



**THE DATASHEET OF
MPI4040R3-4R7-R**



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



Product Specifications

| Part Number ⁵ | OCL ¹ ± 20% (µH) | Part marking designator | I _{rms} ² (amps) | I _{sat} ³ @ 25°C (amps) | DCR (mΩ) ±20% @ 20°C | K-factor ⁴ |
|--------------------------|--------------------------------|----------------------------|---|--|-------------------------|-----------------------|
| R1 — 1.2mm Height | | | | | | |
| 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 |
| R2 — 1.5mm Height | | | | | | |
| 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_{rms}, 0.0A_{dc}

2. I_{rms}: 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_{rms} testing was performed on a 19.05mm long x 6.35mm wide x 0.070mm thick copper wire in still air.

3. I_{sat}: Peak current for approximately 30% roll-off at +25°C.

4. K-factor: Used to determine B_{pp} for core loss (see graph).

B_{pp} = K * L * DI B_{pp}: (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 ⁵ | OCL ¹ ± 20% (µH) | Part marking designator | I _{rms} ² (amps) | I _{sat} ³ @ 25°C (amps) | DCR (mΩ) ±20% @ 20°C | K-factor ⁴ |
|---------------------------|--------------------------------|----------------------------|---|--|-------------------------|-----------------------|
| R3 — 1.85mm Height | | | | | | |
| 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 |
| R4 — 2.0mm Height | | | | | | |
| 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 | 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_{rms}: 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_{rms} testing was performed on a 9.05mm long x 6.35mm wide x 0.20mm thick copper trace in still air.

3. I_{sat}: Peak current for approximately 30% rolloff at +25°C.

4. K-factor: Used to determine B_{pp} for core loss (see graph).

B_{pp} = K * L * DI.B_{pp}: (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

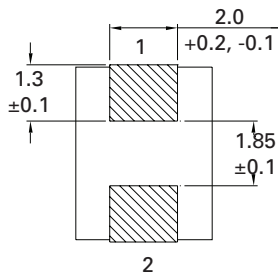
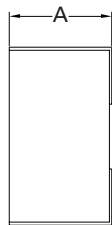
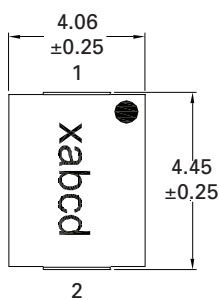
- MPI4040R = product code and size
- X = version indicator
- XXX = inductance value in µH, R= decimal point - If no R is present, then last character equals the number of zeros
- -R suffix = RoHS compliant

† Transient pulse not to exceed 1 millisecond.

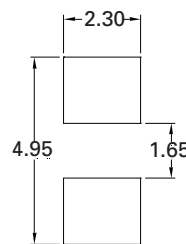
†† Maximum operating frequency less than 10MHz, consult factory for application specific values.

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

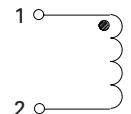
Dimensions (mm)



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 |

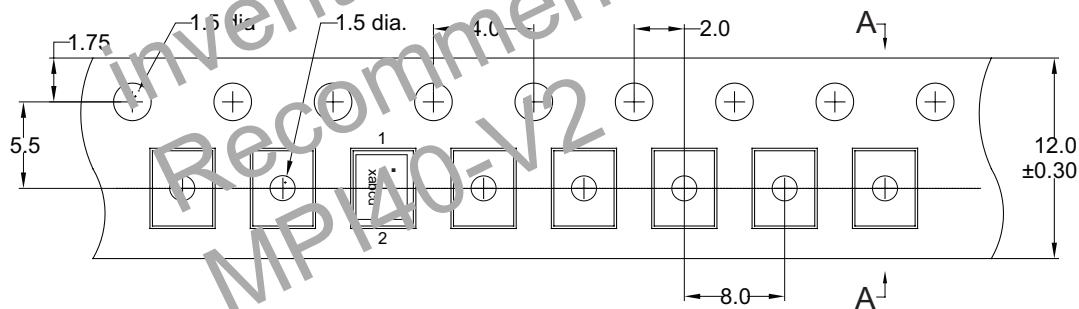
Part marking: xabcd
 x = height: 1 = R1 (1.2mm), 2 = R2 (1.5mm), 3 = R3 (1.85mm), 4 = R4 (2.0mm)
 a = Inductance value per the Part marking designator letter code in Product specification table.
 b = Bi-weekly date code
 c = Last digit of year manufactured
 d = Revision level

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:

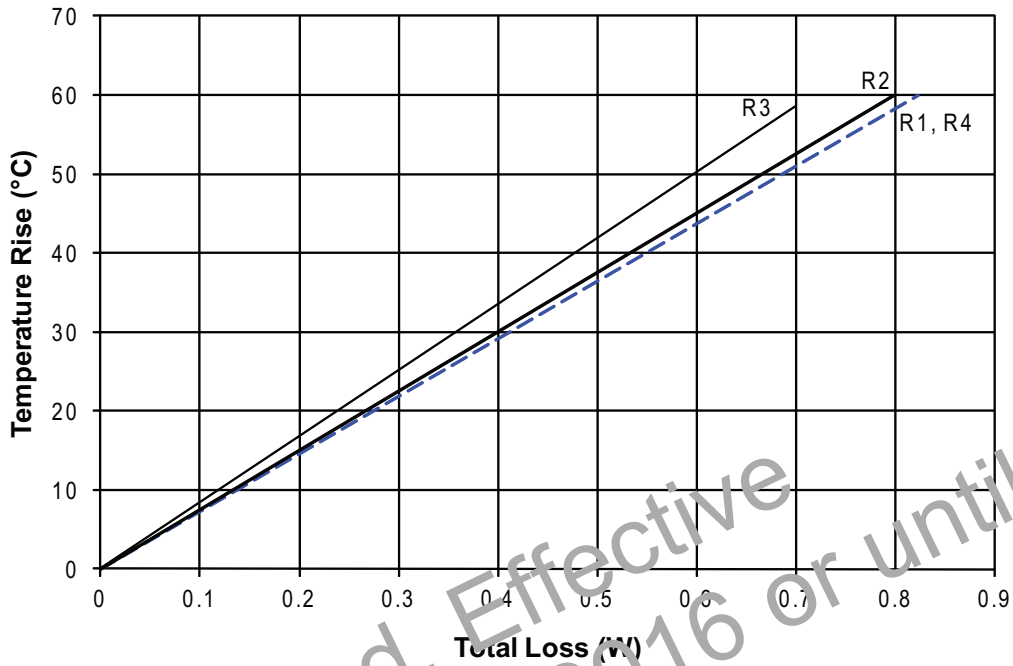
- MPI4040R1 = 5000 parts per 13" diameter reel
- MPI4040R2 = 4500 parts per 13" diameter reel
- MPI4040R3 = 3500 parts per 13" diameter reel
- MPI4040R4 = 3000 parts per 13" diameter reel



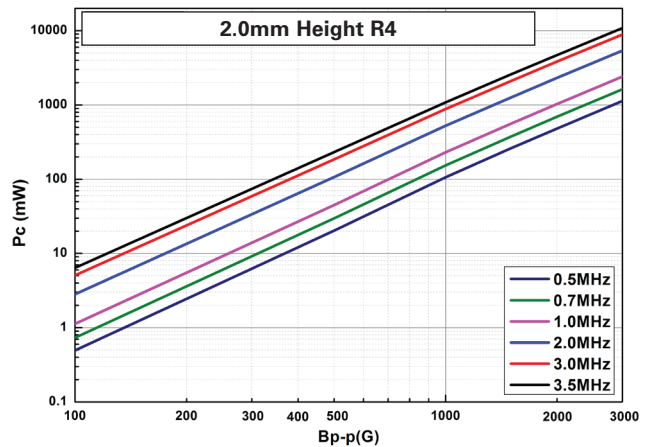
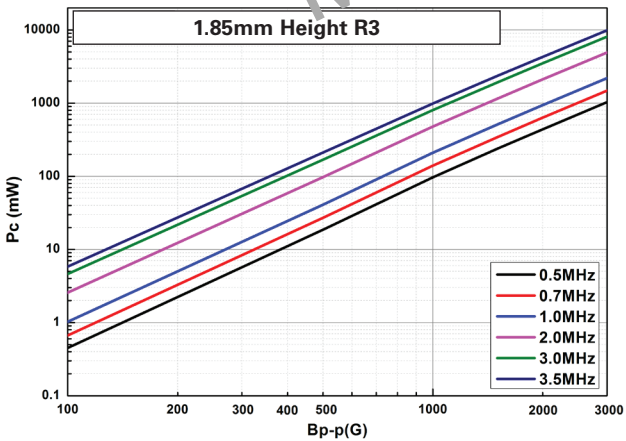
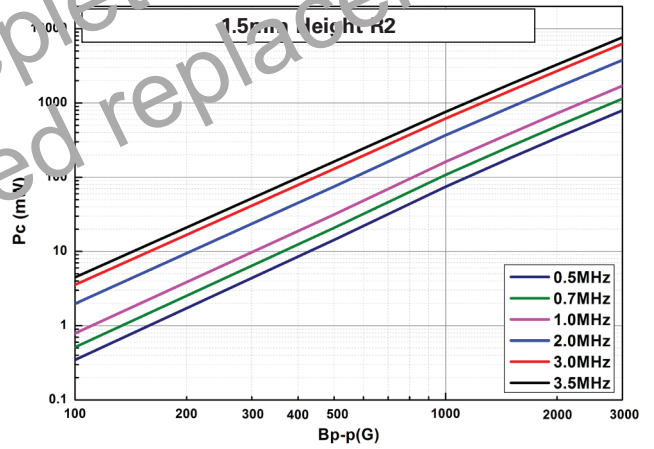
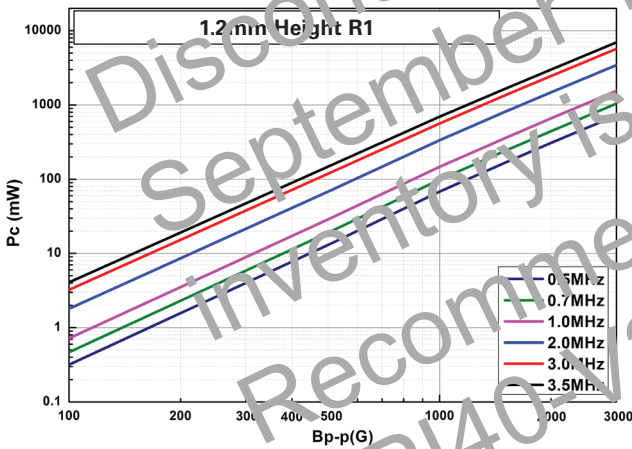
SECTION A-A
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 MPI4040R3=1.95
 MPI4040R4=2.1

User Direction of feed →

Temperature rise vs. total loss

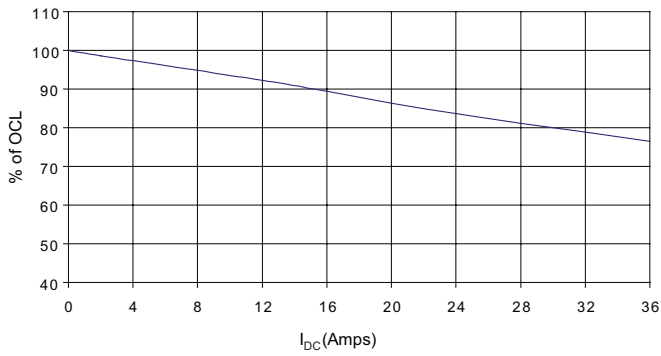


Core loss

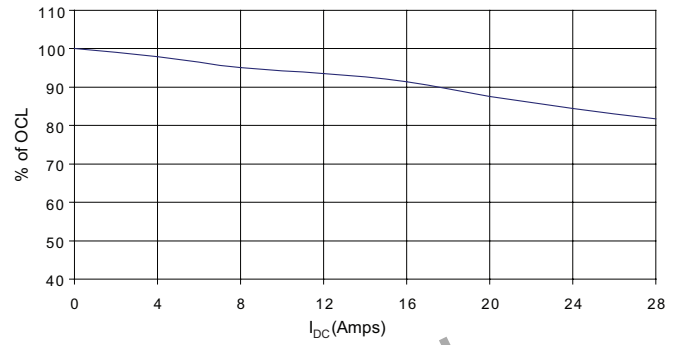


1.2mm Height R1 inductance characteristics — % of OCL vs. I_{DC}

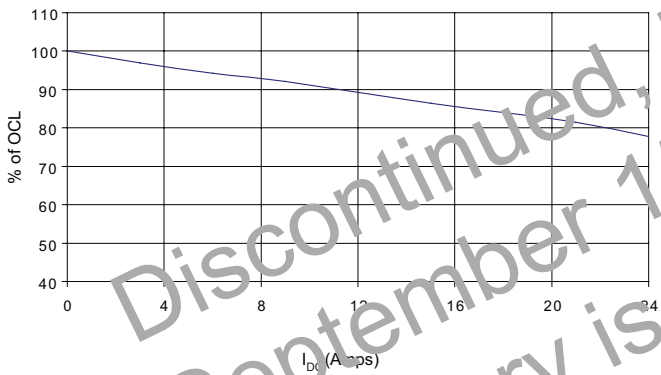
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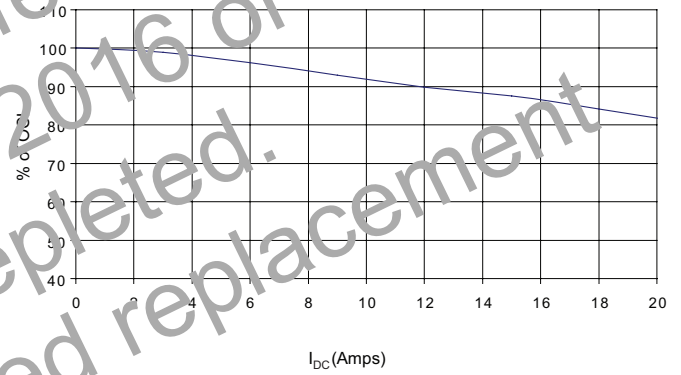
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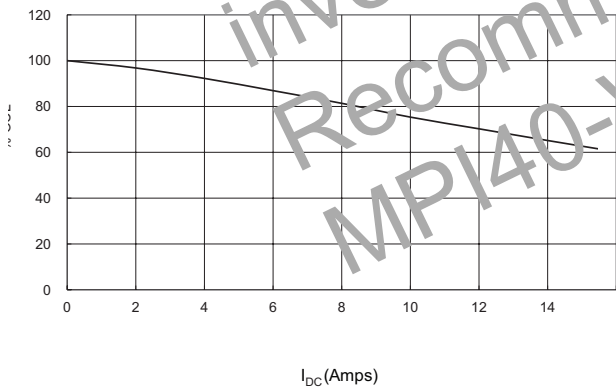
MPI4040R1-R22-R



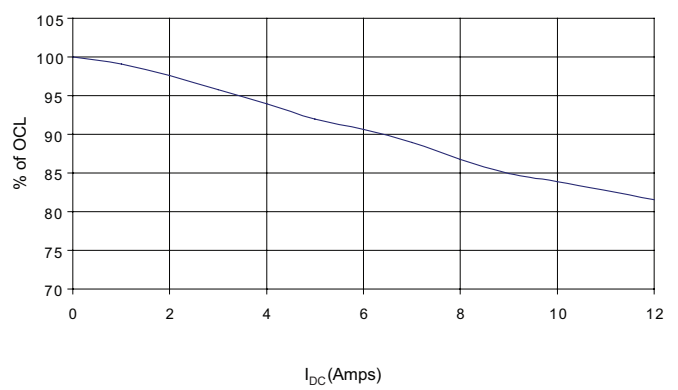
MPI4040R1-R33-R



MPI4040R1-R40-F

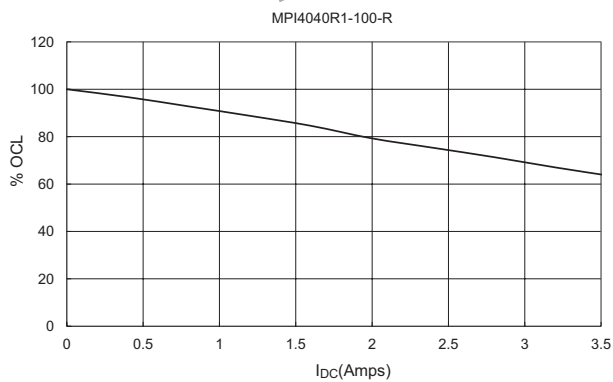
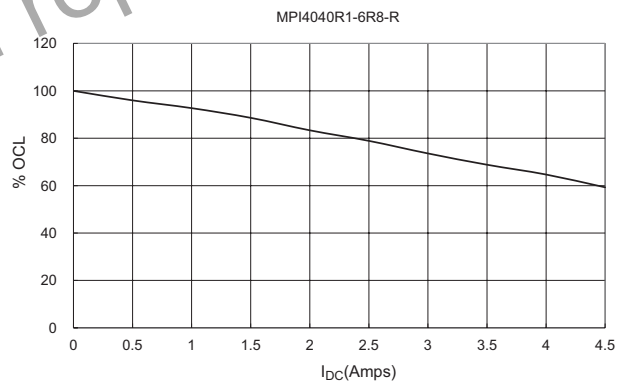
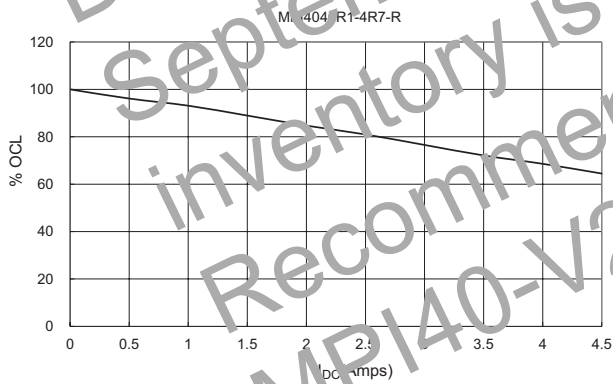
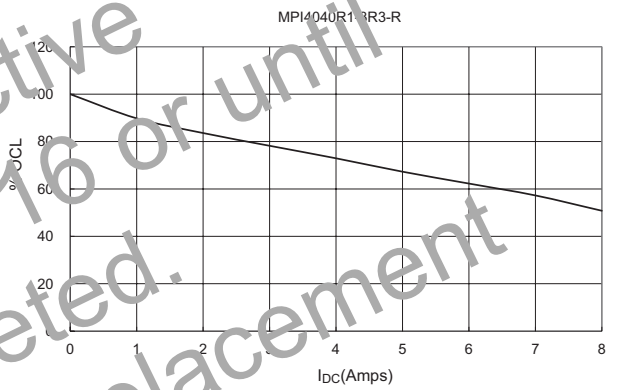
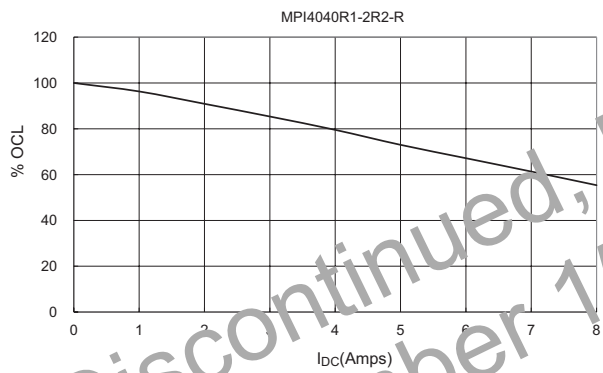
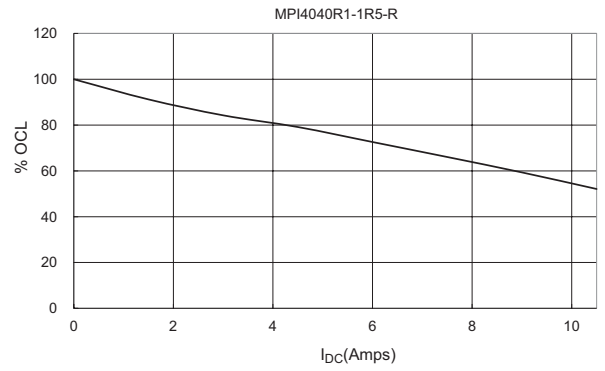
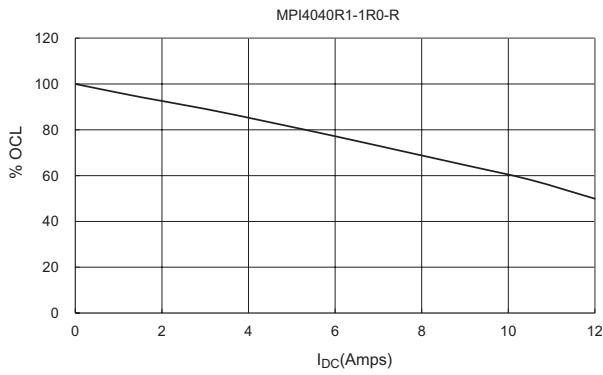


MPI4040R1-R68-R



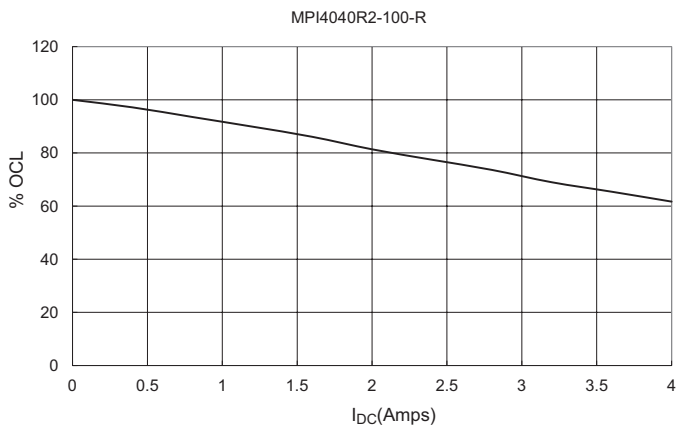
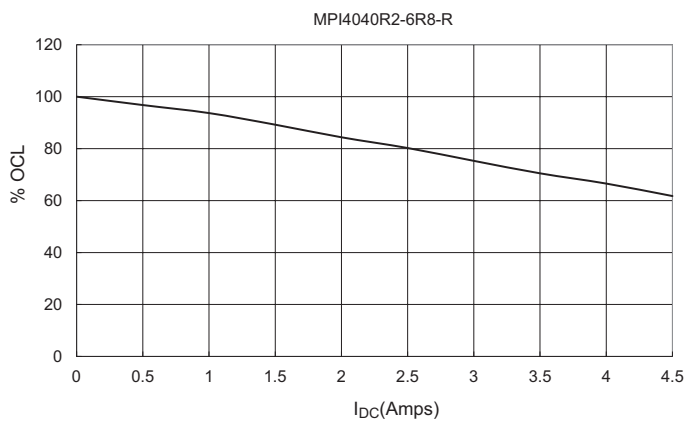
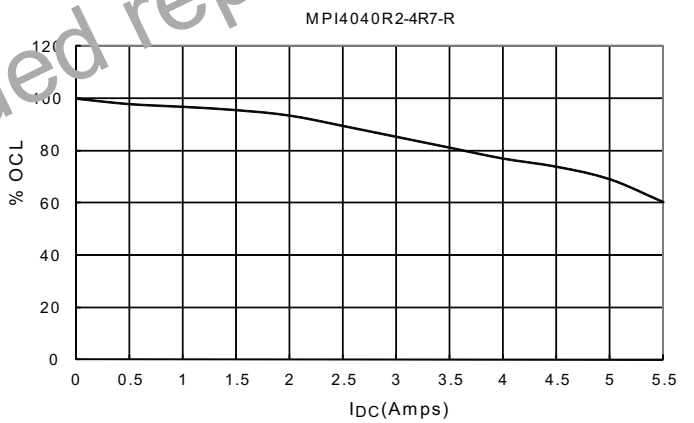
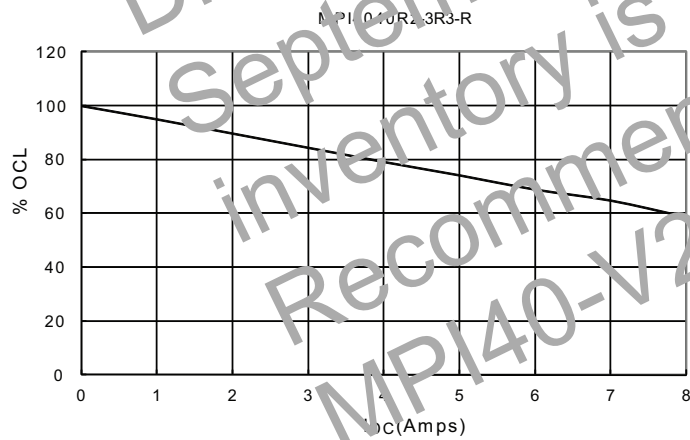
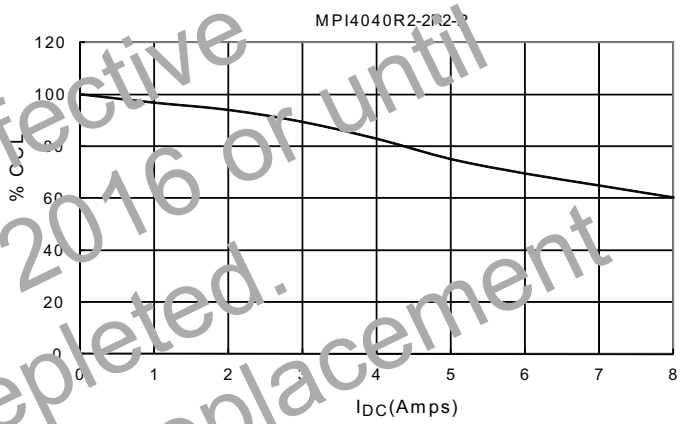
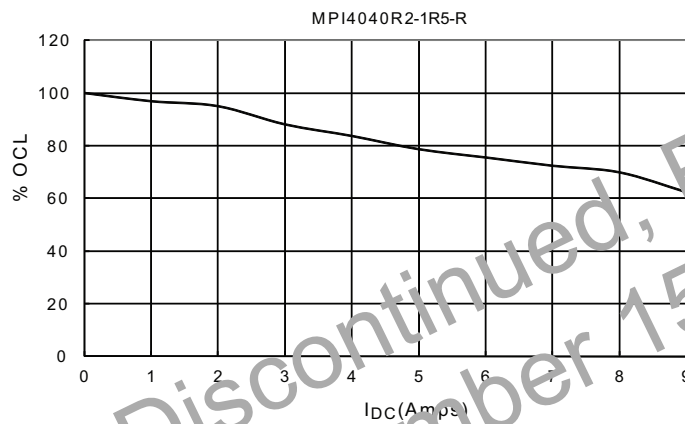
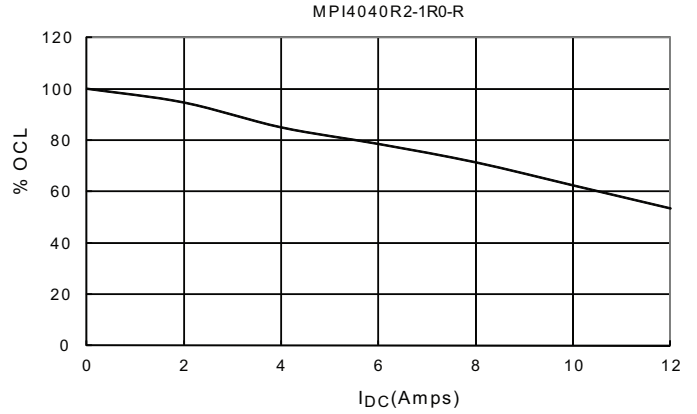
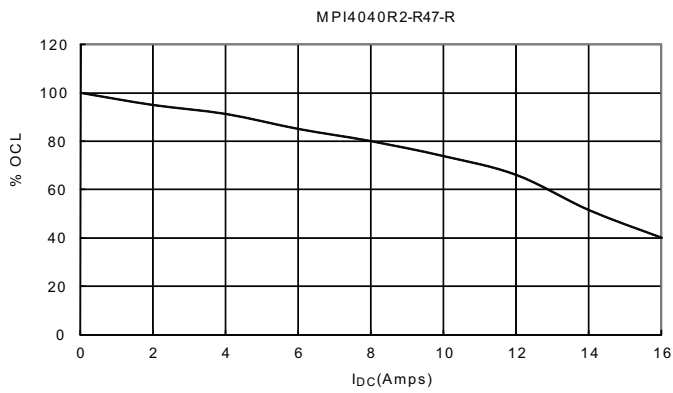
Discontinued, Effective
 September 15, 2016 or until
 inventory is depleted.
 Recommended replacement
 MPI40-V2

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



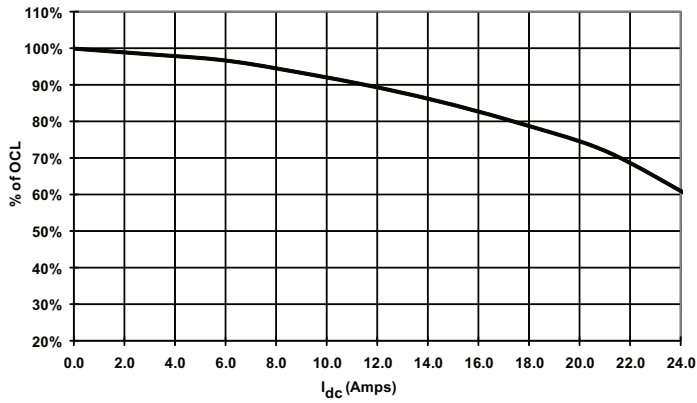
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

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

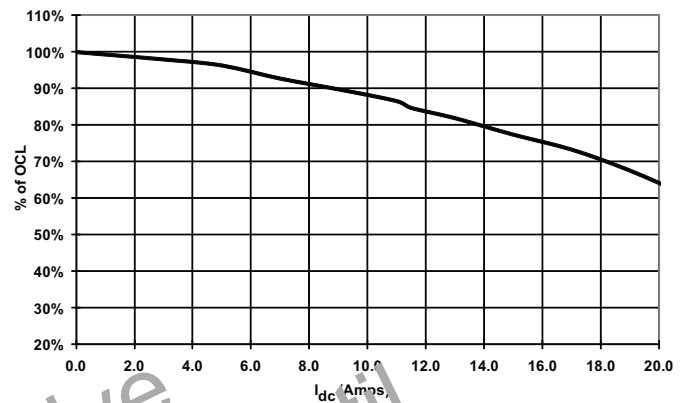


1.85mm Height R3 inductance characteristics — % of OCL vs. I_{DC}

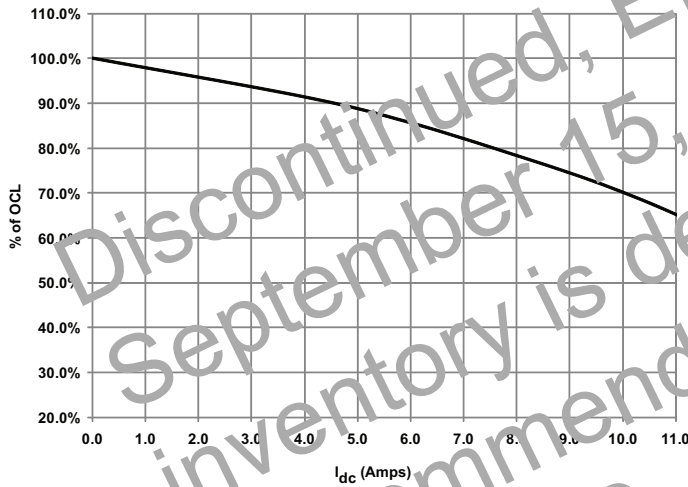
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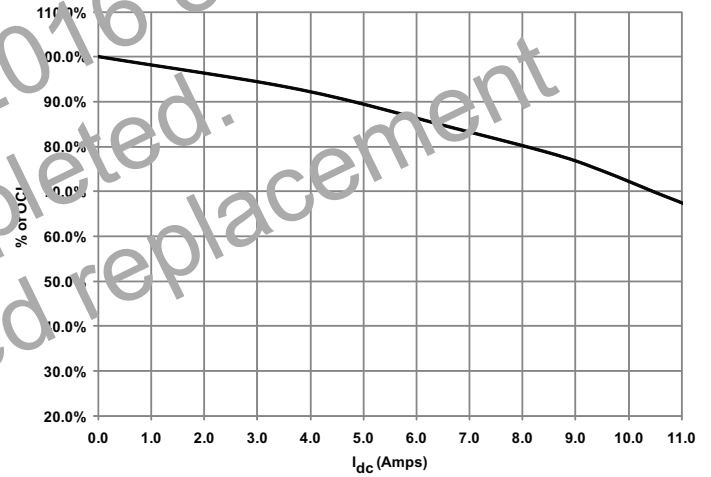
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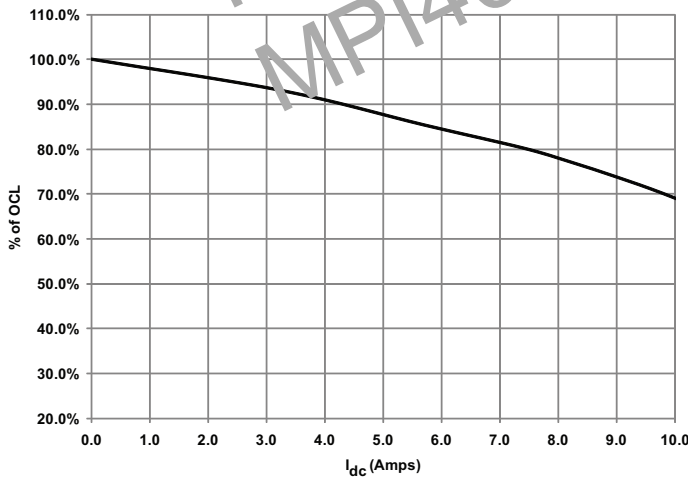
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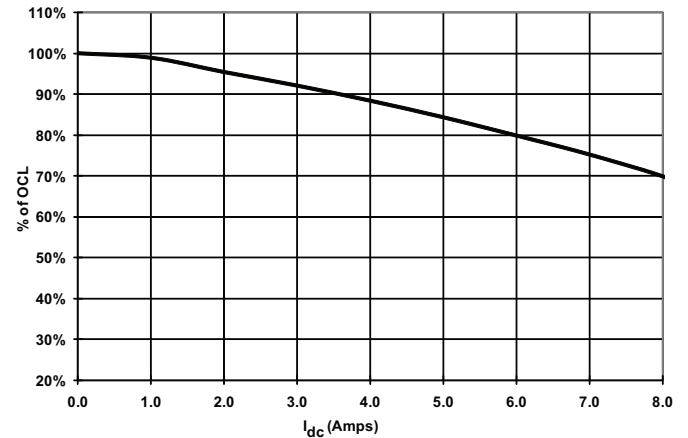
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MPI4040R3-2R2-F

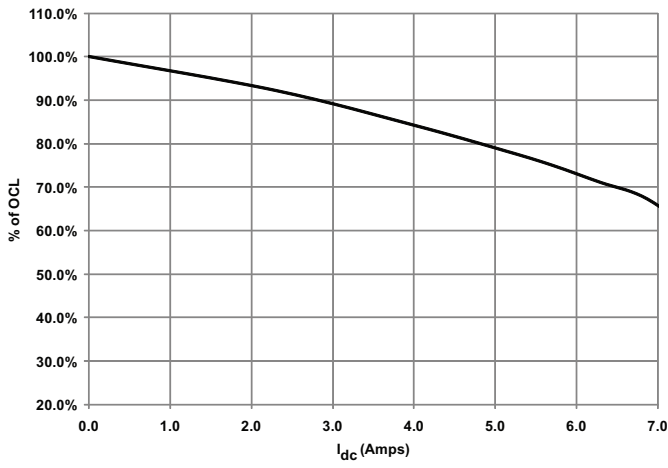


MPI4040R3-3R3-R

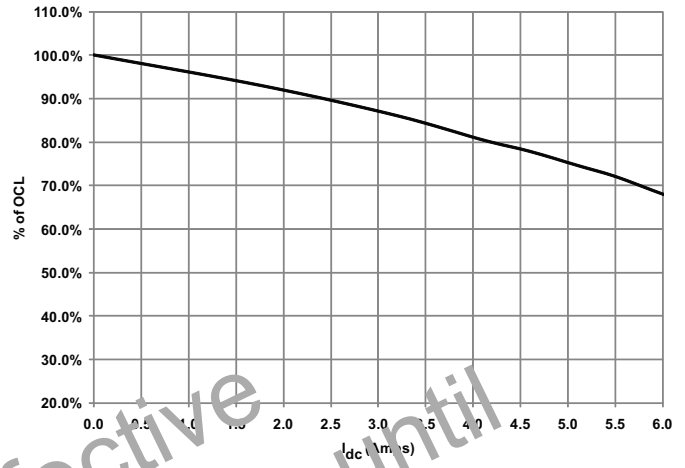


1.85mm Height R3 inductance characteristics — % of OCL vs. I_{DC}

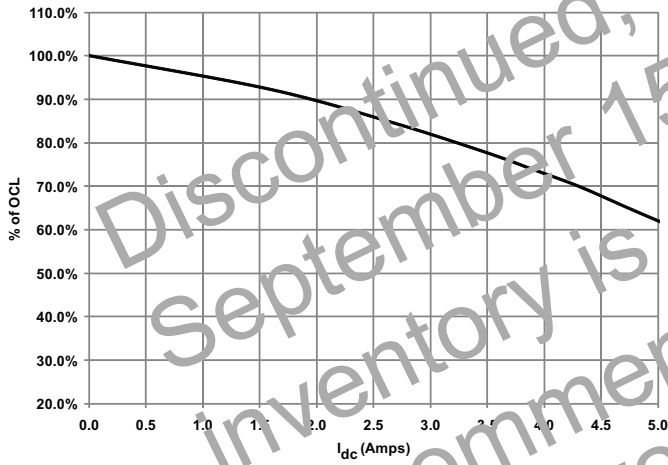
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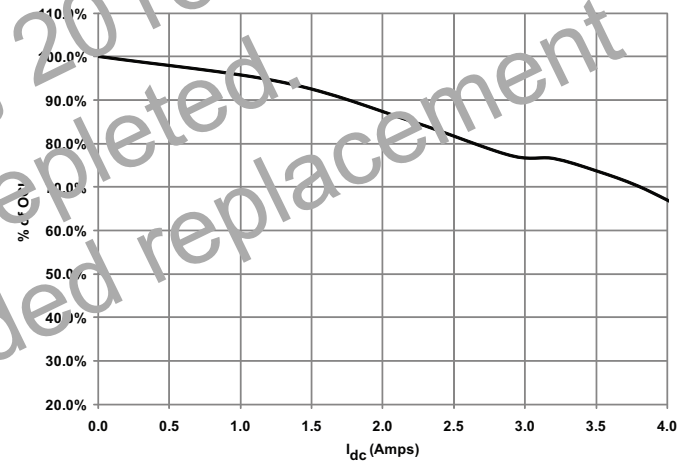
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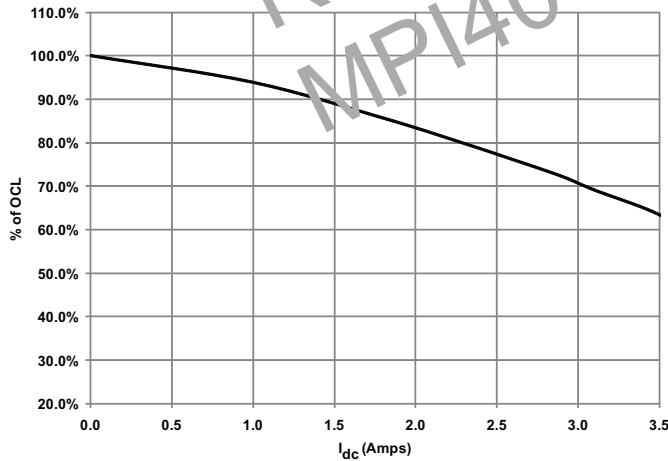
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MPI4040R3-150-R

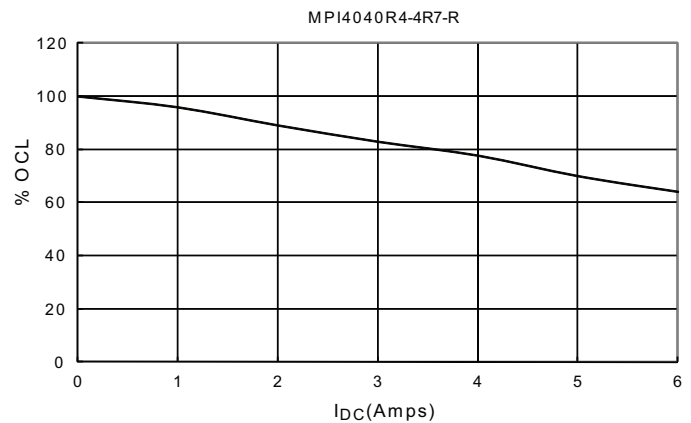
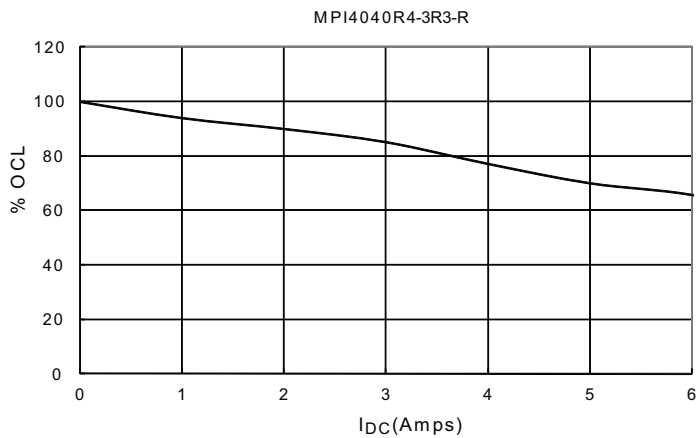
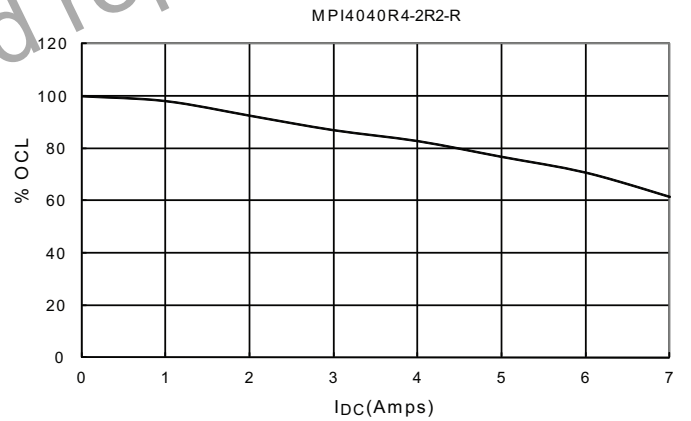
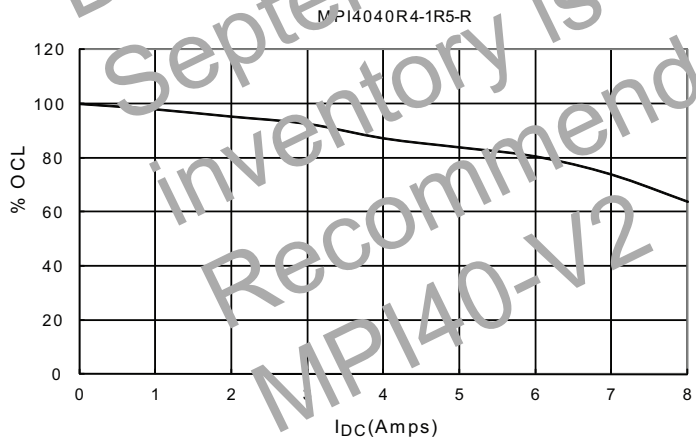
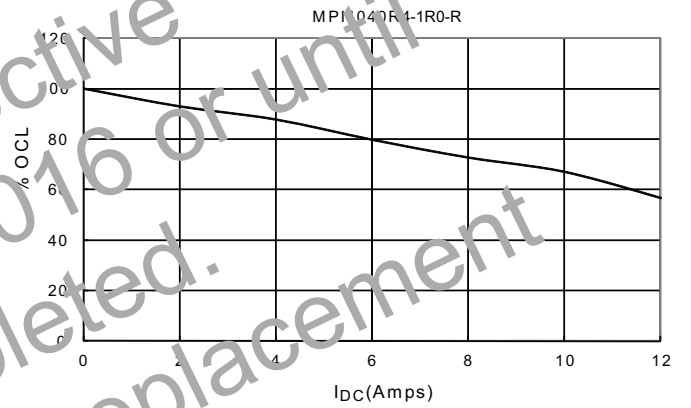
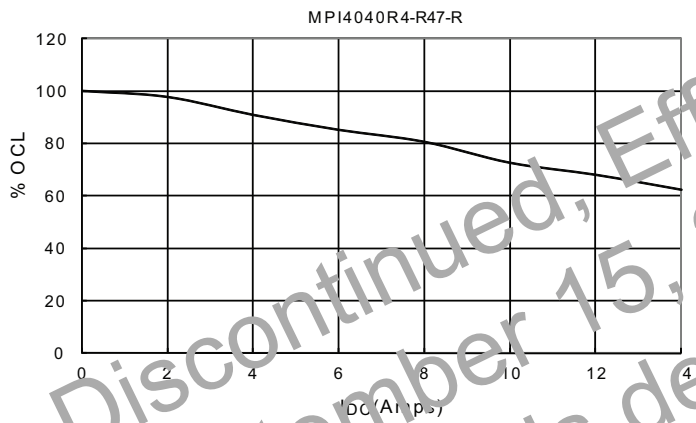
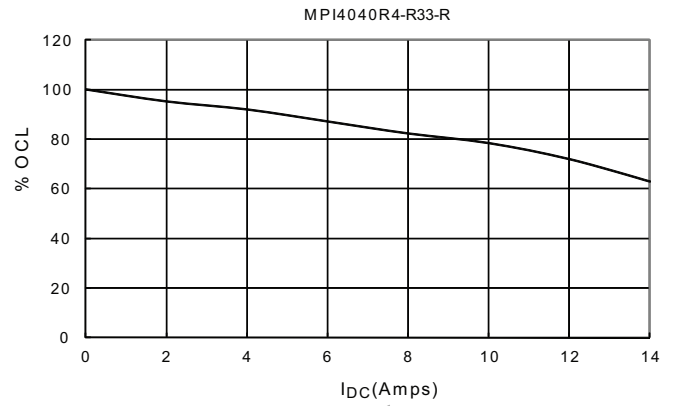
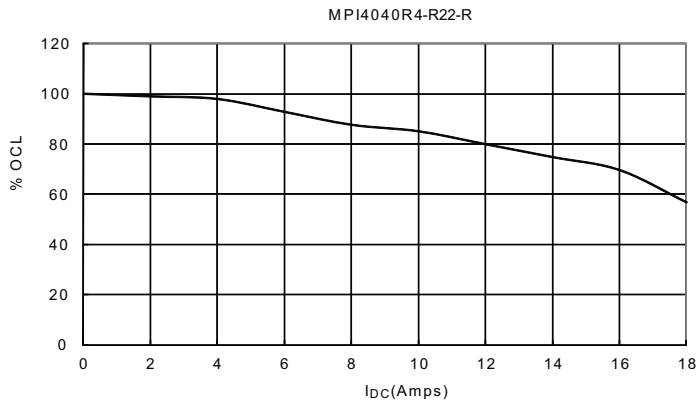


MPI4040F3-220-R



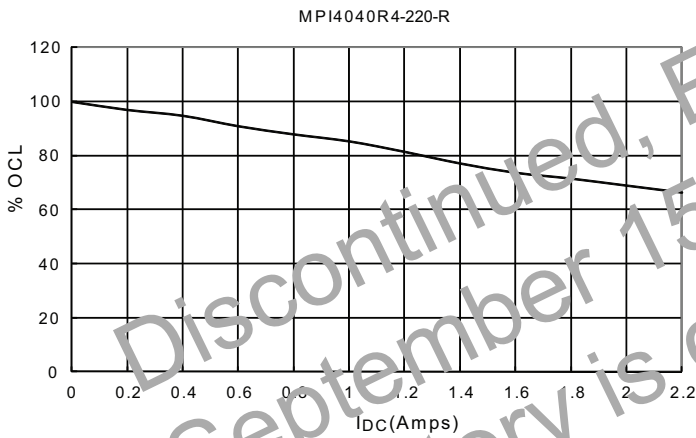
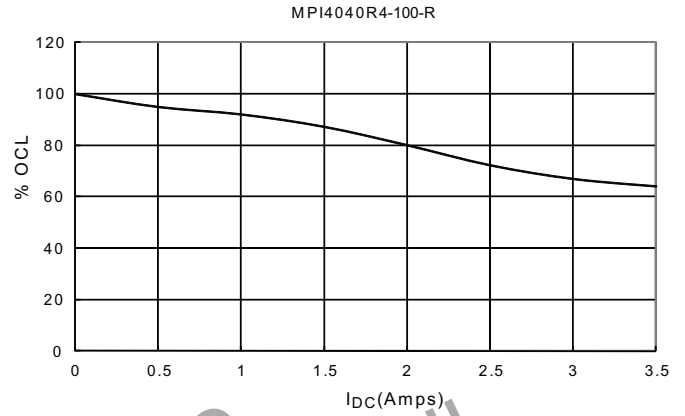
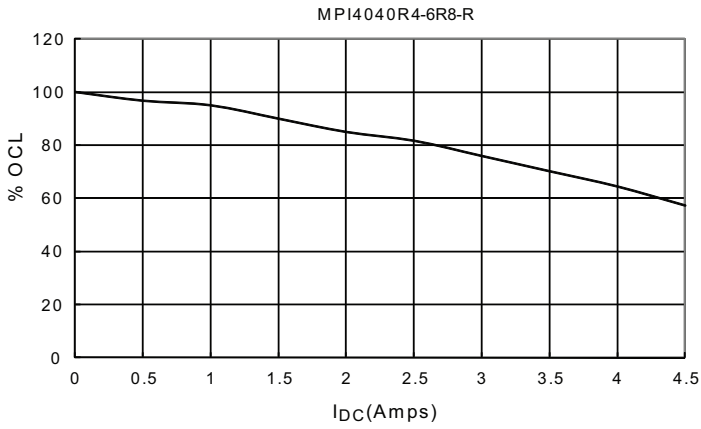
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPI40-V2

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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Solder reflow profile

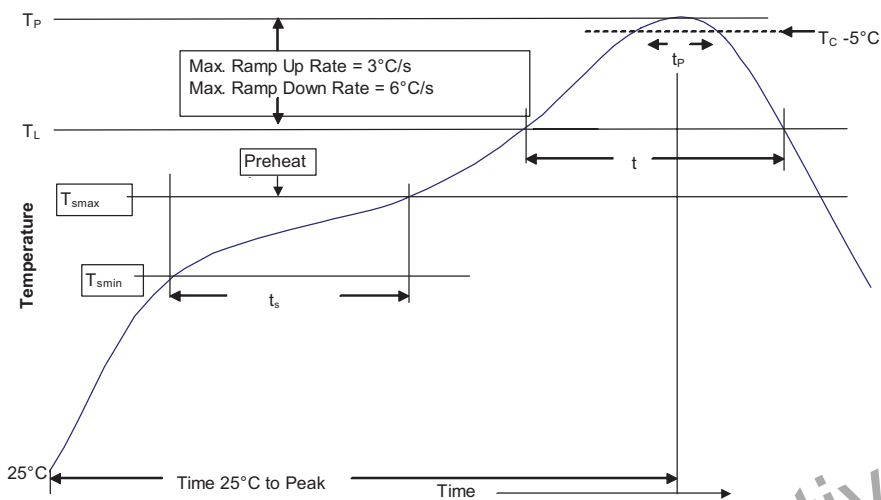


Table 1 - Standard SnPb Solder (T_C)

| Package Thickness | Volume mm ³ <350 | Volume mm ³ ≥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 ³ <350 | Volume mm ³ 350 - 2000 | Volume mm ³ >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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