



CATALOG | ELECTRONIC LEVELS



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## Electronic Levels Applications

Measuring with a Mahr Federal Electronic Level is a relatively simple procedure. In a typical profile application, for example, measurements are made by moving the sensing heads in convenient increments along a straight path on the surface being checked. Comparative readings are taken at each increment.

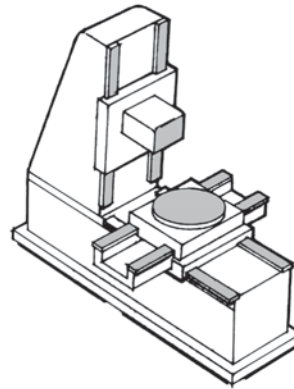
Computer assisted models allow economical, fast, and error-free calculations to be made automatically. As prompted

by the computer, the operator simply enters the value at each measurement point by pressing a hand-held switch. Depressing a computer key activates automatic analysis. Within moments, the results are displayed and printed, if desired, for permanent record.

## Surface Deviation (Machine Tools)

The accuracy of machine tools begins with proper levelness plus the relationship between the ways and the table. These relationships are critical during the manufacturing process.

Once the level is zeroed, the instrument functions as a spirit level, and will check the overall levelness of the machine components to a very high degree of accuracy.



Shown here are just a few of the many surfaces that can be checked on a machine tool using the Electronic Level.

## Differential Sensing

To aid in differential profiling applications, two level sensing heads, operating simultaneously with a single amplifier, are used. When the sensing heads are arranged for opposite response to a common motion (such as vibration or a shift in attitude of the object whose surfaces are being compared), they will ignore the common motion and respond

only to changes which affect the two heads differentially. A deviation of flatness, squareness, parallelism or alignment, therefore, can be accurately determined even though the object (such as a surface plate or a machine way) does not maintain constant orientation.

## Surface Plate Flatness

The next progression in data collection is to combine and print a number of surface straightness checks onto a single chart. This is useful for checking the surface flatness of machine beds and surface plates.

Although the Moody Method for checking surface plates has been traditionally used to check flatness, the computer assisted digital Electronic Level System is ideally suited for highly precise profiling of surface plates and large machined surfaces while eliminating tedious and time-consuming data recording and calculations required by manual systems.

Determining surface flatness is accomplished by using a straight edge as a guide and moving the level along the edge.

Readings are recorded at convenient locations, and entered into the computer via handswitch to produce the surface profile.

## Machine Tool Evaluation

ANSI Standard B5.54, for machining center evaluation, refers to levels as an important part of machine evaluation, calling out angular deviation as a major contributor to machine tool errors.

Electronic Levels are ideal for monitoring such deviations as pitch, yaw and roll.

When used with the Spindle Mount Attachment (EAT-1062), levels become an essential tool towards total Machine Tool Evaluation.

## Electronic Levels

Offer fast response, fine resolution and excellent repeatability



- Used to determine any deviation in the right angle relationship between a horizontal surface and the earth's gravitational force (usually expressed as an angular or linear deviation from absolute level)
- Show any change in this relationship over time.
- Compare the orientation attitude of separate or adjacent horizontal surfaces
- Show any change in this comparison over time.
- Level systems are angular-linear compatible.

## Features

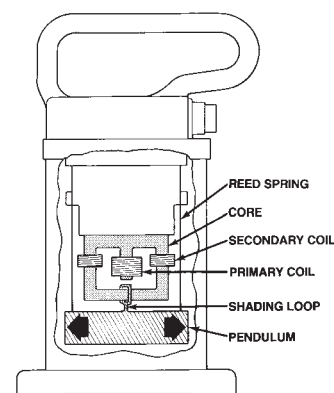
- Sensing heads are interchangeable with Mahr Federal's gage heads to accommodate linear measurements.
- Fast Response – quick response to slight angular changes permit taking fast and accurate measurements at various sensing head positions or taking dynamic position readings.
- Resolution/Repeatability – Mahr Federal's Electronic Levels far exceed the sensitivity and accuracy of precision spirit levels with a resolution to  $6 \mu\text{in}$  per foot (.1 arc second), compared to the spirit level's resolution of .0001in per foot. With repeatability at  $\pm 1$  arc second, Electronic Levels are ideal for ultra-high resolution profiling.
- Direct Dimensional Readout – multiplier feature permits operator to view displacement caused by the angular measurement of the level head – this is displayed as an inches per foot readout rather than arc seconds – eliminates readout confusion when switching from spirit levels to electronic levels.
- Angular-Linear Compatible – sensing heads are easily interchangeable with Federal gage heads to accommodate linear measurements.
- Operator Friendly – Level systems are often compared to the autocollimator or laser calibration systems. In each case, the measurement technique is basically the same. Electronic Levels, however, are much easier to set up and operate. Results are obtained cost-effectively without requiring time consuming sight path alignments. There are no optical surfaces to keep clean, and the Level does not need a turbulence-free environment to achieve accurate readings.

## How They Work

As shown in the figure, our Sensing Head operates on the pendulum principle, with a pendulum supported by two reed springs attached to an extension block at the top of the Sensing Head housing.

Tilting the head causes a change in the position of the pendulum's shading loop in relation to the center leg of the core. This produces an electrical imbalance in the amount of flux passing through the two secondary coils, delivering a signal proportional to the displacement of the pendulum.

This is displayed on a Mahr Federal amplifier meter which is graduated in seconds of arc.



## Millitron 832 Digital Electronic Amplifier



### Features

- Dynamics – simultaneously computes the minimum, maximum, T.I.R., nominal and actual gage head signal for dynamic measurement capability.
- Multi-Range – three selectable ranges in inch or metric units.
- Message Center – display provides a simple “menu-driven” setup procedure in English, French or Spanish.
- RS-232 Output – for communicating with Data Collection Devices.
- Two Gage Head Input – Independent reading or for providing the capability of “summing” for diameter reading, matching clearances, runout and parallelism.
- Angular units – selectable arc seconds or millirads for angular measurement applications (see Electronic Levels).
- User selectable password for full lockout capability or individual key lockout in both setup and gaging modes.
- Specific models available for use with Mahr, Mahr Federal, Tesa or Marposh inductive probes.

### Technical Data

	Measuring Range	Digital Resolution	Analog Minimum Grad.
<b>Linear</b>	±2 mm/ ±0.100" ±.200 mm/ ±.010" ±.020 mm/ ±.001"	.001 mm/ .0001" .0001 mm/ .00001" .00002 mm/ .000001"	0.1 mm/ .005" .010 mm/ .0005" .001 mm/ .00005"
<b>Angular</b>	5 mrad/ ±1000 arc sec. 1 mrad/ ±200 arc sec.	.005 mrad/ 1 arc sec. .0005 mrad/ 0.1 arc sec.	.25mrad/ 50 arc sec. .05mrad/ 10 arc sec.
<b>Auto Range</b>	automatically selects the smallest range for the best resolution, in both linear and angular units		
<b>Repeatability</b>	±1 digit		
<b>Calibration Accuracy</b>	±1 digit		
<b>Linear Error</b>	less than .025% of full scale		
<b>Response Time</b>	42 msec.		
<b>Thermal Stability</b>	.01% /C x full scale		
<b>Temperature Range:</b>	20°C/68°F ±2°C		
<b>At Specified Accuracy</b>	5° to 45°C/40° to 110°F, with a temperature coefficient of .02% change/°C x full scale range.		
<b>Operating Storage</b>	0° to 60°C/0° to 140°F		
<b>Digital I/O</b>	five TTL opto-isolated outputs		
<b>Data Output</b>	RS-232, transmits Channels A, B, or both, units, and tolerances		
<b>Analog Output</b>	±5 VDC full scale for displayed value signal		
<b>Measuring Modes</b>	Actual, Minimum, Maximum, T.I.R., Nominal		
<b>Tolerance Indicators</b>	five LEDs		
<b>Weight</b>	3.5 lbs./1.58kg		
<b>Dimensions</b>	254mm w x 168mm d x 143mm h/10in w x 6.63in d x 5.63in h		
<b>Gage Head Display</b>	A, B or both at any time		
<b>Auto Power Off</b>	User selectable, up to 99 minutes of non-use		
<b>Power Requirements</b>	rechargeable battery, 10 hour operation under full load: or 120 VAC/240 VAC 50-60Hz with power module (furnished with Amplifier)		
<b>Replacement Battery</b>	EBY-1015 Ni-Cad rechargeable, 4.8v, 2.5 amp hours		

## Millitron 832 Digital Electronic Amplifier

### Technical Data

Power	832 F Mahr Federal probe type Order no.
120 VAC adapter	2004005
US battery / 120 VAC charger	2004007
EU/UK 220 / 240 VAC adapter	2004006
EU battery / 220 VAC charger	2004008
UK battery / 240 VAC charger	2004009

### Accessories

	Order no.
RS-232 cable, amplifier to MSP2 printer or computer, 2 m/ 6 ft	7024634
Storage Cover (opaque) – protection for the 832 Amplifier when used in harsh environments	ECV-1276
Oil/Splash Cover (clear) –protection for the 832 Amplifier when used in harsh environments	ECV-1285
Footswitch for SEND DATA, 3 m/ 10 ft cable (15 pin)	ECB-1859
Remote pushbutton for SEND DATA, 1.5 m/ 5 ft cable (15 pin)	ECB-1860
<b>Battery Charger Modules (For 832 Units using 3 pin connector)</b>	
Plug-in, 120 VAC, 50-60Hz charger for use with 120 Vac battery operated units	EBY-1028
220 VAC, 50-60Hz charger for use with 220 Vac battery operated units	EBY-1029
240 VAC, 50-60Hz (UK) charger for use with 240 Vac battery operated units	EBY-1030
<b>Power Supply Module (Bypass battery operated units to direct AC source operation)</b>	
For 120 Vac models (For 832 Units using 3 pin connector)	2010000
For 220/240 Vac models (For 832 Units using 3 pin connector)	2010001

### Single Sensing Head and Amplifier System

Indicates angular deviations from absolute level as small as .1 sec. of arc

Type	Order no.
Consists of 2004007- Millitron 832 F Digital Gaging Amplifier with 120 VAC 50/60 Hz power module, EGH-2013-W1 Electronic Level Gage Head, EAT-1029 adjustable foot and Storage Case	EMD-832P-204-W1
Same system as above , except with 2004008 amplifier with 220 Vac (EU)	EMD-832P-204-W2

### Angular/Linear Measurement Kit

Each kit includes:

- 832F Amplifier with power module and storage case
- Level sensing head EGH-2013-W1 with EAT-1029 adj. foot
- EHE-2048 Lever-type electronic gage head with mounting kit and universal bracket
- 5323014-P2004F Cartridge-type electronic gage head
- EAS-1333 Mounting Kit

Angular/Linear System described above	Order no.
with 120 VAC 50/60 Hz power module	EMD-832P-205-W1
with 220 VAC 50/60 Hz power module(EU)	EMD-832P-205-W2



## Electronic Levels Ordering Information

### Differential Level System

The Differential Level System operates simultaneously with a single amplifier, permitting an immediate comparison between two surfaces.

Adjustable bases permit setup on surfaces that are out-of-level or square by as much as  $\pm 1.5^\circ$ .

Each system includes:

- 832 F Amplifier with power module and storage case
- 2 EGH-2013-W2 Electronic Level Heads with 6m/20ft cables
- 2 EAT-1029 Adjustable Bases
- ECB-1871 Remote data enter handswitch with 6m/20ft cable



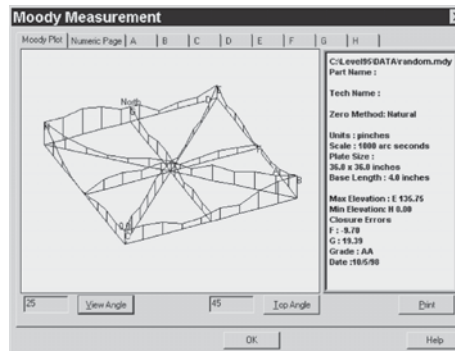
Type	Order no.
Differential Level System described above with 120 VAC 50/60 Hz power module	EMD-832P-48-W1
Differential Level System described above with 220 VAC 50/60 Hz power module (EU)	EMD-832P-48-W2

### Automatic Profiling System

Ideally suited for highly precise profiles of surface plate and large machine surfaces, eliminating tedious and time-consuming data recording and calculating required by manual systems.

Each system includes:

- 832 F Amplifier with power module and storage case
- 2 EGH-2013-W2 Electronic Level Heads with 6m/20ft cables
- 2 EAT-1029 Adjustable Bases
- ECB-1871 Remote data enter handswitch with 6m/20ft cable
- ECB-1872 RS-232 0.6 m/4 ft interconnect cable, 9 pin-9 pin
- Notebook computer (EAS-2836) with notebook printer (ERO-1063) and cable (ECB-1775)
- Mahr Federal Profiling Software (EDD-1035) for single line profile measurements and Moody Method surface plate profiling. Includes 3 data outputs (printout of data point readings, numeric and isometric plots of surface plate readings)



### Surface Plate Certification Software

- Moody and Profile Analysis
- Isometric or numeric plots
- Automatic grading according to industry standards
- On-line help
- Flexible path sequence and orientation
- Multiple run averaging
- Difference of Data Files

Type	Order no.
Automatic Profiling System described above with 120 VAC 50/60 Hz power module	EMD-832P-50-W1
Automatic Profiling System described above with 220 VAC 50/60 Hz power module (EU)	EMD-832P-50-W2
Surface Plate Certification Software	EDD-1035

## Electronic Levels Ordering Information

### Accessories

Type	Order No.
Electronic Level Gage Head, with 2.5m/8 ft cable, 210mm/8.2 in x 114mm/4.5 in x 50.8mm/2 in 3.5 kg/7.75 lbs.	EGH-2013-W1
Electronic Level Gage Head, same as above except with 6m/20 ft cable	EGH-2013-W2
Adapter Cable, to connect EGH-13 Electronic Level Gage Heads or EHE-1xxx Gage Heads to a Series 832 & 830 Gaging Amplifier, 1.8m/6 ft long	ECB-1853



**EAT-1029**

**(Adjustable Leveling Foot)**

The adjustable level foot mounts to the base of the level head. Typically used to assist in leveling the head to its true zero position.



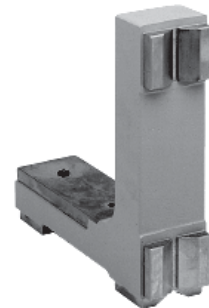
**EAT-1054**  
**(Magnetic Base)**

Incorporates a magnet to fix it in position, providing stability when mounted on a moving carriage.



**EAT-1055**  
**(Vee Base)**

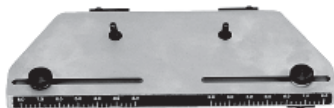
Has a 120° Vee precision ground into the 102mm/4 in base for measuring the straightness or alignment of cylindrical surfaces.



**EAT-1056**

**(Right Angle Attachment)**

Has two 152mm/6 in surfaces, accurately ground to 90°, to simplify measuring flatness on horizontal or vertical and cylindrical surfaces. Each adjacent pair of faces is square to within 0.5µm/25 µin. Attachment includes 120° Vee face, which is parallel to its base to the same limit.



**EAT-1057**  
**(Adjustable Base)**

A three-pad base lets you adjust the distance between the pads from 50mm/2in to 203mm/8 in when using the "Grid" or "Union Jack" measuring methods. Can also be used for straightness movement checks.



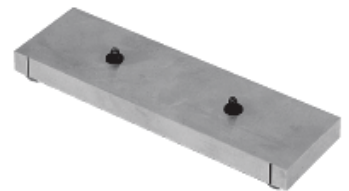
**EAT-1062**  
**(Spindle Block)**

A special spindle mounting block to hold the level head in a horizontal or vertical spindle. Utilizes a 19mm/.750 in bar for mounting and allowing checking angular motion on a machine tool per B5.54 Calibration Standard.



**EAT-1061**  
**(29.5mm/11.625in Base)**

Has a 29.5mm/12.625in ground, flat surface for leveling machine beds and ways. It also has a 120° Vee ground into the base, permitting the base to be positioned on a cylindrical surface. When coupled with an 832 or 830 Electronic Amplifier while in the inch mode, it can display inches/feet as a direct reading.



**EAT-1058 (50mm/2in)**  
**EAT-1059 (102mm/4in)**  
**EAT-1060 (152mm/6in)**

A three-pad base which provides the flexibility to maximize data accumulation for surface plate calibration. Available in three pad spacing sizes.

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