Introduction:

Mach-1™ DC Solid State Contactor switches high-power DC loads up to 2,000VDC and 500A per module. While they support a wide range of power ratings, they can also be configured with the latest semiconductor technology including, SiCFET and GaNFET; this allows a drastic reduction in power loss at higher operating voltages when compared to using conventional BJT semiconductors.

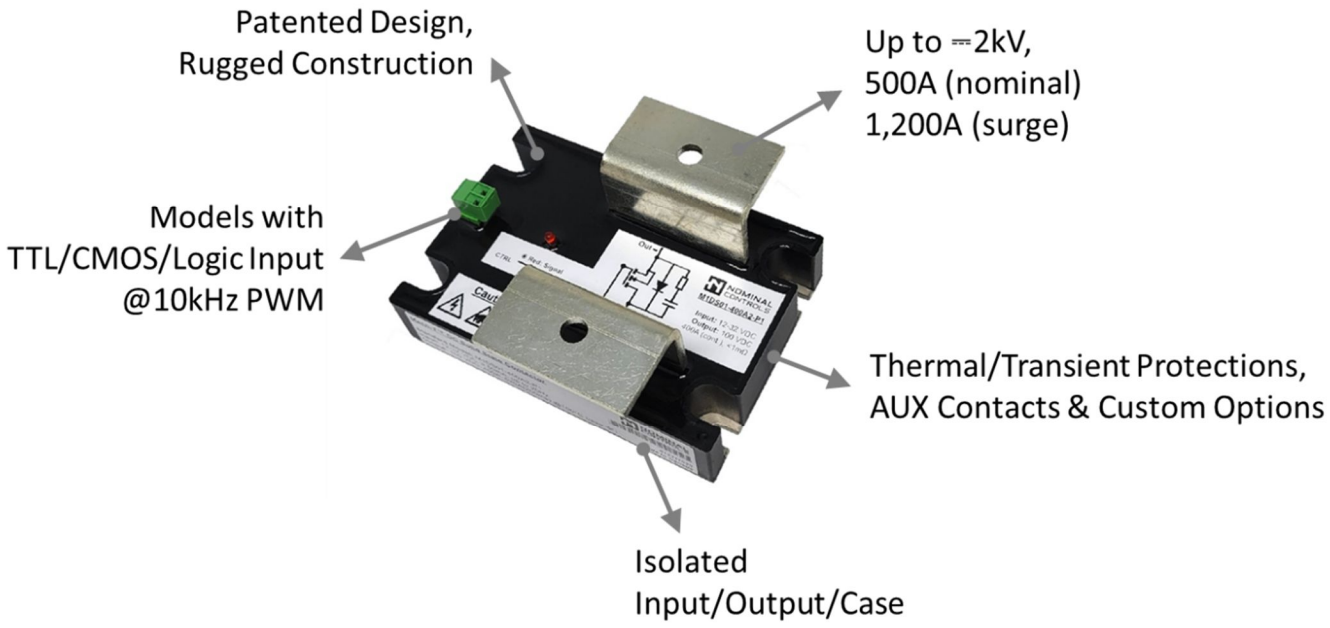
Two available models:

1. **(*M1DS- Series*) Standard Model** is a lower cost Non-PWM model. It may directly retrofit electromechanical contactors.
2. **(*M1DA- Series*) Advanced Model** enables logic PWM up to 10 kHz, thus enabling new applications such as specialized load testing, high-speed circuit interruptions, and PWM power controls.

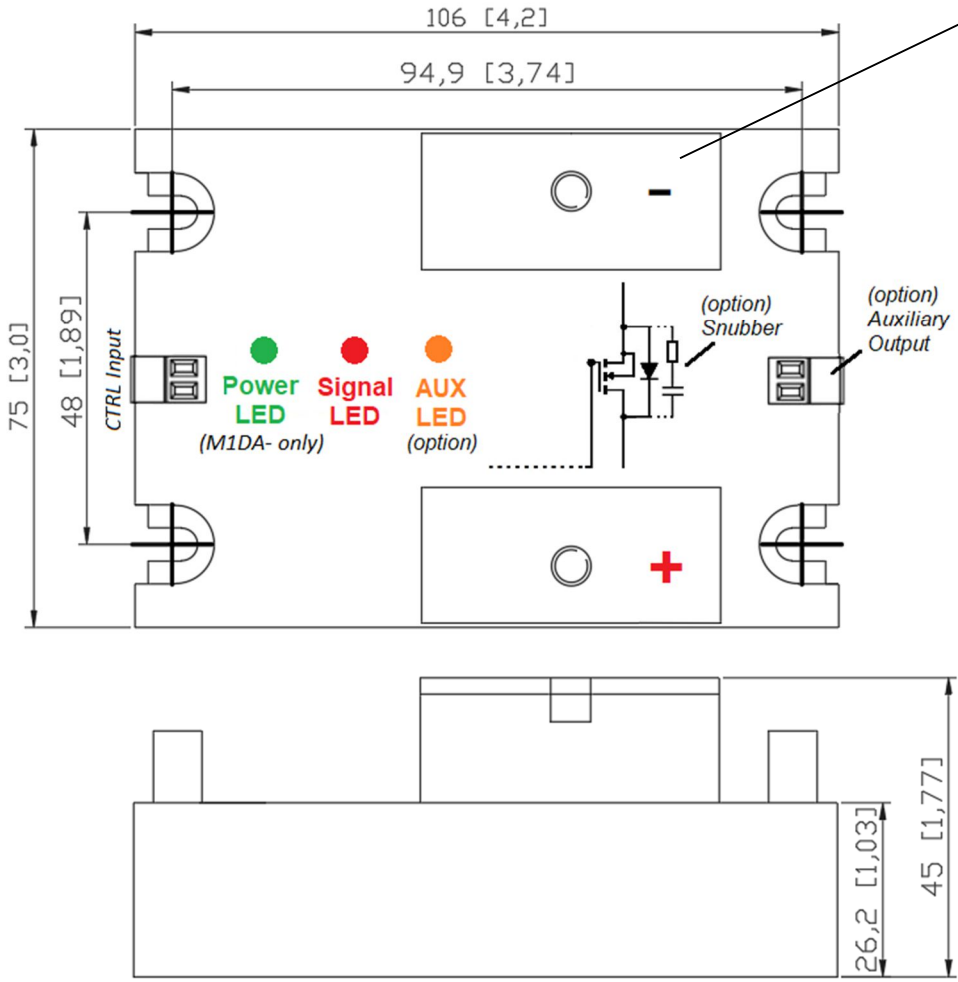
Benefits

- General Purpose Solid-State Switch
- Arc-free, Noise-free, Maintenance-free
- Direct Mechanical Contactor Retrofits
- High Power, Low Loss
- Made in Canada; Semiconductors from USA/Taiwan

Main Features



General Dimensions

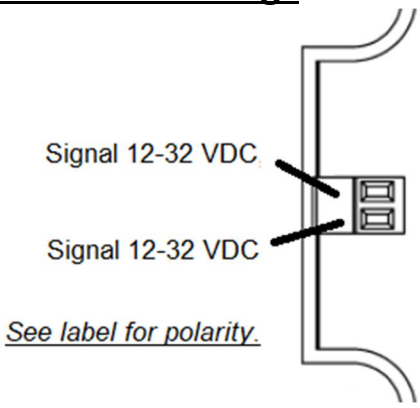


Busbar size may differ for 400A and 500A models.

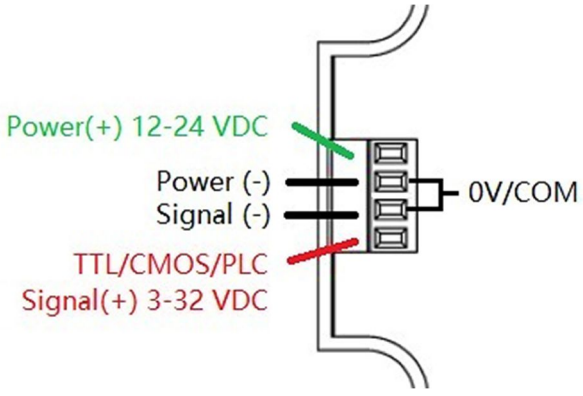
Included Accessories

1x Thermal Pad
4x M4x12 Panel Mount Bolts
2x M6/M8 Busbar Bolts

Control Side Wirings



Standard Model (M1DS-)



Advanced PWM Model (M1DA-)

General Selection Guide:

Ensure sufficient electrical de-ratings; both nominal and peak system parameters (e.g. load voltage, current & transients) must be within the safe limits of the SSC. Below lists some common considerations for various loads.

- When switching resistive loads, consider a 25% margin for both voltage and current parameters.
- When switching constant current loads, ensure open circuit voltage does not exceed SSC's limits.
- When switching motor loads, note both stall & inrush current can be 5-8x higher than normal.
- When switching capacitive loads, ensure the initial short-circuit current condition does not exceed the SSC's peak ratings.
- When switching inductive loads, in addition to higher de-ratings, the user should take measures to suppress back-EMF transients (i.e. using freewheel diodes and snubbers). Note at high currents, even low to moderate inductance can generate high energy transients.

Part# Guide:

<table>
<tr><th colspan="2">Mach-1® Model</th><th colspan="2">Output Voltage</th><th></th><th>Rated Continuous Current</th><th colspan="2">Control Input</th><th></th><th colspan="2">Other Features</th></tr>
<tr><td colspan="2">M1DA</td><td colspan="2">01</td><td>-</td><td>500A</td><td colspan="2">-</td><td>-</td><td colspan="2">P1</td><td>-</td></tr>
<tr><td rowspan="3">M1DS</td><td rowspan="3">Standard Model (ON/OFF up to 20 Hz)</td><td>01 =</td><td>1 - 100 VDC</td><td rowspan="5"></td><td rowspan="8">Rated Continuous Current (A)

*2X250A = models with 2x 250A outputs in parallel.</td><td>-</td><td>3 - 32 VDC</td><td rowspan="8"></td><td rowspan="8">P1/P2 = Internal/External Transient Snubber

T1 = Internal Over-temperature Protection

AX = Auxiliary Contact (advanced PWM model only)

SiC = Silicon-Carbide Models</td><td rowspan="8">Other Reference</td></tr>
<tr><td>01A =</td><td>1 - 150 VDC</td><td>1 =</td><td>3.3 - 11 VDC</td></tr>
<tr><td>02 =</td><td>1 - 200 VDC</td><td>2 =</td><td>12 - 32 VDC</td></tr>
<tr><td rowspan="5">M1DA</td><td rowspan="5">Advanced PWM Model (up to 10 KHz)</td><td>06 =</td><td>1 - 600 VDC</td><td>3 =</td><td>12 - 24 VDC</td></tr>
<tr><td>10/1K=</td><td>1 - 1,000 VDC</td><td>4 =</td><td>36 - 75 VDC</td></tr>
<tr><td>15/1K5=</td><td>1 - 1,500 VDC</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>20/2K=</td><td>1 - 2,000 VDC</td></tr>
<tr><td></td><td></td></tr>
</table>

Contact us for custom options (i.e special use, or higher ratings)

NOMINAL CONTROLS

Mach-1® DC SSC Datasheet

(MOSFET Output, Rated 40 to 200 VDC)

	Group A (100 - 200 VDC)				
Part#	**M1D□004-400A**	**M1D□01-400A**	**M1D□01-500A**	**M1D□01A-250A**	**M1D□01A-500A**
	Output Specifications				
Rated Voltage	1 - 40 VDC	1 - 100 VDC	1 - 100 VDC	1 - 150 VDC	1 - 150 VDC
Rated Load Current [1]	400 A	400 A	500 A	250 A	500 A
Rated Peak Current [2]	750A (@90°C), 900A (@25°C)	500A (@90°C), 600A (@25°C)	1200A (@90°C), 1400A (@25°C)	400A (@90°C), 500A (@25°C)	800A (@90°C), 900A (@25°C)
Typical ON Resistance	0.45 mΩ	0.9 mΩ	0.45 mΩ	1.7 mΩ	0.9 mΩ
Max Leakage Current	<0.1 mA	<0.1 mA	<0.2 mA	<0.1 mA	<0.2 mA
Max PWM [3]	20 Hz (Standard Model) 10 kHz (Advanced Model)	20 Hz (Standard Model) 5 kHz (Advanced Model)	20 Hz (Standard Model) 3 kHz (Advanced Model)	20 Hz (Standard Model) 10 kHz (Advanced Model)	20 Hz (Standard Model) 3 kHz (Advanced Model)
	Standard Model - Input Specifications			**Advanced PWM Model - Input Specifications**	
Control Power Supply	N/A			12-24VDC *(~100mA)*	
Control Input Voltage	12-32VDC ~100mA *(customizable)*			3-32VDC ~2mA *(TTL/CMOS/Logic compatible)*	
Turn-On Response Delay[4]	<5 ms			<50 µs	
Turn-Off Response Delay[4]	<10 ms			<50 µs	
Must Turn-Off Voltage	<10.5 VDC			<1.5 VDC	
Isolation Voltage	Input/Output/Case: 2.5kV (AC 1min 50/60hz)				
LED Indicators	Red (signal) Green (power, *advanced PWM model only*) Amber (auxiliary output, *advanced PWM model only,* 1xNO 200V/200mA)				
	Temperature & Physical Specifications				
Operating/Storage Temp.	-40 to 80°C				
Max Junction & Max Baseplate Temp.	140°C & 90°C	140°C & 90°C	140°C & 90°C	140°C & 90°C	140°C & 90°C
Thermal Impedance [5]	R_{JC} = 0.08°C/W, R_{CH}=0.05°C/W	R_{JC} = 0.12°C/W, R_{CH}=0.05°C/W	R_{JC} = 0.04°C/W, R_{CH}=0.04°C/W	R_{JC} = 0.1°C/W, R_{CH}=0.05°C/W	R_{JC} = 0.06°C/W, R_{CH}=0.04°C/W
Control Input Termination	16-28 AWG (max 0.2 Nm)				
Output Termination	Busbar, M6 rivet nut	Busbar, with M6 rivet nut	Busbar, with M8 rivet nut	Busbar, with M6 rivet nut	Busbar, with M8 rivet nut
Overall Dimensions LxWxH	106x85x45 mm	106x85x45 mm	106x95x45 mm	106x85x45 mm	106x95x45 mm
Material	flame retardant case(PBT) & encapsulate				
Typical Weight	385g	385g	450g	400g	450
M.T.B.F [6]	3 million hours, or 50-250 million cycles				

[1] Rated continuous load current assumes device's baseplate is at a maximum allowable temperature of 90°C

[2] Rated peak current at various baseplate temperatures. Peak-current-withstanding-duration depends on active cooling provided up to a maximum of 5 seconds

[3] Exceeding recommended PWM frequency may result in deviations to output duty cycle

[4] Signal response delay only, actual switching speed is typically in the range of 10's of µS

[5] R_{ch} assumes thermal interface material of 1W/mK, 0.1mm, is applied between the base plate and the heatsink surface

[6] Assumes device is well cooled with baseplate temp. of no more than 60°C

Mach-1® DC SSC Datasheet

(BJT Output, Rated 600 to 1,500 VDC)

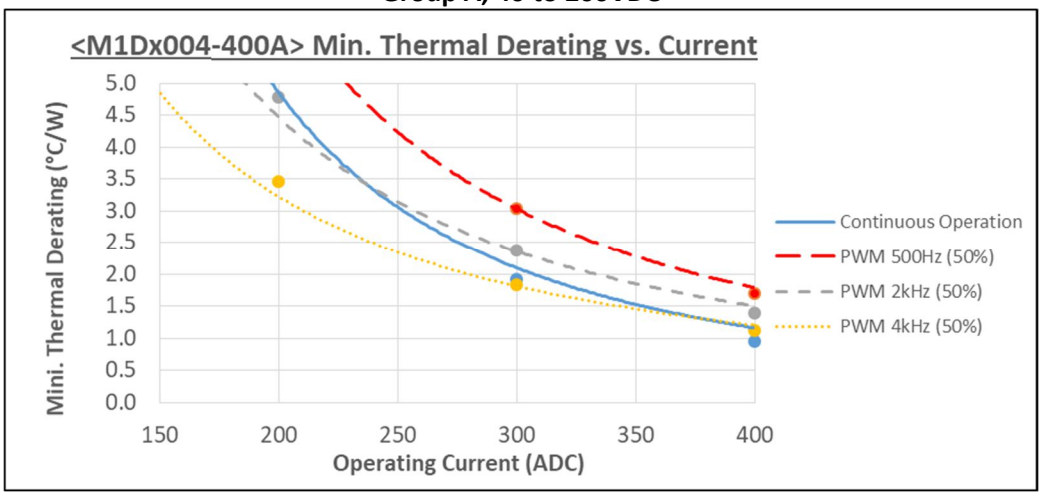
	Group B (600 VDC to 1,500 VDC)				
Part#	**M1D□06-120A**	**M1D□06-200A**	**M1D□1K-150A**	**M1D□1K-250A**	**M1D□1K5-90A**
	Output Specifications				
Rated Voltage	1 - 600 VDC	1 - 600 VDC	1 - 1,000 VDC	1 - 1,000 VDC	1 – 1,500 VDC
Rated Load Current [1]	120 A	200 A	150 A	250 A	90 A
Rated Peak Current [2]	250A (@25°C) 200A (@90°C)	300A (@25°C) 250A (@90°C)	250A (@25°C) 150A (@90°C)	300A (@25°C) 250A (@90°C)	150A (@25°C) 90A (@90°C)
Typical ON Voltage Drop	1.5V@80A	1.5V@150A	1.7V@100A	1.75V@180A	2.5V @60A
Max Leakage Current	<1 mA	<2 mA	<2 mA	<5 mA	<1 mA
Max PWM [3]	20 Hz (Standard Model) 10 kHz (Advanced Model)	20 Hz (Standard Model) 5 kHz (Advanced Model)	20 Hz (Standard Model) 10 kHz (Advanced Model)	20 Hz (Standard Model) 5 kHz (Advanced Model)	20 Hz (Standard Model) 10 kHz (Advanced Model)
	Standard Model - Input Specifications			**Advanced PWM Model - Input Specifications**	
Control Input Voltage DC	N/A			12-24VDC *(~100mA)*	
Control Input Current	12-32VDC ~100mA *(customizable)*			3-32VDC ~2mA *(TTL/CMOS/Logic compatible)*	
Turn-On Response Delay [4]	<5 ms			<50 µs	
Turn-Off Response Delay [4]	<10 ms			<50 µs	
Must Turn-Off Voltage	<10.5 VDC			<1.5 VDC	
Isolation Voltage	Input/Output/Case: 2.5kV (AC 1min 50/60hz)				
LED Indicators	Red (signal) Green (power, *advanced PWM model only*) Amber (auxiliary output, *advanced PWM model only,* 1xNO 200V/200mA)				
	Temperature & Physical Specifications				
Operating/Storage Temp.	-40 to 80°C				
Rated Maximum Junction & Baseplate Temp.	125°C & 90°C	125°C & 90°C	125°C & 90°C	125°C & 90°C	125°C & 90°C
Thermal Impedance [5]	R_{JC} = 0.29°C/W, R_{CH}=0.07°C/W	R_{JC} = 0.16°C/W, R_{CH}=0.05°C/W	R_{JC} = 0.12°C/W, R_{CH}=0.07°C/W	R_{JC} = 0.07°C/W, R_{CH}=0.05°C/W	R_{JC} = 0.3°C/W, R_{CH}=0.1°C/W
Control Input Termination	16-28 AWG (max 0.2 Nm)				
Output Terminations	Busbar, with M6 rivet nut				
Overall Dimensions LxWxH	106x73x40 mm	106x73x40 mm	106x73x40 mm	106x73x40 mm	106x73x40 mm
Materials	Case: Flame retardant PBT | Encapsulate: Flame retardant compound				
Typical Weight	340g	360g	340g	360g	340g
M.T.B.F	3 million hours, or 50-250 million cycles				

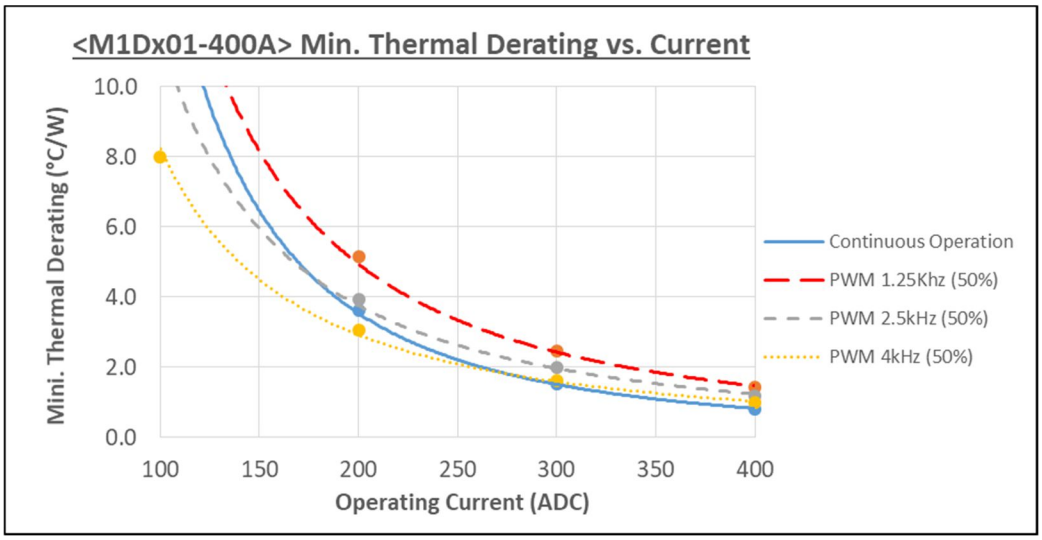
	Group C (1kV+ with Silicon Carbide Semiconductor)				
Part#	**M1D□1K-100A-SIC**	**M1D□1K-350A-SIC**	**M1D□1K5-150A-SIC**	**M1D□2K-60A-SIC**	-
Rated Voltage	pending	pending	pending	pending	-
Rated Load Current [1]					
Rated Peak Current [2]					
Typical ON-Resistance					
Max Leakage Current					
Recommended Max PWM [3]					
	Standard Model - Input Specifications		**Advanced PWM Model - Input Specifications**		
Control Input Voltage DC	N/A		12-24VDC *(~100mA)*		
Control Input Current	12-32VDC ~100mA *(customizable)*		3-32VDC ~2mA *(TTL/CMOS/Logic compatible)*		
Turn-On Response Delay [4]	<5 ms		<50 µs		
Turn-Off Response Delay [4]	<10 ms		<50 µs		
Must Turn-Off Voltage	<10.5 VDC		<1.5 VDC		
Isolation Voltage	Input/Output/Case: 2.5kV (AC 1min 50/60hz)				
LED Indicators	Red (signal) Green (power, *advanced PWM model only*) Amber (auxiliary output, *advanced PWM model only,* 1xNO 200V/200mA)				
Operating/Storage Temp.	-40 to 80°C				
Rated Maximum Junction & Baseplate Temp.	-	-	-	-	-
Thermal Impedance [5]					
Control Input Termination					
Output Termination					
Overall Dimensions LxWxH					
Materials					
Typical Weight					
M.T.B.F	3 million hours, or 50-250 million cycles				

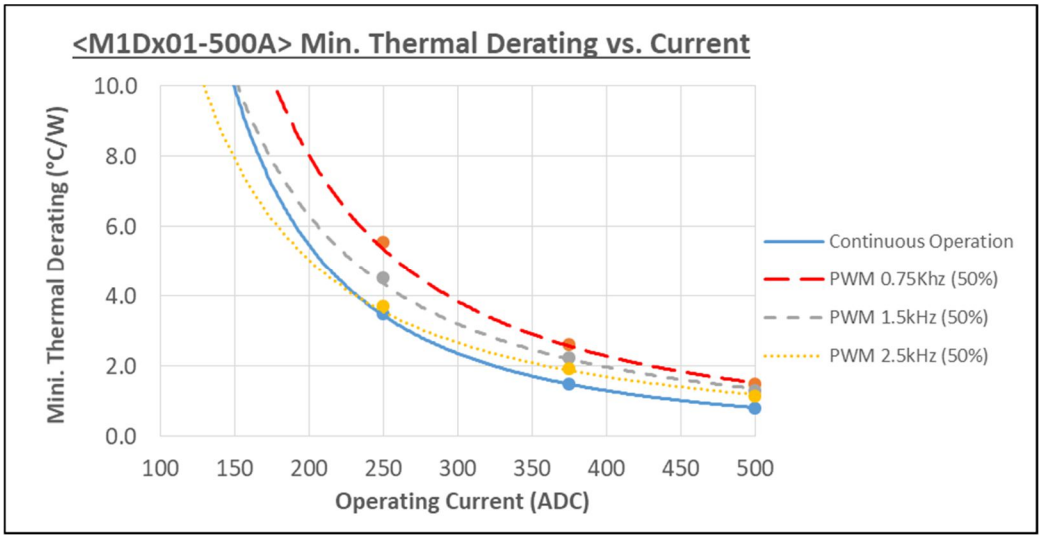
Thermal Derating Requirements

Minimum Thermal Derating Assumes an Ambient Temperature of 40°C, and max baseplate temperature of 90°C

<Group A, 40 to 200VDC>



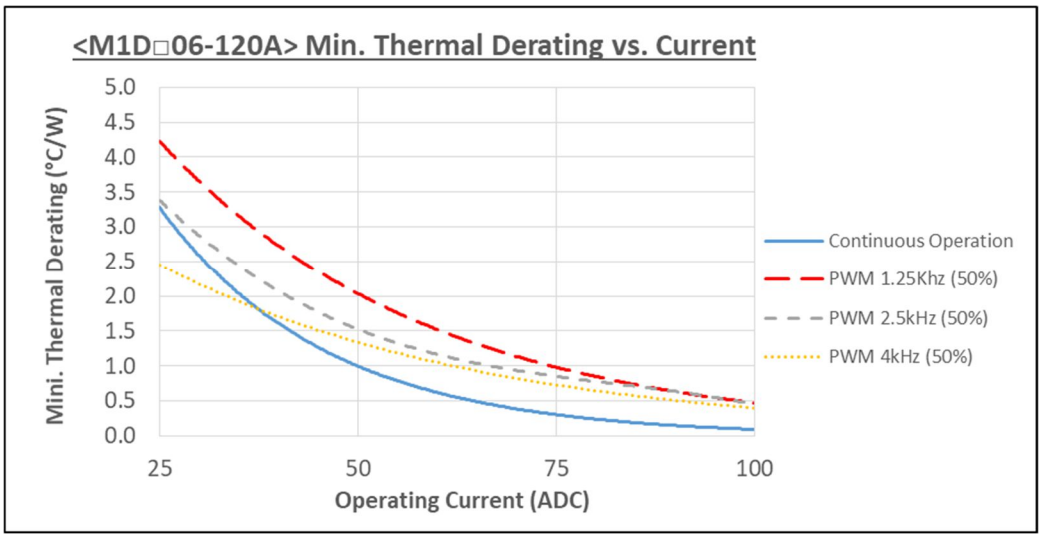


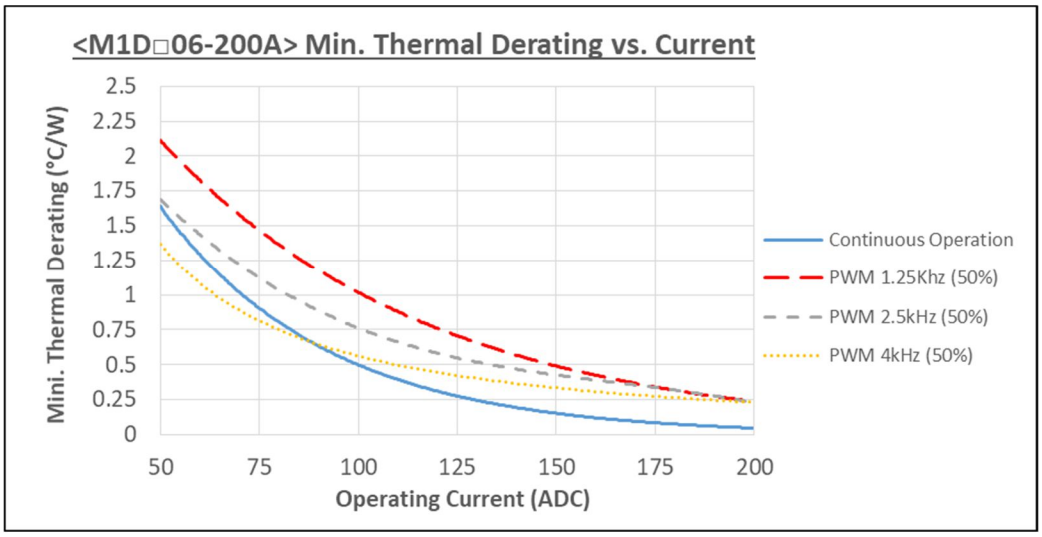


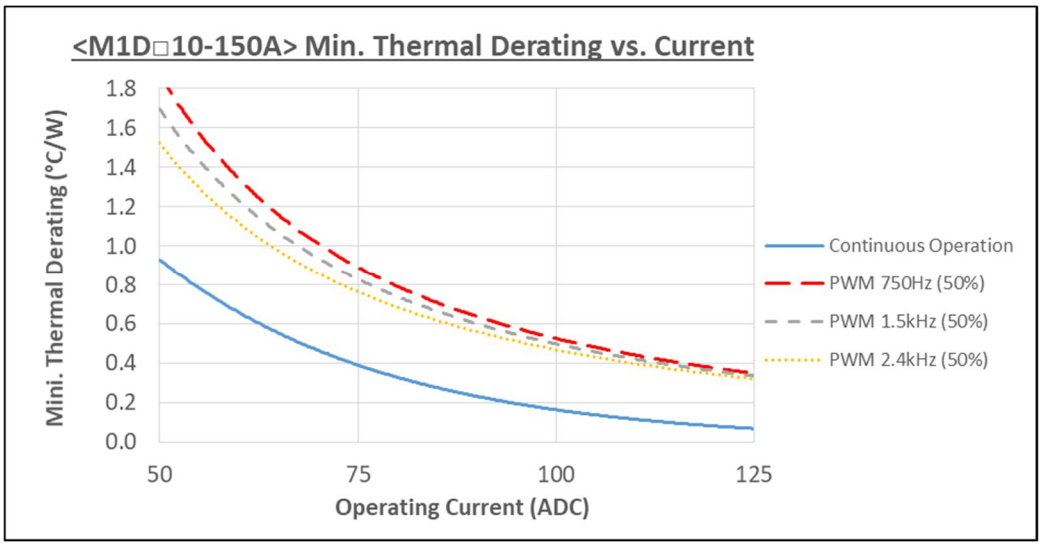
M1Dx01A-250A (pending)

M1Dx01A-500A (pending)

<Group B, 600 VDC to 1,500 VDC>







Thermal Derating Requirements