RIGOL

用户手册

RP1003C/RP1004C/RP1005C

电流探头

2013 年 3 月
RIGOL Technologies, Inc

保证和声明

版权

商标信息

RIGOL 是北京普源精电科技有限公司的注册商标。

文档编号

UGE19002-1110

声明

- 本公司产品受已获准及尚在审批的中华人民共和国专利的保护。
- 本公司保留改变规格及价格的权利。
- 本手册提供的信息取代以往出版的所有资料。
- 对于本手册可能包含的错误，或因手册所提供的信息及演绎的功能，以及因使用本手册而导致的任何偶然或继发的损失，**RIGOL** 概不负责。
- 未经 **RIGOL** 事先书面许可不得影印复制或改编本手册的任何部分。

产品认证

RIGOL 认证本产品符合中国国家产品标准和行业产品标准及 ISO9001:2008 标准和 ISO14001:2004 标准，并进一步认证本产品符合其它国际标准组织成员的相关标准。

联系我们

如您在使用此产品的过程中有任何问题或需求，可与 **RIGOL** 联系：

服务与支持热线：800 810 0002 或 400 620 0002

网址：www.rigol.com

一般安全概要

了解下列安全性预防措施，以避免受伤，并防止损坏本产品或与本产品连接的任何产品。为避免可能的危险，请务必按照规定使用本产品。

将产品接地。

本产品通过电源电缆的保护接地线接地。为避免电击，在连接本产品的任何输入或输出端子之前，请确保本产品电源电缆的接地端子与保护接地端可靠连接。

查看所有终端额定值。

为避免起火和过大电流的冲击，请查看产品上所有的额定值和标记说明，请在连接产品前查阅产品手册以了解额定值的详细信息。

请勿开盖操作。

请勿在仪器机箱打开时运行本产品。

避免电路外露。

电源接通后，请勿接触外露的接头和元件。

怀疑产品出故障时，请勿进行操作。

如果您怀疑本产品出现故障，请联络**RIGOL**授权的维修人员进行检测。任何维护、调整或零件更换必须由**RIGOL**授权的维修人员执行。

保持适当的通风。

通风不良会引起仪器温度升高，进而引起仪器损坏。使用时应保持良好的通风，定期检查通风口和风扇。

请勿在潮湿环境下操作。

为避免仪器内部电路短路或发生电击的危险，请勿在潮湿环境下操作仪器。

请勿在易燃易爆的环境下操作。

为避免仪器损坏或人身伤害，请勿在易燃易爆的环境下操作仪器。

请保持产品表面的清洁和干燥。

为避免灰尘或空气中的水分影响仪器性能，请保持产品表面的清洁和干燥。

防静电保护。

静电会造成仪器损坏，应尽可能在防静电区进行测试。在连接电缆到仪器前，应将其内外导体短暂接地以释放静电。

安全术语和符号

本手册中的术语。以下术语可能出现在本手册中：

警告

警告性声明指出可能会危害操作人员生命安全的条件和行为。

注意

注意性声明指出可能导致本产品损坏或数据丢失的条件和行为。

产品上的术语。以下术语可能出现在产品上：

危险 表示您如果进行此操作可能会立即对您造成危害。

警告 表示您如果进行此操作可能会对您造成潜在的危害。

注意 表示您如果进行此操作可能会对本产品或连接到本产品的其他设备造成损坏。

产品上的符号。以下符号可能出现在产品上：

双层绝缘符号

安全警告

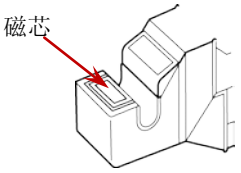
保护性接地

壳体接地

测量接地

一般注意事项

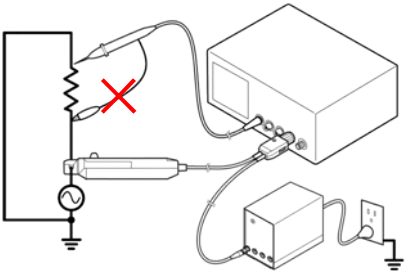
- ✧ 为了避免发生短路和可能的人身伤害，请勿将电流探头连接至工作电压大于最大额定电压或带有裸露导体的电路中。
- ✧ 当被测导体的电压超出安全电压水平但小于最大额定电压且磁芯打开时，为防止短路和电击，请确保被测导体使用的绝缘材料符合测量类别、工作电压和污染等级的基本绝缘要求。
- ✧ 使用符合被测电路的测量类别、工作电压和污染等级要求的基本绝缘材料将探头的输出端口与测量仪器上的其它端口绝缘。
- ✧ 电流传感器的磁芯与其周围的屏蔽箱没有绝缘，请勿将电流传感器与裸露的导体连接。



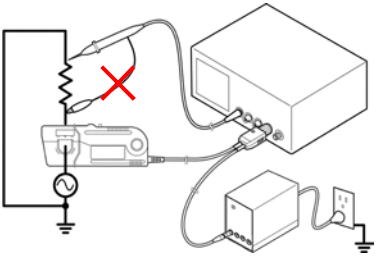
- ✧ 测量时，请勿损坏仪器的绝缘表面。
- ✧ 请使用本产品提供的电源或符合本产品规格的电源，并确保所使用的电源满足双绝缘保护性接地。
- ✧ 请确保连接至电流探头输出端口的测量设备带有双绝缘保护性接地。
- ✧ 如果与该电流探头输出端口（BNC）相连的测量仪器带有其它测量端口时，为避免电流探头跨接至其它测量端口以及任何危险的带电部分，请采取以下措施：
  - a) 请使用符合电路的测量类别、工作电压和污染等级的基本绝缘材料将电流探头的端口与测量仪器的端口绝缘；
  - b) 如果连接本仪器的端口与测量仪器的其它端口之间不满足基本绝缘需求，请确保测量端口的输入电压不超过安全电压水平。
- ✧ 当测量仪器的输入端口、机箱或其它输入端之间没有绝缘时，

不要将接地端口连接至任何非地电势，否则短路电流将通过接地端流入电源适配器或电流探头，导致电气事故或损坏电流探头。

RP1003C 和 RP1004C：



RP1005C：



- ✧ 请保持仪器干燥，并在测量时保持双手干燥，以免发生电击。
- ✧ 测量带电线路时，为防止电击，请使用合适的保护装置，如绝缘手套、长靴和安全帽等。
- ✧ 本仪器并非完全防水或防尘，因此，请勿在潮湿或多尘的环境下使用，以免损坏仪器。
- ✧ 电流传感器为精密仪器，包含一个模制元件、铁氧体磁芯和霍尔效应元件。当环境温度突变、受到机械拉力或撞击时，电流传感器可能会损坏。
- ✧ 电流传感器的齿合面经过了精细的研磨，使用仪器时应格外小心，以免划伤齿合面，影响仪器的性能。

- ✧ 当电流传感器的齿合面上沾有异物时，可能会影响测量结果的准确性。因此，用户需使用干净的软布轻轻擦拭以保持齿合面的清洁。
- ✧ 请不要过度弯折或拉扯电流探头的电缆部分，以免损坏电缆。
- ✧ 在待测导体连接至电流传感器之前，应保持电流传感器闭合，否则，磁芯部分的齿合面可能会被划伤。
- ✧ 请勿踩踏或挤压电缆，以免损坏电缆的绝缘性。
- ✧ 电缆应远离热源，否则其绝缘层将融化，从而造成导线裸露。
- ✧ 当仪器周围存在强磁场（如变压器和高电流导体附近）或强电磁场（如无线电发射机附近）时，测量结果可能不正确。
- ✧ 保存或使用仪器时，请勿将仪器放置在阳光直射、高温、潮湿或容易发生冷凝的地方，否则，仪器的绝缘性可能会降低从而影响其性能指标，甚至损坏仪器。

一般性检查

1. 检查运输包装

如运输包装已损坏，请保留被损坏的包装或防震材料，直到货物经过完全检查且探头通过电性和机械测试。

因运输造成探头损坏，由发货方和承运方联系赔偿事宜。**RIGOL** 公司恕不进行免费维修或更换。

2. 检查探头

若存在机械损坏或缺失，或者探头未通过电性和机械测试，请联系您的 **RIGOL** 经销商。

目录

电流探头简介

RP1003C、RP1004C 和 RP1005C 电流探头可检测流经导体的电流，并将其转换成可以在测量仪器上显示和测量的电压。

主要特色：

- 高精度电流检测
- 简捷的电流测量
- 宽带频率特点（RP1003C：DC 至 50MHz；RP1004C：DC 至 100MHz；RP1005C：DC 至 10MHz）
- 设计紧凑，允许测量低电流电平
- 简便的超量程输入保护功能
- 独创的薄膜霍尔效应元件

RP1003C 部件总览

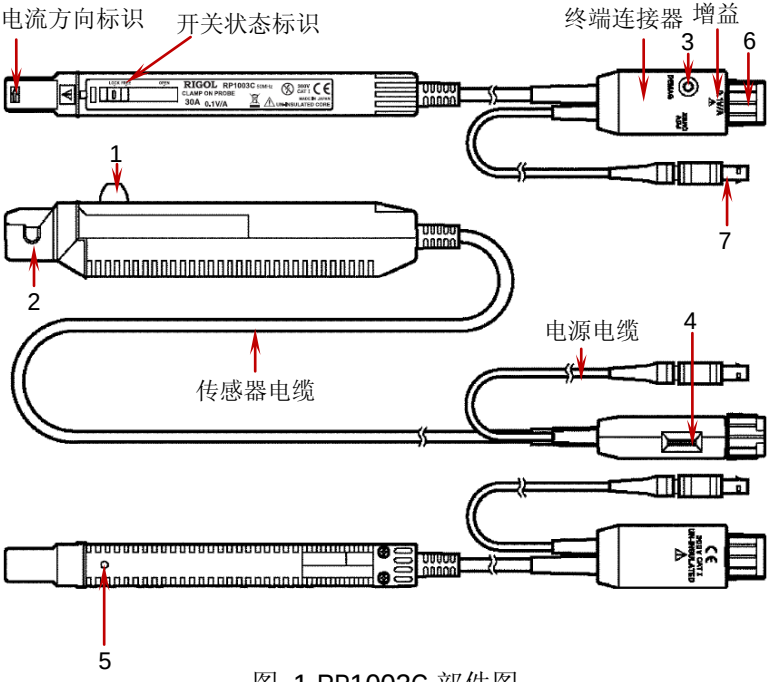


图 1 RP1003C 部件图

注意：关于图中部件 1 至 7，请参见第 4 页中的说明。

RP1004C 部件总览

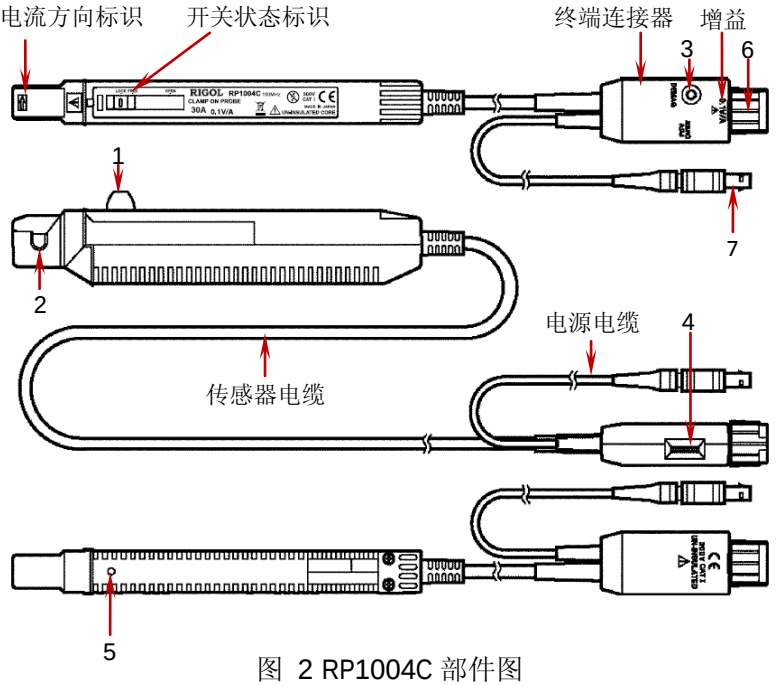


图 2 RP1004C 部件图

注意：关于图中部件 1 至 7，可见第 4 页中的说明。

RP1005C 部件总览

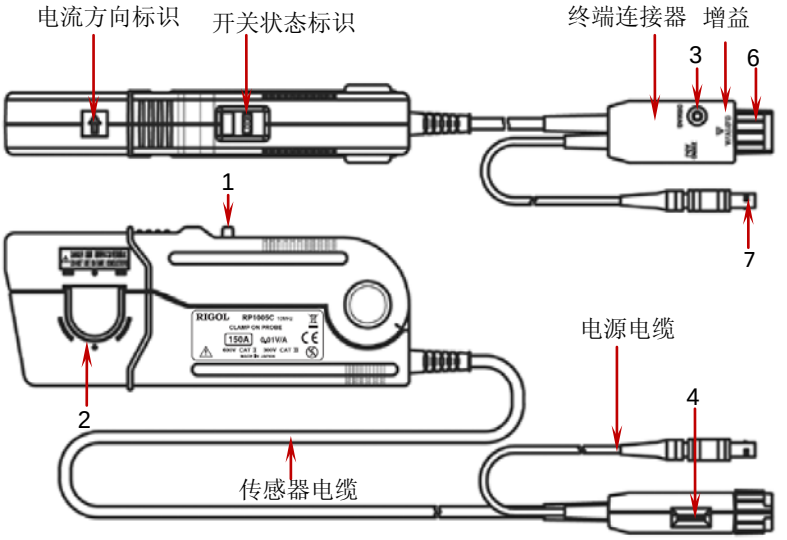


图 3 RP1005C 部件图

1. 滑动开关

用于打开和锁紧电流传感器。建议您测量待测导体时应锁紧电流传感器，以免发生危险。

对于 RP1003C 和 RP1004C，滑动开关的一侧标有 OPEN、FREE 和 LOCK 三种标识，电流传感器的开关状态与滑动开关所处的位置有关：

- ✧ 当滑动开关处于 OPEN 位置时，电流传感器完全打开，此时可将被测导体连接至电流传感器；
- ✧ 当滑动开关处于 FREE 位置时，电流传感器处于闭合状态但未锁紧；
- ✧ 当滑动开关处于 LOCK 位置时，电流传感器头处于锁紧状态，此时，UNLOCK 标识被遮挡。

对于 RP1005C，滑动开关上面标有 LOCK 和 UNLOCK 标识，当开关上面显示 LOCK 标识并且 UNLOCK 标识消失时，电流传感器处于锁紧状态。

2. 电流传感器

进行电流测量时，使用电流传感器夹住被测导体。电流传感器为精密装置，包含一个模制元件、铁氧体磁芯和霍尔效应元件。当环境温度突变、受到机械拉力或撞击时，可能会损坏电流传感器，因此使用时需格外小心。

3. 消磁开关

仪器上电、掉电或当输入电流过大时，磁芯会被磁化，使用消磁开关可为磁芯消磁。进行测量前须执行消磁操作，整个消磁操作持续一秒钟左右。该过程中，电流探头将输出一个消磁波形。

4. 零位调整表盘

使用零位调整表盘可以修正由于仪器的直流电压偏移或温度漂移产生的影响。进行测量时，执行完消磁操作后，应该进行调零，将基线调整至零位。

5. 粗调调整器（仅适用于 RP1003C 和 RP1004C）

当无法在零位调整表盘范围内进行调节时，可以使用绝缘螺丝刀（如陶瓷螺丝刀）通过该调整器进行调节，将基线调整至零位调整表盘可调节的范围内，然后使用零位调整表盘将基线调整至零位。

6. 输出连接器

该输出连接器可直接连接至测量仪器（如示波器或记录仪）的 BNC 输入端，也可以通过 BNC 转香蕉插头转接器或类似转接器将该输出连接器连接至其它测量仪器。此时，被测导体的电流波形将以恒定的增益通过该连接器输出至测量仪器。

注意：

a) 对于 RP1003C 和 RP1004C，输出连接器上标识的 0.1V/A 是测量仪器的输入阻抗为 1MΩ 时对应的增益，当测量仪器的输入阻抗为 50Ω 时，对应的增益为 1/2×0.1V/A=0.05V/A。

b) 对于 RP1005C，输出连接器上标识的 0.01V/A 是测量仪器的输入阻抗为 1MΩ 时对应的增益，当输入阻抗为 50Ω 时，对应的增益为 1/2×0.01V/A=0.005V/A。

7. 电源插头

将该电源插头连接至电源适配器的相应插孔为电流探头的终端连接器提供电源。

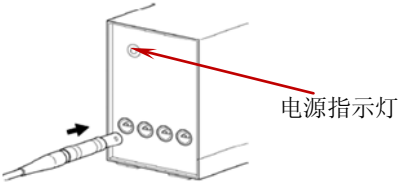
注意：为防止电击，使用过程中请勿触摸保护套之外的部分。

电流探头的使用方法

使用电流探头测量被测设备的电流之前，首先应该进行测量准备、消磁和零位调整等一系列操作，然后按照**测量步骤**中所述的方法进行测量。注意：进行测量前，建议您阅读**测量过程中需要注意的事项**，以免发生不必要的损失。

测量准备

1. 将电流探头的电源插头连接至电源适配器。



2. 关闭电源适配器的开关，并将电源适配器连接至电源。注意：此处所使用的电源电压应与电源适配器上所标注的供电电压相匹配。

3. 打开电源适配器的开关，并检查电源指示灯是否点亮。

消磁

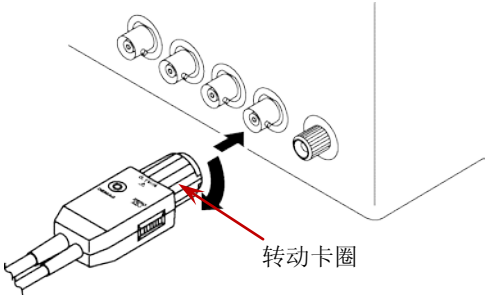
仪器上电、掉电或当输入电流过大时，磁芯会被磁化，因此，进行测量前须执行消磁操作。

1. 如果测量仪器的输入为地电平，应将该测量仪器的耦合设置为

GND，同时将基线调整至零位。

2. 将测量仪器的耦合设置为直流。

3. 将电流探头的输出连接器连接至测量仪器的 BNC 输入端，转动输出连接器的转动卡圈，如下图所示，并检查卡圈是否锁紧。

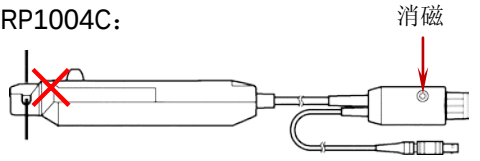


注意：断开输出连接器与测量仪器的连接时，首先按照上图箭头所示的反方向旋转转动卡圈解除锁紧，然后将连接器拔出。否则，直接拔出或拉扯电缆线可能损坏终端连接器。

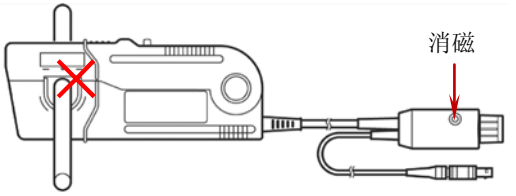
4. 确保电流传感器处于锁紧状态（对于 RP1003C 和 RP1004C，滑动开关应处于 LOCK 位置；对于 RP1005C，滑动开关上面显示 LOCK 标识并且 UNLOCK 标识消失）。

5. 打开电源适配器的开关，然后按下终端连接器上的消磁开关，整个消磁操作将持续一秒钟左右。该过程中，电流探头将输出一个消磁波形。
注意：当电流探头的电流传感器连接被测导体时，请勿进行消磁操作，因为消磁操作会导致电流流入导体，可能会损坏被测电路的器件。

RP1003C和RP1004C：



RP1005C：



零位调整

由于电压偏移和温度漂移可能对电流探头的基线位置产生影响，所以进行测量前，执行完消磁操作后，应进行调零。

1. 拨动终端连接器上的零位调整表盘，将基线调至零位。

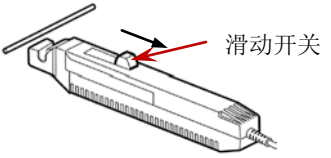
2. 当无法在零位调整表盘范围内进行调节时，可以使用绝缘螺丝刀（如陶瓷螺丝刀）通过粗调调整器将基线调整至零位调整表盘可调节的范围内，然后使用零位调整表盘将基线调整至零位（仅适用于 RP1003C 和 RP1004C）。

测量步骤

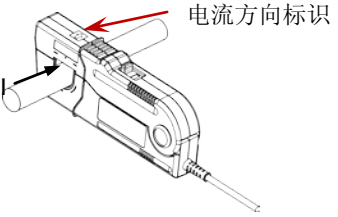
完成上述一系列操作后，开始测量。

1. 按照下图所示的箭头方向拨动滑动开关打开电流传感器（对于 RP1003C 和 RP1004C，滑动开关处于 OPEN 位置；对于

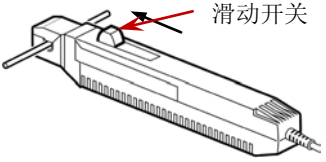
RP1005C，滑动开关上面显示 UNLOCK 标识，LOCK 标识消失）。



2. 调整电流传感器，使其电流方向标识与待测导体中的电流方向一致，使用电流传感器夹住待测导体，并使待测导体位于孔中心。



3. 按照下图所示的箭头方向拨动滑动开关将电流传感器锁紧（对于 RP1003C 和 RP1004C，滑动开关应处于 LOCK 位置；对于 RP1005C，首先应该上下按压电流探头闭合电流传感器，然后拨动滑动开关直至上面显示 LOCK 标识，UNLOCK 标识消失）。



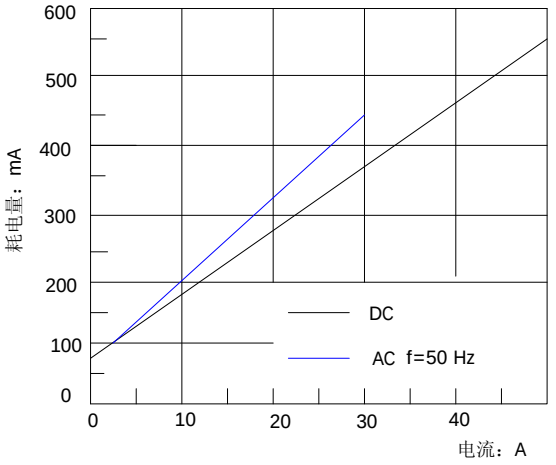
4. 此时，您可以查看测量仪器测得的波形的电压幅度并计算出实际的电流幅度（电流幅度=测得的电压幅度/电流探头的增益）。例如，测得的波形电压幅度为 2V，电流探头的增益为 0.1V/A，则实际电流幅度为：2V/(0.1V/A)=20A。

   注意：您可以通过测量仪器的电压灵敏度计算出电流灵敏度，电流灵敏度等于测量仪器的电压灵敏度与电流探头的增益的比值。例如，测量仪器的电压灵敏度为 0.001V/div，电流探头的

增益为 0.1V/A，则电流灵敏度为：
(0.001V/div)/(0.1V/A)=0.01A/div。

测量过程中需要注意的事项

1. 电流探头的耗电量取决于被测导体的电流大小，在一个电源适配器上同时连接多个电流探头时，请确保连接至电源适配器上的电流探头的总耗电量不超过电源适配器的额定输出电流。下图为输出电流与耗电量之间的关系曲线：



注意：耗电量为正负耗电量代数和。

2. 最大连续输入范围是基于测量过程中仪器内部所产生的热量而定的。注意：输入电流不可超过该范围，否则可能损坏电流探头。

3. 输入电流的线性响应范围随被测电流频率的变化而变化，二者的变化关系曲线图请参考**附录 2 最大输入电流与频率的关系**。

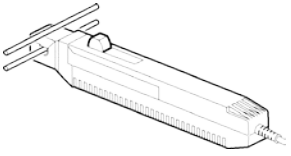
4. 如果输入电流超出最大连续输入范围，可能导致仪器内部温度过高而启动内置的保护电路功能，该功能会阻碍正常的输出。此时，请立即断开电流传感器与被测导体的连接或将输入电流降低至 0，待电流传感器充分冷却后，方可重新进行操作。
   注意：即使输入电流未超出最大连续输入范围，长时间的连续输入也会启动保护电路功能以避免电流传感器发热引起的损坏。

5. 当环境温度过高时，即使输入电流低于最大连续输入范围，也可能会启动内置的保护电路功能。

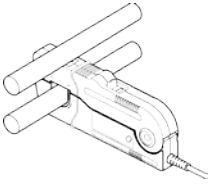
6. 如果输入电流多次超出最大连续输入范围而使保护电路反复启动，将降低保护电路的性能，甚至可能会损坏设备。

7. 由于周围导体中的电流可能会使电流传感器温度升高，因此，请勿将带有 10kHz 或更高频率电流的导体放在电流传感器周围，以免损坏电流传感器，如下图所示。

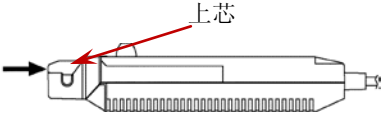
   RP1003C 和 RP1004C：



   RP1005C：



8. 请使用滑动开关打开电流传感器。对于 RP1003C 和 RP1004C，请勿沿下图箭头所示方向推压上芯，以免损坏滑动开关的内部结构。

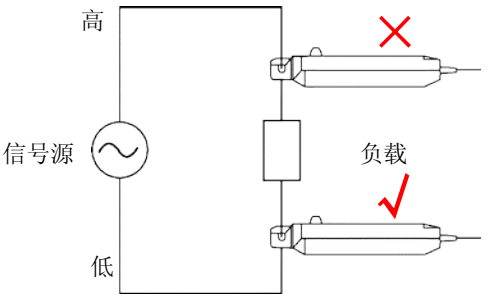


9. 刚接通电源时，由于预热，该仪器将产生明显的直流漂移，因此，进行测量前，应将电流探头预热 30 分钟以上。

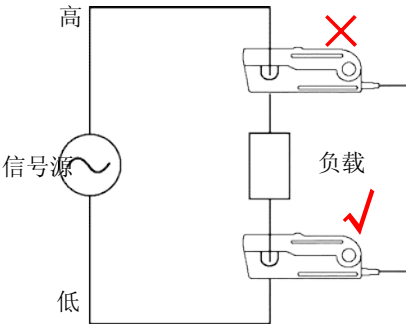
10. 在某些情况下，将电源插头连接至通电的电源适配器时，可能会产生震荡，该情况不属于仪器故障，可通过打开或关闭电流传感器消除震荡并使操作恢复正常。

11. 当输入信号的频率较高时，电流探头所测得的信号对应的共模电压范围降低，此时应将电流探头连接至电路的低压端，如下图所示。

RP1003C 和 RP1004C：



RP1005C：



规格

以下参数适用于仪器在规定的操作温度（10℃-30℃）和湿度（0%RH-80%RH）下连续运行 30 分钟以上。

技术参数

RP1003C：

带宽	DC 至 50MHz（-3dB），见**附录 1 幅频特性**（RP1003C）
上升时间	≤7ns
输入电流线性响应范围	30Arms，见**附录 2 最大输入电流与频率的关系**（RP1003C）
最大峰值电流	50A peak，非连续
增益	0.1V/A
增益精度	±1.0%rdg±1mV，≤30A ±2.0%rdg，30A 至 50A peak 非连续（DC，45Hz 至 66Hz，输入电流线性响应范围内）
噪声	≤2.5mArms（带宽为 20MHz 的测量仪器）
输入阻抗	见**附录 3 输入阻抗（典型）**（RP1003C）
增益精度漂移	≤±2%（温度范围 0℃至 40℃，输入 50Hz，30A）
额定功率	5.6W
供电电压	+12V±0.5V
最大额定电压	300V，CATI（绝缘导体）
增益精度寿命	1 年（操作/关闭高达 10,000 次）
外部磁场影响	≤20mA（DC 和 60Hz，400A/m 磁场）

RP1004C：

带宽	DC 至 100MHz（-3dB），见**附录 1 幅频特性**（RP1004C）
上升时间	≤3.5ns
输入电流线性响应范围	30Arms，见**附录 2 最大输入电流与频率的关系**（RP1004C）
最大峰值电流	50A peak，非连续
增益	0.1V/A
增益精度	±1.0%rdg±1mV，≤30A ±2.0%rdg，30A 至 50A peak（DC 和 45Hz 至 66Hz，输入电流线性响应范围内）
噪声	≤2.5mArms（带宽为 20MHz 的测量仪器）
输入阻抗	见**附录 3 输入阻抗（典型）**（RP1004C）
增益精度漂移	≤±2%（温度范围 0℃至 40℃，输入 50Hz，30A）
额定功率	5.3W
供电电压	+12V±0.5V
最大额定电压	300V，CATI（绝缘导体）
增益精度寿命	1 年（操作/关闭高达 10,000 次）
外部磁场影响	≤5mA（DC 和 60Hz，400A/m 磁场）

RP1005C：

带宽	DC 至 10MHz（-3dB），见**附录 1 幅频特性**（RP1005C）
上升时间	≤35ns
输入电流线性响应范围	150A，见**附录 2 最大输入电流与频率的关系**（RP1005C）
最大峰值电流	300A peak，非连续 500A peak，脉宽≤30μs
增益	0.01V/A
增益精度	±1.0%rdg±1mV，≤150A ±2.0%rdg，150A 至 300A peak（DC，45Hz 至 66Hz）
噪声	≤25mArms（带宽为 20MHz 的测量仪器）
输入阻抗	见**附录 3 输入阻抗（典型）**（RP1005C）
增益精度漂移	≤±2%（温度范围 0℃至 40℃，输入 55Hz，150A）
额定功率	5.5W
供电电压	+12V±1V
最大额定电压	600V：CATII；300V：CATIII（绝缘导体）
增益精度寿命	1 年（打开/关闭高达 10,000 次）
外部磁场影响	≤150mA（DC 或 60Hz，400A/m 磁场）

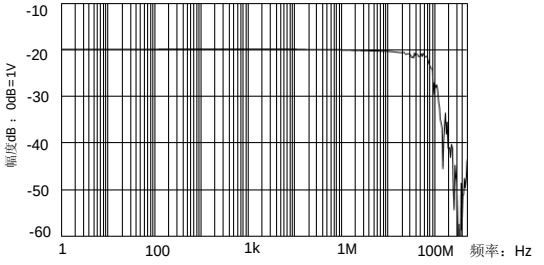
一般技术规格

探头尺寸	电流传感器	RP1003C：约 175mmx18mmx32mm RP1004C：约 175mmx18mmx32mm RP1005C：约 176mmx69mmx34mm
	终端连接器	RP1003C：约 6.9mmx2.5mmx1.6mm RP1004C：约 6.9mmx2.5mmx1.6mm RP1005C：约 6.9mmx2.5mmx1.6mm
被测导体最大尺寸	RP1003C：约 5mm RP1004C：约 5mm RP1005C：约 20mm	
电缆长度	电流传感器电缆	RP1003C：约 150cm RP1004C：约 150cm RP1005C：约 200cm
	电源电缆	RP1003C：约 100cm RP1004C：约 100cm RP1005C：约 100cm
重量	RP1003C：约 230g RP1004C：约 240g RP1005C：约 500g	
工作温度和湿度	0℃至+40℃，湿度 0 至 80%RH	
储藏温度和湿度	-10℃至+50℃，湿度 0 至 80%RH	
使用环境	室内，海拔 2000m 以下	
电磁兼容性	EN61326	
测量级别	RP1003C：I 级（预期瞬态过压为 1500V） RP1004C：I 级（预期瞬态过压为 1500V） RP1005C：II 级、III 级（预期瞬态过压为 4000V）	
污染等级	2 级	
安全认证	符合 EN61010 认证要求	

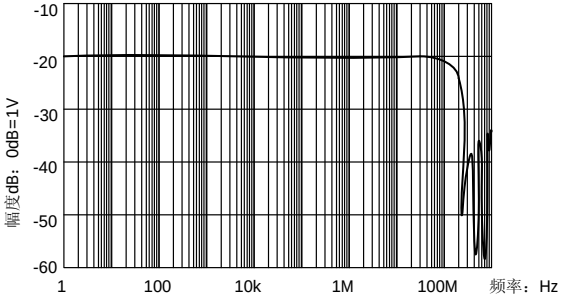
附录

附录 1 幅频特性

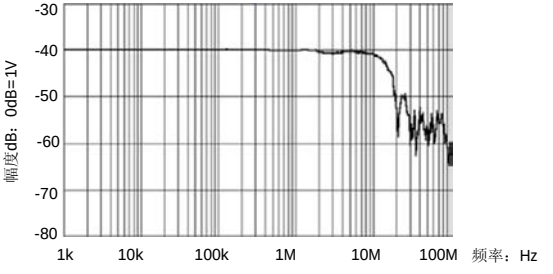
RP1003C：



RP1004C：

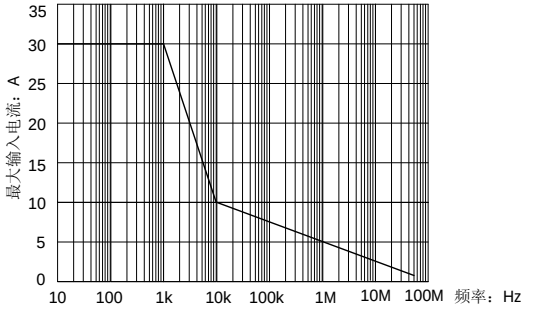


RP1005C：

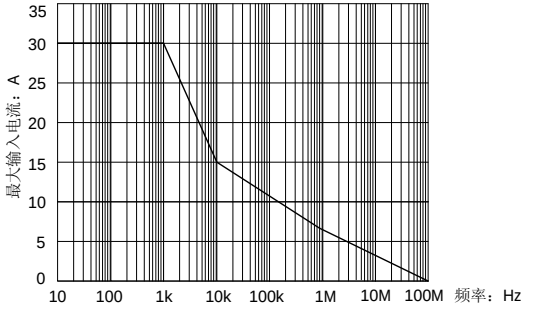


附录 2 最大输入电流与频率的关系

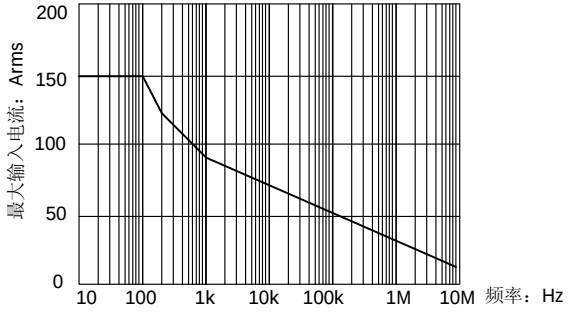
RP1003C：



RP1004C：

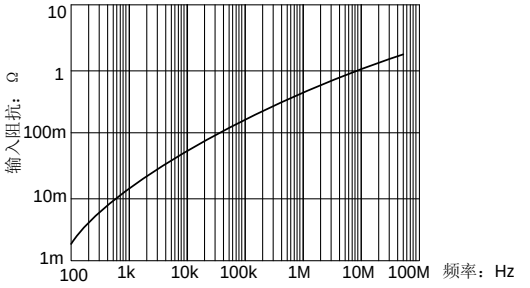


RP1005C：

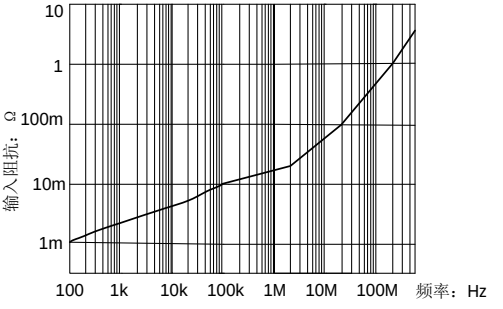


附录 3 输入阻抗（典型）

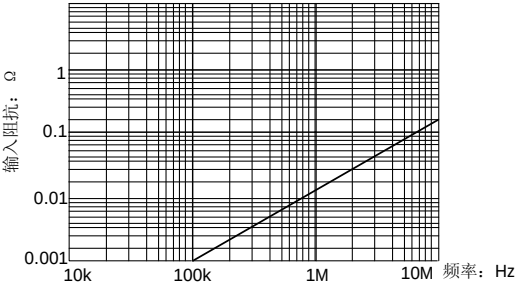
RP1003C：



RP1004C：



RP1005C：



RIGOL

User's Guide

RP1003C/RP1004C/RP1005C

Current Probe

Mar. 2013
RIGOL Technologies, Inc

Guaranty and Declaration

Copyright

Trademark Information

RIGOL is a registered trademark of RIGOL Technologies, Inc.

Publication Number

UGE19102-1110

Notices

- **RIGOL** products are protected by patent law in and outside of P.R.C.
- **RIGOL** reserves the right to modify or change parts of or all the specifications and pricing policies at company's sole decision.
- Information in this publication replaces all previously corresponding material.
- **RIGOL** shall not be liable for losses caused by either incidental or consequential in connection with the furnishing, use or performance of this manual as well as any information contained.
- Any part of this document is forbidden to be copied or photocopied or rearranged without prior written approval of **RIGOL**.

Product Certification

RIGOL guarantees this product conforms to the national and industrial standards in China as well as the ISO9001:2008 standard and the ISO14001:2004 standard. Other international standard conformance certification is in progress.

Contact Us

If you have any problem or requirement when using our products, please contact RIGOL Technologies, Inc. or your local distributors, or visit: www.rigol.com.

General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injuries or damages to the instrument and any product connected to it. To prevent potential hazards, please use the instrument only specified by this manual.

Ground The Instrument.

The instrument is grounded through the Protective Earth lead of the power cord. To avoid electric shock, it is essential to connect the earth terminal of power cord to the Protective Earth terminal before any inputs or outputs.

Observe All Terminal Ratings.

To avoid fire or shock hazard, observe all ratings and markers on the instrument and check your manual for more information about ratings before connecting.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Avoid Circuit or Wire Exposure.

Do not touch exposed junctions and components when the unit is powered.

Do Not Operate With Suspected Failures.

If you suspect damage occurs to the instrument, have it inspected by qualified service personnel before further operations. Any maintenance, adjustment or replacement especially to circuits or

accessories must be performed by **RIGOL** authorized personnel.

Keep Well Ventilation.

Inadequate ventilation may cause increasing of temperature or damages to the device. So please keep well ventilated and inspect the intake and fan regularly.

Do Not Operate in Wet Conditions.

In order to avoid short circuiting to the interior of the device or electric shock, please do not operate in a humid environment.

Do Not Operate in an Explosive Atmosphere.

In order to avoid damages to the device or personal injuries, it is important to operate the device away from an explosive atmosphere.

Keep Product Surfaces Clean and Dry.

To avoid the influence of dust and/or moisture in air, please keep the surface of device clean and dry.

Electrostatic Prevention.

Operate in an electrostatic discharge protective area environment to avoid damages induced by static discharges. Always ground both the internal and external conductors of the cable to release static before connecting.

Safety Terms and Symbols

Terms in this Manual. These terms may appear in this manual:

WARNING
Warning statements indicate the conditions or practices that could result in injury or loss of life.

CAUTION
Caution statements indicate the conditions or practices that could result in damage to this product or other property.

Terms on the Product. These terms may appear on the Product:

DANGER	indicates an injury or hazard may immediately happen.
WARNING	indicates an injury or hazard may be accessible potentially.
CAUTION	indicates a potential damage to the instrument or other property might occur.

Symbols on the Product. These symbols may appear on the product:

Double Insulation

Safety Warning

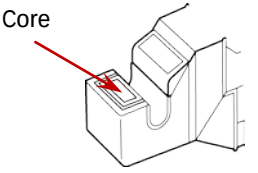
Protective Earth Terminal

Chassis Ground

Test Ground

Precautions

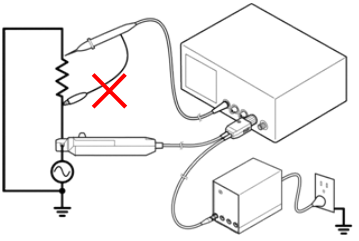
- ✧ To avoid short circuits and potentially life-threatening hazards, never connect the current probe to a circuit that operates at greater than the maximum rated voltage or over bare conductors.
- ✧ When conductors being measured carry in excess of the safe voltage level and not more than the maximum rated voltage, to prevent short circuits and electric shock while the core section is open, make sure that conductors to be measured are insulated with material conforming to the requirements of measurement category, working voltage and pollution degree.
- ✧ Isolate the output terminal of the probe from other terminals on the measuring instrument using basic insulation conforming to the requirements of measurement category, working voltage and pollution degree.
- ✧ The core and shield case of the current sensor are not insulated. Please do not use the current sensor on bare conductors.



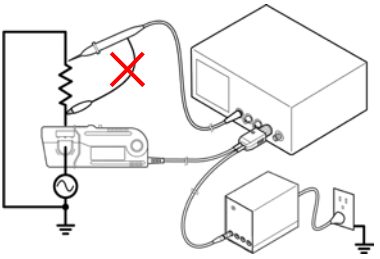
- ✧ Be careful to avoid damaging the insulation surface while taking measurements.
- ✧ Please use the power supply provided with this product or other power supply conforming to the specifications of this product. Make sure that the power supply has a protective earthing with double-insulation construction.

- ✧ Make sure that the measuring instrument connected to the output terminal of the current probe is equipped with a protective earthing with double-insulation construction.
- ✧ If the measuring instrument connected to the output terminal (BNC) of the current probe is equipped with any other measurement terminals, take the following precautions to ensure that the other instrument does not form a bridge between the probe and any hazardous live of a part.
  a) Isolate the terminal of the probe from other terminals on the measuring instrument using basic insulation conforming to the requirements of measurement category, working voltage and pollution degree.
  b) If basic insulation requirement cannot be met between the terminal to which the current probe is connected and other terminals on the measuring instrument, make sure that the voltage input to the measurement terminal does not exceed the safe voltage level.
- ✧ When using a measuring instrument that does not provide isolation between its input terminals and chassis or other input terminals, please do not connect the ground terminal to any non-ground potential. Otherwise, short-circuit current will flow through the power adaptor or current probe from the ground terminal, which could cause an electrical accident or damage.

  RP1003C and RP1004C:



RP1005C:



- ✧ To avoid electric shock, do not allow the device get wet and do not take measurement with wet hands.
- ✧ To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated gloves, boots and a safety helmet.
- ✧ The device is not designed to be entirely water-proof or dust-proof. To avoid damage, do not use it in a wet or dusty environment.
- ✧ The current sensor is a precision assembly including a molded component, a ferrite core and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock.
- ✧ The mating surfaces of the current sensor are precisely ground and should be treated with care. If these surfaces are scratched, the performance may be impaired.
- ✧ Measurements are degraded by dirt on the mating surfaces of the current sensor, so keep the surfaces clean by gently wiping with a soft cloth.
- ✧ To avoid damaging the current probe cable, do not bend or pull the cable.
- ✧ Keep the current sensor closed, except when clamping it onto the conductor to be measured. The mating

surface of the core can be scratched when it is open.

- ✧ Avoid stepping on or pinching the cable, which could damage the cable insulation.
- ✧ Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.
- ✧ Correct measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.
- ✧ Do not store or use the device where it could be exposed to direct sunlight, high temperature, humidity or condensation. Under such conditions, the device might be damaged and insulation may deteriorate so that it no longer meets specifications.

General Inspection

1. Inspect the shipping container for damage

Keep the damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the probe has passed both electrical and mechanical tests.

The consigner or carrier shall be liable for the damage to probe resulting from shipment. **RIGOL** would not be responsible for free maintenance/rework or replacement of the unit.

2. Inspect the probe

In case of any damage, or defect, or failure, notify your **RIGOL** sales representative.

Contents

Current Probe Overview

RP1003C, RP1004C and RP1005C current probes can detect the current flowing through the conductor and convert it to voltage that can be displayed on and measured by the measuring instrument.

Main Features:

- Highly accurate current detection
- Easy current measurement
- Broadband frequency characteristics (RP1003C: DC to 50MHz; RP1004C: DC to 100MHz; RP1005C: DC to 10MHz)
- Compact design, permits measurement of low current levels
- Easy protect function at excessive input
- Unique thin film Hall effect element

RP1003C Parts Overview

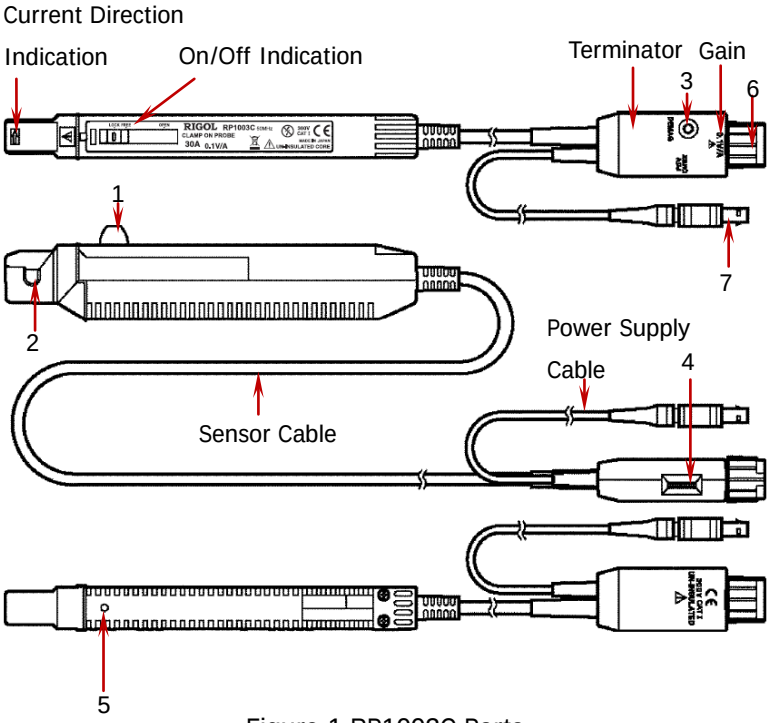


Figure 1 RP1003C Parts

Note: For more information of parts 1 to 7 in the figure above, refer to the introductions on page 4.

RP1004C Parts Overview

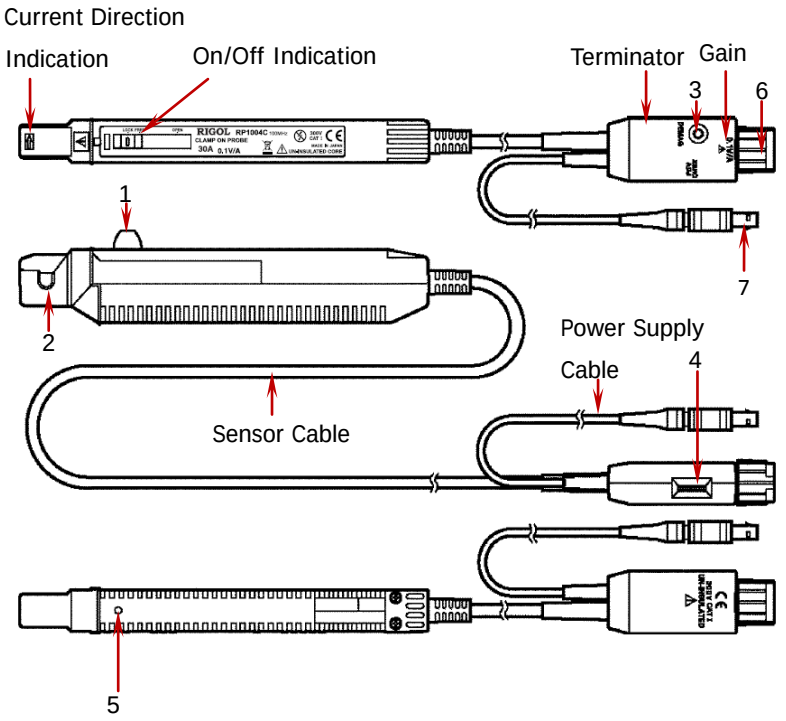


Figure 2 RP1004C Parts

Note: For more information of parts 1 to 7 in the figure above, refer to the introductions on page 4.

RP1005C Parts Overview

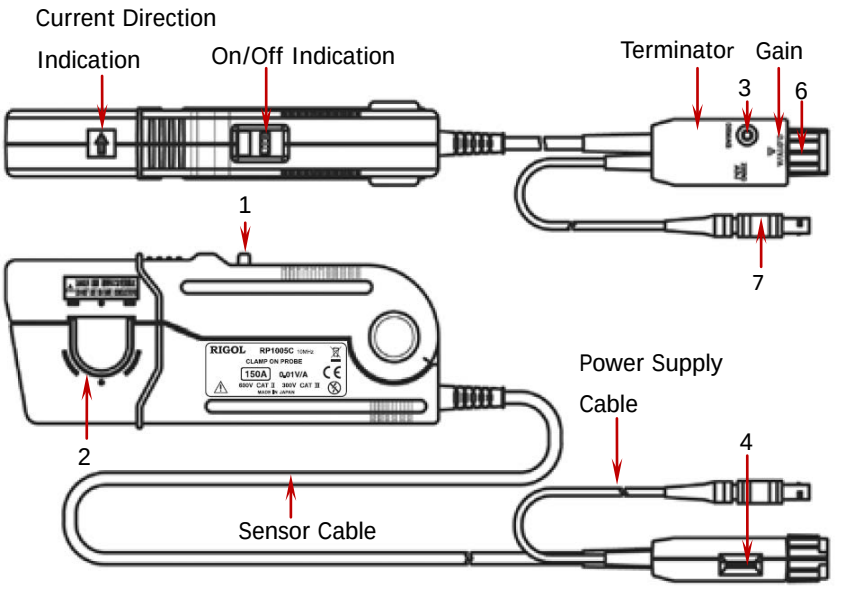


Figure 3 RP1005C Parts

1. Slide Switch

It is used to open and lock the current sensor. You are recommended to lock the current sensor when measuring the conductor to be measured to avoid danger.

For RP1003C and RP1004C, there are OPEN, FREE and LOCK indications on one side of the slide switch. The on/off status of the current sensor is related to the position of the slide switch.

- ✧ When the slide switch is at the OPEN position, the current sensor is open and at this point, the conductor to be measured can be connected to the current sensor;
- ✧ When the slide switch is at the FREE position, the current

sensor is closed but not locked;

- ✧ When the slide switch is at the LOCK position, the current sensor is locked and at this point, the UNLOCK indication is covered (cannot be seen).

For RP1005C, there are LOCK and UNLOCK indications on the slide switch. The current sensor is locked when the LOCK indication is displayed on the slide switch (the UNLOCK indication disappears).

2. Current Sensor

It is used to clamp the conductor to be measured and carries out the actual current measurement. It is a precision assembly including a molded component, a ferrite core and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be taken in handling it.

3. Demagnetizing Switch

It is used to demagnetizing the core if it has been magnetized by switching the power on and off, or by an excessive input. Always carry out demagnetizing before measurement. The demagnetizing process takes about one second. During demagnetizing, the current probe outputs a demagnetizing waveform.

4. Zero Adjustment Dial

Use the zero adjustment dial to correct for the effect of a DC voltage offset or temperature drift on the device. When beginning measurement, after demagnetizing always carry

out zero adjustment to adjust the baseline to zero.

5. Coarse Adjustment Trimmer (only applicable to RP1003C and RP1004C)

When adjustment is not possible within the range of zero adjustment dial, use a nonconductive screwdriver to (such as ceramic screwdriver) to adjust the baseline to the adjustable range of the zero adjustment dial via the coarse adjustment trimmer; then, use the zero adjustment dial to adjust the baseline to zero.

6. Output Connector

This connector can be directly connected to the BNC input terminal of the measuring instrument (such as oscilloscope or recorder), or be connected to other measuring instrument via BNC-to-Banana plug adaptor or similar adaptor. At this point, the current waveform of the conductor under measurement is output at a constant gain.

Note:

a) For RP1003C and RP1004C, 0.1V/A on the output connector is the gain when the input impedance of the measuring instrument is 1MΩ; the corresponding gain is 1/2×0.1V/A=0.05V/A when the input impedance of the measuring instrument is 50Ω.

b) For RP1005C, 0.01V/A on the output connector is the gain when the input impedance of the measuring instrument is 1MΩ; the corresponding gain is 1/2×0.01V/A=0.005V/A when the input impedance is 50Ω.

7. Power Plug

Connect the power plug to the corresponding receptacle of the power adaptor to supply power to the current probe terminator.

Note: To avoid electric shock, do not touch the portion beyond the protective barrier during use.

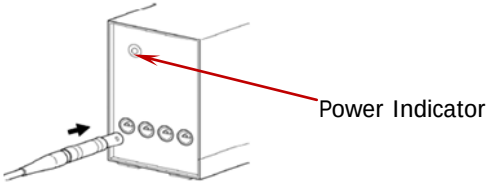
To Use the Current Probe

Before using the current probe to measure the current of the device under measurement, make measurement preparations and perform demagnetizing and zero adjustment. Then, make measurements according to the method described in **Measurement Steps**.

Note: You are recommended to read the **Precautions during Measurements** before making measurements to avoid unnecessary loss.

Measurement Preparations

1. Connect the power plug of the current probe to the power adaptor.



2. Turn off the power adaptor and connect it to the power supply. Note: The voltage of the power supply used should match the rated supply voltage of the power adaptor.

3. Turn on the power adaptor and check whether the power indicator lights.

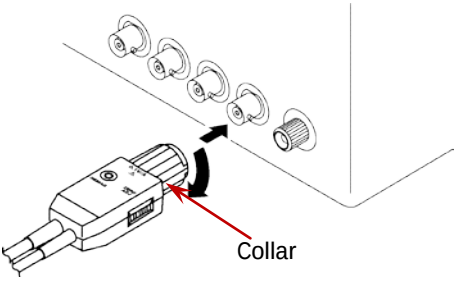
Demagnetizing

The core can be magnetized by switching the power on and off, or by an excessive input. Therefore, perform demagnetizing before making measurements.

1. With the input of the measuring instrument at ground, set the coupling of the measuring instrument to GND and adjust the baseline to the zero position.

2. Set the coupling of the measuring instrument to DC.

3. Connect the output connector of the current probe to the BNC input terminal of the measuring instrument. Turn the collar of the output connector as shown in the figure below and check whether it is locked securely.



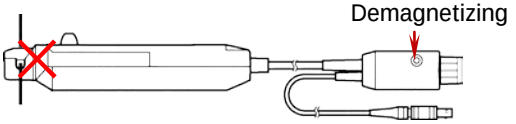
Note: When disconnecting the output connector and the measuring instrument, be sure to release the lock by rotating the collar in the opposite direction of the arrow as shown in the figure above before pulling off the connector. Forcibly pulling the connector without releasing the lock or pulling on the cable can damage the terminator.

4. Make sure the current sensor is locked (for RP1003C and RP1004C, the slide switch should be at the LOCK position; for RP1005C, LOCK should be displayed on the slide switch and UNLOCK should disappear.

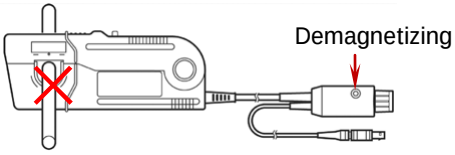
5. Turn on the power adaptor and press the demagnetizing switch on the terminator. The demagnetizing process takes about one second. During the demagnetizing, the current probe outputs a demagnetizing waveform.

   Note: Do not demagnetize the current probe when it is clamping a conductor to be measured. Demagnetizing causes current to flow into the conductor, which may damage the parts in the circuit to be measured.

   RP1003C and RP1004C:



   RP1005C:



Zero Adjustment

As the voltage offset and temperature drift might affect the position of the baseline of the current probe, perform zero adjustment after performing demagnetizing when beginning measurements.

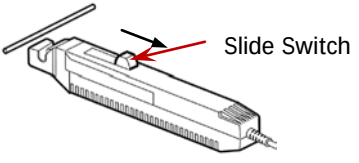
1. Turn the zero adjustment dial on the terminator to adjust the baseline to the zero position.

2. When adjustment is not possible within the range of zero adjustment dial, use a nonconductive screwdriver to (such as ceramic screwdriver) to adjust the baseline to the adjustable range of the zero adjustment dial via the coarse adjustment trimmer; then, use the zero adjustment dial to adjust the baseline to the zero position (only applicable to RP1003C and RP1004C).

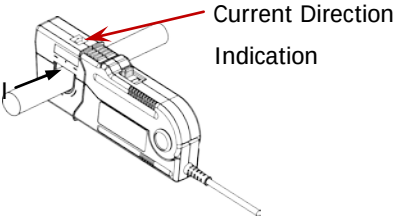
Measurement Steps

Make measurements after the above operations are finished.

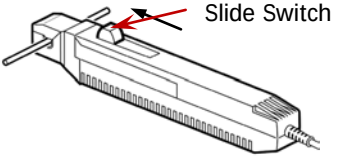
1. Open the current sensor by pushing the slide switch in the direction of the arrow as shown in the figure below (for RP1003C and RP1004C, the slide switch should be at the OPEN position; for RP1005C, UNLOCK should be displayed on the slide switch and LOCK should disappear).



2. Align the current sensor so that the current direction indication corresponds to the direction of current flowing through the conductor to be measured. Clamp the conductor to be measured so that the conductor is in the center of the sensor aperture.



3. Lock the current sensor by pushing the slide switch in the direction of the arrow as shown in the figure below (for RP1003C and RP1004C, the slide switch should be at the LOCK position; for RP1005C, you need to first press the current probe to close the current sensor and then push the slide switch until LOCK is displayed and UNLOCK disappears).

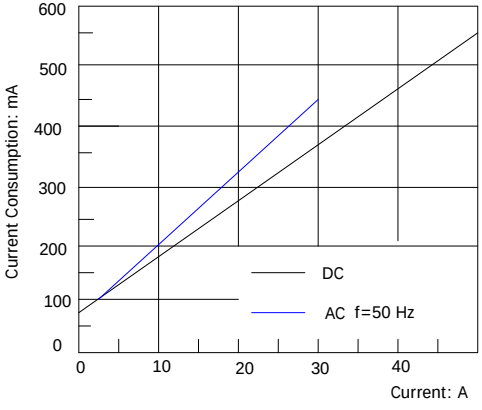


4. At this point, you can view the voltage amplitude of the waveform measured by the measuring instrument and calculate the actual current amplitude (current amplitude=voltage amplitude measured/gain of the current probe). For example, when the voltage amplitude measured is 2V and the gain of the current probe is 0.1V/A, the actual current amplitude is 2V/(0.1V/A)=20A.

Note: The current sensitivity can be derived from the voltage sensitivity of the measuring instrument. The current sensitivity equals the ratio of the voltage sensitivity of the measuring instrument to the gain of the current probe. For example, when the voltage sensitivity of the measuring instrument is 0.001V/div and the gain of the current probe is 0.1V/A, the current sensitivity is (0.001V/div)/(0.1V/A)=0.01A/div.

Precautions during Measurements

1. The current consumption of the current probe depends on the current to be measured. Make sure that the total current consumption of the current probes do not exceed the rated output current of the power adaptor when multiple current probes are connected to the same power adaptor. The figure below is the relation curve between the output current and current consumption.



Note: The current consumption is the algebraic sum of the positive and negative current consumption.

2. The maximum continuous input range is based on the heat that is internally generated during the measurement. Note that the input current should not exceed this range; otherwise, the current probe might be damaged.

3. The linear response range of the input current varies according to the frequency of the current being measured. For the variation relation curve between them, refer to **Appendix 2 Relation between Max Input Current and Frequency**.

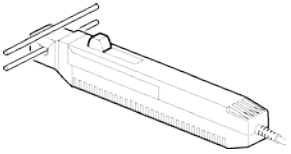
4. If excess current is input, generated heat activates a built-in safety function that blocks normal output. If this happens, disconnecting the current sensor and the conductor under measurement or reduce the input current to zero. Wait until the current sensor has had sufficient time to cool before resuming operation.
   Note: Even if the input current does not exceed the maximum continuous input range, continuous input for an extended period of time may result in activation of the safety circuit to prevent damage resulting from heating of the current sensor.

5. At high ambient temperatures, the built-in safety circuit may activate at current input levels below the maximum continuous input range.

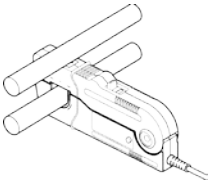
6. Continuous input of current exceeding the maximum continuous input range or repeated safety circuit activation will degrade the performance of the safety circuit, possibly resulting in damage to the device.

7. Do not place any unclamped conductor with an electric current of a frequency of 10kHz or higher near the current sensor (as shown in the figures on the next page). Current flowing in the conductor nearby may heat up the sensor and cause its temperature to rise, leading to damage to the current sensor.

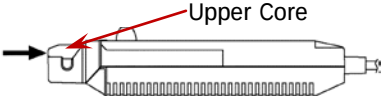
RP1003C and RP1004C:



RP1005C:



8. Be sure to use the slide switch to open the current sensor. For RP1003C and RP1004C, please do not press the upper core in the direction of the arrow as shown in the figure below to avoid damaging the internal structure of the slide switch.



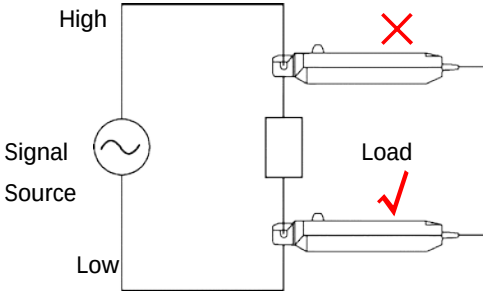
9. Immediately after powering on, the device may be subject to an appreciable DC drift due to the effect of self-heating. To counteract this, allow the current probe to warm up for more than 30 minutes before carrying out measurements.

10. Under certain circumstances, oscillation may occur when the probe is connected to the power adaptor when the power supply is on. This does not indicate a malfunction. Oscillation can be stopped and operation restored to normal by opening

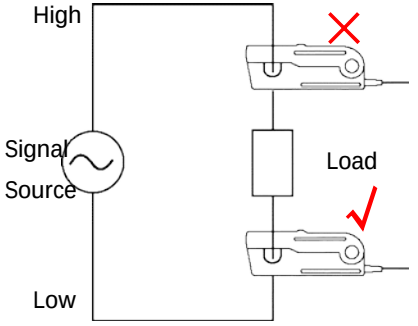
and closing the current sensor.

11. When the frequency of the input signal is relatively high, the common mode voltage range corresponding to the signal measured by the current probe reduces. At this point, connect the current probe to the low-voltage side of the circuit, as shown in the figures on the next page.

RP1003C and RP1004C:



RP1005C:



Specifications

The following parameters are applicable when the instrument has been working for more than 30 minutes under the specified operating temperature (10℃ to 30℃) and humidity (0%RH to 80%RH).

Technical Parameters

RP1003C:

Bandwidth	DC to 50MHz (-3dB), refer to **Appendix 1 Amplitude Characteristics** (RP1003C)
Rise Time	≤7ns
Linear Response Range of Input Current	30Arms, refer to **Appendix 2 Relation between Max Input Current and Frequency** (RP1003C)
Maximum Peak Current	50A peak, non-continuous
Gain	0.1V/A
Gain Accuracy	±1.0%rdg±1mV, ≤30A ±2.0%rdg, 30A to 50A peak non-continuous (DC and 45Hz to 66Hz, within the linear response range of the input current)
Noise	≤2.5mArms (for 20MHz band measuring instrument)
Input Impedance	Refer to **Appendix 3 Input Impedance**

	(Typical) (RP1003C)
Gain Accuracy Drift	≤±2% (0℃ to 40℃ temperature, input of 50Hz, 30A)
Rated Power	5.6W
Supply Voltage	+12V±0.5V
Maximum Rated Voltage	300V, CAT I (insulated conductor)
Gain Accuracy Period	1 year (opening/closing up to 10,000 times)
Effect of External Magnetic Fields	≤20mA (DC and 60Hz, magnetic field of 400A/m)

RP1004C:

Bandwidth	DC to 100MHz (-3dB), refer to **Appendix 1 Amplitude Characteristics** (RP1004C)
Rise Time	≤3.5ns
Linear Response Range of Input Current	30Arms, refer to **Appendix 2 Relation between Max Input Current and Frequency** (RP1004C)
Maximum Peak Current	50A peak, non-continuous
Gain	0.1V/A
Gain Accuracy	±1.0%rdg±1mV, ≤30A ±2.0%rdg, 30A to 50A peak (DC and 45Hz to 66Hz, within the linear response range of the input current)
Noise	≤2.5mArms (for 20MHz band measuring

	instrument)
Input Impedance	Refer to **Appendix 3 Input Impedance (Typical)** (RP1004C)
Gain Accuracy Drift	≤±2% (0℃ to 40℃ temperature, input of 50Hz, 30A)
Rated Power	5.3W
Supply Voltage	+12V±0.5V
Maximum Rated Voltage	300V, CATI (insulated conductor)
Gain Accuracy Period	1 year (opening/closing up to 10,000 times)
Effect of External Magnetic Fields	≤5mA (DC and 60Hz, magnetic field of 400A/m)

RP1005C:

Bandwidth	DC to 10MHz (-3dB), refer to **Appendix 1 Amplitude Characteristics** (RP1005C)
Rise Time	≤35ns
Linear Response Range of Input Current	150A, refer to **Appendix 2 Relation between Max Input Current and Frequency** (RP1005C)
Maximum Peak Current	300A peak, non-continuous 500A peak, pulse width≤30μs
Gain	0.01V/A
Gain Accuracy	±1.0%rdg±1mV, ≤150A ±2.0%rdg, 150A to 300A peak (DC and 45Hz to 66Hz)

Noise	≤25mArms (for 20MHz band measuring instrument)
Input Impedance	Refer to **Appendix 3 Input Impedance (Typical)** (RP1005C)
Gain Accuracy Drift	≤±2% (0℃ to 40℃ temperature, input of 55Hz, 150A)
Rated Power	5.5W
Supply Voltage	+12V±1V
Maximum Rated Voltage	600V: CATII; 300V: CATIII (insulated conductor)
Gain Accuracy Period	1 year (opening/closing up to 10,000 times)
Effect of External Magnetic Fields	≤150mA (DC and 60Hz, magnetic field of 400A/m)

General Specifications

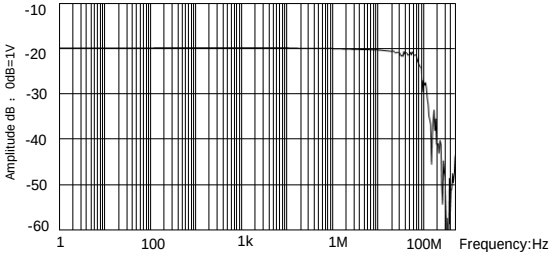
Probe Dimensions	Current Sensor	RP1003C: approx. 175mmx18mmx32mm RP1004C: approx. 175mmx18mmx32mm RP1005C: approx. 176mmx69mmx34mm
	Terminator	RP1003C: approx. 6.9mmx2.5mmx1.6mm RP1004C: approx. 6.9mmx2.5mmx1.6mm RP1005C: approx. 6.9mmx2.5mmx1.6mm
Maximum Dimensions of Conductor to be Measured	RP1003C: approx. 5mm RP1004C: approx. 5mm RP1005C: approx. 20mm	

Cable Length	Current Sensor Cable	RP1003C: approx. 150cm RP1004C: approx. 150cm RP1005C: approx. 200cm
	Power Supply Cable	RP1003C: approx. 100cm RP1004C: approx. 100cm RP1005C: approx. 100cm
Weight	RP1003C: approx. 230g RP1004C: approx. 240g RP1005C: approx. 500g	
Working Temperature and Humidity	0℃ to +40℃, 0 to 80%RH	
Storage Temperature and Humidity	-10℃ to +50℃, 0 to 80%RH	
Location for Use	Indoor, altitude up to 2000m	
Electromagnetic Compatibility	EN61326	
Measurement Category	RP1003C: CAT I (anticipated transient voltage 1500V) RP1004C: CAT I (anticipated transient voltage 1500V) RP1005C: CAT II, CAT III (anticipated transient voltage 4000V)	
Pollution Degree	Degree 2	
Safety	EN61010	

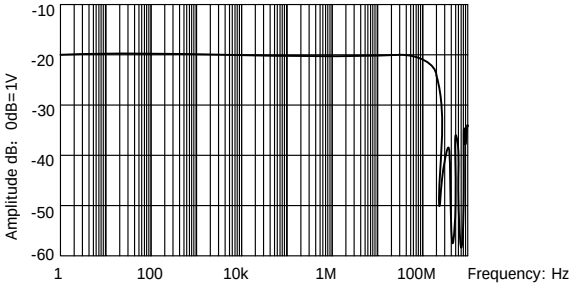
Appendix

Appendix 1 Amplitude-frequency Characteristics

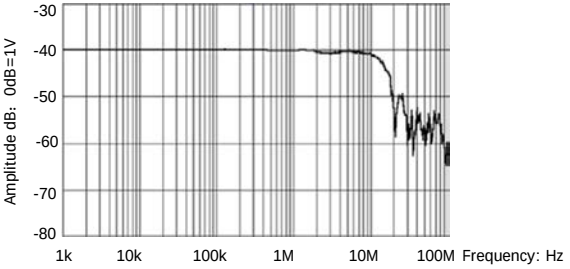
RP1003C:



RP1004C:

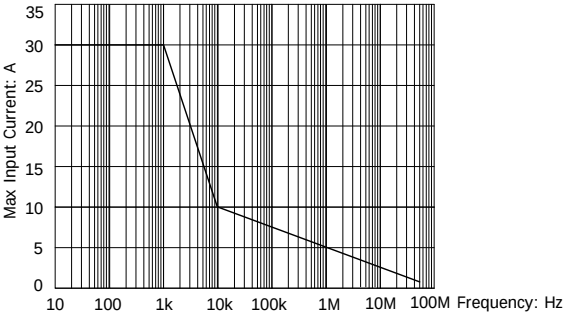


RP1005C:

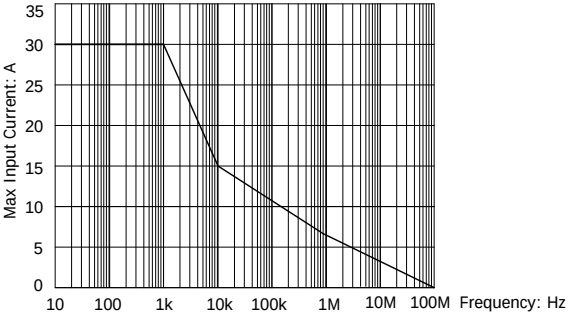


Appendix 2 Relation between Max Input Current and Frequency

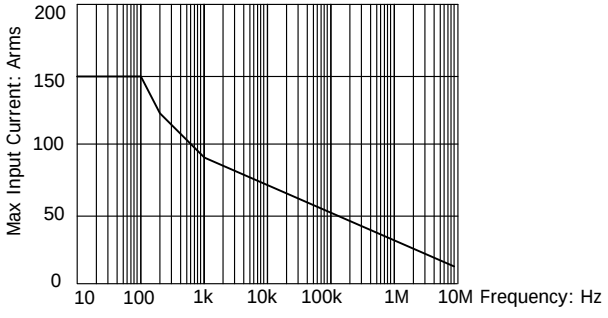
RP1003C:



RP1004C:

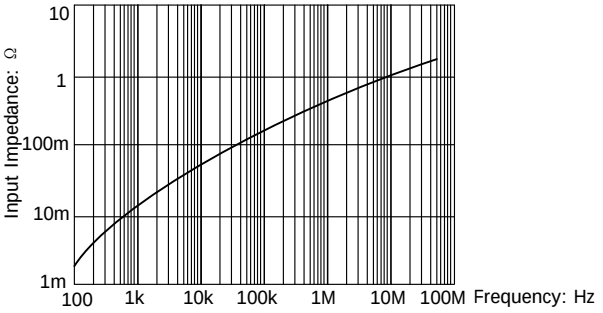


RP1005C:

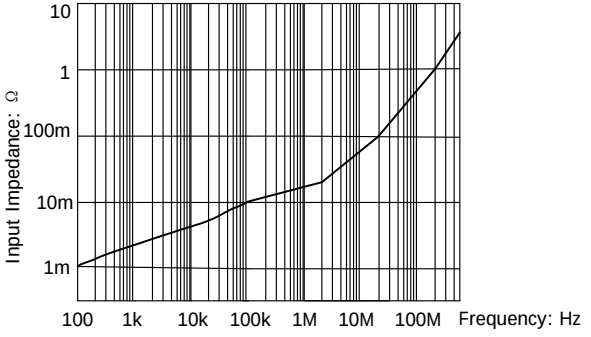


Appendix 3 Input Impedance (Typical)

RP1003C:



RP1004C:



RP1005C: