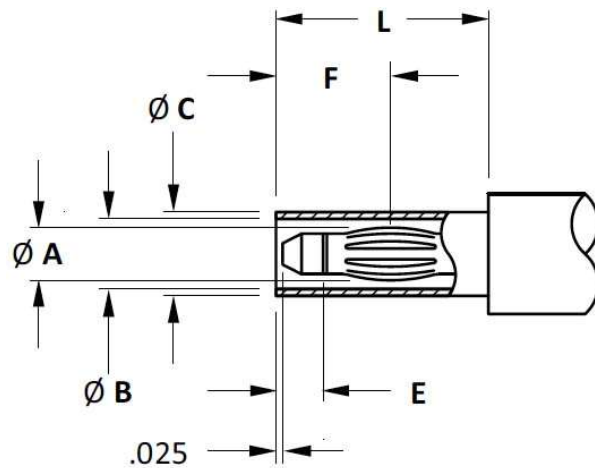


Banana Plugs 101: How Do Banana Plugs Work

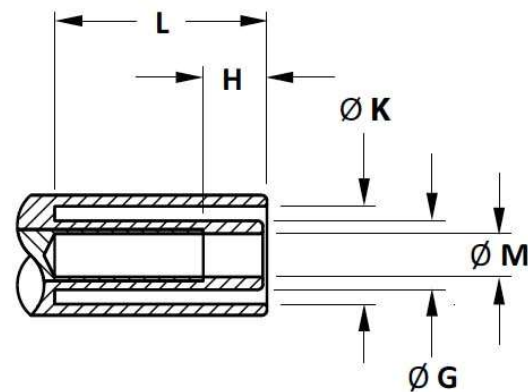
Since its introduction over 90 years ago, the banana plug connector has become the standard single wire connection device for electronic and electrical test equipment. The plug has evolved into a high quality copper alloy contact spring that plugs into a 4 mm (.157") diameter banana jack (socket). The standard spacing for two banana jacks side-by-side is 19.06 mm (.75").

With the introduction of safety standards in the 1980's, banana plugs acquired a cover sheath over the exposed metal contact to enhance user protection. The current international safety standard, IEC 61010-031, *Safety requirements for electrical equipment for measurement, control and lab use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test*, defines dimensions of sheath banana plugs for measurement categories II, III or IV up to 1,000 V.

General dimensions for 4 mm banana plugs and jacks:



4 mm BANANA PLUG



4 mm BANANA JACK

Dimensions Key:

$A = \varnothing .154 \pm .002$ ($\varnothing 3.90 \text{ mm} \pm .05 \text{ mm}$) – Compressed

$B \geq \varnothing .26$ ($\varnothing 6.6 \text{ mm}$)

$C \leq \varnothing .31$ ($\varnothing 7.9 \text{ mm}$)

$.10 \leq E \leq .24$ ($2.6 \text{ mm} \leq E \leq 6 \text{ mm}$)

$F \leq .47$ (12 mm) – Center of contact point

$G \leq \varnothing .25$ ($\varnothing 6.4 \text{ mm}$)

$.16 \leq H \leq .24$ ($4 \text{ mm} \leq H \leq 6 \text{ mm}$)

$K \geq \varnothing .32$ ($\varnothing 8.1 \text{ mm}$)

$L \geq .79$ (20 mm)

$M = \varnothing .157 \pm .002$ ($\varnothing 4 \text{ mm} \pm .05 \text{ mm}$)

Measurement Categories:

(Per IEC 61010-031)

Measurement categories are based on location as related to the mains supply where measurement can be made.

0 (no category)	circuits that are not directly connected to mains. <i>Examples are automobiles or other battery operated circuits or devices.</i>
Category II (CAT II)	applicable to circuits connected directly to sockets outlets of the low-voltage mains. <i>Examples are consumer appliances, power tools, or the consumer side of socket outlets.</i> <i>Typical short circuit currents: < 10 kA</i>
Category III (CAT III)	applicable to circuits connected to the distribution part of a building's low-voltage mains. <i>Examples are power distribution boards, solar cell power assemblies, circuit boxes, circuit breakers, switches and industrial equipment.</i> <i>Typical short circuit currents: > 10 kA</i>
Category IV (CAT IV)	applicable to circuits connected at the source of the building's low-voltage mains. <i>Examples are measurements on devices installed before the main fuse or circuit breaker in a building.</i> <i>Typical short circuit currents: > 50 kA</i> <i>These are high energy circuits so great precautions must be taken while working with these.</i>

The measurement category of a combination of probe, lead and or accessory is the lower of their respective category ratings.

Different Types of Banana Plugs:

Within the scope of IEC 61010-031 there are four defined probe assembly types that include banana plugs. The types are A, B, C & D with banana plugs falling under types A and D.

Type A: Non-attenuating assemblies rated for direct connection to voltages exceeding 30 Vrms / 42.4 Vpeak / 60 VDC.

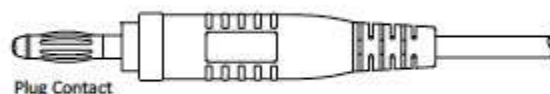
Type D: Non-attenuating assemblies rated for direct connection to voltages not exceeding 30 Vrms / 42.4 Vpeak / 60 VDC.

Below are descriptions of the most common banana plugs.

Banana Plug (Type D)

Features an exposed compliant contact spring and an insulation housing. It plugs into both standard and safety 4 mm banana jacks. Although it can operate at much high voltages, the plug is not recommended for handheld use above 30 VAC / 60 VDC (IEC 61010-031) as the exposed contact is capable of rendering an electric shock.

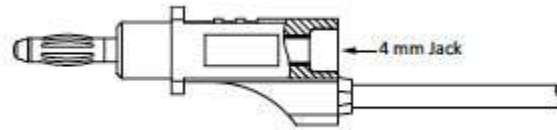
Stacking Banana Plug (Type D)



Has a banana plug on one end and a banana jack (receptacle) on the other end of its insulated housing. This allows another banana plug to share the same test point.

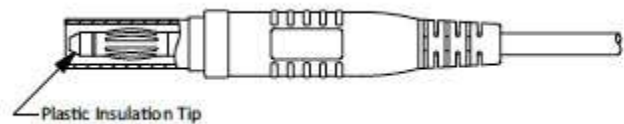
Sheath Banana Plug (Type A)

Also known as a shrouded, sleeved or safety banana plug. It features a fixed protective sheath over the spring contact that prevents unintentional contact. This plug only fits into safety banana jacks, which feature a recessed ring around their connection jack. This plug is recommended for all CAT III and IV applications.



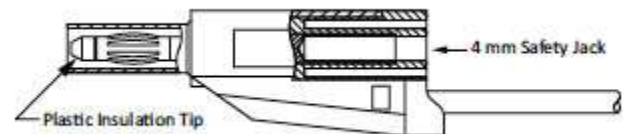
Stacking Sheath Banana Plug (Type A)

Similar to the stacking banana plug, the plug features a sheath banana plug on one end and a safety banana jack on the other. Recommended for all CAT III and IV applications.



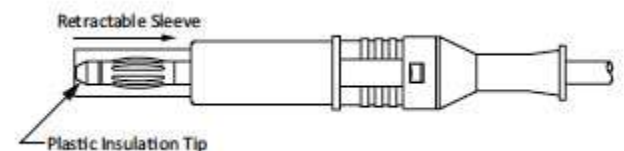
Retractable Sheath Banana Plug (Type A)

Feature a spring-loaded protective plastic sheath that prevents unintentional contact yet slides back when engaging a banana jack. An insulator tip on the plug's contact provides further user protection. Retractable sheath banana plugs are for CAT II applications.



Stacking Retractable Sheath Banana Plug (Type A)

As with the other stacking banana plugs, it features a plug and a female jack in its housing. But, the retractable sleeve over the plug makes it one of the most versatile banana plugs available, usable with all types of banana jacks. Retractable sheath banana plugs are for CAT II applications.



* IEC is a registered trademark of the International Electrotechnical Commission.

