## *flow* MNPC 4w — mixed voltage NPC Application — 1200V/400A

**General conditions**

| half bridge IGBT | | |
|---|---|---|
| $V_{GEon}$ | = | 15 V |
| $V_{GEoff}$ | = | -15 V |
| $R_{gon}$ | = | 1,875 Ω * |
| $R_{goff}$ | = | 1,875 Ω * |

Vout= 230 VAC

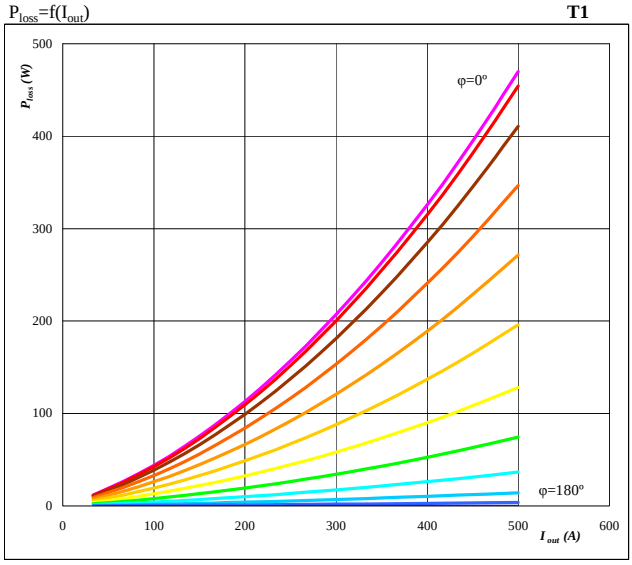
* including chip gate resistor

| neutral point IGBT | | |
|---|---|---|
| $V_{GEon}$ | = | 15 V |
| $V_{GEoff}$ | = | -15 V |
| $R_{gon}$ | = | 1,5 Ω * |
| $R_{goff}$ | = | 1,5 Ω * |

**Figure 1.** half bridge IGBT

**Typical average static loss as a function of of output current $I_{oRMS}$**

$P_{loss}=f(I_{out})$ T1

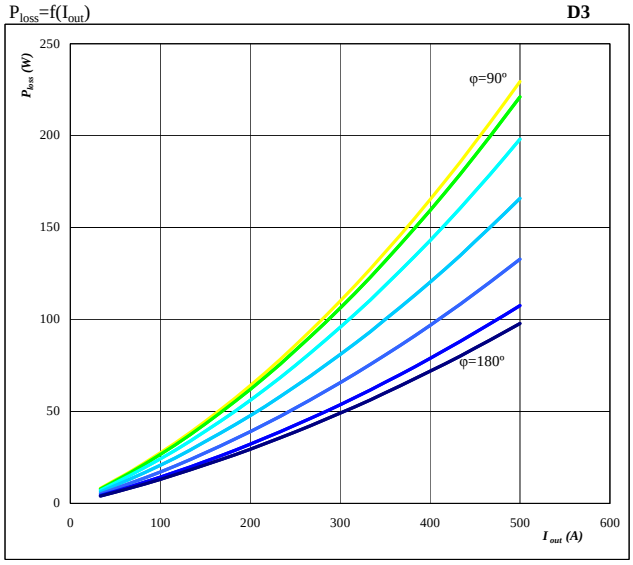



Conditions: $T_j$= 125 °C
parameter: **φ** from 0° to 180°
in 12 steps

**Figure 2.** neutral point FWD

**Typical average static loss as a function of output current $I_{oRMS}$**

$P_{loss}=f(I_{out})$ D3

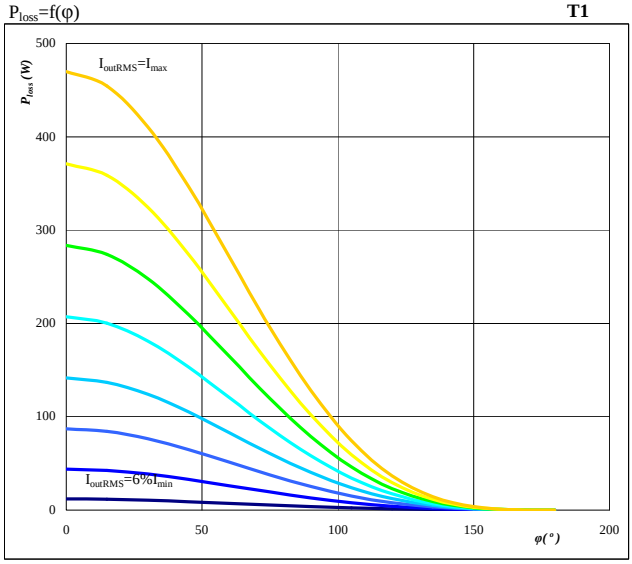



Conditions: $T_j$= 125 °C
parameter: **φ** from 0° to 180°
in 12 steps

**Figure 3.** half bridge IGBT

**Typical average static loss as a function of phase displacement φ**

$P_{loss}=f(\varphi)$ T1

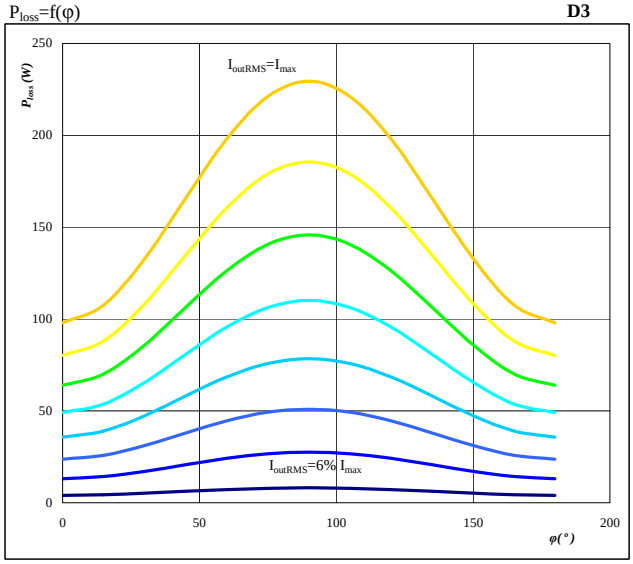



Conditions: $T_j$= 125 °C
parameter: $I_{oRMS}$ from 33,33 A to 500 A
in steps of 67 A

**Figure 4.** neutral point FWD

**Typical average static loss as a function of phase displacement φ**

$P_{loss}=f(\varphi)$ D3



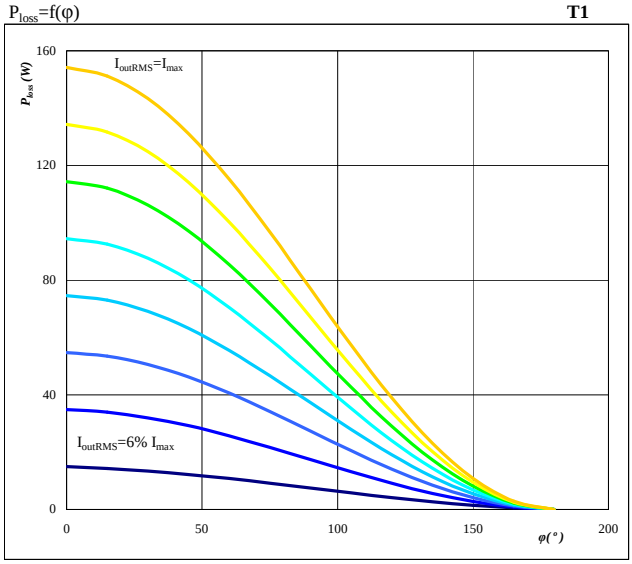

Conditions: $T_j$= 125 °C
parameter: $I_{oRMS}$ from 33,33 A to 500 A
in steps of 67 A

## *flow* MNPC 4w — mixed voltage NPC Application — 1200V/400A

**Figure 5.** half bridge IGBT

**Typical average switching loss as a function of phase displacement φ**

$P_{loss}=f(\varphi)$ **T1**

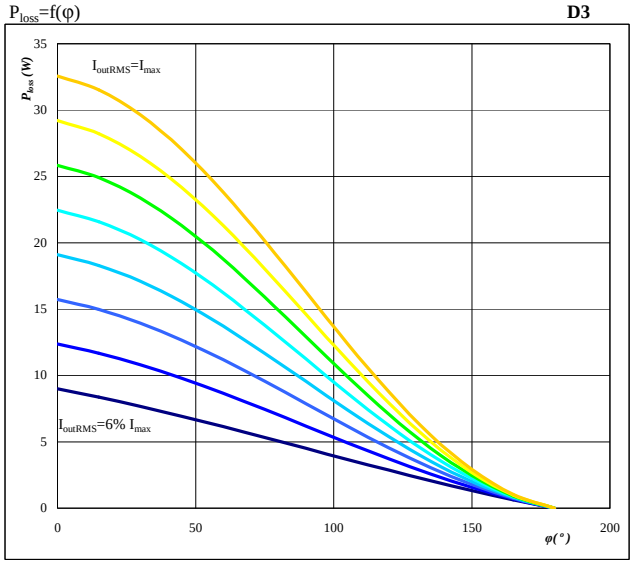



Conditions: $T_j$= 125 °C; $f_{sw}$= 8 kHz; DC link= 700 V
parameter: $I_{oRMS}$ from 33,33 A to 500 A in steps of 67 A

**Figure 6.** neutral point FWD

**Typical average switching loss as a function of phase displacement φ**

$P_{loss}=f(\varphi)$ **D3**

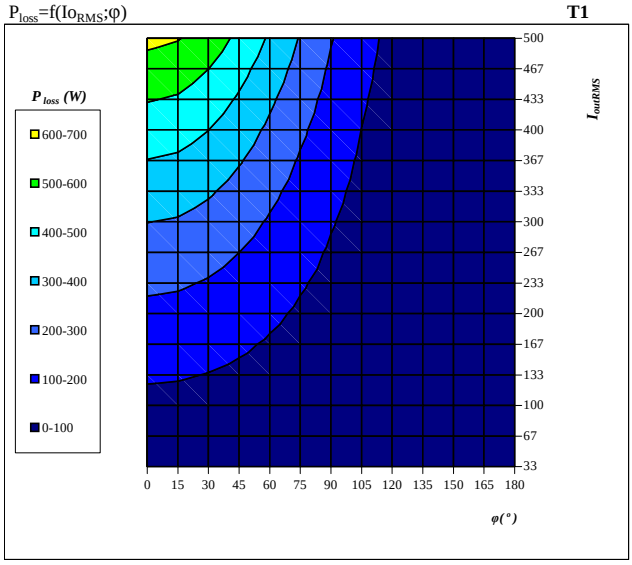



Conditions: $T_j$= 125 °C; $f_{sw}$= 8 kHz; DC link= 700 V
parameter: $I_{oRMS}$ from 33,33 A to 500 A in steps of 67 A

**Figure 7.** half bridge IGBT

**Typical total loss as a function of phase displacement φ and output current $I_{oRMS}$**

$P_{loss}=f(Io_{RMS};\varphi)$ **T1**

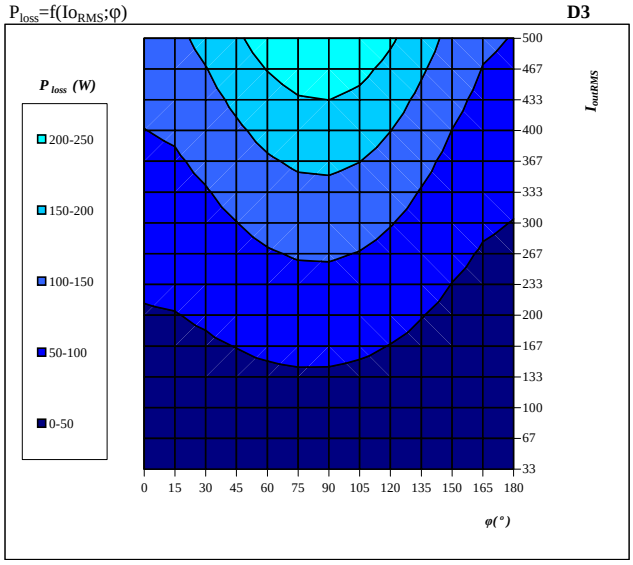



Conditions: $T_j$= 125 °C; DC link= 700 V; $f_{sw}$= 8 kHz

**Figure 8.** neutral point FWD

**Typical total loss as a function of phase displacement φ and output current $I_{oRMS}$**

$P_{loss}=f(Io_{RMS};\varphi)$ **D3**



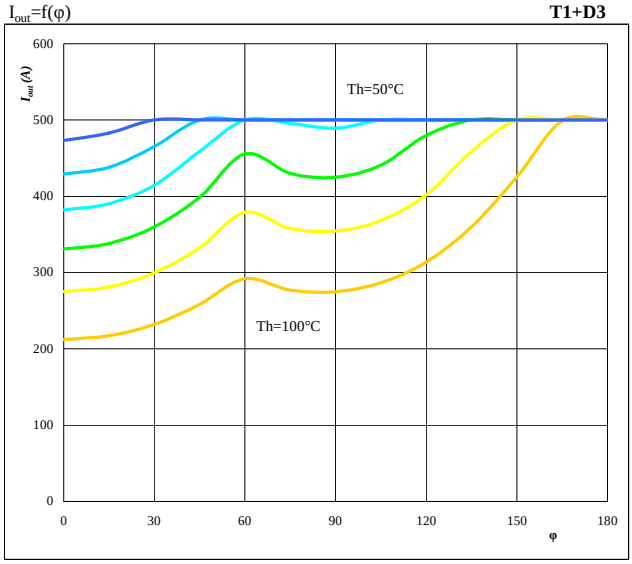

Conditions: $T_j$= 125 °C; DC link= 700 V; $f_{sw}$= 8 kHz

| *flow* MNPC 4w | mixed voltage NPC Application | 1200V/400A |
|---|---|---|

**Figure 9.** for half bridge IGBT+ neutral point FWD

**Typical available output current as a function of phase displacement φ**

$I_{out}=f(\varphi)$ **T1+D3**

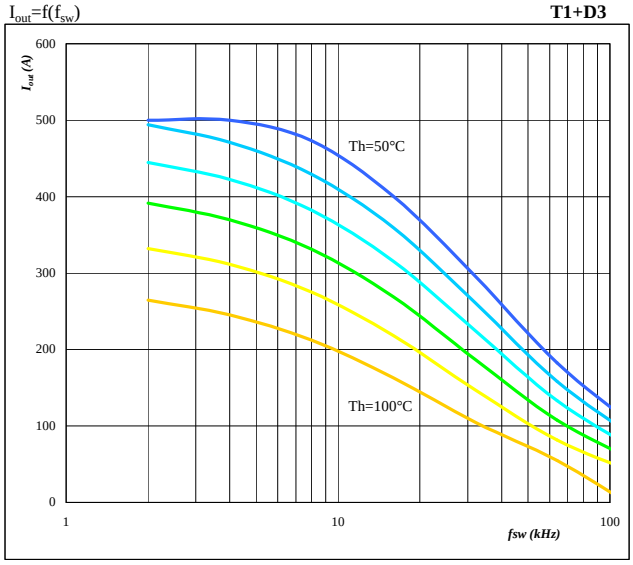



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | $f_{sw}$= | 8 | kHz |
| | DC link= | 700 | V | | | |
| parameter: | Heatsink temp. | | | | | |
| | $T_h$ from | 50 | °C to | 100 | °C | |
| | in | 10 | °C | steps | | |

**Figure 10.** for half bridge IGBT+ neutral point FWD

**Typical available output current as a function of switching frequency $f_{sw}$**

$I_{out}=f(f_{sw})$ **T1+D3**

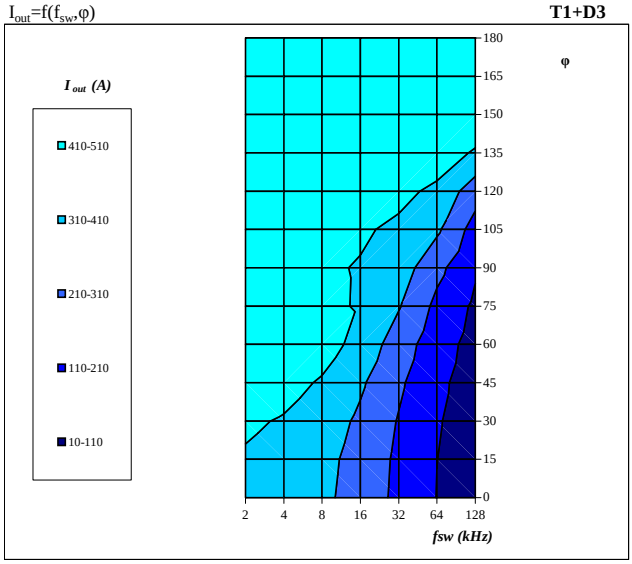



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | | φ= | 0 ° |
| | DC link= | 700 | V | | | |
| parameter: | Heatsink temp. | | | | | |
| | $T_h$ from | 50 | °C to | 100 | °C | |
| | in | 10 | °C | steps | | |

**Figure 11.** for half bridge IGBT+ neutral point FWD

**Typical available 50Hz output current as a function of fsw and phase displacement φ**

$I_{out}=f(f_{sw},\varphi)$ **T1+D3**



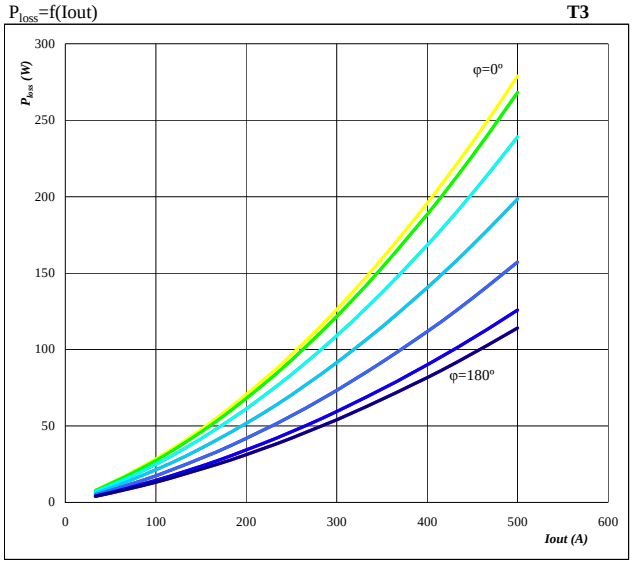

| | | | |
|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C |
| | DC link= | 700 | V |
| | $T_h$= | 80 | °C |

## *flow* MNPC 4w — mixed voltage NPC Application — 1200V/400A

**Figure 12.** neutral point IGBT

**Typical average static loss as a function of output current**

$P_{loss}=f(Iout)$ **T3**

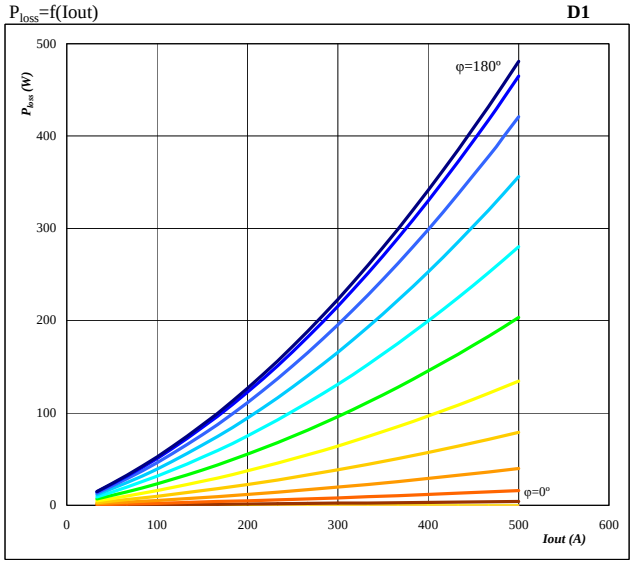



Conditions: $T_j$= 125 °C
parameter: **φ** from 0° to 180°
in 12 steps

**Figure 13.** half bridge FWD

**Typical average static loss as a function of output current**

$P_{loss}=f(Iout)$ **D1**

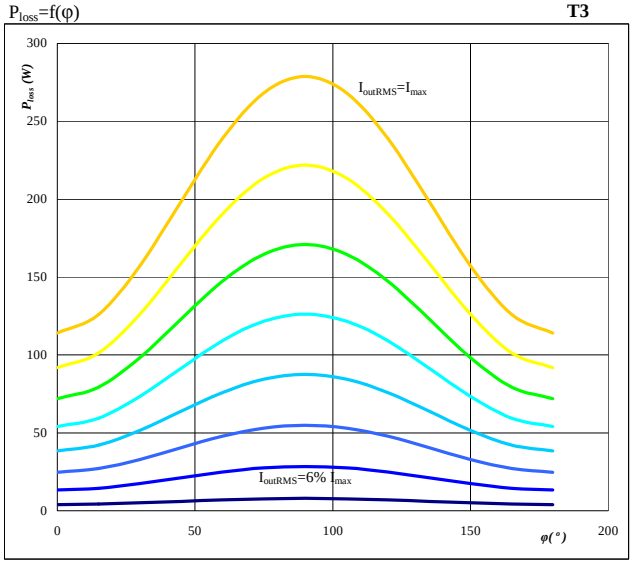



Conditions: $T_j$= 125 °C
parameter: **φ** from 0° to 180°
in 12 steps

**Figure 14.** neutral point IGBT

**Typical average static loss as a function of phase displacement**

$P_{loss}=f(\varphi)$ **T3**

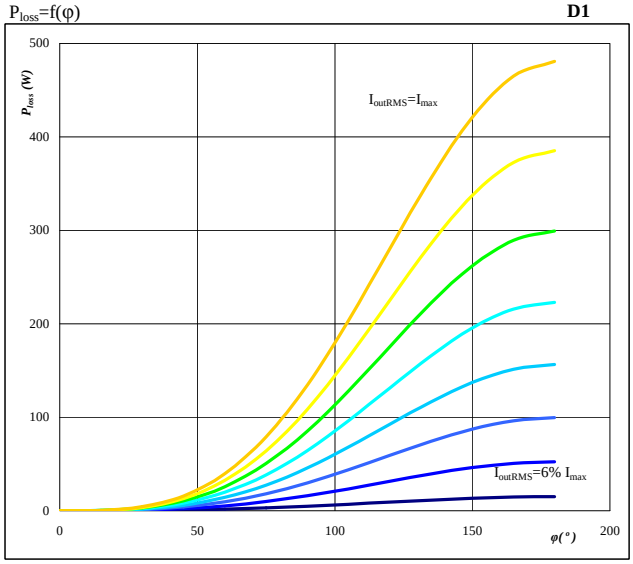



Conditions: $T_j$= 125 °C
parameter: $I_{oRMS}$ from 33 A to 500 A
in steps of 67 A

**Figure 15.** half bridge FWD

**Typical average static loss as a function of phase displacement**

$P_{loss}=f(\varphi)$ **D1**



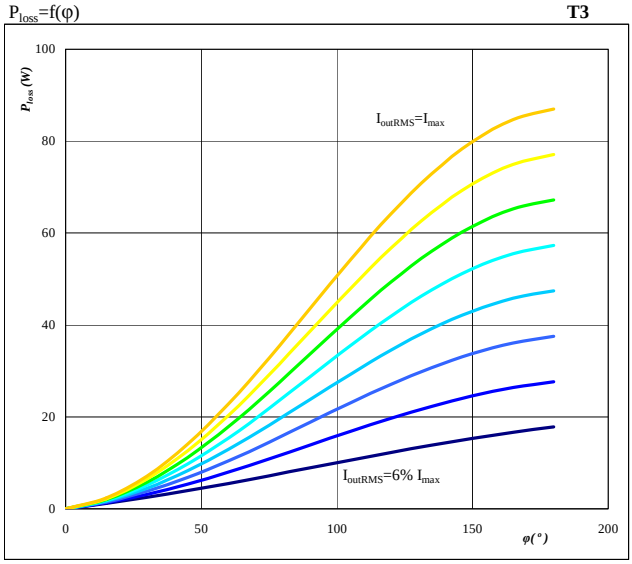

Conditions: $T_j$= 125 °C
parameter: $I_{oRMS}$ from 33 A to 500 A
in steps of 67 A

## *flow* MNPC 4w — mixed voltage NPC Application — 1200V/400A

**Figure 16.** neutral point IGBT

**Typical average switching loss as a function of phase displacement**

$P_{loss}=f(\varphi)$ **T3**

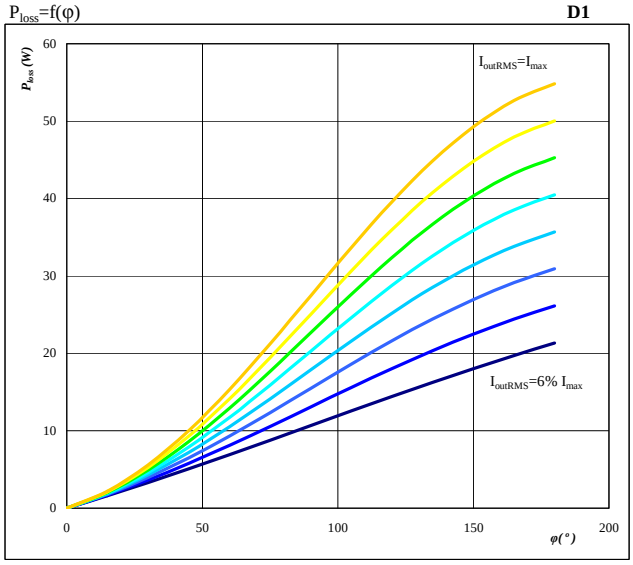



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | $f_{sw}$= | 8 | kHz |
| | DC link= | 700 | V | | | |
| parameter: | $I_{oRMS}$ | from | 33 A | to | 500 A | |
| | | in steps of | 67 A | A | | |

**Figure 17.** half bridge FWD

**Typical average switching loss as a function of phase displacement**

$P_{loss}=f(\varphi)$ **D1**

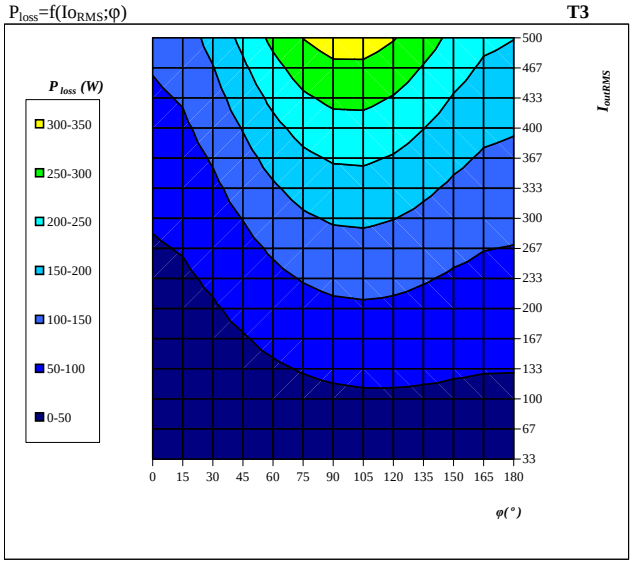



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | $f_{sw}$= | 8 | kHz |
| | DC link= | 700 | V | | | |
| parameter: | $I_{oRMS}$ | from | 33 A | to | 500 A | |
| | | in steps of | 67 A | A | | |

**Figure 18.** neutral point IGBT

**Typical total loss as a function of phase displacement and $Iout_{RMS}$**

$P_{loss}=f(Io_{RMS};\varphi)$ **T3**

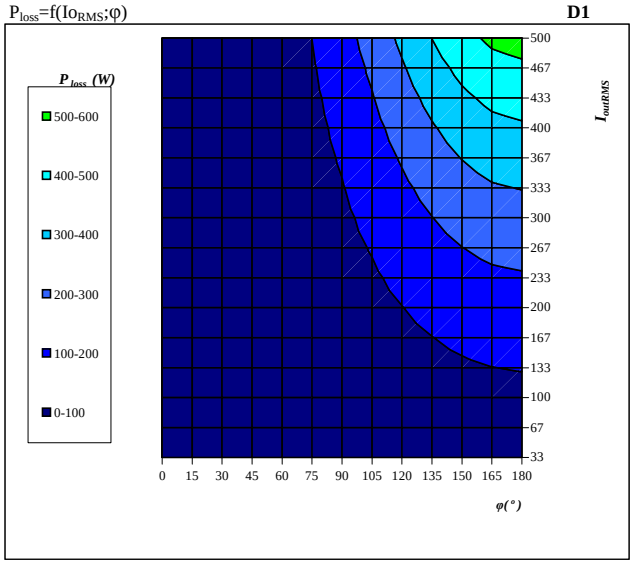



| | | | |
|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C |
| | DC link= | 700 | V |
| | $f_{sw}$= | 8 | kHz |

**Figure 19.** half bridge FWD

**Typical total loss as a function of phase displacement and $Iout_{RMS}$**

$P_{loss}=f(Io_{RMS};\varphi)$ **D1**

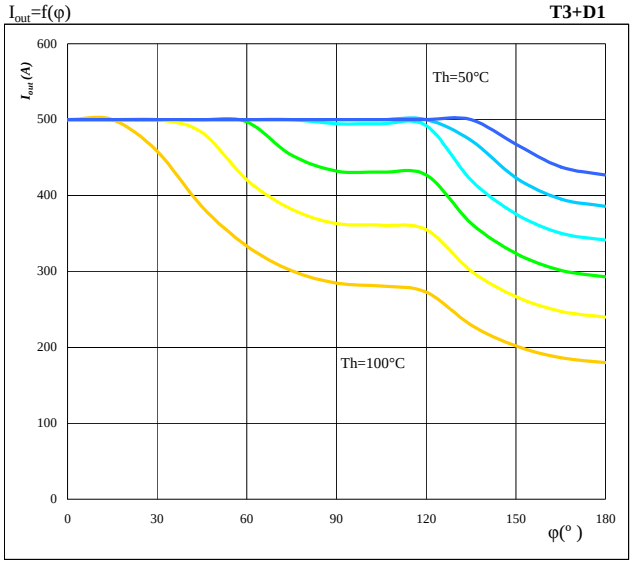



| | | | |
|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C |
| | DC link= | 700 | V |
| | $f_{sw}$= | 8 | kHz |

**Figure 20.** for neutral point IGBT+ half bridge FWD

**Typical available output current as a function of of phase displacement**

$I_{out}=f(\varphi)$ **T3+D1**

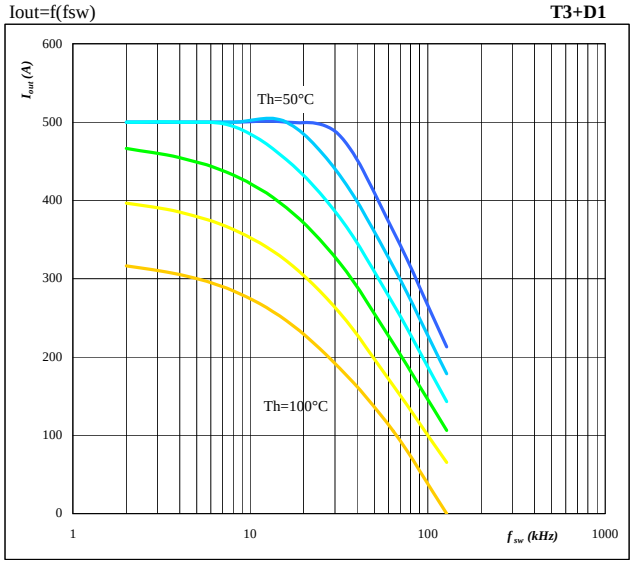



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | | $f_{sw}$= | 8 kHz |
| | DC link= | 700 | V | | | |
| parameter: | Heatsink temp. | | | | | |
| | Th from | 50 | °C to | 100 | | °C |
| | in | 10 | °C | steps | | |

**Figure 21.** for neutral point IGBT+ half bridge FWD

**Typical available output current as a function of switching frequency**

Iout=f(fsw) **T3+D1**

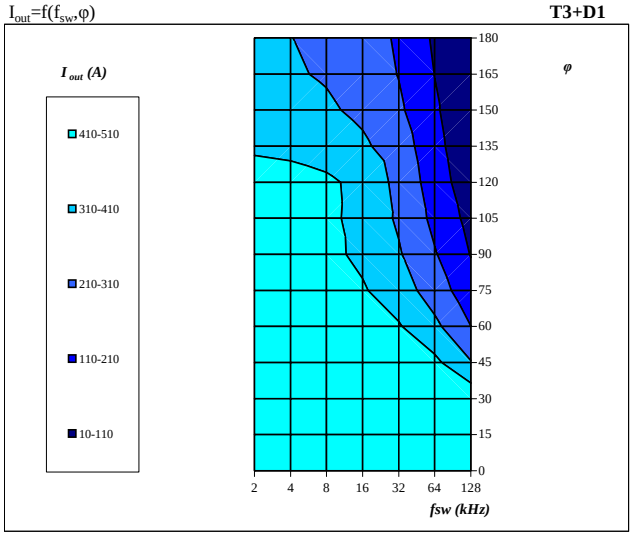



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | | φ= | 90° |
| | DC link= | 700 | V | | | |
| parameter: | Heatsink temp. | | | | | |
| | Th from | 50 | °C to | 100 | | °C |
| | in | 10 | °C | steps | | |

**Figure 22.** for neutral point IGBT+ half bridge FWD

**Typical available 50Hz output current as a function of fsw and phase displacement**

$I_{out}=f(f_{sw},\varphi)$ **T3+D1**



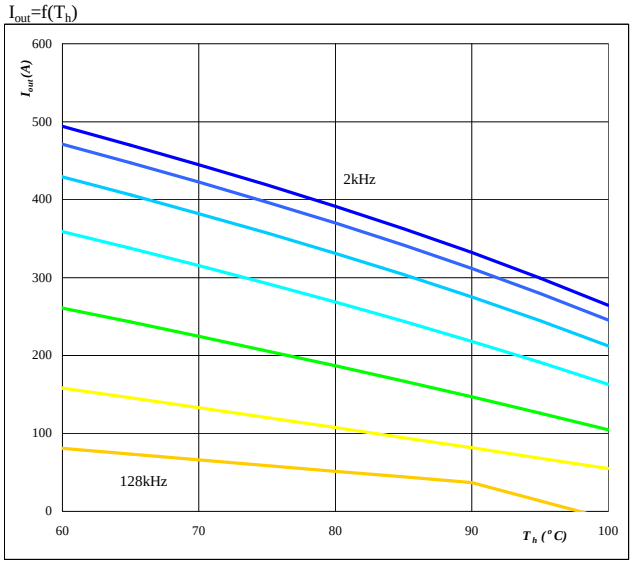

| | | | |
|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C |
| | DC link= | 700 | V |
| | $T_h$= | 80 | °C |

## *flow* MNPC 4w — mixed voltage NPC Application — 1200V/400A

**Figure 23.** per PHASE

**Typical available output current as a function of heat sink temperature**

$I_{out}=f(T_h)$

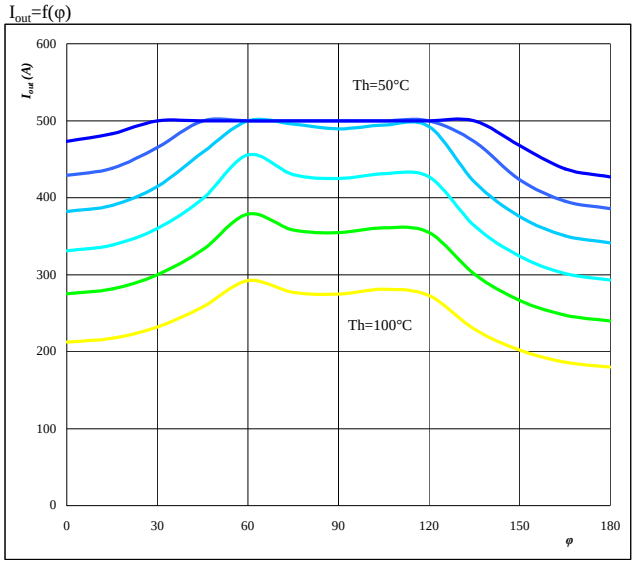



| | | | | |
|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | |
| | DC link= | 700 | V | |
| | φ= | 0 ° | | |
| parameter: | Switching freq. | | | |
| | fsw from | 2 | kHz to | 128 kHz |
| | in steps of factor 2 | | | |

**Figure 24.** per PHASE

**Typical available output current as a function of phase displacement**

$I_{out}=f(\varphi)$

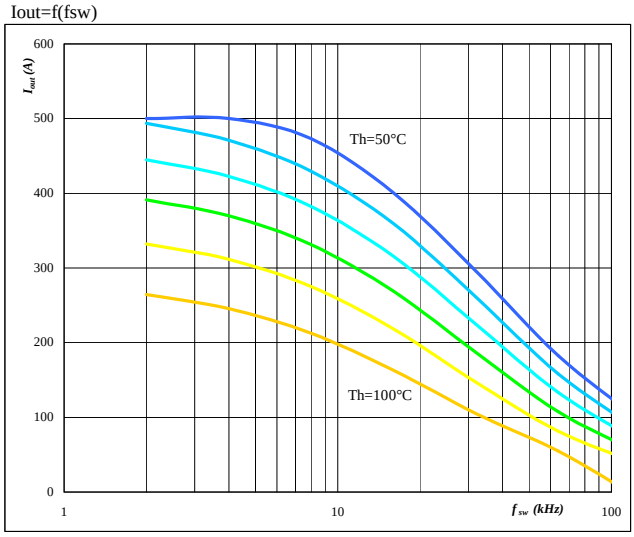



| | | | | |
|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | |
| | DC link= | 700 | V | |
| | $f_{sw}$= | 8 | kHz | |
| parameter: | Heatsink temp. | | | |
| | Th from | 50 | °C to | 100 |
| | in | 10 | °C | steps |

**Figure 25.** per PHASE

**Typical available output current as a function of switching frequency**

Iout=f(fsw)

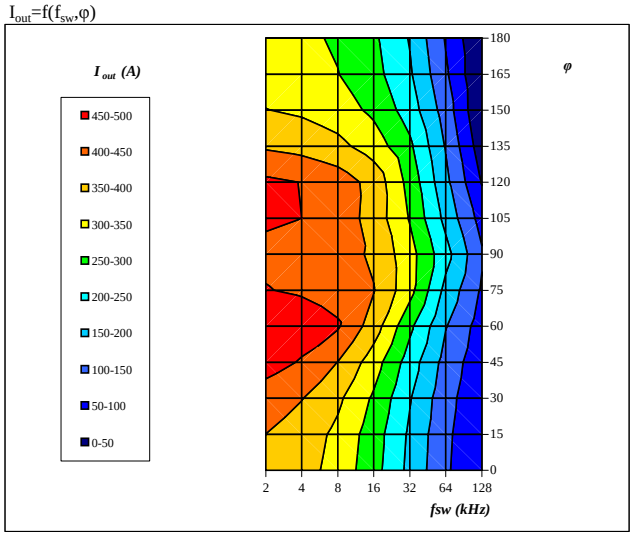



| | | | | | | |
|---|---|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | φ= | 0 ° | |
| | DC link= | 700 | V | | | |
| parameter: | Heatsink temp. | | | | | |
| | Th from | 50 | °C to | 100 | | |
| | in | 10 | °C | steps | | |

**Figure 26.** per PHASE

**Typical available 50Hz output current as a function of fsw and phase displacement**

$I_{out}=f(f_{sw},\varphi)$

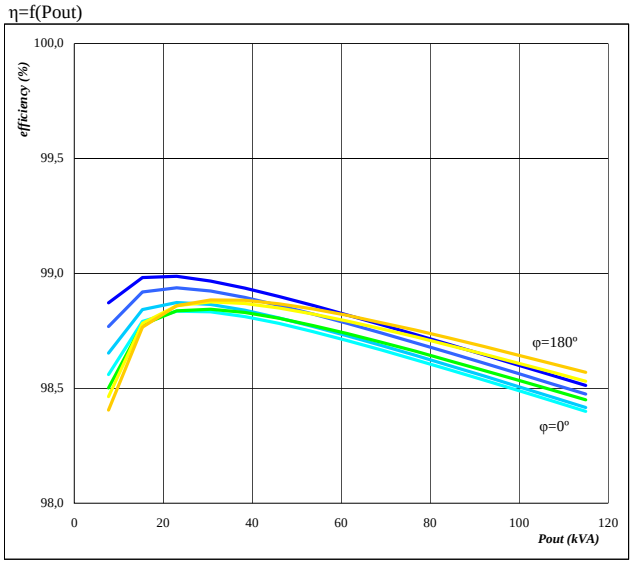



| | | | | |
|---|---|---|---|---|
| Conditions: | $T_j$= | 125 | °C | |
| | DC link= | 700 | V | |
| | $T_h$= | 80 | °C | |

**Figure 27.** per PHASE

**Typical efficiency as a function of output power**

η=f(Pout)

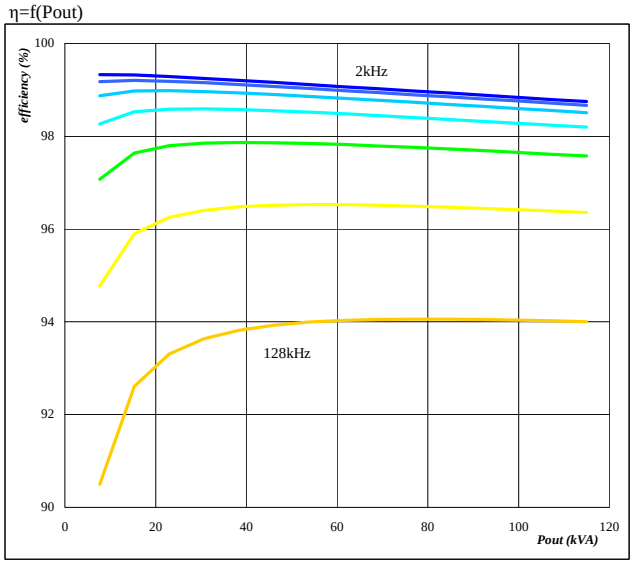



Conditions: $T_j$= 125 °C
$f_{sw}$= 8 kHz
DC link= 700 V
parameter: phase displacement
φ from 0 ° to 180 °
in steps of 30 °

**Figure 28.** per PHASE

**Typical efficiency as a function of output power**

η=f(Pout)

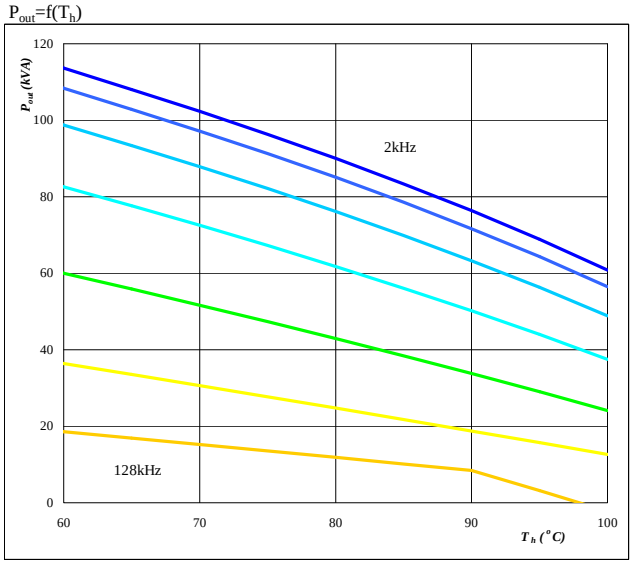



Conditions: $T_j$= 125 °C φ= 0 °
DC link= 700 V
parameter: Switching freq.
fsw from 2 kHz to 128 kHz
in steps of factor 2

**Figure 29.** per PHASE

**Typical available output power as a function of heat sink temperature**

$P_{out}=f(T_h)$

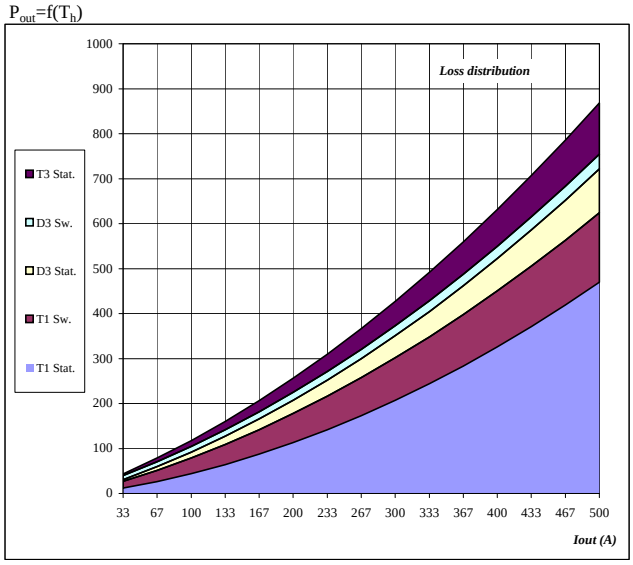



Conditions: $T_j$= 125 °C
DC link= 700 V
φ= 0 °
parameter: Switching freq.
fsw from 2 kHz to 128 kHz
in steps of factor 2

**Figure 30.** per PHASE

**Typical loss distribution as a function of output current**

$P_{out}=f(T_h)$

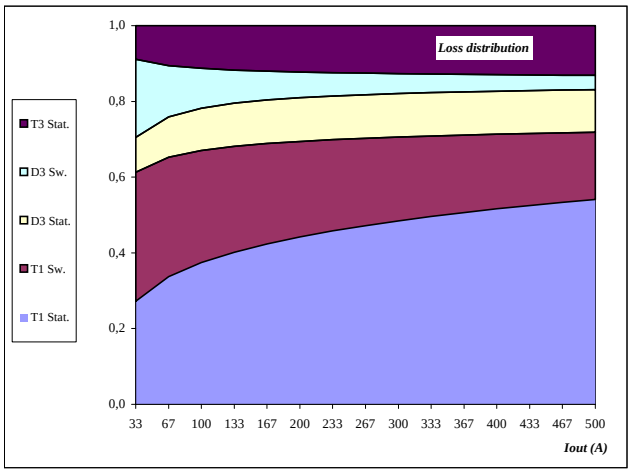



Conditions: $T_j$= 125 °C
$f_{sw}$= 8 kHz
DC link= 700 V
φ= 0 °

**Figure 31.** **per PHASE**

**Typical relativ loss distribution as a function of output current**

$P_{out}=f(T_h)$




| Conditions: | | | |
|---|---|---|---|
| | $T_j$= | 125 | °C |
| | $f_{sw}$= | 8 | kHz |
| | DC link= | 700 | V |
| | φ= | 0 ° | |