

flowMNPC 0 mixed voltage NPC Application 1200 V/80 A & 600 V/50 A

half bridge IGBT	
$V_{GEon}$	= 15 V
$V_{GEoff}$	= -15 V
$R_{gon}$	= 8 $\Omega$
$R_{goff}$	= 8 $\Omega$

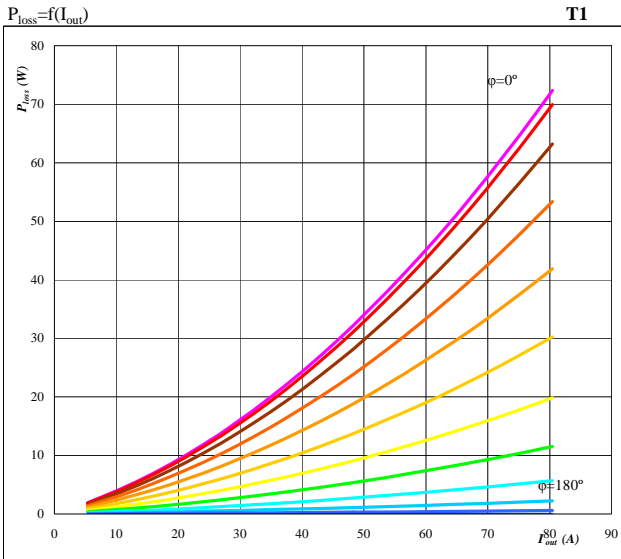
General conditions

$V_{out}$  = 230 VAC

neutral point IGBT	
$V_{GEon}$	= 15 V
$V_{GEoff}$	= -15 V
$R_{gon}$	= 8 $\Omega$
$R_{goff}$	= 8 $\Omega$

Figure 1. half bridge IGBT

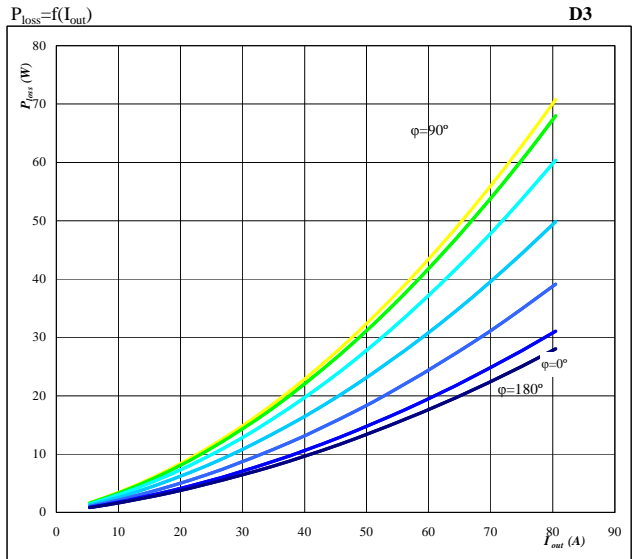
Typical average static loss as a function of output current  $I_{oRMS}$



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

Figure 2. neutral point FRED

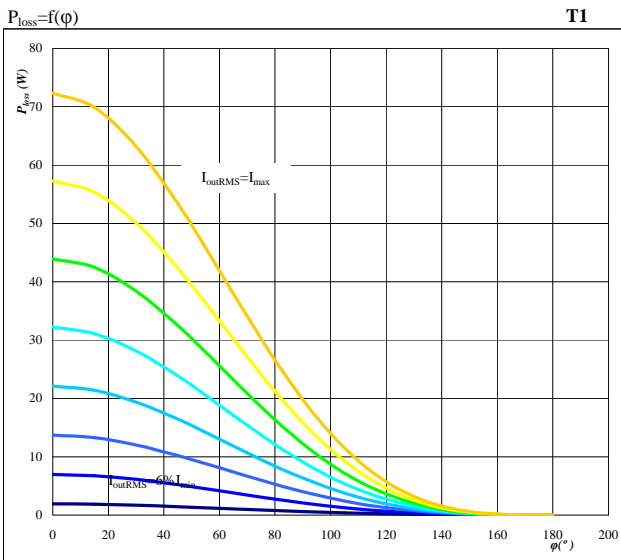
Typical average static loss as a function of output current  $I_{oRMS}$



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

Figure 3. half bridge IGBT

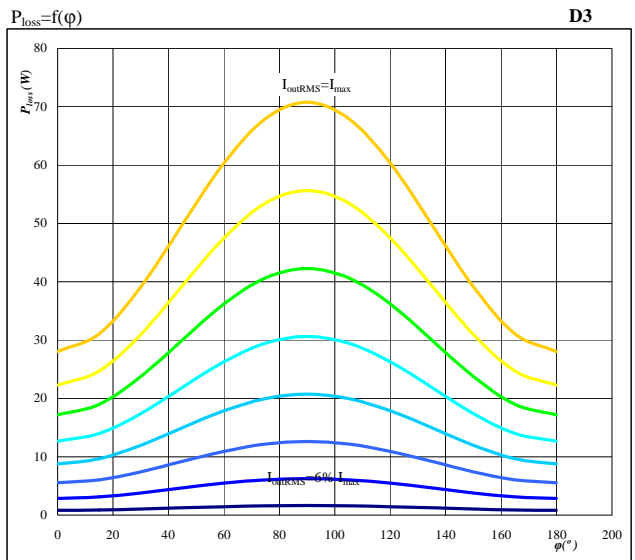
Typical average static loss as a function of phase displacement  $\phi$



Conditions:  $T_j$  = 125 °C  
parameter:  $I_{oRMS}$  from 5,36 A to 80 A in steps of 11 A

Figure 4. neutral point FRED

Typical average static loss as a function of phase displacement  $\phi$



Conditions:  $T_j$  = 125 °C  
parameter:  $I_{oRMS}$  from 5,36 A to 80 A in steps of 11 A

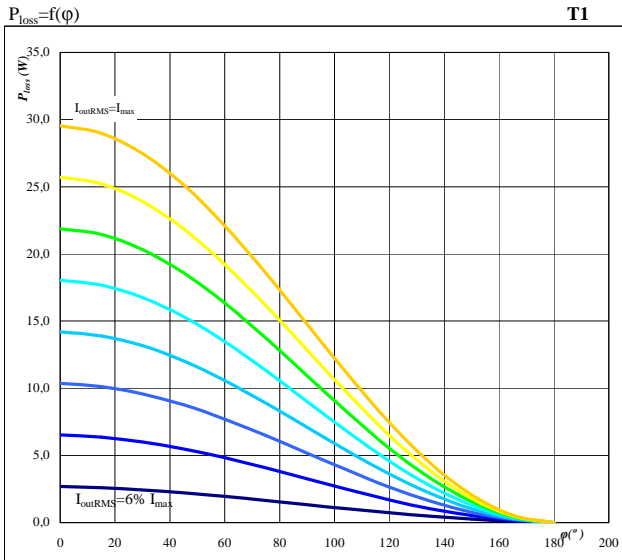
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Figure 5. half bridge IGBT

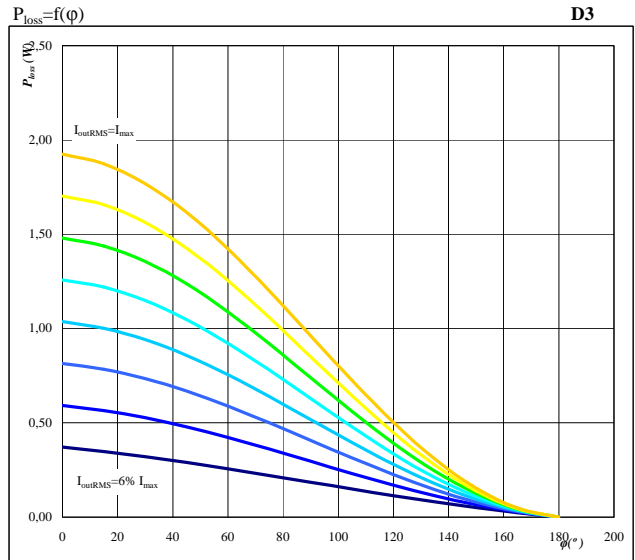
Typical average switching loss as a function of phase displacement  $\phi$



Conditions:  $T_j = 125$  °C  
 $f_{sw} = 16$  kHz  
 DC link = 700 V  
 parameter:  $I_{oRMS}$  from 5,36 A to 80 A  
 in steps of 11 A

Figure 6. neutral point FRED

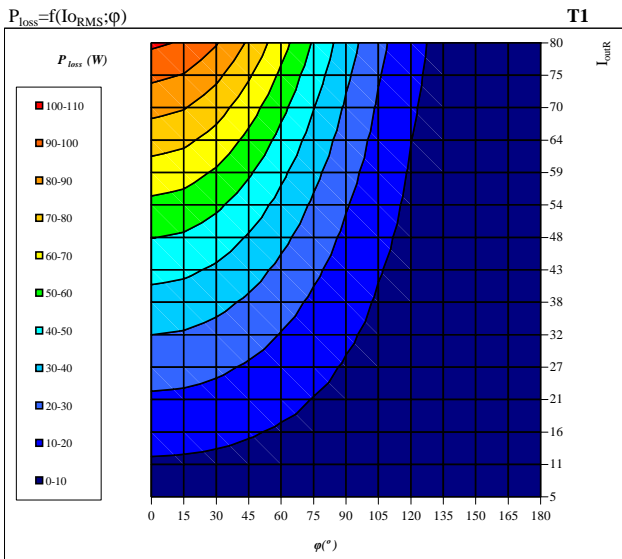
Typical average switching loss as a function of phase displacement  $\phi$



Conditions:  $T_j = 125$  °C  
 $f_{sw} = 16$  kHz  
 DC link = 700 V  
 parameter:  $I_{oRMS}$  from 5,36 A to 80 A  
 in steps of 11 A

Figure 7. half bridge IGBT

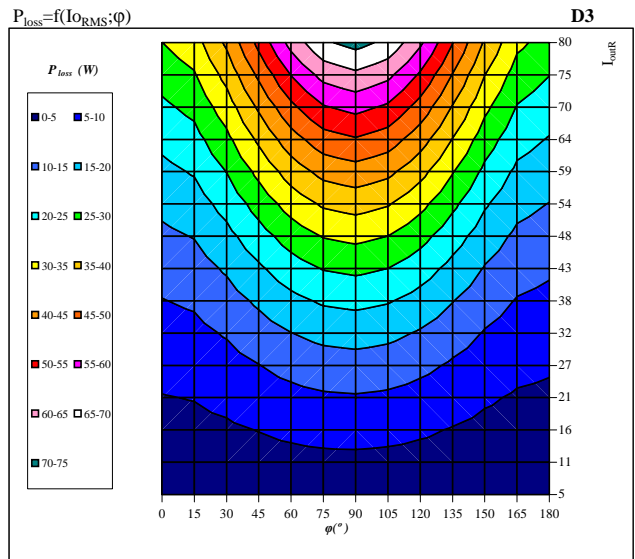
Typical total loss as a function of phase displacement  $\phi$  and output current  $I_{oRMS}$



Conditions:  $T_j = 125$  °C  
 DC link = 700 V  
 $f_{sw} = 16$  kHz

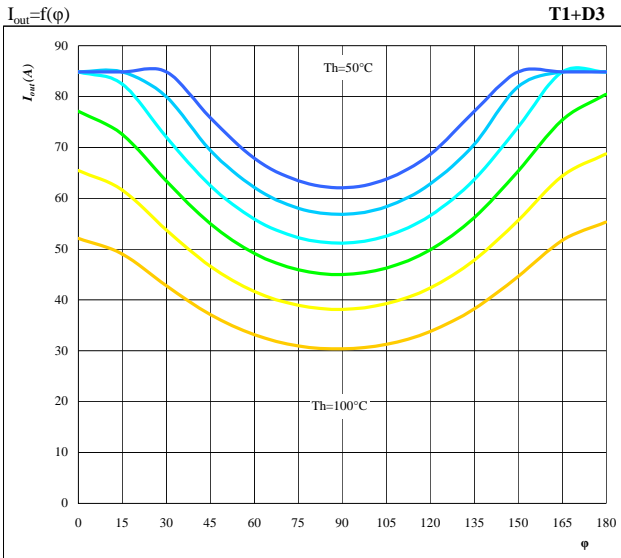
Figure 8. neutral point FRED

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



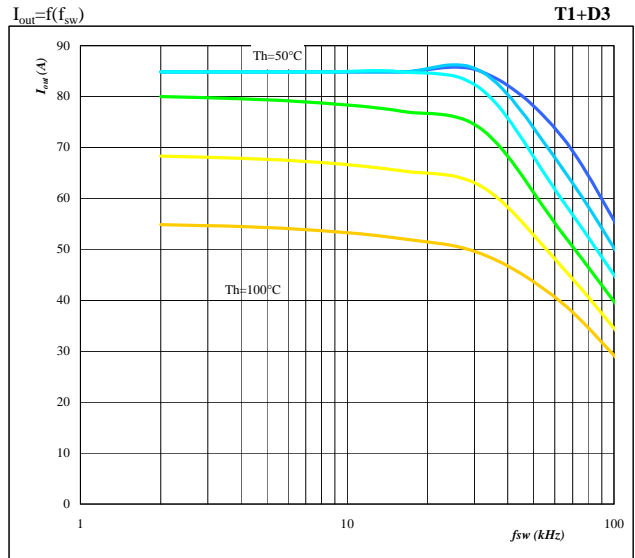
Conditions:  $T_j = 125$  °C  
 DC link = 700 V  
 $f_{sw} = 16$  kHz

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

**Typical available output current as a function of phase displacement  $\varphi$** 


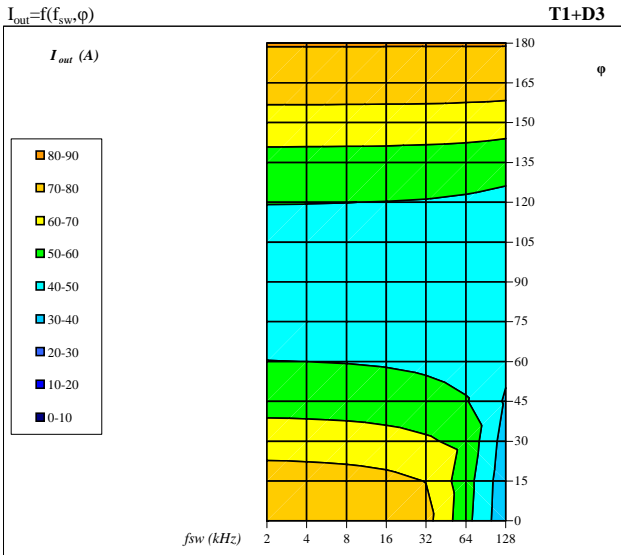
Conditions:  $T_j = T_{jmax} - 25 \text{ }^\circ\text{C}$   $f_{sw} = 16 \text{ kHz}$   
 DC link = 700 V  
 parameter: Heatsink temp.  
 $T_h$  from 50  $^\circ\text{C}$  to 100  $^\circ\text{C}$   
 in 10  $^\circ\text{C}$  steps

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

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


Conditions:  $T_j = T_{jmax} - 25 \text{ }^\circ\text{C}$   $\varphi = 0 \text{ }^\circ$   
 DC link = 700 V  
 parameter: Heatsink temp.  
 $T_h$  from 50  $^\circ\text{C}$  to 100  $^\circ\text{C}$   
 in 10  $^\circ\text{C}$  steps

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

**Typical available 50Hz output current as a function of  $f_{sw}$  and phase displacement  $\varphi$** 


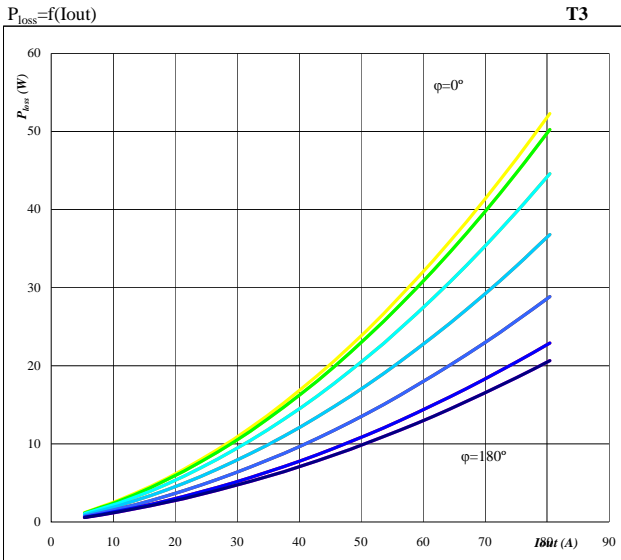
Conditions:  $T_j = T_{jmax} - 25 \text{ }^\circ\text{C}$   
 DC link = 700 V  
 $T_h = 80 \text{ }^\circ\text{C}$

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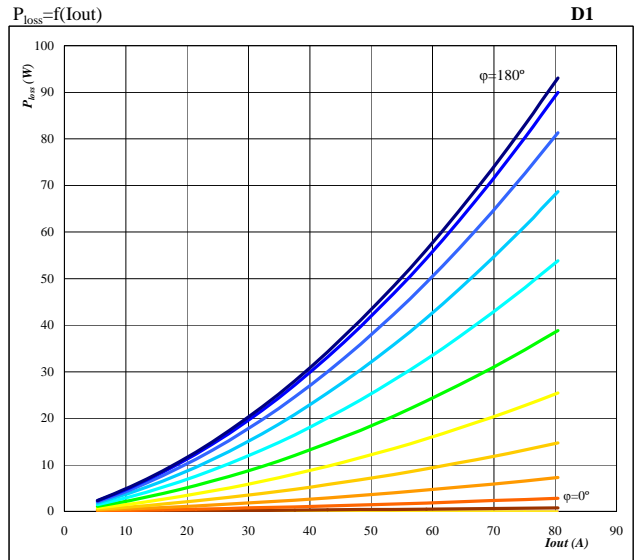
mixed voltage NPC Application

1200 V/80 A &amp; 600 V/50 A

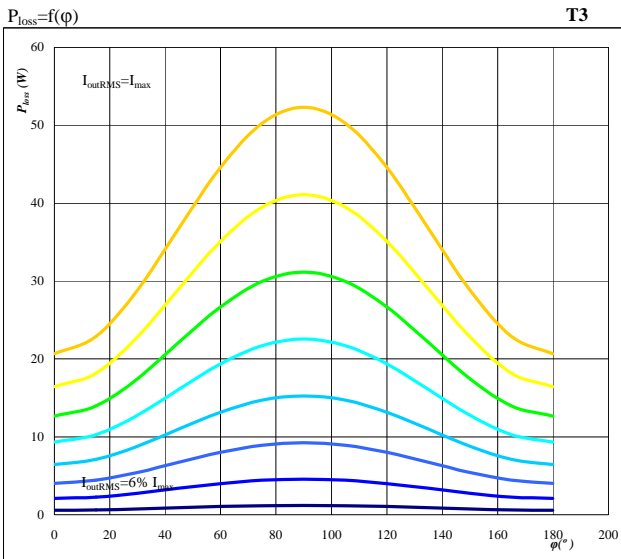
**Figure 12.** neutral point IGBT

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

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

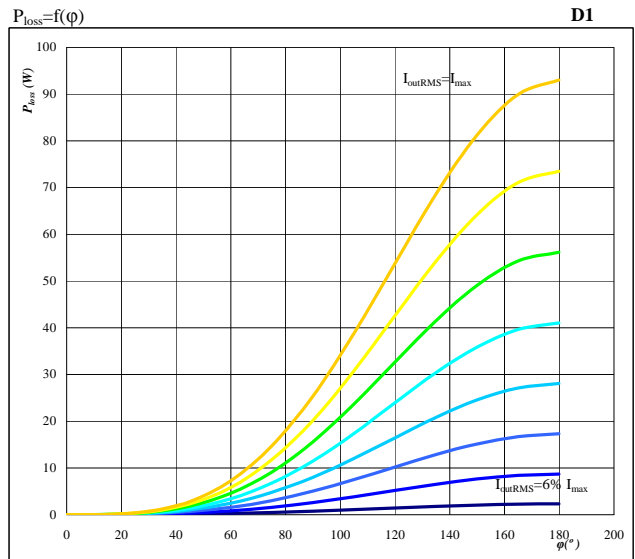
**Figure 13.** half bridge FRED

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

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

**Figure 14.** neutral point IGBT

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

 Conditions:  $T_j = 125$  °C  
 parameter:  $I_{oRMS}$  from 5 A to 80 A  
                   in steps of 11 A

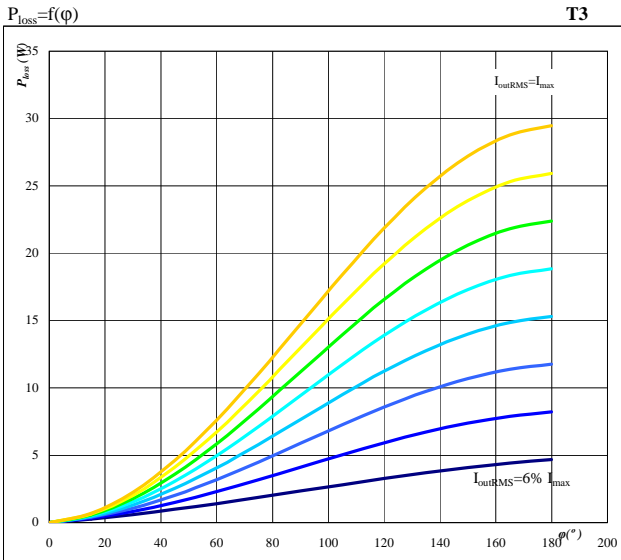
**Figure 15.** half bridge FRED

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

 Conditions:  $T_j = 125$  °C  
 parameter:  $I_{oRMS}$  from 5 A to 80 A  
                   in steps of 11 A

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Figure 16. neutral point IGBT

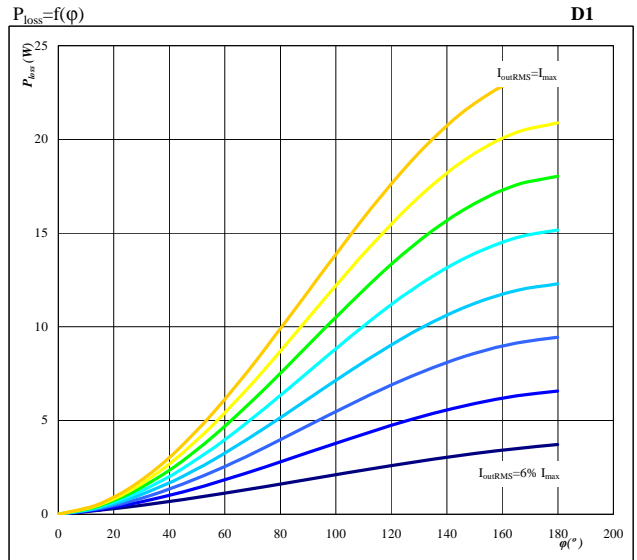
Typical average switching loss as a function of phase displacement



Conditions:  $T_j = 125$  °C  $f_{sw} = 16$  kHz  
 DC link = 700 V  
 parameter:  $I_{0RMS}$  from 5 A to 80 A  
 in steps of 11 A A

Figure 17. half bridge FRED

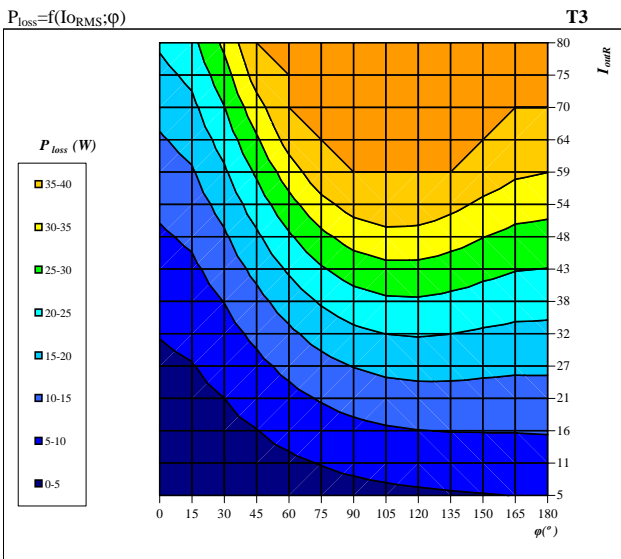
Typical average switching loss as a function of phase displacement



Conditions:  $T_j = 125$  °C  $f_{sw} = 16$  kHz  
 DC link = 700 V  
 parameter:  $I_{0RMS}$  from 5 A to 80 A  
 in steps of 11 A A

Figure 18. neutral point IGBT

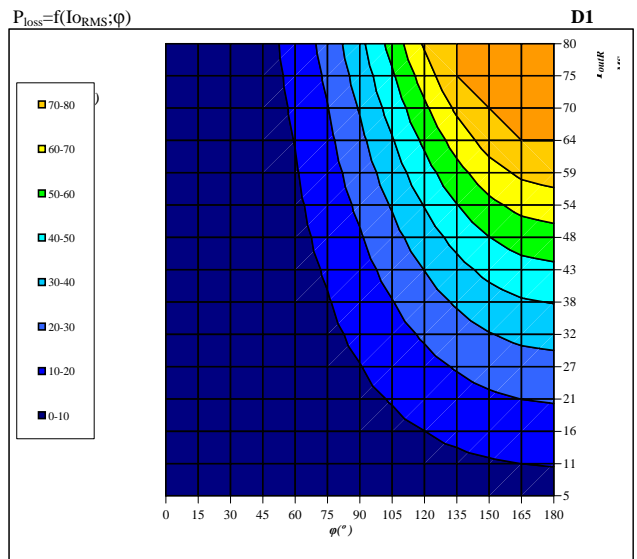
Typical total loss as a function of phase displacement and  $I_{0RMS}$



Conditions:  $T_j = 125$  °C  
 DC link = 700 V  
 $f_{sw} = 16$  kHz

Figure 19. half bridge FRED

Typical total loss as a function of phase displacement and  $I_{0RMS}$

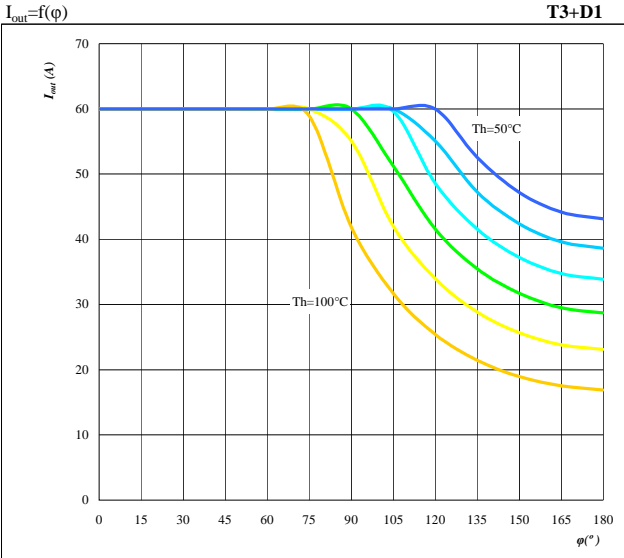


Conditions:  $T_j = 125$  °C  
 DC link = 700 V  
 $f_{sw} = 16$  kHz

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Figure 20. for neutral point IGBT+ half bridge FRED

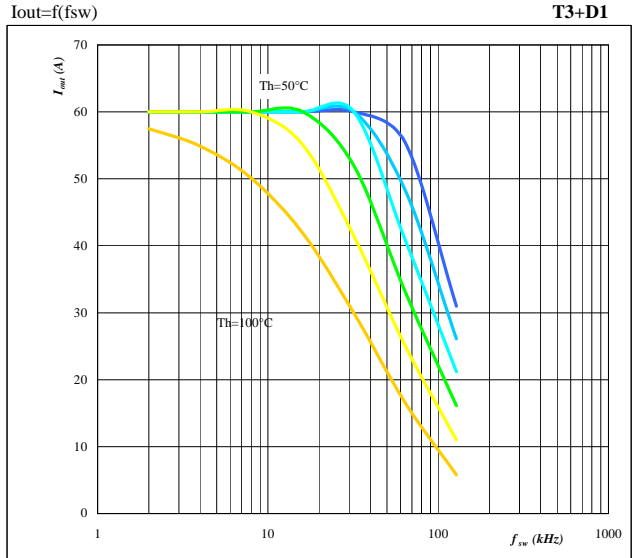
Typical available output current as a function of phase displacement



Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$   $f_{sw} = 16 \text{ kHz}$   
 DC link = 700 V  
 parameter: Heatsink temp.  
 Th from 50  $^\circ\text{C}$  to 100  $^\circ\text{C}$   
 in 10  $^\circ\text{C}$  steps

Figure 21. for neutral point IGBT+ half bridge FRED

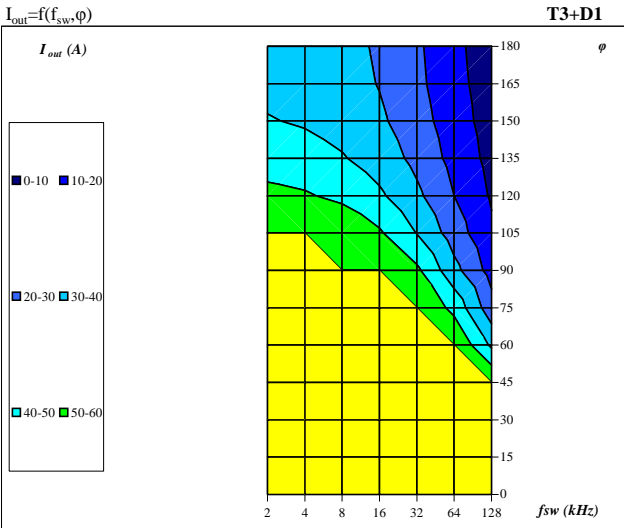
Typical available output current as a function of switching frequency



Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$   $\phi = 90^\circ$   
 DC link = 700 V  
 parameter: Heatsink temp.  
 Th from 50  $^\circ\text{C}$  to 100  $^\circ\text{C}$   
 in 10  $^\circ\text{C}$  steps

Figure 22. for neutral point IGBT+ half bridge FRED

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



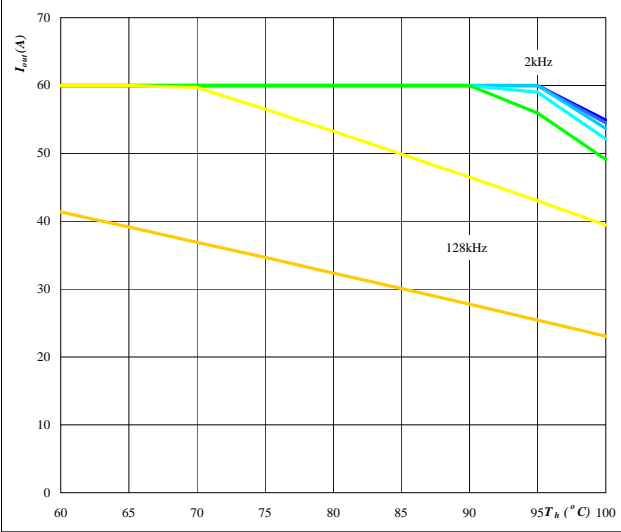
Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$   
 DC link = 700 V  
 $T_h = 80 \text{ } ^\circ\text{C}$

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**Figure 23.** per MODULE

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

$$I_{out} = f(T_h)$$



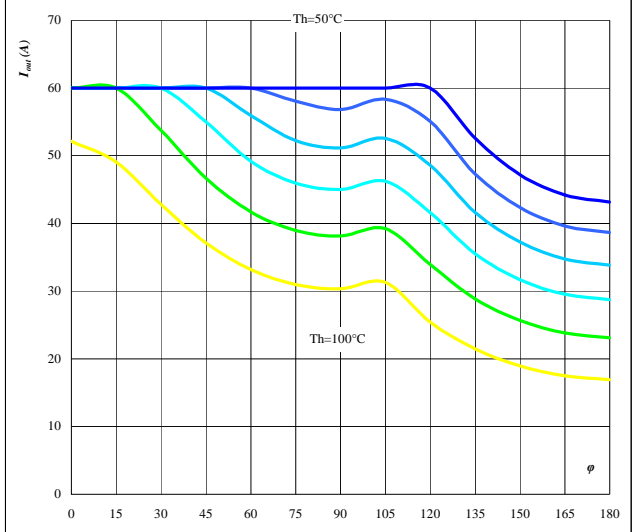
Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$   
 DC link = 700 V  
 $\varphi = 0^\circ$

parameter: Switching freq.  
 fsw from 2 kHz to 128 kHz  
 in steps of factor 2

**Figure 24.** per MODULE

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

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



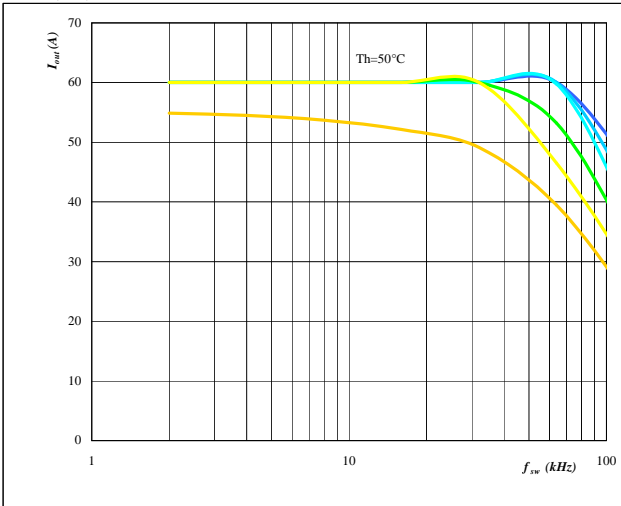
Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$   
 DC link = 700 V  
 fsw = 16 kHz

parameter: Heatsink temp.  
 Th from 50 °C to 100 °C  
 in 10 °C steps

**Figure 25.** per MODULE

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

$$I_{out} = f(f_{sw})$$



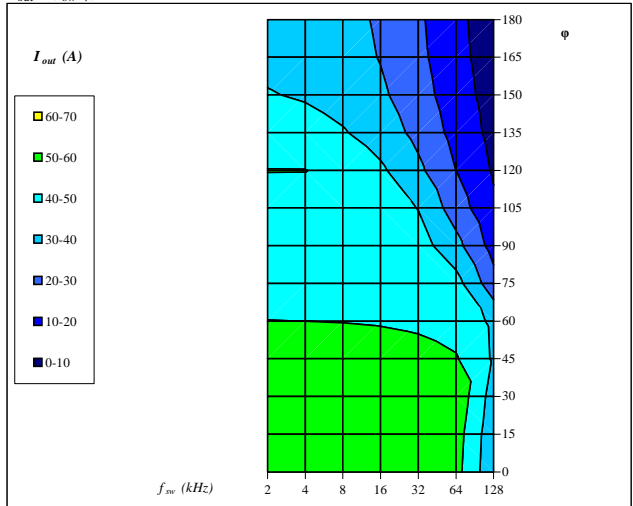
Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$        $\varphi = 0^\circ$   
 DC link = 700 V

parameter: Heatsink temp.  
 Th from 50 °C to 100 °C  
 in 10 °C steps

**Figure 26.** per MODULE

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

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



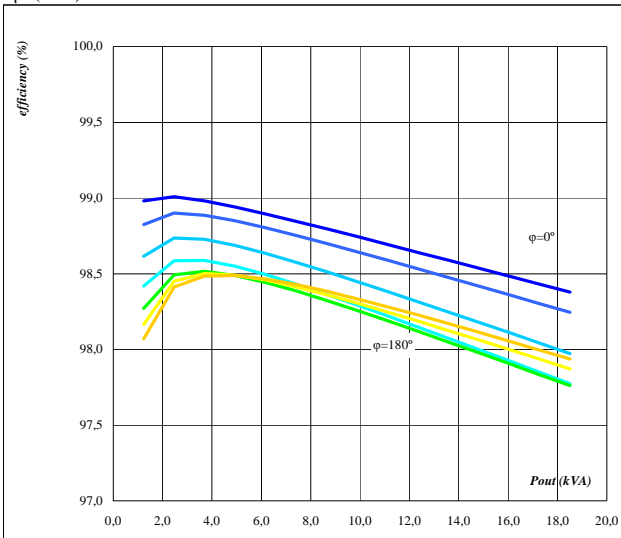
Conditions:  $T_j = T_{jmax} - 25 \text{ } ^\circ\text{C}$   
 DC link = 700 V  
 $T_h = 80 \text{ } ^\circ\text{C}$

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Figure 27. per MODULE

Typical efficiency as a function of output power

$\eta=f(P_{out})$

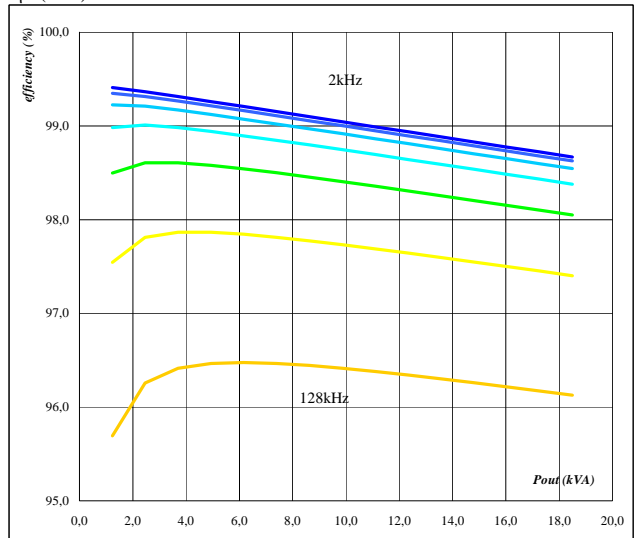


Conditions:  $T_j = 125 \text{ }^\circ\text{C}$   
 $f_{sw} = 16 \text{ kHz}$   
 DC link = 700 V  
 parameter: phase displacement  $\varphi$  from  $0^\circ$  to  $180^\circ$  in steps of  $30^\circ$

Figure 28. per MODULE

Typical efficiency as a function of output power

$\eta=f(P_{out})$

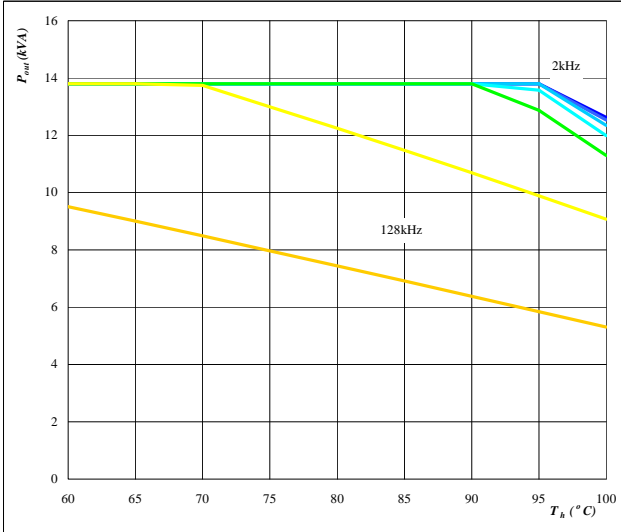


Conditions:  $T_j = 125 \text{ }^\circ\text{C}$   $\varphi = 0^\circ$   
 DC link = 700 V  
 parameter: Switching freq.  $f_{sw}$  from 2 kHz to 128 kHz in steps of factor 2

Figure 29. per MODULE

Typical available output power as a function of heat sink temperature

$P_{out}=f(T_h)$

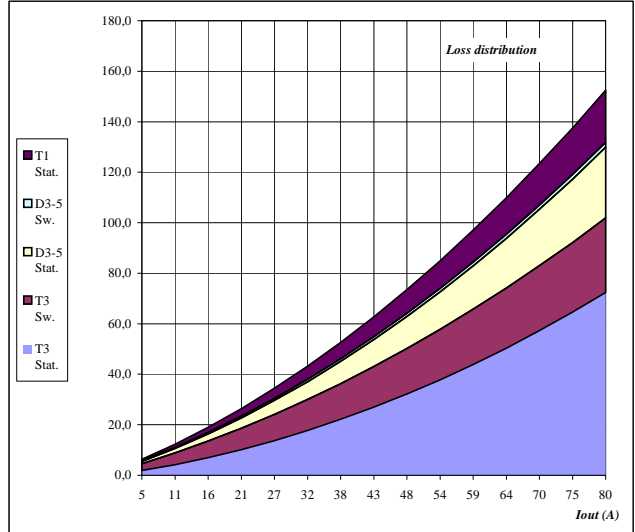


Conditions:  $T_j = T_{jmax}-25 \text{ }^\circ\text{C}$   
 DC link = 700 V  
 $\varphi = 0^\circ$   
 parameter: Switching freq.  $f_{sw}$  from 2 kHz to 128 kHz in steps of factor 2

Figure 30. per MODULE

Typical loss distribution as a function of output current

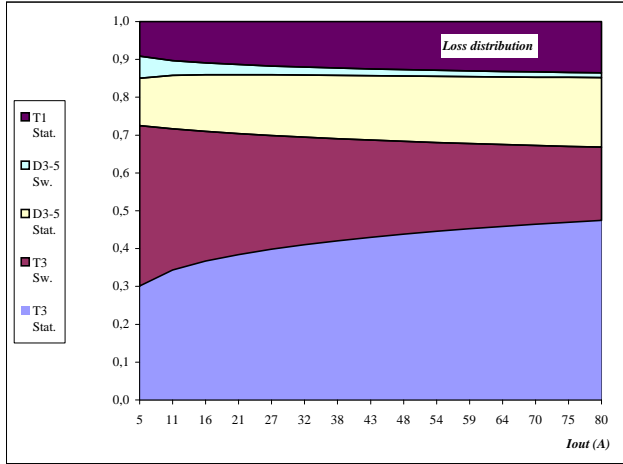
$P_{out}=f(T_h)$



Conditions:  $T_j = 125 \text{ }^\circ\text{C}$   
 $f_{sw} = 16 \text{ kHz}$   
 DC link = 700 V  
 $\varphi = 0^\circ$



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**Figure 31.** per MODULE

**Typical relativ loss distribution as a function of output current**
 $P_{out}=f(T_h)$ 


Conditions:

$T_j =$	125	°C
$f_{sw} =$	16	kHz
DC link =	700	V
$\varphi =$	0°	

