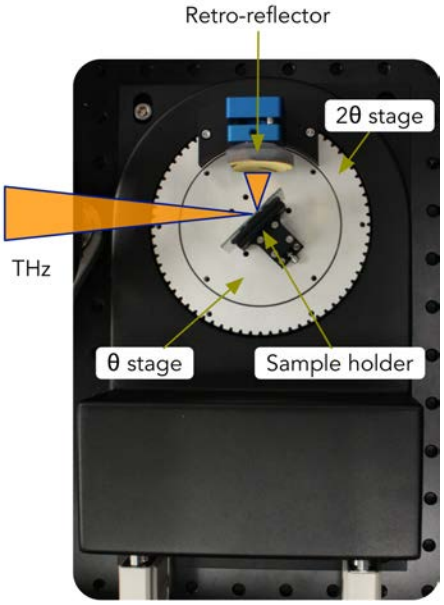


Figure 21. T2T option allows for characterizing reflectivity of samples at non-normal angles between 15 to 80 degrees.

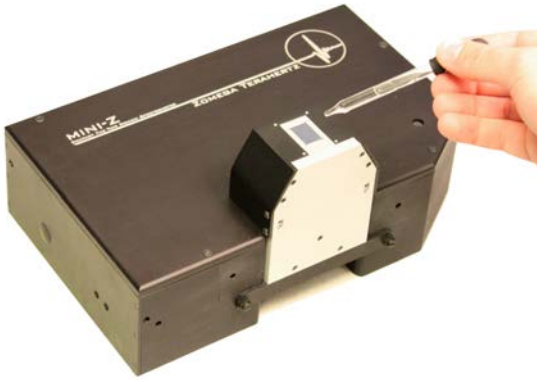


Figure 22. Mini-Z with ATR module. Temperature control version is also available (room temperature to 100 °C).

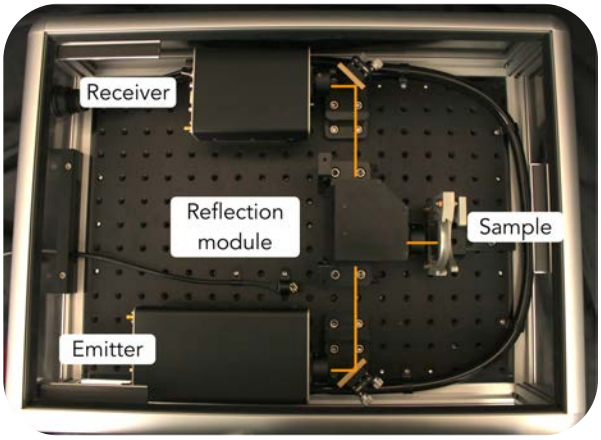


Figure 23. Purge chamber for FiCO allows removing water vapor effects in spectroscopic measurements. Configuration shown is normal reflection. Transmission is also available by replacing the reflection module with the transmission module.

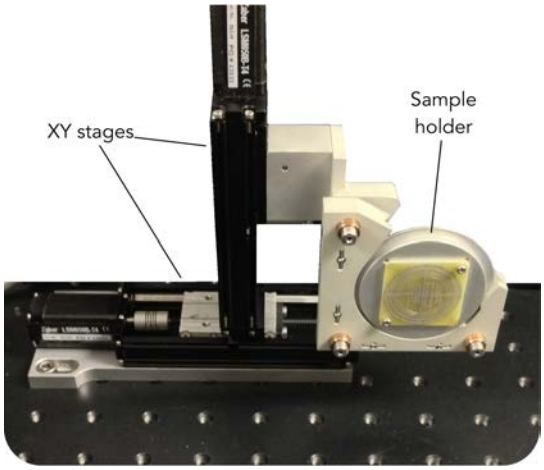


Figure 24. XY 50 mm x 50 mm imaging stage. The stages are controlled by a TIC box and TAC software.

Research and Development Services

From Feasibility to Prototype

Introduction

Terahertz technology is the last frontier of the electromagnetic spectrum to be unlocked for exploration and commercialization. For new entrants to the field, exploring applications for terahertz technology within your organization can be high-risk and financially challenging. Zomega offers a scalable selection of Research and Development services that can accelerate your terahertz program from simple sample measurements and proof-of-concept through prototype development. Let Zomega's staff with a combined 30 years of terahertz experience work for you!

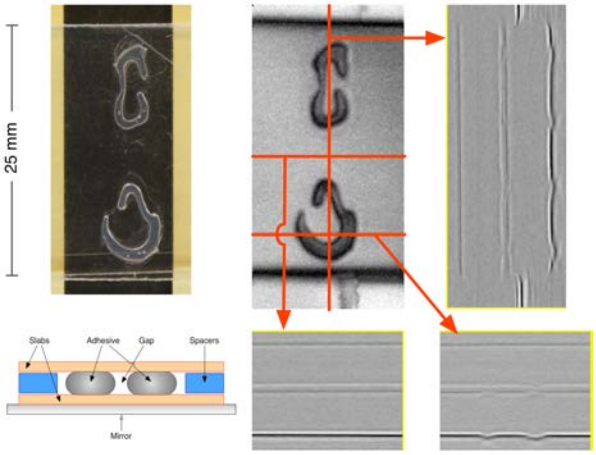


Figure 25. Inspection of the presence of adhesive between plastic slabs. Time-domain data provides depth information for layer analysis and thickness measurement.

Facilities and Equipment

Services include terahertz time domain measurements using our flagship spectrometer Mini-Z, which can be configured for transmission or reflection geometry. We provide high dynamic range point measurements or imaging, depending on your application and requirements. Other instrumentation and measurement modes may be available for project-level services, contact us for further information.

Flexible Locations

Zomega offers R&D services at its facility in East Greenbush (NY) with non-exclusive and exclusive intellectual property rights, with daily, weekly and project-level pricing. We also offer on-site testing services with our Mini-Z system when you need the experiment to come to you rather than shipping the samples to us. The service rates are the same as above but additional fees apply for transportation and per-diem costs.

Intellectual Property Rights

With our flexible R&D services, you can choose a plan that grants either exclusive or non-exclusive intellectual property rights to the experimental results, depending on your business model and requirements. You can also upgrade from non-exclusive coverage to exclusive coverage up to 60 days after the tests are concluded by simply paying the additional testing fees.

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