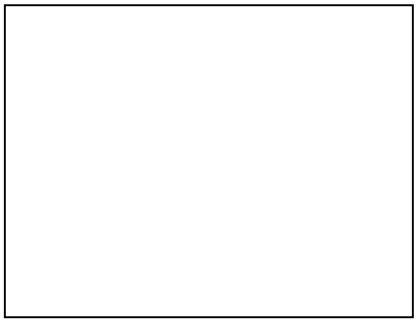
B&K PRECISION®



INSTRUCTION MANUAL

Test Bench® Handheld Digital
Multimeter
Model 388B

FEATURES

- Complete Handheld Test Bench
- 11 Functions, 41 Ranges.
- Auto power off extends battery life.
- Five dc voltage ranges: 400mV to 1000V.
- Five ac voltage ranges: 400mV to 750V.
- Six dc current ranges: 400µA to 20A.
- Six ac current ranges: 400µA to 20A.
- Six resistance ranges: 400Ω to 40 MΩ.
- Five capacitance ranges: 4nF to 40µF.
- Four autoranging frequency ranges: 4kHz to 4 MHz.
- hFE transistor test function; measures dc gain (hFE) of NPN and PNP transistors.
- Logic probe function: indicates logic high or logic low for TTL circuitry.
- Diode test function; measures forward voltage drop:
- Audible continuity buzzer.
- Audible warning buzzer if probe inserted into wrong jack.
- Extra large, easy to read 3-3/4 digit display with annunciators for polarity, decimal, frequency, ac/dc, capacitance, and low battery.
- Basic accuracy: +0.5% (DCV).
- Resolution of 100µV, 0.1µA, 0.1Ω, 1pF, 1Hz.
- Auto polarity, auto zero.
- Overrange indication on all ranges.
- Overload protection.
- High energy fuses.
- Fused 20A range.
- Safety type test leads.
- Tilt stand.
- Hanger strap
- Protective holster (withstands 10ft drop on concrete).
- Built-in probe storage.

SAFETY

WARNING

An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a fatal current under certain conditions. Higher voltages are even more dangerous. Observe the following precautions.

1. Do not exceed the following input ratings. Personal injury or damage to the instrument may result.

DC VOLTS	1000V (dc + ac peak) 500 V (dc + ac peak) on 400 mV range
AC VOLTS	750 V rms 500V (dc + ac peak) on 400 mV range
⚠OHMS	500 V (dc + ac peak)
mA μA	2000 mA (fuse protected)
20 A	10A continuous, 20A for 60 seconds max
COM	Do not float more than 500 volts from earth ground.

2. Remove test leads before replacing batteries or flues and before performing any servicing on the instrument.

3. Use only the safety type test leads supplied with the instrument.

4. Turn off equipment while making test connections in high voltage circuits. Discharge high voltage capacitors after removing power.

5. For voltage or current measurements in high voltage equipment, do not touch equipment, meter or test leads while power is applied.

6. Never apply an external signal to the Cx or hFE input jacks. Damage to the meter will result.

7. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.

8. Use an insulated floor material or floor mat to stand on, and an insulated work bench surface; make certain such surfaces are not damp or wet.

9. Keep "one hand in the pocket" while handling an instrument probe, Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.

10. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.

11. Some equipment with a two-wire ac power cord, including some with polarized power plugs, in the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result. To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B+K Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653A or 1655A AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.

12. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off

13. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardiopulmonary resuscitation) first aid is highly recommended.

MAINTENANCE

WARNING

Remove test leads before changing battery or fuse or performing any servicing.

BATTERY REPLACEMENT

A low battery is indicated when the symbol in the upper right hand comer is on. The low battery indication first appears when the battery is about 90% depleted. The meter may be operated a few more hours but the battery should be replaced soon thereafter.

1. Remove two screws from back of unit securing the tilt stand.
2. Remove tilt stand.
3. Remove two screws securing case back, then carefully lift back off to gain access to battery. Remove and save the battery insulator.
4. Replace the dead battery with a fresh 9 volt "transistor" battery. Replace the battery insulator. Use alkaline batteries such as the NEDA 1604 or equivalent for longer life. To prolong battery life set the **Function/Range** switch to the OFF position when not making measurements.
5. Reinstall back cover, tilt stand.

FUSE REPLACEMENT

If no current measurements are possible, check for a blown overload protection fuse. There are two fuses; Fl for the mA/µA jack and F2 for the 20A jack. A quick check for a blown 20A fuse can be performed by inserting the probe into the 20A jack and setting the function switch to any other position except 20A or OFF. If no warning tone is heard the fuse is probably blown. This procedure can be used for the µA/mA jack fuse by inserting the probe in the µA/mA jack and setting the function switch to any position other than the OFF, µA or mA positions. For access to fuses, remove the case back as described for battery replacement. Replace Fl only with the original type 2A, 600V, fast acting ceramic fuse **(B+K Precision** Part No. 194-044-9-001). Replace F2 only with the original type 20A, 600V, fast acting ceramic fuse **(B+K Precision** Part No. 194-043-9-001).

TEST LEADS

Use only *safety type leads, like those supplied.* Periodically examine the test leads to ensure that the conductors are not intermittent or broken. Also make sure that good contact pressure exists at the test receptacles and fuse holder, and keep these areas free from dirt and corrosion.

SPECIFICATIONS

Specifications apply from + 18°C to + 28°C at relative humidity up to 75% unless *otherwise noted.*

DC VOLTAGE Manual ranging.

Range	Resolution	Accuracy	Over voltage Protection
400mV	I00µV	± (0.5 % rdg + 1 dm)	500VDC or peak AC
4V	1mV		1000VDC ot peak AC
40V	10 mV		
400V	100 mV		
1000V	I V		

Input Impedance 20MG
Normal Mode Rejection ..... Greater than 50dB (50/60Hz)
Common Mode Rejection ..... Greater than 100dB (50/60Hz)

AC VOLTAGE Manual ranging. Average responding, rms reading.

Range	Resolution	Accuracy (50 Hz to 500 Hz)	Over voltage Protection
400m V	100µV	±(1.2%rdg + 3 dgts)	500VDC or peak AC
4V	1mV		1000VDC or peak AC
40V	10mV		
400V	100mV	±(1.5% rdg + 3 dgts)	
750V	1V		

Input Impedance .....20 MG/less than 100pF

DC CURRENT Manual ranging.

Range	**Resolution**	Accuracy	Burden **Voltage**
400µA	0.1 RA	± (l.0 % rdg 1 dgt)	600mV max.
4mA	1µA		
40mA	10µA		
400mA	100µA		
2000mA	1mA	t (1.5 %rdg + I dm)	900mV max.
*20A	10mA	±(2.0%rdg + 3 dgts)	

Overload Protection - 2A(600V) fast blow ceramic fuse and 20A(600V) fast blow ceramic fuse.

*20A Range Maximum Current - 10A continuous, 20Afor 60 sec. max

C CURRENT Manual ranging. Average responding rms reading.

Range	**Resolution**	**Accuracy (50 Hz to 500 kHz)**	**Burden Voltage**
400 RA	0.1 RA	+(1.5%rdg + 4 dgts)	600 mV rms max.
4mA	1pA		
40 mA	10RA		
400 mA	100RA		
2000 mA	1mA	± (2.0 % rdg + 4 dgts)	900 mV ms max.
*20A	101	±(2.5%rdg + 4 dgts)	

Overload Protection - 2A(600V) fast blow ceramic fuse and 20A(600V) fast blow ceramic fuse.

*20A Range Maximum Current - 10A continuous, 20A for 60 sec. max

RESISTANCE Manual ranging.

Range	Resolution	Accuracy	Max Open Circuit Voltage
400Ω	0.1Ω	±(1.0% rdg + 4 dgt)	3.2V
4kΩ	1Ω	±(0.75 %rdg 4 dgts)	0.6V
40 kΩ	10Ω		
400 kΩ	100Ω		
4 MΩ	1 kΩ		
40MΩ	10kΩ	±(2.0% rdg + 5 dgts)	

Overload Protection .....500V DC or peak AC

CAPACITANCE Manual ranging.

Range	Resolution	Accuracy	Test Frequency
4nF	1pF	±(3.0% rdg + 4 dgts)	180Hz
40nF	10pF		
400nF	100pF		
4µF	1nF		
40µF	10nF		

FREQUENCY COUNTER Auto ranging.

Range	Resolution	Accuracy	Sensitivity
4kHz	1Hz	±(0.1% rdg + 2 dgts)	250mV rms (10Hz to 1MHz) 500mV ms (1MH z to 4MHz)
40kHz	10Hz		
400kHz	100Hz		
4000kHz	IkH z		

Overvoltage Protection .....500V DC or peak AC
Duty Cycle ..... at >30% and <70%

DIODE CHECK

Range	Resolution	Accuracy	Max Test Current	Max Open Circuit Voltage
	1mV	±(1.5% rdg + 1 dgt)	1.0mA	3.2VDC

Overvoltage Protection ..... 500V DC or peak AC

CONTINUITY TEST

Range	Response Time	Description	Max Open Circuit Voltage
	Approx 100 ins	Buzzer sounds below approx. 100Ω	3.2V DC

Overload Protection ..... 500V DC or peak AC

LOGIC

LCD Displays Number "**OL**" when selected

Detector ..... AC coupled

Logic Threshold

Logic 1 (high) ..... 2.8V ±0.8V

Log 0 (low) ..... 0.8V ±0.5V

Duty Cycle ..... at >20% and <80%

Indications ..... 40 ms beep at logic low

Rise Width ..... 25 ns min.

Rise Rep Rate ..... 1Mpps max.

Rise Rise Time ..... 10µs max.

Input Impedance 120 kΩ/100pF

Input Overvoltage Protection ..... 500V DC or peak AC

TRANSISTOR hFE (DC GAIN) MEASUREMENT

Base Current 10µA

Vice 3.2V

Gain Measurement Range ..... 0 -1000

GENERAL SPECIFICATIONS

Display: 3-3/4 digit liquid crystal display (LCD) with a maxi-mum reading of 3999 counts. Large 0.7" digits.

Polarity: automatic (-) negative polarity indication.

Overrange Indication: “OL”.

Functional Annunciator: AC, DC, V, A, F, kHz, Ω, Hfe, and Logic on LCD display.

Low Battery Indication: " " is displayed when the battery drops below minimum operating voltage.

Sampling rate: 2.5 measurements per second, nominal, 1 time per second for frequency measurements.

Operating temperature: 0°C to +50°C, 0 to 70% relative humidity.

Power: Single 9V battery, NEDA 1604.

Battery life: 500 hours typical (alkaline).

Auto Power Off: Automatic ally shuts down after 45 minutes inactivity.

Dimensions (H x W x D): 7.8" x 3.6" x 1.7" (198 x 90 x 44mm).

Weight: 14.1 oz. (400g) including battery.
Accessories: Test leads (pair), battery, instruction manual.

NOTE: Specifications and information are subject to change without notice. Please visit www.bkprecision.com for the most current product information.

SYMBOLS

	See instruction manual for further precautionary information.
	High voltage terminal; up to 1000V may be present if connected to high voltage.
COM	Common input terminal.
	Diode test.
	Double insulation.
1000VDC MAX 750VDC	Maximum input rating or V-0-Flz terminal with respect to earth ground.
	Continuity test.
□	Logic high.
□	Logic low.
hFE	Transistor gain test.

OPTIONAL ACCESSORIES

Replacement Test Leads .....Model TL-I

Deluxe Test Leads .....Model TL-2A

Accessory Tips for Deluxe Test Leads ..... Model TL-3

High Voltage Robe (40 k VDC) .....Model PR-28A

Temperature Adapter Type K thermocouple ..... Model TP-30B

CONTROLS AND INDICATORS

1. **Display.** 3-3/4 digit display (3999 maximum) with automatic decimal point, polarity indication, high-low logic indicators, and low battery indicator. Indicates measured value, unit of measurement, and whether dc or ac is selected (for current and voltage readings). Overrange is indicated by displaying OL.

2. **MAX Switch**. Selects maximum hold or normal mode.

3. **Function/Range/Power Switch.** Selects function and range; V(1000 DCV/750 ACV, 400V, 40V, 4V, or 400mV), kHz · LOGIC, and •)) continuity) F (40µF, 4µF, 400nF, 40nF or 4nF), Ω (400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, or 40MΩ), hFE (PNP or NPN)→|← (diode). A (400µA, 4 mA, 40mA, 400mA, 2000mA, or 20A) ac or dc. When knob is pointing left or right, TEST BENCH power is off.

4. **hFE Jacks.** Input for direct insertion of NPN and PNP transistor leads. Emitter, collector, and base sockets are labeled.

5. **20A Jack.** Input for dc or ac current measurements on the 20 A range (currents greater than 10A not to be connected to TEST BENCH for longer than 60 seconds). For measurements greater than 3A, high current test leads are recommended.

6. **mA/µA Jack**. Input for dc or ac current up to 2A.

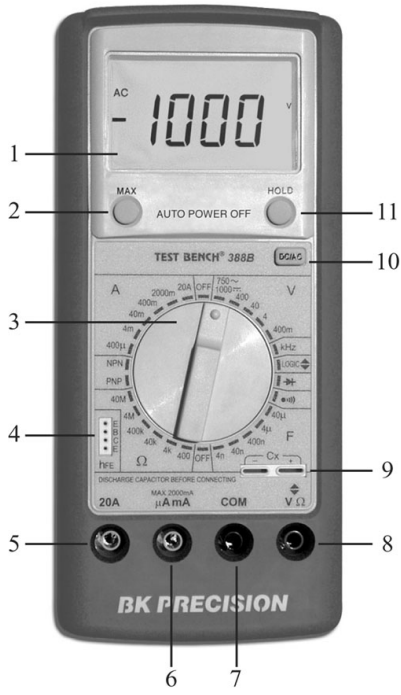
7. **COM Jack**. Input for common or reference test lead for measurements except Cx (capacitance) and hFE (transistor gain). Connect to earth ground or reference point not more than 500V (dc + ac peak) from earth ground.

8. **→|← VΩHZ Jack**. Input for voltage, resistance, frequency, hFE, Logic, and continuity/diode test functions.

9. **Cx Socket**. Input for capacitance measurements. Inputs are polarized for measuring polarized capacitors.

10. **AC/DC Switch**. Selects ac or de voltage and cement ranges. When switch is set to DC position, all voltage and current ranges are for dc measurements. When switch is set to AC position, all voltage and current ranges are for ac measurements.

11. **Hold Switch.** Activates data hold feature.


AC
-1000
V
MAX
HOLD
AUTO POWER OFF
TEST BENCH® 388B
DC/AC
A
V
OFF
NPN
PNP
LOGIC
kHz
F
Ω
hFE
Cx
DISCHARGE CAPACITOR BEFORE CONNECTING
20A
MAX 2000mA
μAmA
COM
VΩ
BK PRECISION
1
2
3
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5
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10
11

OPERATING INSTRUCTIONS

RANGE SELECTION

1. If the quantity to be measured is unknown, start with the highest range.
2. When an overrange is indicated (OL displayed) switch to the next highest range.

CAUTION

Do not switch between ranges while connected to a high voltage.

AUTO POWER OFF

1. The meter will automatically shut off if the Function/Range switch position is not changed within 45 minutes.
2. To restore operation, rotate the Function/Ranges switch to any other position.

VOLTAGE MEASUREMENTS

1. The annunciators in the lower left corner of the display indicate whether the ac or dc function is selected. The mV or V annunciator on the right indicates that voltage is selected.
   a. To measure ac voltage, set the **AC/DC** switch to the **AC** position.
   b. To measure dc voltage, set the **AC/DC** switch to the **DC** position.
2. **Set the Function/Range** switch to the desired voltage range.
3. Connect the test leads to the points of measurements.
4. For dc, a (-) sign is displayed for negative polarity: (+) positive polarity is implied.

RESISTANCE MEASUREMENTS

1. Set the **Function/Range** switch to the desired resistance range.
2. Remove power from the equipment under test.
3. Connect the red test lead to the →►◆ **VΩHz** jack and the black test lead to the **COM** jack. The red lead is (+) polarity.
4. Connect the test leads to the points of measurements and read the value from the display.

CONTINUITY MEASUREMENTS

1. Set the **Funtion/Range** switch to the •)) position.
2. Connect the red test lead to the →►◆ **VΩHz** jack and the black test lead to the **COM** jack.
3. Touch the test leads to the desired test point.
4. The buzzer will sound when resistance is less than 150**Ω**.

DIODE TEST

1. Set the **Function/Range** switch to the ⊣►position.
2. Connect the red test lead to the ⊣►⏚ **V Ω** Hz jack and the black test lead to the **COM** jack.
3. To check forward voltage (Vf), connect the red test lead to the anode and the black test lead to the cathode of the diode. Diodes and semiconductor junctions with normal Vf of less than approximately 3.000V can be checked.
4. The display indicates the forward voltage. Normal diode voltages are approximately 0.300V for germanium diodes, 0.700V for silicon diodes, and 1.600V for light emitting diodes (LED's). A reading of approximately 3.45V indicates an open diode. A shorted diode reads near 0V.
5. To check reverse voltage, reverse the test lead connections to the diode. The reading should be the same as with open test leads (approx. 3.45V). Lower readings indicate a leaky diode.

CURRENT MEASUREMENTS

WARNING

For current measurements, the meter must be connected in series with the load, If incorrectly connected on parallel with the load, the meter presents a very low impedance (almost a short), which may blow the fuse or damage the equipment under test.

NOTE

A warning tone will be heard if the test lead is corrected to µA mA input jack while the knob is not set to mA or µA range. A warning tone will also be heard if the test lead is corrected to 20A input jack while the knob is not set to 20A range.

1. The annunciators in the lower left corner of the display indicate whether the ac or dc function is selected. The µA or mA annunciator on the lower right indicates that current is selected.
   a. To measure ac current, set the AC/DC switch to the AC position.
   b. To measure dc current, set the AC/DC switch to the DC position.
2. For current measurements less than **2A**, connect the red test lead to the mA/µA jack and the black test lead to the **COM** jack.
3. For current measurements of **2A** or greater, connect the red test lead to the **20A** jack and the black test lead to the **COM**

jack. For current measurements greater than 3A, high current test leads are recommended.

NOTE

Maximum continuous input current is 10A. For current measurements higher than 10A, the current should not be corrected to the inputs for longer than 60 seconds.

4. Remove power from the circuit under test and on the normal circuit path where the measurement is to be taken. Connect the meter **in series** with the circuit.
5. Apply power and read the value from the display.

CAPACITANCE MEASUREMENTS

CAUTION

Never apply an external voltage to the Cx jacks. Damage to the meter may result. Always short capacitor leads together before connecting to meter.

1. Set the **Function/Range** switch to the desired Cx (capacitance) range.
2. Insert the capacitor leads directly into the slotted Cx test jacks. Observe polarity when measuring polarized capacitors. Insert one lead into the (+) jack and the other lead into the (-) jack.
3. Read the capacitance directly from the display. A shorted capacitor will indicate an overrange. An open capacitor will indicate near zero on all rang

USEFUL CONVERSIONS

pF	nF	µF
1,000	1.0	0.001
10,000	10.0	0.01
100,000	100.0	0.1
1,000,000	1,000.0	1.0
	10,000.0	10.0
	100,000.0	100.0
	1,000,000.0	1000.0

pF= picofarads (10^{-12})
nF= nanofarads(10^{-9})
µF= microfarads (10^{-6})

FREQUENCY MEASUREMENTS

1. Set the **Function/Range** switch to the kHz function.
2. Correct the red test lead to the ⊣▶⊢◆ **V Ω Hz** jack and the black test lead to the **COM** jack.
3. Connect' the test leads to the point of measurement and read the frequency from the display.

TRANSISTOR GAIN MEASUREMENTS

CAUTION

*Never apply an external voltage to the **hFE** sockets. Damage to the meter may result.*

1. Set the **Function/Range** switch to the desired **hFE** (dc transistor gain) range (**PNP** for pnp type transistors and **NPN** for npn type transistors).
2. Plug the transistor directly into the **hFE** socket. The sockets are labeled E, B, and C for emitter, base, and collector.
3. Read the transistor **hFE** (dc gain) directly from the display.

LOGIC MEASUREMENTS

1. Set the **Function/Range** switch to **LOGIC** ◆ position**.**
2. Connect the red test lead to the ⊣▶◆ **V Ω Hz** jack and the black test lead to the **COM** jack.
3. Connect the black test lead to the circuit ground (common).
4. Connect the red test lead to the test point.
5. A□ on the display indicates TTL logic high and a □ indicates a TTL logic low. Both indicators are on when the point of measurement is toggling high and low.

MAX MEASUREMENTS

MAX is used to measure the maximum value of a changing voltage or current such as surge current when power is first turned on or peak audio.

1. Set the meter to the desired function and range (MAX applies to all voltage and current measurement fractions).
2. Correct test leads to read voltage or current. Set the MAX switch to the On (right) position. A MAX should be on the top of the display. Red lead must be connected to the more positive point of the current or voltage measurement points when reading do values.

3. Read the measured value from the display.
4. To take another maximum measurement turn the MAX switch off to clear the previous maximum reading, then repeat steps 2 and 3.

NOTE: While the MAX switch is on, avoid touching the probes to fingers or any object that may hold a static charge. The maximum function is particularly susceptible to noise pickup when test leads are open circuited and the function range switch is in the 400 mV or 4 V range.

Limited Three-Year Warranty

B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of three years from date of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. The warranty is void if the serial number is altered, defaced or removed.

B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages. So the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

B&K Precision Corp.
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Yorba Linda, CA 92887
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714-921-9095

Service Information

Warranty Service: Please return the product in the original packaging with proof of purchase to the address below. Clearly state in writing the performance problem and return any leads, probes, connectors and accessories that you are using with the device.

Non-Warranty Service: Return the product in the original packaging to the address below. Clearly state in writing the performance problem and return any leads, probes, connectors and accessories that you are using with the device. Customers not on open account must include payment in the form of a money order or credit card. For the most current repair charges please visit www.bkprecision.com and click on "service/repair".

Return all merchandise to B&K Precision Corp. with pre-paid shipping. The flat-rate repair charge for Non-Warranty Service does not include return shipping. Return shipping to locations in North American is included for Warranty Service. For overnight shipments and non-North American shipping fees please contact B&K Precision Corp.

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Include with the returned instrument your complete return shipping address, contact name, phone number and description of problem.

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