



**THE DATASHEET OF  
FP0404R1-R022-R**



# FP0404

## High frequency, high current power inductors



### Product features

- High current carrying capacity
- Low core loss
- DC-DC converter applications up to 2 MHz
- Filtering applications see inductance vs frequency and impedance vs frequency curves on page 5
- Inductance Range from 22 nH to 170 nH
- Current range up to 40 A
- 4.0 mm x 4.0 mm footprint surface mount package in 3.0 mm and 4.0 mm heights
- Moisture sensitivity level (MSL): 1
- Ferrite core material

### Applications

- Multi-phase and Vcore regulators
- Voltage Regulator Modules (VRMs)
- Server and desktop VRMs and EVRDs
- Laptop and notebook regulators
- Data networking and storage systems
- Graphics cards and battery power systems
- Point-of-Load modules

### Environmental data

- Storage temperature range (component): -40 °C to +125 °C
- Operating temperature range: -40 °C to +125 °C (ambient plus self-temperature rise)



**Product specifications**

Part number <sup>8</sup>	OCL <sup>1</sup> (nH) ±15%	FLL <sup>2</sup> (nH) minimum	I <sub>DC</sub> <sup>3</sup> (A)	I <sub>pk1</sub> <sup>4</sup> (A)	I <sub>pk2</sub> <sup>5</sup> (A)	I <sub>pk3</sub> <sup>6</sup> (A)	DCR (mΩ) @ +20 °C ±25%	K-factor <sup>7</sup>
FP0404R1-R022-R	22 ±20%	15	40	40	34	32	0.32 ± 15%	2351
FP0404R1-R065-R	65	44	40	24	22	20	0.32	2248
FP0404R1-R080-R	80	54	40	19.5	18	16	0.32	2248
FP0404R1-R100-R	100	68	40	15.6	14	13	0.32	2248
FP0404R1-R110-R	110	74.5	40	14.2	13	11.8	0.32	2248
FP0404R1-R170-R	170	116	40	9.0	7.8	7.6	0.32	2248

1. Open Circuit Inductance (OCL) Test parameters: 100 kHz (1 MHz for R022), 0.1 Vrms, 0.0 Adc, +25 °C  
 2. Full Load Inductance (FLL) Test parameters: 100 kHz (1 MHz for R022), 0.1 Vrms, I<sub>DC</sub><sup>3</sup>, +25 °C  
 3. I<sub>DC</sub><sup>3</sup>: DC current for an approximate temperature rise of 40 °C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed +125 °C underworst case operating conditions verified in the end application.

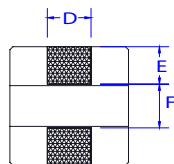
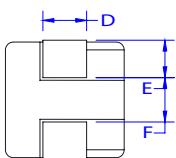
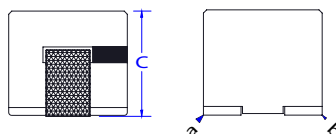
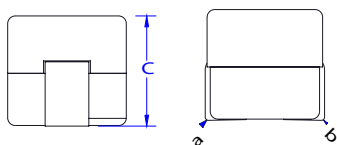
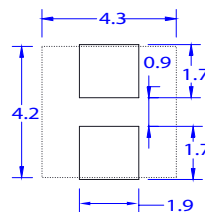
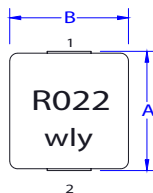
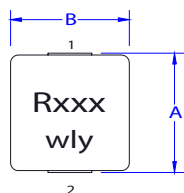
4. I<sub>pk1</sub><sup>4</sup>: Peak current for approximately 20% rolloff @ +25 °C  
 5. I<sub>pk2</sub><sup>5</sup>: Peak current for approximately 20% rolloff @ +100 °C  
 6. I<sub>pk3</sub><sup>6</sup>: Peak current for approximately 20% rolloff @ +125 °C  
 7. K-factor: Used to determine Bp-p for core loss (see graph). Bp-p = K \* L \* ΔI \* 10<sup>-3</sup>. Bp-p:(Gauss), K: (K-factor from table), L: (Inductance in nH), ΔI (Peak to peak ripple current in Amps).  
 8. Part Number Definition: FP0404Rx-Rxxx-R  
 FP0404 = Product code and size  
 Rx= DCR indicator  
 Rxxx=Inductance value in μH, R=decimal point  
 -R suffix = RoHS compliant

**Dimensions (mm)**

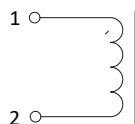
R065, R080, R100, R110, R170

R022

Recommended pad layout



SCHEMATIC



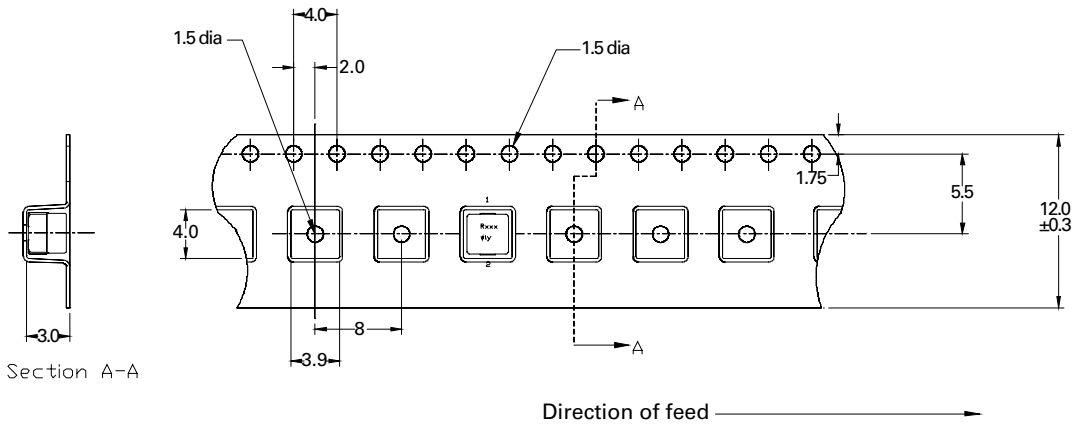
Part number	A	B	C	D	E	F
R022-R	4.0 maximum	4.0 maximum	3.0 maximum	1.4 ±0.20	1.2 ±0.2	1.4 ±0.3
R065-R	3.7 ±0.30	3.7 ±0.30	3.5 ±0.50	1.4 ±0.20	1.2 ±0.2	1.4 ±0.3
R080-R	3.7 ±0.30	3.7 ±0.30	3.5 ±0.50	1.4 ±0.20	1.2 ±0.2	1.4 ±0.3
R100-R	3.7 ±0.30	3.7 ±0.30	3.5 ±0.50	1.4 ±0.20	1.2 ±0.2	1.4 ±0.3
R110-R	3.7 ±0.30	3.7 ±0.30	3.5 ±0.50	1.4 ±0.20	1.2 ±0.2	1.4 ±0.3
R170-R	3.7 ±0.30	3.7 ±0.30	3.5 ±0.50	1.4 ±0.20	1.2 ±0.2	1.4 ±0.3

Part marking: Rxxx xxx=inductance value in uH, R=decimal point, wly= lot code  
 All soldering surfaces to be coplanar within 0.1 millimeters  
 DCR is measured from point "a" to point "b"  
 Traces or vias underneath the inductor is not recommended

**Packaging information (mm)**

**FP0404R1-R022-R**

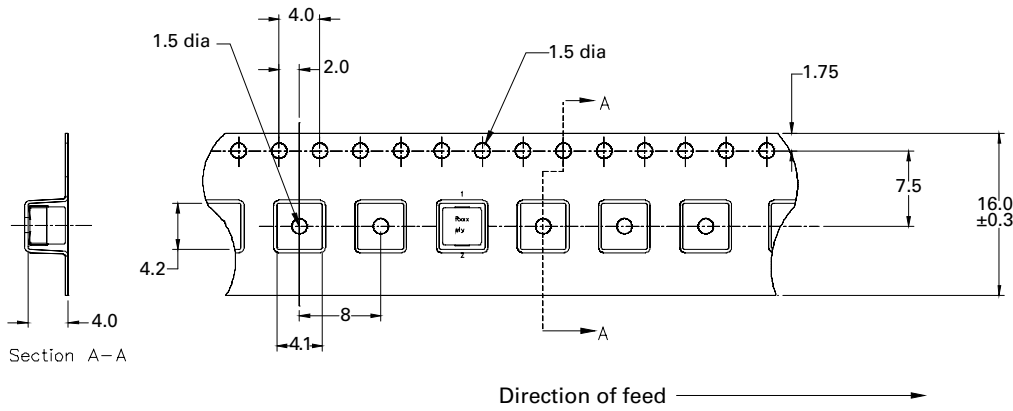
Supplied in tape and reel packaging, 1,800 parts per 13" diameter reel



**Packaging information (mm)**

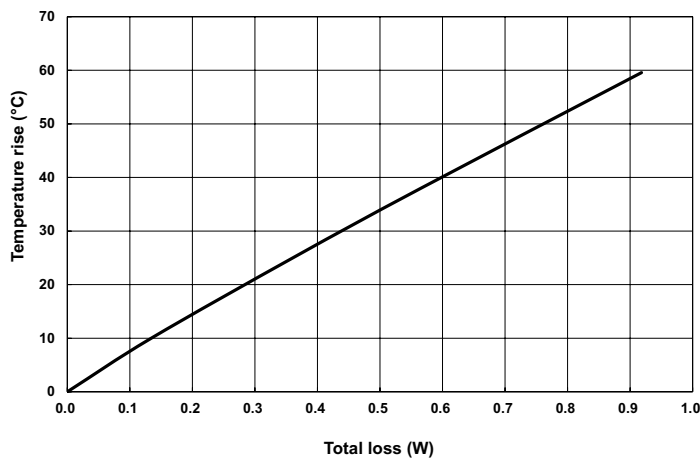
**FP0404R1-R065-R, R080-R, R100-R, R110-R, R-170**

Supplied in tape and reel packaging, 1,800 parts per 13" diameter reel

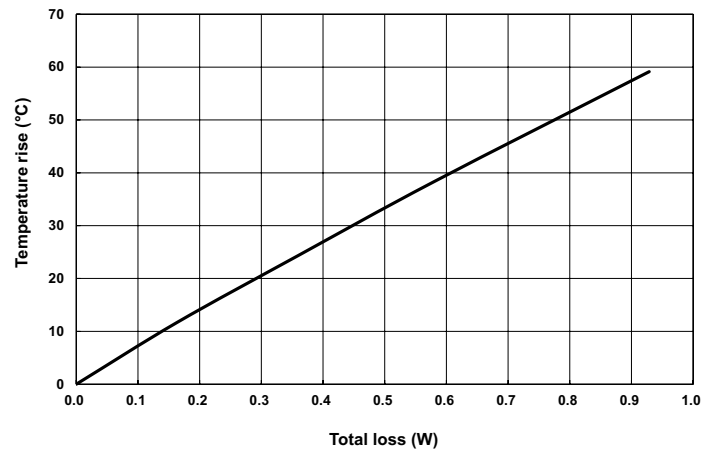


**Temperature rise vs. total loss**

FP0404R1-R022-R

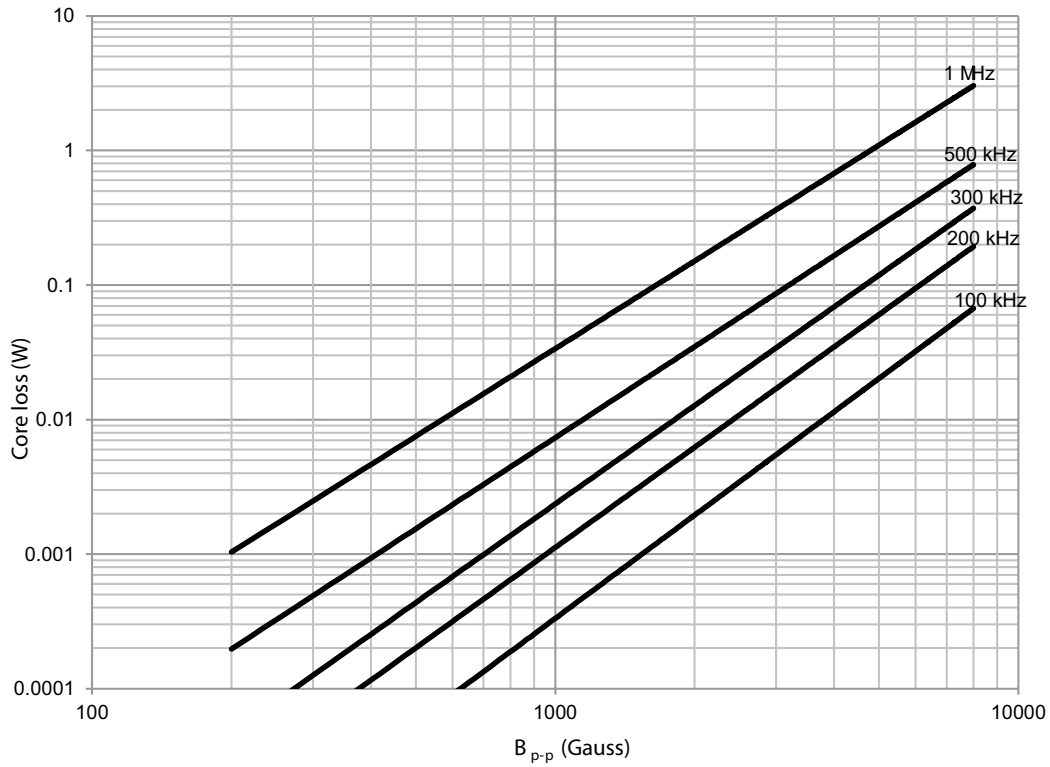


FP0404R1-R065-R, R080-R, R100-R, R110-R, R170

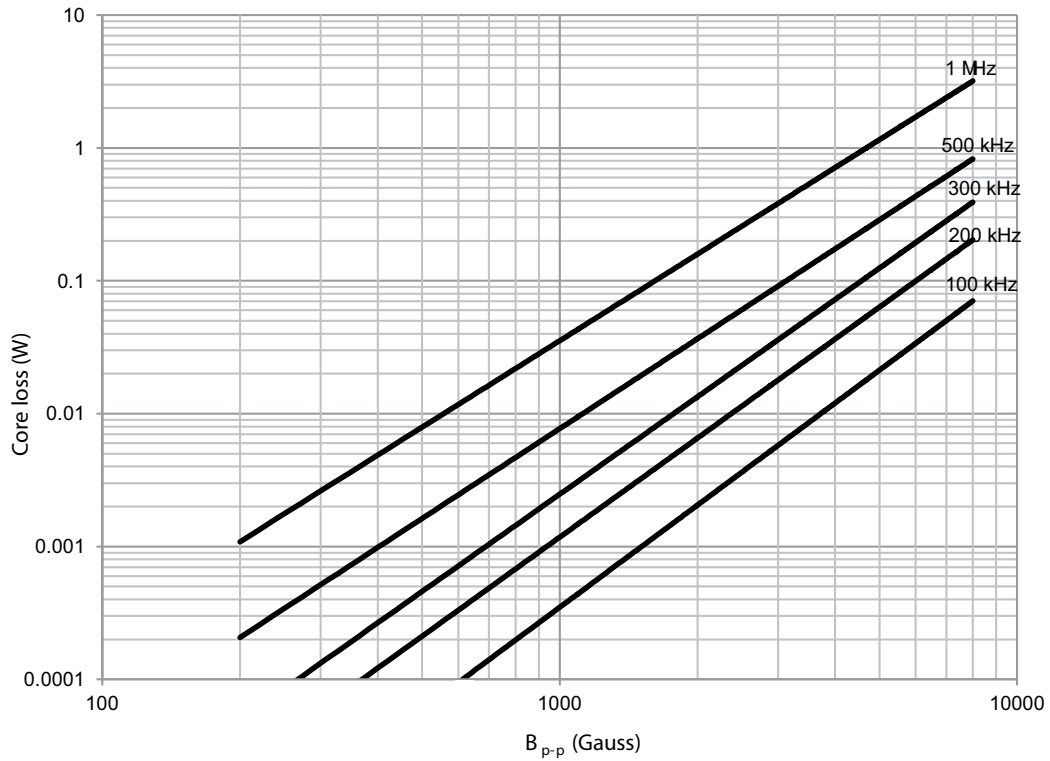


**Core loss vs B<sub>p-p</sub>**

**FP0404R1-R022-R**

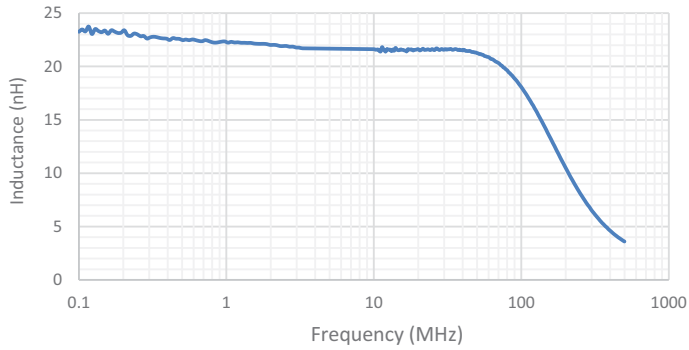


**FP0404R1-R065-R, R080-R, R100-R, R110-R, R-170**

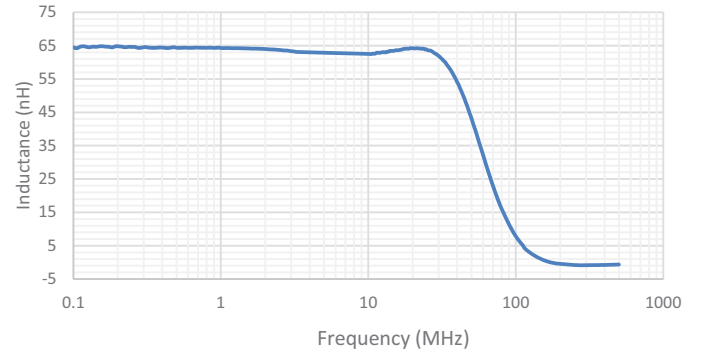


Inductance vs frequency

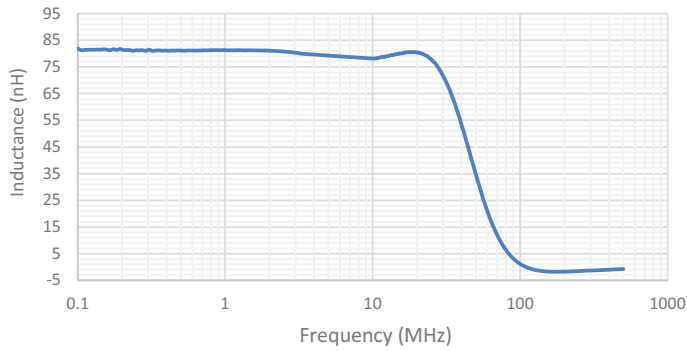
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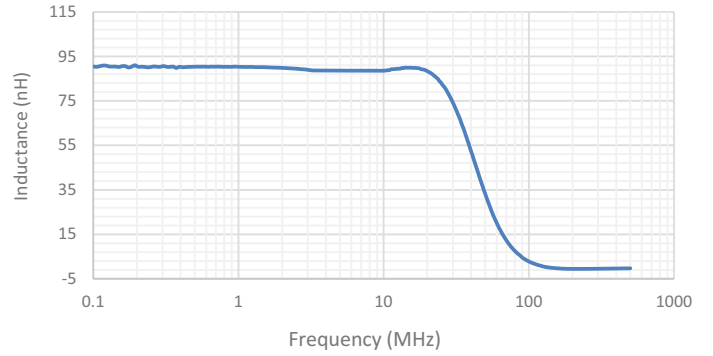
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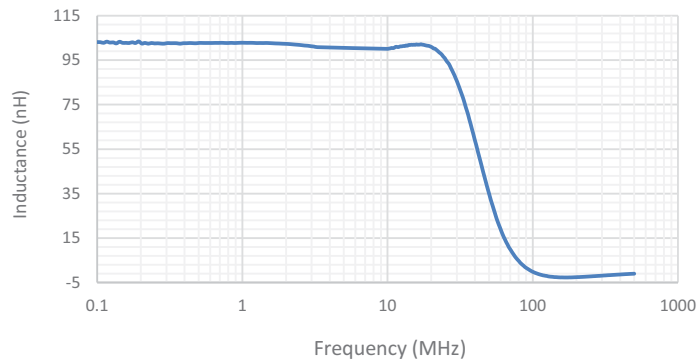
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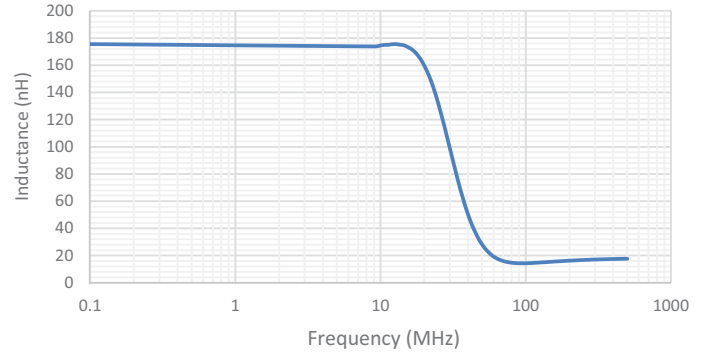
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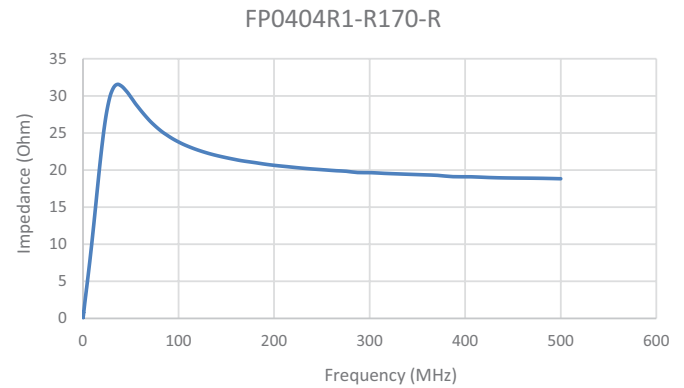
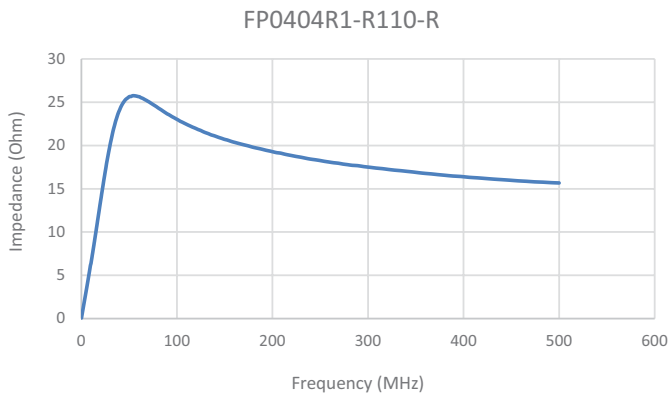
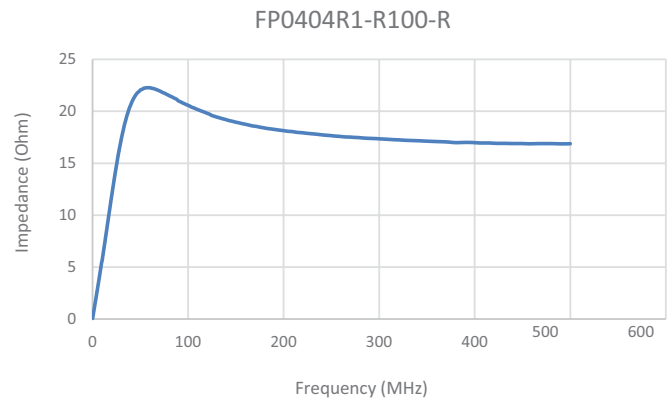
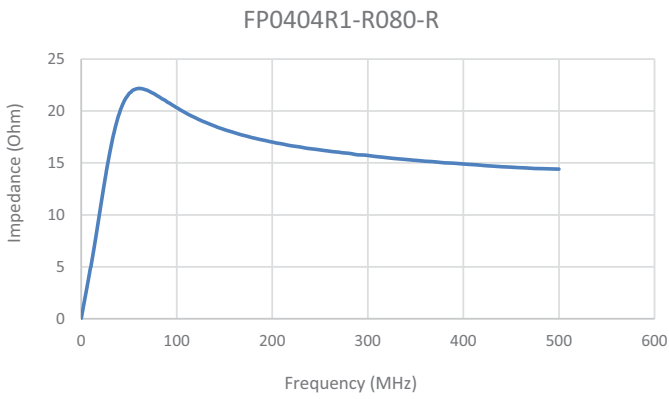
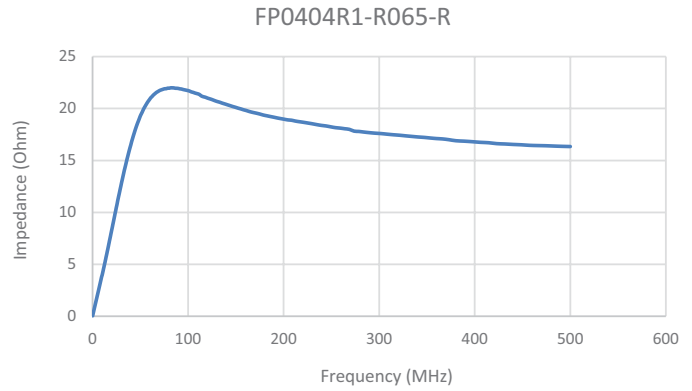
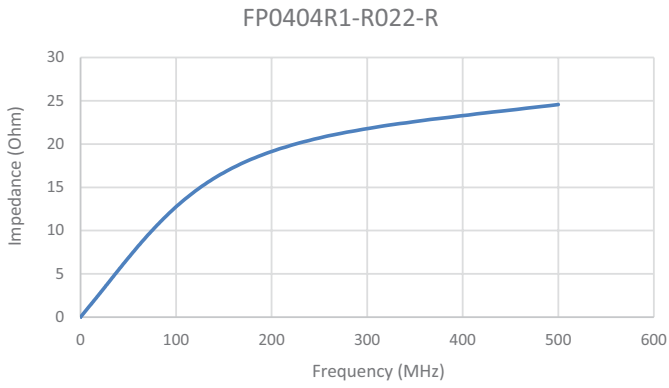
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FP0404R1-R0170-R

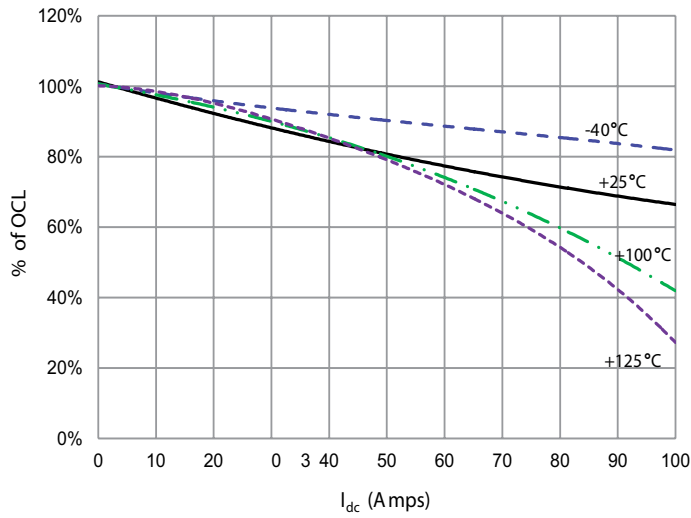


Impedance vs frequency

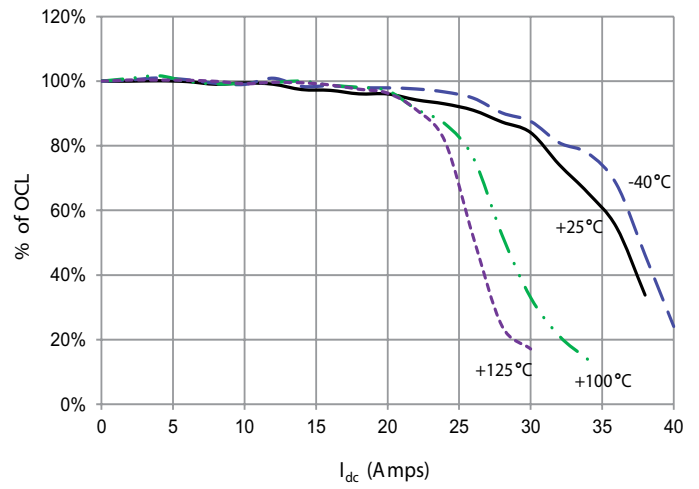


Inductance characteristics

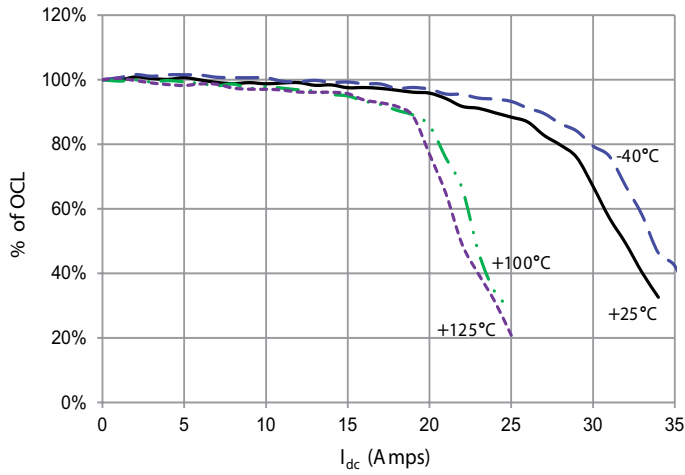
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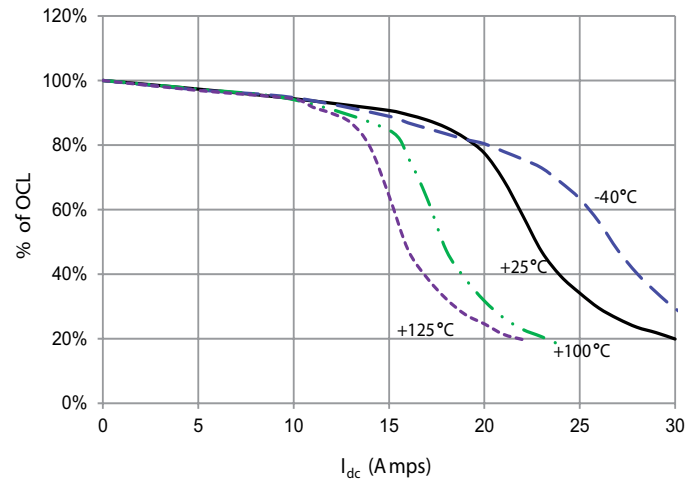
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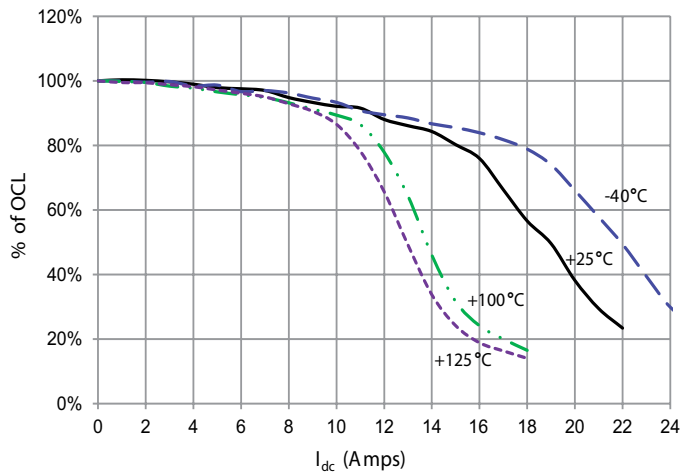
FP0404R1-R080-R



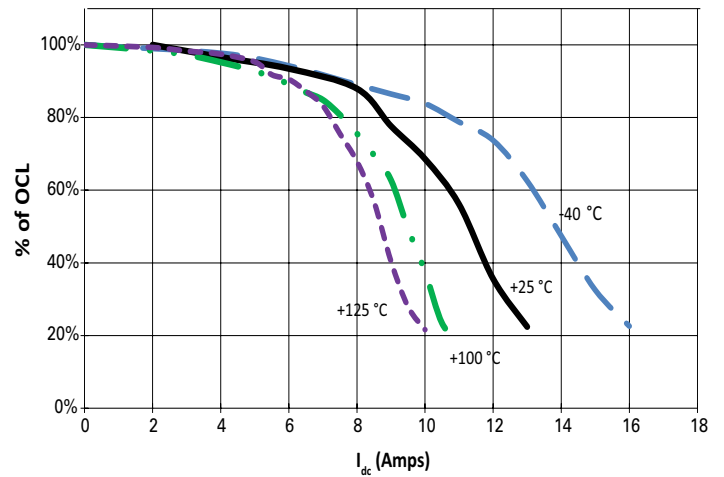
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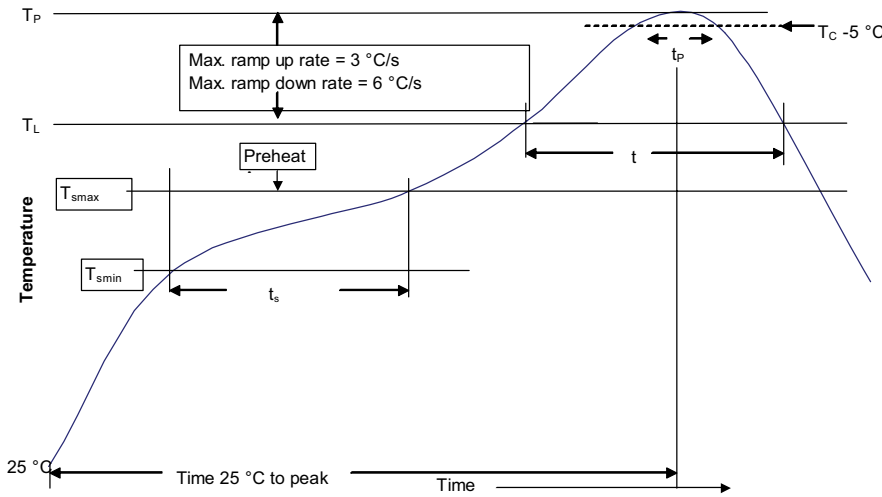
FP0404R1-R110-R



FP0404R1-R170-R



**Solder reflow profile**



**Table 1 - Standard SnPb solder ( $T_C$ )**

Package thickness	Volume $\text{mm}^3$ <350	Volume $\text{mm}^3$ $\geq$ 350
<2.5 mm	235 °C	220 °C
$\geq$ 2.5 mm	220 °C	220 °C

**Table 2 - Lead (Pb) free solder ( $T_C$ )**

Package thickness	Volume $\text{mm}^3$ <350	Volume $\text{mm}^3$ 350 - 2000	Volume $\text{mm}^3$ >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 – 2.5 mm	260 °C	250 °C	245 °C
>2.5 mm	250 °C	245 °C	245 °C

**Reference J-STD-020**

Profile feature	Standard SnPb solder	Lead (Pb) free solder
Preheat and soak		
• Temperature min. ( $T_{smin}$ )	100 °C	150 °C
• Temperature max. ( $T_{smax}$ )	150 °C	200 °C
• Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Ramp up rate $T_L$ to $T_P$	3 °C/ second max.	3 °C/ second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time ( $t_L$ ) maintained above $T_L$	60-150 seconds	60-150 seconds
Peak package body temperature ( $T_P$ )*	Table 1	Table 2
Time ( $t_p$ )* within 5 °C of the specified classification temperature ( $T_C$ )	20 seconds*	30 seconds*
Ramp-down rate ( $T_P$ to $T_L$ )	6 °C/ second max.	6 °C/ second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

\* Tolerance for peak profile temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.

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Printed in USA  
Publication No. 4373 PCN23011  
May 2023

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