


# APPLICATION **RECYCLING TECHNOLOGY**

## SHREDDING OF MATERIALS

**EN**

## RECYCLING - SOLUTIONS FOR WASTE MANAGEMENT

- Efficient shredding with minimal energy input
- Protection of the plant through the detection of contaminants
- Minimized blockages with higher torque than in mains operation
- Reduced downtimes due to active reversing in case of overload
- IP65 installation directly in the vicinity of the shredding plant

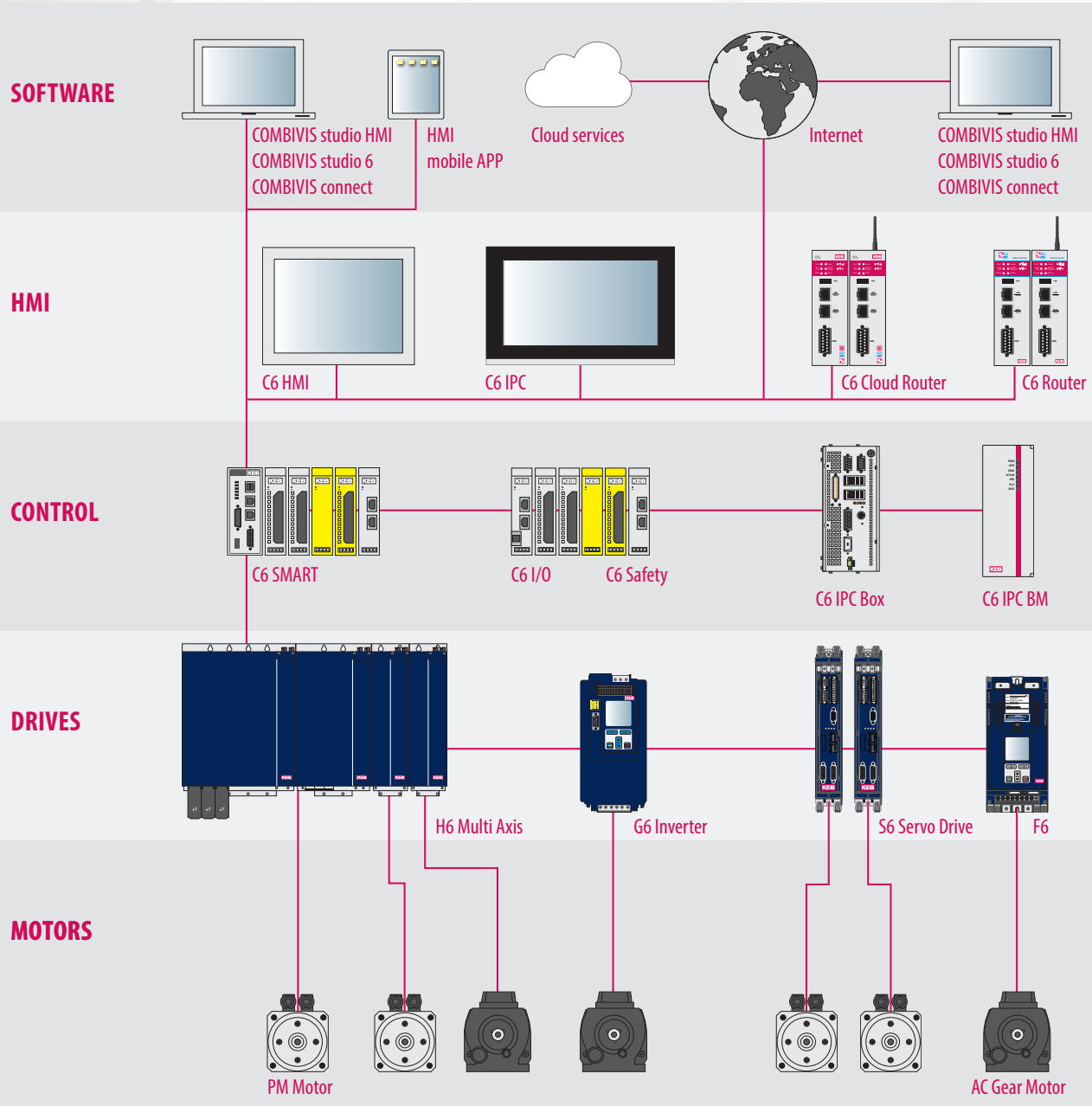
## TRUST THE MARKET LEADER FOR ELECTRICAL CONTROLS ON SHREDDERS.
## CONTINUITY AND EXPERIENCE

Conventionally shredders work with motors starting directly on the mains or to limit the starting currents with U/f – inverter. When directly starting on the mains supply surge currents occur that can reach 9-times the rated current. This must be considered at the dimensioning of the power supply.

KEB offers a new approach which allows a high-dynamical control of speed-variable shredders.

The frequency inverters COMBIVERT F5 – ASCL with optimized field-oriented control without encoder feedback, adjust the voltages and currents on asynchronous motors accurately due to the load requirements.

COMBIVERT F5 – ASCL operates within the optimal range of the characteristic and provides over the entire speed range almost the breakdown torque as peak torque. Thus the input current to generate repeated torque remains in the operating range. (page 5)




# ENERGY COSTS **SAVING**

A reduction of the energy costs is ensured by:

- Reduced current consumption during start-up
- High-dynamical compensation of load jumps and slip compensation
- By having stable speed in case of load, the energy existing in the system is used for shredding the material
- Less current consumption due to fewer reversings
- Lower energy base rate since no high current peaks

**COMBIVERT F5 - ASCL** on a shredder increases material flow and improves material quality:

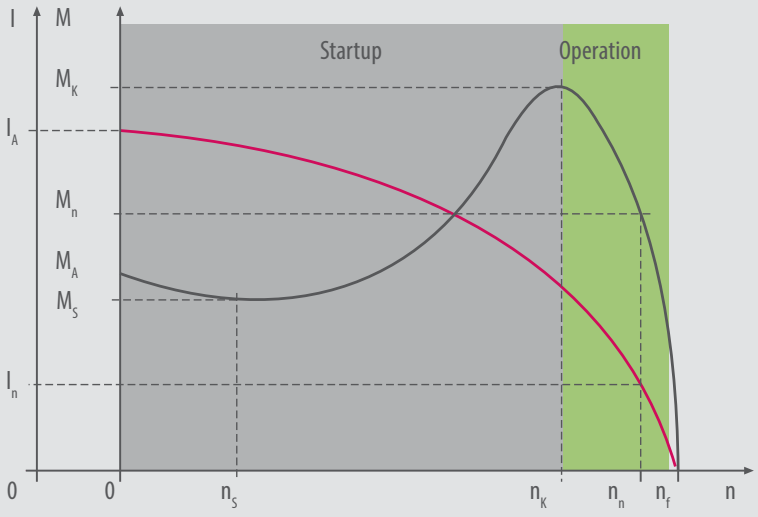
- Start-up with load is possible
- High-dynamic reaction on load requirements
- Reversing procedures are accomplished automatically, if necessary
- Information from the inverter like torque or speed can be used for the control of pushers, conveyors etc.
- Manual emptying of shredders is no longer necessary – thus resulting in fewer downtimes
- Different speeds and acceleration times are possible

## FURTHER ADVANTAGES FOR USING THE COMBIVERT F5 – ASCL ON SHREDDERS:

- Installation of turbo coupling is not necessary
- Smaller dimensioning of the diesel motor due to lower maximum currents of the diesel-electrical system
- No contactor wearout due to powerless switching
- Main contactor is not necessary by using the option „Safe Stop“ in accordance with EN 954-1 Cat. 3 or STO according to EN 13849
- The mechanics of the machine (gear, shaft, etc.) can be protected by using the precisely adjustable torque limits
- Energy saving by using a frequency inverter on hydraulic drives

## RELATED TO THREE-PHASE INDUCITON MOTORS (TPIM)

| | |
|---|---|
| I | Current |
| M | Torque |
| n | Speed |
| $I_n$ | TPIM rated current |
| $I_A$ | TPIM starting current |
| $M_K$ | TPIM breakdown torque |
| $M_n$ | TPIM rated torque |
| $M_A$ | TPIM starting torque |
| $M_S$ | TPIM pull-up torque |
| $n_S$ | TPIM pull-up speed |
| $n_K$ | TPIM breakdown speed |
| $n_n$ | TPIM rated speed |
| $n_f$ | TPIM theoretical frequency speed / synchronous speed |




*M/n - characteristic*

# THE PERFORMANCE OF THE **ASYNCHRONOUS MACHINE**

## STARTUP PERFORMANCE

Direct connection of the mains voltage to the motor causes maximum slip and thus a high current at moderate torque (Image 01)
(see T/n characteristic page 5).

The inverter accelerates the motor with voltage and frequency ramp. The motor operates only within the optimal range of the characteristic.
The slip is adjusted to minimum value. More possible torque shortens the acceleration due to substantially smaller current consumption from the mains supply. (Image 04)

## LOAD JUMP WITH 150 % OF RATED TORQUE

The speed of the motor on mains decreases. The motor increases the slip to provide required torque. The current rises from idle run value to approx. 165 % of the rated current. (Image 02)

By increasing the frequency the inverter readjusts the motor speed to the set value. Slip and current are slightly lower than at mains operation. (Image 05)

### ... DIRECTLY ON MAINS SUPPLY

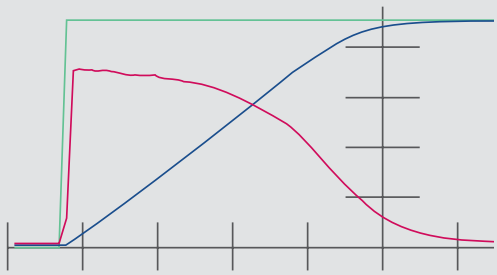


*Image 01*

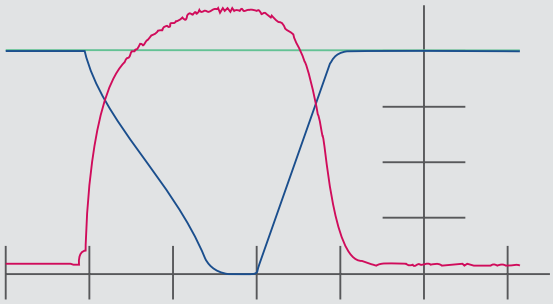


*Image 03*

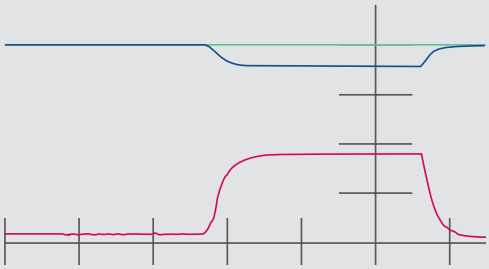


*Image 02*

- Frequency
- Speed
- Current

## LOAD JUMP WITH 300 % OF RATED TORQUE

The motor on mains breaks down. The speed decreases to zero. The slip rises to maximum value. Thus the drive is unable to provide the required torque of 3 x $T_N$ directly on mains. 100 % slip causes maximum current (in this case approx. 500 % of rated motor current). (Image 03)

The inverter reduces the output frequency at maximum voltage. Therefore the motor is over-magnetized and generates substantially more torque as it would be possible at mains operation. Even though high torque of 3 x $M_N$ is needed the drive is able to adjust this! (Image 06)

## ... AND WITH COMBIVERT F5 - ASCL

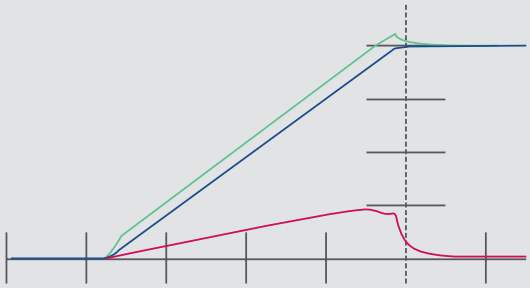


*Image 04*

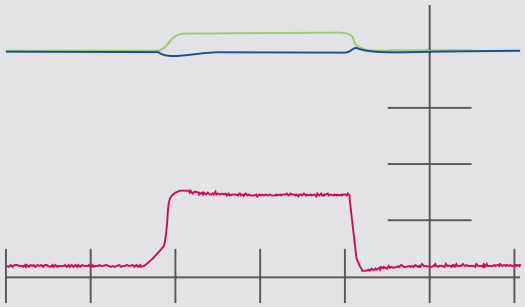


*Image 05*

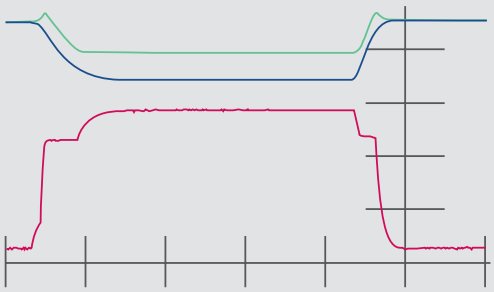


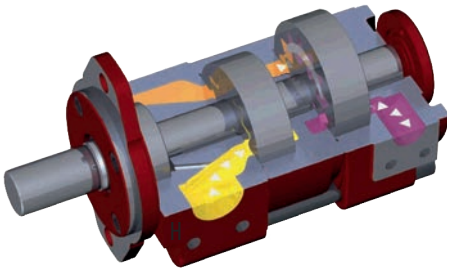
*Image 06*

- Frequency
- Speed
- Current


# ENERGY SAVING **THROUGH REGULATED HYDRAULIC PUMP**

Because of increased environmental awareness and a competition of different drive technologies, the energy consumption and noise development of machines and plants have become crucial application criteria.

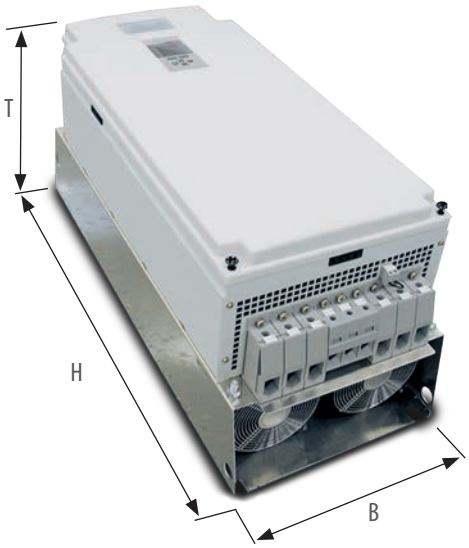
With fixed displacement pumps and COMBIVERT F5 energy-efficient hydraulic drives are realized, which achieve up to 30 % energy saving compared to a displacement-controlled drive. As the flow rate is proportional to the speed, a fixed displacement pump is able to deliver variable flow rate.



# ... **UNIVERSAL** INSTALLATION IN CONTROL CABINET

Following advantages are achieved through the employment of KEB frequency inverters e.g. on balling presses, hydraulic shredders, ancillary units, etc.:

- Reduced energy consumption particularly in no-load and partial-load operation
- Continuously adjustable volume flow rate (0 - 100 %)
- Flow control already integrated in the frequency inverter
- Employment depending on design in 1- to 4-quadrant operation
- Low noise level
- Operation in field weakening range (speeds > 1500 rpm)
- High pressures even at small speeds in short-time and pressure hold-up operation at zero-conveyance are possible
- High efficiency factor (η ˜ 70 % with asynchronous motor, 80 % with synchronous motor)
- Same system for 50/60 Hz 380 ... 480 V mains
- Cos phi ≈ 1
- Reduction of motor rating by 87-Hz-characteristic
- No current peaks at startup
- No limit of Start/Stop
- Easy integration into the machine control
- Possible saving of control valves, bypass valves, etc.
- Fast response time by using synchronous motors
- Saving of further pumps because of speed-variablity




## IN-BUILD UNITS AS WELL AS PUSH-THROUGH-MOUNTED VERSIONS IN PROTECTION CLASS IP 54 OR HIGHER

- Factory-mounted brake resistors
- Absorption of pulse energy without additional space requirement

## FOR EACH ENVIRONMENT THE RIGHT COOLING CONCEPT

- STANDARD -air cooling
- LIQUID COOLED - (LC) liquid cooling
- EXTERNAL HEAT - (EH) push-through heat sink
- for the thermal separation of the power circuit
- FLAT-REAR - (FR) - direct thermal connection to heat sinks

*560 kW P-housing cascaded*

# PERFORMANCE AND COMPETENCE

For the handling of your specific task requirements qualified personnel is available for you in the responsible regional offices and in the head office.

## UNIT VERSIONS

| DESIGN | RATING | INSTALLATION VERSION IP20 | AVAILABLE VERSIONS | | |
|---|---|---|---|---|---|
| | [kW] | B x H x T [mm] | FR | LC | EH |
| G | ... 22 | 170 x 340 x 255 | ✔ | ✔ | ✔ |
| H | ... 37 | 297 x 340 x 255 | ✔ | ✔ | ✔ |
| R | ... 90 | 340 x 520 x 355 | ✔ | ✔ | ✔ |
| U | ... 200 | 340 x 800 x 355 | - | ✔ | - |
| P | ... 315 | 340 x 960 x 454 | - | ✔ | - |
| W | ... 400 | 670 x 940 x 368 | - | ✔ | - |
| Pmodular | ... 900 | 2/3 x 340 x 960 x 454 | - | ✔ | - |

** FR Flat Rear* **LC Liquid Cooled* **EH External Heat*

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