

# MPI4040

High current, high frequency, miniature power inductors



## Applications

- Handheld/mobile devices
- Portable media players
- GPS/PDAs
- MP3 Players
- Battery operated devices
- Notebook/netbook/laptop
- Tablets/smartphones
- LCD Displays
- LED Drivers
- FOL Converters

## Description

- Handles high transient inrush current spikes
- Magnetically shielded
- Frequency range 20kHz to 10MHz
- Inductance range from 0.1µH to 22µH
- Current range from 1.1A to 32.0A
- 4.7 x 4.31 foot print surface mount package in 1.2, 1.5, 1.85 or 2.0mm heights
- Rugged construction
- Halogen free, lead free, RoHS compliant

## Environmental Data

- Storage temperature range (component): -55°C to +125°C
- Operating temperature range: -55°C to +125°C (Ambient plus self temperature rise)
- Solder reflow temperature: J-STD-020D compliant



Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

Product Specifications

Part Number <sup>5</sup>	OCL <sup>1</sup> ± 20% (µH)	Part marking designator	I <sub>rms</sub> <sup>2</sup> (amps)	I <sub>sat</sub> <sup>3</sup> @ 25°C (amps)	DCR (mΩ) ±20% @ 20°C	K-factor <sup>4</sup>
<b>R1 — 1.2mm Height</b>						
MPI4040R1-R10-R	0.10	A	8.0	32†	8.5	1401
MPI4040R1-R15-R	0.15	B	7.0	26†	11	989
MPI4040R1-R22-R	0.23	C	5.5	21	18	814
MPI4040R1-R33-R	0.33	D	4.4	17	28	659
MPI4040R1-R47-R	0.47	E	5.2	11.5	20	1295
MPI4040R1-R68-R	0.68	F	3.3	9.0	51	461
MPI4040R1-1R0-R	1.0	G	3.7	7.7	40	990
MPI4040R1-1R5-R	1.5	H	3.0	6.5	60	732
MPI4040R1-2R2-R	2.2	I	2.6	5.9	80	623
MPI4040R1-3R3-R	3.3	J	2.2	5.1	115	481
MPI4040R1-4R7-R	4.7	K	1.8	3.8	180	411
MPI4040R1-6R8-R††	6.8	L	1.5	2.7	250	344
MPI4040R1-100-R††	10	M	1.2	2.8	370	276
<b>R2 — 1.5mm Height</b>						
MPI4040R2-R47-R	0.47	A	6.4	12.2	13	1403
MPI4040R2-1R0-R	1.0	B	4.6	8.9	25	935
MPI4040R2-1R5-R	1.5	C	3.8	7.6	37	701
MPI4040R2-2R2-R	2.2	D	3.2	5.7	58	647
MPI4040R2-3R3-R	3.3	E	2.6	5.4	76	495
MPI4040R2-4R7-R	4.7	F	2.1	4.3	105	421
MPI4040R2-6R8-R	6.8	G	1.8	3.4	158	351
MPI4040R2-100-R††	10.0	H	1.5	3.1	240	271

1. Open Circuit Inductance (OCL) test parameter: 100kHz, 0.10V<sub>rms</sub>, 0.0A<sub>dc</sub>

2. I<sub>rms</sub>: DC current for an approximate temperature rise of 40°C without core loss. Derating is necessary for AC currents. Temperature rise is dependent upon several factors, including the PCB pad layout, trace thickness and width, air-flow and proximity to other heat generating components. It is recommended the part temperature not exceed 125°C under worst case operating conditions and therefore, the temperature rise should be verified in the end use application. I<sub>rms</sub> testing was performed on a 19.05mm long x 6.35mm wide x 0.070mm thick copper wire in still air.

3. I<sub>sat</sub>: Peak current for approximately 30% roll-off at +25°C.

4. K-factor: Used to determine B<sub>pp</sub> for core loss (see graph).

B<sub>pp</sub> = K \* L \* DI B<sub>pp</sub>: (Gauss), K: (K-factor from table), L: (inductance in µH),

DI = (peak-to-peak ripple current in amps).

5. Part Number Definition: MPI4040RX-XXX-R

- MPI4040R = product code and size

- X = version indicator

- XXX = inductance value in µH, R= decimal point - If no R is present, then last character equals the number of zeros

- -R suffix = RoHS compliant

† Transient pulse not to exceed 1 millisecond.

†† Maximum operating frequency less than 10MHz, consult factory for application specific values.

Product Specifications

Part Number <sup>5</sup>	OCL <sup>1</sup> ± 20% (µH)	Part marking designator	I <sub>rms</sub> <sup>2</sup> (amps)	I <sub>sat</sub> <sup>3</sup> @ 25°C (amps)	DCR (mΩ) ±20% @ 20°C	K-factor <sup>4</sup>
<b>R3 — 1.85mm Height</b>						
MPI4040R3-R22-R	0.22	A	8.0	20	5.8	1870
MPI4040R3-R47-R	0.47	B	5.8	17	10.3	1530
MPI4040R3-1R2-R	1.2	C	4.0	9.4	32	732
MPI4040R3-1R5-R	1.5	D	3.8	8.2	36	673
MPI4040R3-2R2-R	2.2	E	3.4	7.9	48	543
MPI4040R3-3R3-R	3.3	F	3.0	6.6	60	432
MPI4040R3-4R7-R	4.7	G	2.3	4.8	92	374
MPI4040R3-6R8-R	6.8	H	2.0	4.5	120	306
MPI4040R3-100-R	10	I	1.5	3.8	213	251
MPI4040R3-150-R	15	J	1.3	3.0	285	213
MPI4040R3-220-R††	22	K	1.1	2.2	408	174
<b>R4 — 2.0mm Height</b>						
MPI4040R4-R22-R	0.22	A	10.1	15	5.3	2405
MPI4040R4-R33-R	0.33	B	9.5	12.8	6.0	1870
MPI4040R4-R47-R	0.45	C	8.1	11.5	8.2	1530
MPI4040R4-1R0-R	1.0	D	5.7	8.2	17	900
MPI4040R4-1R5-R	1.5	E	4.9	6.9	23	802
MPI4040R4-2R2-R	2.2	F	3.9	5.7	35	673
MPI4040R4-3R3-R††	3.3	G	3.3	4.5	40	510
MPI4040R4-4R7-R††	4.7	H	2.9	3.9	67	455
MPI4040R4-6R8-R††	6.8	I	2.4	3.2	91	374
MPI4040R4-100-R††	10	J	1.9	2.6	148	306
MPI4040R4-220-R††	22	K	1.3	1.8	316	203

1. Open Circuit Inductance (OCL) Test Parameters: 100mV, 0.1Vrms, 0.0Adc

2. I<sub>rms</sub>: DC current for an approximate temperature rise of 4°C without core loss. De-rating is necessary for AC currents. Temperature rise is dependent upon several factors, including the PCB pad layout, trace thickness and width, air-flow and proximity to other heat generating components. It is recommended that the part temperature not exceed 125°C under worst case operating conditions and therefore, the temperature rise should be verified in the end use application. I<sub>rms</sub> testing was performed on a 9.05mm long x 6.35mm wide, 0.070mm thick copper trace in still air.

3. I<sub>sat</sub>: Peak current for approximately 30% rolloff at +25°C.

4. K-factor: Used to determine B<sub>pp</sub> for core loss (see graph).

B<sub>pp</sub> = K \* L \* DI.B<sub>pp</sub>: (Gauss), K: (K-factor from table), L: (inductance in µH), DI = (peak-to-peak ripple current in amps).

5. Part Number Definition: MPI4040RX-XXX-R

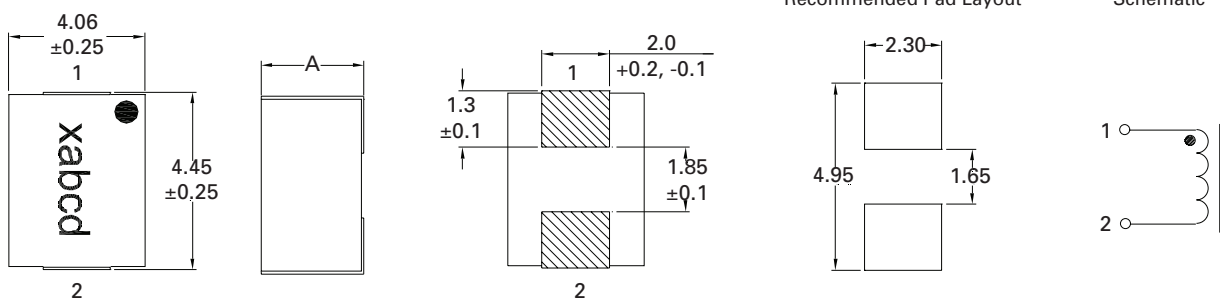
- MPI4040R = product code and size
- X = version indicator
- XXX = inductance value in µH, R= decimal point - If no R is present, then last character equals the number of zeros
- -R suffix = RoHS compliant

† Transient pulse not to exceed 1 millisecond.

†† Maximum operating frequency less than 10MHz, consult factory for application specific values.

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Dimensions (mm)



Part number	A Max
MPI4040R1-xxx-R	1.2
MPI4040R2-xxx-R	1.5
MPI4040R3-xxx-R	1.8
MPI4040R4-xxx-R	2.0

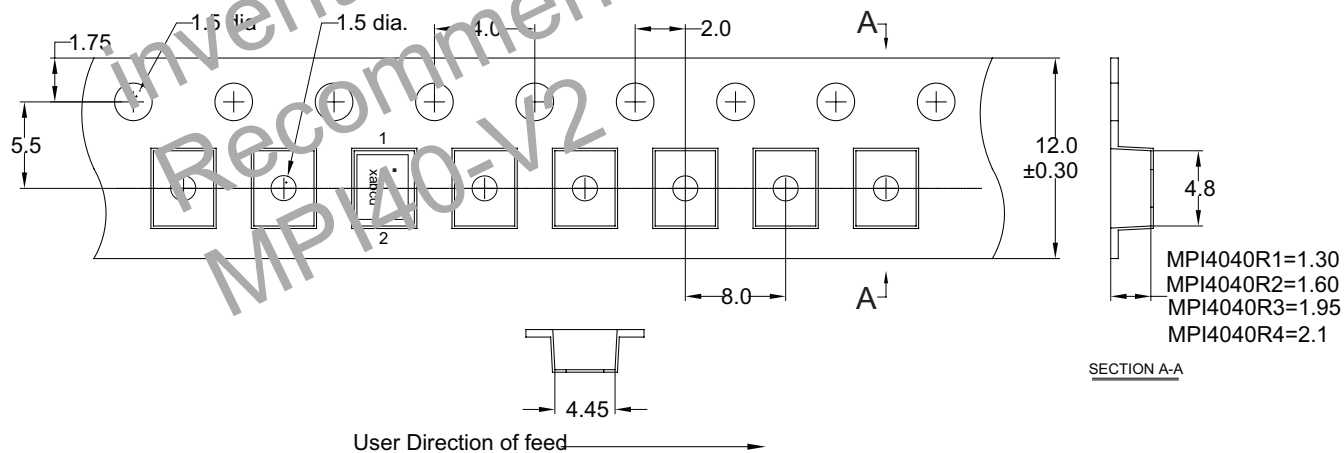
Part marking: xabcd  
 x = height: 1 = R1 (1.2mm), 2 = R2 (1.5mm), 3 = R3 (1.85mm), 4 = R4 (2.0mm)  
 a = Inductance value per the Part marking designator letter code in Product specification table.  
 b = Bi-weekly date code  
 c = Last digit of year manufactured  
 d = Revision level

Soldering surfaces to be coplanar within 0.10 millimeters  
 PCB tolerances are ±0.1 millimeters unless stated otherwise  
 Do not route traces or vias underneath the inductor

Packaging information (mm)

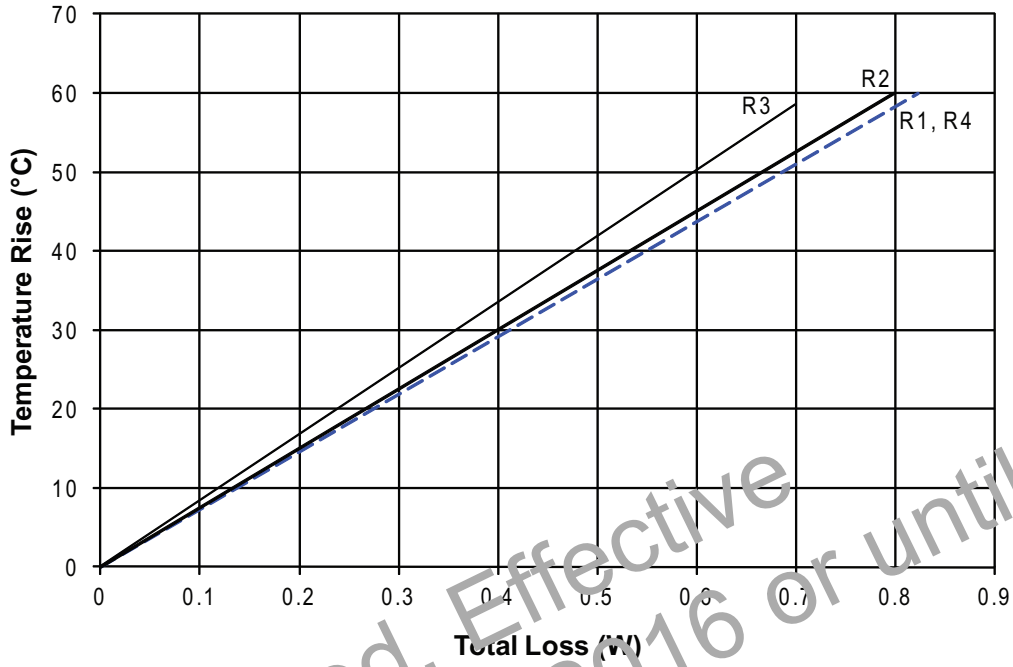
Supplied in tape and reel packaging:

- MPI4040R1 = 5000 parts per 13" diameter reel
- MPI4040R2 = 4500 parts per 13" diameter reel
- MPI4040R3 = 3500 parts per 13" diameter reel
- MPI4040R4 = 3000 parts per 13" diameter reel

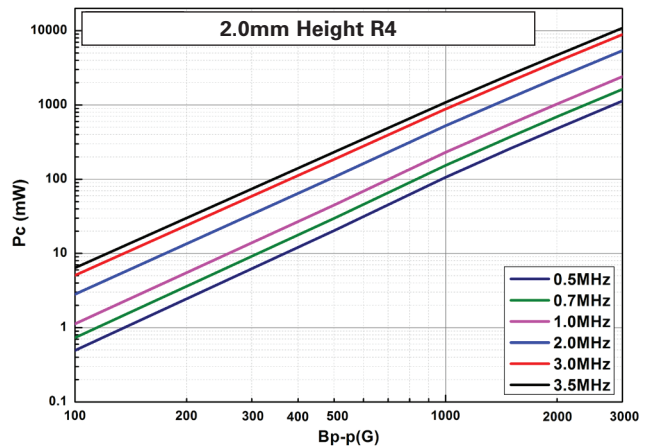
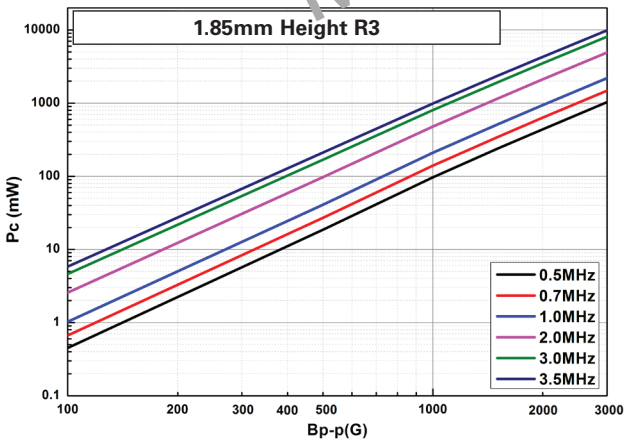
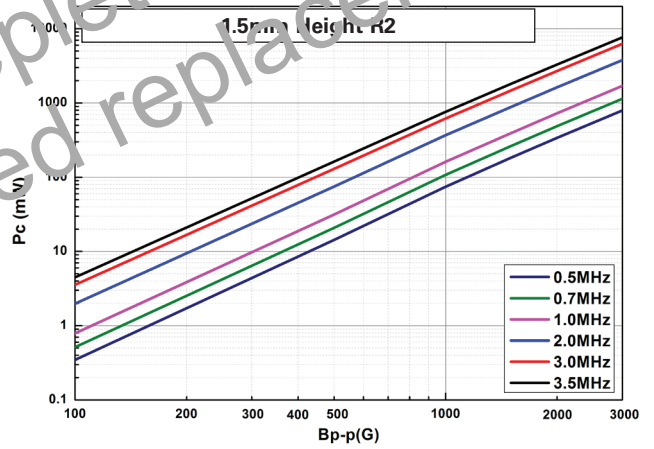
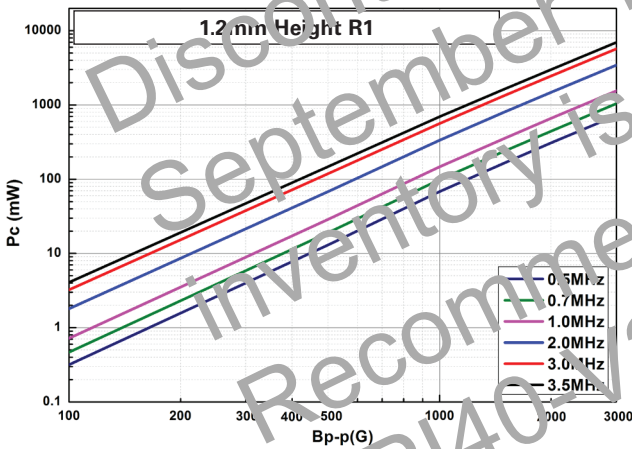


SECTION A-A

Temperature rise vs. total loss

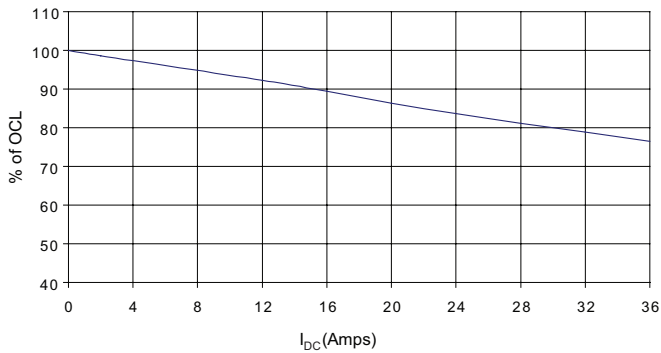


Core loss

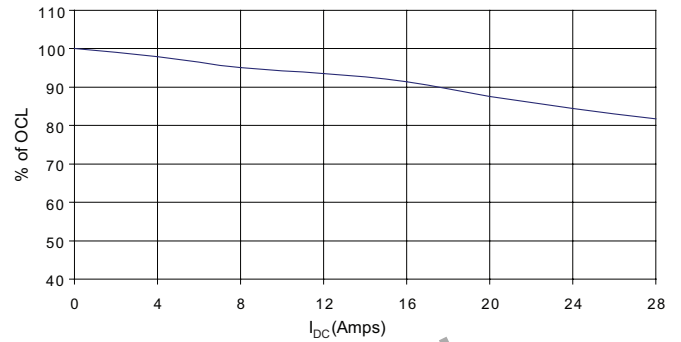


1.2mm Height R1 inductance characteristics — % of OCL vs.  $I_{DC}$

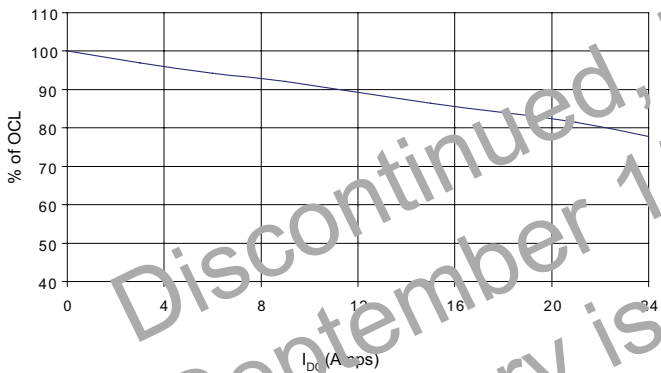
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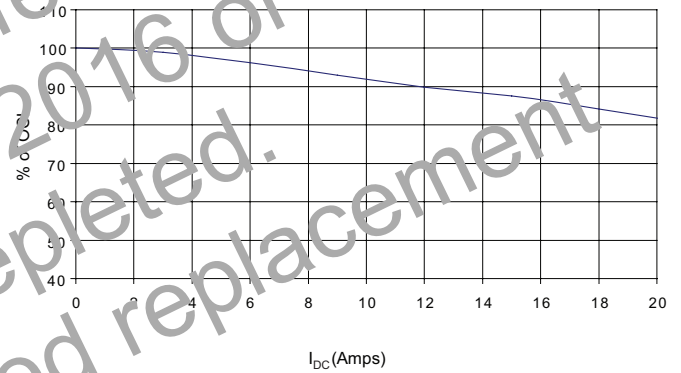
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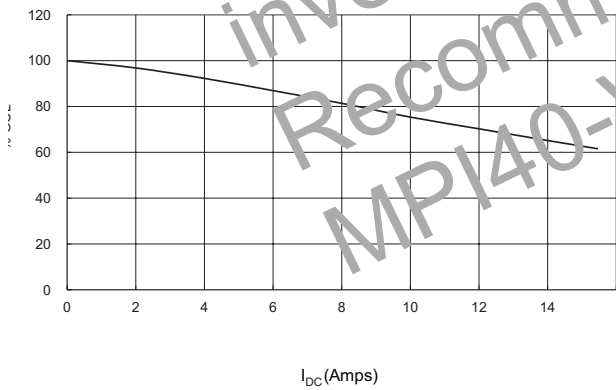
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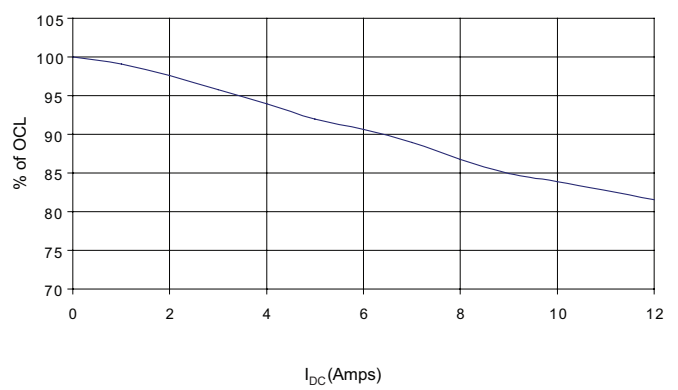
MPI4040R1-R33-R



MPI4040R1-R40-F

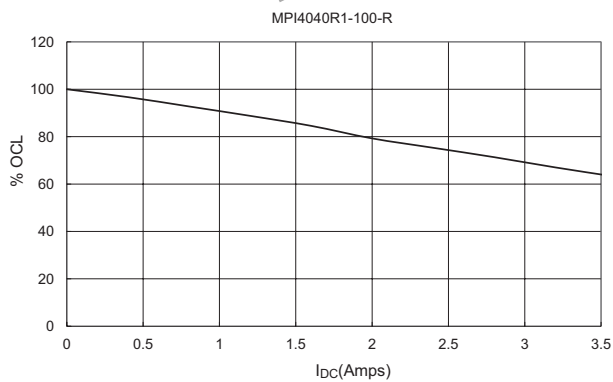
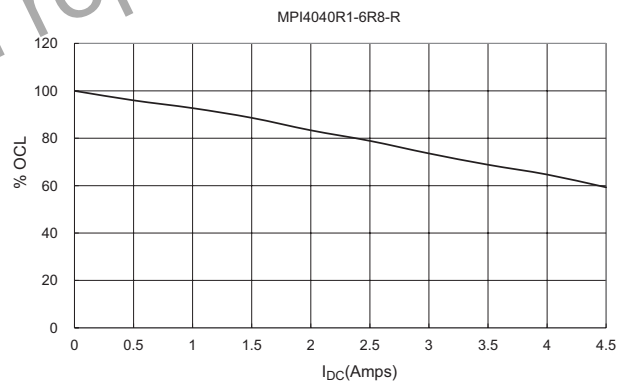
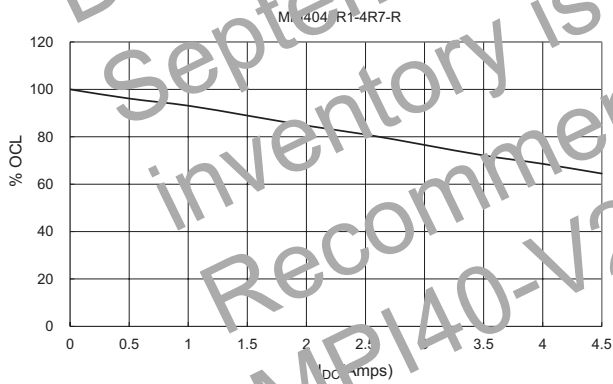
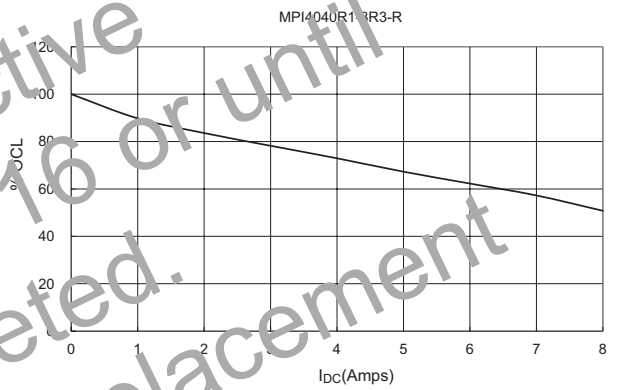
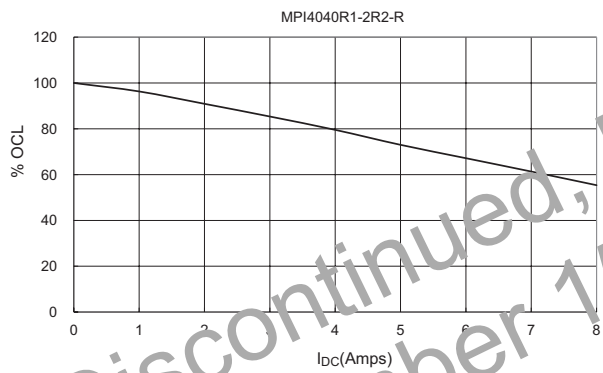
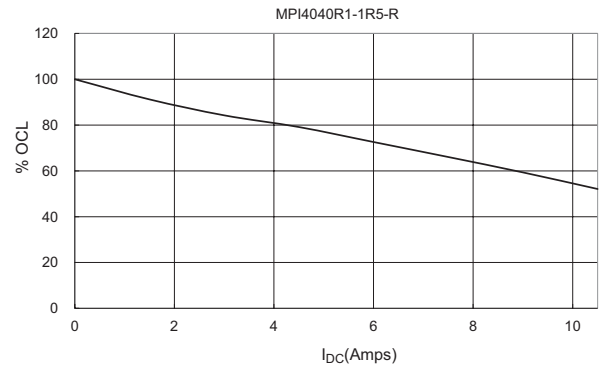
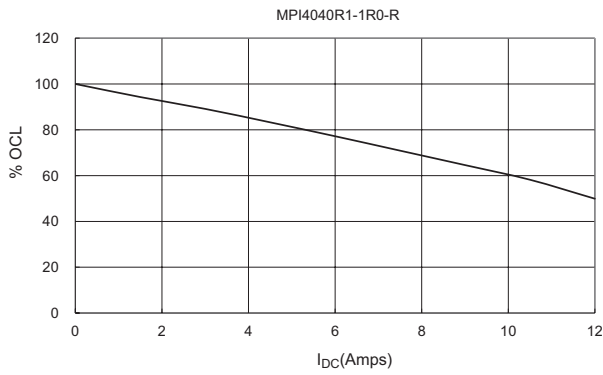


MPI4040R1-R68-R



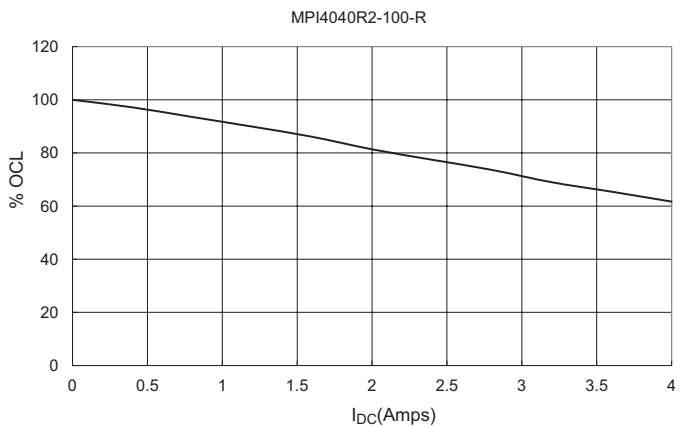
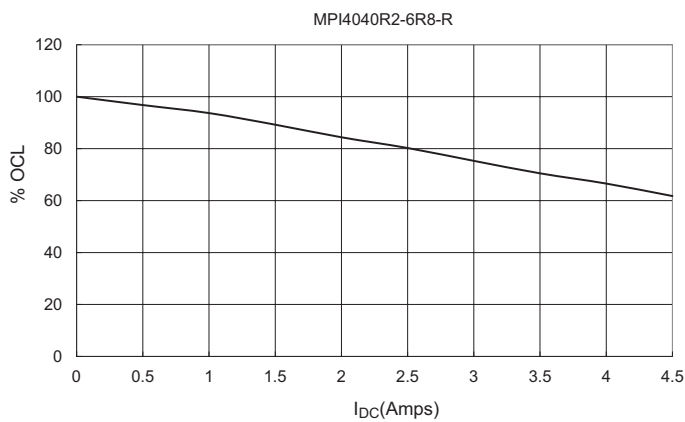
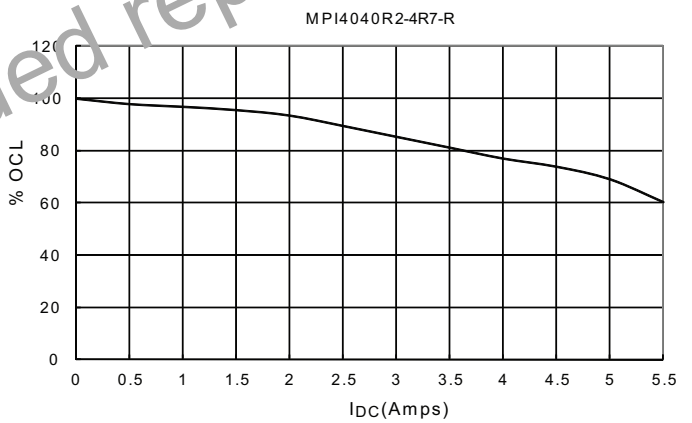
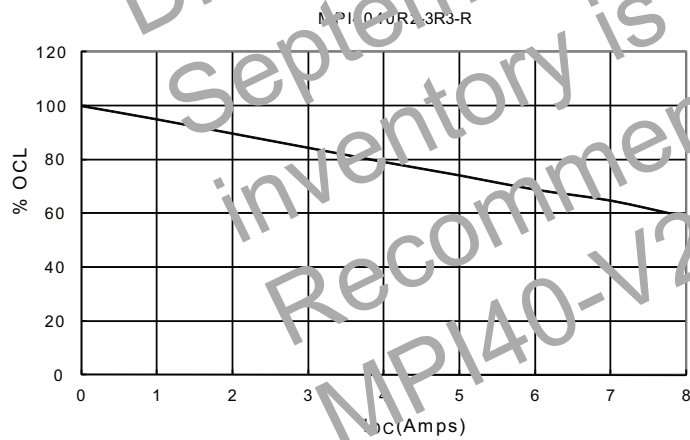
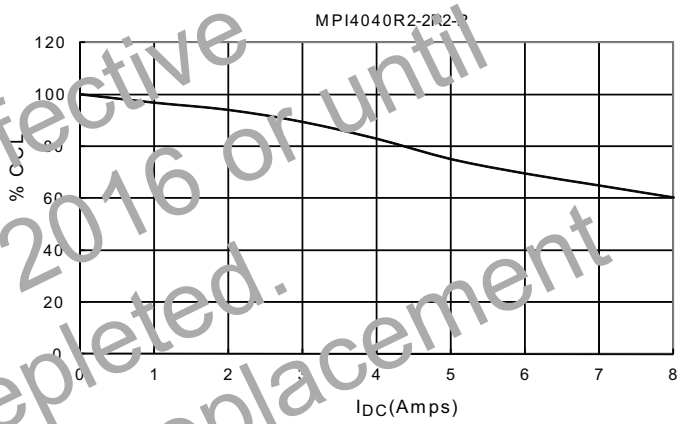
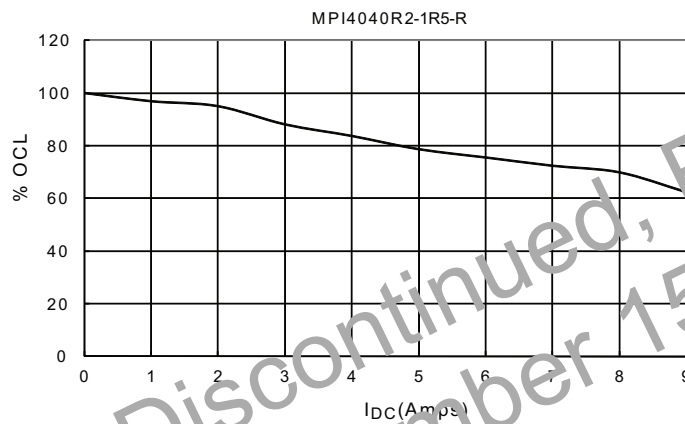
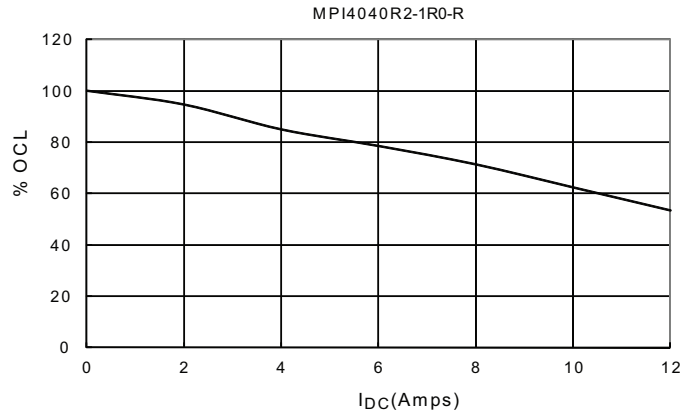
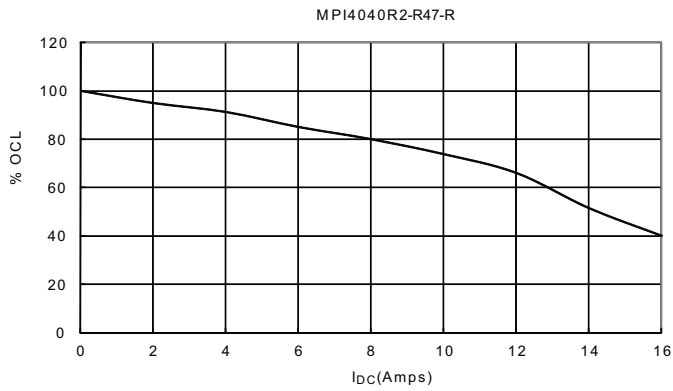
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

1.2mm Height R1 inductance characteristics — % of OCL vs.  $I_{DC}$



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 September 15, 2016 or until  
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 MPI40-V2

1.5mm Height R2 inductance characteristics — % of OCL vs.  $I_{DC}$

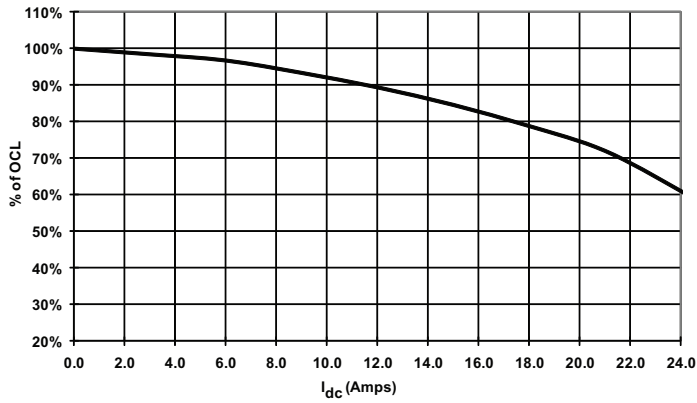


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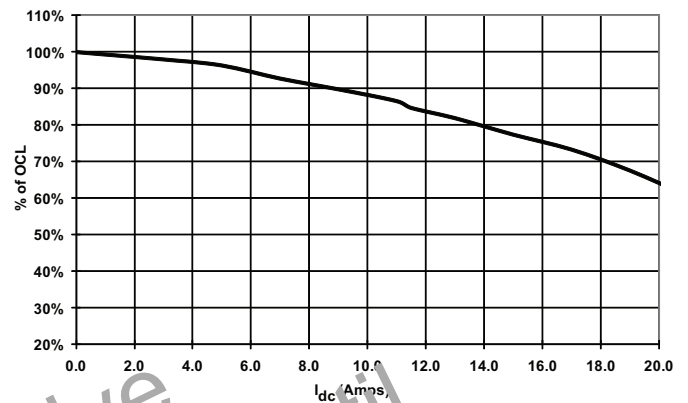


1.85mm Height R3 inductance characteristics — % of OCL vs.  $I_{DC}$

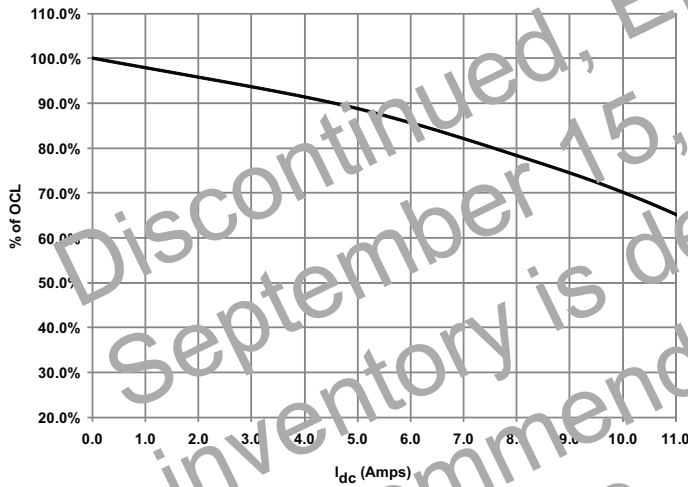
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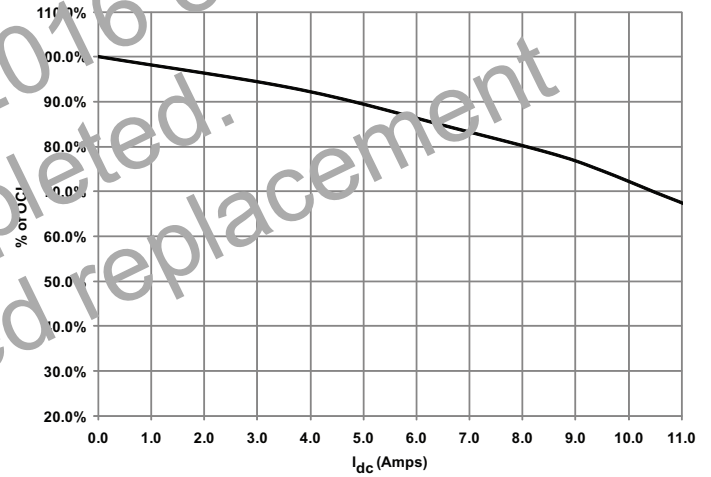
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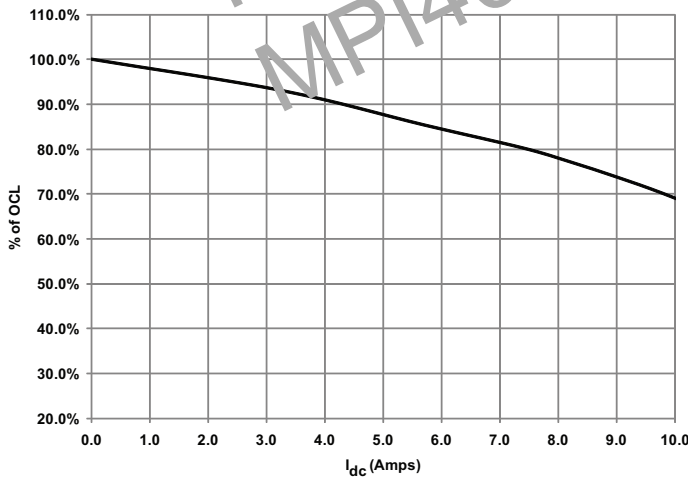
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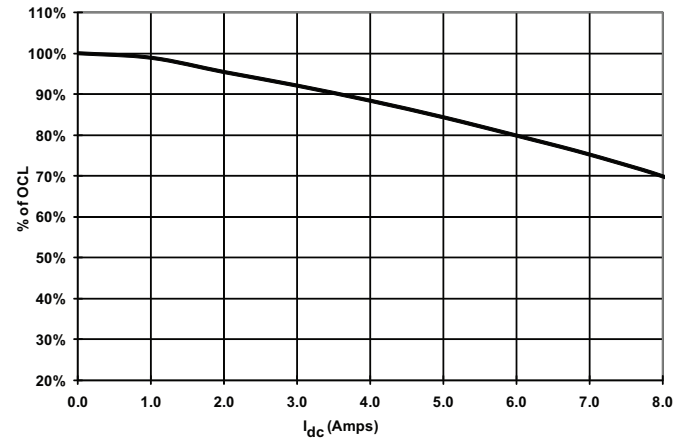
MPI4040R3-1R5-R



MPI4040R3-2R2-F

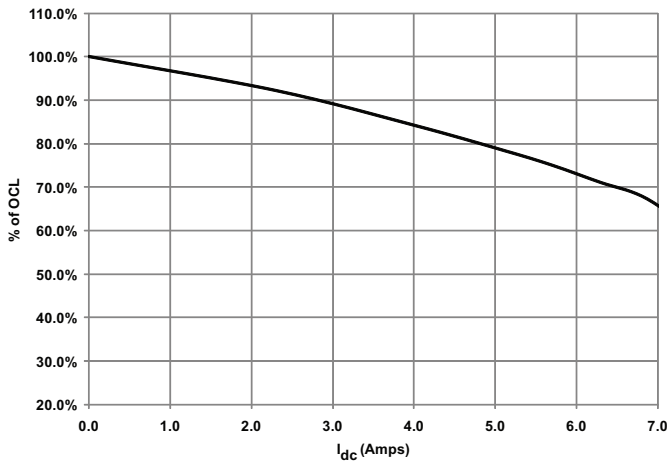


MPI4040R3-3R3-R

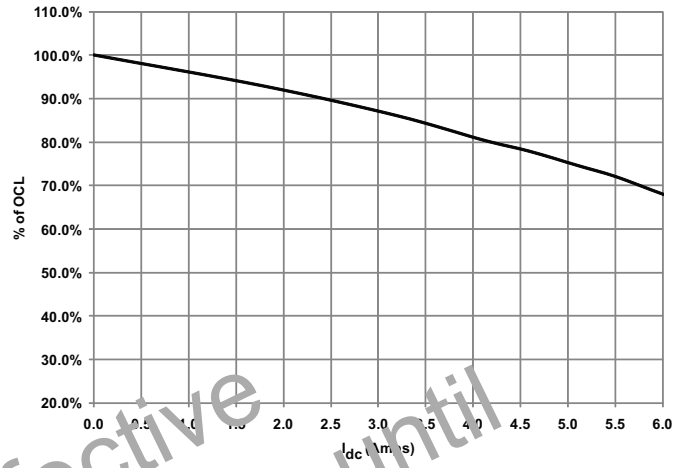


1.85mm Height R3 inductance characteristics — % of OCL vs.  $I_{DC}$

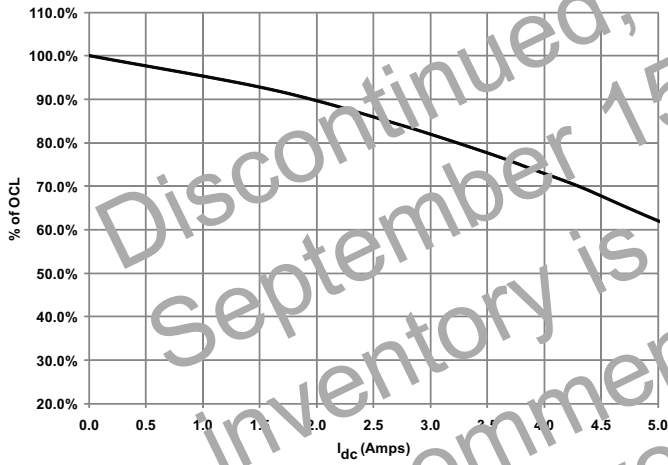
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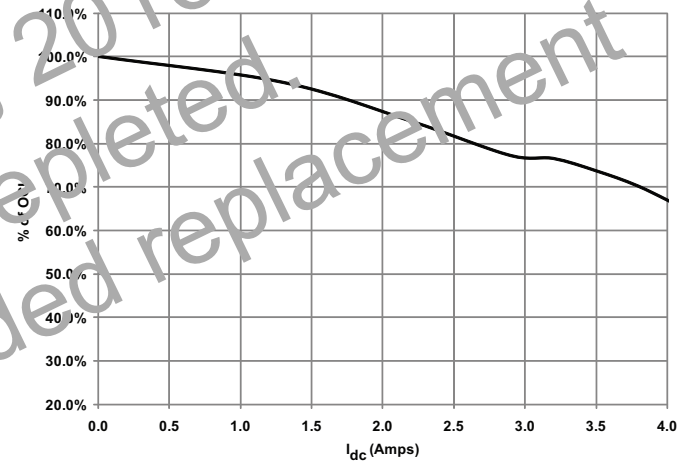
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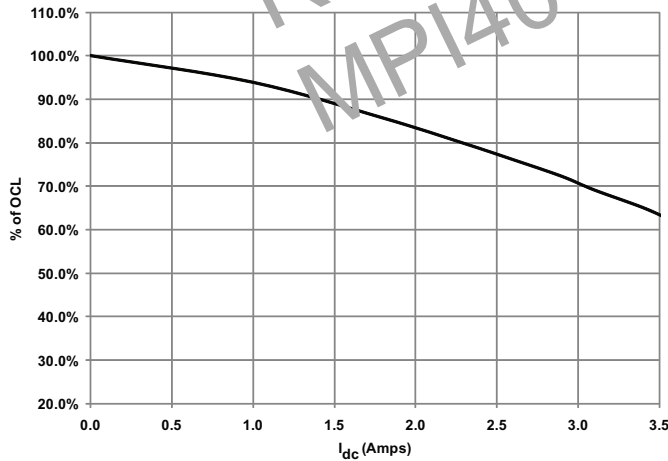
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MPI4040R3-150-R

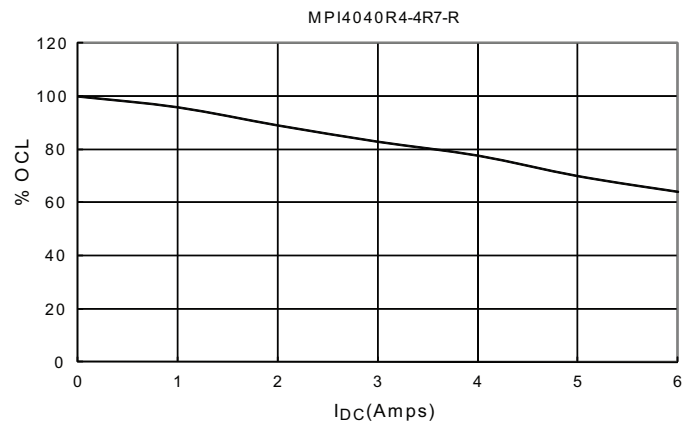
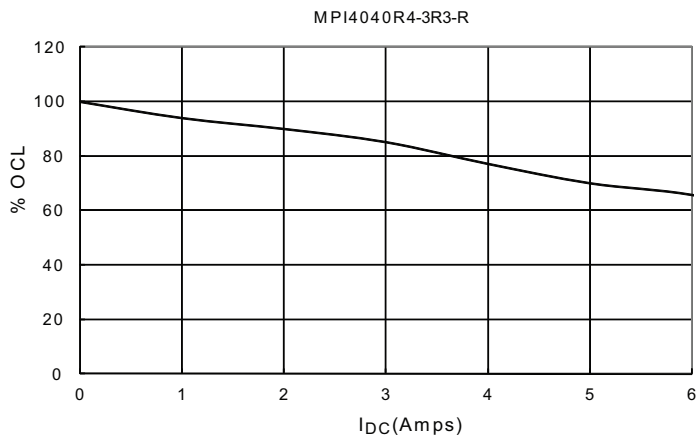
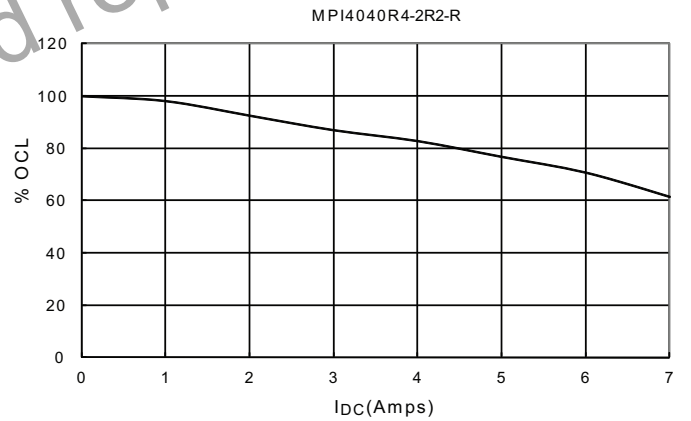
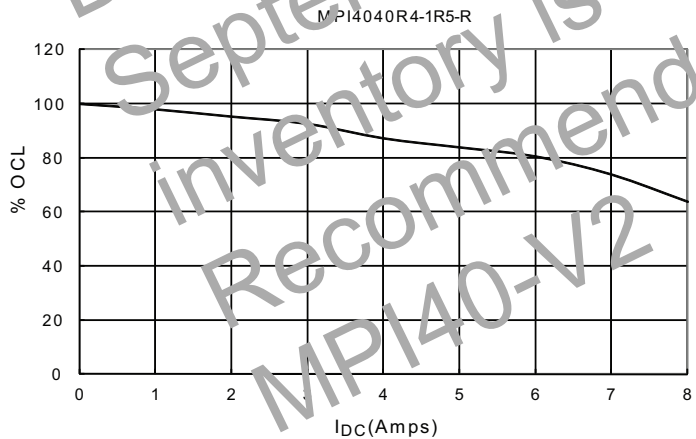
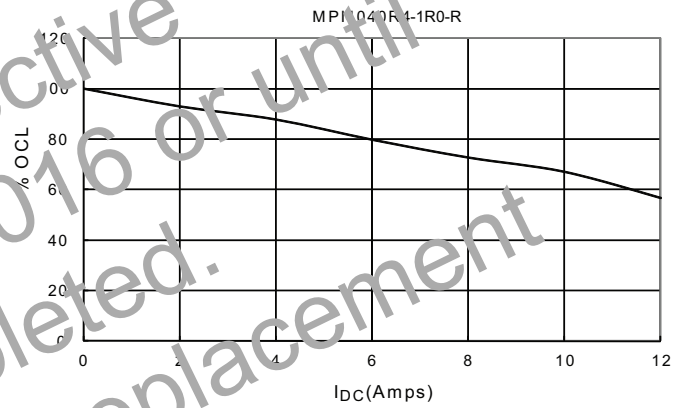
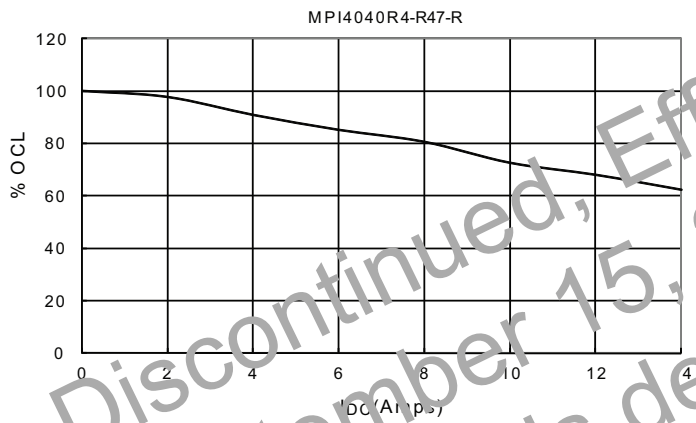
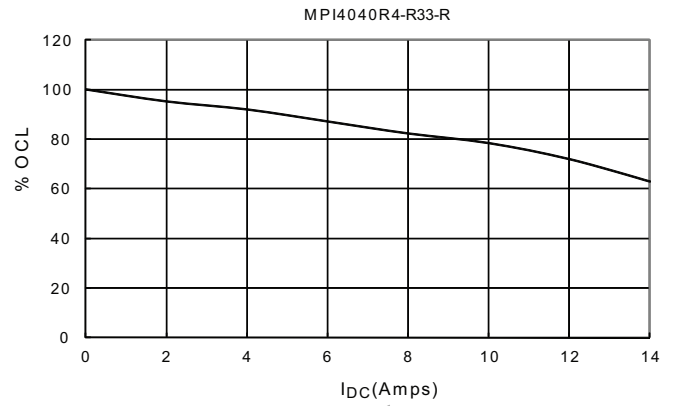
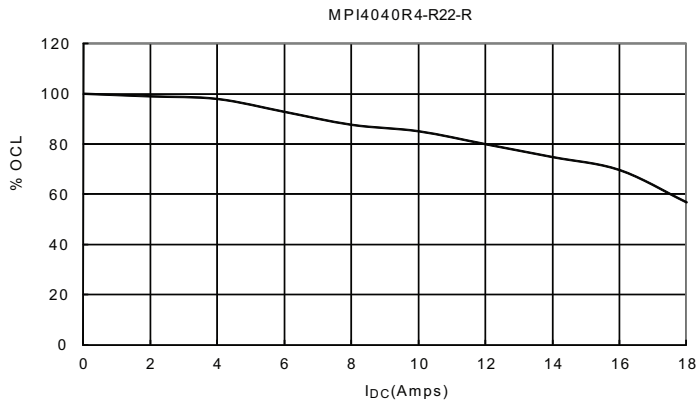


MPI4040F3-220-R



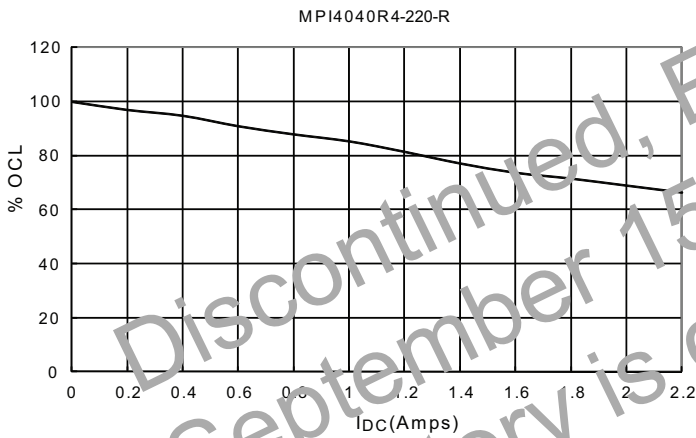
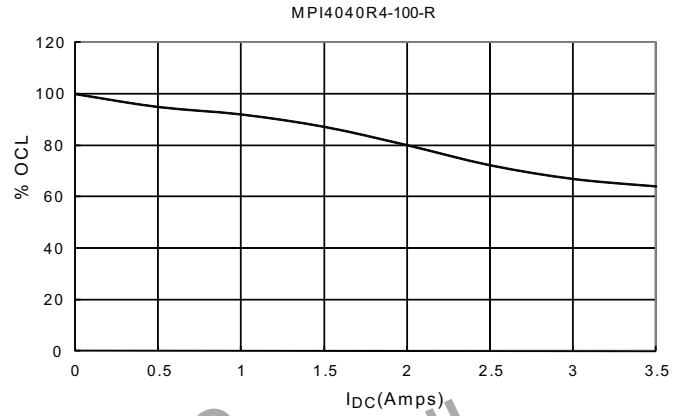
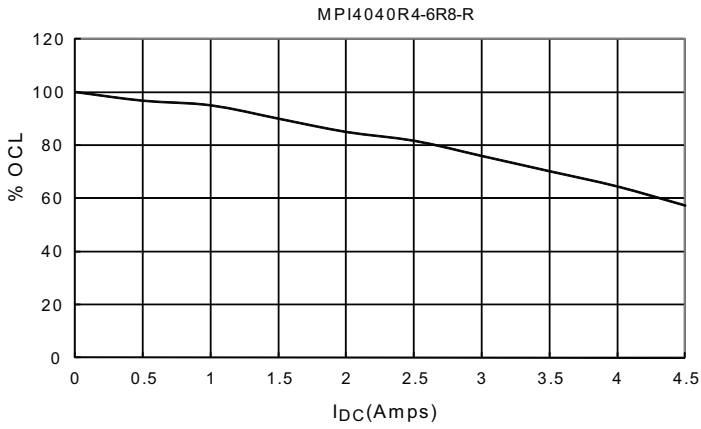
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

2.0mm Height R4 inductance characteristics — % of OCL vs.  $I_{DC}$



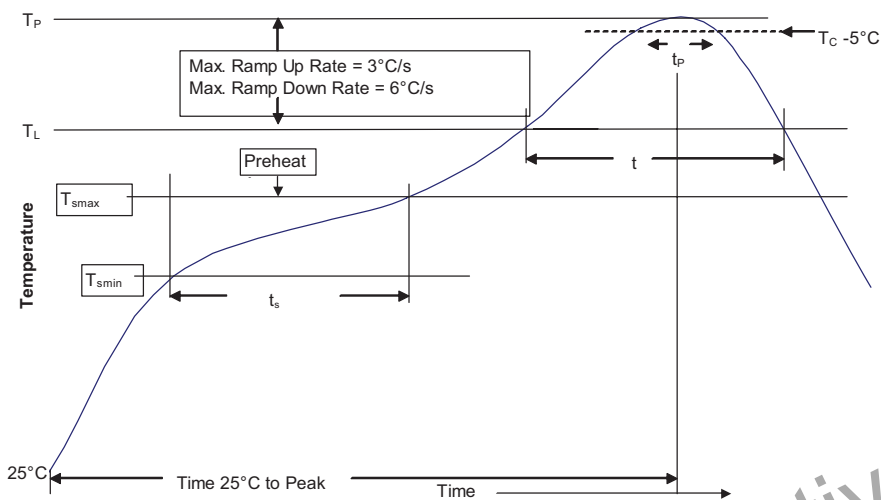
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2.0mm Height R4 inductance characteristics — % of OCL vs.  $I_{DC}$



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Recommended replacement  
MPI40-V2

**Solder reflow profile**



**Table 1 - Standard SnPb Solder (T<sub>C</sub>)**

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5mm)	235°C	220°C
≥2.5mm	220°C	220°C

**Table 2 - Lead (Pb) Free Solder (T<sub>C</sub>)**

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350 - 2000	Volume mm <sup>3</sup> >2000
<1.6mm	260°C	260°C	260°C
1.6 - 2.5mm	260°C	250°C	245°C
>2.5mm	250°C	245°C	245°C

**Reference JDEC J-STD-020D**

Profile Feature	Standard SnPb Solder	Lead (Pb) Free Solder
Preheat and Soak		
• Temperature min. (T <sub>smin</sub> )	100°C	150°C
• Temperature max. (T <sub>smax</sub> )	150°C	200°C
• Time (T <sub>smin</sub> to T <sub>smax</sub> ) (t <sub>s</sub> )	60-120 Seconds	60-120 Seconds
Average ramp up rate (T <sub>smax</sub> to T <sub>L</sub> )	3°C/ Second Max.	3°C/ Second Max.
Liquidous temperature (T <sub>L</sub> )	183°C	217°C
Time at liquidous (t <sub>L</sub> )	60-150 Seconds	60-150 Seconds
Peak package body temperature (T <sub>p</sub> )*	Table 1	Table 2
Time (t <sub>p</sub> )** within 5 °C of the specified classification temperature (T <sub>C</sub> )	20 Seconds**	30 Seconds**
Average ramp-down rate (T <sub>p</sub> to T <sub>smax</sub> )	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<sub>p</sub>) is defined as a supplier minimum and a user maximum.  
\*\* Tolerance for time at peak profile temperature (t<sub>p</sub>) is defined as a supplier minimum and a user maximum.

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