

# 87 Hz motor technique with AC drives (Part 1)

The 87 Hz Technique is becoming more popular and widely used in AC Inverter applications as understanding of the advantages of the technique increases. This applications guide gives some basic detail on the theory and advantages of this approach. A second application guide is available with calculation and theory explained in more depth.

Using this technique when commissioning gear motors allows you to obtain many advantages, for example:

- Constant torque up to 87 Hz at 400 V supply
- 1,7 times more power from the same IEC-motor size

This means that the technique is most suitable when commissioning standard motors for 400V servo drives or inverters. The advantages are

- Bigger control ratio compared with technique at 50 Hz
- Smaller IEC-motor size in relation to the same power
- Bigger gear torque for the same IEC-motor size
- Possibilities of avoiding the use of external fan

To use the 87 Hz Technique it is necessary for the nameplate of the motor to specify that the motor can be connected in both 230 V Delta (Triangle) and 400 V star configurations.

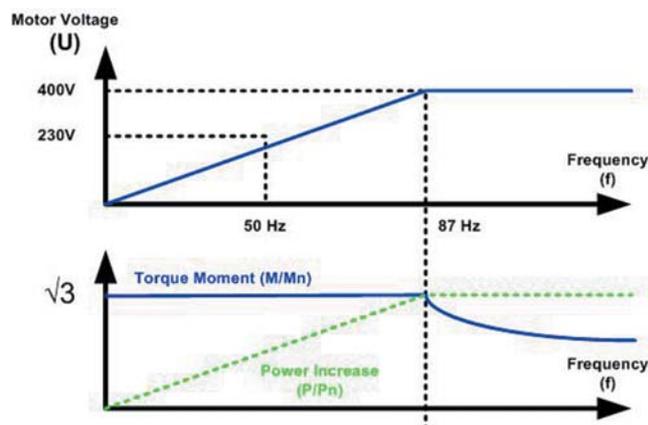
<b>Lenze</b>		Hans-Lenze-Straße 1, D-31855 Aerzen		CE	
Made in Germany					
3-M	Typ	MDEMAXM071-32C	IP 54	I.C. F	
$\gamma / \Delta$	400 / 230 V	50 Hz	1390	min <sup>-1</sup>	
0.37	kW	1.2 / 2.1	A	COS $\phi$ 0.70	
Geber:	Bremsen		V-	A	Nm
C86:					
Auftr.Nr.		Typ-Nr.		Mot.Nr.	

Furthermore a 400V three-phased motor controller is required.

The 87 Hz Technique is realised by configuring the motor in Delta (230V) operation and then supplying the motor with an inverter drive fed from a 400V supply and set to 400V, 87Hz output (V/f ratio). In this configuration the magnetizing current is constant up to 87 Hz, with the output torque of the motor also being constant (ignoring the effects of motor losses at low speed).

As the speed of the motor is 1,7 times bigger than at 50 Hz it is compensated by choosing the gear ratio being 1,7 times bigger.

The result obtained is a 1,7 times bigger output ratio of the gear giving improvement in torque performance and power from the equivalent motor size.

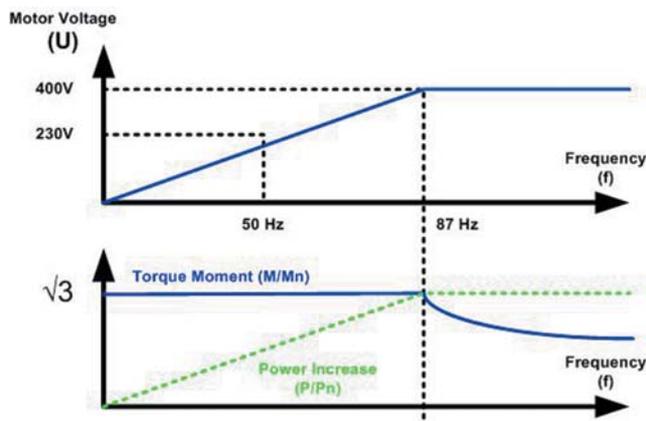


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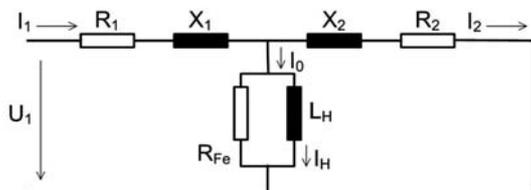
# 87 Hz motor technique with AC drives (Part 2)

The 87 Hz Technique is often beginning used in AC Inverter applications. This applications guide is the second part of a set that explains the principle and advantages of this technique. Part 2 expands on the basic concept given in part 1 with additional theory and calculations.

The 87 Hz Technique uses a standard 4-poled AC standard motor. The motor must have provision for connection of 3 x 230V Δ / 400V γ 50 Hz supplies specified in the nameplate of the motor. The motor should be connected in the Δ (Delta) configuration and is then supplied through a 3 x 400V, 87 Hz output Inverter (the V/f ratio of the frequency inverter is set at 87 Hz). In this way you take advantage of the constant torque of the motor up to 87 Hz.



Looking at the current diagram of the motor (below) it is evident that the above characteristic is possible without breaking the motor. The motor uses the current  $I_0$  to magnetize the stator and the rotor. To obtain a constant torque it is necessary to have a constant  $I_0$  current.



Due to the fact that in every coil being connected to an alternating voltage a resistance to alternating current, called the reactance, will occur,  $I_0$  can be described as

$$I_0 = \frac{U_1}{X_L \times f} = \frac{U_1}{2 \times \pi \times f \times L}$$

Where L is the inductance of the coil. As L is constant it means that the current  $I_0$  is constant when the ratio between the voltage and frequency is constant.

Increasing the voltage rating of the motor from 230 to 400 V in a Delta (triangle) coupling and you will at the same time have to increase the rated frequency in the same ratio to keep the magnetizing current constant and to avoid a break down of the motor caused by a bigger loss of power in the stator. The result is to obtain 1,7 times more power from the same standard motor size.