

# 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

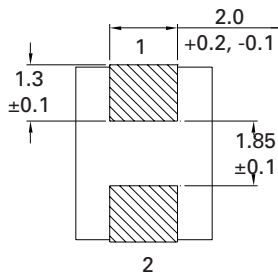
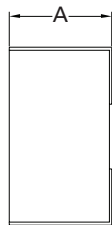
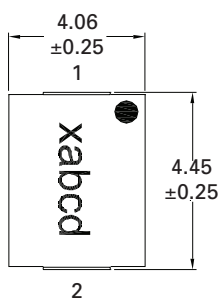
- MPI4040R = product code and size
- X = version indicator
- XXX = inductance value in µH, R= decimal point - If no R is present, then last character equals the number of zeros
- -R suffix = RoHS compliant

† Transient pulse not to exceed 1 millisecond.

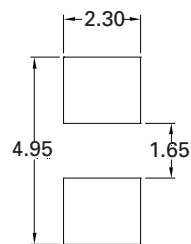
†† Maximum operating frequency less than 10MHz, consult factory for application specific values.

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

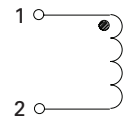
Dimensions (mm)



Recommended Pad Layout



Schematic



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

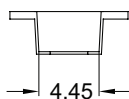
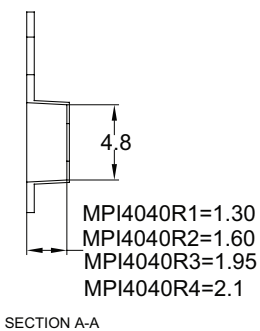
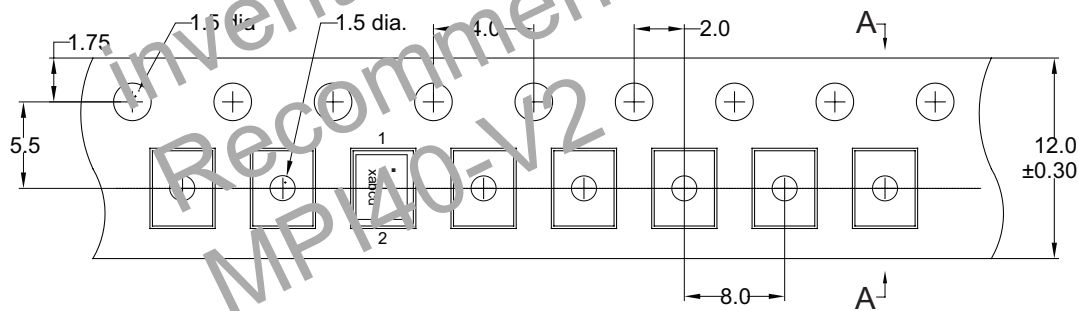
Part marking: xabcd  
 x = height: 1 = R1 (1.2mm), 2 = R2 (1.5mm), 3 = R3 (1.85mm), 4 = R4 (2.0mm)  
 a = Inductance value per the Part marking designator letter code in Product specification table.  
 b = Bi-weekly date code  
 c = Last digit of year manufactured  
 d = Revision level

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)

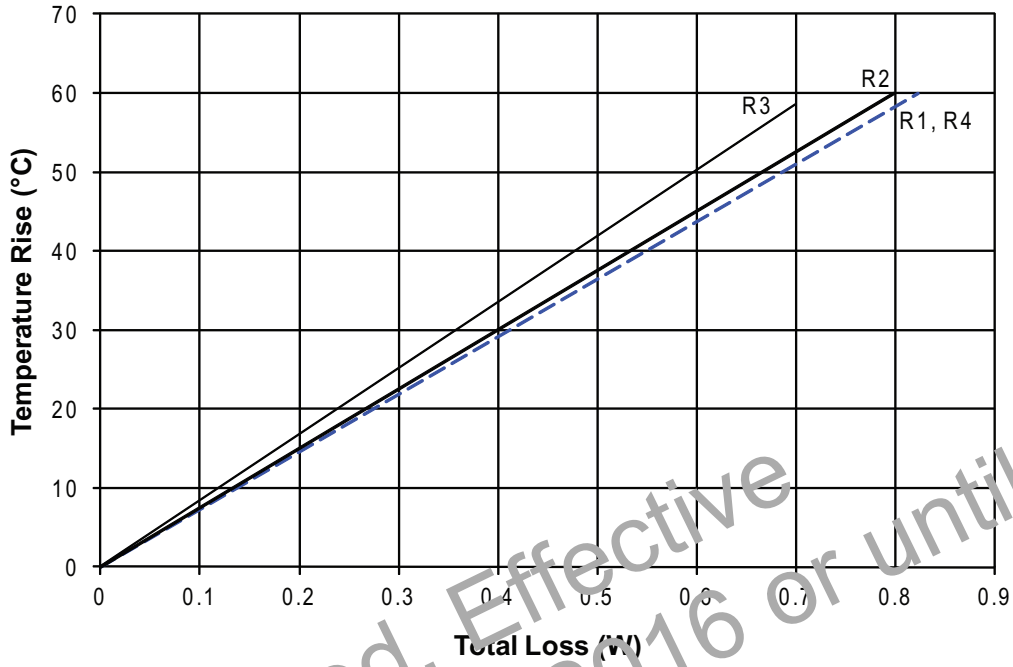
Supplied in tape and reel packaging:

- 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

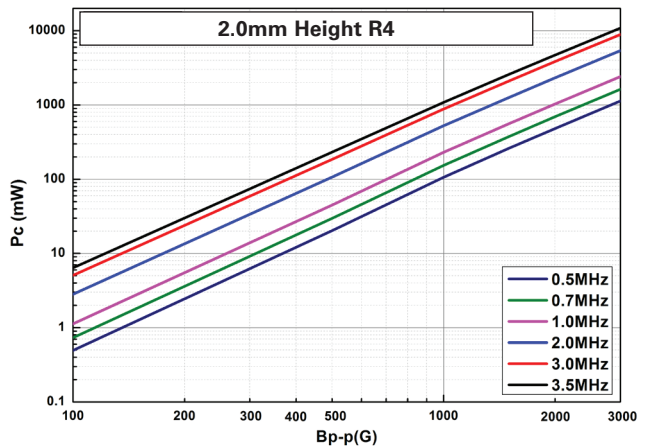
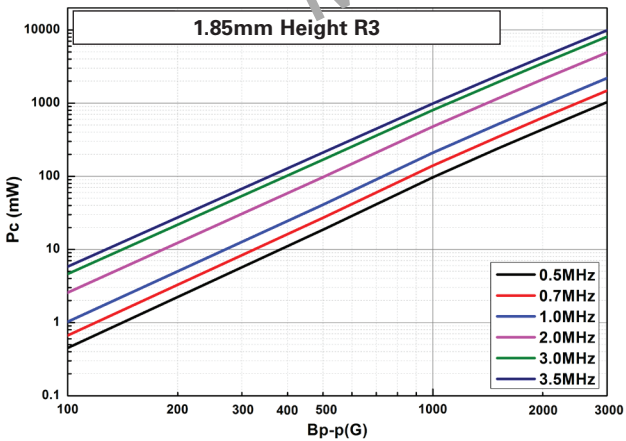
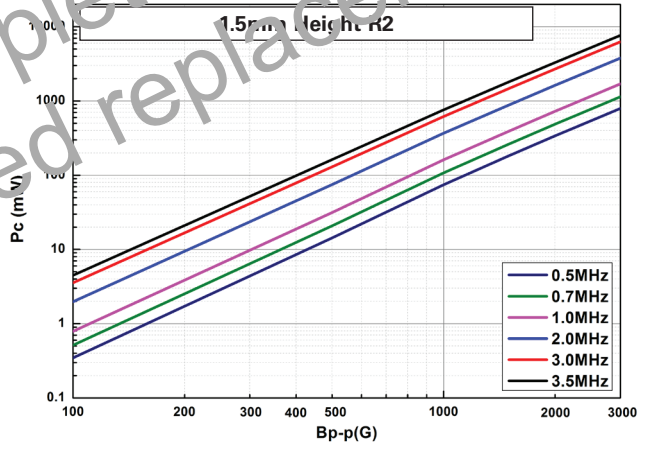
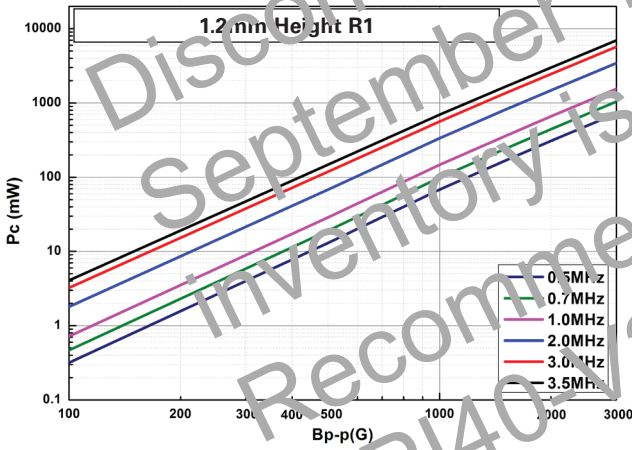


User Direction of feed →

Temperature rise vs. total loss

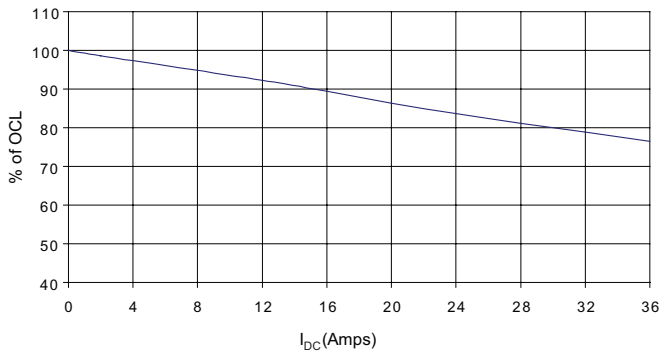


Core loss

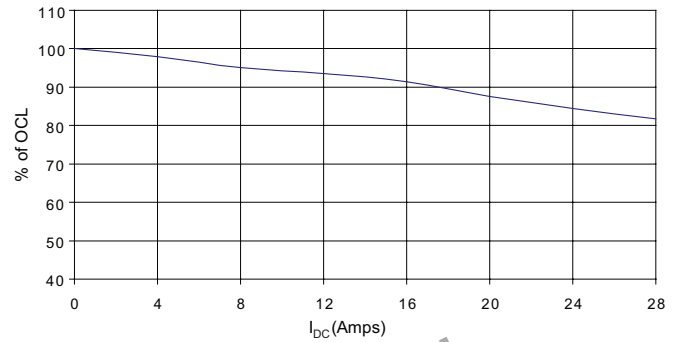


1.2mm Height R1 inductance characteristics — % of OCL vs.  $I_{DC}$

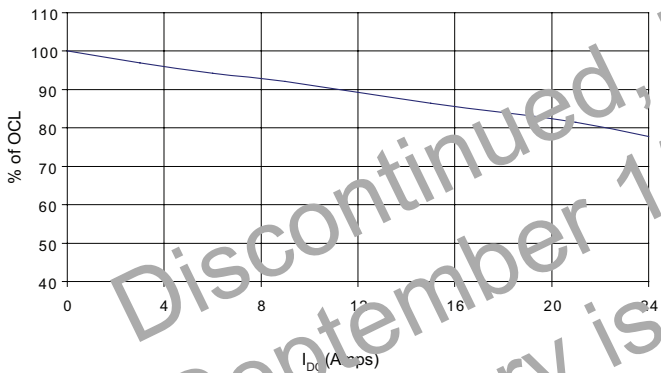
MPI4040R1-R10-R



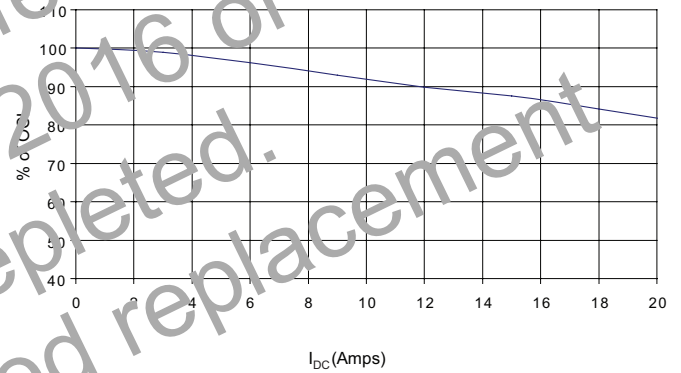
MPI4040R1-R15-R



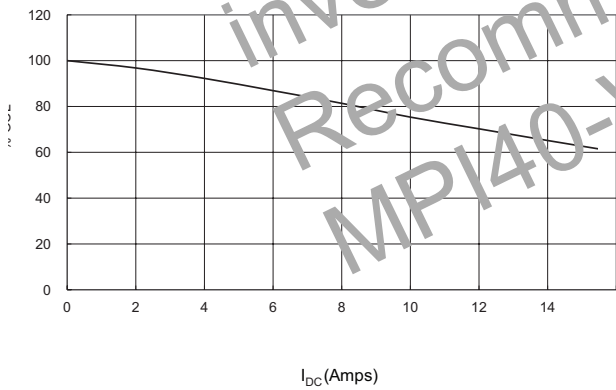
MPI4040R1-R22-R



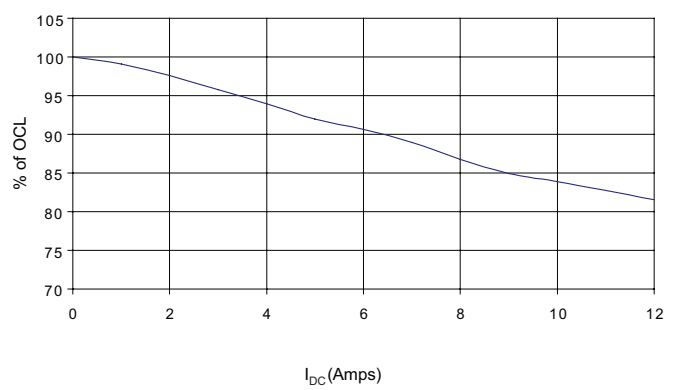
MPI4040R1-R33-R



MPI4040R1-R44-F

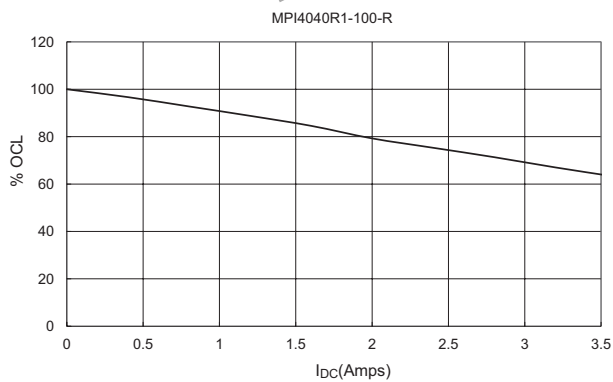
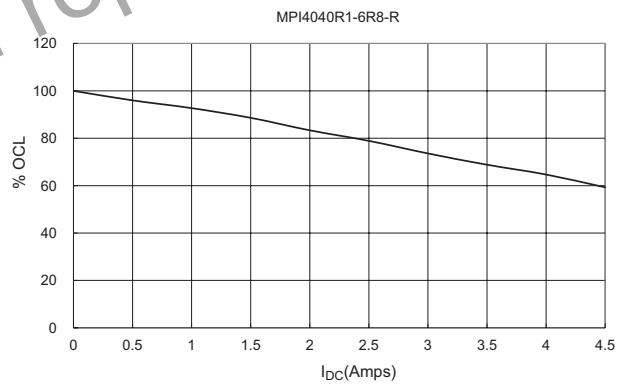
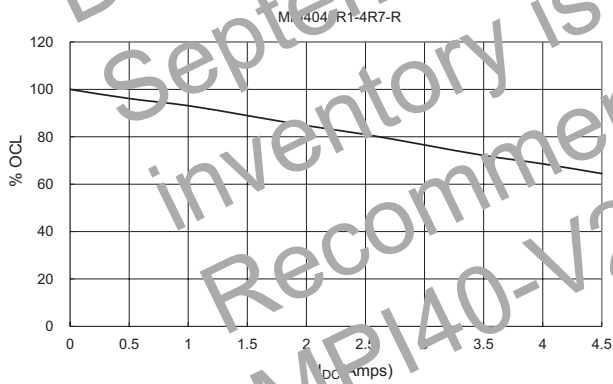
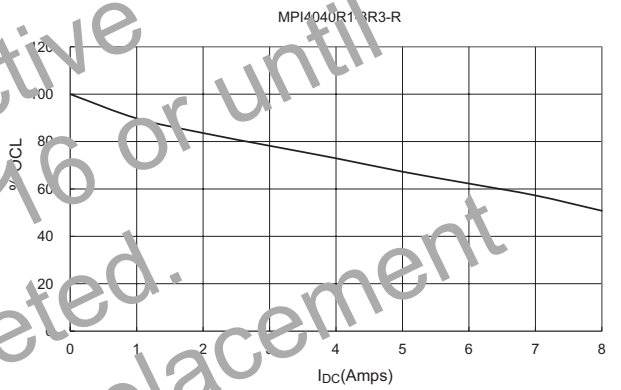
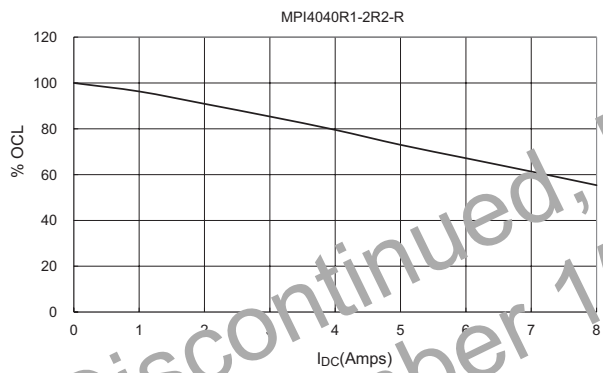
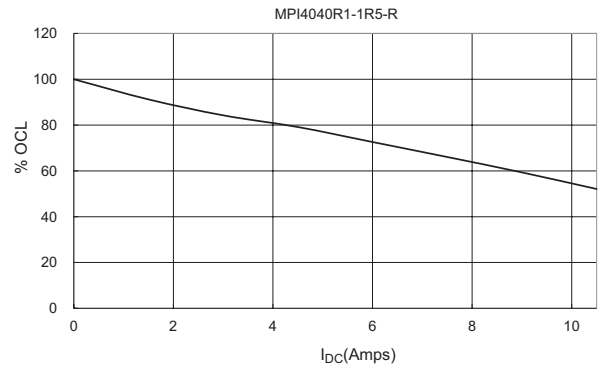
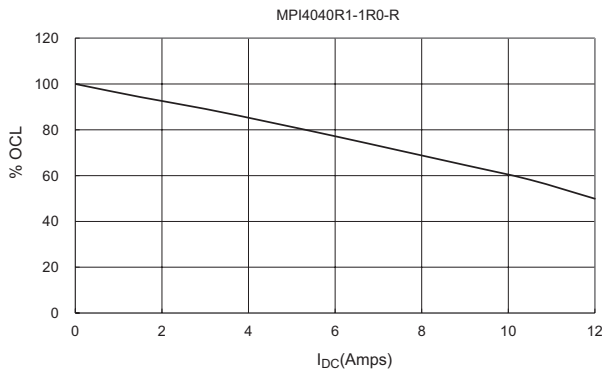


MPI4040R1-R68-R



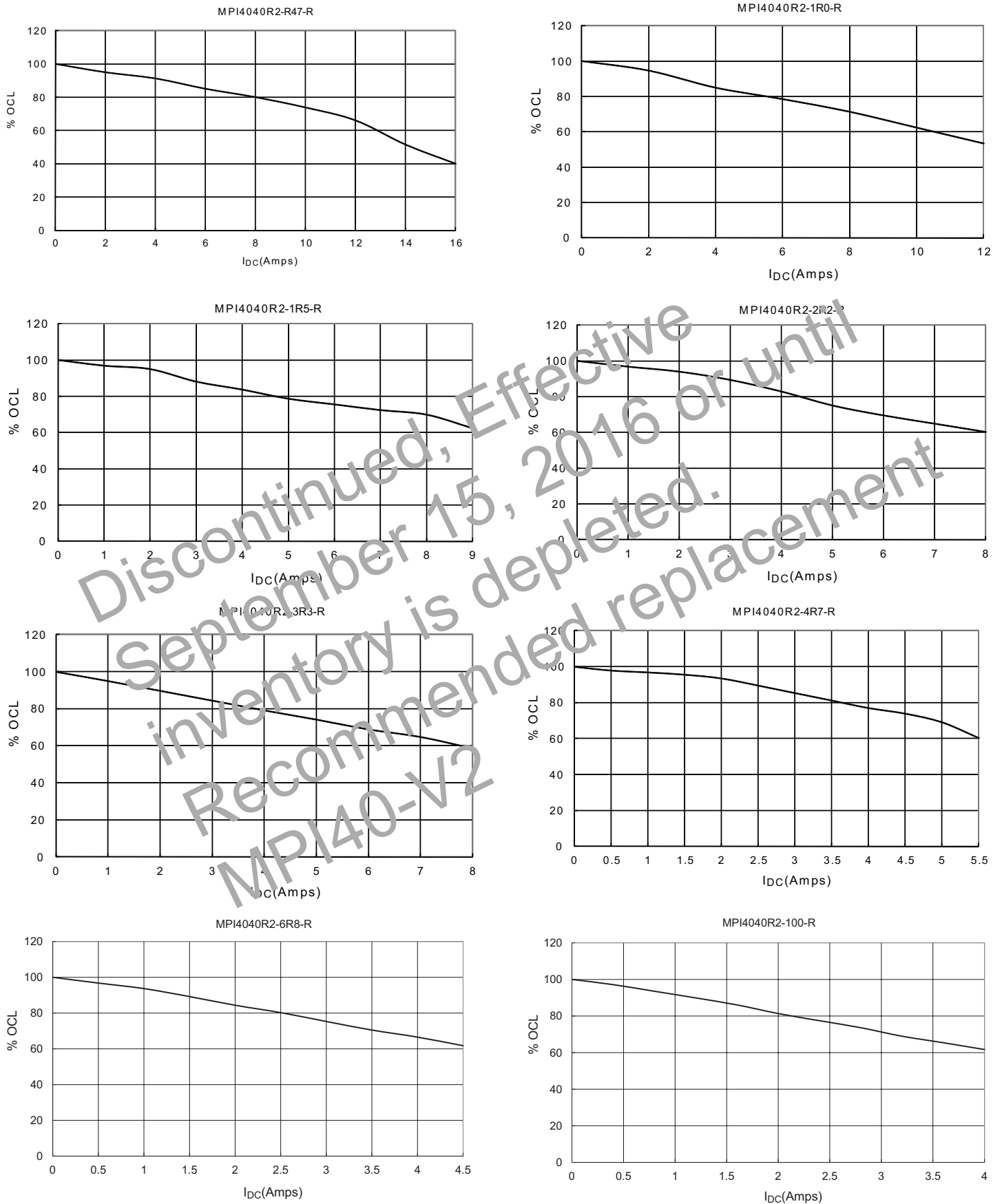
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

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



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

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

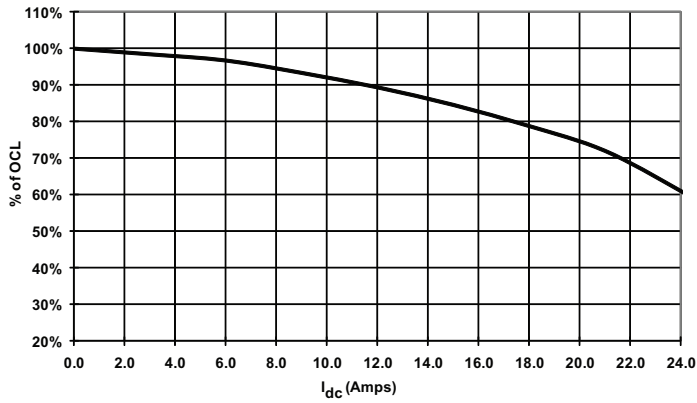


Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

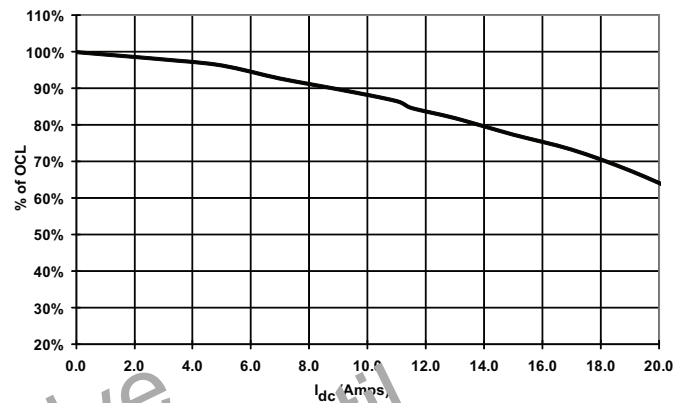


1.85mm Height R3 inductance characteristics — % of OCL vs.  $I_{DC}$

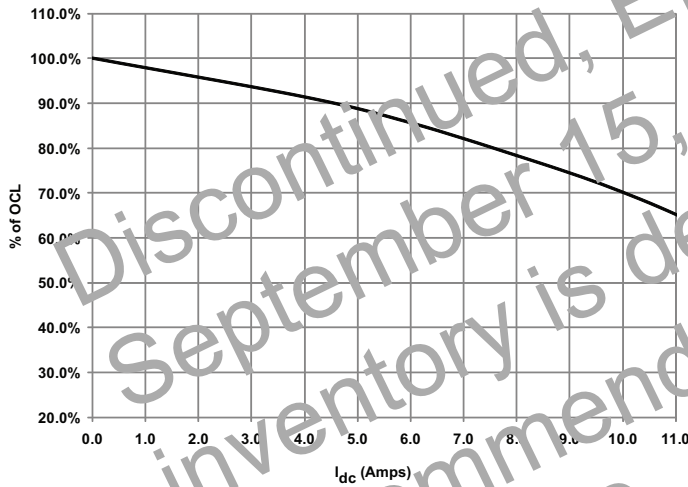
MPI4040R3-R22-R



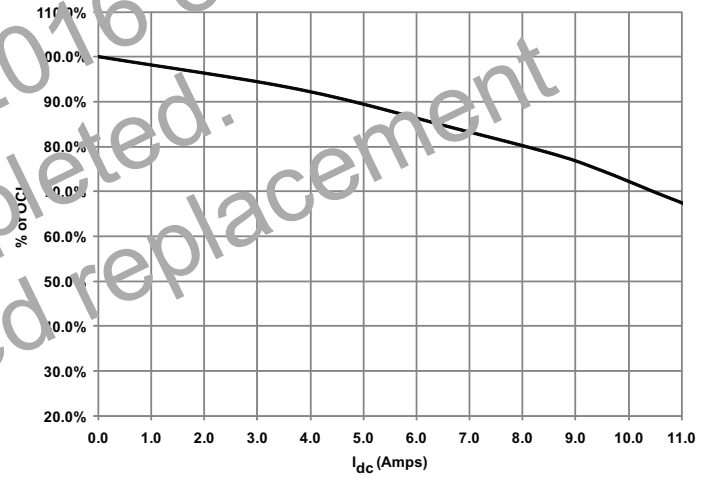
MPI4040R3-R47-R



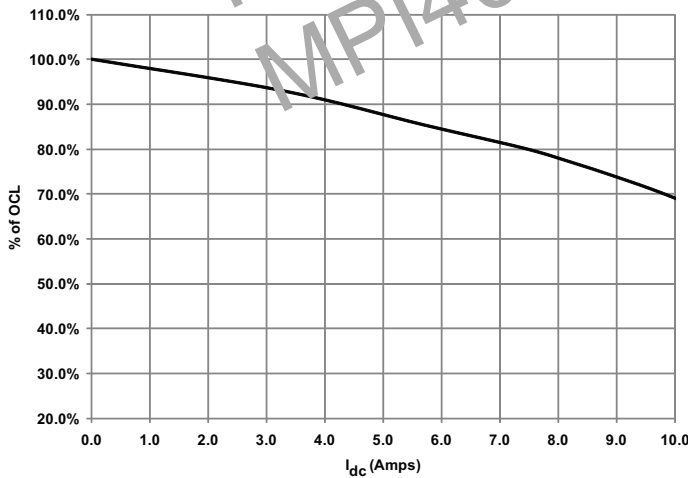
MPI4040R3-1R2-R



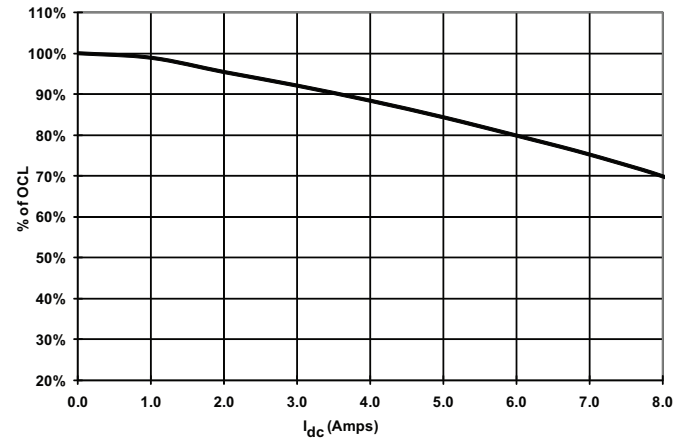
MPI4040R3-1R5-R



MPI4040R3-2R2-F



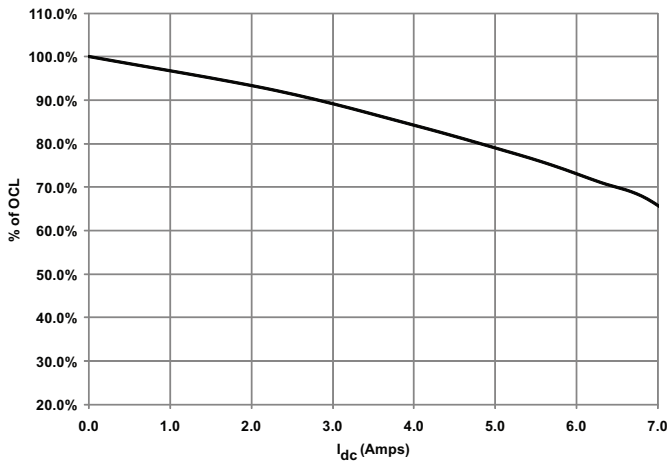
MPI4040R3-3R3-R



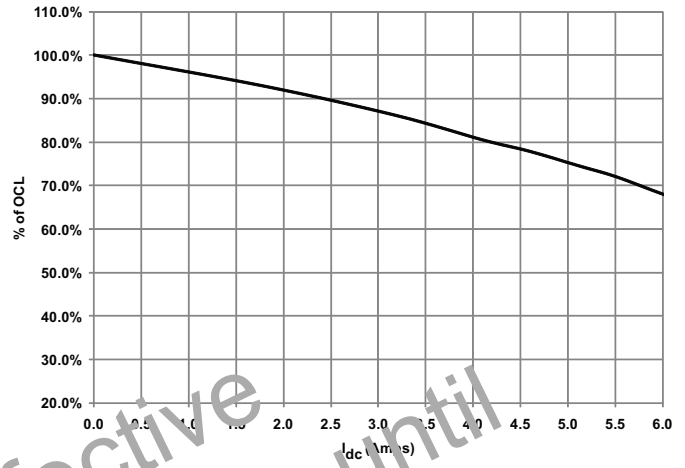
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

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

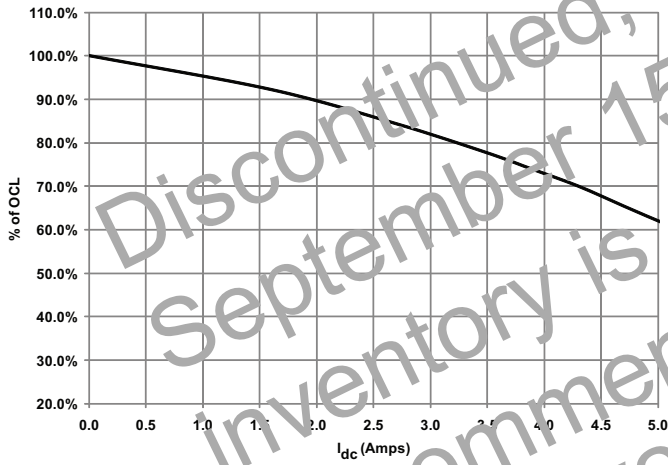
MPI4040R3-4R7-R



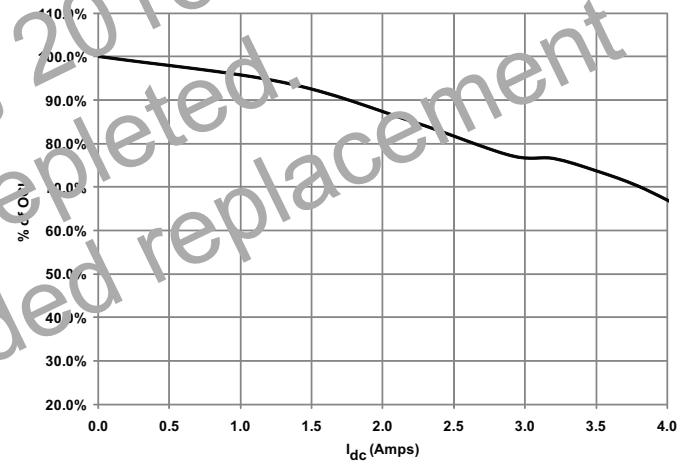
MPI4040R3-6R8-R



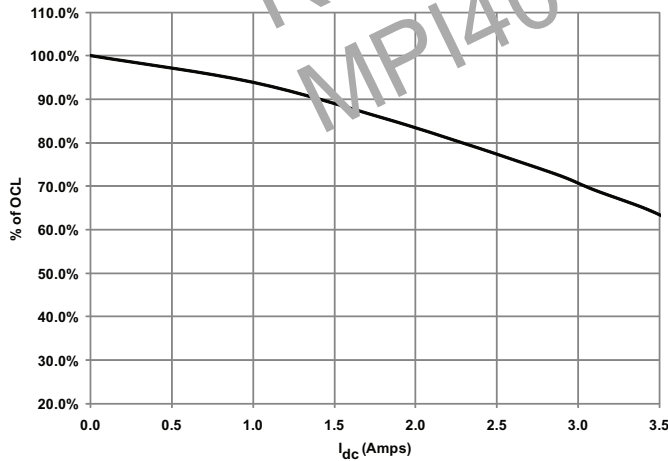
MPI4040R3-100-R



MPI4040R3-150-R

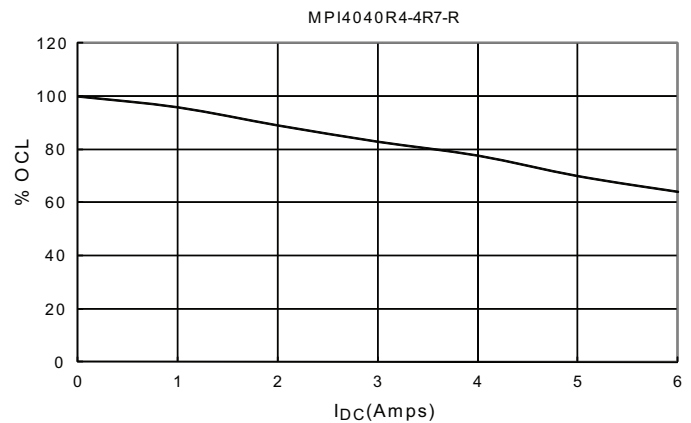
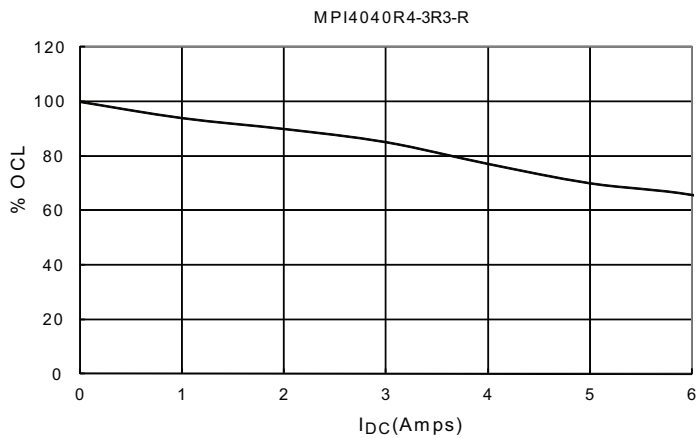
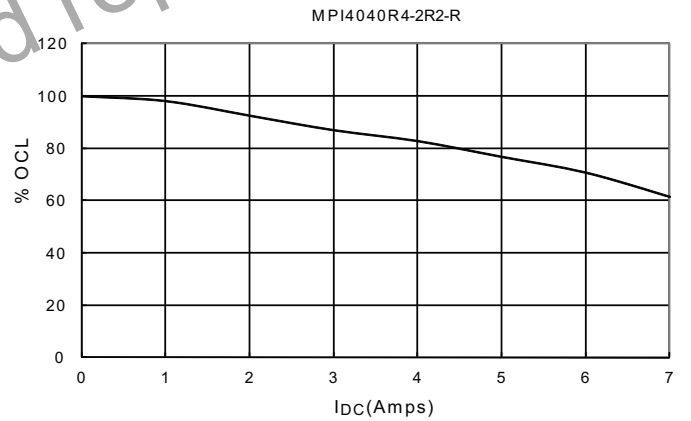
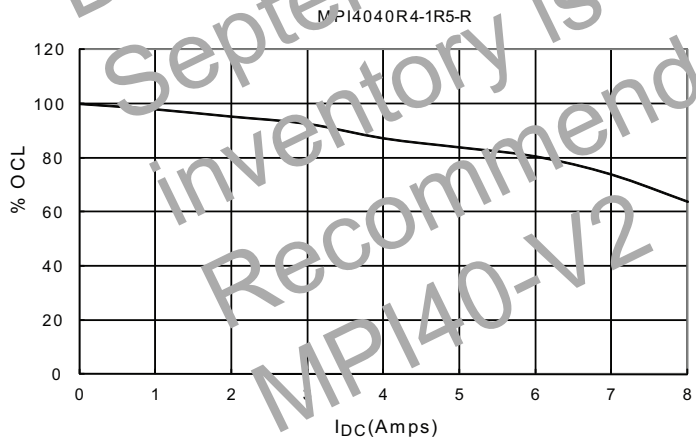
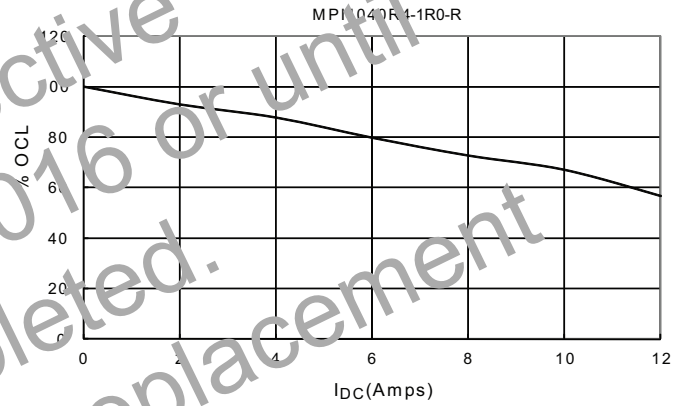
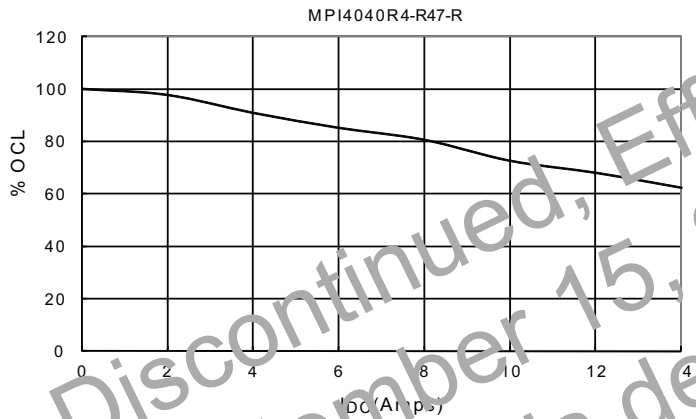
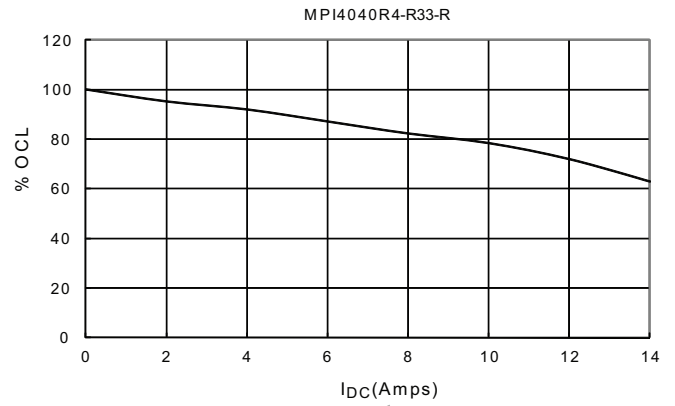
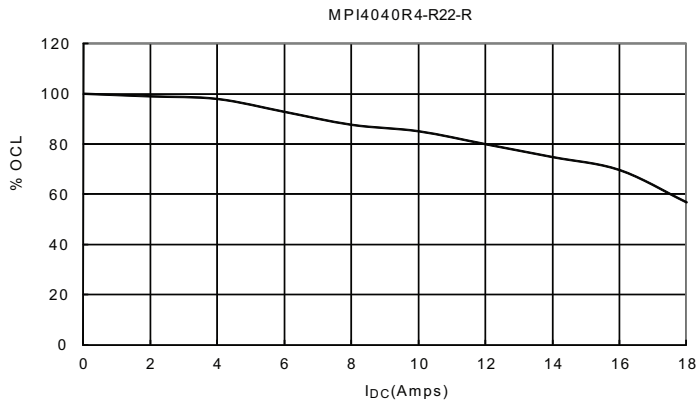


MPI4040F3-220-R



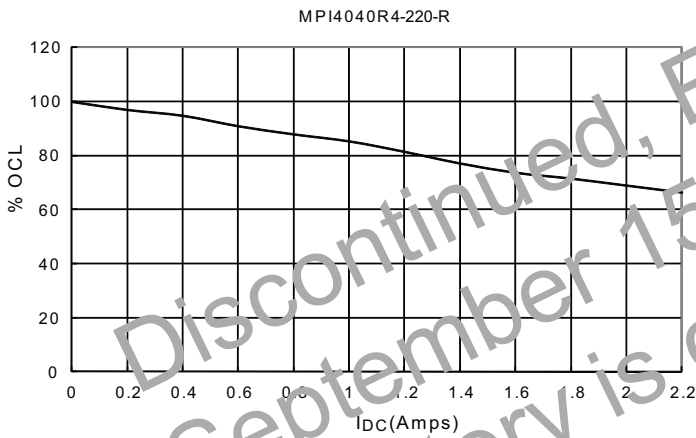
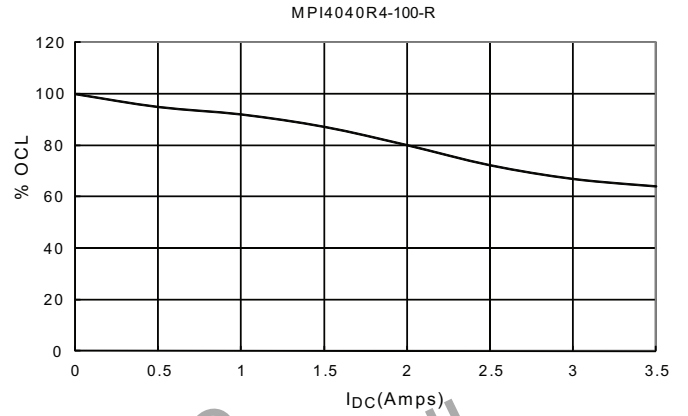
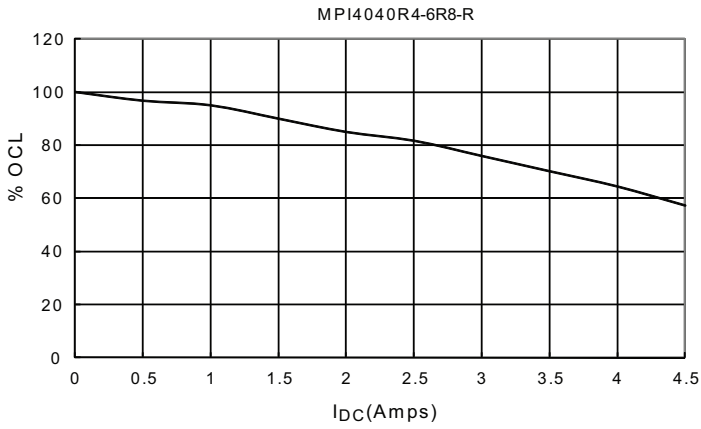
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

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



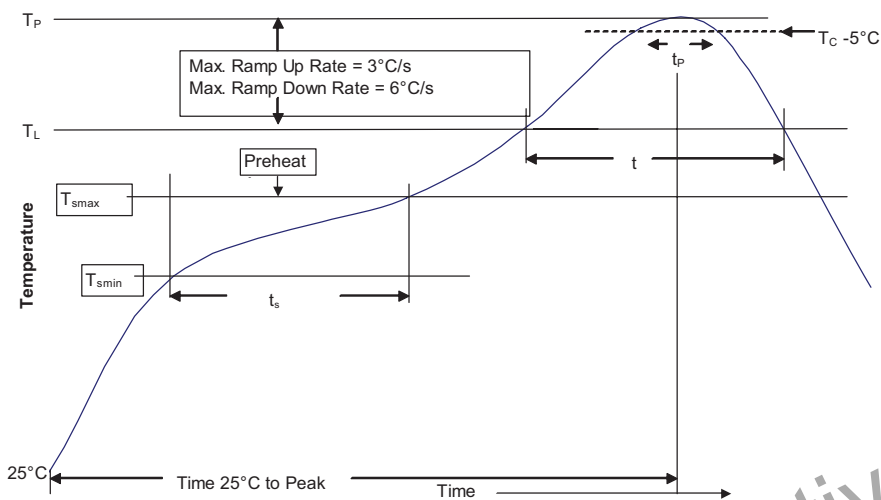
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

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



Discontinued, Effective  
September 15, 2016 or until  
inventory is depleted.  
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.

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

Life Support Policy: Eaton does not authorize the use of any of its products for use in life support devices or systems without the express written approval of an officer of the Company. Life support systems are devices which support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

Eaton reserves the right, without notice, to change design or construction of any products and to discontinue or limit distribution of any products. Eaton also reserves the right to change or update, without notice, any technical information contained in this bulletin.

**Eaton**  
**Electronics Division**  
 1000 Eaton Boulevard  
 Cleveland, OH 44122  
 United States  
 www.eaton.com/elx

© 2015 Eaton  
 All Rights Reserved  
 Printed in USA  
 Publication No. 4086 BU-SB14232  
 October 2015

Eaton is a registered trademark.

All other trademarks are property of their respective owners.