system combination

“screw“ + “inverter“ = rock n´roll… ?!

STULZ
CLIMATE. CUSTOMIZED.

07.11.2018 / Hamburg

preliminary remarks

placeholder

- constant screw
- inverter

The aim of the presentation is show the combination of a constant screw compressor with an external inverter. It´s content is purely technically driven as being based on a generic and conceptual level.

agenda

- expectations / customer
- technical characteristics / generic m+e
- application & integration / product
- Q & A
- job done for today - ☺

expectations - customer / consultant

- low inrush currents / start-up
- high(er) EER-values
- accurate capacity control (25 – 100%)
- add-on cooling capacity / supersychronous operation
- plug & play
- ☺ + ☺ + … = ☺ ☺ ☺ ☺ ☺

VSD – why it all started

affinity laws

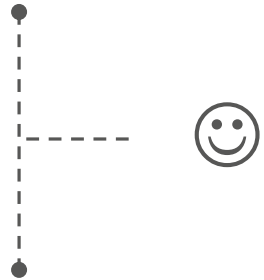
$$\frac{P_1}{P_2} = \left(\frac{n_1}{n_2}\right)^3 \qquad \frac{\Delta p_1}{\Delta p_2} = \left(\frac{n_1}{n_2}\right)^2 \qquad \frac{P_1}{P_2} = \left(\frac{n_1}{n_2}\right)^3$$

n_1 = 1.000 rpm

n_2 = 500 rpm

= “2“ -> 2^3 ≙ “1/8“ ≙ 12,5 %

VSD	(+)
partload optimized	(+)
energy efficiency	(+)



VSD - where it all started

(AC)
EC

(constant speed)
VSD

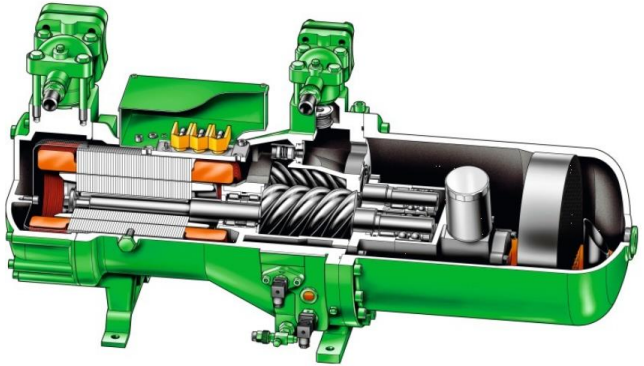
turbocor
VSD

(screw – constant)
a.k.o. VSD

screw
VSD

characteristics – asynchronous motor

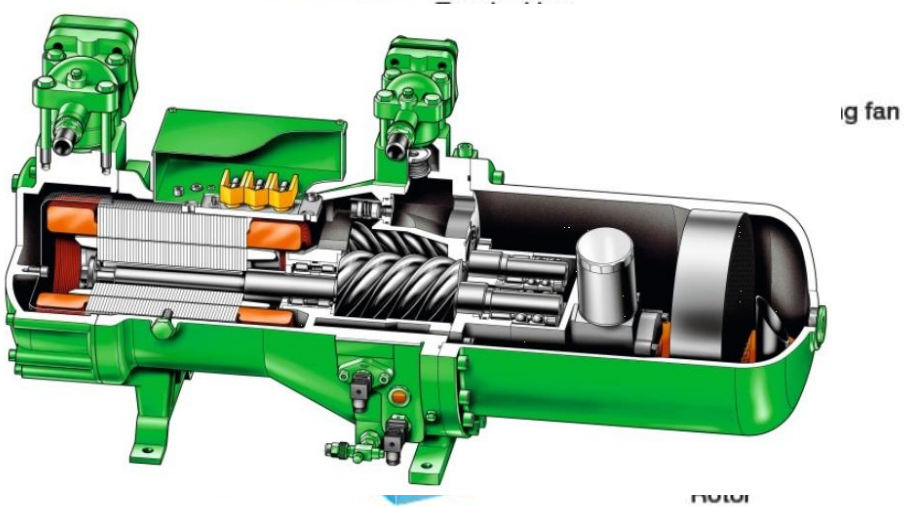
compressor – speed constant



inverter– speed variable

∑= VSD compressor ?

characteristics – asynchronous motor



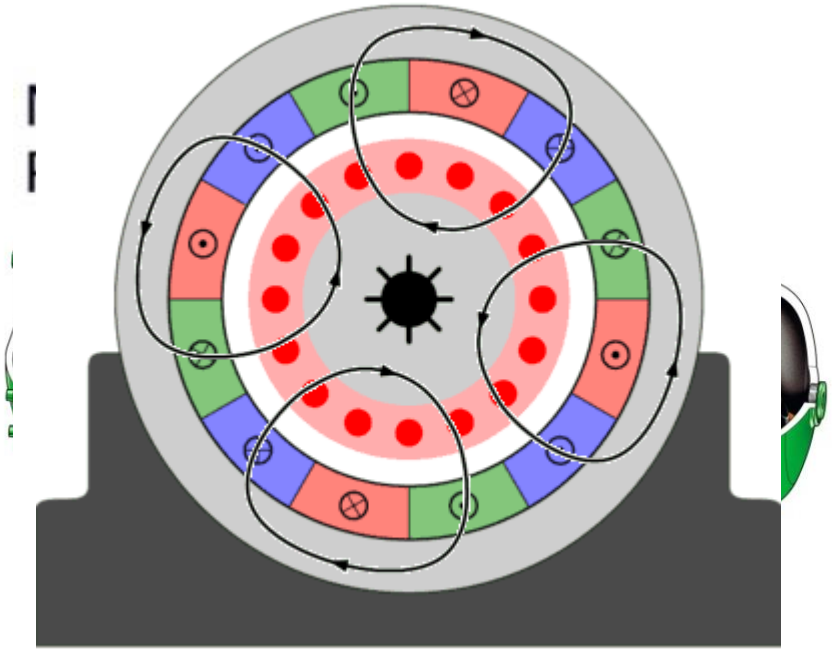
conceptual setup – constant speed

$$n_{motor} = \frac{f \times 60}{\text{number of pole pairs}} - n_{slip}$$

n_{motor} = ~ 2.900 rpm

n ~ f

characteristics – asynchronous motor



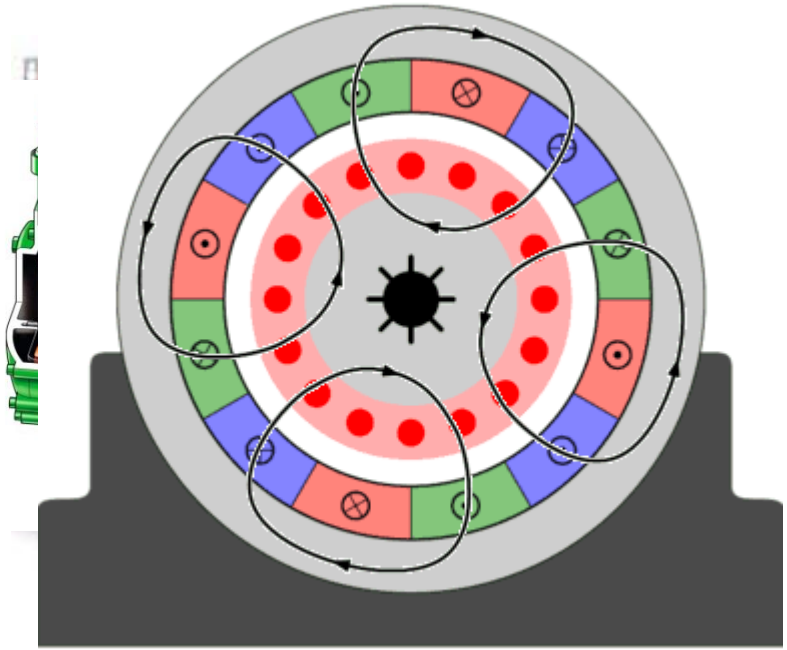
$n_{variable}$ - VSD

≙ constant torque

≙ constant **magnetic flux**

$$\text{ratio} = \frac{\text{voltage (U)}}{\text{frequency (f)}} = \text{constant}\ !$$

characteristics – asynchronous motor



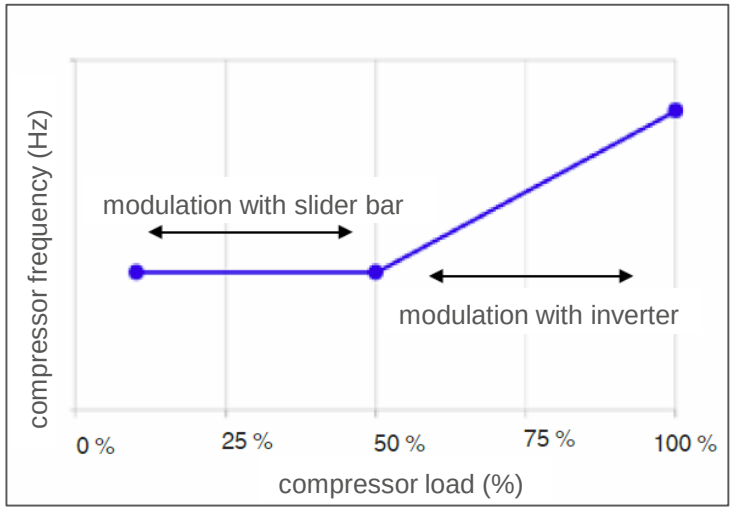
operation modes

< 50 Hz (load 0-50%)	“ok-?“
< 50 Hz (load 50-100%)	“ok-!“
> 50 Hz (load 100-111%)	“ok-?!“

$$\text{ratio} = \frac{\text{voltage (U)}}{\text{frequency (f)}} = \text{constant}\ !$$

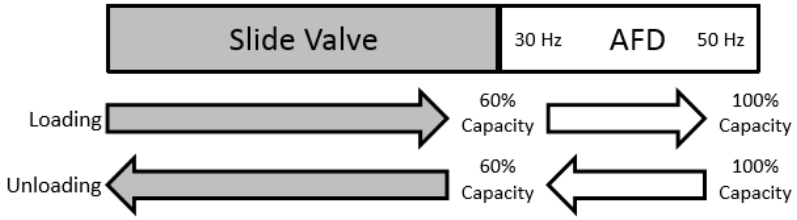
application & integration / product

(A)



(B)

This loading/unloading schema is a general figure, it could be different in case of sudden modifications of the operating data. Also it has not to be considered as a starting/stopping mode.



- LRA, OA, FLA = ?

application & integration / product

inverter separate

(±) 2.900 rpm

LRA = 666 A (?!)

inverter integrated

1.250 - 8.000 rpm

LRA = < 20 A

12.000 - 38.000 rpm

LRA = ~ 5 A

application & integration / product

ref. circuit

electrical power supply

Q_0 = 1.000 kW

P_{el} = 300 kW

losses ~ 5%

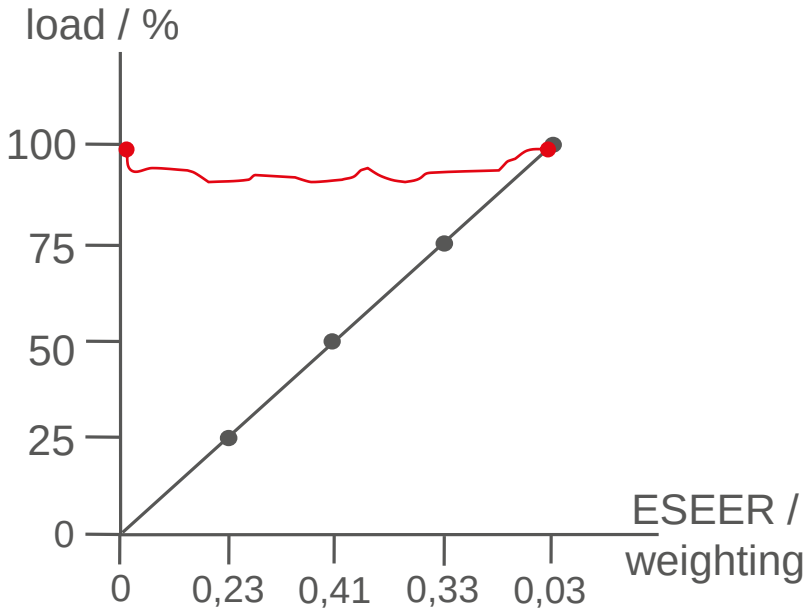
P_{el} = 315 kW

EER = 3,33 (gross)

EER = 3,17 (net)

Eurovent

- no free cooling (Mix / FC)
- load profile (Q_0 ~ AT)
- CHW - temp. level (7 / 12)
- operation mode 1 : 0 / 0.5 : 0.5 ?
- tolerances



Eurovent - tolerances

Table 11: Table of tolerances, intermediate and high deviations

	Tolerance	Intermediate	High deviation
	Standard Point (EN 14511:2013)		
Cooling or heating capacity, EER or COP	< -5%	< -8%	< -10%
	ESEER		
EER on part load point if only one or two points are tested (%)	< -(2+3/%Part Load)	< -(3+4.5/%Part Load)	< -(4+6/%Part Load)
Part Load 75%	<-6%	<-9%	<-12%
Part Load 50%	<-8%	<-12%	<-16%
Part Load 25%	<-14%	<-21%	<-28%
ESEER if all points have been tested	<-9%	<-13%	<-17%
	Sound		
A-weighted sound power level rounded to the closest integer value (*) in heating mode for units ≤ 70 kW.	> +3 dB(A) > + 2 dB(A)*	> +5 dB(A)	> +7 dB(A)

? --- !

? --- !

? --- !

combination - screw compressor / inverter

expectations – customer / consultant	?	!
• low inrush currents / start-up	☺	☹
• high(er) EER-values	☺	☺☹
• accurate capacity control (25 – 100%)	☺	☺☹
• add-on cooling capacity / supersychronous operation	☺	☺☹
• plug & play	☺	☺☹
• ☺ + ☺ + … = ☺ ☺ ☺ ☺ ☺		😐

wrap up

characteristics /
asynchronous motor

n ~ f

$$\text{ratio} = \frac{\text{voltage (U)}}{\text{frequency (f)}} = \text{constant}\ !$$

asynchron

“limited“ VSD

asynchron

synchron

“unlimited“ VSD

Q & A

standard fare

special offer – TODAY !!!

5€ / question

12,50 € / 3 questions

“?THX & cheers”