

# MPIA4040

Automotive Grade

High Current, High Frequency, Miniature Power Inductors



#### Product description:

- AEC-Q200 Grade 3 qualified
- Handles high transient inrush current spikes
- Magnetically shielded
- Frequency range: 10kHz to 10MHz
- Inductance range from 0.02µH to 22µH
- Current range from 1.1A to 3.2A
- 4.7 x 4.31 footprint surface mount package in 1.2, 1.5, 1.75 or 2.0mm heights
- Rugged construction
- Halogen free, lead free, RoHS compliant

#### Applications:

- Body electronics
    - Central body control module
    - Vehicle access control system
    - Headlamps, tail lamps and interior lighting
    - Door control
  - Advanced driver assistance systems
    - 77GHz radar systems
    - Automatic parking control
    - Collision avoidance system
  - Basic and smart surround, and rear and front view camera
    - Adaptive Cruise Control (ACC)
    - Car black box system
  - Infotainment and cluster electronics
    - Active noise cancellation (ANC)
    - Audio subsystem: head unit and trunk amp
    - Digital instrument cluster
  - In-vehicle infotainment (IVI) and navigation
    - Port power/USB hub for front and rear passengers
  - Chassis and safety electronics
    - Airbag control unit
- 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 <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>						
MPIA4040R1-R10-R	0.09	A	8.00	32.0†	8.50	1401
MPIA4040R1-R15-R	0.15	B	7.00	26.0†	11.0	989
MPIA4040R1-R22-R	0.23	C	5.50	21.0	18.0	814
MPIA4040R1-R33-R	0.33	D	4.40	17.0	28.0	659
MPIA4040R1-R47-R	0.47	E	5.20	11.5	20.0	1295
MPIA4040R1-R68-R	0.68	F	3.30	9.00	51.0	461
MPIA4040R1-1R0-R	1.0	G	3.70	7.70	40.0	990
MPIA4040R1-1R5-R	1.5	H	3.00	6.50	60.0	732
MPIA4040R1-2R2-R	2.2	I	2.60	5.90	80.0	623
MPIA4040R1-3R3-R	3.3	J	2.20	5.10	115	481
MPIA4040R1-4R7-R	4.7	K	1.80	3.80	180	411
MPIA4040R1-6R8-R <sup>††</sup>	6.8	L	1.50	3.20	250	344
MPIA4040R1-100-R <sup>††</sup>	10.0	M	1.20	2.80	370	276
<b>R2 -- 1.5mm Height</b>						
MPIA4040R2-R47-R	0.47	A	6.40	12.2	13.0	1403
MPIA4040R2-1R0-R	1.0	B	4.60	8.50	25.0	935
MPIA4040R2-1R5-R	1.5	C	3.80	7.60	37.0	701
MPIA4040R2-2R2-R	2.2	D	3.30	5.70	58.0	647
MPIA4040R2-3R3-R	3.3	E	2.60	5.40	76.0	495
MPIA4040R2-4R7-R	4.7	F	2.20	4.30	105	421
MPIA4040R2-6R8-R	6.8	G	1.80	3.40	158	351
MPIA4040R2-100-R <sup>††</sup>	10.0	H	1.50	3.10	240	271

1 Open Circuit Inductance (OCL) Test Parameters: 10kHz, 0.10V<sub>rms</sub>, 0.0A dc

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 25°C under worst case operating conditions and therefore, the temperature rise should be verified in the end use application. Irms 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% rolloff at +25°C.

4 K-factor: Used to determine B<sub>p-p</sub> for core loss (see graph). B<sub>p-p</sub> = K \* L \* DI. Bp-p : (Gauss), K: (K-factor from table), L: (inductance in µH), DI (peak-to-peak ripple current in amps).

5 Part Number Definition: MPIA4040RX-XXX-R

- MPIA4040X = product code and size
- XXX = inductance value in all, "R" = decimal point  
- If no "R" is present, then third digit 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.

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>						
MPIA4040R3-R22-R	0.22	A	8.00	20.0	5.8	1870
MPIA4040R3-R47-R	0.47	B	5.80	17.0	10.3	1530
MPIA4040R3-1R2-R	1.2	C	4.00	9.40	32.0	732
MPIA4040R3-1R5-R	1.5	D	3.80	8.20	36.0	673
MPIA4040R3-2R2-R	2.2	E	3.40	7.90	48.0	543
MPIA4040R3-3R3-R	3.3	F	3.00	6.60	60.0	432
MPIA4040R3-4R7-R	4.7	G	2.30	4.80	92.0	374
MPIA4040R3-6R8-R	6.8	H	2.00	4.50	120	306
MPIA4040R3-100-R	10.0	I	1.50	3.80	213	251
MPIA4040R3-150-R	15.0	J	1.30	3.00	235	213
MPIA4040R3-220-R <sup>††</sup>	22.0	K	1.10	2.20	408	174
<b>R4 -- 2.0mm Height</b>						
MPIA4040R4-R22-R	0.22	A	10.1	15.0	5.3	2405
MPIA4040R4-R33-R	0.33	B	9.50	12.8	6.0	1870
MPIA4040R4-R47-R	0.45	C	8.10	11.5	8.2	1530
MPIA4040R4-1R0-R	1.0	D	5.70	7.20	17.0	990
MPIA4040R4-1R5-R	1.5	E	4.90	6.90	23.0	802
MPIA4040R4-2R2-R	2.2	F	3.90	5.70	35.0	673
MPIA4040R4-3R3-R <sup>††</sup>	3.3	G	3.30	4.50	49.0	510
MPIA4040R4-4R7-R <sup>††</sup>	4.7	H	2.90	3.90	67.0	455
MPIA4040R4-6R8-R <sup>††</sup>	6.8	I	2.40	3.20	91.0	374
MPIA4040R4-100-R <sup>††</sup>	10.0	J	1.90	2.60	148	306
MPIA4040R4-220-R <sup>††</sup>	22.0	K	1.30	1.80	316	203

1 Open Circuit Inductance (OCL) Test Parameters: 10kHz, 0.10V<sub>rms</sub>, 0.0A dc

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 25°C under worst case operating conditions and therefore, the temperature rise should be verified in the end use application. Irms 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% 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>p-p</sub> : (Gauss), K: (K-factor from table), L: (inductance in µH), DI (peak-to-peak ripple current in amps).

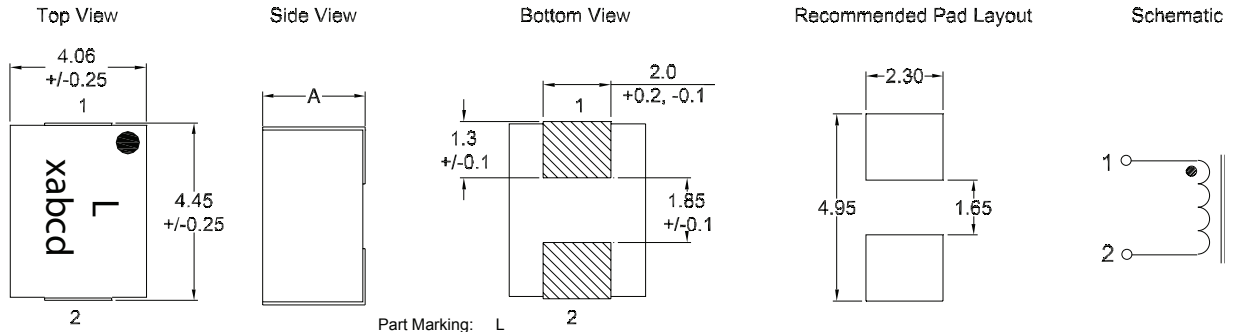
5 Part Number Definition: MPIA4040RX-XXX-R

- MPIA4040X = product code and size
- XXX = inductance value in all, "R" = decimal point  
- If no "R" is present, then third digit equals the number of zeros
- "-R" suffix = RoHS compliant

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

Dimensions - mm

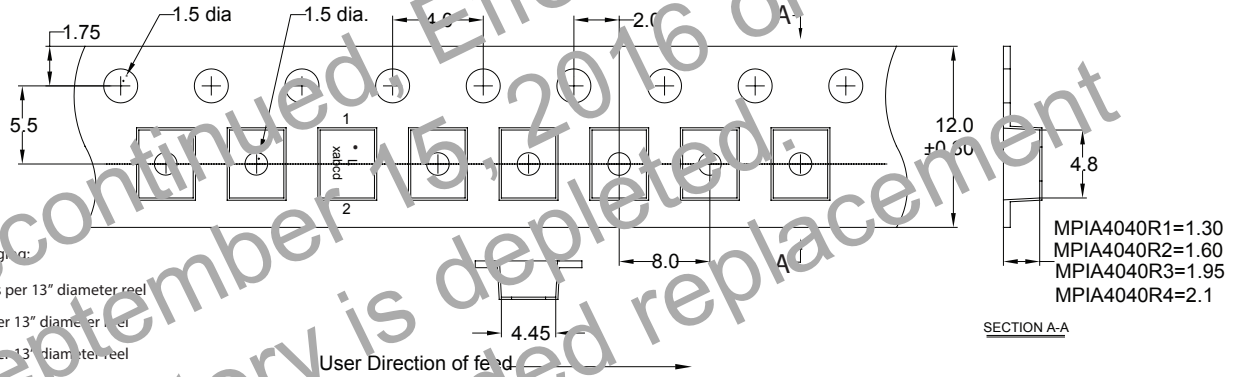


Part #	A Max
MPIA4040R1-xxx-R	1.2
MPIA4040R2-xxx-R	1.5
MPIA4040R3-xxx-R	1.8
MPIA4040R4-xxx-R	2.0

Part Marking: L xabcd  
 L = Automotive product  
 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 table above  
 b = Bi-weekly date code  
 c = Last digit of year manufactured  
 d = Revision level

Soldering surfaces to be coplanar within 0.1016 millimeters  
 PCB tolerances +/- 0.1mm unless otherwise specified  
 Do not route traces or vias underneath the inductor

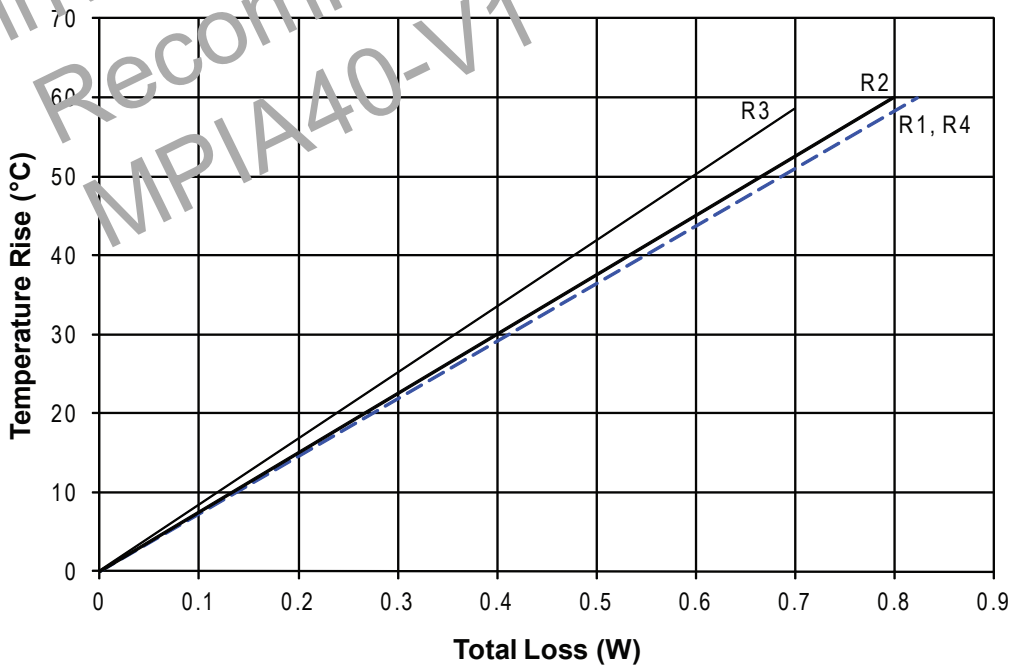
Packaging information - mm



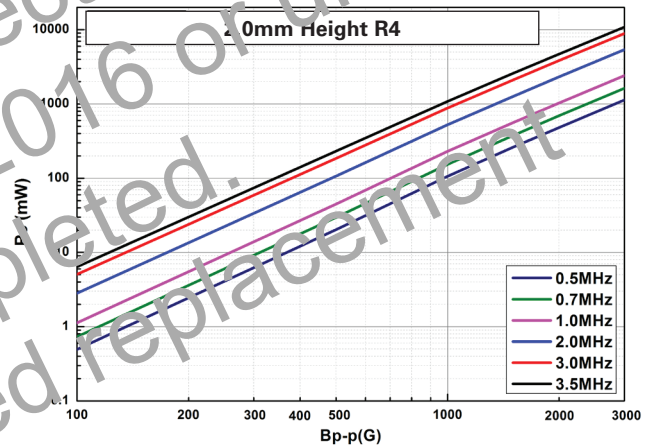
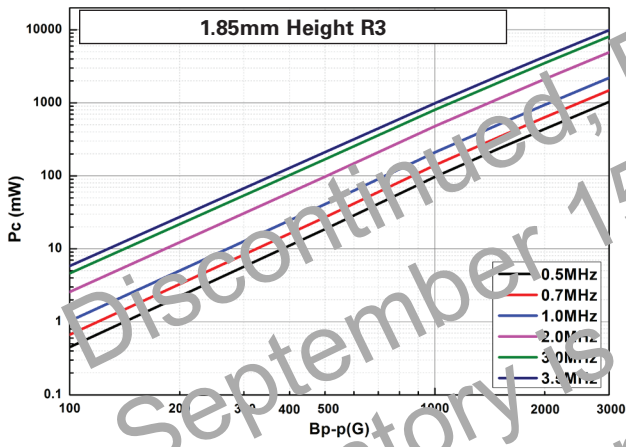
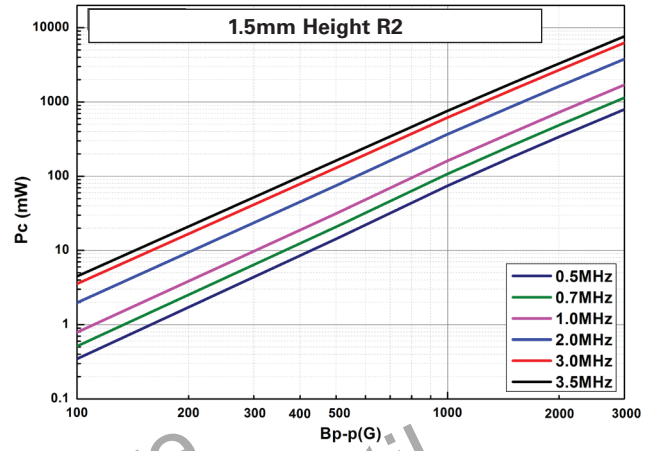
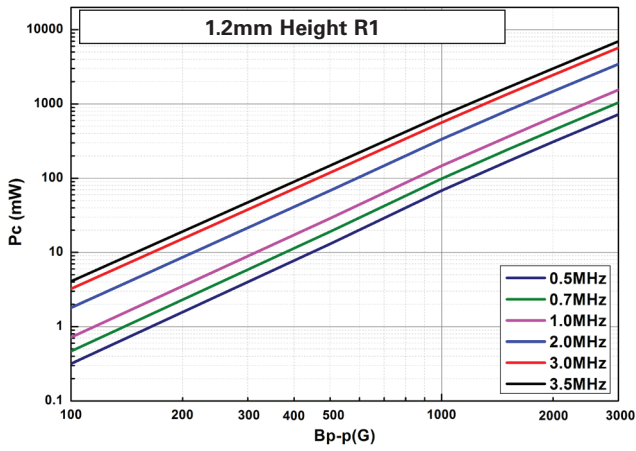
Supplied in tape and reel packaging:

- MPIA4040R1 = 5,000 parts per 13" diameter reel
- MPIA4040R2 = 4,500 parts per 13" diameter reel
- MPIA4040R3 = 3,500 parts per 13" diameter reel
- MPIA4040R4 = 3,000 parts per 13" diameter reel

Temperature rise vs. total loss



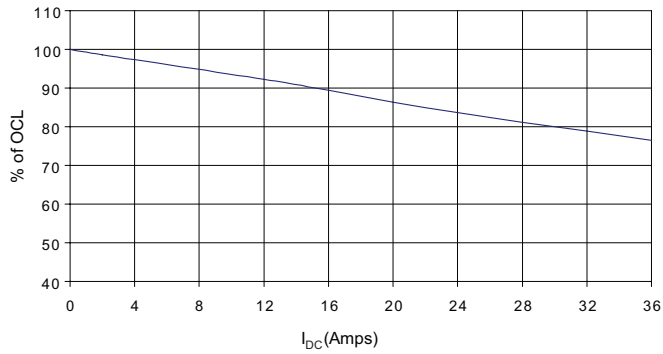
Core loss



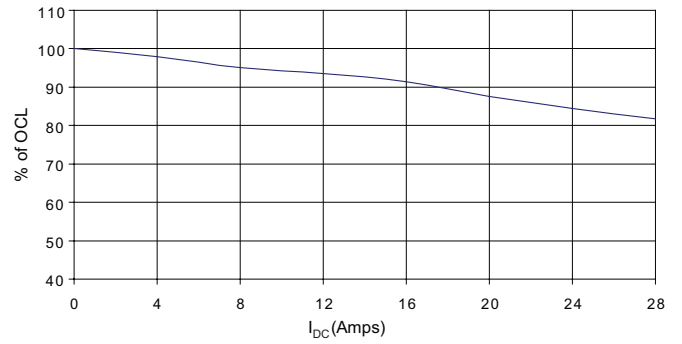
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPIA40-V1

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

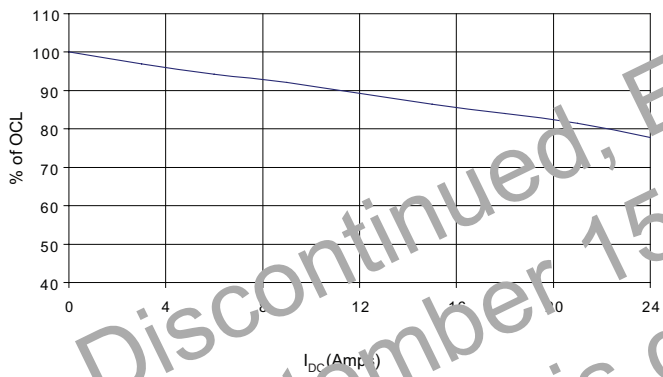
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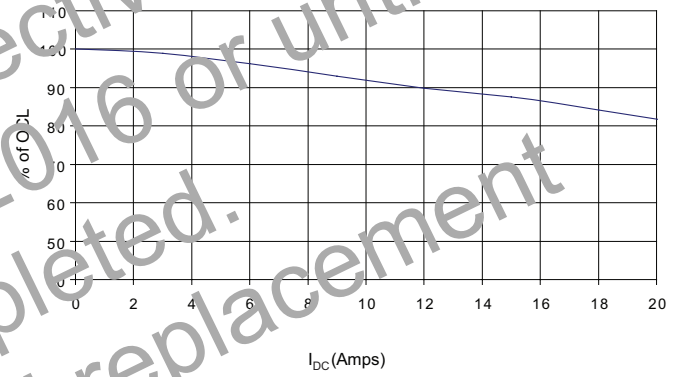
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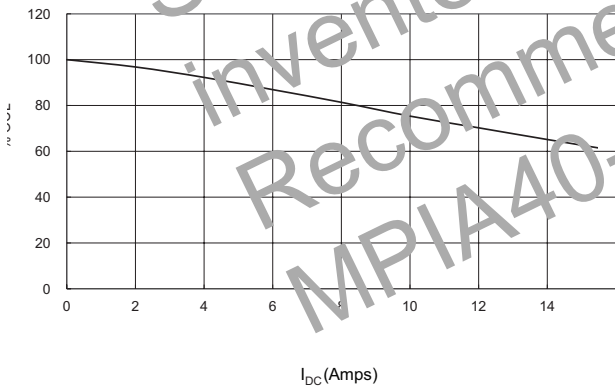
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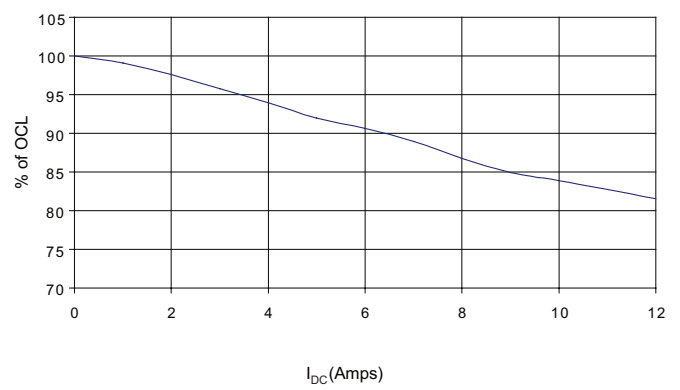
MPIA4040R1-R33-R



MPIA4040R1-R47-R

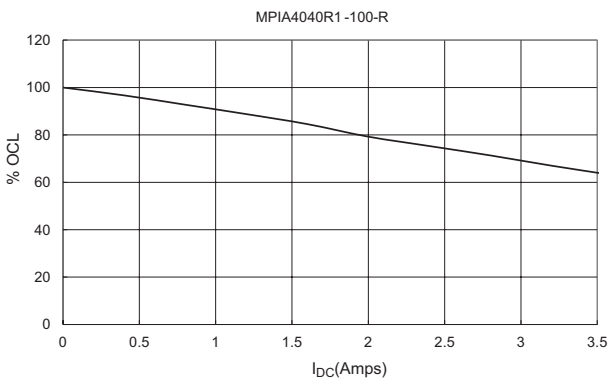
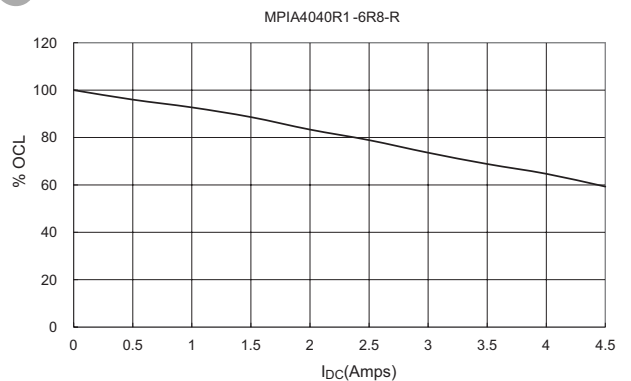
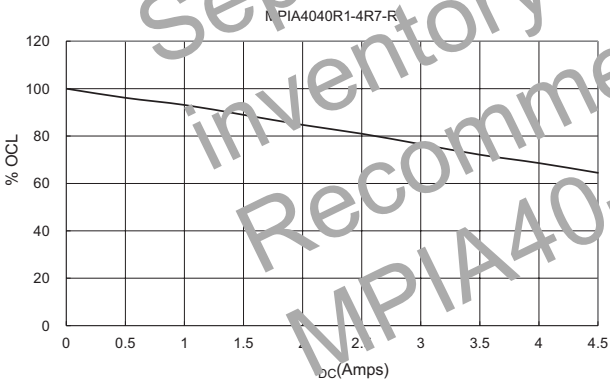
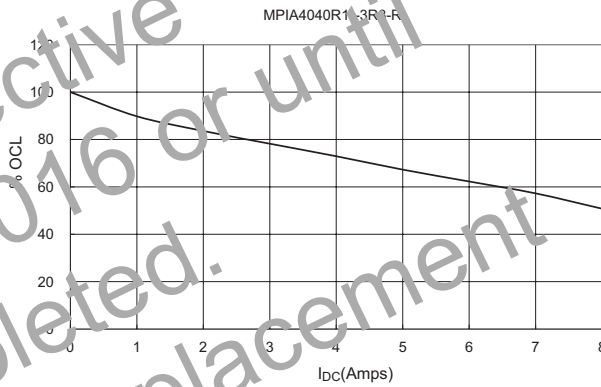
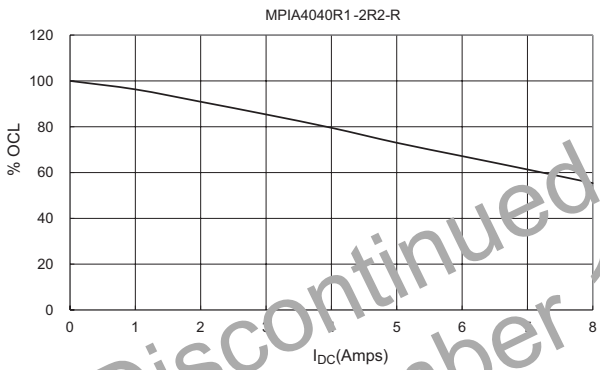
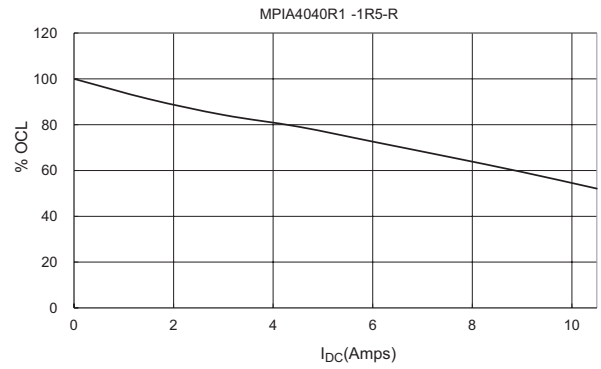
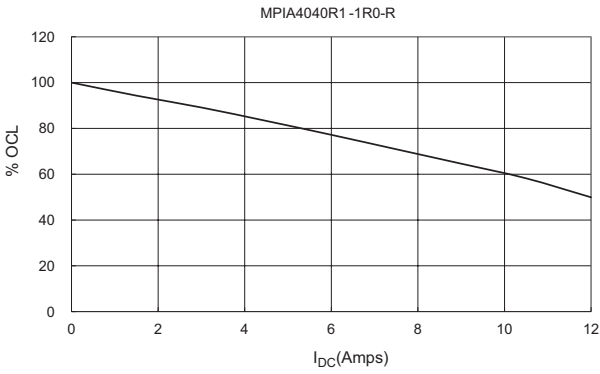


MPIA4040R1-R68-R



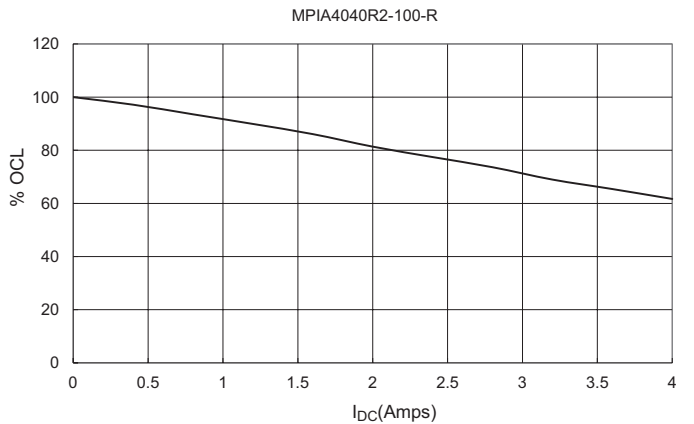
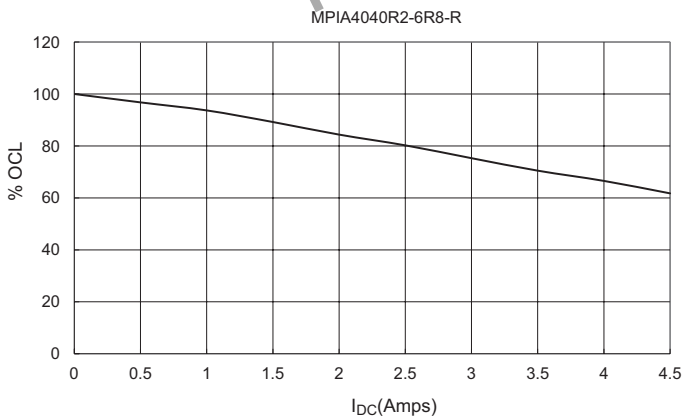
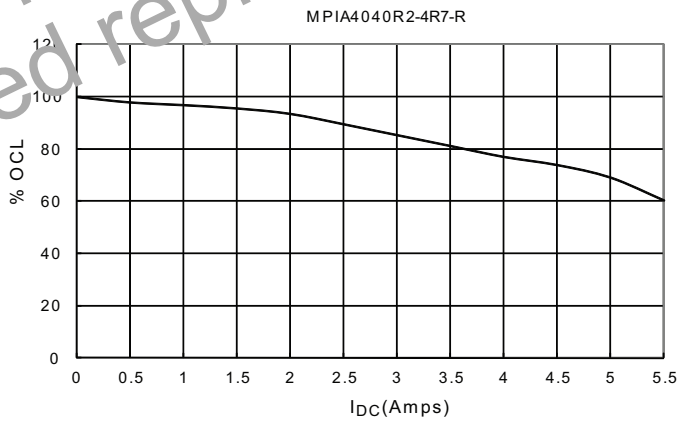
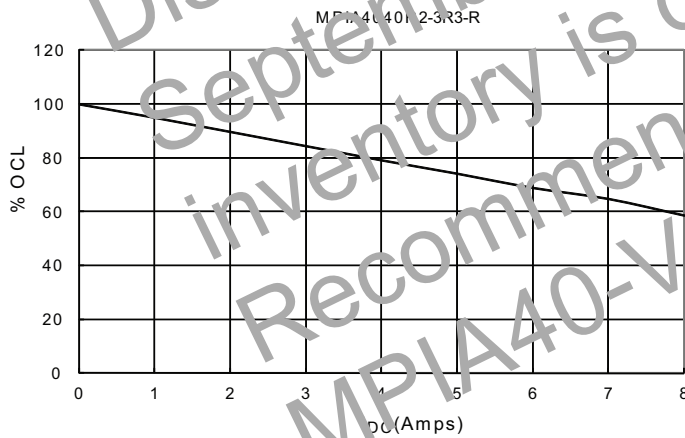
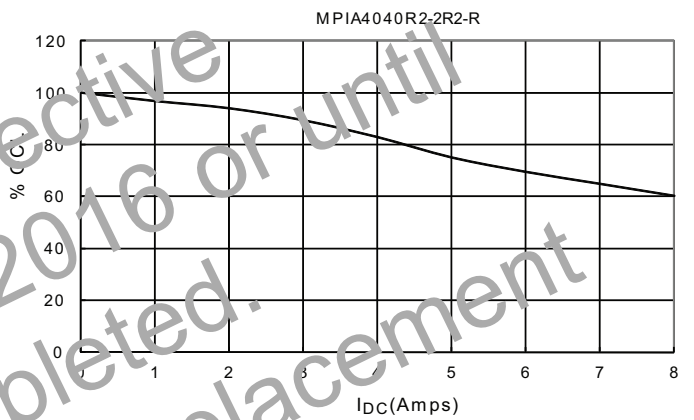
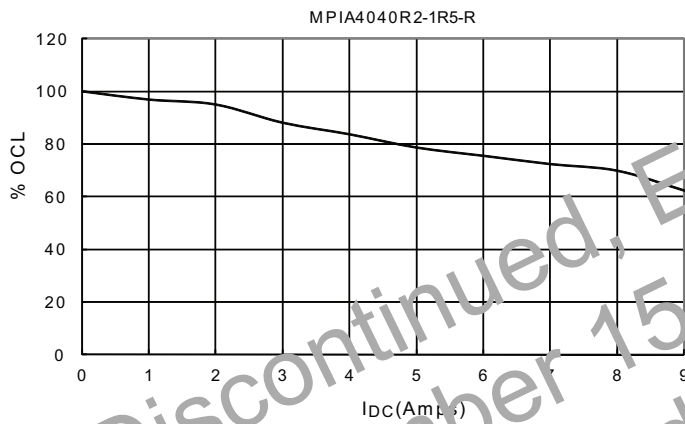
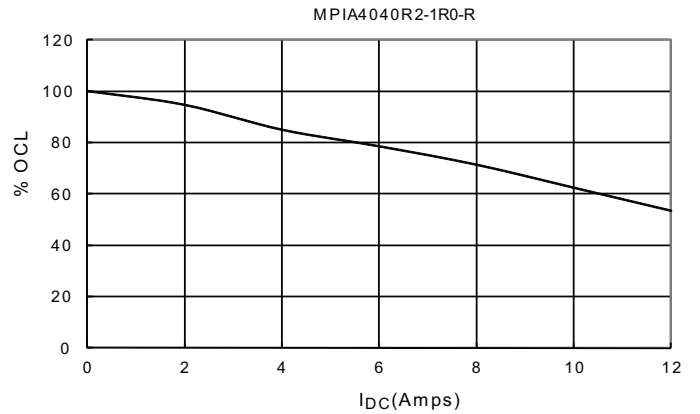
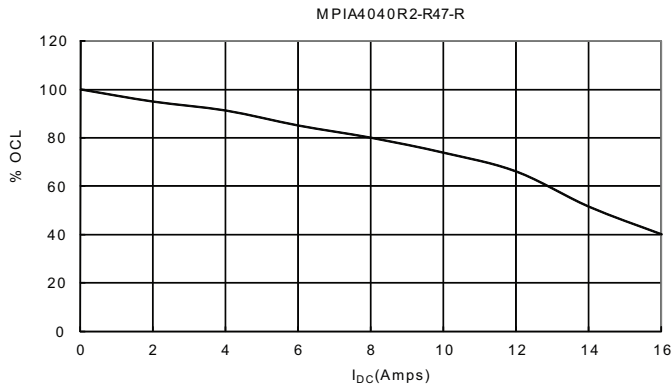
Discontinued, Effective  
September 15, 2016 or until  
inventory is depleted.  
Recommended replacement  
MPIA40-V1

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



Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPIA40-V1

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

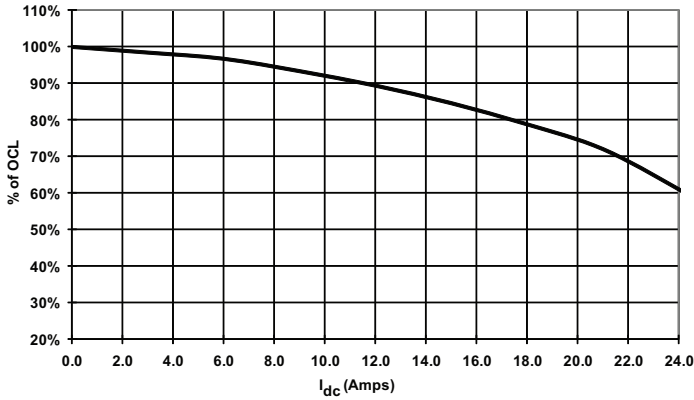


Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPIA40-V1

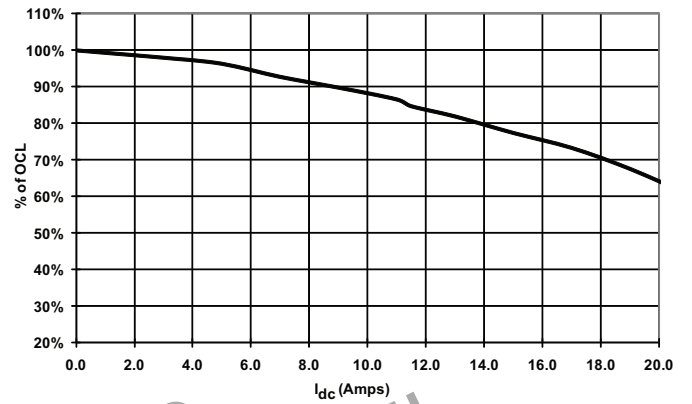


1.85mm Height R3 inductance characteristics — % of OCL vs.  $I_{DC}$

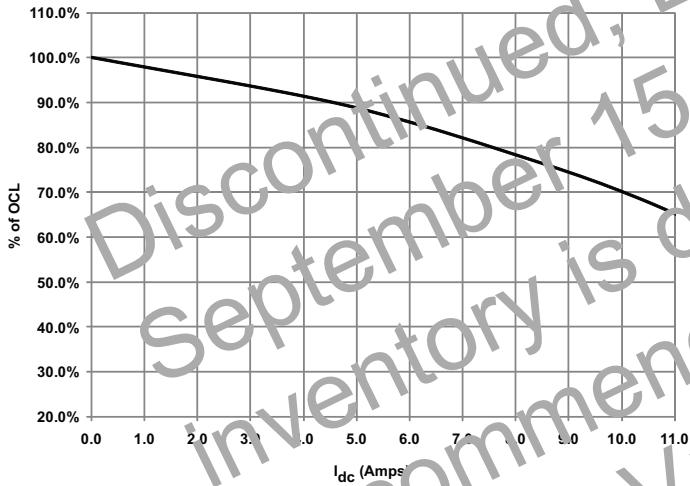
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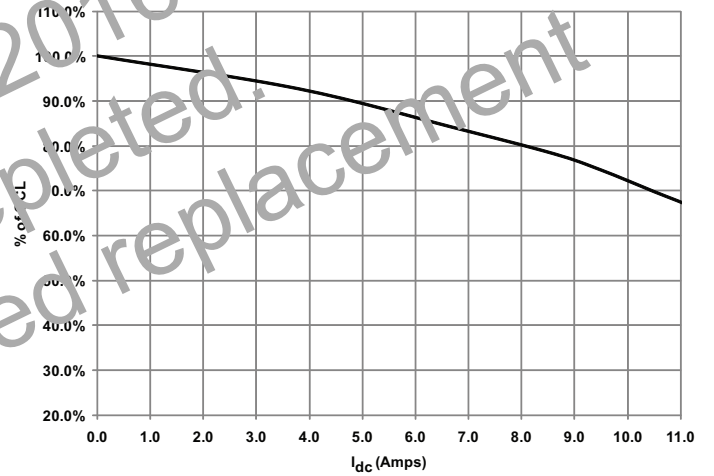
MPIA4040R3-R47-R



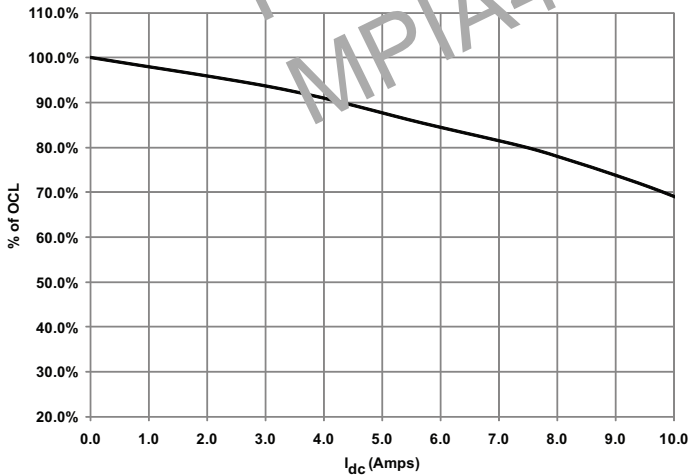
MPIA4040R3-1R2-R



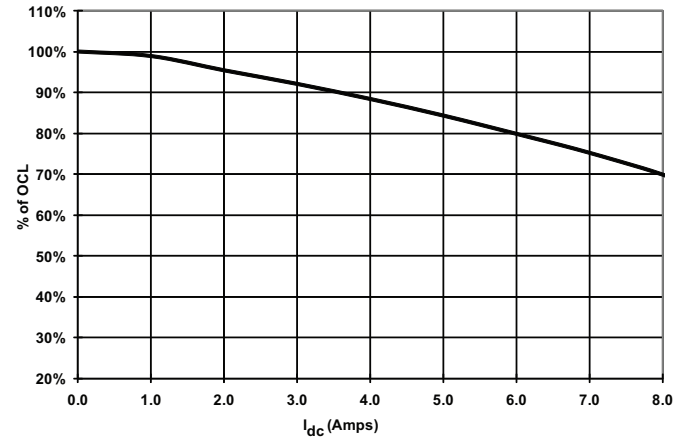
MPIA4040R3-1R5-R



MPIA4040R3-2R2-R



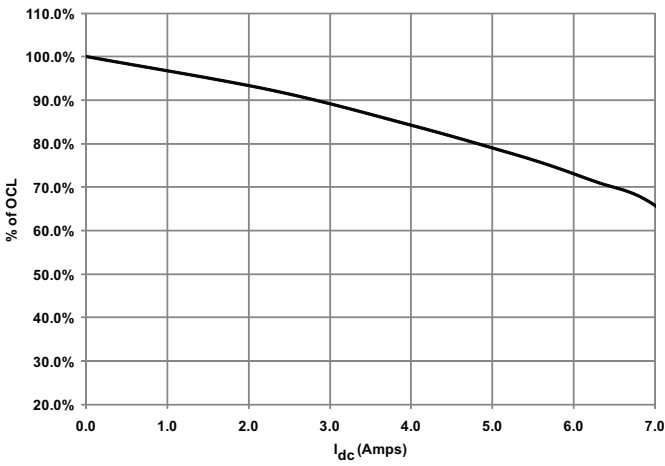
MPIA4040R3-3R3-R



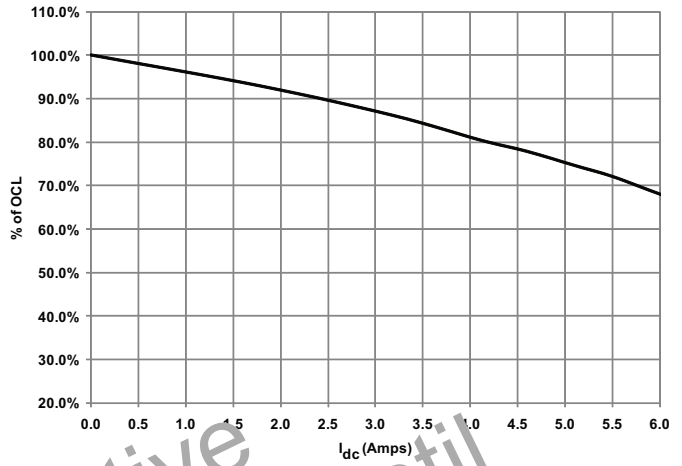
Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPIA40-V1

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

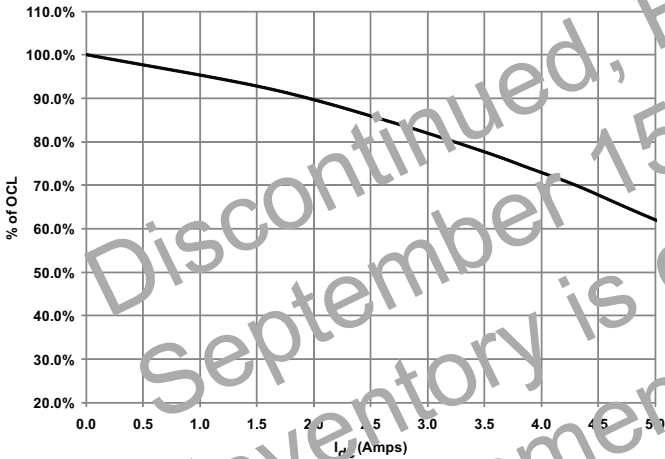
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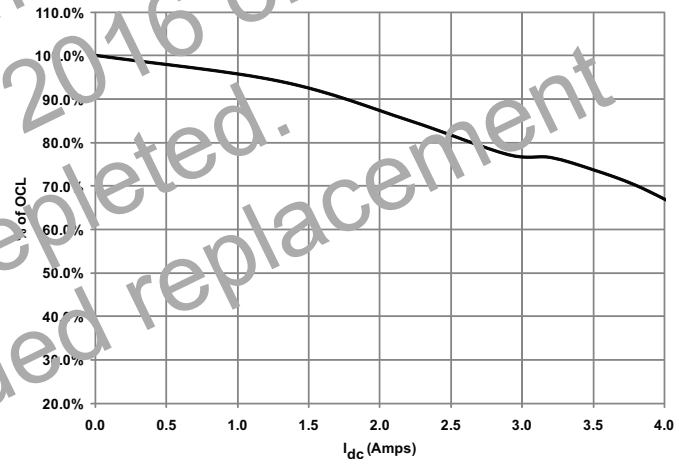
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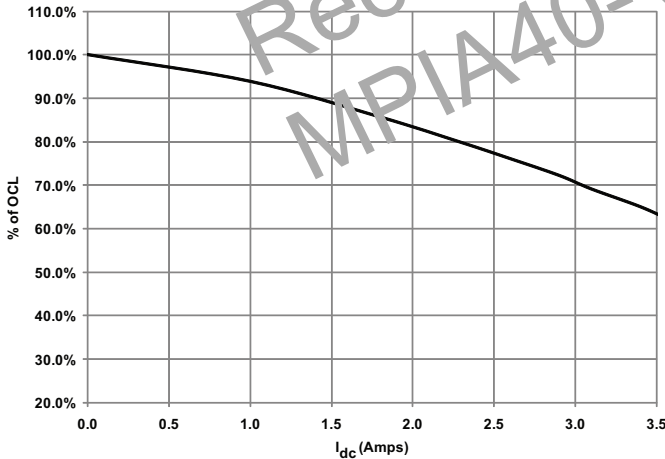
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MPIA4040R3-150-R

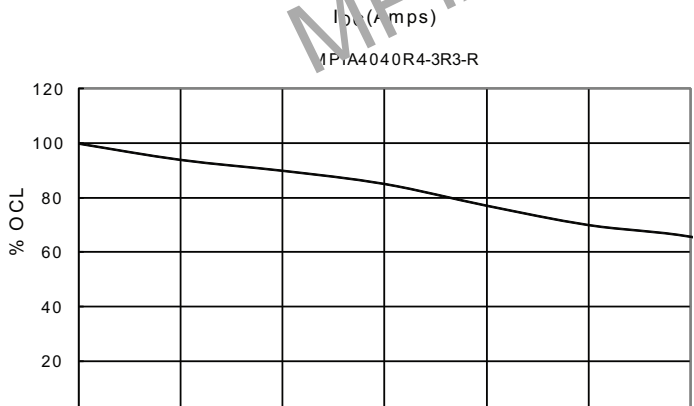
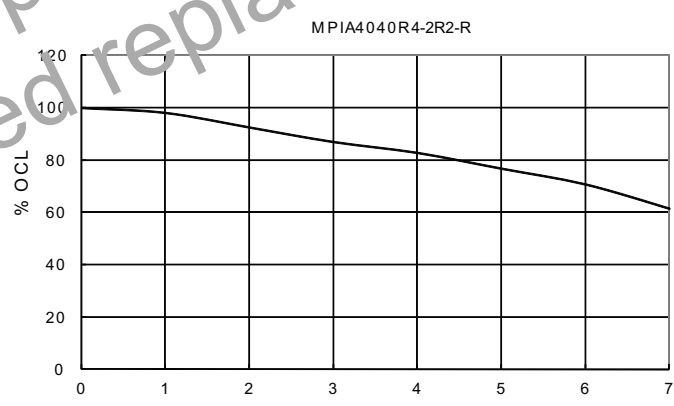
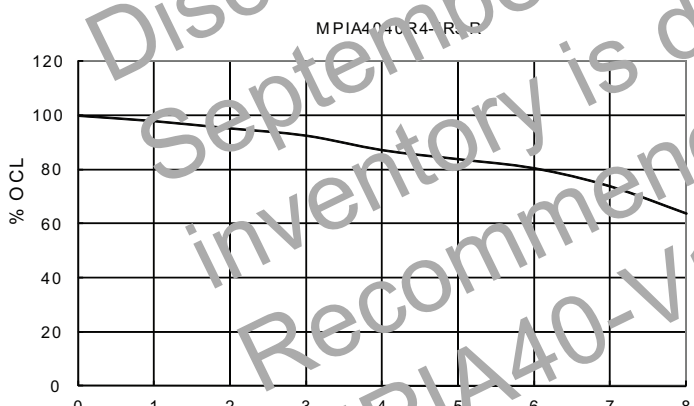
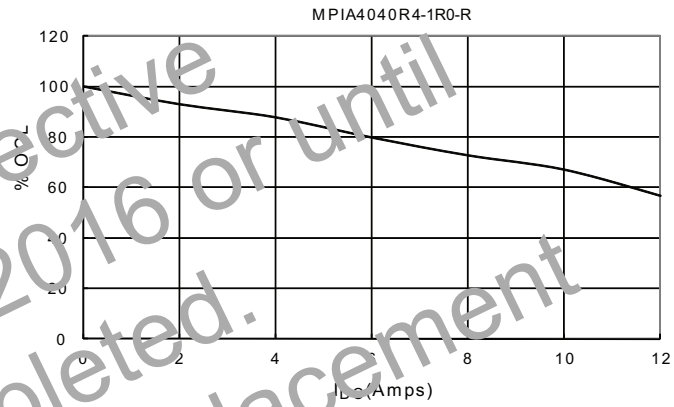
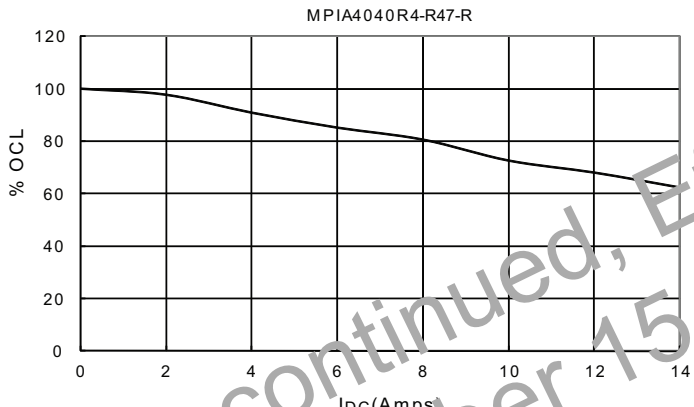
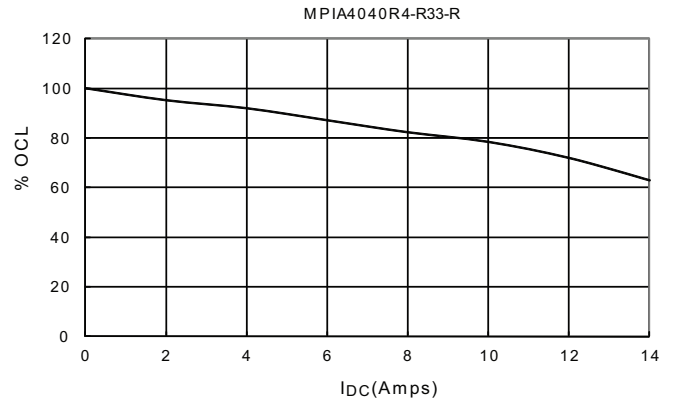
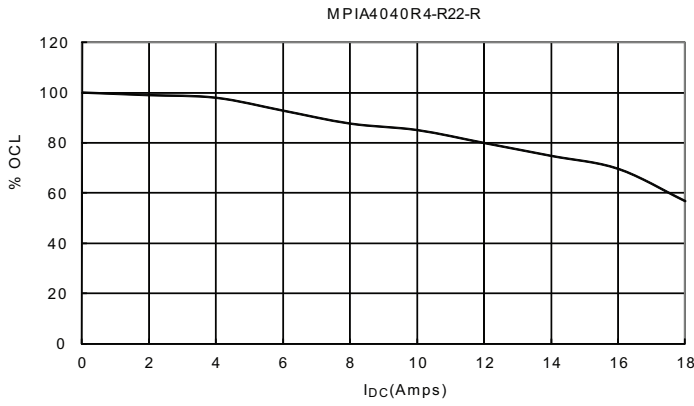


MPIA4040R3-220-R



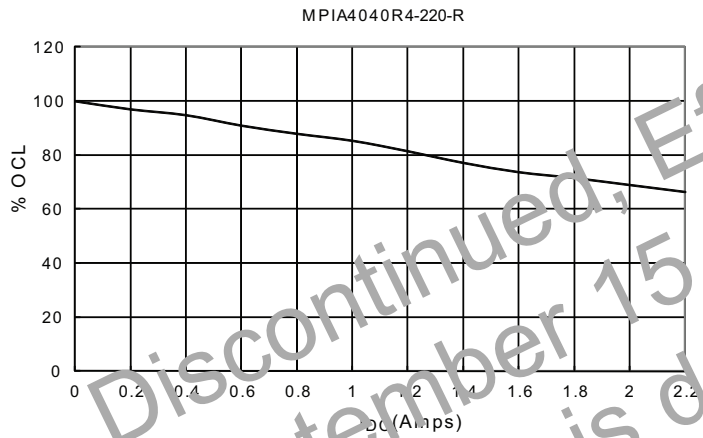
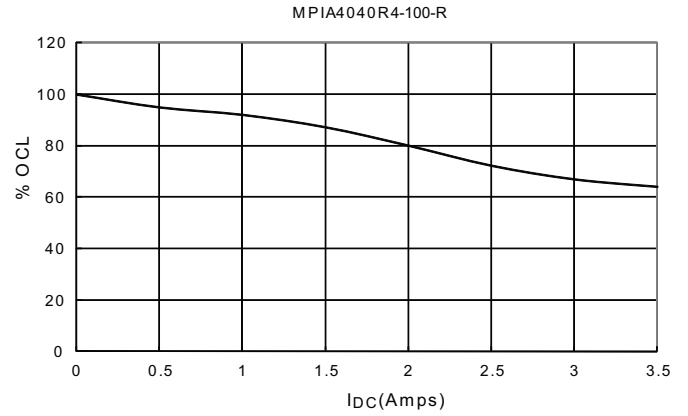
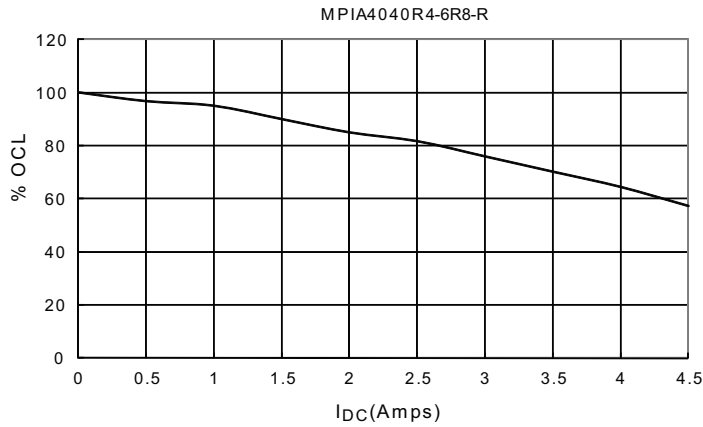
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2.0mm Height R4 inductance characteristics — % of OCL vs.  $I_{DC}$



Discontinued, Effective September 15, 2016 or until inventory is depleted. Recommended replacement MPIA40-V1

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



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inventory is depleted.  
Recommended replacement  
MPIA40-V1

**Solder reflow profile**

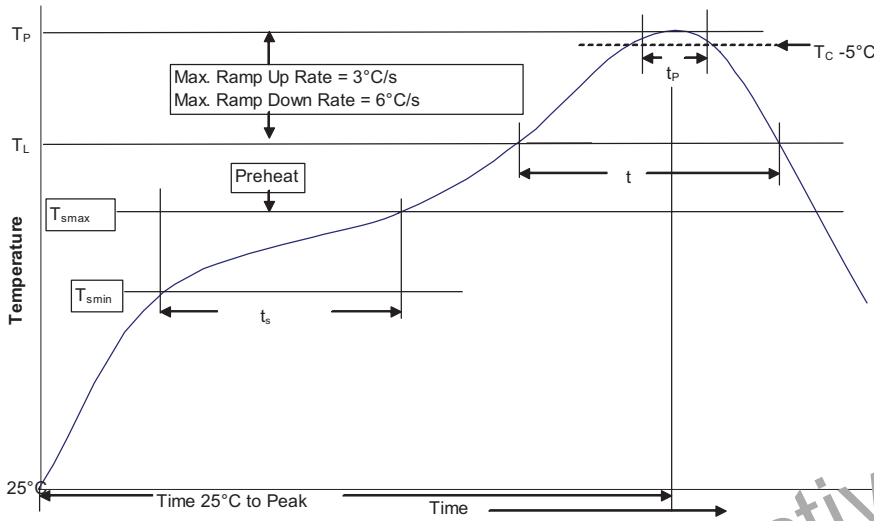


Table 1 - Standard SnPb Solder (T<sub>C</sub>)

Package Thickness	Volume <350 mm <sup>3</sup>	Volume ≥350 mm <sup>3</sup>
<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 <350 mm <sup>3</sup>	Volume 350 - 2000 mm <sup>3</sup>	Volume >2000 mm <sup>3</sup>
<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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