

High-Precision Ballistic Analyzer

BA08MH

Improved 0.1% version of BA08M



The seamless upgrade of older Ballistic Analyzers
BA04S,S2,SE, BA06S & K2519A.

Modular construction of BA08MH

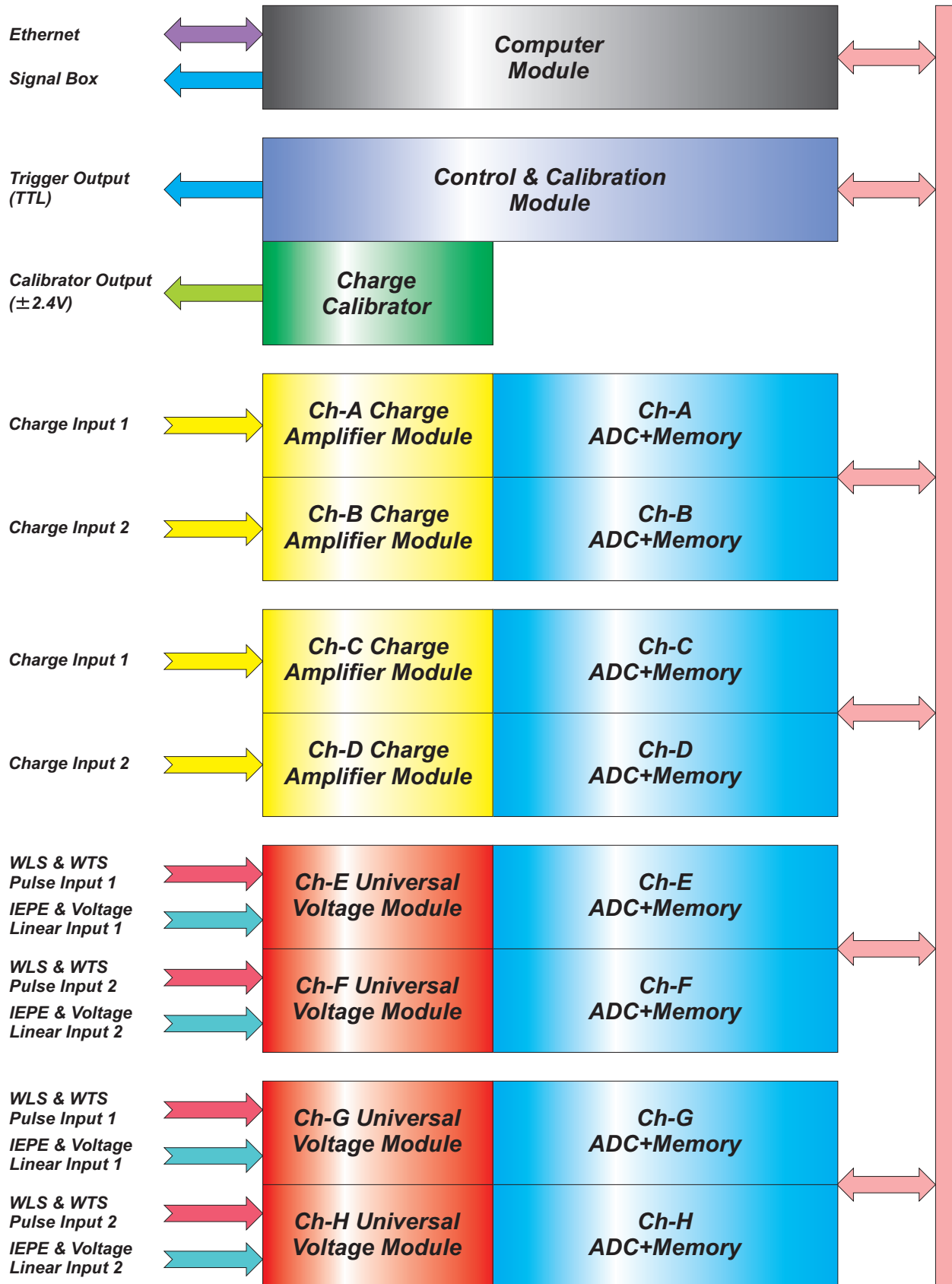


Features of the BA08MH High-Precision Ballistic Analyzer :

- seamless upgrade of older Ballistic Analyzers BA04S, S2, SE, BA06S & K2519A (similar software and data evaluation = no special training is required)
- **Charge Amplifier accuracy** (accuracy of pressure measurement) **improved to 0.10%**
- reference instrument for ballistic measurements or for calibration of sensors
- very robust mechanical construction in standard 19" system frame
- metal case and modules with double shielding for the best EMC
- easy **custom-made configuration** of the instrument
- fast and easy service without special tools or knowledges
- built-in precision calibrator for checking of accuracy and recalibration
- trigger output for synchronization of next instruments
- push-button Power On-Off controller with integrated protection of instrument
- improved Charge Amplifiers with filters for ballistics and pyrotechnics
- Universal Voltage Amplifiers with Linear Input (for voltage and IEPE sensors) and galvanically isolated Pulse Input for Light Screen or Target System

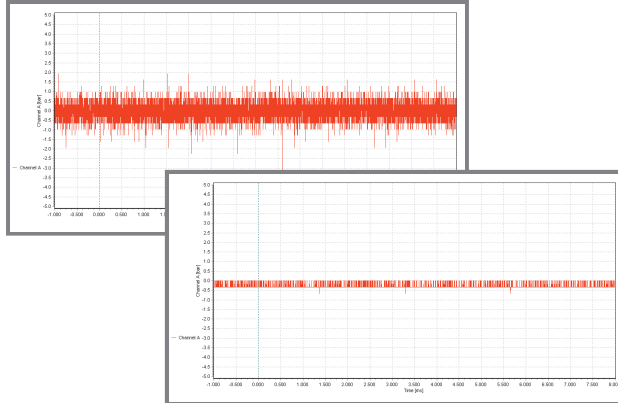
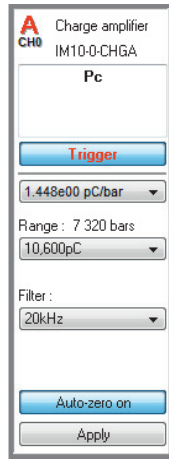
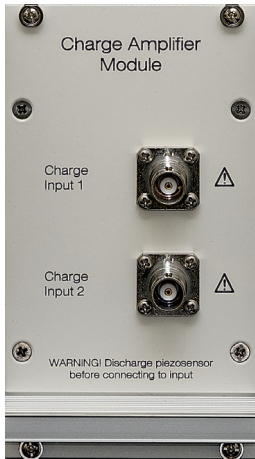


BA08MH block diagram and parameters



BA08MH modules

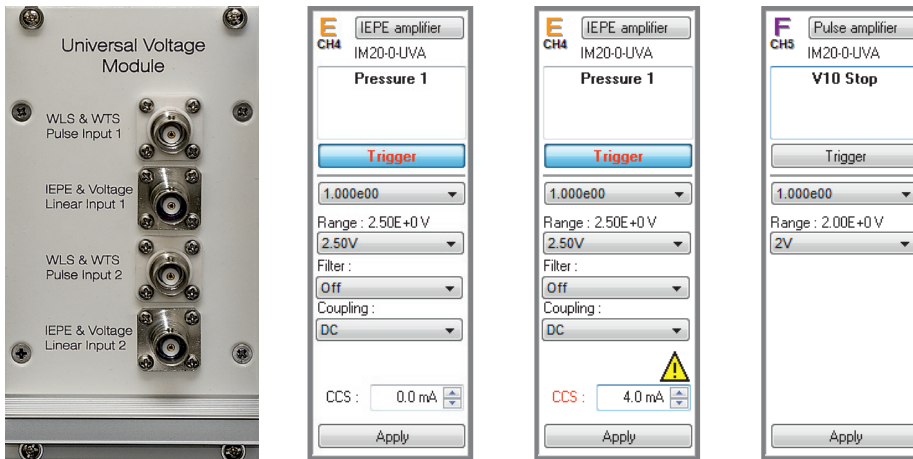
BA08M-CAM01H (High-Precision Charge Amplifier Module)



Noise comparison : BA08M (left), newer BA08MH (right)

BA08MH : HIGH-PRECISION CHARGE AMPLIFIER MODULE			
Type :	BA08M-CAM01H (High-Precision Charge Amplifier Module)		
Input Ranges (FSR) :	Range [pC]	dQ/dt @ AZON max. [pC/s]	dQ/dt @ AZOFF max. [pC/s]
	2 600	80	2
	5 200	80	2
	10 600	80	2
	20 200	80	2
	220 000	80	2
Nonlinearity, max. [%] of FS :	0.05		
Total Error, max. [%] of FS @ Tcal :	0.10 (AZOn, 1.0 MHz (MSa/s))		
Total Error, max. [%] of FS @ Tcal (220 000 pC):	0.25 (AZOn, 1.0 MHz (MSa/s), range 220 000 pC)		
TC, max. [%/°C] :	0.005		
Noise (Peak Value, Unfiltered) :	< ± 0.015 % of FS (AZOn, 1.0 MHz (MSa/s), 400000 samples)		
Capacity of Cable & Sensor :	unlimited (guaranteed stability only)		
Automatic Drift Compensation :	yes		
High-Speed Discharge :	yes		
High-Speed Overload Recovery :	yes		
High-Speed Overload Recovery Time, max. [s] :	1		
Max. Input Voltage (DC or AC, DC+AC <1kHz) [V] :	±50		
Bandwidth (-3dB) : (Bessel 2nd order Low-Pass Filter)	Filter [kHz]	Bandwidth [kHz]	Rise/Fall Edge 10% to 90% [µs]
	1	1	<500
	2	2	<250
	5	5	<100
	10	10	<50
	20	20	<25
	40	40	<12
	50	50	<10
OFF	>100	<5	

BA08M-UVM01H (High-Precision Universal Voltage Module)



BA08MH : HIGH-PRECISION UNIVERSAL VOLTAGE MODULE			
Type :	BA08M-UVM01H (High-Precision Universal Voltage Module)		
Input Ranges AC, DC or AC+DC (FSR) :	a) WLS & WTS Pulse Input [V]	b) IEPE & Voltage Linear Input [V]	
	1.00	0.25	
	2.00	0.50	
	5.00	1.25	
	10.00	2.50	
		5.00	
		12.50	
		25.00	
Coupling / Time Const. / -3dB Low Freq. Limit : (IEPE Amplifier)	AC / 0.1s / 1.6Hz	AC / 1.0s / 0.16Hz	
		AC / 10s / 0.016Hz	
		AC / OFF / ---	
		DC / --- / ---	
Input Impedance :	approx. 1kOhm	2.5MOhm II <100pF	
Slew Rate [V/us] :	>5	>10	
Bandwidth [kHz] :	>200	>500	
Nonlinearity [%] of FS :	---	<0.1	
Total Static Error [%] of FS @ Tcal :	---	<0.5	
Total Dyn. Error [%] of FS @ Tcal, after >2us :	---	<1.0	
Gain TC, max. [%/°C] :	---	0.02	
Max. Input Voltage - IEPE Current Source OFF (DC or AC, DC+AC <1kHz) [V] :	±20	±50	
Max. Input Voltage - IEPE Current Source ON (DC or AC, DC+AC <1kHz) [V] :	±20	±25	
IEPE Constant Current Source (CCS) :			
Range [mA] :	0 to 10 @ 0.1 incr.		
Error, typ. [%] of FS :	<5.0		
TC, max. [%/°C] :	0.5		
Bandwidth (-3dB) : (Bessel 2nd order Low-Pass Filter)	Filter [kHz]	Bandwidth [kHz]	Rise/Fall Edge 10% to 90% [µs]
	1	1	<500
	2	2	<250
	5	5	<100
	10	10	<50
	20	20	<25
	40	40	<12
	50	50	<10
OFF	>500	<2	

Computer Module, Control & Calibration Module



BA08MH : CHARGE CALIBRATOR

Type :	BA08M-CCM01
Output Voltage [V] :	±2.4000
Output Voltage Step [V] :	0.0001
Output Voltage Error, max. [% of FS] :	±0.050
Output Voltage Temperature Drift, max. [% of FS / °C] :	±0.002
Output Voltage Time Drift, typ. [% of FS / 1000 hours] :	±0.005
Output Voltage Noise, 0.1-10Hz, typ. [µVpp] :	5
Output Impedance, typ. [Ohm]:	100
<p>BA06PCAL is precision voltage-step source, which is converted by means of precision reference capacitor to charge.</p> <p>Recommended calibration capacitor : KISTLER 5371A10000 (10nF nom. ±0.1%)</p>	

BA08MH : TIME MEAS. ACCURACY

Total Error, max. @ Tcal, [s] :	$(0.0001 \times \text{Time}) + (2 / \text{SR})$
Total Error, max. @ Tcal, [%] :	$0.01 + 200 / (\text{Time} \times \text{SR})$
<p>SR = Sample Rate (20 kHz = 20 000, 5 MHz = 5 000 000, etc.) Time = measured value of time (START - STOP) [s] Temperature coefficient < 0.001%/°C</p>	

BA08MH VELOCITY MEAS. ACCURACY (with WLS03/04 or WTS03/04 : Base = 1m, Accuracy = 0.2%)

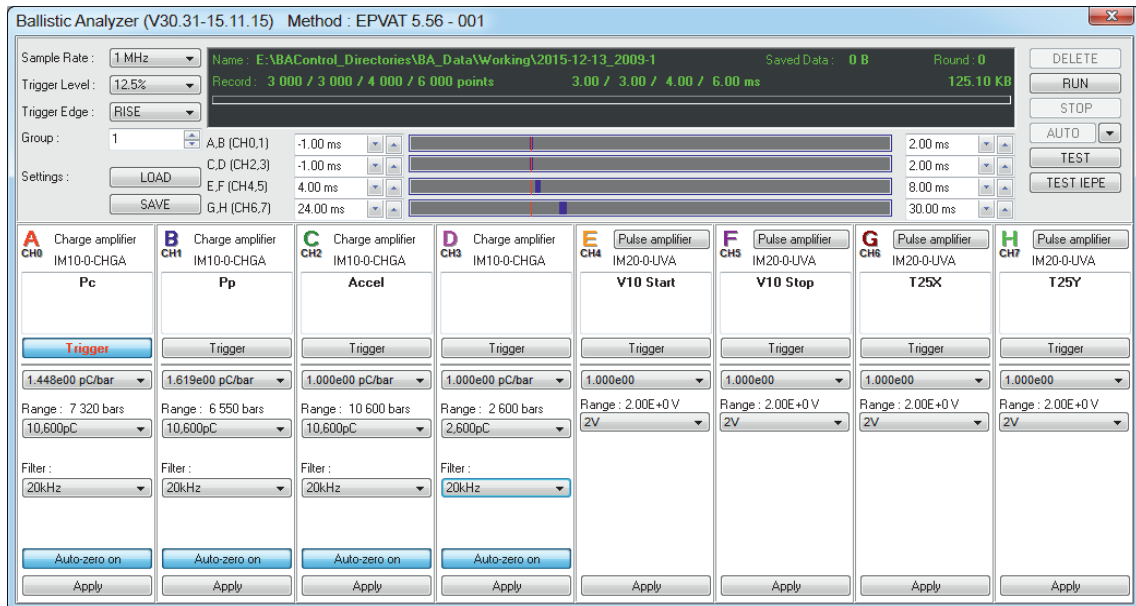
Total Error, max. @ Tcal, [m/s] :	$(\text{Base} / \text{Time}) - (\text{Base} / (\text{Time} + (0.0001 \times \text{Time}) + (2 / \text{SR}))) + (0.002 \times \text{Base} / \text{Time})$
Total Error, max. @ Tcal, [%] :	$0.01 + 200 / (\text{Time} \times \text{SR}) + 0.2$
<p>SR = Sample Rate (20 kHz = 20 000, 5 MHz = 5 000 000, etc.) Time = measured value of time (START - STOP) [s] Base = base for measurement of velocity [m] Temperature coefficient (TC) < 0.005%/°C</p>	

BA08MH : COMMON PARAMETERS

Input Channels :	Max. 8 Independent Channels (ADC+RAM), Full Synchronised					
Analog to Digital Converter (ADC) :	16 bit (± 15 bit), $\pm 5V$ Input Range					
Memory (RAM)	512k x 16 bit SRAM					
	Max. 400 000 Points Accessible					
	Max. -100 000 Points (Pretrigger), +300 000 Points (Posttrigger)					
Sample Rate & Record Length :	Sample Rate :	Pretrigger [Points] :	Pretrigger [ms] :	Posttrigger [Points] :	Posttrigger [ms] :	BREAK Function :
	2.0 MHz (MSa/s)	- 100 000	- 50	+ 300 000	+ 150	No
	1.0 MHz (MSa/s)	- 100 000	- 100	+ 300 000	+ 300	No
	0.5 MHz (MSa/s)	- 100 000	- 200	+ 300 000	+ 600	No
	0.2 MHz (MSa/s)	- 100 000	- 500	+ 300 000	+ 1 500	No
	0.1 MHz (MSa/s)	- 100 000	- 1 000	+ 300 000	+ 3 000	No
	50.0 kHz (kSa/s)	- 100 000	- 2 000	+ 300 000	+ 6 000	Yes
	20.0 kHz (kSa/s)	- 100 000	- 5 000	+ 300 000	+ 15 000	Yes
	10.0 kHz (kSa/s)	- 100 000	- 10 000	+ 300 000	+ 30 000	Yes
	5.0 kHz (kSa/s)	- 50 000	- 10 000	+ 300 000	+ 60 000	Yes
	2.0 kHz (kSa/s)	- 20 000	- 10 000	+ 300 000	+ 150 000	Yes
	1.0 kHz (kSa/s)	- 10 000	- 10 000	+ 300 000	+ 300 000	Yes
	0.5 kHz (kSa/s)	- 5 000	- 10 000	+ 300 000	+ 600 000	Yes
	0.2 kHz (kSa/s)	- 2 000	- 10 000	+ 300 000	+ 1 500 000	Yes
0.1 kHz (kSa/s)	- 1 000	- 10 000	+ 300 000	+ 3 000 000	Yes	
Time Base Parameters :	X-tal Controlled, Error < ± 100 ppm Ageing < ± 5 ppm/year Temperature Coefficient < ± 1 ppm/ $^{\circ}C$ Shock Resistance < ± 20 ppm					
Time Measurement Error :	$\pm((0.0001 * \text{Time}) + 2 / (\text{Sample Rate}))$ Time = Measured Value of Time in [s] (between START and STOP Cursor), Sample Rate in [Hz] Temperature Coefficient < ± 10 ppm/ $^{\circ}C$					
Trigger :	Trigger Source :	Channel A (CH0) to Channel H (CH7)				
	Trigger Level :	0 to ± 87.5 % of Full Scale in 12.5 % Increments				
	Trigger Edge :	Rising or Falling				
Power Supply :	Voltage :	nom. 12V DC (11 - 26V DC) - External 100 - 240V AC Power Adapter included				
	Consumption :	nom. 25W (max. 40W)				
Operating Conditions :	Temperature Range :	-20 $^{\circ}C$ to +40 $^{\circ}C$				
	Relative Humidity :	Less than 90% (no condensation)				
	Sealing :	IP50				

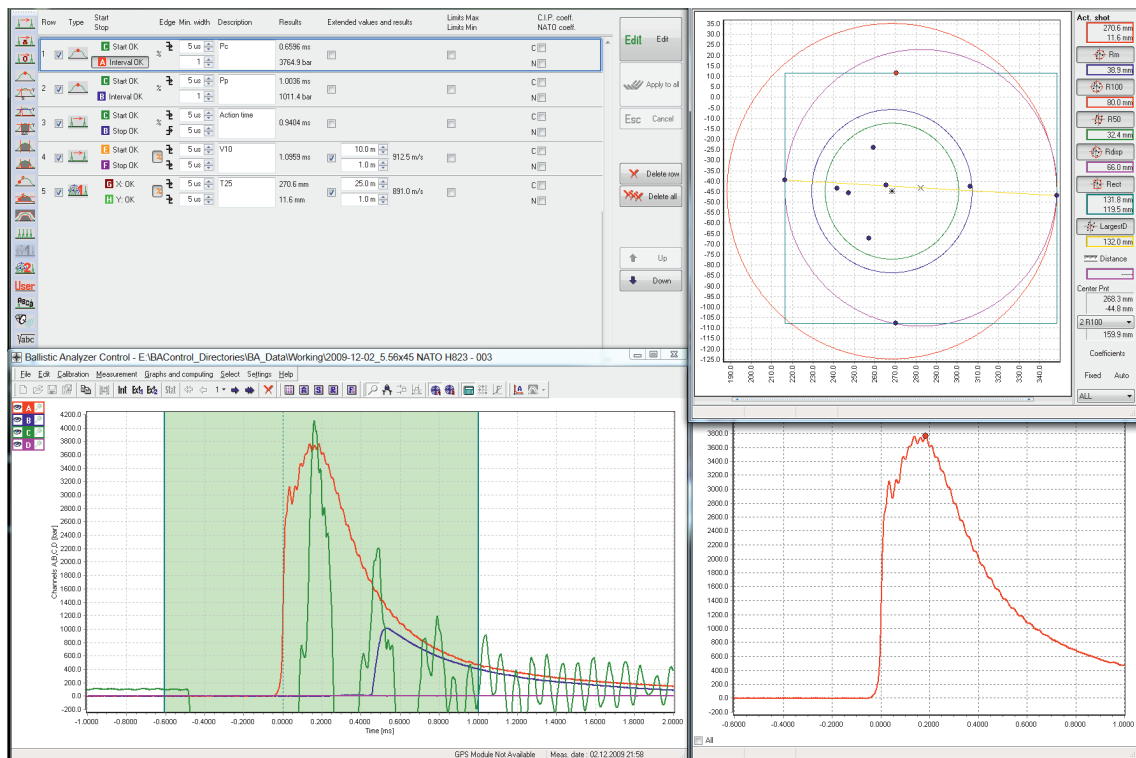
BA08MH Control Software and Applications

Control panel of the virtual ballistic analyzer

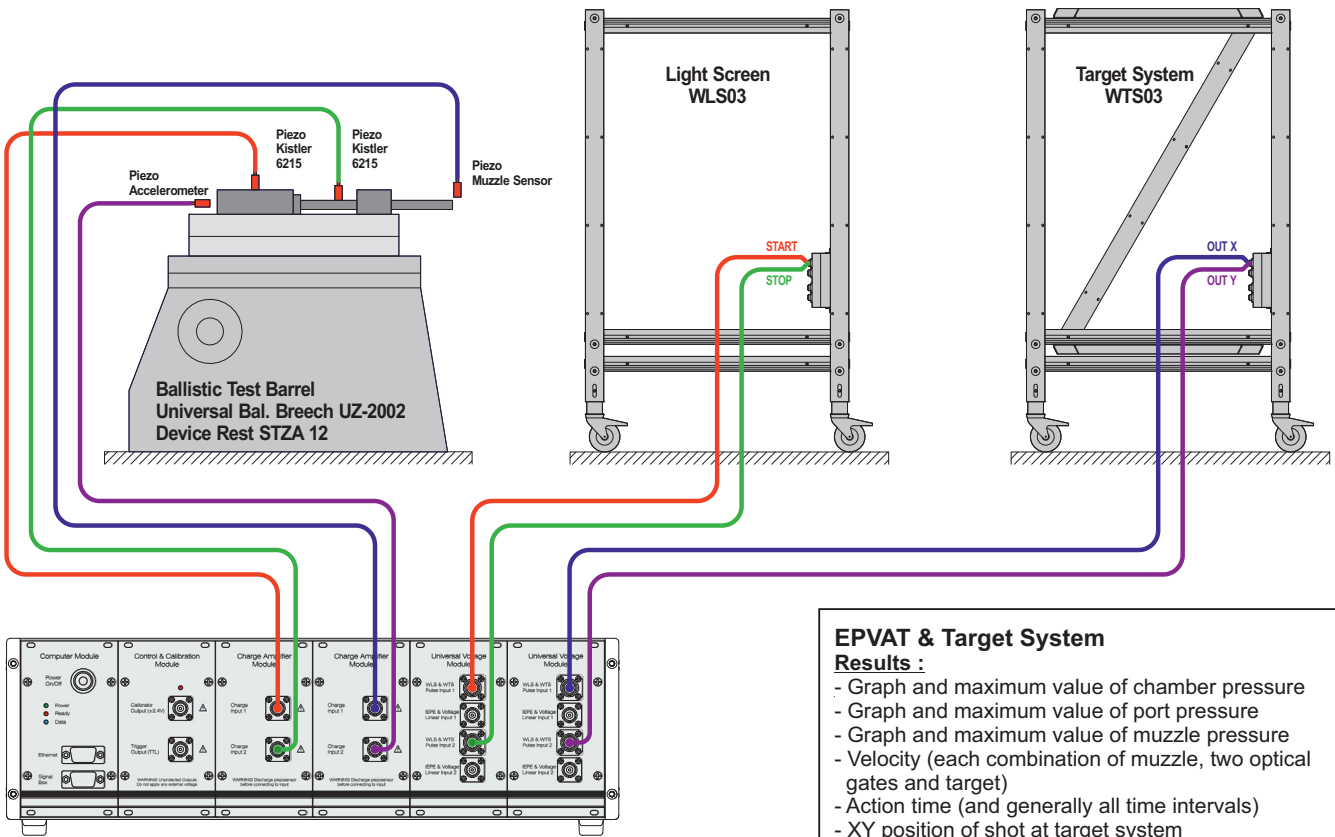


This panel serves for the adjustment of all the parameters of the ballistic analyzer. It contains (from left to right) : the adjustment of sampling rate, the level and the edge of triggering, the display for the list of important information, setting up the memory and the mode of the measurement, and in the lower row, the panels for the controlling of the output modules.

Viewing of the graphs, computing and output report

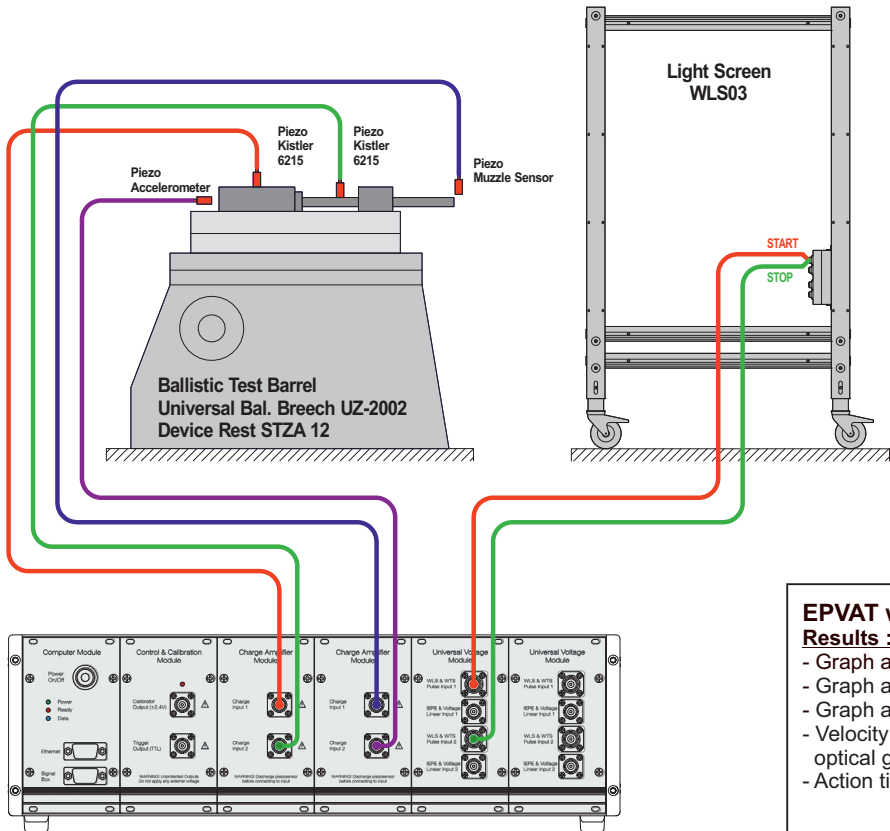


These windows of the program contain the measured curves, setting of calculations of numerical values from measured curves and window of the virtual target. All these settings are possible to save and, this way, make standard measuring methods.



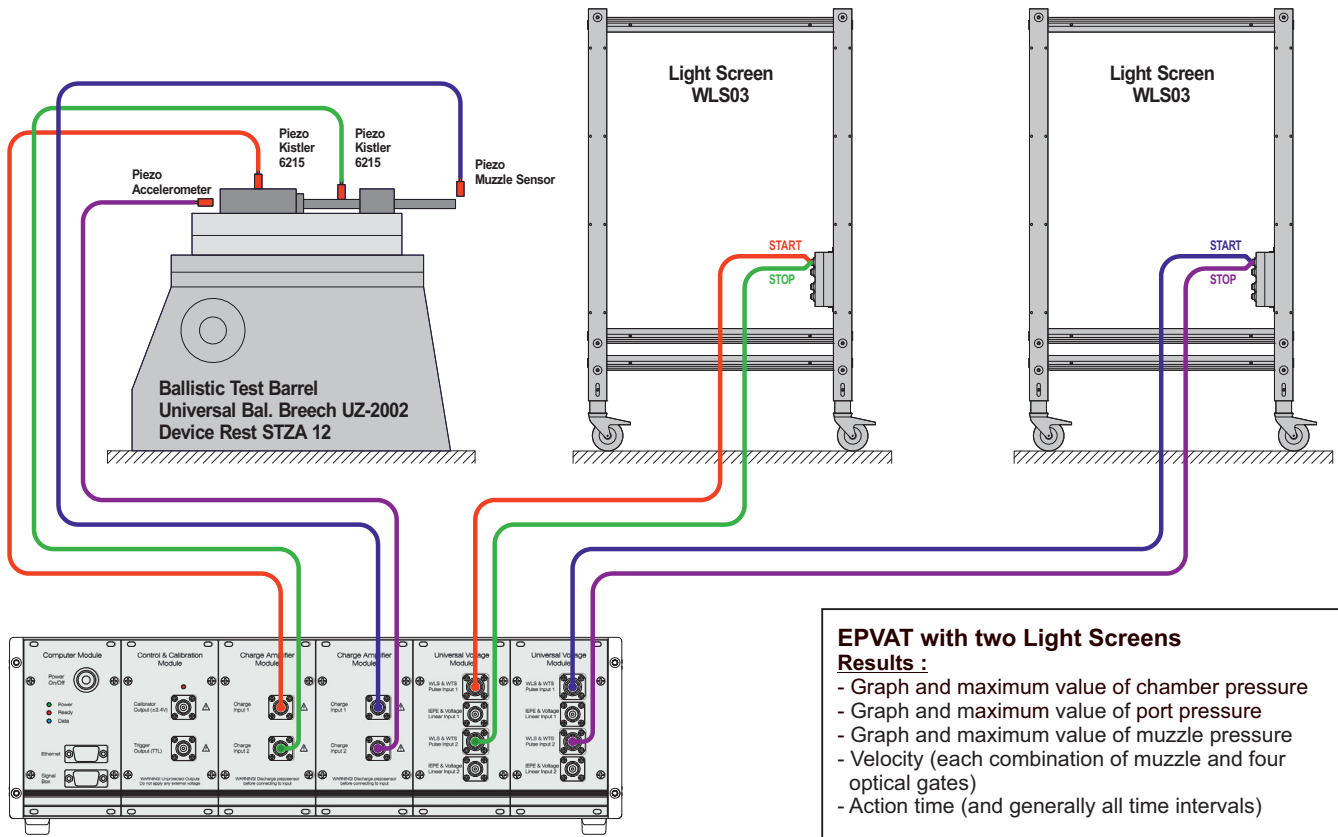
EPVAT & Target System
Results :

- Graph and maximum value of chamber pressure
- Graph and maximum value of port pressure
- Graph and maximum value of muzzle pressure
- Velocity (each combination of muzzle, two optical gates and target)
- Action time (and generally all time intervals)
- XY position of shot at target system
- Target velocity and energy of bullet



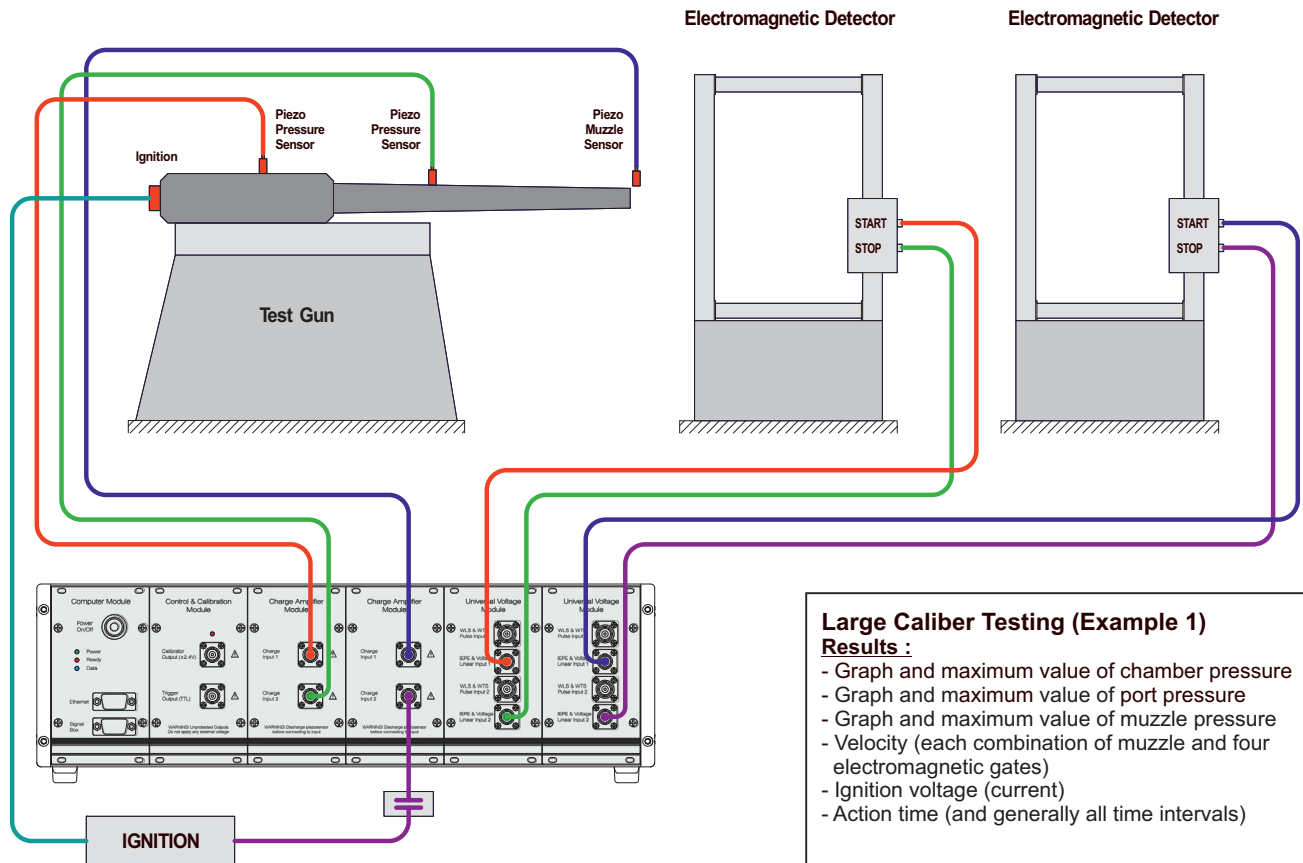
EPVAT with one Light Screen
Results :

- Graph and maximum value of chamber pressure
- Graph and maximum value of port pressure
- Graph and maximum value of muzzle pressure
- Velocity (each combination of muzzle and two optical gates)
- Action time (and generally all time intervals)



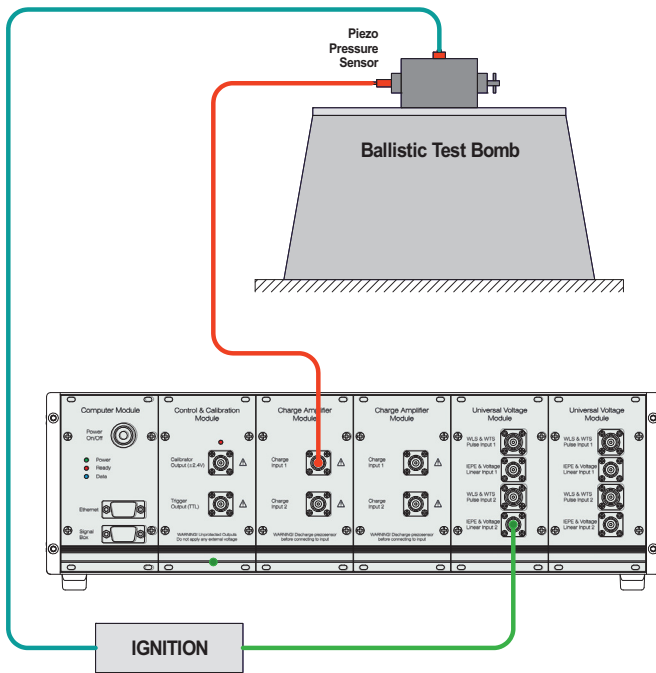
EPVAT with two Light Screens
Results :

- Graph and maximum value of chamber pressure
- Graph and maximum value of port pressure
- Graph and maximum value of muzzle pressure
- Velocity (each combination of muzzle and four optical gates)
- Action time (and generally all time intervals)



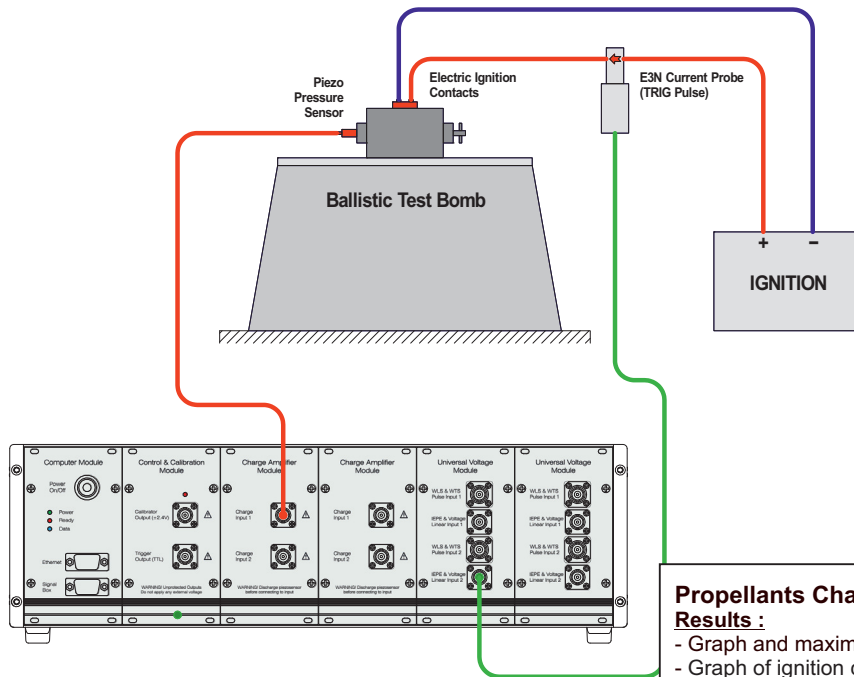
Large Caliber Testing (Example 1)
Results :

- Graph and maximum value of chamber pressure
- Graph and maximum value of port pressure
- Graph and maximum value of muzzle pressure
- Velocity (each combination of muzzle and four electromagnetic gates)
- Ignition voltage (current)
- Action time (and generally all time intervals)



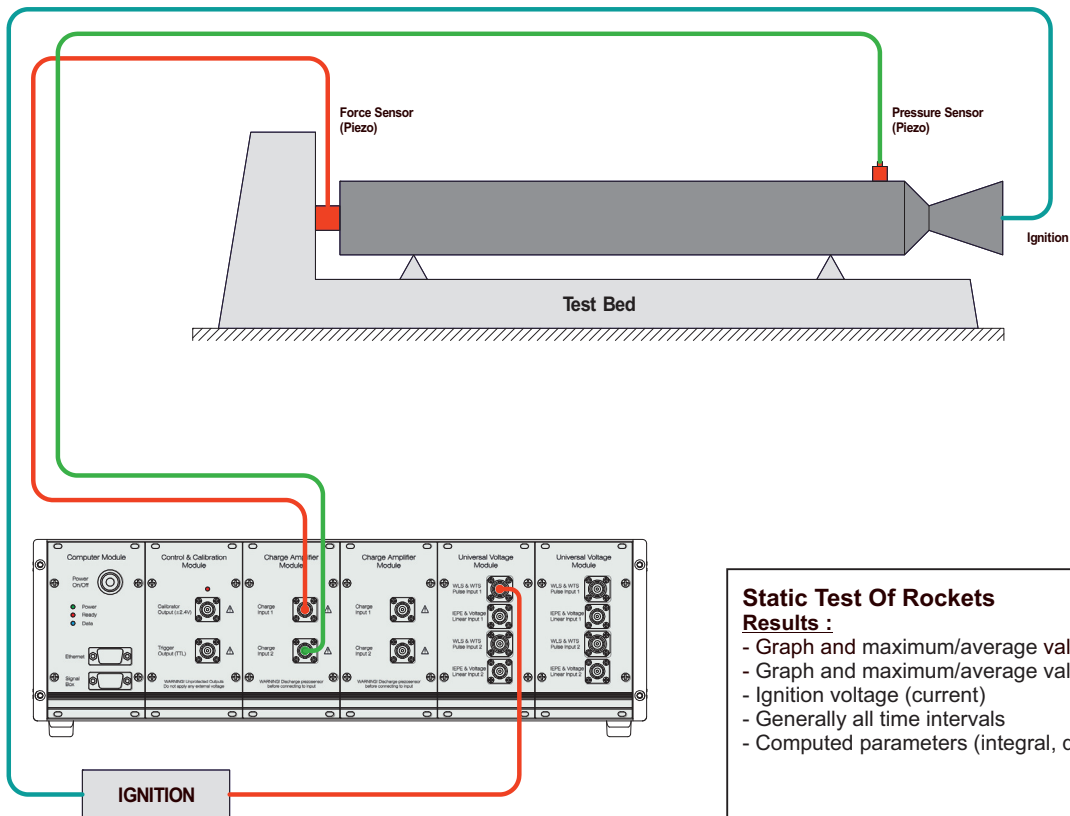
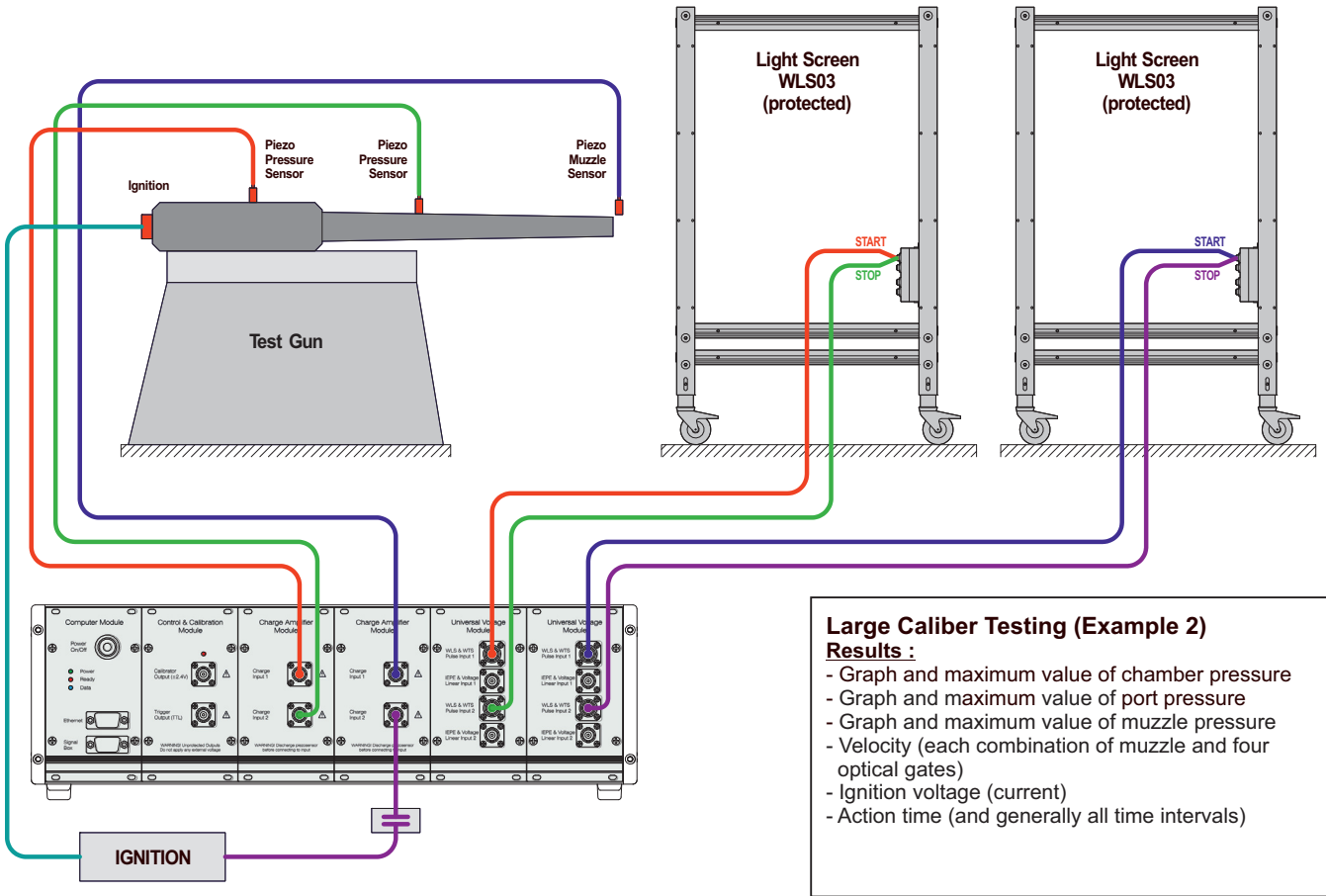
Propellants Characteristics (MIL STD 286B)
Results :

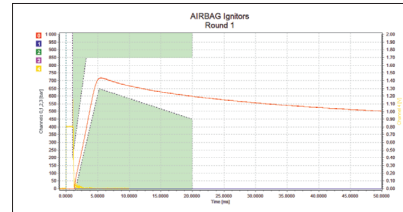
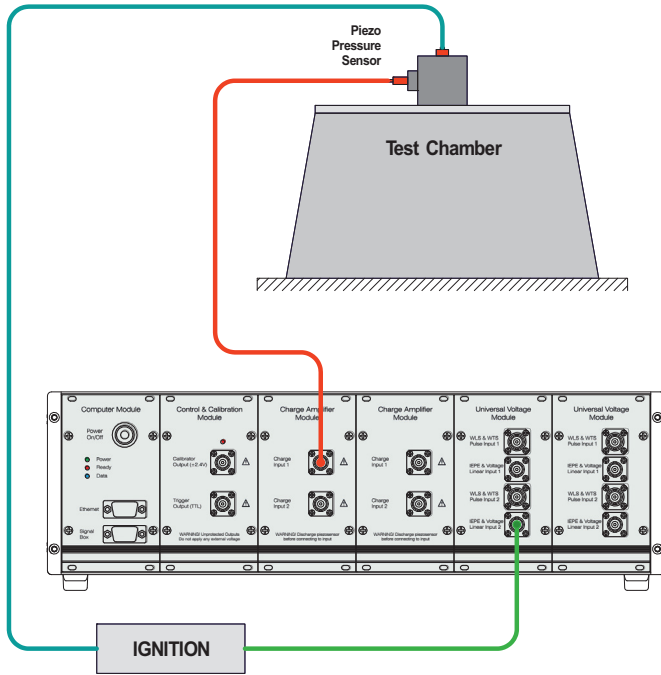
- Graph and maximum value of bomb pressure
- Graph of ignition voltage (current)
- Generally all time intervals
- Computed parameters (force, covolume, pressure exponent, absolute quickness, relative quickness, dynamic vivacity against P/Pmax, fraction of burnt charge, dynamic vivacity against of burnt charge, ...)



Propellants Characteristics (MIL STD 286B)
Results :

- Graph and maximum value of bomb pressure
- Graph of ignition current
- Generally all time intervals
- Computed parameters (force, covolume, pressure exponent, absolute quickness, relative quickness, dynamic vivacity against P/Pmax, fraction of burnt charge, dynamic vivacity against of burnt charge, ...)





Pyrotechnics (AIRBAG igniters etc.)

Results :

- Graph and maximum value of chamber pressure
- Graph of ignition voltage (current)
- Generally all time intervals
- Pass/Fail testing (by use of limit bands)