

## Product Specifications

| Part Number <sup>5</sup>      | OCL <sup>1</sup><br>± 20% (μH) | Part marking<br>designator | I <sub>DC</sub> <sup>2</sup><br>(amps) | I <sub>sat</sub> <sup>3</sup><br>@ 25°C (amps) | DCR (mΩ)<br>±20% @ 20°C | K-factor <sup>4</sup> |
|-------------------------------|--------------------------------|----------------------------|----------------------------------------|------------------------------------------------|-------------------------|-----------------------|
| <b>R1 — 1.2mm Height</b>      |                                |                            |                                        |                                                |                         |                       |
| MPI4040R1-R10-R               | 0.10                           | A                          | 8.0                                    | 32 <sup>†</sup>                                | 8.5                     | 1401                  |
| MPI4040R1-R15-R               | 0.15                           | B                          | 7.0                                    | 26 <sup>†</sup>                                | 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 <sup>††</sup> | 6.8                            | L                          | 1.5                                    | 3.2                                            | 250                     | 344                   |
| MPI4040R1-100-R <sup>††</sup> | 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 <sup>††</sup> | 10.0                           | H                          | 1.5                                    | 3.0                                            | 240                     | 271                   |

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

2. I<sub>DC</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 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>DC</sub> testing was performed on a 19.05mm long x 6.35mm wide x 0.070mm thick copper trace 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: MPI4040R-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><br>± 20% (μH) | Part marking<br>designator | I <sub>rms</sub> <sup>2</sup><br>(amps) | I <sub>sat</sub> <sup>3</sup><br>@ 25°C (amps) | DCR (mΩ)<br>±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                      | 930                   |
| MPI4040R4-1R5-R           | 1.5                            | E                          | 4.9                                     | 6.9                                            | 23                      | 802                   |
| MPI4040R4-2R2-R           | 2.2                            | F                          | 3.9                                     | 5.1                                            | 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: 100kHz, 0.1Vrms, 0.0Adc

2. I<sub>rms</sub>: DC current for an approximate temperature rise of 40°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 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 x 0.20mm 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).

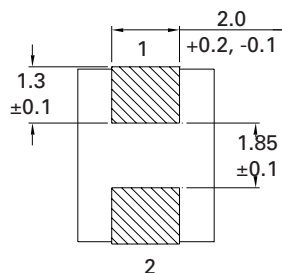
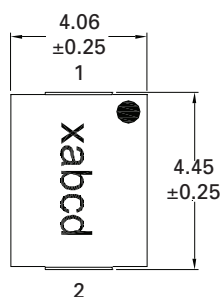
5. Part Number Definition: MPI4040RX-XXX-R

- 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

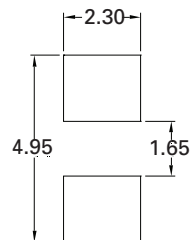
† Transient pulse not to exceed 1 millisecond.

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

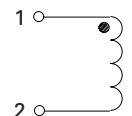
## Dimensions (mm)



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  $\pm 0.1$  millimeters unless stated otherwise  
Do not route traces or vias underneath the inductor

## Packaging information (mm)

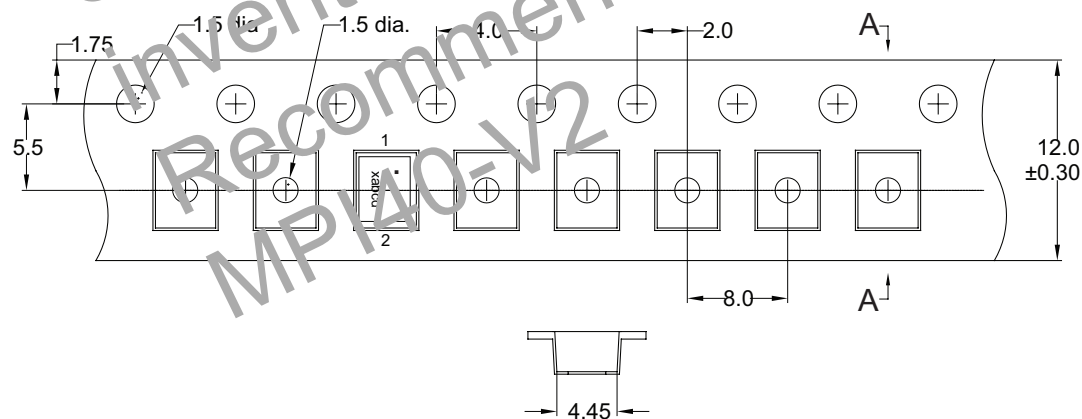
Supplied in tape and reel packaging:

MPI4040R1 = 5000 parts per 13" diameter reel

MPI4040R2 = 4500 parts per 13" diameter reel

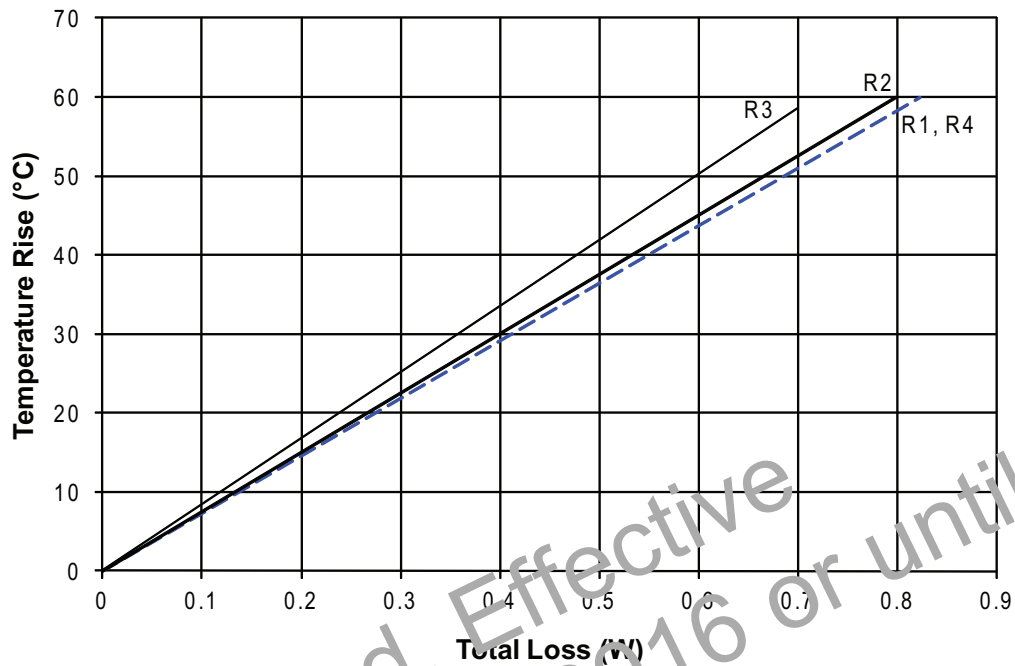
MPI4040R3 = 3500 parts per 13" diameter reel

MPI4040R4 = 3000 parts per 13" diameter reel

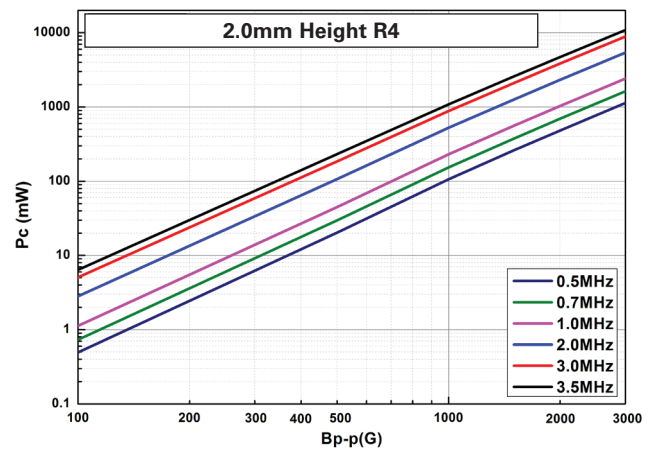
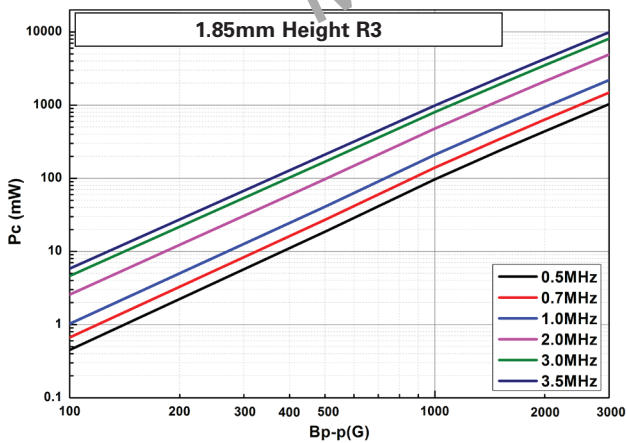
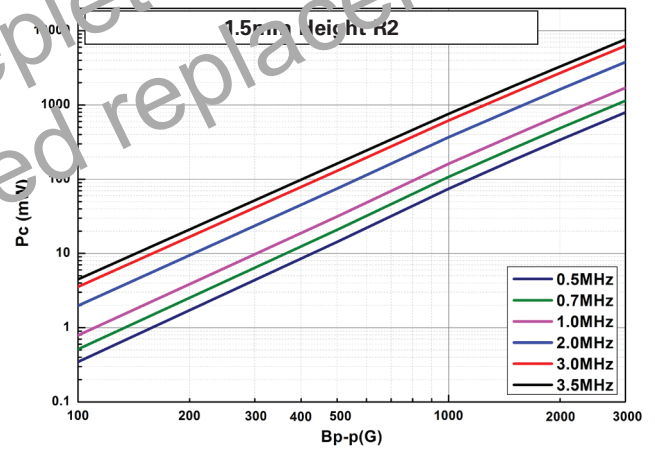
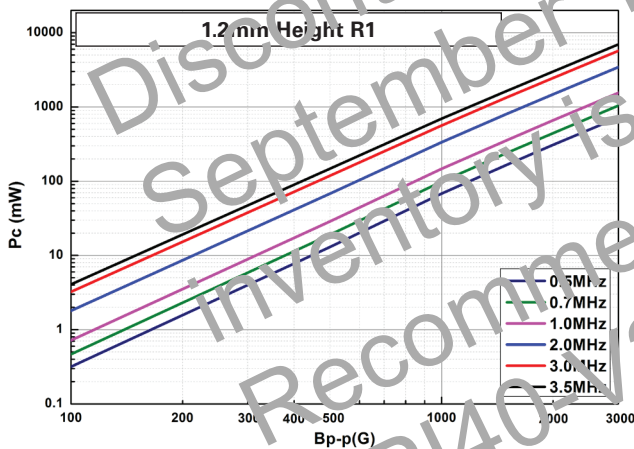


SECTION A-A

### Temperature rise vs. total loss

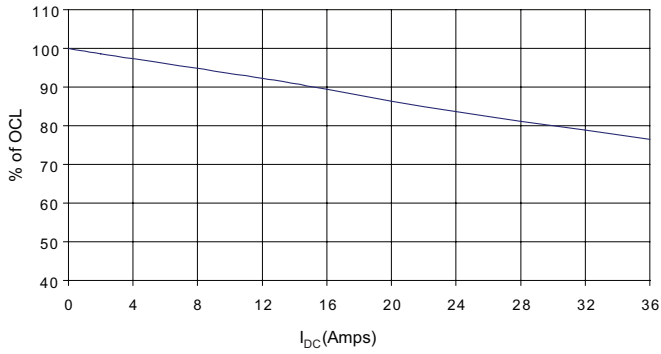


### Core loss

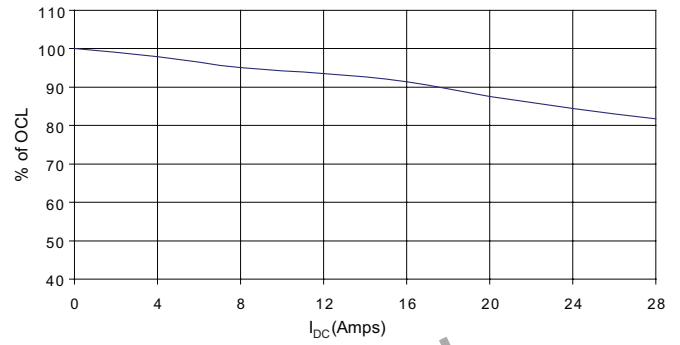


1.2mm Height R1 inductance characteristics — % of OCL vs.  $I_{DC}$

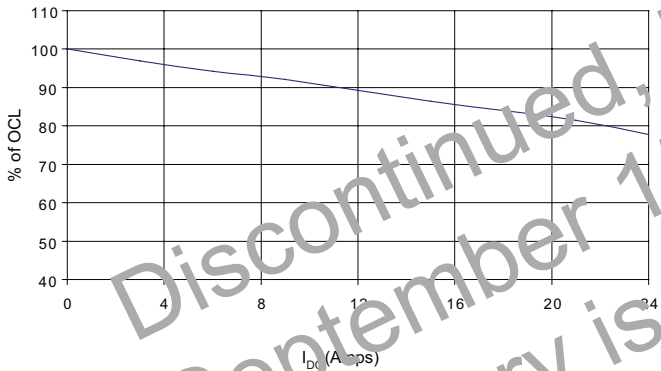
MPI4040R1-R10-R



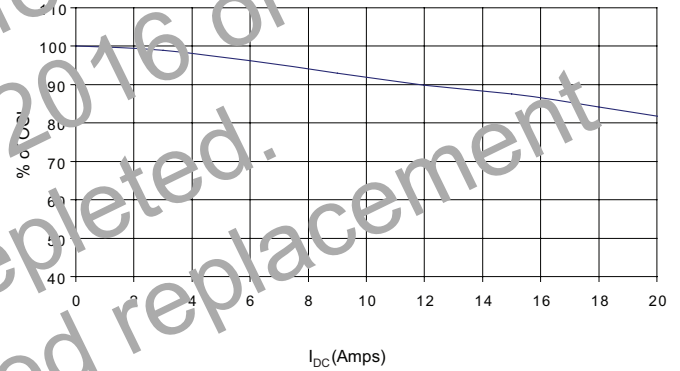
MPI4040R1-R15-R



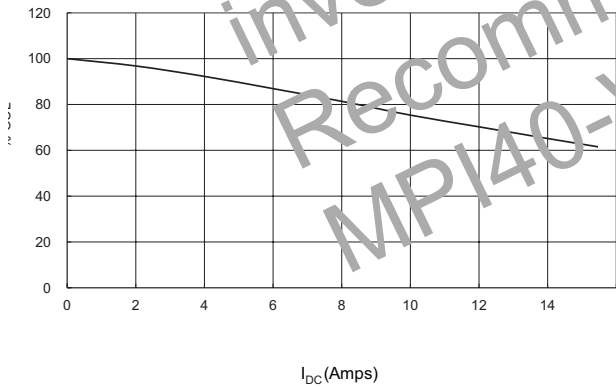
MPI4040R1-R22-R



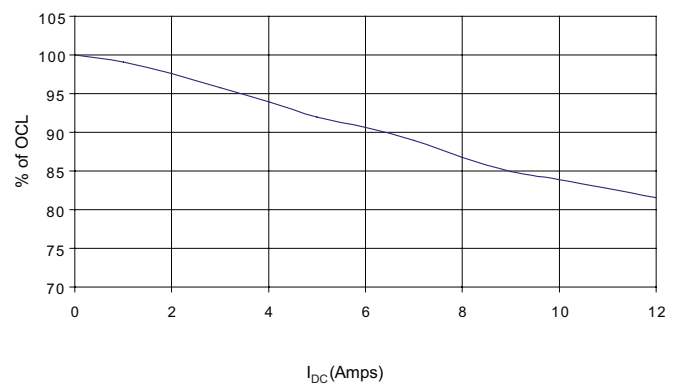
MPI4040R1-R33-R



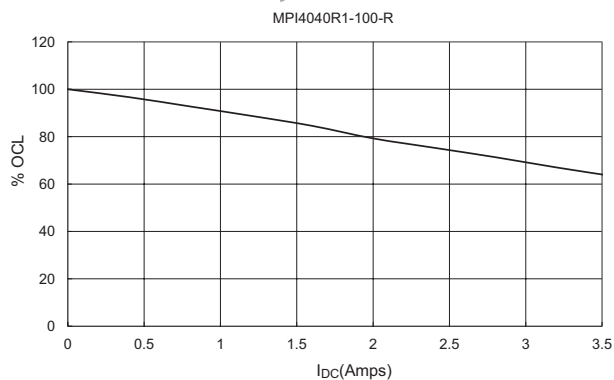
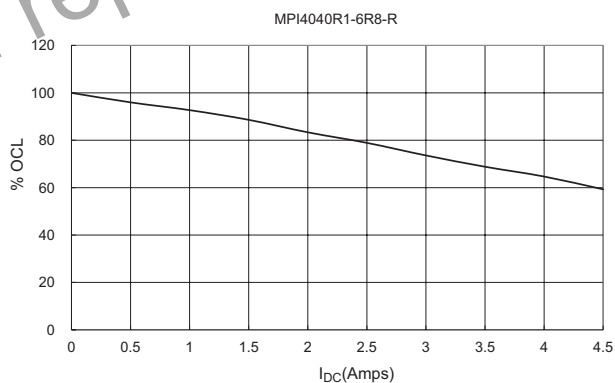
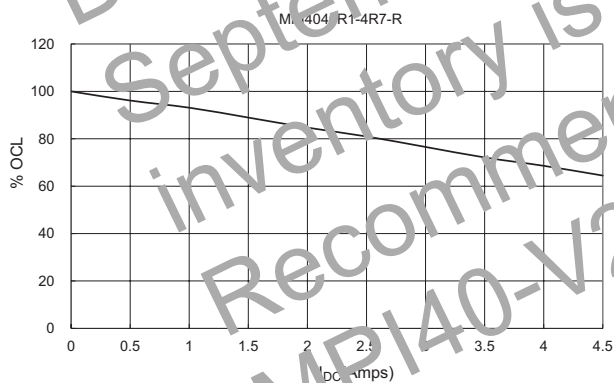
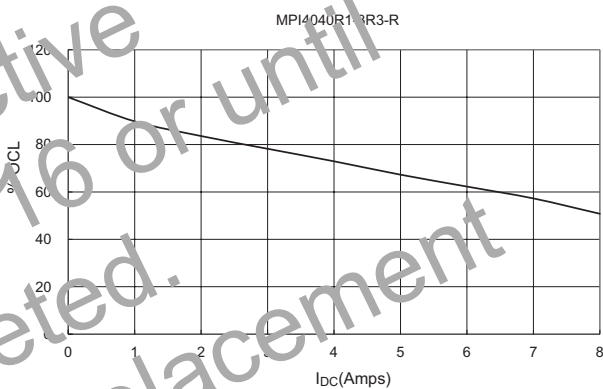
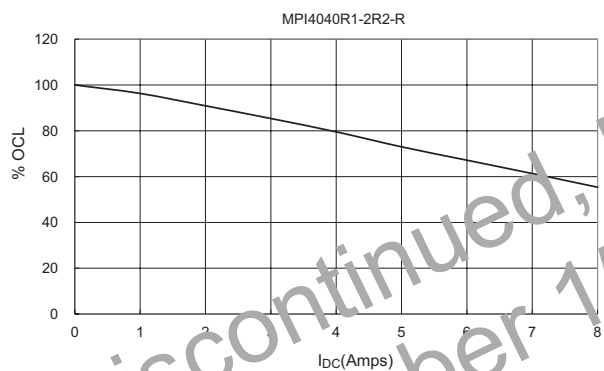
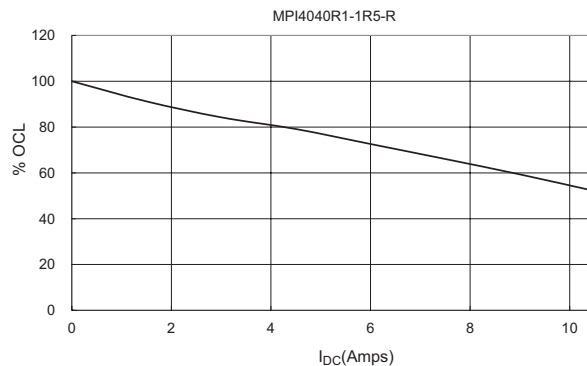
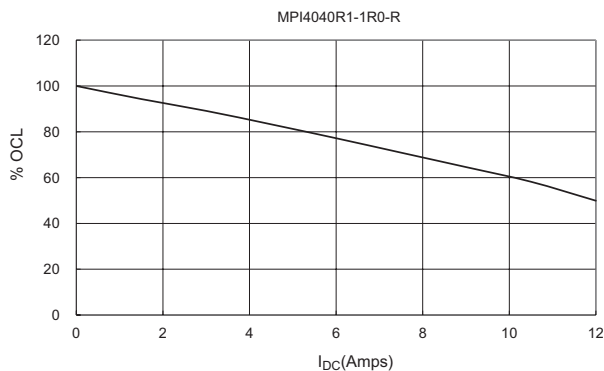
MPI4040R1-R44-R



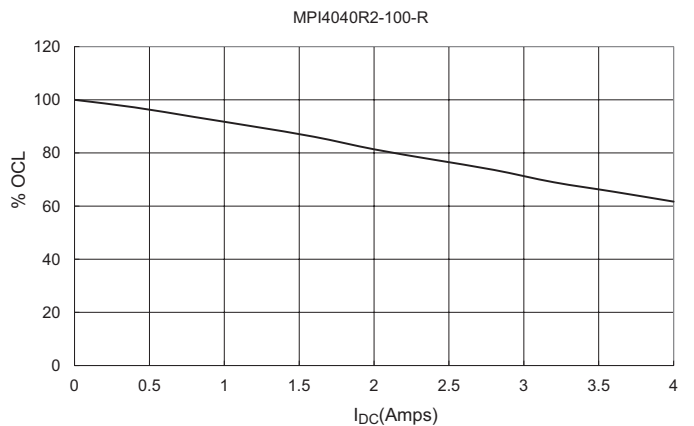
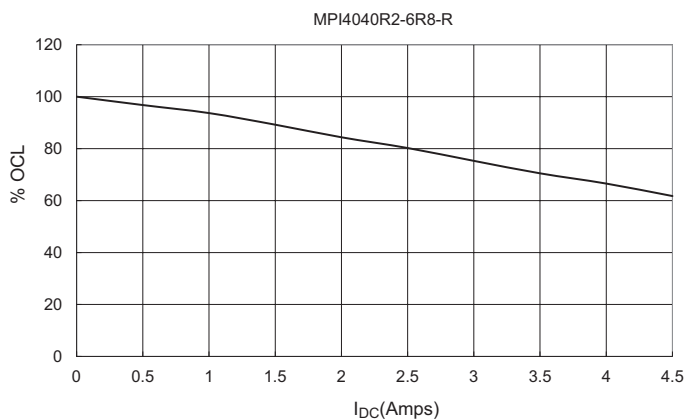
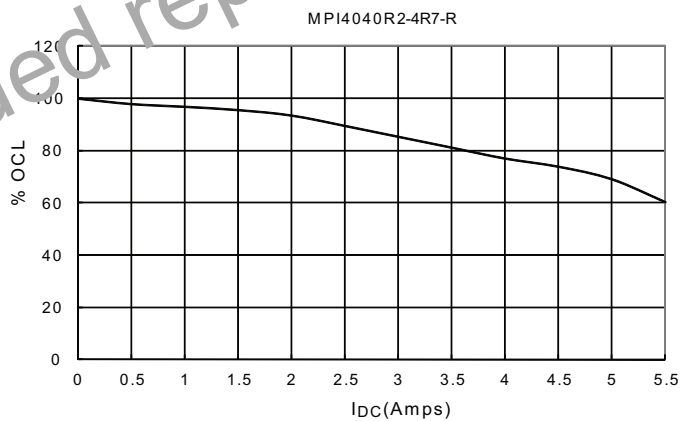
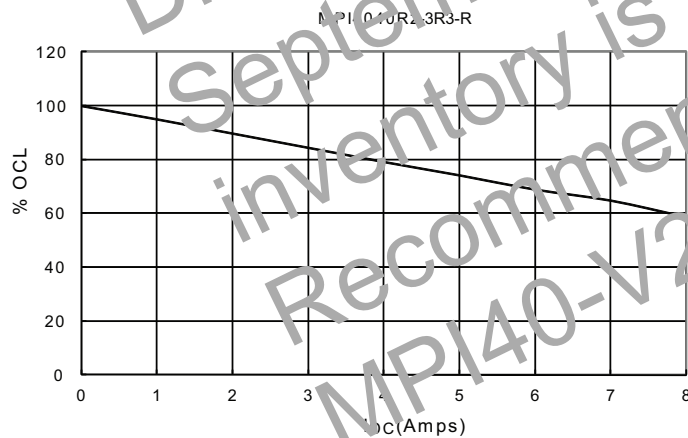
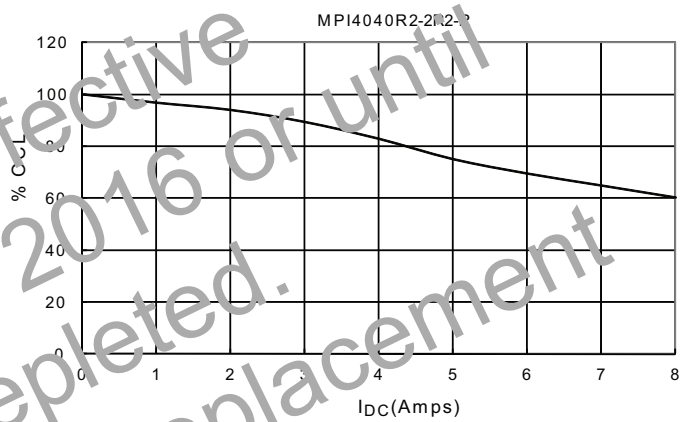
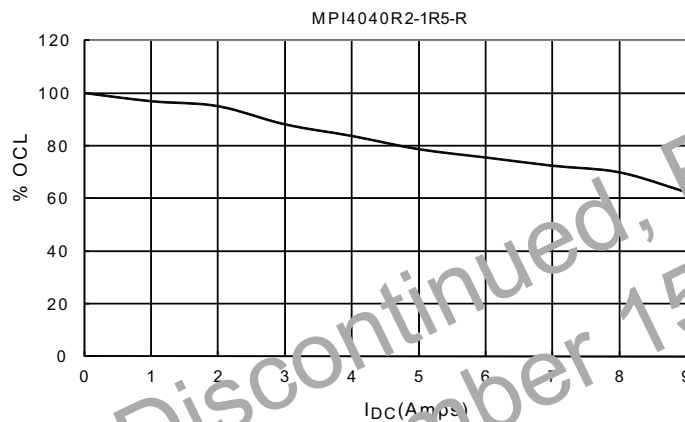
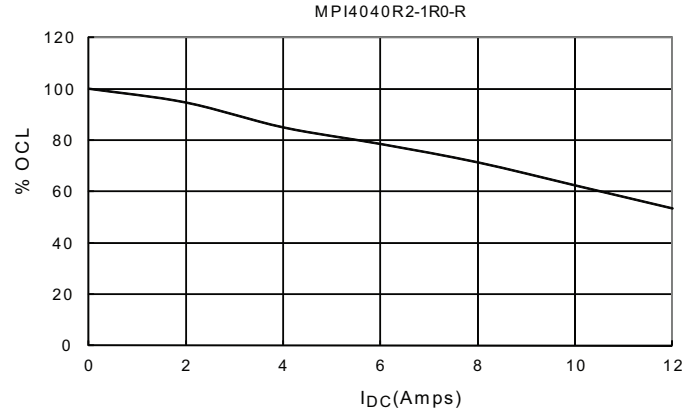
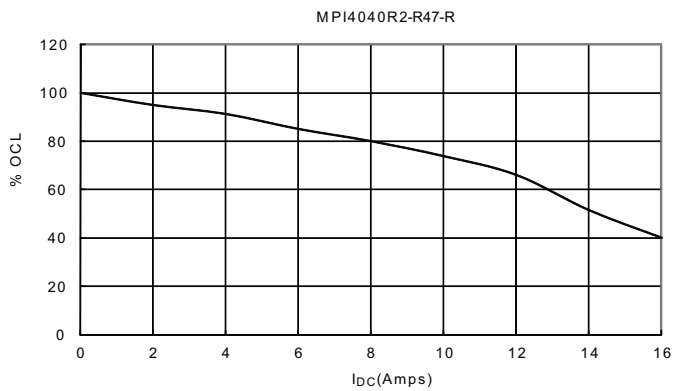
MPI4040R1-R68-R



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

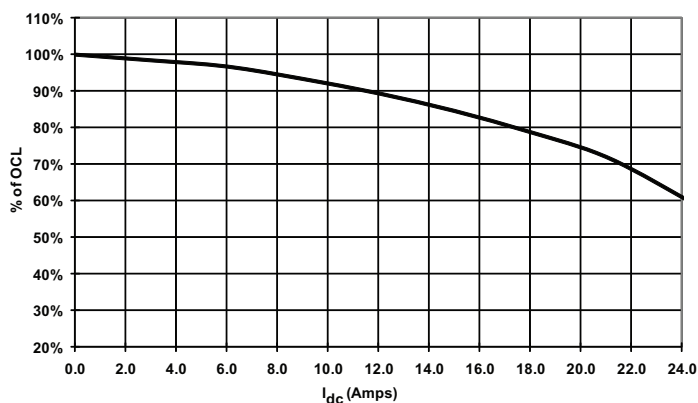


1.5mm Height R2 inductance characteristics — % of OCL vs.  $I_{DC}$

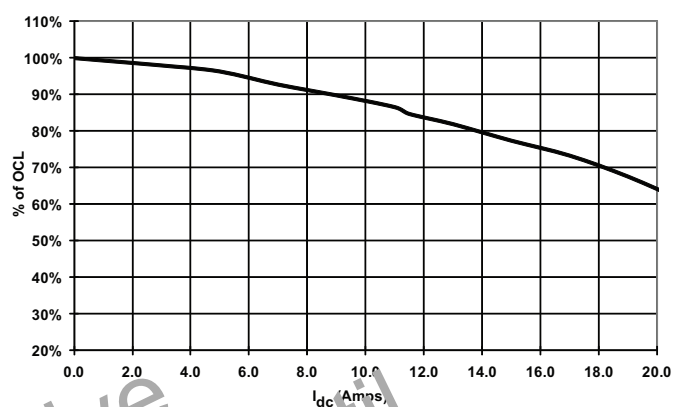


1.85mm Height R3 inductance characteristics — % of OCL vs.  $I_{dc}$

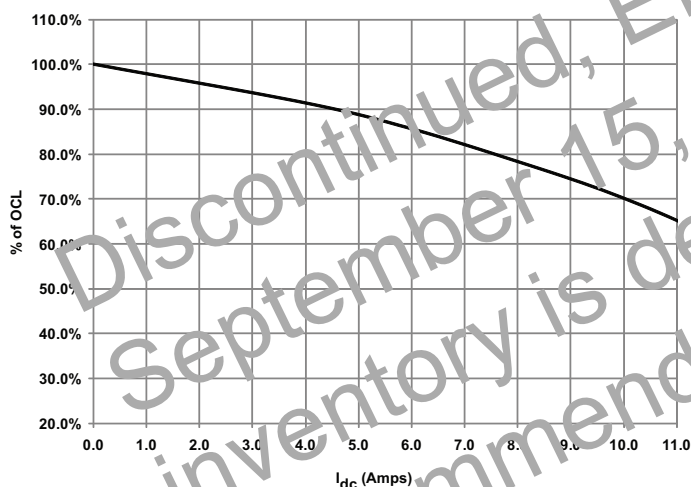
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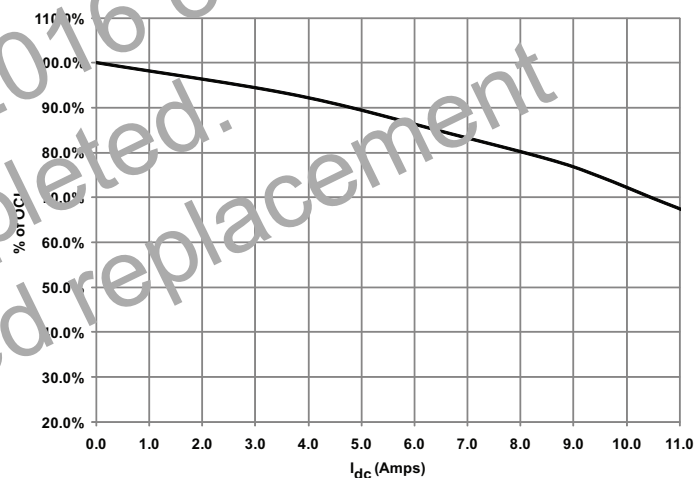
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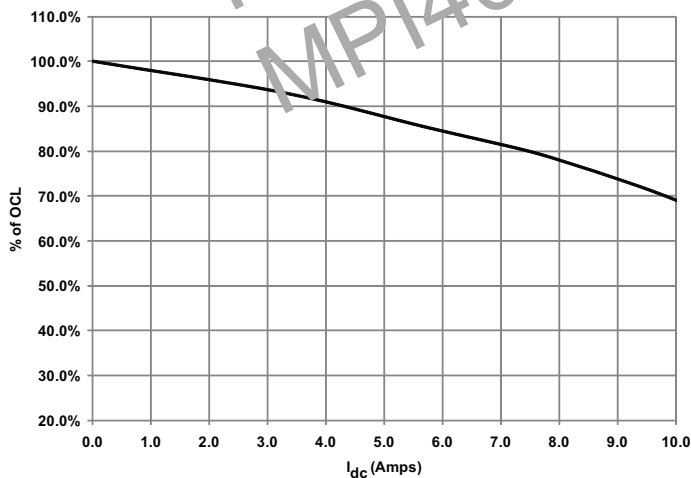
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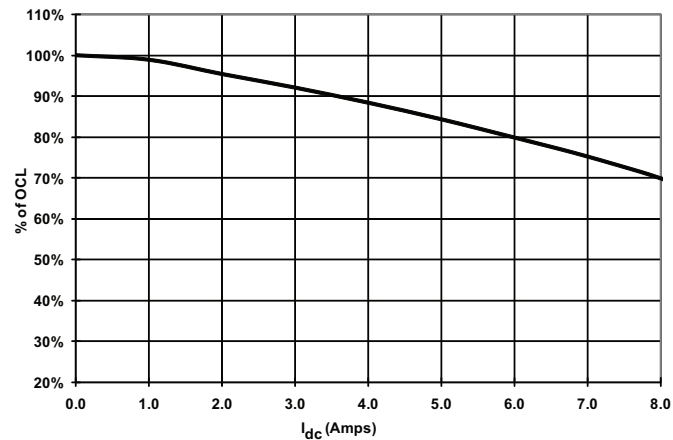
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MPI4040R3-2R2-F

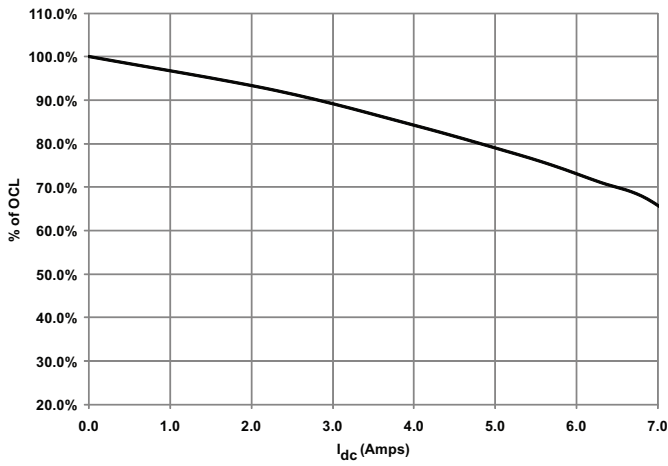


MPI4040R3-3R3-R

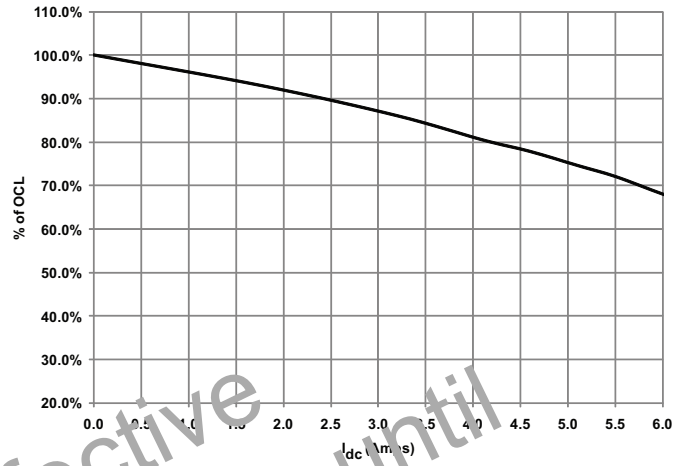


1.85mm Height R3 inductance characteristics — % of OCL vs.  $I_{dc}$

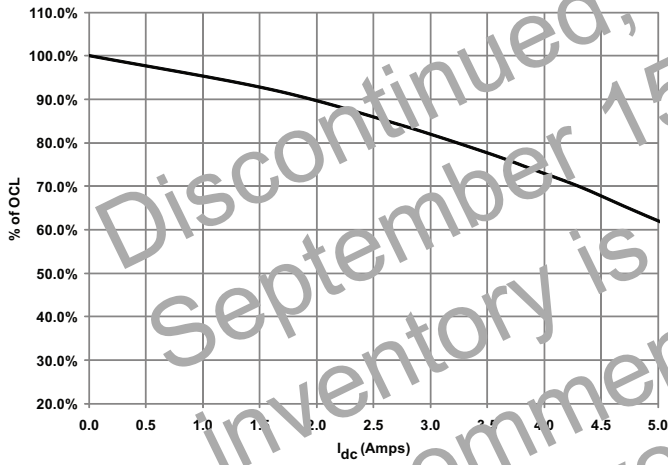
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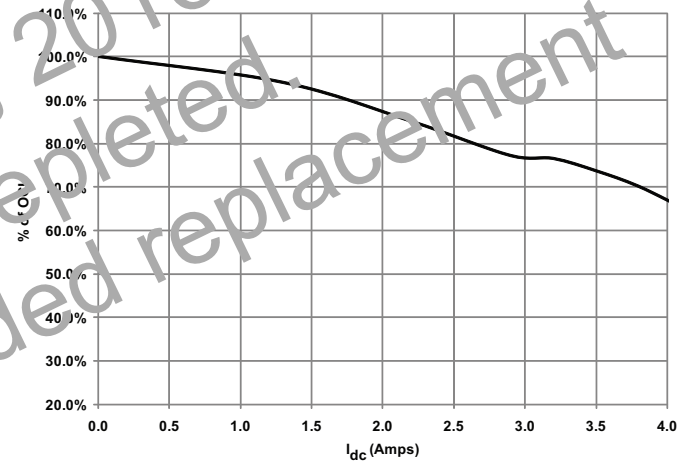
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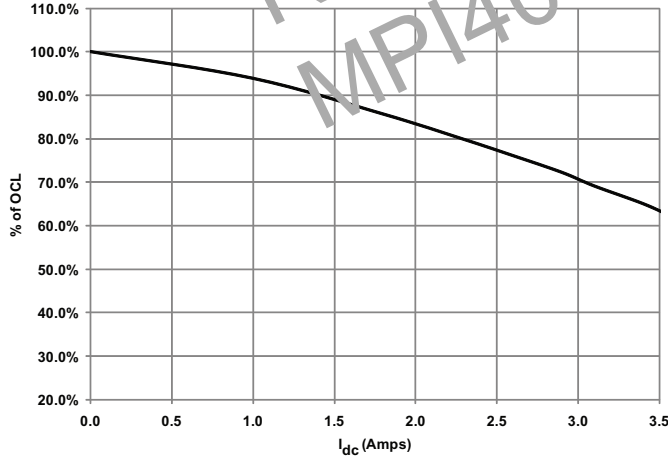
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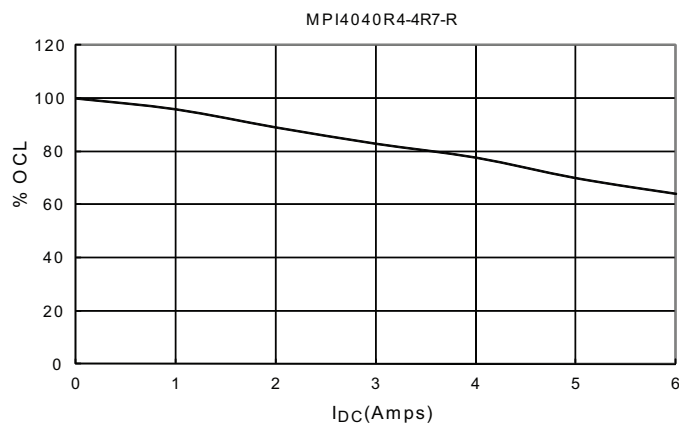
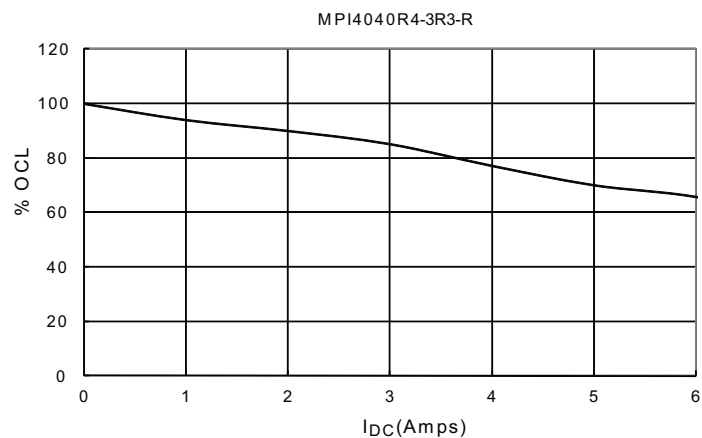
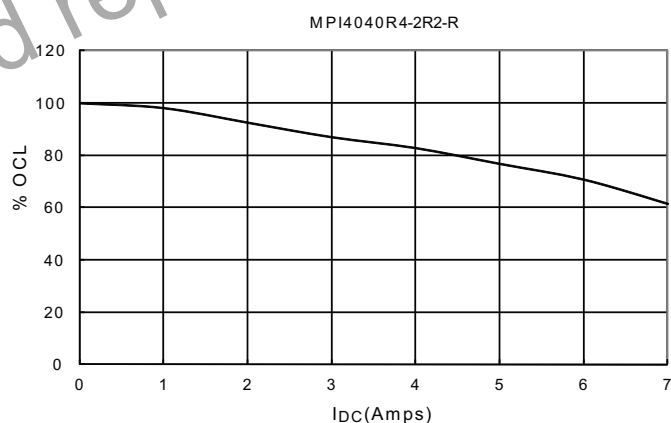
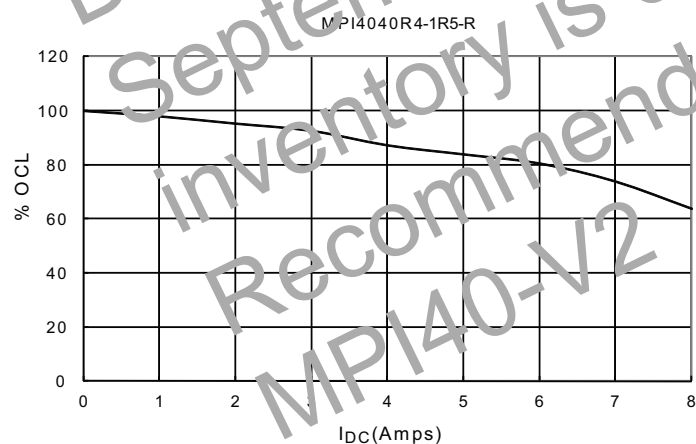
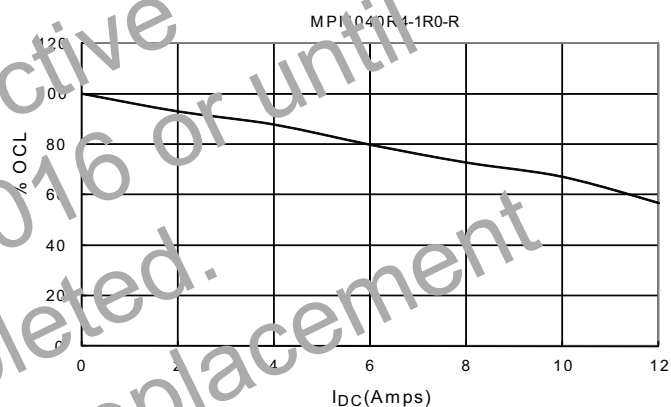
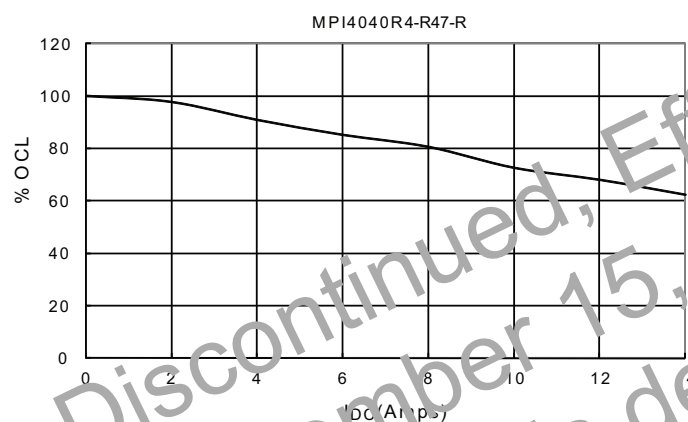
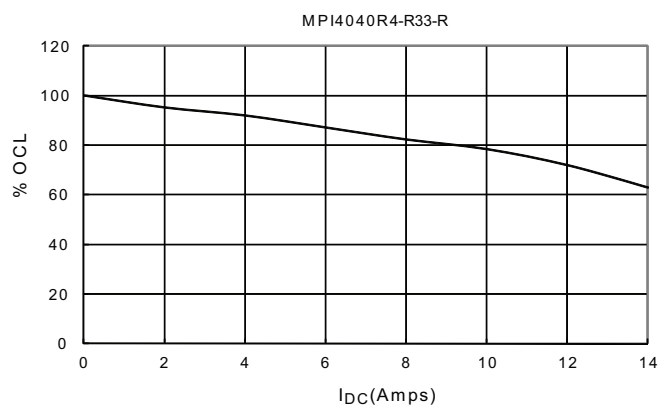
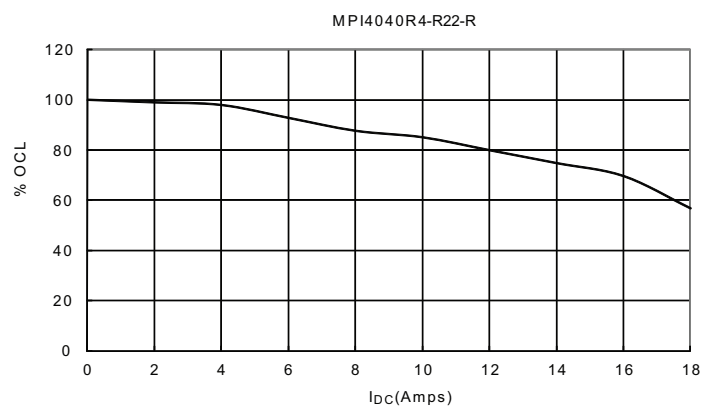
MPI4040R3-150-R



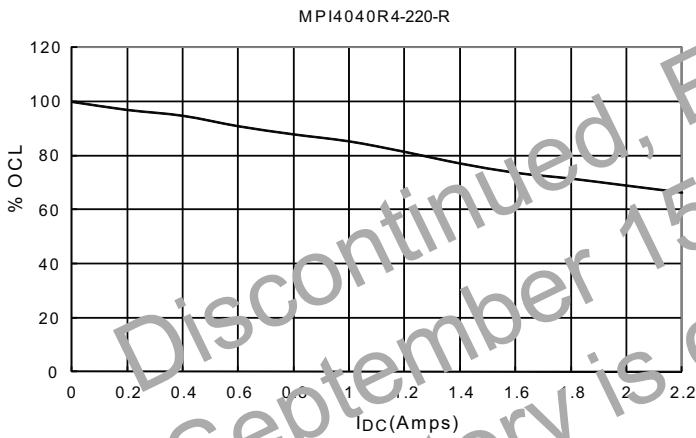
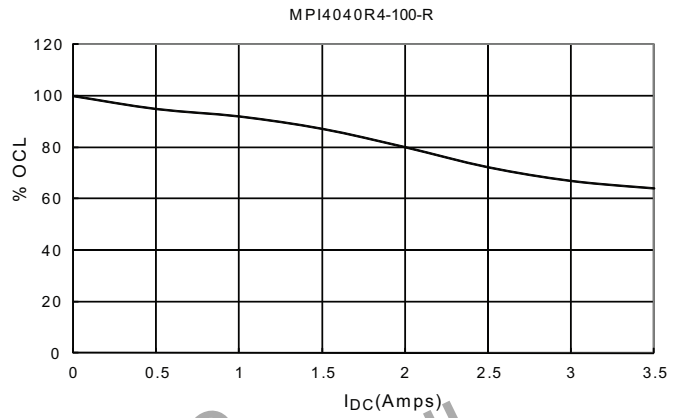
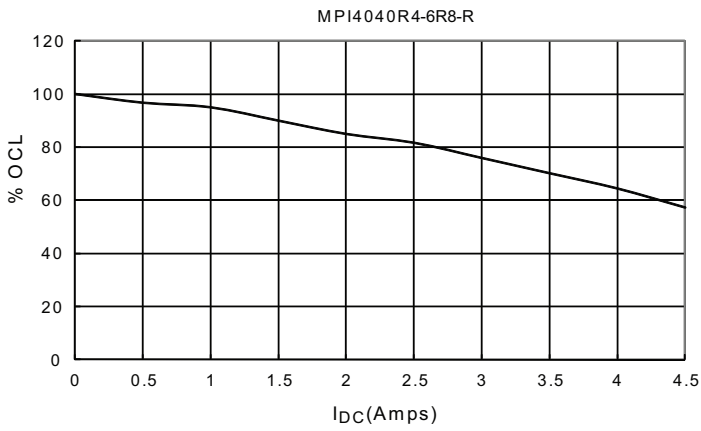
MPI4040R3-220-R



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



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

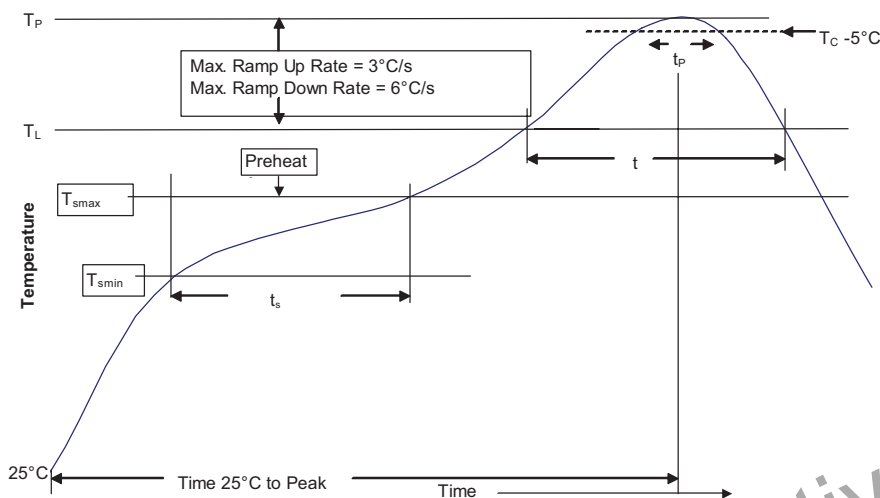


Table 1 - Standard SnPb Solder ( $T_C$ )

| 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 ( $T_C$ )

| 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. ( $T_{smin}$ )                                                  | 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        |
| Average ramp up rate ( $T_{smax}$ to $T_L$ )                                       | 3°C/ Second Max.     | 3°C/ Second Max.      |
| Liquidous temperature ( $T_L$ )                                                    | 183°C                | 217°C                 |
| Time at liquidous ( $t_L$ )                                                        | 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**          |
| Average ramp down rate ( $T_P$ to $T_{smax}$ )                                     | 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.

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

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Printed in USA  
Publication No. 4086 BU-SB14232  
October 2015

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