To Calculate Average and Peak Pulse Current Working in PFC Diode

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1. To Calculate Average Current of PFC Diode

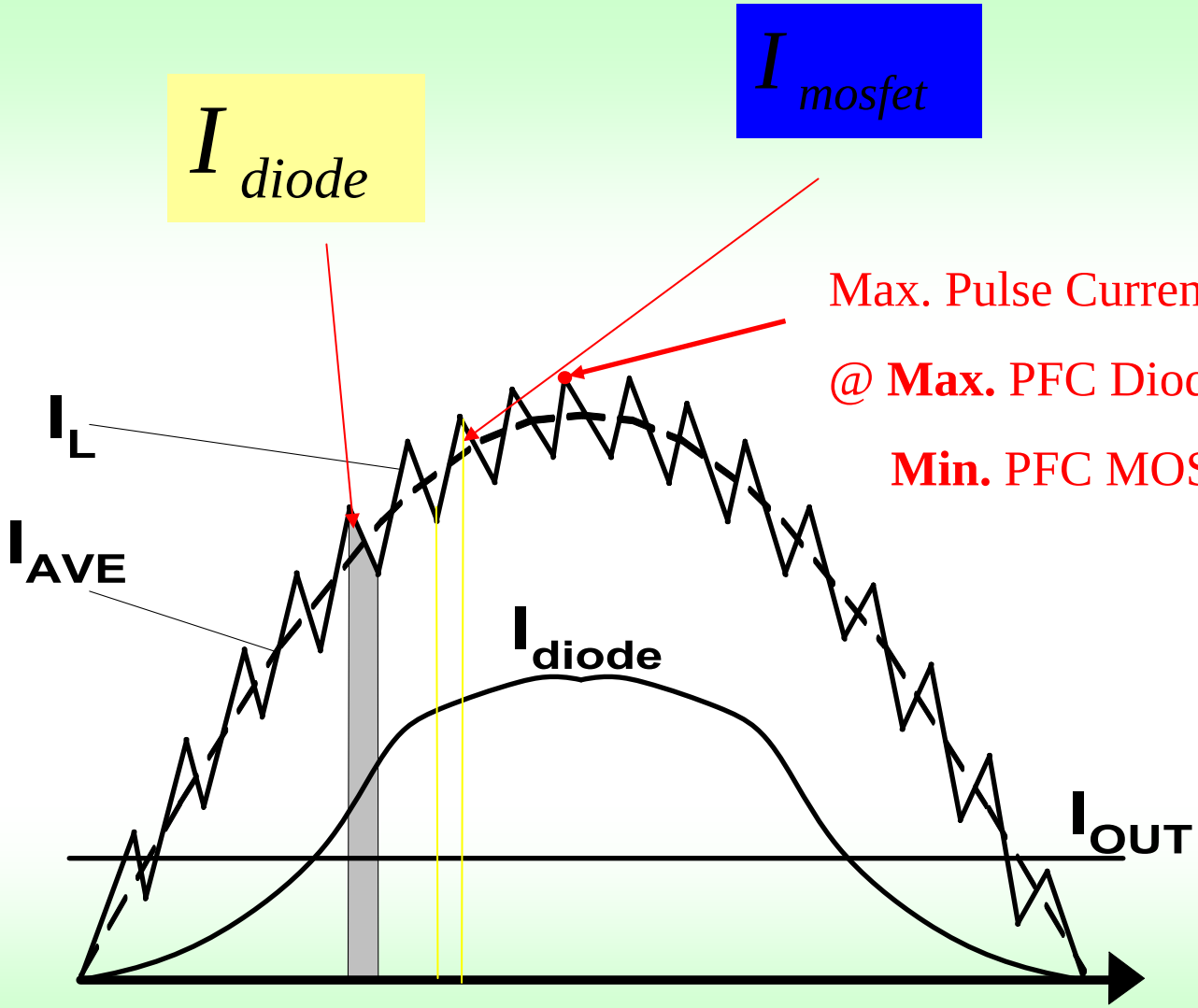
Step 1. $$I_{in\_RMS} = \frac{P_{out}}{V_{in\_min} \cdot \eta}$$

Step 2. $D_{on,\ avg.\ (FET)} = 1 - (V_{in\_min} / V_{out})$

Step 3. $D_{on,\ avg.\ (Diode)} = 1 - D_{on,\ avg.\ (FET)}$

Step 4. $I_{avg.\ (Diode)} = I_{in\_RMS} * D_{on,\ avg.\ (Diode)}$

2. To Calculate Peak Repetitive Pulse Current of PFC Diode - (1)



Max. Pulse Current in PFC Choke

@ **Max.** PFC Diode Turn-on Duty

Min. PFC MOSFET Turn-on Duty

2. To Calculate Peak Repetitive Pulse Current of PFC Diode - (2)

Step 1. $$I_{in\_RMS} = \frac{P_{out}}{V_{in\_min} \cdot \eta}$$

Step 2. $$I_{in\_pk} = \sqrt{2} \cdot I_{in\_RMS}$$

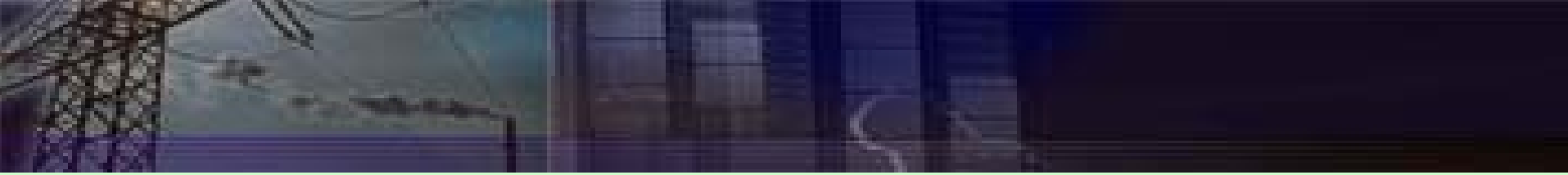
Step 3. high frequency current in PFC Choke, peak to peak,

$$I_{HF} \sim= 30\% * I_{in\_pk}$$

Step 4. $$I_{max.\ pulse\ (Diode)} = I_{in\_pk} + 1/2 * I_{HF}$$

Step 5. $$D_{on,\ min.\ (FET)} = 1 - (\sqrt{2} * V_{in\_min} / V_{out})$$

$$D_{on,\ max.\ (Diode)} = 1 - D_{on,\ min\ (FET)}$$



Example #1 **:**

1KW PFC Application

Target Specification of 1KW PFC

Input voltage	**90VAC ~ 265VAC**
Input frequency	50Hz
Output voltage and current	**400VDC**
Output power	**1KW**
Efficiency	**>92% at full load**
Switching Frequency	**70KHz**
Maximum Ambient temperature around PFC	**50**℃

1. To Calculate Average Current of PFC Diode

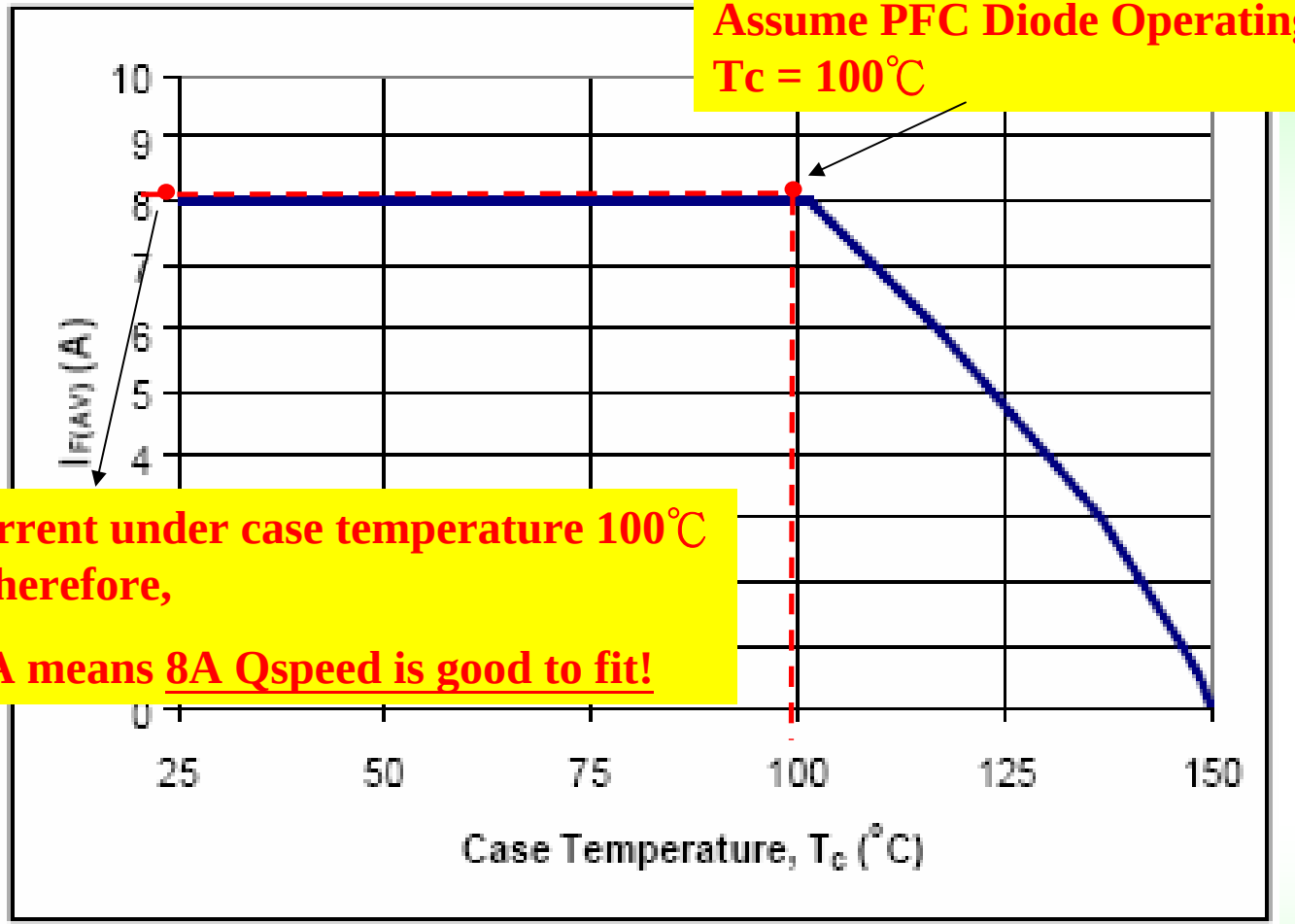
Step 1. $$I_{in\_RMS} = \frac{P_{out}}{V_{in\_min} \cdot \eta}$$ **= 1KW / (90 * 92%) = 12.07A**

Step 2. $D_{on,\ avg.\ (FET)} = 1 - (V_{in\_min} / V_{out}) = 1 - (90 / 400) = 0.775$

Step 3. $D_{on,\ avg.\ (Diode)} = 1 - D_{on,\ avg.\ (FET)} = 1 - 0.775 = 0.225$

Step 4. $I_{avg.\ (Diode)} = I_{in\_RMS} * D_{on,\ avg.\ (Diode)} = 12.07 * 0.225 =$ **2.72A**

Assume PFC Diode Operating Condition :
Tc = 100℃



LQA08TC600 DC Current Derating Curve

The DC Current under case temperature 100℃ is 8A, and therefore,

8A >> 2.72A means 8A Qspeed is good to fit!

2. To Calculate Peak Repetitive Pulse Current of PFC Diode

Step 1. $I_{in\_RMS} = \frac{P_{out}}{V_{in\_min} \cdot \eta}$ **= 1KW / (90 * 95%) = 12.07A**

Step 2. $I_{in\_pk} = \sqrt{2} \cdot I_{in\_RMS}$ **= 12.07 * 1.414 = 17.07A**

Step 3. high frequency current in PFC Choke, peak to peak,

$I_{HF} \sim= 30\% * I_{in\_pk}$ **= 17.07 * 30% = 5.12A**

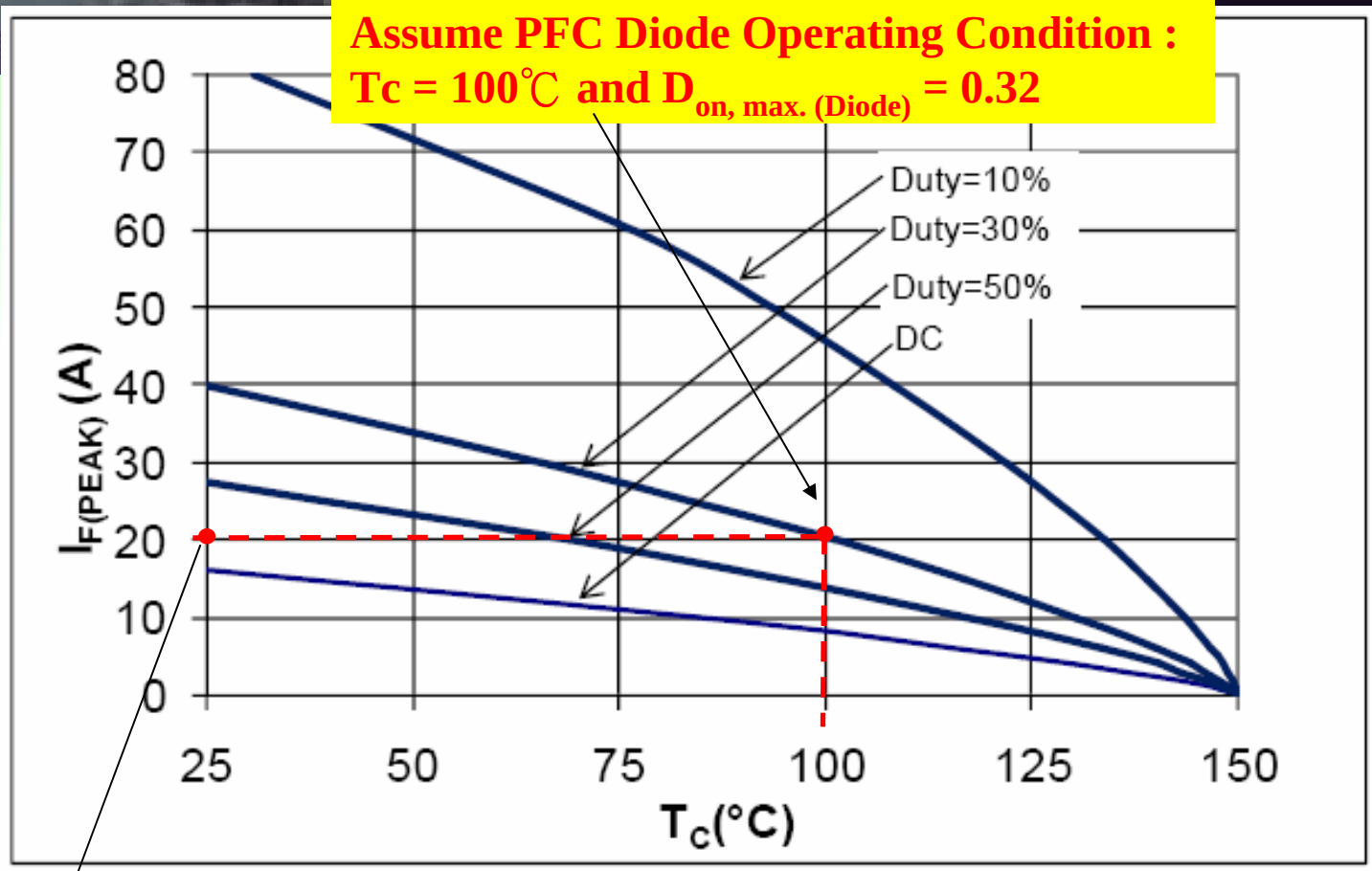
Step 4. $I_{max.\ pulse\ (Diode)} = I_{in\_pk} + 1/2 * I_{HF}$ **= 17.07 + 0.5 * 5.12 = 19.63A**

Step 5. $D_{on,\ min.\ (FET)} = 1 - (\sqrt{2} * V_{in\_min} / V_{out})$

= 1 - ($\sqrt{2}$ * 90 / 400) = 0.68

$D_{on,\ max.\ (Diode)} = 1 - D_{on,\ min\ (FET)}$ **= 1 – 0.68 = 0.32**

Assume PFC Diode Operating Condition :
Tc = 100℃ and $D_{on, max. (Diode)}$ = 0.32



LQA08TC600 I_F(PEAK) vs T_C, f=70kHz.

The sustainable repetitive pulse current under this operation condition is 20.5A, and therefore,

20.5A > 19.63A means 8A Qspeed is good to fit!

Example #2 **:**

500W PFC Application

Target Specification of 500W PFC

Input voltage	**90VAC ~ 265VAC**
Input frequency	50Hz
Output voltage and current	**400VDC**
Output power	**500W**
Efficiency	**>92% at full load**
Switching Frequency	**70KHz**
Maximum Ambient temperature around PFC	**50**℃

1. To Calculate Average Current of PFC Diode

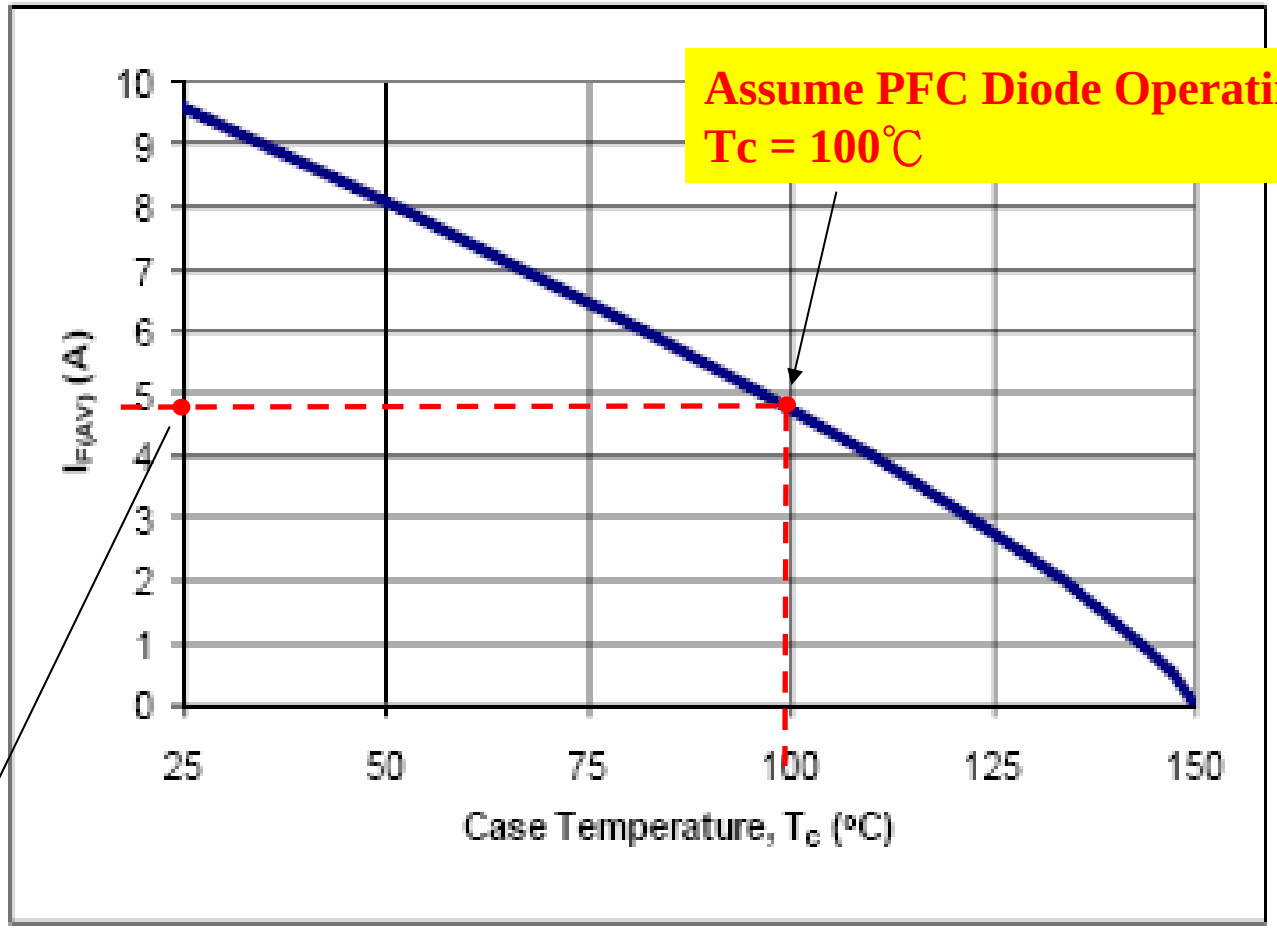
Step 1. $$I_{in\_RMS} = \frac{P_{out}}{V_{in\_min} \cdot \eta}$$ **= 500W / (90 * 92%) = 6.04A**

Step 2. $D_{on,\ avg.\ (FET)} = 1 - (V_{in\_min} / V_{out}) = 1 - (90 / 400) = 0.775$

Step 3. $D_{on,\ avg.\ (Diode)} = 1 - D_{on,\ avg.\ (FET)}$ **= 1 – 0.775 = 0.225**

Step 4. $I_{avg.\ (Diode)} = I_{in\_RMS} * D_{on,\ avg.\ (Diode)}$ **= 6.04 * 0.225 = 1.36A**

Assume PFC Diode Operating Condition :
Tc = 100℃



LQA03TC600 DC Current Derating Curve

The DC Current under case temperature 100℃ is 4.7A, and therefore,

4.7A >> 1.36A means 3A Qspeed is good to fit!

2. To Calculate Peak Repetitive Pulse Current of PFC Diode

Step 1. $I_{in\_RMS} = \frac{P_{out}}{V_{in\_min} \cdot \eta}$ **= 500W / (90 * 95%) = 6.04A**

Step 2. $I_{in\_pk} = \sqrt{2} \cdot I_{in\_RMS}$ **= 6.04 * 1.414 = 8.54A**

Step 3. high frequency current in PFC Choke, peak to peak,

$I_{HF} \sim= 30\% * I_{in\_pk}$ **= 8.54 * 30% = 2.56A**

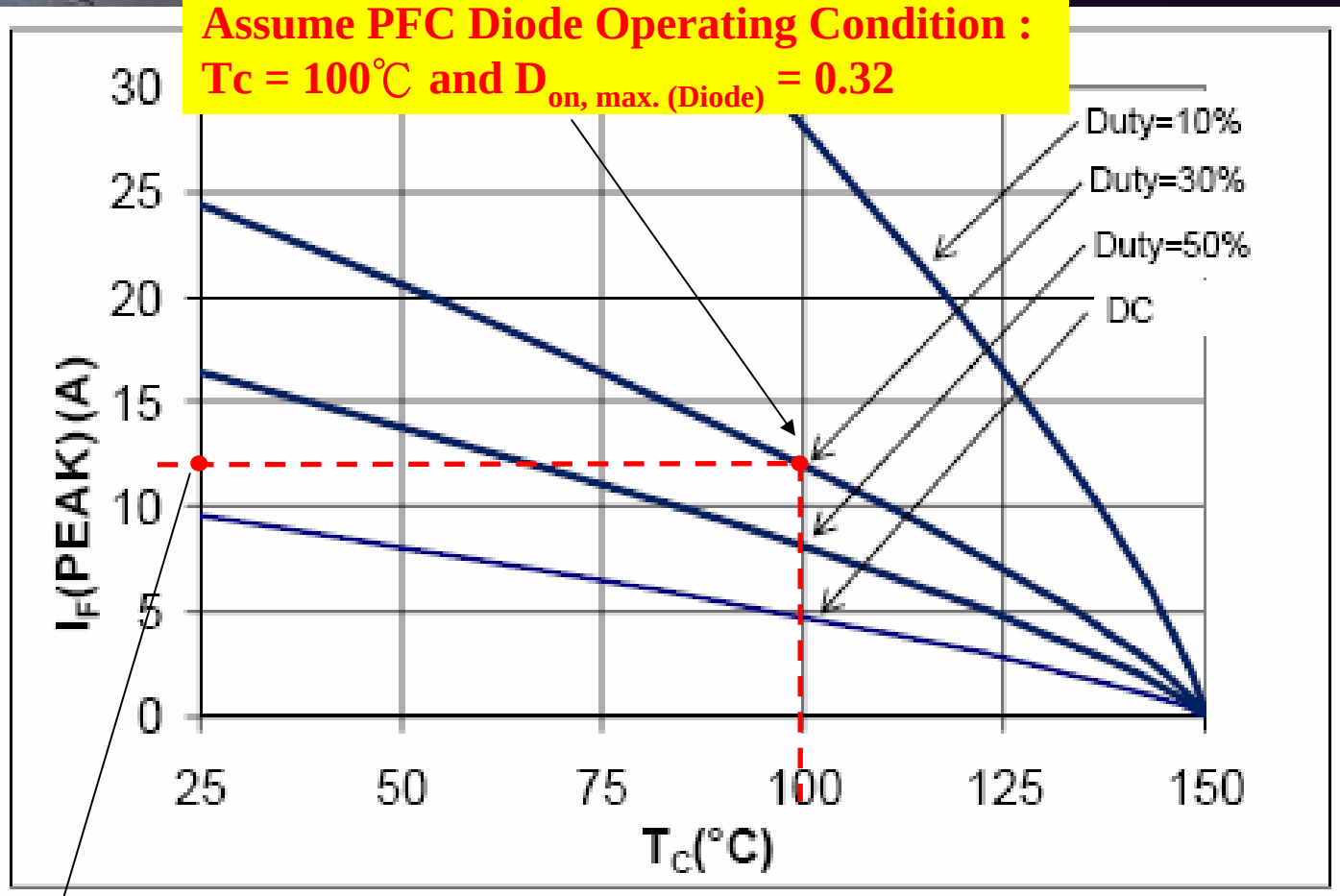
Step 4. $I_{max.\ pulse\ (Diode)} = I_{in\_pk} + 1/2 * I_{HF}$ **= 8.54 + 0.5 * 2.56 =** **9.82A**

Step 5. $D_{on,\ min.\ (FET)} = 1 - (\sqrt{2} * V_{in\_min} / V_{out})$

= 1 - ($\sqrt{2}$ * 90 / 400) = 0.68

$D_{on,\ max.\ (Diode)} = 1 - D_{on,\ min\ (FET)}$ **= 1 – 0.68 = 0.32**

Assume PFC Diode Operating Condition :
Tc = 100℃ and $D_{on, max. (Diode)}$ = 0.32



LQA03TC600 I_F(PEAK) vs T_C, f=70kHz.

The sustainable repetive pulse current under this operation condition is 12.5A, and therefore,

12.5A > 9.82A means 3A Qspeed is good to fit!

Take Action Now# :

According to Two Parameters Guaranteed by LQA03TC600,

Average DC Current and, Peak Repetitive Pulse Current,

3A Qspeed Can Be Safely Designed in 500W PFC Application