



CURRENT SENSE / LOW OHM
OPEN FRAME TYPE
MONOLITHIC CONSTRUCTION

OF
SERIES
OPEN FRAME

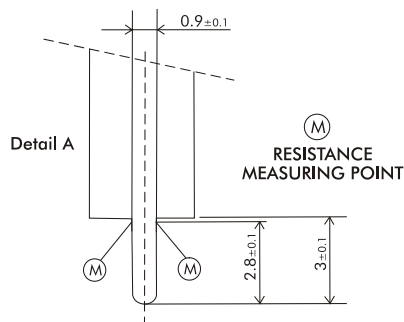
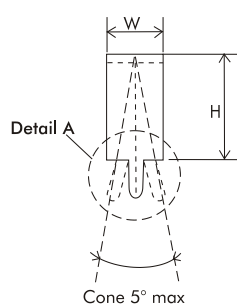
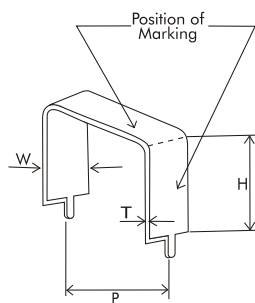
- 1W to 10W
- R001 to R10
- Low TCR





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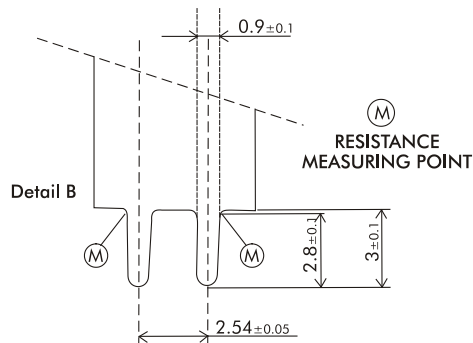
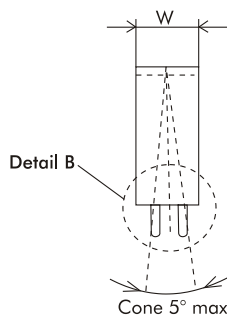
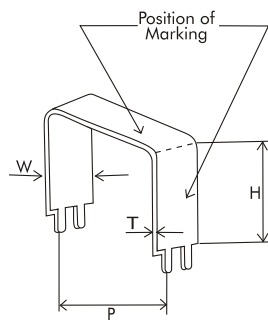
PHYSICAL CONFIGURATION



HTR TYPE	POWER RATING at 85°C	DIMENSIONS (mm)				RESISTANCE VALUE	WEIGHT PER PC (gms)
		W ±0.15	T ±0.03	H (max)	P ±0.5		
OF1	1.0W	2.0	0.2	14.5	10.0	R047	0.15
OF1A	1.0W	2.0	0.2	11.75	15.0	R047	0.15
OF1	1.0W	2.0	0.2	15.0	10.0	R051	0.16
OF1A	1.0W	2.0	0.2	12.75	15.0	R051	0.16
OF1A	1.0W	3.0	0.15	11.0	15.0	R10	0.16
OF1.5	1.5W	3.0	0.15	14.0	10.0	R10	0.16
OF1.5	1.5W	3.0	0.2	14.45	10.0	R033	0.22
OF1.5A	1.5W	3.0	0.2	12.0	15.0	R033	0.22
OF1.5	1.5W	2.0	0.2	23.25	10.0	R068	0.23
OF1.5A	1.5W	2.0	0.2	20.50	15.0	R068	0.23
OF2	2.0W	4.0	0.5	14.75	10.0	R01	0.7
OF2A	2.0W	4.0	0.5	12.0	15.0	R01	0.7
OF2A1	2.0W	5.0	0.35	9.0	15.0	R01	0.77
OF2	2.0W	4.0	0.3	12.75	10.0	R015	0.43
OF2A	2.0W	4.0	0.3	10.25	15.0	R015	0.43
OF2	2.0W	4.0	0.2	12.85	10.0	R022	0.26
OF2A	2.0W	4.0	0.2	10.5	15.0	R022	0.26
OF2A	2.0W	3.0	0.3	16.5	15.0	R024	0.35
OF2.5	2.5W	5.0	0.7	12.0	10.0	R005	*
OF2.5A	2.5W	5.0	0.7	9.5	15.0	R005	*
OF2.4A	2.4W	5.0	0.65	9.0	15.0	R0054	*
OF2.5	2.5W	4.0	0.8	16.0	10.0	R0068	*
OF2.5A	2.5W	4.0	0.8	13.75	15.0	R0068	*
OF2.2A	2.2W	5.0	0.50	9.0	15.0	R0068	*

* Where there is a choice between different resistance alloys possible depending on TCR limitations the weight has not been provided.

PHYSICAL CONFIGURATION





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HTR TYPE	POWER RATING at 85°C	DIMENSIONS (mm)				RESISTANCE VALUE	WEIGHT PER PC (gms)
		W ±0.15	T ±0.03	H (max)	P ±0.5		
OF2B	2.0W	4.0	0.2	11.0	15.0	R022	*
OF2.75B	2.75W	5.0	0.8	12.75	15.0	R005	*
OF2.75B	2.75W	4.0	0.2	20.5	15.0	R033	*
OF3.5B	3.5W	5.0	0.7	21.75	15.0	R0068	1.6
OF4B	4.0W	7.0	0.2	17.00	15.0	R015	*
▲ OF4BL	4.0W	10.0	0.8	9.8	15.0	R001	*
OF4.5B	4.5W	9.0	0.2	13.8	15.0	R01	0.81
OF4.5B	4.5W	10.0	0.5	11.85	15.0	R0033	2.0
▲ OF6.5(5)L	6.5W	10.0	0.8	28.0	5.0	R002	3.25
OF6.5B	6.5W	9.0	0.20	16	15.0	R012	0.8
▲ OF6.5BL	6.5W	10.0	0.8	21.75	15.0	R0022	3.5
OF10 (10)	10W	10.0	0.6	10.0	10.0	R002	
OF10 (15)	10W	10.0	0.6	15.0	15.0	R003	

* Where there is a choice between different resistance alloys possible depending on TCR limitations the weight has not been provided.

▲ The shunt resistors whose type is suffixed with L are made with a different type of alloy to attain these very low resistance values. In these cases the TCR would be approx 180ppm/°C.

Note:

The shunt resistor types / power rating and resistance value shown above are merely a sample of the wide variety available in this series and represent certain popular types and resistance values.

In case the shunt resistors shown above are not found suitable, then if the requirement is sufficient in volume, HTR can provide a custom solution.

The possibilities based on customers requirement are infinite, however tempered by the reality that the dimensions of the part required are dictated by the ratio between requested power rating and physical size necessary to dissipate the heat generated in working condition. As a rule of thumb, OF series resistors are designed upto a maximum of 10 watts power.

INFORMATION TO BE PROVIDED BY THE CUSTOMER TO HTR WHEN REQUESTING A 'CUSTOM BUILT' SHUNT RESISTOR.

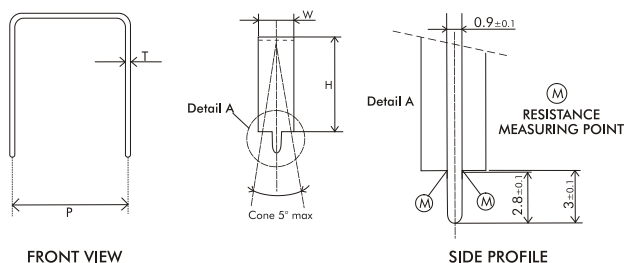
1. Required power rating and approximate ambient operating temperature.
2. Required resistance value and resistance tolerance.
3. Physical limitations - Height (H) and breadth desired (W) refer below.
4. Mounting pitch required (P) (Available in steps of 5 mm)
5. HTR provides six different mounting tag types as given below and the customer should select one based on power rating and resistance value required.

On receipt of the information HTR will provide a detailed spec. sheet to the customer for approval with quote.

On approval of quote, HTR will provide samples for approval.

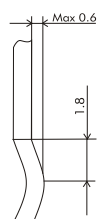
Tag Type 1-S (Straight Tag Profile)

[All dimensions shown are in mm]



Tag Type 1-P (Snap-in Profile)

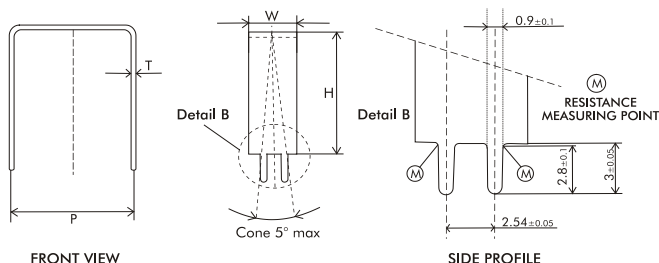
(Front view same as 1-S but with snap-in profile shown below)



SIDE PROFILE

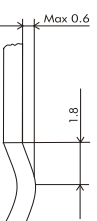
Tag Type 2-S (Straight Tag Profile)

[Suitable for low resistance values]



Tag Type 2-P (Snap-in Profile)

(Front view same as 2-S but with snap-in profile shown below)



SIDE PROFILE

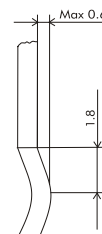
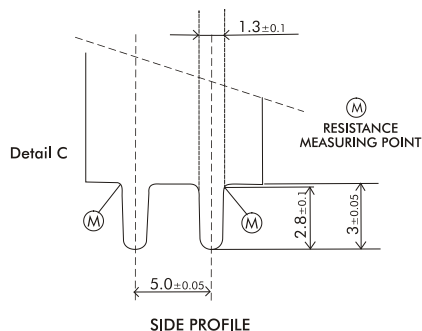


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Tag Type 3-S (Straight Tag Profile)**Tag Type 3-P** (Snap-in Profile)

(Front view same as 3-S but with snap-in profile shown below)

[Suitable for very low resistance values and very high power rating]



SIDE PROFILE

Application / Design Notes on 'OF' Series Shunt Resistors**A. Selection of Shunt Resistor**

As can be observed, HTR provides different mounting tags for standard resistance values, for low resistance values and for very low resistance values and high power.

Therefore the customers should select the right tag for his application based on the following facts which will help him in his quest for the right tag for his application.

- 2 tags (one on each side) are suitable for most applications apart from where the resistance value is very low <R005 and hence there are high current requirements.
- (i) For such applications, 4 tags (two on each side) are more suitable, as two tag / shunt resistor can carry upto 70 Amps. Hence, ideally a 4 tag shunt resistor should be able to carry 140 Amps (limited by thickness / current carrying capacity of resistance alloy selected)
- (ii) When Kelvin connections for very high tight resistance tolerances are sought.

B. Soldering of Shunt Resistor

- If the mounting tag is not completely covered / imbedded in solder, it will give a completely wrong resistance value / reading as the tag itself represents a significant resistance value. In addition to giving a wrong reading there may be overheating observed at such solder joints.
- In order to facilitate optimum levels of solderability, the 'OF' series is supplied pre-solder alloy dipped. In the RoHS version - Pb free solder alloy (96.4% Sn / 3.2% Ag / 0.4% Cu) is used.
(ALL DIMENSIONS PROVIDED OF THE TAGS ARE PRE-SOLDER DIPPED)
- PCB Design
Since these shunt resistors have restricted suitability when wave soldered, the application Lab. at HTR has recommended the following PCB hole diameters for the different tags offered.

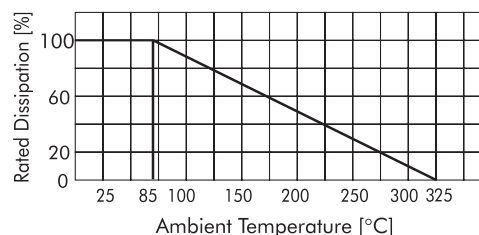
Tag Type 1-S / 1-P / 2-S / 2-P

Thickness of Resistance Strip (T)	Recommended PCB Hole Ø
Upto 0.37 mm	1.1 mm
0.4 mm to 0.51 mm	1.2 mm
0.6 mm to 0.75 mm	1.3 mm
0.8 mm	1.5 mm

Tag Type 3-S / 3-P

Thickness of Resistance Strip (T)	Recommended PCB Hole Ø
Upto 0.29 mm	1.5 mm
0.3 mm to 0.6 mm	1.65 mm
0.65 mm to 0.8 mm	1.75 mm

- Due to the very nature of their physical construction, the 'OF' series shunt resistors act like a heat - sink during solderability. In view of this, soldering parameters like temperature of bath and dwell time must be adjusted accordingly to achieve optimum results.

DERATING CURVE



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ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS

PARAMETER/PERFORMANCE TEST&TEST METHOD	PERFORMANCE REQUIREMENTS
Power Rating (Rated Ambient Temperature) to zero at +325°C (Refer derating curve above)	Full power dissipation at 85°C and linearly derated
Resistance Tolerances Available	±10% [K]; ±5% [J]; ±3% [H]; ±2%[G]; ±1% [F]
Temperature Range	-55°C to +325°C with suitable derating as per derating curve above
Voltage Rating / Limiting Voltage / Max. Working Voltage	$V = \sqrt{P \times R}$
Short Time Overload (5 x Rated power for 5 secs)	$\Delta R \pm [0.75\% + R0005]$ - Average $\Delta R \pm [1.25\% + R0005]$ - For resistance values near maximum range.
Temperature Co-efficient of Resistance [Measured from -55°C to +125°C referenced to +25°C]	< +40 to > - 80 ppm/°C or +180 ppm/°C (Depending on resistance value / alloy selected)
Climate Category	55 / 350 / 56
Temperature Cycling (Room temperature → -55°C → Room temperature → 200°C → Room temperature for 5 cycles)	$\Delta R \pm [0.5\% + R0005]$ - Typical
Damp Heat (Steady State) (40°C at 93% R.H for 1000 hours - no load applied)	$\Delta R \pm [0.5\% + R0005]$ - Average
Endurance - Load Life [70°C with limiting voltage - 1.5 hours on / 0.5 hours off for 1000 hours]	$\Delta R \pm [\leq 2.75\% + R0005]$ - Average

MECHANICAL SPECIFICATIONS

PARAMETER/PERFORMANCE TEST/TEST METHOD	PERFORMANCE REQUIREMENTS
Resistance to Soldering heat (260°C - 270°C for 10 secs)	$\Delta R \pm [0.2\% + R0005]$ - Typical
Solderability (As per IEC Pub. 60068-2-20 Ta)	Must meet the requirements laid down

TYPICAL APPLICATIONS

The OF series offers a non-insulated, non-inductive resistor having high stability / overload capacity. These shunt resistors are finding increasing usage in SMPS / linear power supplies and other current sensing circuits. Since the solder tag is made from the same alloy, provided the tag is correctly soldered, there will be very accurate reading of TCR as compared to other types where a copper termination is welded to the resistance alloy.

MARKING

Due to the nature of their construction, these resistors cannot be marked with all relevant details on the resistive element. However resistance value (in either ohms or mohms), tolerance and date code will be marked on the device. All other relevant details will be on the packing box.

ORDERING INFORMATION

Series	Type	Packing	Resistance Value	Tolerance
OF	OF 1.5A / OF 1.5A*	Bulk OF 1.5A / OF 1.5A*	R033	J

For RoHS version- OF 1.5A *