PM-1 Broadband power meter

Table of contents

Read first:

- First of all read this manual.
- RF power can be dangerous please always use or wear proper Personnal Protective Equipment (PPI).
- Be sure to understand radiofrequency behavior when measuring power otherwise it can destroy amplifiers or hurts.
- Be sure to measure power not beyond capacity of the device or it can destroy device.
- Clean the device with a slightly damp cloth.
- This device must'nt be exposed to rain, moisture.
- Do not install the device near any heat sources.
- This device must be serviced by a qualified service personnel.
- Specifications are subject to change without notice.

Firmware revision:

V1.39 10/10/19

->Added new menu item MOD measure: (0) CW signal (FM per ex),(1)QPSK signal, (2)Pulse FM signal

- •Enable measure of QPSK signal (Digital wireless TX)
- •Enable FM Pulse signal measure
- •The mode will be displayed during power up display sequence

V1.38 08/04/19

->when OFFSET is different from 0 the mW position will display the compensated value (depending on offset value)

- •In mW position when OFFSET is <0, value will be displayed as W (the mW led will blink to remind you that)

V1.37 07/11/19

If you need to make an update of firmware please contact us at:
contact@bs-rf.com

Description:

First of all thanks for buying this product from BSRF, we hope it will serve you well!

The BSRF PM-1 is a broadband power meter that can be use to measure absolute RF power and also measure insertion loss of coxial cables, filters, splitters etc... A RF power source is needed to measure insertion loss.

What's in the box:

- **PM-1**: *Broadband RF Power meter.*
- **PM-REF-C1**: *15cm coxial cable, BNC male.*
- **PM-AD-1**: *50ohms BNC(male)-SMA(female) adaptator.*
- **PM-BAT1**: *9V alkaline battery.*

Front Panel:

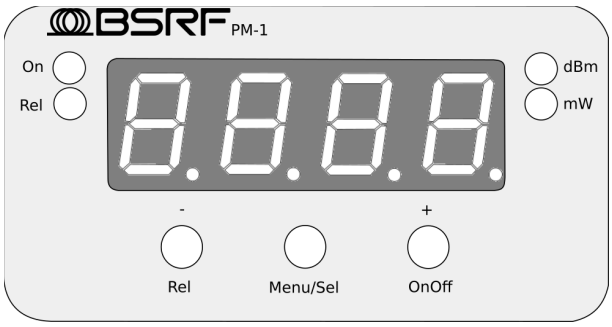


Illustration 1: Front panel PM-1.

The PM-1 is controlled and operated from the front panel. Result of measures are displayed on the 7-segment displays. Four leds will indicate some important informations. At last three switches are used to operate the PM-1.

LEDS:

- **On**: indicates power is on. It will blink if battery voltage goes under 7V.
- **Rel**: indicates the device displays a relative power.
- **dBm**: indicates the device displays dBm (absolute) or dB (Rel mode).
- **mW**: indicates the device displays an absolute power in milliwatt. [This led will blink if added a negative offset to tell you that display is now labelled as W/since version 1.38]

SWITCHES:

- **Rel**: press this switch to switch measure between absolute to relative. Press this switch 1sec to store a new reference value to make a realtive measurement (it will display 0 or almost).
- **Menu/sel**: press this switch 1sec to enter menu. While in menu press this switch to jump to following menu item.
- **On/Off**: press this switch to power on the device. Press this switch for 1sec to shut down the device.

Quick start:

Measure absolute power.

1) Be sure the power you will measure is not above 2W(33dBm). If it is refer to measure power above 2W(33dBm) section.
2) Switch on the PM-1. The **REL** led must be clear, if not press shortly *Rel*.
3) Plug on **PM-REF-C1** to PM-1 . At the other side of the cable plug the RF source/emitter (use an adaptator if needed). Switch on the the RF source/emitter.
4) Read measure on the PM-1. Press shortly *OnOff/Unit* to switch from dBm view to mW view.

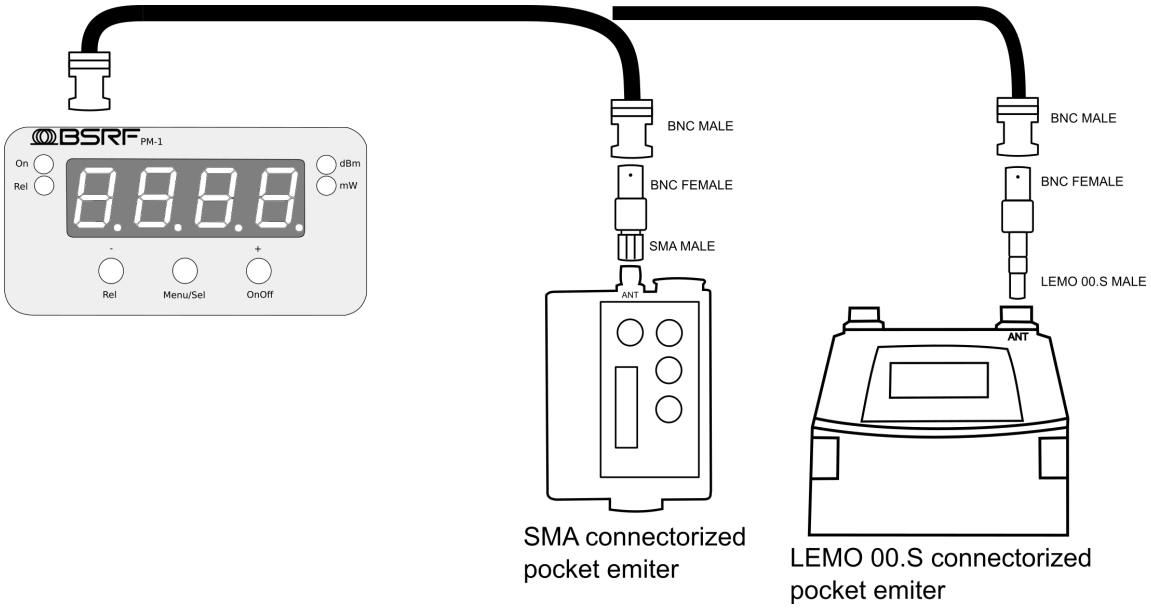


Illustration 2: Connecting PM-1 to a pocket emitter.

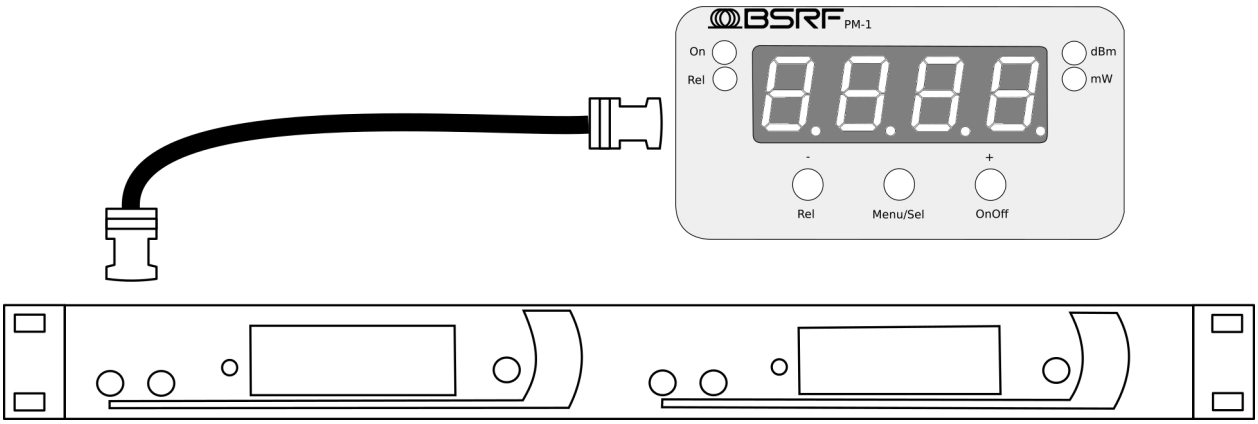


Illustration 3: Connecting PM-1 to an IEM TX(BNC)

Measure insertion loss, cable loss:

1) First you need to use a reference RF power source/emitter., be sure the power you will measure is not above 2W(33dBm). Plug power source to PM-1 as described in "Measure absolute power".
2) Switch on the PM-1. Select dBm reading by pressing *OnOff/Unit* switch if needed.
3) Plug on **PM-REF-C1** to PM-1. At the other side of the cable plug the RF source/emitter (use an adaptator if needed). Switch on the the RF source/emitter.
4) Press Rel switch during 1s, then the led Rel will light up and 0.0 should be displayed. Now the led Rel will light up.

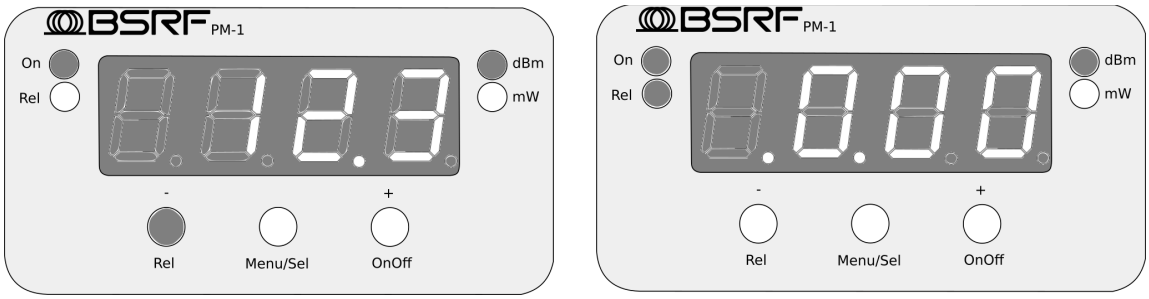


Illustration 4: While displaying power as dB press 1 sec Rel to switch to relative mode

5) Power off the RF source/emitter and disconnect it from the BNC cable. Plug the cable whom you want to measure loss between the **PM-REF-C1** cable and the RF source/emitter . Use adaptator if neeeded. Then power up the RF source/ emitter. Now it will display insertion loss of cable (ex: -3.2). You can compare the measure you get from the calculated value: cable length*attenuation per meter. Some common cable insertion loss are listed in the "Insertion loss of usual coaxial cables" section of this manual.
6) Depending on internal circuits of IEM or pocket transmitters if you try to measure small cable or if you need max precision of measure, a good habits is to to add an attenuator at the output of the power source. This will reduce SWR* effect. You can use a 3dB or 6dB attenuator.

   If you use a laboratory RF power source you should not need to add an atttenuator at the output.

   (*)Standing Wave Ratio

   NOTE: If you use a small power source as pocket emitter or IEM with RF power under 100mW you can avoid switching off power source when you disconnect source from cable as reflections are not able to destroy the output power amplifier of the device.

Menu:

MENU is accesssed by pressing during 1s the central switch. To naviguate to the next item just press again central switch. Parameters can be changed by pressing first switch (decrease) or right switch (increase). At any time you can leave MENU by pressing central switch during 1s. Following tab explains functionnality of items in MENU.

Codes		Description
A0	Menu/ default value:0(dB)	Attenuation/Amplification compensation (dB), max is +20dB, min is -20dB. If you connect an attenuator at the input, let's say it's a 6dB attenuation, decrease the A value to -6dB. Then when you go back to normal mode, the displayed dBm value will increase the value by 6dB to compensate for the loss. With a 6 dB atttenuator the max displayed power will be +39dBm (8W). As soon as value become different from '0' the lefter point will blink to make you remember a compensation is applied.
u53	Menu/ default value:53(dB)	Upper threshold alarm (dBm), if input power goes above this value, a beep will sound and the alarm port will be set on (internal connector, open drain).
L-20	Menu/ default value: -20(dB)	Lower threshold alarm(dBm), if input power goes under this value, a beep will sound and the alarm port will be set on (internal connector, open drain).
F50	Menu/default value:50(x10 MHz)	Frequency (10MHz), set it according to the frequency of the signal you're measuring, this will increase accuracy.
n0d	Menu/default value:0	Mode:(0) CW signal measure (FM modulated per ex),(1)QPSK signal measure (digital microphones...) and (2) Pulsed CW signal. At startup after the BSRF display, the mode will be displayed: (0)AnA, (1)DiG and (2)Pul
SEr0	Menu/default value:0	Serial data, enable serail data emission from the PM-1. Data are available through an internal RS-232 port.
0F0	Menu/default value:0	Offset, used to calibrate low power response don't change it unless you have calibrated devices to do it.
9b0	Menu/default value :0	Global correction offset, used during calibrating process. Don't change it unless you have calibrated devices to do it.
b8	Menu	Battery(Volt), voltage of the supply, from 9V battery or external, only read
t26	Menu	Temperature (°C), internal temperature, in the -10/+60 range, only read.
H500	Menu	Hardware Software version,only read.

Tableau 1: Menu items descritption.

Alarm:

Alarm has two ouputs: one is an internal BUZZER and the second is an internal OUPUT (open drain output, max 100mA). As soon as an alarm is ON the output is ON.

The PM-1 is fitted with some alarm functions to give you real-time informations.
First if you ear an continuous buzz (500Hz) this means the input power is higher than the maximum allowed power (>33dBm,>2W) and this could lead to failure of PM-1. As those power are quite high first power down the transmistter or amplifier conneted to the PM-1.
You also can ear this buzz if internal temperature is above 60°C (340K). This temperature is too high and can be caused by the input power. Disconnect properly equipements.

Secondly you can set a Upper and a Lower threshold. If input signal override the Upper threshold the BUZZER will beep. If the input signal goes under the Lower threshold the BUZZER will beep. The output port will be set if any of these alarm are active. This helps you monitoring constantly RF power.

Battery:

PM-1 is powered by a 9V alkaline battery. You better choose a well known brand for best autonomy.

Few battery are longer from the other (generally cheapest ones), pick one with a length about 4.4/4.5mm (body without contacts).

To replace battery: remove hex nut from BNC connector. Then remove the two screws using proper screw driver.

How to:

1) How to measure RF power at the output of an transmitter?
   First be sure the power you're going to measure won't overload the device, means power is lower or equal to 33dBm (2W). Power up your PM-1. Then plug your PM-1 to the transmitter output using quality 50ohms coaxial cables and adaptor. Then switch on your transmitter. Press the third switch to alternate view from dBm to mW and use the one you're more familiar with. Dont' forget that used cable induce RF loss, you've to take it in account.
   Third "how to" will tell you how to get this attenuation information.

2) How can know if a coaxial cable is good or not?
   The best way to test a coaxial cable is to test insertion loss by putting a RF signal at a side and checking what comming out at the other side. If this value of attenuation is too low, from the manufacturer's datasheet, this mean the cable or connectors have a problem.
   The PM-1 is the ideal tool to perform this test. You just need a RF source as a transmitter (pocket or rack) with a power about 17dBm (50mW), this allows you to measure up to 37dB of attenuation, the correct adaptor (if needed), the test cable.
   First plug the test cable to the transmitter, then connect to PM-1. On "dBm" display mode the power is displayed, press for 1sec the first switch to select REL mode and store the current value (the reference). The PM-1 will display 0,00dB or almost.
   Second, now connect the cable we want to test between the transmitter and the test cable (with proper adapters). As soon as this is done the amount of attenuation will be displayed. That's all: make the reference and then read.

3) How can I do the accurest measurement?
   To do so, first take care of the frequency of measurment (the one of the transmitter) and set the Frequency compensation accordingly. Be sure to use a test/reference cable in good shape. Be aware that even the test/reference cable exhibit a small portion of insertion loss and one's could add this value to get the accurest value.

4) How can I measure an absolute power above 33dBm(2W). You need to add an attenuator that can stand almost the maximum power you want to measure. Enter the menu and decrease A value down to -10 and then exit menu. The offset led led will be on. [The maximum measurable power is 33dBm + Attenuator value. With a 10dB attenuator you can measure power up to 43dBm while the minimum measured power will be reduced in the same proportion. With no external attenuator the minimum measured power is about -10dBm so with a 10dB attenuator the minimum measured power will be 0dBm.]
   (Note)As soon as you add an offset, the offset red led on display will light up and when you measure a power in dBm it will display compensated power (power measured -"Attenuation"). [~~If you switch to mW it will display measured power in mW without compensation so you can check what power really goes inside the PM-1. Version 1.37~~]

5) How can I check power of an amplifier while emitting?To do this you'll need a directionnal coupler. This 3/4 ports passive device will let most of the power to be

transmitting by the antenna while a small portion of this power will be forwaded to a coupled output where you'll plug the PM-1. This device can be use forward or backward to monitor forward power or reflected power. Set the Attenuation factor according to your coupler's "coupling factor" (for example -6,-10 or -13). Then it will display the compensated value. If you set Upper or Lower threshold alarm it will take in account the compensation but be aware that power swing at the input must remain in the +33dBm/-10dBm (2W/1mW) or it can't measure the power. To be sure you're still in the power range, from DBM mode switch to MW mode and the PM-1 will display the measured input power without compensation (mW). If it displays : LO P it means input power is to low. Consider using a coupler with a bigger coupling factor. Feel not comfortable with that please contact us at contact@bs-rf.com.

6) What means LO P ? It means that the input power is to low to be measured. It will be displayed as soon as the incomming RF power is under -10dBm (0,01mW). If you see this appearing during a measure it seems that you get too much loss somewhere.

7) What means H IGH ? It means that the input power is above 33dBm(2W). Avoid this situation as it can damage permanently the equipment. If after this your equipement doesnt behave correclty please contact us in order to service the equipement at contact@bs-rf.com.

8) How to change the battery? Remove screws and nut of BNC connector, open panel and you can change the battery.

9) How can I estimate loss in a coax (coax plus connectors). The minimum loss is loss occuring in the coax cable itself. From the Illustration 6: Insertion loss versus frequency. you can calcs minimum loss in coax. Choose frequency(closest one from the generator frequency for example), select the type of coax used. Then multiply the value of attenuation per meter to the length of the coax. Ex: 625MHz => use 600MHz, RG316, so loss per meter is 0,7dB. If length is 50 centimeter, minimum loss is 0,7*0,5=0,35dB.Now you need to add loss of connectors. Loss of good connectors is about 0,05dB max. Finally the $Loss_{total} = Loss_{connector} * 2 + Loss_{coax\ cable}$; $Loss_{total} = 0{,}45\,dB$.
If the value you get is not above twice the $Loss_{total}$, it's ok, try to bend a little cable near connectors to check that nothing break.
If the value you get from the measure is above twice the $Loss_{total}$, it's suspect. Check that the procedure to calibrate is ok. If calibration is ok the cable should be not used.

10) I try to measure loss in a small coax (50cm per example) and after I had set reference my measure does'nt seem ok (for example loss too low in regard of calculus or positive value meaning an amplification!). This typically happens when a impedance mismatch occured. To avoid that place an attenuator at the output of your RF power source (3dB or 6dB attenuator can be used). Then re-do the reference process and the measure. This will fix this behavior.

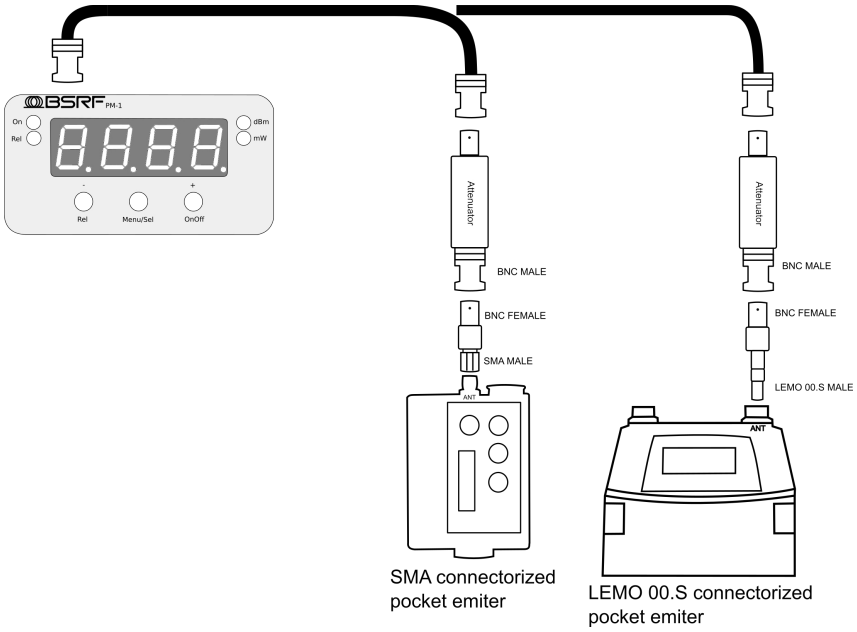


Illustration 5: Adding an attenuator to reduce SWR effects

Usefull datas:

Insertion loss of usual coaxial cables:

	Frequency						
Cable (50ohms) :	10MHz	100MHz	400MHz	500MHz	600MHz	700MHz	1GHz
RG316	0,1dB	0,3dB	0,6dB	0,6dB	0,7dB	0,8dB	0,9dB
RG58	0,1dB	0,2dB	0,3dB	0,4dB	0,4dB	0,5dB	0,6dB
RG213-RG214-RG8	0,02dB	0,1dB	0,2dB	0,2dB	0,2dB	0,2dB	0,3dB
LMR400	0,04dB	0,1dB	0,1dB	0,1dB	0,2dB	0,2dB	0,2dB
Ecoflex 10	0,012dB	0,04dB	0,08dB	0,1dB	0,1dB	0,1dB	0,14dB

Illustration 6: Insertion loss versus frequency.

Insertion loss of connectors:

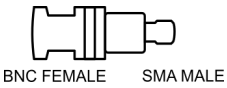
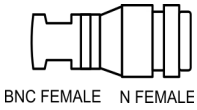
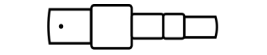
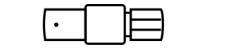
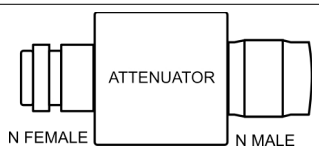
A good connector is typically 0,05dB of loss (400MHz-800MHz). You can check the datasheet of the connector to find this value.

Insertion loss of 1:N port passive splitters (min theoric):

N ports :	Min att (dB)
2	-3
3	-5
4	-6
5	-7
6	-8
7	-8
8	-9
10	-10
16	-12

Illustration 7: Minimum insertion loss of passive splitter

Accessories:

Reference:	Description:	
PM1C01	10 cm RG58, BNC-BNC male, 50 ohms	
PM1A01	I BNC female, 50 ohms	
PM1A02	Adapter, BNC male, SMA female, 50 ohms	
PM1A03	Adapter, BNC male, N female, 50 ohms	
PM1A04	Adapter, BNC female, Lemo 00.S male, 50ohms	
PM1A05	Adapter, BNC female, SMA male, 50ohms	
PM1A06	Adapter, BNC female, N male, 50ohms	
PM1M01	Rear panel with external power port connector.	Contact us...
PM1M02	1U panel to host up to 4 PM-1.	Contact us...
PM1CP01	3 ports RF coupler....	Contact us...
PM1AT01	Attenuator 6dB/10W	

Specifications:

Bandwidth	10-1000MHz	
Absolute max RF input	2,5W(34dBm)	
Max RF input	2W (+33dBm)	CW* measure
Min RF input	0,01mW (-10dBm)	CW* measure
Input SWR	1,32 max	(10-3000MHz)
Accuracy	+/-0,2dB typ. (0 to 33dBm); +/-0,4dB typ.(-10 to 0dBm	0 to 40°C (273 to 313K)
Temperature range	0 to 50°C (263 to 323K)	
Connector	BNC 50ohms	
Supply	9V battery	30mA (power on) / 20µA (power off)
Autonomy	Up to 8h	(continuous)
Dimensions	84x59x31mm (3,3x2,3x1,2in)	(enclosure)
Weight	0,2kg (0,44lbs)	(w battery

(*)constant wave, unmodulated carrier or FM/phase modulated.

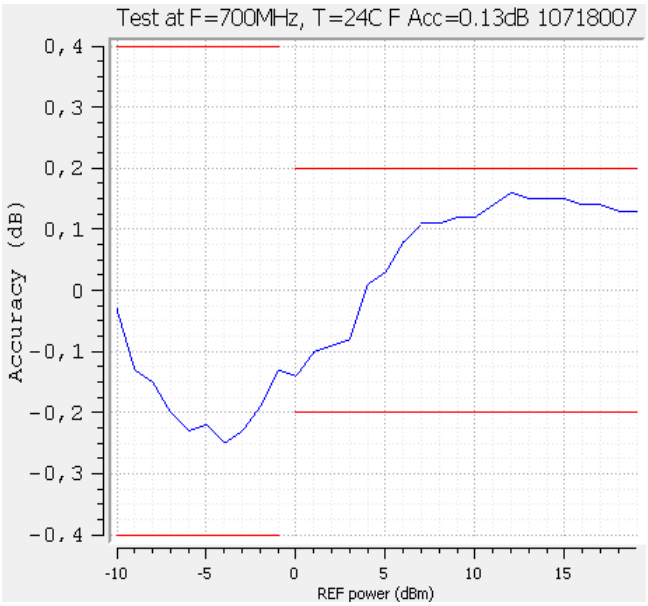


Illustration 8: Typ. accuracy of PM-1

Accuracy is measured using a calibrated reference power meter. Making difference of power measured by PM-1 and reference meter while input power is swept (from -10dBm to +20dBm). The result of a test whith a 700MHz unmodulated signal (CW) figure on the Illustration 8.
Red +/-lines define accuracy target area.

Reference used:
-Minicircuits PWR-SENN-4GHS
S/N:116061130024

Warranty:

The PM-1 comes with a 2 years warranty. This Limited Warranty covers any defects in material or workmanship under normal use during the Warranty Period. During the Warranty Period, BSRF will repair or replace, at no charge, products or parts of a product that proves defective because of improper material or workmanship, under normal use and maintenance.

Send us an email first at:

contact@bs-rf.com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